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The Future Development of Transportation Costs

- A Study for Volvo Logistics

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Abstract

In the past couple of years, the transport industry has experienced rapid changes. With globalisation, the needs for effective and cheap transport solutions have increased. However, the costs for transport services are expected to increase because of certain factors. These factors are investigated and evaluated in this thesis with emphasis on Volvo Logistic's main markets; EU, USA, India, China and Russia in the three primary used modes; railway, road and sea transport. It is important for Volvo Logistics to be aware of what changes might come in order to be pro-active and closely follow the most important factors affecting transport costs.

The methodology used in this thesis is considered to have a qualitative inductive approach. A lot of information is required and it is practically impossible to carry out experiments and tests to verify hypothesis. Furthermore, the approach can also be seen as predictive since the study is going to predict what will happen in the future.

To get a better picture of the target areas, every region is described and conditions are evaluated. The target areas are alike in some ways but very different in others. It is important to know the basic characteristics and basic conditions of the areas in order to analyze them correctly.

After conducting interviews with two people at Volvo Logistics, the factors that are most likely to affect transportation costs in the future were decided to be the price of fuel, taxation, infrastructure and lack of educated personnel.

After further analysis of the factors mentioned above and how transport costs, an attempt to rank them was made and the result was:

- Fuel prices and environmental taxation are closely connected and will be the primary factors that affect transportation costs.
- The infrastructure and taxation on the roads are the second most important factor.
- The lack of educated personnel, especially drivers, will be an important question to address in the future in order to keep transport rolling.

EU will be the region that will first be affected by the new environmental taxation policies. There are hard-hitting taxation policies formed by the EU, with kilometre taxation and soon also emission trading in the transport industry. This will result in external costs being put on every transport mode.

The lack of drivers will first affect the US but then also EU and probably to more of the target areas. The US is also highly affected by the weak dollar that together with a high crude oil price make gasoline and diesel expensive.

In the developing countries India, China and Russia, the increasing number of vehicles and insufficient transport network affect the transport sector. It is essential to keep building new infrastructure in order to meet the growing demand for services and goods.

Acknowledgement

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1 Introduction

The purpose of this chapter is to give a general description of the topic with the background information. Further the problem is discussed and the research questions are presented. In addition, the purpose and limitations of the thesis are stated.

1.1 General Background

1.1.1 Volvo Logistics Corporation

Volvo Logistics Corporation (VLC) is a wholly owned subsidiary within the Volvo Group that designs, handles and develops comprehensive business logistics systems for automotive, commercial transport and aviation industries. It is the appointed lead logistic provider for the companies of Volvo Group. It also serves the global suppliers and other external customers like Volvo Car Corporation, GM Land Rover, Renault, Nissan, Ford, Jaguar, Aston Martin and Boeing.

VLC is represented by over 1000 employees in 27 countries throughout the world. It is organized in three major business regions namely VLC Europe, VLC North America and VLC Scandinavia & Overseas. It provides logistic services and business solutions in inbound (material supply), outbound (distribution) and emballage (packaging). This master thesis was made on the outbound business unit on logistic development.

Transportation costs for VLC has risen between 2-4 % annually. In the contracts VLC forms with the transports providers the only variable part is the fuel price, if the price of fuel rises with a certain percentage VLC has to pay the difference between the old and new fuel price.

About 45-50 % of VLC:s distribution expenditure is for goods transported by water. The second largest transport mode based on value is road transport and only about 3-4 % is transported by rail. VLC has a new project called Viking Rail that is supposed to move goods from the roads to rail and making daily call offs between Gothenburg and Hannover. The system is, when fully extended, supposed to reduce the transport times with about 11 hours and reduce emissions of carbon dioxide with 2700 tonnes annually.

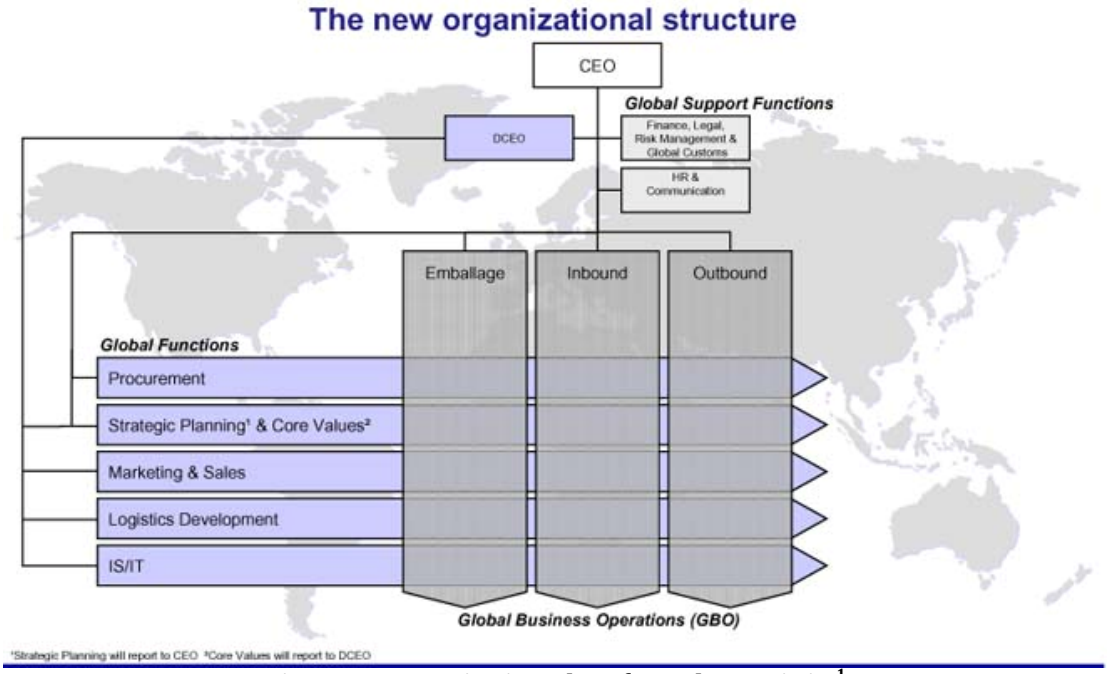


Figure 1-1 Organization Chart for Volvo Logistics[1]

1.2 Problem Discussion

In the past few years the transport industry has experienced rapid changes. The changes in the last 7-8 years have been as large as the 80 years prior to that combined. Today the competition between companies is greater which makes the drive for improvement and cost savings a more important part of the every day work. New laws and regulations are implemented that have far reaching consequences for the transport industry. As a result companies now plan and manage their freight transport activities in a broader sense than only a couple of years ago.

The business environment will become even more complex in the future and there are many driving forces which significantly impact the future logistics. It will become even more difficult to remain in balance with and have agility to adapt to and integrate with the frequent and many changes. To prepare for an even more successful future, VLC must be aware of the most important social and business related driving forces. The business related forces must be identified and understood in time to plan and take necessary actions.

The automotive industry is well established in Europe and United States, but is relatively new in India, China and Russia. A need for good logistic infrastructure is closely connected to different transport modes and every region has its own special characteristics that need to be taken into consideration when buying transport services. As globalisation continues, the significance of a well structured supply chain grows in order to keep the costs to a minimum. However, globalisation also brings longer distances between suppliers and customers and as the distance grows, so do transportation costs and the risk that something happens during the transport.

[1] Volvo Logistics Intranet

Since the changes are happening much faster today, the need to be pro-active has increased. To closely map the changes and new trends is a necessity to be competitive. The transportation cost of the total share of a product is increasing.

1.3 Research Questions

The main research question has been stated as follows:

Which are the most important factors that will affect the transportation cost for VLC in the short and long term?

In order to analyse which factors that will affect transportation costs in the future, four main parameters have been investigated. These four factors were determined after theory studies and interviews.

In order to solve such an extensive research question, it is broken down into "sub" questions, as follows:

Will these factors change in the different regions?
The different regions studied in this research have different characteristics and basic conditions. In what manner and to which extent will the basic conditions affect the transportation costs?

How will the factors affect each other and to which extent are they linked?
The factors affecting transportation costs are often closely linked. If one factor changes will this change the others?

Which are the major uncertainties in the factors above?
Since this thesis is trying to "predict" what is going to happen in the future there will be a certain amount of uncertainty.

1.4 Purpose

The purpose of this thesis is to define the most significant factors of transport cost for the future and estimate the change of cost levels within a 10 year horizon based on those factors.

The focus shall be on Europe, USA, China, India and Russia and respectively modes of rail, road and sea transports.

The purpose is not primarily to estimate exact cost figures but define trends and levels considering the uncertainty in looking at a long-term horizon. It shall also consider the cause and effect correlations between the defined significant factors.

1.5 Limitations and focus

As regards of the thesis purpose some limitations have been stated. The main factors are information accessibility, geographical and transport mode considerations. The time horizon of the thesis is set to 20 weeks, spanning from February to June 2008 which implies that information after this period of time has not been taken into consideration.

Limitation to the three transport modes: railway, road and sea, were set due to the fact that these are considered the main modes VLC utilizes. The regions: Europe, USA, China, India and Russia where chosen for the same reason.

As it appears today the most essential changes in the transport sector is going to happen in road transportation. The reason for this is that experts state that the competition between the modes is unfair currently. Therefore, a focus is going to be put on road transports. Many of the taxes proposed by the EU are in regards to road transportation and the external costs the industry causes.

2 Methodology

This part presents the research methodology used in this thesis writing. The methodology chapter gives the reader information about how the research led to the result.

2.1 Research Approach

It is very important that a good design and approach are considered for conducting successful research. There is no best approach, but the most effective approach for the resolution of a given problem depends on a large number of variables, among which the nature of the research is one of the problems[2].

A study can have different approaches based on what is supposed to be accomplished. Approaches can be classified according to focus. An exploratory approach is used when further explaining how things work. A descriptive approach can be used when trying to answer more specific problems. A predictive approach is used when the goal is to foresee the future. An explorative approach is used when there is only partial knowledge about a certain subject[3]. In this thesis a predictive approach is used since the aim is to predict what consequences something that will happen in the future will have on the current situation.

There are two different scientific approaches, inductive or deductive approach. The inductive approach uses real observations and experiences to make general and theoretical conclusions. Research starts with the gathering of empirical data to form a theory. When using the deductive approach pre-existing theory makes the base for the study and the researcher uses experiments to test the theory in reality.

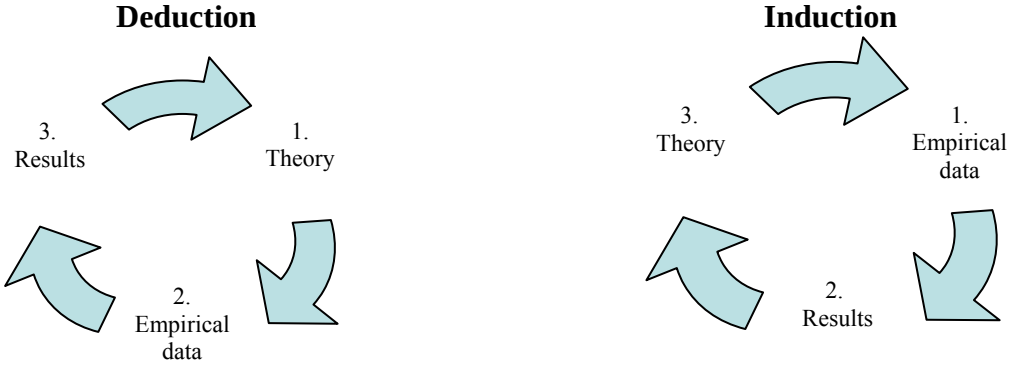


Figure 2.1 Illustration of deduction and induction[4]

The deductive approach uses existing theory before gathering data and facts based on that theory. When using an inductive approach, the researcher test the chosen theory in order to find theory that matches[5]. The approach for this thesis is inductive. There is a lot of information available and it is difficult to carry out tests and experiments to verify a hypothesis. Therefore, the inductive approach is a better option than the deductive.

[2] Gill J et al. (1997)
[3] Lekvall, P et al. (2001)
[4] Hörte, S-Å (1998)
[5] Merriam S.B (1997)

2.1.1 Quantitative and Qualitative methods

There are two different techniques to collect, process and analyze information. These are the quantitative and qualitative methods. A connection can be made between the quantitative method and deduction and between qualitative and induction[6].

A quantitative approach is conducted by the measuring and valuing of primary numerical data. An example when it is good to use a quantitative method is when processing statistical data[7].

The qualitative approach is better used when the data collected should describe meaning rather than statistical conclusions. A collection of data in a qualitative way is best done by doing case studies or interviews; this provides a more in depth and extensive description.

The focus of this master thesis covers a wide area since it affects many different parts of the transport industry. Therefore, a qualitative approach is used in this thesis. The reason for the use of this approach was that the size of the studied area made a more quantitative analysis more difficult to conduct. The information used has been books, articles and interviews in mostly non-numerical form. Another reason for choosing a qualitative approach is that the method intends to clarify connections, potential questions and insecurities, which is the intent of this thesis.

2.2 Data Collecting Approach

2.2.1 Methods of Data Collecting

2.2.1.1 Primary Data Collecting Approach

Primary data is collected in order to solve a specific problem. The data is new and has not been used before. It can be collected by observations, interviews or surveys. This thesis uses interviews in order to find out areas that VLC sees as the most important factors about what is going to affect transport costs in the future.

Interviews

Interviews are used when secondary data is unable to satisfy the needs of the researcher and get specific information in a particular area. The most common type of interview is face-to-face interviews.

There are three different ways to conduct an interview; structured, semi-structured and unstructured interviews. In a structured interview the interviewees are asked the same questions in the exact same order. It is a quantitative research tool and commonly used in survey research[8]. A semi-structured interview is a more flexible form of interviewing where questions that arise during the interview can be asked immediately[9]. In an unstructured interview, questions can be changed and adapted to meet the beliefs and intelligence of the respondent. This way of conducting interviews are fairly limited and are not often used outside sociology[10].

[6] Björklund, M et al. (2003)
[7] ibid.
[8] Davidson och Patel (2003)
[9] ibid.
[10] ibid.

The type of interview primarily used during this research is semi-structured interviews. A general structure is followed to ensure that the interviewer covers the necessary areas and asks the questions in a similar way in all interviews. However, the interviewer is allowed to ask resulting questions that occurs during the interview.

Interviews in this thesis are used to determine which factors to focus on and where industry facts and past developments are used to help support the analysis. Two interviews where conducted. The interviews generally had the same opinion regarding which factors that probably were going to affect transportation costs the most.

2.2.1.2 Secondary Data Collection Approach

The secondary data collection can be described as a method using data that has already been collected, for example government statistics, organizations databases and previous reports. When using secondary data it is important to be critical. The main advantage of using secondary data is that it is usually available and can easily be analyzed. However, secondary data can be doubtful in terms of validity and reliability.

This thesis is mainly based on secondary external data, collected outside the company. It is based on journal articles and Internet-based information since these sources easily can be accessed and provides a wide spectrum of ideas and information. In the interest of reliability, many of the sources are governmental sources like the International Energy Agency (IEA) and the European Commission homepage. However, the purpose of this thesis is to try to predict what is going to happen with transportation costs in the future. Articles from Internet newspapers are also sources in this thesis and are used to see what "trends" that are occurring in the different target areas today. The reliability of these sources is not as good as governmental sources, but this is taken into consideration in the writing process. As there are five major regions presented for this study there is no single source that covers all of them. A mix of national and international sources has been reviewed during the data collection.

2.2.2 Availability of data

The availability of data varies significantly within the countries. Accessibility to official information also differs considerably among countries. In general the information from the EU and the United States is more detailed than that available for the other three countries. Since the target areas include developed and undeveloped countries there is sometimes a huge difference in available facts. There is also great difference between what the government of each country is allowed to present. Information from China is especially difficult to find and to rely upon based on the lack of freedom of the press. It is also in some cases hard to find information about a developed country such as the US. This writer finds that structure of the government is not as easy to find as the information from the EU. One of the reasons for this is, of course, that the writer is from Europe and is more familiar with the EU and the EU homepage.

Since road transport is the dominating mode of all the target areas the main focus will be on this mode of transport. The railway system is still very national and in the EU it is difficult to find information that applies to all member countries.

Statistics from China is often unreliable due to the way it is collected and the fact that there is a huge amount of inaccuracy in them. The Chinese statistical bureau claims that China is adjusted to international standards. However, that appears doubtful. Also information from

China is affected by the fact that the country, not long ago, was a communistic country with a planned economy and in many ways that still affect the country[11].

2.3 The Quality of the Study

It is very important to evaluate the accuracy of the research concerning data collection methods and findings of the empirical study. Every step is followed by data quality measurement in order to be logical in findings which lead to an analysis with high quality. The methods used to conduct the evaluation include validity and reliability.

2.3.1 Validity

Validity reflects whether an item measures or describes what it supposed to be described[12]. It can be achieved through evidence from multiple sources or establishing chains of evidence, as well as data triangulation[13].

2.3.2 Reliability

Reliability means the extent to which a procedure or test produces similar result under constant conditions on all occasions[14]. The reliability is based on mainly two criteria: the use of the methods and the time dimension. The transport industry is very dynamic and the new emerging markets are changing fast making it harder to predict what is going to happen in the future. Since the different target areas are at different stages of development changes can occur basically on a day-to-day basis. It is hard to ensure a high reliability since many factors changes continuously in the environment.

The figure below shows two different sets of rounds fired from a pistol. The picture on the left shows good reliability, but poor validity. The one to the right shows both good validity and good reliability. The reliability can be tested by redoing the experiment and see if the result is the same. The validity can only be tested indirectly and if the knowledge about the truth already exists. However, there is no reason for conducting the research unless the purpose is to question the knowledge[15].

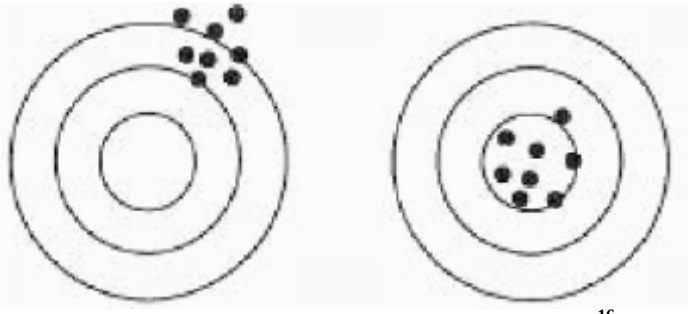


Figure 2.2 Illustration of validity and reliability[16]

[11] Sandklef, K (2004)
[12] Bell, J (1999)
[13] Yin, R.K (1994)
[14] Bell, J (1999)
[15] Abnor, I et al. (2004)
[16] ibid.

2.4 Analysis Approach

The analysis for the research is built on the collected and interpreted data, primary and secondary. Since the thesis is a combination of investigating, explaining and describing, the analysis is the result of combining all of these factors.

3 Frame of References

This chapter aims to give an introduction into transportation costs and which factors that affect the total cost. The cost structure of the different modes is also described as well as competition between the different modes.

One of the challenges of transportation today is to increase capacity and reduce costs and it is not uncommon that the transportation cost is about 20 % of the total cost of a product. The transport cost is the price the service provider has to pay for performing the transport. Transport costs can be divided into fixed cost, such as costs regarding infrastructure and variable cost, such as costs of operation. There are different parameters that affect these costs like geography, infrastructure, administrative barriers, energy and mode of transport.

The most significant factors that affect transportation costs are:

- Geography – Distance affect transportation costs by fuel time and administration.
- Types of product – Some products need packing and special handling that increase the cost. For example fresh flowers require different storage facilities than coal.
- Economies of scale – A large quantity transported decrease the cost for each unit.
- Energy – All transports are more or less energy intense. For example air transport is more sensible to changes in fuel price.
- Trade imbalances – If the import exceeds the export a negative balance makes the price for importing goods higher than exporting goods to the same location, especially if the goods are carried by containers that need to be transported back to the first destination.
- Infrastructure – Poor infrastructure often results in higher transport cost and delays. Efficiency and capacity at terminals and transport modes also have an impact on transportation cost.
- Mode – Each transport mode has its own capacity limitations and operational conditions. A lower transport cost can be the outcome if two different modes compete for the same market share[17].

Lumsden (1995) divides transportation cost into direct and external transportation costs[18].

3.1 Direct transportation costs

Direct costs are costs that are brought on the freight company when buying resources or services on a market. These can for example be wages, interest on capital and fuel costs. Further, direct cost can be divided into fixed or variable costs. An important analysis is to see how the costs vary over time. The variations can be either over a longer period of time or a shorter and should be brought on the activities that cause them. In the long term all costs are variable but there is a large variation depending on which mode of transport that is being analysed. For example, ports are very expensive but have a longer life span. Road transports, however, have low capital costs and a shorter life span. Most costs are considered to be fixed in the short-term and variable in the long term. The time perspective also varies depending on which mode of transportation that is utilized. This creates the problem of which costs that are

[17] Rodrigue, J-P et al. (2008)
[18] Lumsden, K (1995)

fixed and which costs should be considered. In the very short term, however, the most variable costs are wages, fuel and maintenance[19].

Economy of scale is very important in the transport sector in order to make savings. For example larger vehicles result in lower wage, production and energy costs per unit.

3.2 External transportation costs

The direct costs that occur when a transport service is bought are not the only costs that arise. One of the major factors is that the transport industry brings costs on to society like air pollution and noise. These factors are very important to include in a total analysis when buying a specific transport[20].

Carbon Dioxide

The externalities of greenhouse gas emissions are ideally suited to be put on the transport provider through fuel taxes. Emissions are directly related to energy and carbon content of different fuels. However, it is very difficult to estimate the costs CO_2 emissions bring on the society. There are several different factors that affect theses costs, for example, emission levels, response of the climate, time horizon. Estimates tend towards about US$ 10 per tonne of CO_2 in emissions. However, estimated damage and control costs can be both significant higher and lower than this number. In order to get more precise estimate one would need to have a better understanding of consequences and cost of global warming[21].

Noise

Transport activities are major sources of noise pollution. It can be divided into direct noise from road or rail vehicles and vibration caused by heavy vehicles and trains. Noise pollutions are harmful not only to humans, but also to buildings and underground services[22].

Safety

Lack of safety in transport can cause injuries on people and property. There is injury risk for both the transport driver and humans in the surrounding areas. Risks increases when a transport contains hazardous goods[23]. It is hard to make risk comparisons between modes and across time. Data is not reported in the same format for the modes. For some modes accident most commonly occur during the actual transport, and for others accidents occur during loading and unloading[24].

There is also another safety aspect, safety in terminals and ports. Since 9/11 new security routines has been forced on companies. The safety that is most notable to normal people is the new security routines in airports. These costs also highly affects cargo travelling trough the ports. In the last couple of years the port costs have risen and new regulations are expected. One of the most important factors is traceability of goods, which can require investment in new equipment[25].

[19] Lumsden, K (1995)
[20] ibid.
[21] Hensher, D et al. (2003)
[22] ibid
[23] Lumsden, K (1995)
[24] Hensher, D et al (2003)
[25] www.portgot.se

3.3 The meaning of transportation costs

Depending on which type of industry transportation needs serve, the costs can be a more or less important aspect. In some industries a significant part of the total cost of a product can be transportation cost, thus making a decision about where to locate factories an important decision. Fixed and variable costs affect producing companies in different ways. Reducing fixed costs is often difficult so companies usually focus on reducing the variable cost. Lardners laws suggest that if the variable cost is reduced, the market area is increased. This will make it possible to increase the distance between the factory and the costumer[26].

3.4 Cost structure Railway

The cost structure for railway transportation is characterized by high fixed cost and relatively low variable costs. The situation exists because the railroads are the only mode that pays for the maintenance of their network and terminals. Fixed costs are for example roadbed maintenance, taxes, administrative costs and costs for terminal facilities. Labour cost is the largest single element of variable costs for railroads followed by fuel and power. With high fixed cost the economy of scale is significant and the average cost per unit declines as the number of units increases. The unit cost will continue to decline until full utilization at terminal and tracks are reached. As long as there is excess capacity on a certain line there are possibilities to reduce the cost per unit[27].

Railway characteristics make transportation on rail more competitive on longer distances since the time it takes to break up trains at terminals is a smaller percentage of the total delivery time on long hauls[28].

3.5 Cost structure Road

The cost structure for transports on road consists of high variable costs and relatively low fixed costs. Approximately 70 to 90 % of the costs are variable. The public investment in the highway system is a major factor contributing to the low fixed-cost structure. Another contributing factor is that motor carrier is able to increase or decrease the number of vehicles used in a short periods of time. At last road transports do not need expensive terminals to load and unload its goods, contributing to low fixed cost. The primary variable costs are fuel, wages and administration[29].

[26] Lumsden, K (2006)
[27] Coyle, J et al. (2000)
[28] www.cbdd.wsu.edu
[29] Coyle, J et al. (2000)

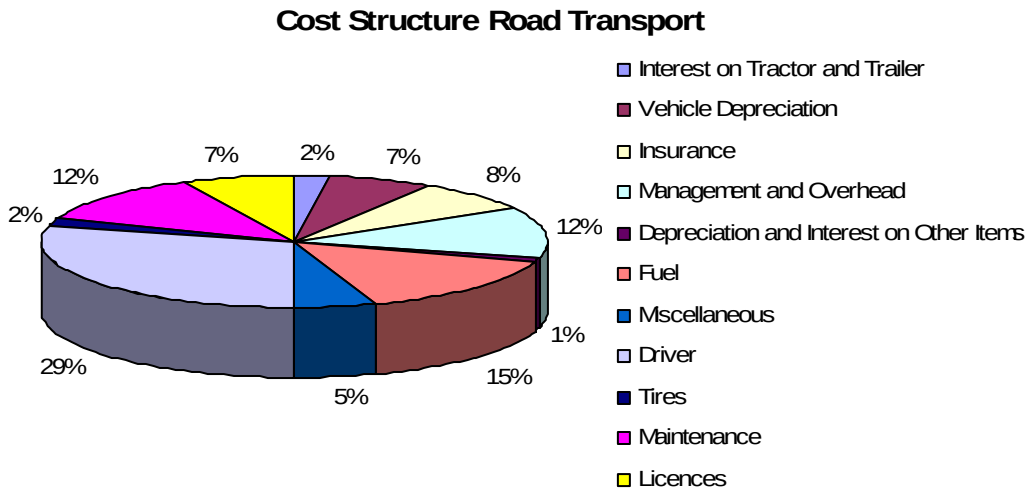


Figure 3-1 Cost Structure Road Transport[30]

There is no major economics of scale for a trucking operation. In the last couple of years the percentage of fuel costs as a portion of the total cost has risen due to the high price of gasoline and diesel[31].

3.6 Cost structure Sea

The short-term cost structure of sea transport consists mainly of variable costs. Characteristics for water carriers are that the fixed costs are low and the variable costs are high. There is no charge for using the sea and waterways and canals provide the "roads". However, the waterways needs maintenance, improvement and may be controlled by a government. Carriers pay user charges for example lock fees, dock fees and fuel taxes. The user charges are directly connected to the volume of goods carried. The largest cost is line-operating costs which includes labour costs, fuel, user charges and direct operating costs.[32].

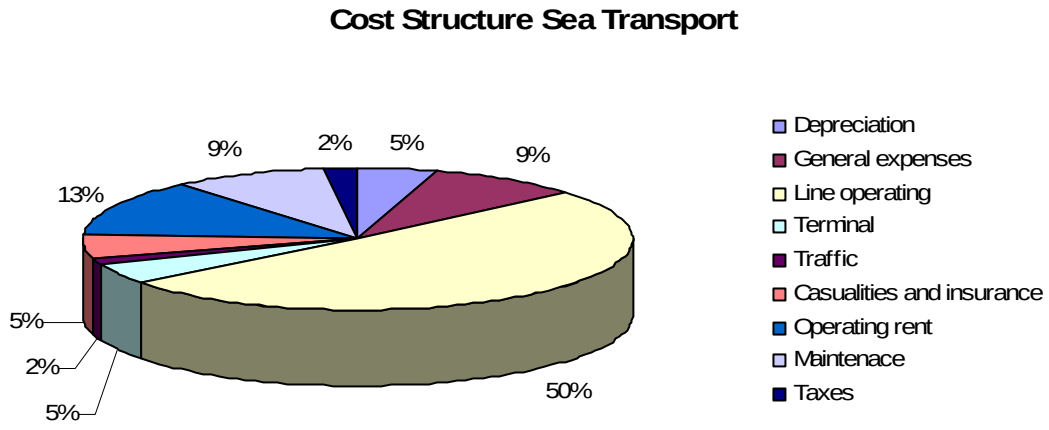


Figure 3-2 Cost Structure Sea Transport[33]

[30] Coyle, J et al. (2000)
[31] ibid.
[32] ibid.
[33] ibid

In the general expenses, fuel is a major cost and the price on crude oil has a large impact on the price[34].

3.7 Competition between the different modes

The costs vary between the different modes. The most significant differences are between the extremely high costs for flight transport compared to the extremely low costs for sea transports. The total cost is a very important factor when a company buys a transport service, but the access of a transport services and technical factors also affect the decision of which mode of transport is utilized. National and international regulations and demands can make one mode more favourable compared to the others[35].

Road transport does not experience competition between the different modes as the main problem to handle. The different modes have their own segments according to different kinds of goods and geographical distances. Trucks have large advantages when it comes to short distances and door-to-door solutions[36].

Railway transports can carry more goods than trucks and should be competitive over longer distances and especially for low value goods. This is the segment where rail is most competitive. Since the railway sector was a regulated market not long ago, there are still limits when it comes to competition. Rail transport has to compete both externally, against road and sea transport and internally, against passenger trains. One way to make railway transports more competitive is to use more multi-modal transports. Combining the railway's advantages of covering long distances and the flexibility of a truck should lead to lower costs. However, the efficiency at terminals is an area that needs improvement before multi-modal transport can be more competitive compared to just transporting by truck[37].

Competition within the sea transport sector is mainly within the shipping industry. The cost for personnel is a large part of the cost and by flagging ships under low cost countries is a way to reduce the cost for labour. In order to support the whole supply chain there is also a trend within the shipping companies to buy or cooperate closely with road transport haulers[38].

3.8 Time and Distance Dependence of Transportation Costs

For different transport modes cost varies depending on how time and distance are divided. Costs that relate to how long a vehicle is occupied with a certain transport is time dependent and costs that directly are related to how far the goods is transported are distance dependent. Costs that are time related are especially important when it comes to loading and unloading since cost can arise when goods are mainly to get off loaded[39].

[34] Coyle, J et al. (2000)
[35] Lumsden, K (2006)
[36] Enarsson, L (2006)
[37] ibid.
[38] Coyle, J et al. (2000)
[39] Lumsden, K (2006)

4 Description of the Transport Sector in the Target Areas

This chapter aims to give a short background of how the transport market in the different regions looks like today and how it has developed over the years.

4.1 Europe

One of the fundamental freedoms in the European Union (EU) is the free movement of goods. Every year the transport sector generates 10 % of the EU's wealth measured in GDP and provides more than 10 million jobs. In 2004, the EU was enlarged and the removal of barriers to cross boarders to the new countries increased the volume of long distance goods transports, especially road freight. Since then road freight has continued to grow and today congested roads and airports adds about 6 % to the total fuel consumption in the EU[40].

The imbalances between the utilisation of the different transport modes continue to affect Europe's transport policies. Especially road transports are facing higher fuel prices and tolls. These are also a cause large emissions of CO_2 to the society[41].

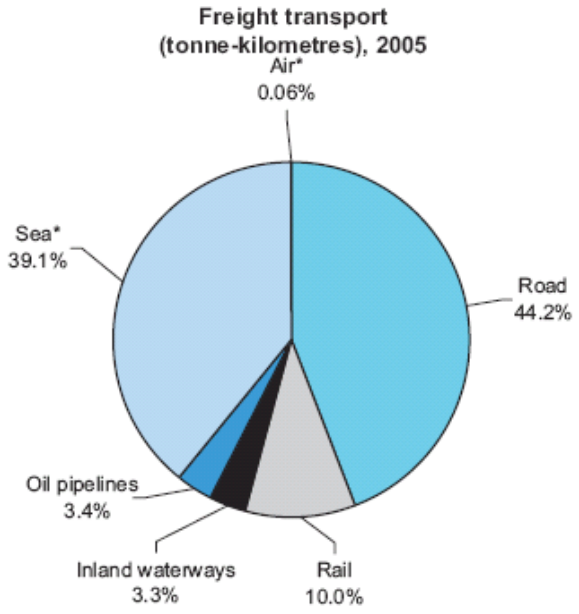


Figure 4-1 Modal Split in Europe in 2005[42]

[40] www.europa.eu
[41] www.ec.europa.eu
[42] www.epp.eurostat.ec.europa.eu

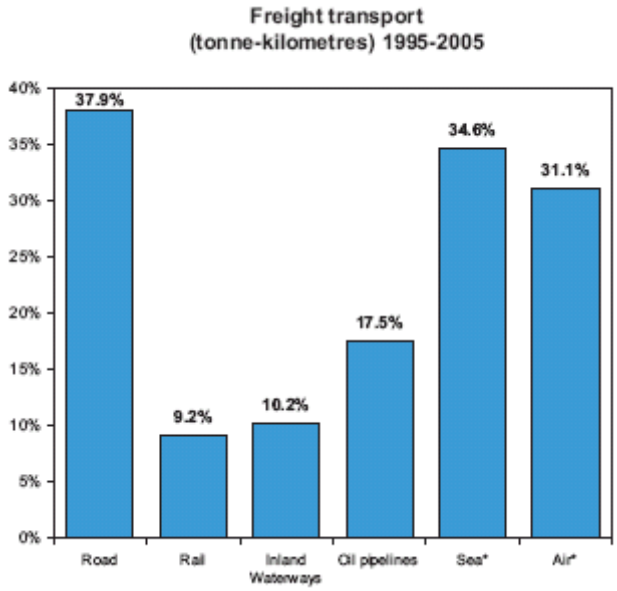


Figure 4-2 Increase in the need for freight transportation between 1995-2005[43]

Between 1995 and 2005 the demand for transportation increased; especially the demand for road transports which has increased by almost 40 % since 1995. One factor to the rapid increase can be the growing demand for door-to-door solutions and Just-in-Time production[44].

4.1.1 Railway

In the past couple of years the freight transported by rail has lost in share of the total market, despite the fact that freight volumes are increasing and the roads get more and more congested and the air gets more polluted[45]. Between 2000 and 2006 the market share kept by inland railroad transports decreased. Lack of efficiency and quality can be the main contributing factors to the decrease[46].

The lack of efficiency can also be explained by the fact that not two European countries use the same signalling system or electrical current for their trains. In Britain the trains run on the left side and in the rest of Europe on the right. Crossing the boarder between Spain and France requires every car on the train to be lifted so the wheals can be changed because the width of the tracks is not the same[47].

The lack of common standards makes the cost for transporting goods on the rail higher and it also makes the train less competitive compared to transportation by road. Every time a train needs to pull over to let a faster passenger train by it loses time. Another problem is boarder passing for example between France and Germany where you need to have drivers who are educated on both the French and German signalling system[48].

[43] www.epp.eurostat.ec.europa.eu
[44] ibid.
[45] www.swedfreight.se
[46] ibid.
[47] http://www.wright.edu/~tdung/eurpoe-train.htm
[48] ibid.

4.1.2 Road

During the past couple of years freight transported on roads has increased. Road transport is the mode that has increased the most over the last few years; about 38 % between 1995 and 2005. One of the first actions taken by the European Union was to create a standard transit document that is used when crossing the inner borders in the Union. The next step was to allow the trucks to drop off and pick up goods in every country, so the trucks did not have to return home empty[49].

Between 1999 and 2005 a number of EU-15 member states showed a strong rise in tonne-kilometres. The increases were evident mainly in Spain and Ireland but also in Luxembourg, Sweden, Italy, Germany and Belgium. During the same time, Denmark and the Netherlands showed a decrease in freight transport. The ten member states that joined EU in 2004 have since then shown strong growth, especially Hungary, Lithuania and Latvia[50].

4.1.3 Sea

The total volume of freight transported on the inland waterways in 2005 was 465 million tonnes. 47 % of the total volume was transported nationally and 53 % internationally. A total 87 % of the goods carried on the inland waterways in the EU were contributed by Germany, the Netherlands and Belgium. The latest members of the EU stand for the fastest growing rates in shipping on inland waterways[51].

Short-sea shipping (SSS) in Europe increased drastically in 2006 and it is predicted that 2007 will show an additional rise. In 2006 SSS represented 62 % of the total goods transported on water in EU-27[52]. Transport officials are thrilled when freight is moving from the congested highways on the continent to the unutilised waterways. Mainly accountable for the growth is the Baltic Region and imports to Russia. The Gulf of Finland is becoming the new highway transporting goods between Russia and Eastern Europe. SSS is considered to be a good alternative to road transport and transport on the poorly maintained railways in the east. Some challenges still remains for continued growth. There are many low-cost Eastern European and Russian truckers still getting a large portion of the transport business and the regulatory barriers to use SSS is more difficult compared to trucking in the EU[53].

4.2 The US

The US economy is becoming more and more service oriented and the demand for freight services are expected to continue to increase in the next couple of years. Since 1990 the total tonnes-kilometres transported has increased from 2.16 trillion ton-miles to 3.18 trillion ton-miles in 2001, a growth rate of 2.1 % annually. Rail and road transports makes up the major part of the domestic freight market. These two modals have increased its share on the expense of mainly waterborne freight[54].

[49] www.ec.europa.eu
[50] Pasi, S (2008)
[51] de la Fuente Layos, L (2006)
[52] Amerini, G (2008)
[53] Anonymous (2007)
[54] www.fhwa.dot.gov

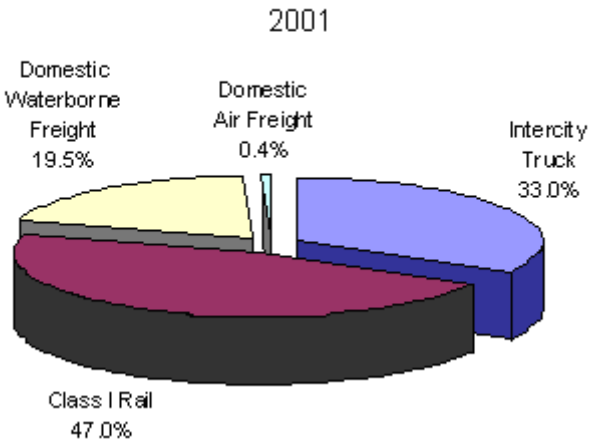


Figure 4-3 Modal Split in the United States in 2001[55]

4.2.1 Railway

In the US over 90 % of the freight railroads are privately owned and operated. Very little of the funding comes from the government. Each year the railroad companies invest in construction and maintenance of their tracks and other infrastructure while their competitors – road and sea transports – operate on government funded highways and waterways[56].

To stay in business the railroad companies must make a reasonable profit and since the deregulation in the 1980s the profits in the railway business have been very low and in many cases insufficient to cover the total costs. Even when the railroads had more traffic than ever before in 2006, the industry's profitability was still below average compared to other industries. At the same time railroad freight must offer high quality services at compatible rates to compete against other transport providers[57].

In the past 15 years, an increase in ton-miles carried by rail has increased. In 2005 over 40 % of the freight ton-miles were transported on railroad making it larger than any other mode of transportation[58].

In the US there is only one company that serves intercity passenger by rail, Amtrak. The majority of tracks that Amtrak operate on are owned by freight railways. By law the freight companies must give Amtrak access to the tracks when requested and also prioritise these trains. Amtrak will pay fees for using the system but the fees do not nearly cover the expenses caused[59].

4.2.2 Road

In 2004 the trucking industry grew 10.4 % compared to the year before. American Trucking Association expects a continued growth in the next decade. However, there are some threats to the industry:

[55] www.fhwa.dot.gov
[56] www.aar.org
[57] ibid.
[58] ibid.
[59] ibid.

- Shortage of drivers make wages higher, wages are the largest expense and they needed to be higher to recruit new people and retain the old. The demand for drivers is very high but there are few that are being educated.
- The second highest expense is fuel. In 2004 the cost for fuel in the transport industry rose by USD10 billion compared to 2003.

Other expenses that also are expected to rise are employee health insurance, liability insurance and cost from government regulations, including costs relating to security[60].

4.2.3 Sea

Over the last couple of years the roads in the US have become more and more congested resulting in delays. This in combination with other factors has shed new light on short sea shipping (SSS). In United States SSS has been suggested or established along the Atlantic coast and in the mid-west from Mississippi, Ohio and, Illinois Rivers to the Gulf of Mexico and along the Pacific coast. The definition of SSS is "the movement of cargo or passengers by water along the coastlines, to and from nearby islands, or within lakes and river systems, but without crossing an ocean"[61]

Figure 4-4 Inland waterways in United States[62]

4.3 India

Since the Indian economy started to grow more rapidlyin the beginning of the 1990s the demand for transport infrastructure and services has increased by about 10% annually. However, the transport sector has not been able to keep up with this. A good infrastructure is essential for continued economic growth and to reduce poverty since it increases the mobility of people and goods[63]. The infrastructure in India needs improvement, the roads are underdeveloped and the ports lack infrastructure and efficiency[64].

[60] Costello, B (2005)
[61] Higginson, J (2007)
[62] www.worldbank.org
[63] http://go.worldbank.org
[64] www.business-in-asia.com

4.3.1 Railway

The railway in India was introduced in 1853. In 1951 the Indian Railways was founded and it is a state-owned company that handles almost all rail operations in the country. The Indian rail network is said to be the second largest in the world and annually transports 5 billion passengers and over 350 million tonnes of freight. The Indian rail network also connects to the neighbouring countries Nepal, Bangladesh and Pakistan but the service to these countries is limited[65].

The high density railway corridors are heavily trafficked and are experiencing capacity constrains. At the same time the passenger traffic is heavily subsided to encourage passengers to travel by train. Since the capacity on the rail is limited and passenger trains are prioritized, the cost for transporting goods on the railway are higher than switching the goods towards the road[66].

4.3.2 Road

Today road transports are the dominant transport mode carrying about 65 % of the inland freight in India. However 40 % of the villages in India do not have access to all-weather roads and most highways are narrow with poor surface quality. The capacity of the highways is poor with mainly two lanes or less and about 25 % of the highways are heavily congested reducing speed to 30-40 km/h. These are all factors leading to higher transportation costs[67].

4.3.3 Sea

India is surrounded by water on three sides making it an ideal country for transporting goods over sea. The total length of the coastline is about 7600 km. India has 12 major ports and 185 minor ports along the coastline. The ports are the main gateways of trade handling about 95 % of the quantity traded and 77 % of the value[68].

The freight transported on inland waterways in India is only about 0.1 % of the total inland traffic, compared to about 20 % in the US. Even though India has an extensive network of rivers and canals this system is very much unutilised[69].

4.4 China

The transformation of the Chinese economy started in 1978 towards a market economy and today the economy of China is a driving factor in the economic world. Since China is the worlds largest country by population it is a gigantic market that needs to be taken into consideration[70].

When doing business in China it is important to understand the administrative system. The government controls planning and operation of infrastructure, energy and resources, market entries and taxation. Even though the economic structure has changed the political and administrative structure still looks a lot like the planned economy and this leads to high institutional costs.

[65] www.en.wikipedia.org
[66] ibid.
[67] ibid.
[68] ibid.
[69] ibid.
[70] Global Perspecitves China, (2006)

The total logistics cost can be divided into three parts:

- Transportation costs – 57 % of the total logistics cost
- Storage costs – 29 % of the total logistics cost
- Administrative costs – 14 % of the total logistics cost

When comparing the total logistic costs in China as a percentage of the GDP with United States, the percentage is much higher in China, 21.3 %[71] compared to 8.6 % in 2004[72]. Since 1991, the percentage has decreased by about 2.7 % showing that China has made their logistic services more efficient. To experience a continuing growth in the Chinese economy the government has realised the importance of investing in the infrastructure[73].

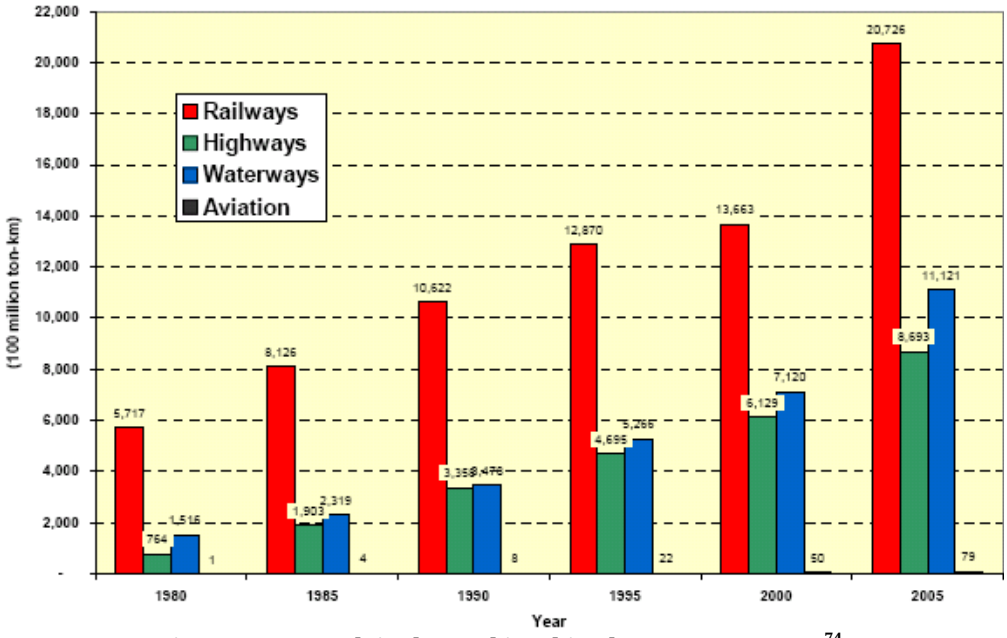


Figure 4-5 Growth in demand in China between 1980-2007[74]

Percentage of total tonne-km by mode				
Year	**Road**	**Railway**	**Waterway**	**Aviation**
1980	10	71	19	0,02
2005	21	51	27	0,2

Figure 4-6 Change in the modal split China between 1980-2005[75]

4.4.1 Railway

The railway in China carries up to 5.2 million people every day. A quarter of the world's rail freight transported on 6 % of the world's total track length makes the railway in China the most heavily used. About 55 % of the national freight volume is rail freight. Despite the rapid development, where new railway tracks are laid, the growing needs for rail freight is not met. Recent estimations show that on a typical day the current system only meets 35 % of the freight orders. The Chinese railway is one of the few railway systems in the world that increases its length. A surcharge on freight transport on rail is being charged and helps the

[71] Global Perspecitves China, (2006)
[72] http://www.scdigest.com/assets/FirstThoughts/06-02-02.cfm?cid=124&ctype=content
[73] Global Perspecitves China, (2006)
[74] www.worldbank.org
[75] ibid.

funding of new tracks. By 2020 the railway system is expected to separate high-speed passenger trains from freight trains on the main routes between, for example, two cities or between natural resources and factories[76].

4.4.2 Road

Over the last few years road transportation has helped to maintain the economic growth in China and road freight has increased its modal share from 24 % to 30 % in the last ten years. A rapid growth in road infrastructure has been possible because of extensive funding from national, provincial, municipal and local government budgets; user charges and fees; foreign investments and loans; and domestic banks. Tolls are an important source of income for financing expressways. In addition to tolls there are also three different road user charges:

- A fee based on the revenue from passenger transport enterprises and the capacity for freight vehicles intended for road maintenance.
- A vehicle purchase fee based on the vehicle's retail price. 10 % of the retail price has to be paid for road maintenance.
- A highway transport management fee.

However less than half of these incomes actually goes to road maintenance, the majority goes to the funding of new roads. All government owned vehicles are exempted from these fees[77].

The vehicle fleet in China continues to grow rapidly and China is predicted to pass the US as the largest market for new vehicles by 2010. However, the Chinese government now wants a balance between road transport and other public goals. The population wants an increase in mobility and desire car ownership which comes with great environmental impact with increased greenhouse gas emissions and energy dependence[78].

4.4.3 Sea

China has about 5800 rivers that are navigable and 15 of those are longer than 1000 km. The country also has 12 lakes that are greater than 1000 km^2. However the major freight on inland waterways, about 80 %, is transported on four of the rivers and one canal. China has a long history of using the waterways but insufficient funding has reduced the length of navigable water in the last couple of years[79].

China has more than 1400 ports, both seaports and inland river ports. Twelve of the ports handle over 100 million tons per year. China's extensive import and export volumes have forced the ports to raise the capacity and improve the freight handling for an efficient flow of goods through the ports[80].

4.5 Russia

In the late 1980s Russia was the most transport intense economy in the world. The large volume of freight was mainly due to the large natural resources the country possesses and huge distances between the natural resources and factories where they were processed. As a result of the deregulation of the transport sector in 1993 the transport costs rose when the

[76] Bin, N (2006)
[77] www.worldbank.org
[78] ibid.
[79] www.worldbank.org
[80] ibid.

actual price for a transport was taken out. Due to the huge distances in the country, air freight plays an important role, especially for fragile and high value goods[81].

Multinational companies acting in the country transport about 70 % of their freight by road, 20 % by railway and the rest by air[82].

One of the problems for the Russian transport industry is the underdeveloped handling of goods and difficulties when a change of transport mode is needed. Poor interaction between the different transport modes often leads to delays. In the last few years an increase in demand has been evident due to liberalization of foreign trade[83].

4.5.1 Railway

In May 2001 the government in Russia funded a program to reform its railway system; the changes are supposed to be finished in 2010. The goal is to create a market environment where almost all property currently owned by the Russian Ministry of Railways becomes assets of a new joint stock company owned by the state. When the changes have been made the goal is that the Russian government only will own the infrastructure and the centralized dispatching system. Railway is important to support the growing economy and early in the 21st century 80 % of all freight was transported by rail[84]. The lack of roads in large parts of the country makes rail transport the only option. All the changes that are made in the basic structure of the railway industry aims to create opportunities for investment from Russian and foreign investors[85].

4.5.2 Road

In the western part of Russia goods transported by truck has increased over the past couple of years and is today about 30 % of the total freight volume, compared to 40 % in Western Europe. The road infrastructure in Russia is very underdeveloped and in need of improvement. As a result of increased utilisation of the roads and lack of investment by the government the existing roads are in poor quality[86].

4.5.3 Sea

The most important inland waterway is Volga and its tributaries. About 2.5 % of the total goods transported in Russia are carried on water. Over the last couple of years there has been a decrease in shipping by water. However, it is still a good option together with rail if the goods are transported a long distance. There are about 40 ports in Russia and most of them were built in the beginning of the 20th century and today lack storage capacity and is in need of improvement to the standards of today[87].

[81] Swedish Trade Council (2005)
[82] ibid.
[83] ibid.
[84] Bregman, R (2003)
[85] ibid.
[86] Swedish Trade Council (2005)
[87] ibid.

5 Interviews

The interviewees in this section were chosen because they work with or close to logistic development at VLC in Gothenburg. This chapter aims to find out which factors experts in the area think will be the most important in the future. The interview guide is attached in Appendix 1.

5.1 Dan Geyer

The major factors that will affect transportation costs in the future

- Price on fuel
- The requirement for taxation and regulation
    - Tolls and fees are a new way for every mode to pay for maintaining the existing infrastructure and building of new.
    - Every mode needs to pay its part of the costs brought on the society.

The price on fuel is a large part of the total transportation cost and the price on crude oil is rising because of increased demand in the new developing countries. The price on crude oil is also affected by the political situation in the world. Conflicts in the Middle East, where many of the oil producing countries are situated are also affecting transportation costs. It is harder to make predictions today because the surroundings are changing faster and the uncertainties are larger and affects more.

Another factor affecting costs on transportation is the goods flow. For example a lot of goods are produced in China but then need transport to Europe and the US. However the flow in the opposite direction, Europe to China, is very small. This creates an imbalance and transportation costs are different, due to the demand situation.

EU
It is predicted that the need for transportation will increase by 50 % by 2020.

There is an increasing demand for ethical alternatives that is hard to handle. How long are the customers willing to buy product produced in countries where child labour is accepted?

The US
The fuel price in the US is relatively low. The prices are rising but are by no way close to the price in Europe. The rising price on crude oil will have a huge affect on the whole North America. At the same time the "environmental awareness" is increasing and the people are starting to affect the politicians regarding, for example, taxation.

The lack of educated drivers is already today a large problem that is expected to worsen as the number of drivers that will retire in the next ten years heavily exceeds the number of newly educated drivers. This will also increase the price of transport as transport companies are forced to raise salaries.

Another problem transporting goods in the US is the lack of usage of multimodal transports. The railroad is privately owned and the large trucking companies see the railway as a competitor even if they should work together to take advantage of each mode's strengths. The systems used in road transport are also totally different from the ones that the railroad companies use.

India
There are a few challenges in India. For example the infrastructure is underdeveloped and the efficiency when it comes to handling goods is poor. The states in India possess a lot of power when it comes to decisions regarding the infrastructure. When a new road is built there are often problems when it comes to crossing the boarder to the next state.

The ports in India are very inefficient and the Indian government does not see the potential in the long coast line the country possesses. It is often a problem to look at a national level and not a regional.

China
China is also challenged by problems with the infrastructure and the handling of goods is inefficient. However, the issues are not as severe as in India. The country is currently investing a lot of money in new infrastructure, especially new roads.

Russia
Volvo is currently building a new factory in Kaluga. The automobile market in Russia is large and as the standard of living is rising so does the demand for new cars. A problem in Russia and especially Moscow is the congested roads. The infrastructure does not grow as fast as it needs to. The roads are very congested, not only during rush hour.

How will globalisation proceed?
In a couple of years the production cost in China will be too high and production will move to for example India. The Baltic States are no longer considered as countries with low wages. Which countries will take over after China and India? There are a few suggestions:

1. Africa, for example Angola and Tanzania
2. The Arabic countries. However the development is getting slowed down by the political situation.
3. At Volkswagen they think that as the cost of transportation rises the production will move closer to the market.

As the distance increases so do the transportation costs. A higher transportation cost makes the margins lower and as the distance increase so do the uncertainty. These factors affect companies when deciding where to build new factories.

5.2 Kjell-Åke Hvittfeldt

The major factors that will affect transportation costs in the future:

- Fuel price
- Taxes
    - Direct – Taxes and tolls for example
    - Indirect – CO_2- taxes

Both the price of fuel and the taxes have increased in the past couple of years. The need for fuel has increased over the last 24 months and China and India is responsible for about two thirds of the increase.

EU
In Europe about 40-50 % of the cost for a transport is represented by fuel costs. The high price on crude oil has not affected Europe as much as the US, since the dollar is weak compared to the Euro, and oil I generally traded in US currency.

The US
In the US the price of fuel has tripled over the last couple of years. A week dollar combined with a high price on crude oil is responsible for this increase.

India
The culture in the Indian business world is more similar to ours than other developing countries. India was an English colony for many years and that affected the business culture making it easier for western companies to do business in the country.

China
Kjell-Åke thinks that China is a country that is difficult to do business in and with. The political structure makes it hard for foreign countries to establish and make profit. A large political reform is needed to keep the foreign companies in the country. Should the government focus on developing themselves before beginning global sourcing?

Russia
Today there is already a lack of drivers in Russia and it is expected to get worse over the next couple of years. Russia is an emerging market with large natural resources and so are the neighbouring countries of Kazakhstan, Belarus and Ukraine. The Baltic Sea and the Black Sea will be two important highways on the sea to support the enormous market.

Transportation costs in Russia have increased in the past couple of years and are expected to continue to do so. As the demand for transportation for people and goods are increasing so will the cost.

6 Important factors affecting transportation costs

The factors presented in the chapter where chosen based on the interview conducted with persons at VLC that work with or close to logistic development. Since these factors today are a large part of the transportation cost they are not expected to get less important in the future.

6.1 Oil prices

During many centuries energy has been essential to development, reducing poverty and expanding economies and enhancing welfare and the standard of living. Fossil fuel provides more than 90 % of the world's total commercial energy needs and oil is the most used energy source. The demand for oil is expected to continue to rise in the next two decades. The new developed countries in Asia stand for most of the increase and are expected to double their consumption 2030. Even with the increase in oil consumption in these countries they will still use five times less energy per capita than the OECD countries[88].

The transportation sector will be the main source for future oil demand growth and the potential increase in vehicle ownership in the developing countries will be an important factor in this growth[89].

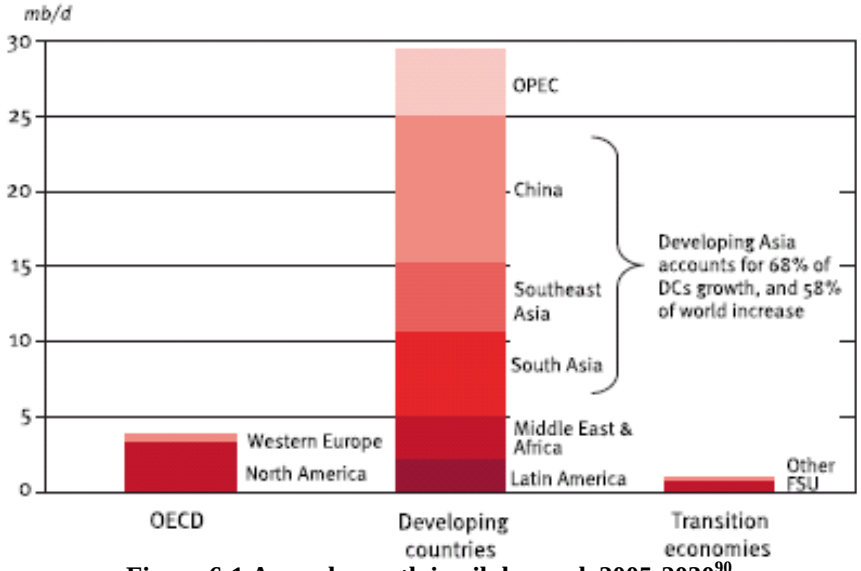


Figure 6-1 Annual growth in oil demand, 2005-2030[90]

Even with the increased consumption in the developing countries they are far behind North America and Europe. The oil use per capita in China is almost one fourth of the expected use in 2030 in North America[91].

[88] Salem El-Badri, Abdalla (2007)
[89] ibid.
[90] ibid.
[91] ibid.

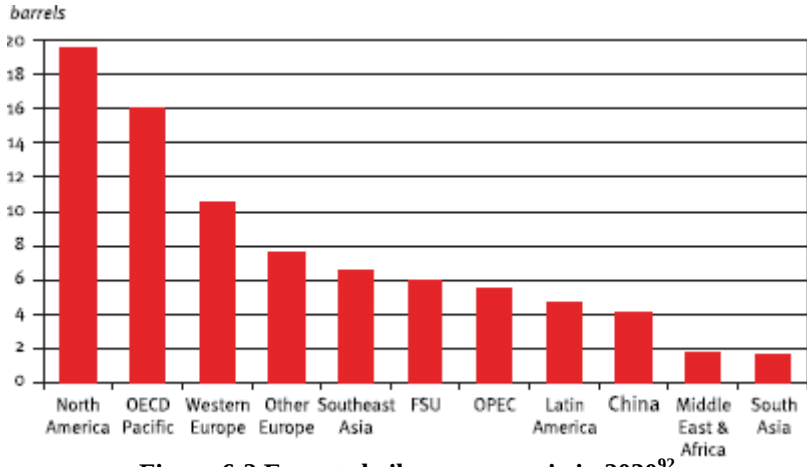


Figure 6-2 Expected oil use per captia in 2030[92]

The world's oil exports are dominated by a couple of regions. Saudi Arabia, USA, Russia, Mexico, Iran, China, Norway, Canada, Venezuela and United Arab Emirates produced about 60 % of the global crude oil in 2001[93].

6.1.1 OPEC

Organization of the Petroleum Exporting Countries (OPEC) is a permanent intergovernal organization of twelve oil exporting countries. OPEC was founded in Bagdad, Iraq in 1960 by five oil producing countries. The founding countries where Iran, Iraq, Kuwait, Saudi Arabia and Venezuela.

Figure 6-3 OPEC member countries[94]

OPEC wants to ensure a stabilization of the international oil market and eliminate harmful and unnecessary fluctuations. The primary interest of the oil producing countries is to secure a steady income by always making sure that there is a regular supply to the consuming nations and a fair return of investment to the exporting countries[95].

[92] Salem El-Badri, A. (2007)
[93] www.nog.se/files/NOG%20Referat%20051207.pdf
[94] www.opec.org
[95] ibid.

In 2005 OPEC stood for about 40 % of the total oil production in the world[96].

However, it is important to understand that there is also a lot of critics regarding OPEC. For example Saudi Arabia will, based on the current price on crude oil, make more money on oil this week than the sixty poorest countries in the world make this year[97]. Since many of the countries in OPEC are not "America friendly" and many expert maintain that OPEC do not increase production to reduce the price on crude oil in order to punish the American economy[98].

6.1.2 Factors affecting the oil price

Price on crude oil

Crude oil is the primary raw material to produce gasoline and other petroleum products. But the crude oil price only accounts for about half of the price of gasoline. The price on crude oil has risen drastically in the past couple of years, driven by strong global demand. Crude oil prices are also affected by other things like for example the political situation in the countries exporting oil[99].

Figure 6-4 How oil price reached US$100 per barrel[100]

The figure above shows that the price of oil has been used in political situations several times. The first time was in the Arab-Israeli war in 1973 when prices increased about 400 % in just six months putting pressure on the US, which in turn pressured Israel to accept United Nation's negotiations in the crisis. In the beginning of the 1980s the price on crude oil rose. A combination of the Iranian revolution and later the Iraq invasion of Iran severely restrained the two important oil producing countries capacity to produce crude oil, restraining the total world production by 10 %. The higher oil price led to a reduction in demand and the market started looking for more energy effective solutions. This, in combination with increased production led to the oil price crash in 1986. The low oil price in 1990 was one of the contributors to the Gulf war where Iraq wanted to take control over Kuwait, the third largest oil nation. After the war the prices declined and in 1994 they reached the lowest level in 21

[96] www.bp.com
[97] www.thestar.com
[98] www.businessandmedia.org
[99] www.thepriceoffuel.com
[100] www.news.bbc.co.uk

years. After a couple of years of rapid growth in the Asian economy it came to a halt in 1997 which led to a lower consumption of oil. In combination with an increase in production in the OPEC countries which led to a very low price. After 9/11 the US economy declined and so did oil prices. An increased production of oil in Russia also contributed to the low oil price. However, the oil price started to rise in 2002 and since then a continuing increase in oil price has been evident with a temporary decline after the Lebanon conflict in 2006. It started with the US invasion of Iraq which led to sever losses in oil production in the Gulf State in 2003[101]. The recent high price can be linked to primarily four things: strong demand, weak dollar, political tension and fear of supply shortages[102].

There are a few different benchmarks for crude oil.

- OPEC Reference Basket (ORB) which is a weighted average of prices for petroleum produced by OPEC countries[103].
- West Texas Intermediate often used in North America and the oil is light weighted and often used to produce low-sulphur gasoline
- Brent Crude is a mix of oil from 15 oil fields in the North Sea[104].

Oil Supply and Demand

Since oil is a limited resource, the world will most likely run out of oil in the future. The largest oil fields are called "super giants" and many of them are situated in the Middle East. The latest super giant was discovered in the 1960s and since then only smaller fields have been discovered worldwide. An oil field has a typical lifespan measured in decades and the peak production is reached in a few years after the start of production. After the peak the production starts to decrease and to keep up the production, new fields need to be found. If new oil fields cannot be found and brought into production there will be no opportunity to satisfy increasing demand, as per the figure below. Some expert say that a whole new Saudi Arabia will have to be found and developed every couple of years to satisfy the demand forecasts[105].

[101] www.news.bbc.co.uk
[102] www.guardian.co.uk
[103] www.en.wikipedia.org
[104] ibid.
[105] Hirsch, R (2005)

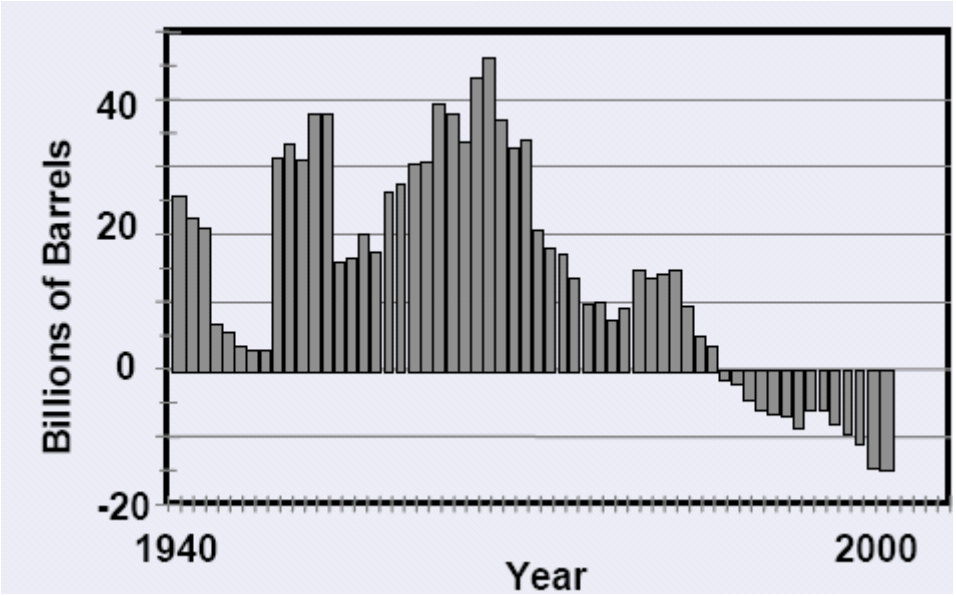


Figure 6-5 Net difference between annual world oil reserve addition and annual consumption[106]

If a disruption in supply occurs or demand grows it pushes the price of crude oil upwards. At the gas station level these principles also apply and if one retailer prices its gasoline too high the customers may take their business elsewhere. An increase in demand earlier led to new findings of oil as money was invested in exploration of new oil fields[107].

6.1.2.1 EU

The oil consumption in the EU is estimated to be about 14.5 million barrels per day. The EU has tried to be pro-active and cutting oil consumption resulting in high taxes on gasoline and a relatively high usage of renewable energy resources[108].

6.1.2.2 The US

The oil consumption in the US is over 20 million barrels per day and climbing and the share of transportation is 69 %. The weak economic growth and high price on crude oil is expected to temporarily decrease the consumption by 330 000 barrels per day. However, forecasts predict that the need for petroleum and other liquid fuels are expected to continue to rise in 2009[109].

When the world price on crude oil is rising the immediate effect is clear in the US. Since crude oil is a commodity that is valued in dollars a weak dollar immediately affect the price on gasoline and diesel[110].

6.1.2.3 India

Today India is the sixth largest consumer of oil and is expected to be the fourth largest in a few years. About 65 % of the oil is imported today and the dependence on imported oil is expected to grow rapidly in the next couple of years. Over 95 % of the oil is used in the growing transport sector. The Indian economy is very sensitive to changes in the oil price.

[106] Hirsch, R (2005)
[107] www.thepriceoffuel.com
[108] www.sika-institute.se
[109] www.eia.doe.gov
[110] ibid.

The fuel price in India is heavily subsidized and a goal is that a change in gasoline price should not affect the "man on the street". During this year the cost for the oil subsidies are expected to cost about SEK 80 billion and the losses for the oil companies with an oil price on US$90/barrel are about SEK 400 million each day[111].

6.1.2.4 China

The growth in China's oil consumption has accelerated mainly because the car is more affordable for the Chinese public today. A shift from public transportation and bicycles towards more energy consuming modes is underway. The numbers of automobile are growing with 19 % every year. Projections predict that China will surpass the US by 2030. Contributing to the increase in automobile purchasing is the low gasoline price. It is now ranked among the lowest in the world for oil importing countries. China's ability to produce its own oil is limited and the oil reserve is small in relation to consumption. Until 1993 China was a net exporter of oil but today China imports more than 32 % of its oil[112].

6.1.2.5 Russia

Russia is the second largest producer of oil in the world, only Saudi Arabia produces more. The oil production in Russia peaked in the late 1980s and decreased drastically in the 90s. Since 2000 the domestic need for oil has increased by about 1.5 % annually, and is expected to continue to do so for the next 15-20 years. About 30 % of the total production volume is used for the country's own needs and the remainder goes on export[113].

The price of oil in Russia has historically been below the average price on the world market and the consumption of oil was much higher during the Soviet era, on the other hand the prices were heavily subsided and did not reflect the world market price[114].

There are three major taxes on the Russian oil:

- Royalty – tax on the volume of oil produced.
- Export tax – a tax that depends on the world market price. If the price on the world market is above US$15/barrel the tax starts to apply.
- VAT – a tax that applies on the oil used on the domestic market. 18 % of the oil price[115].

6.1.3 Alternative fuels

The transport sector is almost totally dependent on the use of fossil fuels. Carbon dioxide emission from transportation is increasing of a higher rate than from any other industry and the choice of fuel is affecting all the emissions from transportation. However, improvements have been made over the years and today lead is almost eliminated in fuels, the content of sulphur has undergone major reductions and a change in the formulation of gasoline has reduced the content of benzene. At the same time technologies have improved for example the introduction of the three-way catalytic converter and lean burning diesel has reduced many pollutants[116]. There are several fuel options that might be important in the future:

[111] www.swedishtrade.se
[112] www.iags.org
[113] www.malkaoil.se
[114] ibid.
[115] ibid.
[116] Hensher, D et al.(2003)

Methane gas
Methane gas can be made from both fossil and renewable energy resources. Natural gas, that is a by-product from a fossil energy source, is today widely used in the energy sector but only to a minor extent in the transport industry. Biogas is either produced by collecting gas from landfills or by fermenting organic waste in biogas plants. Studies show that emission from natural and biogas fuelled vehicles can be very low[117].

Biodiesel
Biodiesel is produced when oil from biomass is extracted from plants like soybeans, sunflowers or rapeseed. Rape methyl ester (RME) is also an alternative within the biodiesels that usually can be used directly in diesel engines. Advantages from biodiesels are that emissions of hydrocarbon and particulates can be reduced. However, replacing diesel with RME would result in an increase of NO_x emissions[118].

Ethanol
One of the most commonly used biofuels is ethanol and it is widely used in the EU, the US and Brazil. Ethanol can be produced from sugar cane, maize and bacteria and researches shows that emission levels of all the regulated pollutants can be lowered[119].

The largest producer of ethanol today is Brazil with a yearly production of 13 million tonnes. The second largest is the US with 11.8 million tonnes. These two countries stand for almost 70 % of the world's production and most ethanol is produced from sugar canes. The production of ethanol does not only give positive effects. When land is allocated for cultivation of sugar canes this directly affects the domestic food market. For example has the price of corn risen since American ethanol manufacturing has increased. Lately there has also been a debate about the working conditions for sugar cane workers in Brazil. The workers earn about US$ 4 each day and are expected to gather 15 tonnes of sugar canes every day. The number of working related accidents is also high and about 1400 sugar cane workers have died between 2002 and 2006. In order to make room for the plantation, rain forest is being cut down affecting the earths ability to make oxygen from $C0_2$[120].

Methanol and dimethyl ether (DME)
DME can be effectively produced from natural gas and has similar properties to ethanol. Emission levels from DME are also similar to those of ethanol but DME is a typical diesel fuel with potential to significantly lower emissions compared to regular diesel[121].

Hydrogen
Hydrogen can be produced from many different kinds of feedstock and is often proposed as the fuel of the future. One of the huge advantages is the possibility to greatly reduce the emissions of carbon monoxide, hydro carbons and particles. Hydrogen will be a very interesting alternative in the future as carbon can easily be removed from natural gas at plants where carbon sequestration is competitive. The idea is to remove the carbon before it enters the atmosphere. Hydrogen can also be produced by electrolysis. A challenge that needs to be investigated is the need to develop distribution systems and effective and cheap storage

[117] Hensher, D et al.(2003)
[118] ibid.
[119] Hensher, D et al.(2003)
[120] www.baff.info
[121] ibid.

systems for hydrogen. Today storage of liquid hydrogen is wasteful and energy consuming when it comes to the use in private cars[122].

Electricity
One of the major advantages with using electricity in vehicles is that local emissions are basically zero. However emissions may arise at the plant where the electricity is produced. One of the main problems with electricity in vehicle use is the energy storing. No storage system is currently providing driving ranges compared to conventional vehicles[123].

6.2 Environmental taxation

There are a couple of taxes that are supposed to affect the environment. Theses factors can either affect the emission of GHG, the environment surrounding major infrastructure or help finance new infrastructure.

6.2.1 Road Taxation

Road pricing is not a new idea and has been used all over the world to finance infrastructure, reduce congestion and improve air quality. In the past few years the interest for road pricing has increased. In recent years new technology has increased the opportunity for cost efficient systems by using automatic road charge systems. The reasons for tolling a road are either one of two; it can either control congestion or lighten an environmental problem[124].

There are different ways to control congestion, for example higher parking fees can be charged in certain areas, higher fuel taxation, subsidies to public transportation, higher vehicle licences fees. An alternative to ease congestion is to invest and build additional and better roads[125].

6.2.1.1 Eurovignette

The Eurovignette system is the system that collects road tolls in the EU. Across the EU the different member states vary in methods when it comes to charges and tolls on heavy vehicles. The first directive was 1999/62/EC and in May 2006 the current directive 2006/38/EC was amended. Eurovignette allows EU member states to levy charges on vehicles that weights more than 3.5 tonnes and transport goods. The directives give the member states an opportunity to integrate external costs caused by road transportation in toll prices. These external costs include congestion costs, environmental pollution, noise, damage to the landscape and social cost. EU legislators agreed that the external costs have to be proven "undeniable"[126].

The new directive give the member states more flexibility to levy tolls or charges and the fees can be raised on an entire road network, not just motorways:

- Toll revenue should be used to maintain the road infrastructure or benefit the transport sector as a whole by cross-financing.
- In 2010 the countries which apply tolls or user charges will be obligated to vary the prices based on the vehicle's pollution standards, to favour the cleanest ones.

[122] www.baff.info
[123] Hensher, D et al.(2003)
[124] Braga, C et al.(2004)
[125] ibid.
[126] www.euractiv.com

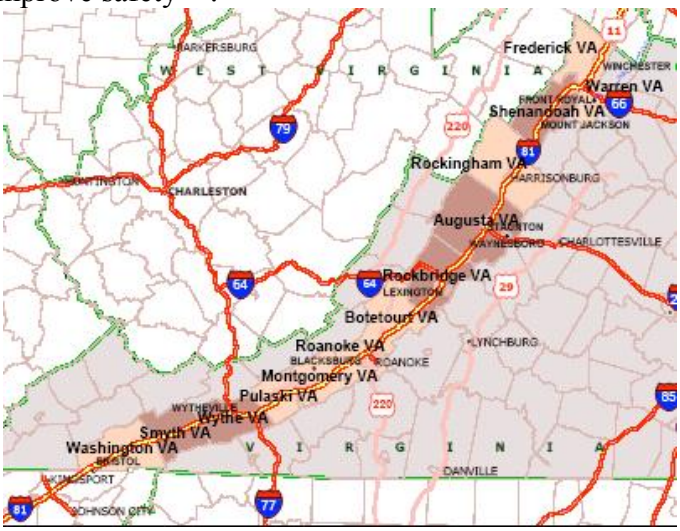
- Isolated areas or weak economic regions can be exempt from the charges to favour the specific region.
- Discounts will be possible for frequent users[127].

6.2.1.2 Toll Collect GmbH

Germany is one of the first country in the EU that uses a new road toll to charge vehicles that weight over 12 tonnes when driving on the German motorways (autobahn). The development of the system started in 2002 and the system was opened in 2005, two years behind schedule. A charge varies according to the emission category of the vehicle and the number of axles and is between 9 and 14 cents per kilometre[128]. The German government claims that the charge is justified since Germany is a centre of the international goods traffic. This means that huge investments have to be made to maintain and build new motorways[129].

6.2.1.3 Interstate 81 project

Interstate 81 (I-81) is a vital link in the west of Virginia, USA, serving 21 cities. It carries a large number of commercial trucks, making it a critical facility for the economy; the trucks carry raw materials generated in the south to factories situated in the northeast. I-81 has two lanes in each direction and due to the varying terrain with many steep hills; the right lane is often used by heavy trucks creeping uphill. When I-81 was planned it was anticipated that about 15 % of the traffic would be trucks, however the range is between 24 to 34 %. The Virginia Department of Transportation is suggesting that I-81 will be made into a toll road, where the money raised should be invested in building another lane in each direction. The reconstruction work cannot be achieved without colleting tolls. Tolls can only be collected for trucks, Virginia State law forbids tolling on passenger cars[130]. Another concern is the amount of accidents that occur on I-81, over an 18 month period 41 people were killed and 1528 were injured. Trucks stand for about half of the number of deaths and in the next couple of years the number is expected to grow as the standard of the roads drops. The collected tolls are also going to be used to improve safety[131].



Figur 6-6 The I-81

[127] www.euractiv.com
[128] www.toll-collect.de
[129] ibid.
[130] www.fhwa.dot.gov
[131] www.virginiadot.org

6.2.1.4 Road tolls in India

When crossing a state border in India truck drivers need to hand in copies of their driving licences, vehicle registration and a list of taxable goods on the truck. This causes each state crossing to take about one to three hours. The driver pays toll fees and taxes to the state and sometime even a bribe to the police. Since there are 28 different states in India, each with its own regulations and rules, its own tax code and sometimes even its own language, boarder crossings takes time. This system hurts the Indian economy and a unified tax- and transport system would help solve the problem. About fifty percent of the cost of any product is freight charges[132].

One example of a toll road is the Mumbai-Pune Express. This was Indias first toll road connecting the two cities Mumbai and Pune. The road was opened in 2002 and it reduces the time it takes to travel 95 km between the two cities to about 2 hours. In 2004 another toll road was opened between Ahmedabad-Vadodara cutting the travel time between the two cities from 3 hours to 1 hour. Another project is to build a new road between the two large cities of Mumbai and New Delhi[133].

6.2.1.5 Road tolls in China

China is using a large number of toll roads to raise money to build new infrastructure. Since China is a country that is developing fast and need a lot of new infrastructure to support the needs for the massive amount of people that live in the country, collecting tools is a good way to support the building. Especially the west region of China needs to build new infrastructure and the government is now allocating resources to build a new expressway in the west. Today nearly all of the expressways and express routs are toll roads[134].

6.2.1.6 Road tolls in Russia

In 2007 a new toll road law was adopted in order to develop this sector. Today about 0.05 % of the total road network in Russia is tolled. The road between Nevil and Valezh is being tolled today and the charge is about US$8[135].

6.2.2 Fuel taxation

When fuel first was taxed it was mainly a way for governments to generate revenue. Today it is also one of the most important tools to deal with global warming. The fuel consumption stands in direct proportion to emission of the most important green house gases (GHG), CO_2. However, fuel taxation does not take, for example noise and congestion created from the vehicle into consideration[136].

If it were not for fuel taxation some expert contends that the atmospheric contents of carbon would be much higher. In OECD countries motor fuel accounts for over half of the total oil related carbon emission. If the EU had similar taxation as the US, the emission of carbon would be substantially higher[137]. When comparing the EU and the US, see figure below, the taxes in the EU are five to twelve times higher. This is clearly related to higher fuel use. The

[132] www.csmonitor.com
[133] ibid.
[134] www.cnaec.org.cn
[135] www.newsfromrussia.com
[136] Braga, C et al.(2004)
[137] Sterner, T (2007)

annual consumption of gasoline in the US is 1300 litre per capita, while most EU countries use less than a third or the amount[138].

Gasoline taxes in cents/litre in selected countries, 2005

Western Europé	Gas tax	***Eastern Europe***	Gas tax
Italy	90	Hungary	125
UK	97	Czech Rep.	117
Netherlands	100	Poland	118
France	89		
Belgium	94	Average	120
Germany	90		
Finland	85	***Non European***	
Norway	74	Japan	46
Portugal	103	Australia	35
Sweden	80	New Zealand	42
Denmark	70	Canada	26
Spain	72	Mexico	21
Austria	68	USA	10
Ireland	62		
Luxembourg	60	Average	30
Switzerland	50		
Average	80		

Figure 6-7 Gasoline tax in selected countries, 2005[139]

Fuel taxes are an important source of income for financing the cost that road users cause on infrastructure. The taxations are necessary to maintain, manage and develop mainly the road infrastructure. In many of the developing countries even a small tax on fuel is sufficient to cover the financing of the existing network. In addition, taxation on fuel can be used to cover so called external costs of transport such as environmental pollution, noise, and congestion[140].

6.2.2.1 Europe

Most of the countries in the EU have similar methods when pricing gasoline and diesel. In a general conclusion this means that if you know how the gas price is constructed in one country you can make basic assumptions about the rest of the countries[141].

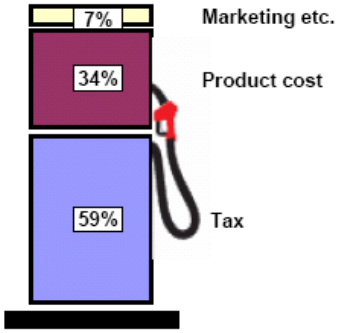


Figure 6-8 The distribution cost of one litre gasoline in Sweden February 2008[142]

[138] Sterner, T (2007)
[139] Sterner, T (2007)
[140] www.sutp.org
[141] www.spi.se
[142] ibid

The tax parts of the cost are in Sweden divided into $C0_2$- and energy tax which are fixed taxes and VAT (25% in Sweden) which vary in the different countries in the EU. The retail price was an average 1.33 € in February 2008[143].

6.2.2.2 The US

In the US about two thirds of all oil refined is used in the transportation sector. In the rest of the world the oil is more commonly used for power generation and heating. In 2008 the declining economy combined with a high oil price are expected to restrain the consumption of liquid fuels and petroleum products[144].

In the past few years the demand for petroleum products in the US has increased and now outpaced the country's production capacity. The US imports currently represents 60 % of the crude oil the country needs to meet demand[145].

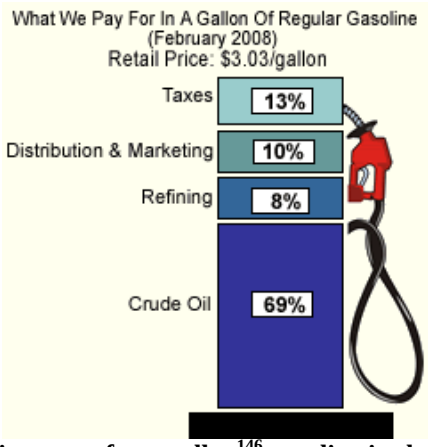


Figure 6-9 The distribution cost of one gallon[146] gasoline in the US February 2008[147],[148]

The price per liter is € 0.51 where the tax represents only € 0.06[149].

6.2.2.3 India

The fuel taxation in India is low. The government control prices and refuses on principle to adjust consumer prices. As a result, they have an unsecured national budget, inflation and increasing public debt[150].

6.2.2.4 China

In 2008 China is planning to commence environmental taxation to protect nature. The Chinese government department of tax and environment will try to work out a taxation that promotes protection of the environment. The principal idea behind the taxation will be to pay according to profits and the first proposition states that companies should pay taxes according to how much they earn from products that consume natural resources or pollutes the environment. Another tax proposal suggests that a tax is levied on companies based on how

[143] 1 € = 9,36 SEK, 2008-04-09
[144] www.thepriceoffuel.com
[145] www.thepriceoffuel.com
[146] 1 gallon = 3,785 litres
[147] www.eia.doe.gov
[148] 1€ = US$1.57, 2008-04-09
[149] Calculation by the Author
[150] www.international-fuel-prices.com

much pollutants they emit. A third suggestion would levy a tax on consumers when using fossil fuels, there is today no such tax in China. A fuel tax was first suggested in China in 1994 but the government has delayed the introduction stating that it will put a great burden on the people that use a lot of oil fuel, for example taxi- and bus drivers[151].

6.2.2.5 Russia

There is no fuel taxation in Russia. Instead fuel prices are subsidised by the government. Due to the high price of crude oil, Russia profits from the high price of crude oil which continues to support the subsidy policy. Taxes are levied on oil companies and the revenue is used for subsidising the gasoline price[152].

6.2.3 Kilometre taxation

Many researchers consider kilometre taxation to be a superior way when dealing with traffic flows and their external costs. The tax is primarily based on the distance travelled but also which environment class and the number of axels the vehicle has. It is a tax that can control the vehicle fleet so that aged cars and trucks can be fazed out and replaced by new, less fuel consuming vehicles[153].

6.2.3.1 Kilometre taxation in Switzerland

Switzerland was the first country in the EU to introduce a kilometre taxation in 2001. The system is based on modern information technology and when using the entire road network a charge is levied for all vehicles with a weight over 3.5 tonnes. The taxation is differentiated based on the total number of kilometres driven, the maximum weight the vehicle is allowed to carry and the environmental classification of the vehicle. Benefits from using this system are that charges are based on the maximal weight the vehicle is allowed to carry, whether it is fully loaded or not. This encourages transporters to refrain from driving with an empty load[154].

6.2.3.2 Kilometre taxation in Austria

The Austrian system for kilometre taxation was started in 2004 and affects all transports with a weight over 3.5 tonnes. Austria had a system with Ecopoints before mainly to punish very unclean transports. The motive to change to the new system was mainly to be able to afford to finance new infrastructure and maintenance of the old. The taxation is based on the number of axles the vehicle has and is currently not based on the environmental class[155].

6.2.3.3 Planned kilometre taxation systems in EU

There are a couple of countries in Europe that are planning to introduce kilometre taxation within the next few years. For example the UK plans to introduce the system and investigates how and where the taxation should be levied. Another country that plans to introduce the taxation in 2012 is the Netherlands. The system would not only be based on distance travelled and environmental classification but also on time of the day[156].

[151] www.chinadaily.com
[152] www.international-fuel-prices.com
[153] Braga, C et al.(2004)
[154] www.affarsvarlden.se
[155] www.asfinag.at
[156] www.sika.se

6.2.3.4 Russia

The need for new infrastructure and maintenance of the old one is massive in Russia. The number of cars has more than doubled in the past few years and a kilometre taxation would be one way to finance new projects. Taxation would be based on the number of axles on the vehicle and taxation would apply on all vehicles, national and international, between 12 and 44 tonnes[157].

6.2.3.5 The US, China and India

There was no information found about whether or not the countries are planning on levy introducing kilometre taxation.

6.2.4 Carbon dioxide taxation

In the last 10 000 years the climate on earth has been relatively stable. The industrial revolution however has led to the rapid increase of GHG and the levels of primarily CO_2, CH_4 and N_2O are well above the natural levels. If the emissions of CO_2 continue to grow, the levels will at 2100 be twice as high as before the industrial revolution. The increase is expected to raise the average temperature with 1.2-1.5°C. Such change will bring major climate changes around the world[158].

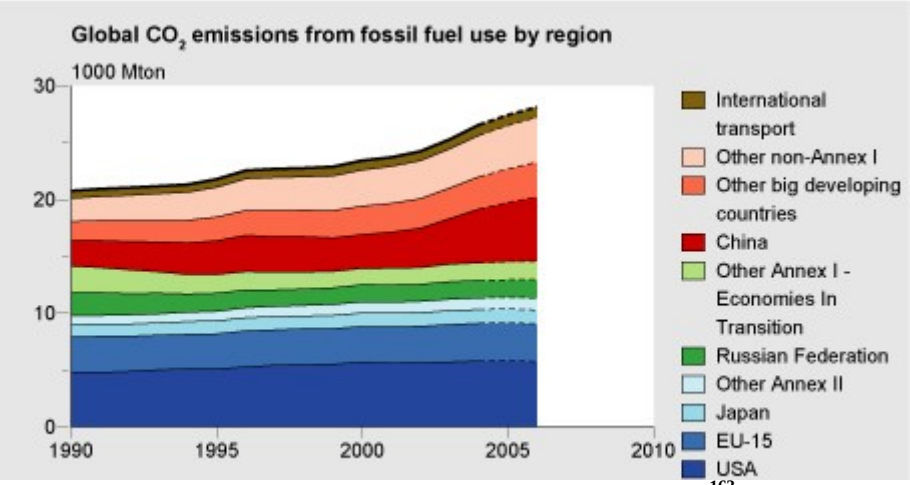
Global warming is often considered an external cost. Typical for this type of cost is that the people that are affected by them cannot affect or take actions to prevent these problems. Since the resource is being overexploited no one is willing to take the extra cost brought on, in many cases, the society[159].

When it comes to coordinating activities among countries to reduce emission of GHG, there are some instruments that might be helpful when fighting global warming. One of the first steps is to coordinate international carbon dioxide taxation. When a tax is brought on a specific activity the cost for this action increases, hopefully leading to a reduction in utilization of the specific activity[160]. The second step to unite the world in the war against CO_2 is to introduce emission trading, giving every country the "right" to a certain amount of GHG. The outcome of these two proposals, however, is uncertain. Introducing taxation on carbon dioxide will not for sure reduce emissions, the result depends on what kind of activity that is taxed and how important it is. If the activity is important enough the only outcome can be that the price for the end costumer will be higher. Initiating the rights to trade emission will bring results, assuming that a majority of the countries responsible for GHG emission will participate. Emission trading will act as a market mechanism to ensure that the total cost of accomplishing the target is as low as possible. However, before an international taxation system and emission trading can be put into action there are some important questions that needs to be addressed. First there is the question of what total level of GHG emissions that will be allowed. Next is to make a fair distribution of how much which country is allowed to emit. Finally there is the question of a reasonable distribution of the gains from emission trading[161].

[157] www.sika.se
[158] Hensher, D et al.(2003)
[159] ibid.
[160] ibid.
[161] ibid.

6.2.4.1 Emission of carbon dioxide

In 2006 CO_2 emission from fossil fuel increased by about 2.6 % compared to a 3.3 % increase in 2005. The increase was mainly due to higher global coal consumption for which China was the primary contributor. In 2006 the total fossil CO_2 emissions of China increased by 8.7 %. As shown in the figure below the developing countries and China stand for the largest part of the increase in emissions. China has surpassed the US as the country that emits the most CO_2 followed by EU, Russia, India and Japan[162].



Figur 6-10 Global emission of carbon dioxide from fossil fuels use by region[163]

6.2.4.2 The Kyoto protocol

During the United Nation conference in Rio the Janeiro in 1992 the countries of the world met and talked about climate changes and an agreement called United Nations Framework Convention on Climate Change (UNFCCC) was signed. The agreement stated that the 189 countries should work together to form similar rules and goals to tackle the global threat coming from climate changes[164]. In December 1997 the Kyoto protocol was adopted when the countries met in Kyoto, Japan. It symbolizes the new international attitude towards climate changes. The protocol states that the industrialized countries have agreed to reduce emission of six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydroflourcarbons, perflourcarbons and sulphur hexafluoride. The reduction should be at least 5 % in the first period (2008-2012) compared with the levels of 1990[165]. To ratify the Kyoto protocol at least 55 countries must sign the protocol and these countries have to be responsible for at least 55 % of the industrial countries emissions of GHG. The problem at this time was that neither Russia nor the US ratified the protocol and together they stand for more than 50 % of the industrial countries emissions of GHG. When the Kyoto protocol was signed Bill Clinton was the president of the United States. However, the US congress did not ratify the protocol during his presidency. In 2001 the new president, George W. Bush, declared that the US was not going to ratify the Kyoto protocol. The reason was that he thought the agreement was unfair because the developing countries did not have to reduce their emissions of GHG in the same extent as the industrial countries[166]. A couple of years later Russia joined the World

[162] www.mnp.nl
[163] ibid.
[164] www.energimyndigheten.se
[165] www.europa.eu
[166] www.energimyndigheten.se

Trade Organisation and after being pressured by the EU Russia also ratified the Kyoto Protocol in November 2004. In December 2007 Australia also signed the protocol[167].

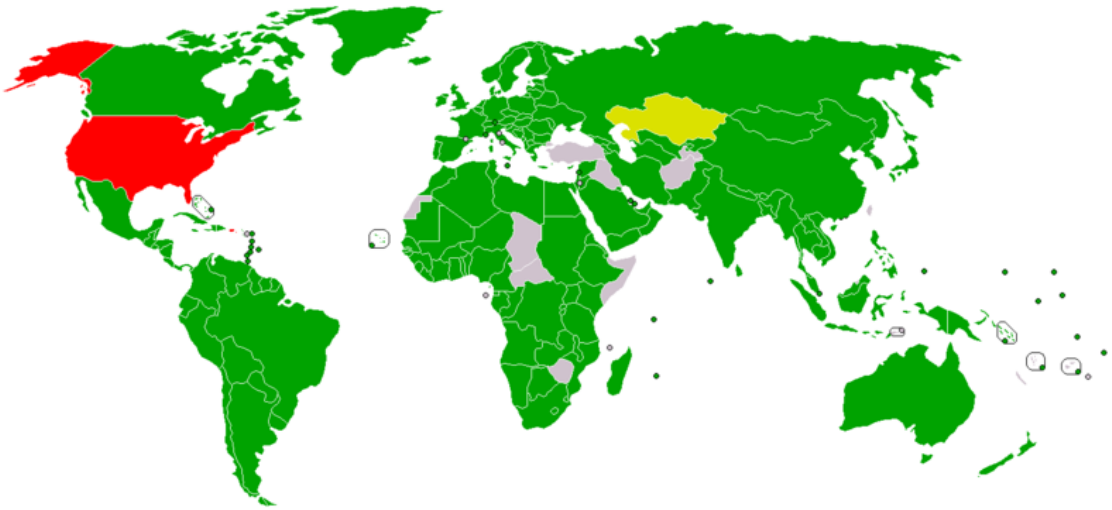


Figure 6-11 Countries which had ratified the Kyoto Protocol in 2007[168]

Within the Kyoto protocol there are three market-based mechanisms:

- Emission trading between the countries who signed the protocol.
- Joint implementation of projects by these countries.
- Clean development mechanism with countries that did not sign the protocol[169].

The mechanisms were defined to lower the overall costs for reaching the emission targets. If one country can reduce their emissions more than the agreement states, emission rights can be sold to other countries[170].

6.2.4.3 Emission Trading

Emission trading is a system used to control pollution by providing economic enticement for accomplishing reductions in the emission of pollutants. Trading with emission rights might for example make a coal power plant less competitive compared to more environmental friendly energy sources[171]. There are also suggestions to include the transport sector[172].

Usually the government or an international union set a limit on the amount of pollutants that can be emitted and companies in the sector chosen are required to follow the regulations. Every company is given a certain amount of emission rights or credits and if a company needs to increase their amount of credits, they can buy them from a company that emits less than the

[167] www.en.wikipedia.org
[168] ibid.
[169] www.europa.eu
[170] ibid.
[171] www.ieta.org
[172] ibid.

allowed amount. The total number of credits set for a specific sector cannot be exceeded and the total emission levels are limited. The idea behind the system is that the companies who work actively with reducing their emissions are awarded when they sell credits to a company that is polluting. Those companies that easily can reduce emissions cheaply will do so which will result in the reduction of pollution levels at the lowest possible cost to society[173].

Experts state that trading with carbon is a better approach than introducing a carbon tax. The emission rights are initially divided based on the history of previous emissions and most of the money earned in the system is spent on environmental activities. There are also a couple of problems that need to be addressed, for example experts state that the complex nature of the problem will make it harder to control how much that is actually emitted[174].

There are proposals that the sea transport industry should start emission trading. The primary pollutants from ships are SO_2 and NO_x. By stating an incitement for the sea industry there would be a drive to reduce the external effects of shipping. The proposal is being evaluated in the EU commission and is a part of the work of including the transport sector in emission trading for CO_2[175].

EU

The largest trading organization for GHG is the EU Emission Trading Scheme (EU ETS) and was founded when the Kyoto Protocol was ratified. Today it is the only mandatory carbon trading program. The first trials where conducted in the UK and Denmark and in January 2005, and 25 of the 27 member states are participating. The program regulates the amount of $C0_2$ emitted from power plants and factories that are carbon intense industries. Almost half of the EU's carbon dioxide is covered by the organization. In the first phase of the program the participating countries can trade emission nationally and in credits from the developing countries through Kyoto's Clean Development Mechanism. The first phase has received criticism because of an oversupply of total credits and the distribution of credits among the countries and industries[176].

There is a proposal to include the transport industry in the EU ETS system in 2013 according to a report from the European Council. Estimations states that the proposition could save up to 23 million tonnes of $C0_2$ per year until 2020. Including the road transport sector would be a contribution to reach the goals set by the Kyoto Protocol[177].

The US

One of the first emission trading system was the Acid Rain program in the 1990s in the US. The system is a so called "cap-and-trade" where a limit, cap, is set and then trading is allowed within the system and the substance being traded is SO_2. A 50 % reduction between 1980 and 2010 is expected and some experts say the reductions can be as large as 80 %[178].

The state of New York has a "cap and trade"- system with CO_2 emissions for power generators that is called the "Regional Greenhouse Gas Initiative. The program is supposed to

[173] www.ieta.org
[174] ibid.
[175] www.sweship.se
[176] www.ec.europa.eu
[177] www.environmental-finance.com
[178] www.epa.gov

launch in 2009 and the goal is to reduce emission from the generators with at least 10 % by 2018[179].

China, India and Russia
There is no information that any of the countries have emission trading systems today. However all of the countries have signed the Kyoto protocol and will eventually need to follow the guidelines set up in the protocol.

6.2.5 Annual vehicle tax

Basically all of the industrial countries use this system. It can be differentiated based on variables like weight, engine power and environmental class. This tax can not be used to cover external cost since it is not based on actual usage[180].

6.2.6 Vehicle sales tax

This tax is also called VAT and applies to new cars sold on the market. There are two different aspects of this tax; the first one means that if this tax is high there will be fewer cars on the road. Other states that if VAT is high it will make people buy used vehicles that are not as fuel efficient as new ones[181].

6.2.7 Fees affecting rail transports

A railway company has its own cost for transportation and pays a fee to the state or to a rail track organisation. The track fees are relatively small compared to fees and taxes for trucks. For example the rail companies in Sweden pay the following fees to Banverket:

- Track fee
- Accident fee
- Diesel fee
- Switch fee

There is no fee for using electrical power but train companies pay for the electricity used. Similar systems are used in other countries, but since countries do not use the same kind of systems the structure and level of the fees vary[182].

6.2.8 Taxation affecting sea transports

Due to the sensitive nature in and around the Baltic Sea region special laws now affect the sea transport industry. Most likely, more areas in Europe will follow. Later there will probably be more areas like this around the world forcing companies to use more environmentally friendly ships[183].

A port fee is levied on sea transports as well as fees for piloting trough sensitive areas. Costs for goods handling and reloading to different modes will also be added[184].

[179] www.rggi.org
[180] Braga, C et al.(2004)
[181] ibid.
[182] Enarsson, L (2006)
[183] www.europarl.europa.eu
[184] www.gotport.se

6.3 Other Factors Affecting Transportation Cost

6.3.1 Lack of educated personnel

6.3.1.1 EU

In the United Kingdom (UK) there is a significant shortage of drivers. About 20 % of drivers are leaving the industry each year due to retirement or poor health. At the same time less than 10 % of the vacancies are being filled by new drivers. There are different factors affecting the recruitment of new drivers, for example people do not want to work five nights a week and there is a lot of stress put on them with increasing health and safety regulations. New production methods like Just-in-Time has also put more stress on the drivers forcing them to start extra early to be sure that they arrive at the factory in time[185].

6.3.1.2 United States

For many companies in the US the lack of truck drivers is a limiting factor. In 2006 the trucking industry employed 3.4 million drivers. An issue now affecting the transport industry is that many of the drivers are going to retire in the next few years and no new drivers are hired, resulting in a driver shortage. At the moment the shortage is expected to be about 20,000 drivers. The trucking industry has an extremely high employee turnover rate[186].

The drivers in the US are expected to follow Hours of Service (HOS). The HOS states that a driver can work a maximum of fourteen hours a day and maximum ten of these driving. Of the remaining ten hours the driver must spend at least eight of them in a row, sleeping or resting. One problem with these rules is that many of the drivers are paid by mile and not by the hour, forcing the driver to work overtime but not getting paid for them. For this reason many drivers choose to break the rules and drive longer than allowed, putting their health and others at risk[187].

6.3.1.3 India

The transport sector in India is growing rapidly and the demand for skilled professionals is increasing. Today there are already severe gaps in the recruitment of skilled workers in the road freight sector and in warehousing and the problem is not going to solve itself. Especially truck drivers, loading supervisors, warehouse managers and seafarers need to be found and educated. The problem is that there are not enough people wanting to work in the industry and that people who do are not educated enough. India spends about 13 % of its GDP on logistic activities and the reason for this high number is the inefficiencies in the system with lower than average trucking speed, high turnaround time at ports and high cost of administrative delays. Truck drivers are the most critical profession in the road segment, attracting illiterate people with no formal training for the job. There are today about 3 million drivers in India and that number is expected to grow to about 50 million by 2015. If only 50 % of the drivers were going to be educated, over 100 new training centers are required to be built in the next few years[188].

[185] www.roadtransport.com
[186] www.gsa.gov
[187] ibid.
[188] www.indiaprwire.com

6.3.1.4 China

In China the problem is that there is little or no educated personnel in the logistic area. This makes goods handling inefficient at many terminals and ports[189].

6.3.1.5 Russia

There is no information about the situation in Russia.

6.3.2 Infrastructure Issues

6.3.2.1 Congestion

Transport congestion is a problem that is expected to get worse. Estimates show that delays caused by border crossing increases the cost of the goods transported by 0.8 % for each day of waiting. Bottlenecks in traffic significantly contribute to pollution and global warming. Forecasts show that congestion problems are going to occur more often in the future. Car ownership in developing countries is increasing, leading to congested urban areas. Container transport from China to Europe is expected to increase in the next few years, making the harbors and the road and railroad in the immediate surroundings congested. Traveling by air is going to at least double in the next 20 years, leading to congested airports[190].

Transport congestion can be divided into two types; occasional congestion and structural congestion. Occasional congestion is a sudden disruption in the traffic flow, such as traffic jams in the morning and afternoon. Structural congestion is the result of poorly adapted infrastructure, insufficient for the traffic flow or lack of technical compatibility, for example administrative procedures at borders. Occasional congestion can only be dealt with when it occurs, but structural congestions needs to be tackled in a broader way, preventing it from escalating[191].

EU

Every year road congestion cost about 1 % of the GDP in the EU countries. The number is even higher in Britain and France, about 1.5 %. In the next few years, air traffic and maritime container traffic are expected to double, further intensifying road traffic. The roads cannot be expanded as fast as demand is growing, expert states that the existing infrastructure needs to be managed better. The boarder crossing areas, between the EU and neighboring states, are the worst areas especially for international drivers that require visas[192].

The US

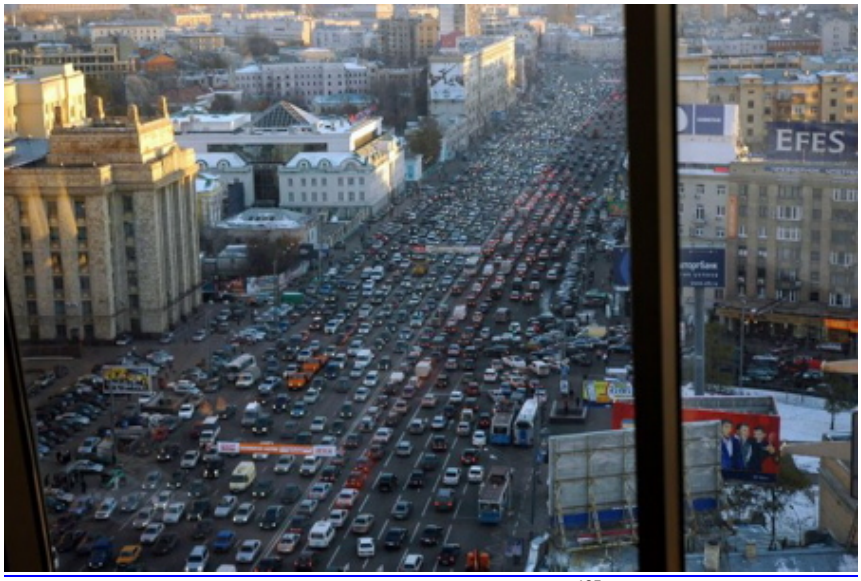
Congestion problems in the urban areas of the US are continuing to grow and it is estimated that congestion wasted 8.7 billion liters of fuel in 2002. Transportation improvement is not able to keep up with the growth in travel demand especially in the urban areas. Estimates states that the cost of congestion is US$1.7 billion every year[193].

Russia

In 2007, car use increased by 10 % to 170 vehicles per 1000 Russians and it is expected to double by 2015. The Russian roads are today very congested, about 38 % are overcrowded. In

[189] www.china.org.cn
[190] www.internationaltransportforum.org/sofia/pdf/07sofia.pdf
[191] www.clecat.org
[192] www.eubusiness.com
[193] ibid.

the next few years the growth in cars will be five times higher than the increase of new roads built. The reason for the increase in car traffic is growing household incomes and that the pace for new infrastructure projects is slow[194].



Figur 6-12 One of many congested roads in Russia[195]

In 2001, the Russian government adopted a new federal transit program. The idea is to modernize the Russian transport system and US$63 billion are earmarked for the project. When it comes to road traffic the first phase includes maintaining the function of the existing public road network and only construct new roads where it is absolutely necessary. For the second phase, 2006-2010, maintaining activities and construction of the main traffic corridors connecting Russia with international transit systems are prioritized.

China

The large cities in China are the most congested. In Beijing, with a population density of 14694 people per square kilometre (compared with 8811 in New York, 8071 for Paris and 4554 for London) most complains from the inhabitants are regarding the extremely high traffic volume. The inner city population has quadrupled since 1950[196].

India

As much as a quarter of the highways in India are congested and reducing truck speed to about 30-40 km/h. The quality of the roads is poor and the highways often have only two lanes. Maintenance of the roads is significantly under funded and only one third of the maintenance needs are met. The centres of large cities are also congested mainly due to the increased number of privately owned vehicles. During rush hours the speed is often limited to 5-10km/h[197].

The rail system is facing severe capacity constrains and all the high density corridors are congested. The countries ports are also experiencing capacity restrains. Since the 1990s traffic

[194] www.en.rian.ru
[195] ibid.
[196] www.china.org.cn
[197] www.worldbank.org

has more than doubled and further growth is expected. Both capacity and efficiency needs to increase to meet the demand[198].

[198] www.worldbank.org

7 Analysis

This chapter aims to give answers to the research questions that were stated in the first chapter. An attempt to rank the most important factors that will affect the transportation costs at VLC will also be done.

7.1 Evaluation of the most important transportation cost factors

7.1.1 Fuel and Oil prices

The transport sector is today highly dependent on fossil fuels. An increased use of these types of products in the developing countries not only gets regional effects, but affects the price of gasoline and diesel all over the world. This will have a large impact on the transport sector resulting in higher prices on transport services.

OPEC is an organisation that "controls" about 40 % of the worlds oil supply. The critics of OPEC complain about the secrecy regarding the actual reserve supply that the large oil producing countries posses. OPEC states that one of the organisation's primary goals is to keep the oil price on the "right" level. However, experts contend that they have seriously failed since the price on crude oil has quadrupled in the past few years. The organisation is now being accused of trying to maximize profits for its members. However, OPEC will continue to control a large part of the oil supply in the world and highly affect the oil price.

The political situation in the world is affecting the price on crude oil, especially situations that affect the oil producing countries. As long as the situation is unstable in Iraq and Iran price of oil will be used as a "weapon". As figure 6.4 shows, the price on crude has risen when the political situation is not stabile. Oil is a powerful resource that controls many economies around the world and every increase in price of crude oil affects transportation costs.

It is a fact that the oil supply in the world is not going to last forever. We do not know when we are going to run out of oil but it is going to happen. Some experts say that we now have reached peak production and production from now on will continue to fall. As the demand for oil products increases this will make the price on all petrol products continue to rise.

As Figure 6-5 shows the net difference in oil production and demand is negative today. Discoveries of new large oil fields, so called giants, have not been discovered in many years and the now existing giants in mainly the Middle East are expected to last for a maximum of a few decades. Since no new large fields are being discovered new areas have to be explored. Many of these areas are situated in regions with very different climate and other geological factors than where oil production today is situated. This means that new technologies have to be developed to endure the tough weather conditions.

Many of the international supply chains that have developed over the last decade have relied on low transportation costs between the different "stations" in the chain. Since basically all transportation costs are dependent on oil, higher oil prices can make it difficult to keep the transportation costs low and this also affects the globalisation. Higher transport cost can make industries that earlier moved to low cost countries move back or closer to their "home" countries.

7.1.1.1 Alternative fuels

The percentage of vehicles fuelled by alternative fuel will probably increase in the future. A soaring oil price combined with higher taxes on fossil fuels will make alternative fuels a more appealing option in the transport industry. The debate today about if alternative fuels are as climate neutral as they are said to be will probably lead to more discussions and the need to develop more environmentally friendly production methods in the future.

The debate about the Brazilian ethanol is an example of one of the issues that now affect the alternative fuel sector. First, it is the discussion of whether or not it is acceptable to cut down rain forest to make room for sugar cane plants? Or if the sugar cane plants take land that in other cases would have been used for agriculture? Experts state that there is no competition between sugar canes and food production. However, the land owners want to earn as much money as possible when he or she sells the land and often the large sugar cane companies pay a lot more. These issues will fall under the questions about ethical transportation solutions that potentially will be more important in the future.

7.1.2 Environmental Taxation

Different taxation and charges will probably be more common in the future. Many of the taxes are ways to support development of new technologies and reconstruction of new infrastructure but it is also an important instrument to keep consumption down.

7.1.2.1 Road taxation

Taxation for using roads and specific infrastructure like bridges and tunnels are becoming more and more common. It is an excellent way to finance building and maintenance of new infrastructure. Road transport is very favoured today because they do not pay for their own infrastructure and road taxation would make the situation more even between the modes. In the future new technologies have made it possible to collect the fees and the slowdowns at checkpoints are in many cases gone.

Road taxation also has a few downsides. For example, charge on a highway may lead to that traffic taking alternative roads with quality leading to an increased number of accidents. It can be quite important to make sure that the gains for using the toll road are so much higher than using the road with not as good quality in order to save some time.

As road taxation and toll roads get more and more common they will have an impact on transportation costs. Taxation for heavier vehicles will probably be a first step to make the users pay for the use of infrastructure. However, taxes on roads are not all appealing since it gives governments a chance to improve the quality of the roads. If taxes are used in the proper way it will lead to better and hopefully safer roads that will benefit not just the transport industry but also the society as a whole.

It is important that if road charging is used to reduce congestion the money earned really is used to improve the infrastructure.

7.1.2.2 Fuel taxation

Fuel taxation has for many years been a powerful way to make users of fossil fuels pay for the costs that emissions cause society. The earnings governments claim to have been invested in developing new technologies leading to more fuel efficient engines as well as in the infrastructure. Higher taxes on fossil fuels also automatically drive truck producing

companies toward development of more fuel efficient engines making their trucks more competitive as a reduction in fuel use leads to lower fuel costs.

Fuel taxes will continue to affect the transportation costs via the fuel price. However, the situation of fuel taxes in the target areas today is very different and an important factor to take into consideration in the future. More about the possible effects on fuel taxation in the target areas followed below.

7.1.2.3 Kilometre taxation

Systems with kilometre taxation have been introduced in a couple of European countries in the last few years and it is expected that additional countries will follow. Kilometre taxation as it looks today is only levied on heavy vehicles and often based on the number of axles and environmental classification. The taxation also helps to phase out old trucks since it will be more expensive to use the roads if the vehicles in the fleets are old and has a low environmental class.

Today kilometre taxation only affects transportation costs in the countries and areas that apply the taxes. However, as more countries join the system it becomes a more important factor to take into consideration and that can have a large impact on transportation costs in the future.

An important factor to take into consideration is the competitive advantage it gives to get an early start to phase out old vehicles and to encourage the suppliers of transport services to do so. Especially when driving through Germany, Austria and Switzerland that today already apply kilometre taxation.

7.1.2.4 Annual vehicle taxation

The annual vehicle tax is not one of the factors that will affect the transport industry the most in the future. It is a relatively small part of the total yearly costs of a vehicle. In the future it can be differentiated in ways to support exchanging of old trucks for new and less fuel consuming ones.

7.1.2.5 Carbon dioxide taxation

Emission of carbon dioxide in the world is still increasing and the new developing countries are responsible for most of the increase. However, the impact of GHG emission does not only affect the environment close to the pollutant. The atmosphere's content of carbon dioxide is today at record levels leading to sever climate changes affecting the whole globe, for example the average temperature is expected to be 1.2-1.5°C higher in 2100 than before the industrial revolution.

The transport industry is a large GHG emitter especially since fossil fuels are the primary energy source for almost all transport modes. Global warming is a typical external cost that affects people but no one pays for. This will probably change in the future, either by introducing carbon taxation or by setting limits in how much every country is allowed to emit e.g. emission trading systems.

7.1.3 Other factors that affect transportation costs

7.1.3.1 Lack of educated personnel

In order to make driving a more appealing profession in the future there will need to be serious changes in the line of work.

There are a few options in how to make the trucker profession more appealing. The first one is to raise wages. This will lead to higher transportation costs since salaries are one of the largest parts of transportation costs. Another way to attract more people into the transport sector is to make the working times more attractive. However, as a trucker, your job is basically to be away from home and to many that is not an attractive option. The lack of especially long haul drivers will affect the transport industry in the next coming years and signs have already started to show in especially the US.

7.1.3.2 Infrastructure issues

A good infrastructure is essential to keep the economy growing providing services and products to the customers. However, the increased need for transports has made the infrastructure insufficient in many areas and the problems are expected to get worse as the need for transport services continues to rise. In some countries, fuel taxation is used for building new and maintaining old infrastructure. However, that differs between countries.

Especially the railway network is limited since there are just a number of tracks that can be used and this is a restraining factor. The nature of the railway as sensitive to disruption also affects the competition between the modes, in favour for road transports. However, railway is considered as environmental friendly making it an important question for politicians to address. Railroad infrastructure is very expensive and decisions regarding their development need to be taken on governmental level.

A factor that affects the transportation time, and indirectly the cost, is the infrastructure at terminal and ports. An effective way to handle goods makes turnaround time shorter reducing the total costs.

7.1.4 Ranking of the most important factors affecting transportation cost

The list bellow is an attempt to rank the factors evaluated previously. When trying to rank the factors in both the short and long term the result was that the most important factors will be the same. Changes in legislation affecting the transport industry today happen very fast. The difference when comparing the last 10-15 years with the coming decade or two is that political interests in the sector will be stronger than the commercial one that has been a driving force in the past.

7.1.4.1 Ranking

1. **Fuel prices** – If the price of crude oil continues to rise this will affect the price on especially road transport, but also sea transports will be highly affected. Indirectly fuel taxation will also affect the price. But as the price of crude oil continues to increase it will be harder for governments to increase fuel taxation as it could seriously harm the economy. For example the US government has taken these decisions lately. The price of crude oil has risen drastically this year and quadrupled in only a couple of years. One of the reasons for the increase is the rising demand of fossil fuels in the developing countries. As the number of privately owned cars and an increased demand

for products and services the vehicle industry is blooming. As the vehicles get more and more affordable to people the increased number of cars increases the demand for gasoline. The supply of crude oil is not going to last forever and as the years pass by the fields will be more and more drained. These two factors will lead to an impossible equation, it will be impossible to keep the prices down and at the same time produce less than what is consumed. In the long term new technologies for fuel efficiency and use of alternative fuels will be important to keep the cost for transportation down.

2. **Taxation** – There are different kinds of taxes that affect the transport industry. In particular so called environmental taxes that "handles" external costs are becoming more common. Road taxation has already been levied on roads in Europe and the US. China is using road taxation to pay for and maintain its massive need for infrastructure. Road taxation will probably be more common in the future. The question is how soon? Different sorts of taxation will probably be more used in the future. The external costs of transport are today not paid to the society.

   Road taxations is today one of the most common ways to put the external costs on the transporters and will also in the future be a way to make vehicles pay for maintenance of the infrastructure being utilized. Trains pay fees to use the tracks and ships pay for using ports, it is only a "natural" step that these rules apply to road transports as well.

   Kilometre taxations are today implemented in three European countries and a couple of other countries within the EU are planning to apply the taxation in the near future. These taxes will probably be based on the number of axels and the environmental classification of the vehicle, encouraging transport companies to renew their vehicle fleet resulting in trucks that are more environmentally friendly. The cost for the renewal of the fleet will indirectly be paid by the transport service buyers. However, the "gain" would be a lower cost per kilometre in the end.

   A carbon dioxide taxation or an emission trading system for emission of CO_2 for the transport industry will soon be taken into action. A similar system to the one used today for factories that emits a lot of CO_2 can soon be a reality for the transport industry as well. A system for making sea transports cleaner, trading with emission right for SO_2 and NO_x can also soon be implemented. Regulations that affect the sea transport industry are making the impact of such systems more global.

3. **Infrastructure** – The infrastructure highly affects the transport industry and congestion on both rail, road and in the ports is reducing the efficiency. The infrastructure takes long time to change and decisions are often taken on government levels making time-to-action long. The road taxes are one way to finance new infrastructure. Private investments are becoming more and more common, especially in developing countries like China. However the infrastructure issues will be difficult to solve in a short term. It is important to try to be pro-active and direct the investments to central areas where for example congestion is common.

4. **Lack of educated personnel** – it is uncertain when the lack of educated drivers are going to start to affect the transport sector. However, the problem is going to affect at least the US and Europe to a larger extent than in the other target areas. The problem with the lack of drivers is an issue that will affect the transport industry in short term but is hard to solve immediate. To change people's values is not easily done so the

immediate actions that can be taken are to raise wages which will increase transportation costs.

7.2 Global versus regional differences in the target area

The global perspective is stated above and the next part describes differences in a regional perspective.

7.2.1 EU

- **Fuel prices -** The price of gasoline and diesel has not increased to the same extent as in the US. Since the dollar is weak compared to the Euro this has prevented fuel prices from soaring. Another factor that has affected the fuel prices is the fact that the fuel taxation has been reduced in order to keep the prices down as the price of crude oil is soaring.

- **Taxation -** The EU are far ahead of the rest of the world when it comes to environmental "thinking". There are a lot of factors that probably will affect the transport industry in EU before the rest of the target areas. Kilometre taxation is already a reality in countries in central Europe and others are just waiting to join.

- **Infrastructure Railway –** In the future the railway is going to compete with especially road transports in a different way. The politics and directives stated by the EU are acceptable for development of the railway sector. However, the governments in the member states financing is limited. The large investments in the railway sector have been in transporting people instead of goods.

  The factors below are factors that are affecting the railway industry in Europe:
  - The rail operators are still largely nationally based, without technical harmonisation, for instance in terms of signalling and electrical systems
  - Border complications due to different national rail systems.
  - Inadequacy in the capacity and quality of infrastructure, particularly regarding the ability to operate high speed passenger and combined transport freight services
  - Unreliable delivery times especially on international routes
  - Common IT system support for the customers is non-existent
  - Less competitive total integrated transport systems door-to-door
  - Different track gauge

  The problems described above will affect transportation costs making rail less favourable compared to the other transport modes. Governments today are lobbying for rail transport as the most environmental friendly alternative. However, there are factor that do not work in favour rail transport. Today, flexibility and door-to-door solutions are important and rail can in many cases not provide these services.

- **Infrastructure Road** - Road transport is the most commonly used mode for transport on land in the EU. The advantages are flexibility and a regulatory framework that is harmonized and mainly the same in all the EU countries. However, there are a few challenges for road transport:
  - Congestion
  - Road usage fees
  - Infrastructure cost

- Environment and rising CO2 emissions

Today congestion is a problem in many of the urban areas, especially during rush hour. Congestion contributes to higher transport costs as time is "lost" and fuel are being used ineffectively. The congestion problem is hard to solve and will probably always exist in one way or another. Construction of new infrastructure is not prioritized and it is even hard to find funding for maintenance.

Road usage fees will probably be more common in the future. It is a way to put the external costs on transports. The road usage systems that apply in Europe today is affecting transport through the large transit countries like Austria and Switzerland. The fees will probably be higher in the future and more countries will implement the system.

The EU ETS system will probably also apply on the transport industry in the near future. This will mainly affect road and air traffic. Emission trading will restrain transport and will force transport companies to better plan and execute their transports. Hopefully another effect will be that the number of "empty runs" will decrease.

- **Infrastructure Sea -** The main infrastructure that affects sea transports are the ports and the inter-modality at ports are not developed enough. Sea transports also lack the flexibility of road transports. Better and more efficient handling at ports is needed to reduce costs and turnaround time for ships.

  The Baltic Sea is one of the heaviest trafficked oceans in the world. Russia, being a large importer of goods, needs to improve the port structure in the Baltic.

  To reduce the need for fossil fuels in the shipping industry one suggestion being discussed is to reduce speed. This is an effort to try to keep the fuel costs at a reasonable level. The reduction in speed will lead to longer time to delivery for the customers and higher capital binding. Another attempt to try to keep the cost at lower levels is that all new ships built are able to convert to alternative fuels when that becomes an economic option.

7.2.2 The US

- **Fuel prices -** The fuel price development in the US has been radical. Prices on gasoline and diesel have increased drastically. One of the reasons is that the price on crude oil affects the price of oil more directly, compared to in Europe. Almost 70 % of the gasoline price is crude oil so the price at the pump is immediately effected. The dollar has been weakening and as crude oil is a commodity traded in dollar this has a large impact. Figure 3-1 shows that 17 % of the total cost for road transports is fuel. These numbers, however, are a couple of years old and based on a gasoline price around US$1; the prices today are close to US$4. Transportation costs in the past have been at a very low level and are now rising dramatically.

  The fuel taxation is a very small part of the total gasoline price in the US and as the price of crude oil is increasing the government is protecting the economy by reducing the fuel tax. Compared to Europe the most important issue is to keep the fuel price at a low level and today the public is annoyed since the fuel price is so high. High compared to what? The price a couple of years ago? Yes, the price has increased

drastically. Compared to Europe? The fuel price is still at very low levels. When countries like China suggest fuel taxes to protect the environment, it is to be expected that fuel taxation will be higher in the US in the future. A fuel tax is not only "bad", the revenue can be used to develop new technologies and drive change towards more fuel efficient vehicles. Furthermore, higher fuel prices make people more interested in buying more fuel efficient vehicles.

- **Taxation** - The US is the only country in the developed world that has not ratified the Kyoto Protocol. If it will be ratified when a new president is elected is uncertain. However, it is unlikely that the rest of the world, especially the developed countries that work hard with environmental issues, will stand by and let the US "do nothing". Regulations that affect the transport sector will sooner or later also be suggested and implemented in the US. The US is far behind Europe when it comes to environmental "thinking". The road taxes that are starting to appear, like the I-81 project, is used to finance new infrastructure and projects like this will probably be more common in the future.

- **Infrastructure Railway** - The railway system in the US is privately owned and there are a couple of large railway companies using the lines. The difference between the American rail network and others across the globe is that freight transports are prioritized in the US. Railway in the US has the advantages, compared to Europe, that there is only one gauge and signal system used.

  Inter-modal transport systems are a challenge for the railway industry in the US. As road- and rail transporters see each other as competitors the changes will probably take a longer time.

- **Road Infrastructure** - The road network in the US is insufficient in many areas and congestion appears at especially rush hour. The building of new infrastructure can not keep up with the amount of cars. An insufficient infrastructure with congested roads drives up the prices on transport.

- **Sea Infrastructure –** The ports in the US have started to be congested. However, the situation in the US is not yet as critical as in other ports in the target areas. Hopefully inter-modal transport solutions will be more utilized in the US in the future and connections with both terminal and ports will be important. The systems need to be efficient in order to truly compete with road transports.

7.2.3 India

- **Fuel prices** - The fuel price in India is very low and the government is trying to keep the prices down in order to make vehicles affordable to everyone. How long is the government going to offer subsidies on the gasoline price? As the private vehicle ownership increases the demand for fuel is increasing costing the government more and more money. India is one of the countries that are responsible for driving the increased price of crude oil. Transportation prices will rise

- **Taxation** - Taxes have a small impact on the transport industry in India. In emerging markets, the environment is not valued to the same extent as critical as in the industrialized markets. Still the environmental awareness is increasing and truck transports will meet new legislations – it is just a matter of time.

- **Infrastructure Railway -** The capacity restrains on the heavily trafficked corridors will be a hold back for the development of the Indian rail sector. Another restraining factor is that the government is subsidising passenger traffic.

- **Road Infrastructure** - The road transport sector in India is growing and today it is the primary mode. A restraining factor in India is the fact that road network is very underdeveloped and needs improvement. Speed is limited in heavily used areas increasing the time of transport indirectly leading to higher transportation costs.

  The system in India is divided so that every state is like a small country within the country, planning and managing their budget and infrastructure. This leads to problems when needing to build a road through several states. To be effective the actions need to be coordinated on government level.

  Congestion appears at the state boarders and there are a number of different papers to fill out before letting the truck pass the boarder. New effective routines and less paper that needs to be filled out would make time for boarder crossing shorter, reducing the transportation costs.

- **Sea Infrastructure** - The shipping industry in India is very underdeveloped and hopefully the government will see soon the potential in the long coastline the country possesses. It is important to build new ports and develop the existing one in order to be able to possibly "take over" after China as the primary low cost country in Asia.

7.2.4 China

- **Fuel prices –** the fuel prices today in China is on a low level and there is no taxation on fuel. China is, together with primarily India, the reason that demand in the world is increasing leading to a higher price of crude oil and as prices on crude increases so will the gasoline and diesel prices.

- **Taxation –** China is today using road taxes in a larger extent than the rest of the world. Since the need for new infrastructure is massive in the country more tolls will be set up increasing the transport cost. The Chinese government is discussing more forms of environmental taxations but when they are going to be a reality is not clear. The question is when China is going to the environment in front of prioritizing their economy.

- **Infrastructure Railway –** The long distances in China make railway a good transport mode. However, with the growing demand for rail transport and the new construction in railway tracks the demand exceeds the capacity of the network. The surcharge on railway transports is being charged to help funding. The lack of capacity can lead to higher transports costs in the future if the problem is not solved.

- **Infrastructure Road –** The modal share of road transport have increased in the past couple of years and new roads are being built. The question is how long it will take before the new highways are finished. In the meantime the road problems can lead to higher transport costs.

  The Chinese government have realised the importance of charges in order to finance new infrastructure. It will take a long time before the road network in China is sufficient to the increase of vehicle, privately owned and commercial. The charges will probably be used in the future as well.

- **Infrastructure Sea –** Inland sea transports are relatively unexplored areas that have the potential to be a viable option in the future. Lack of funding in the past has reduced the length of navigable water. Hopefully the Chinese government will realize the potential of inland water transports.

  China is a country that, especially in the ports, lacks educated personnel to handle the goods. Logistics is an important area of improvement, however, not just in the ports. An inefficient handling of goods in the ports leads to higher turnaround time for the ships, which increases the cost.

7.2.5 Russia

- **Fuel prices –** The fuel prices in Russia are relatively low, mainly because Russia is one of the largest oil producers in the world. This can be an advantage in the future because the prices can be kept at a lower level.

  There is today no major taxation on gasoline and diesel, instead the government subsidises fuel prices. For how long the government is going to continue this policy is uncertain.

- **Taxation –** Road taxation is expected to be more commonly used in the future. The infrastructure needs to be improved and new expressways needs to be built in order to handle the increasing amount of goods.

- **Infrastructure Railway –** Rail is a mode that has a great potential in Russia, the large distances in the country makes road transport less appealing than in smaller countries.

  Railway will in the future also be an important way to connect the Russian market with China and the possibility to use Russia as a transit country in order to connect China with Europe. Hopefully railway will be a faster option compared to sea transports.

- **Infrastructure Road –** The road network in Russia is congested in especially urban areas and congestion does not only appear during rush hour. This is a problem the Russian government will need to address in the near future. As world crude oil prices have increased, the Russian economy has benefited from increased revenues which have had large impacts. To be able to import large amount of goods, the need to handle and transport it to customers is essential.

- **Infrastructure Sea –** The importance of sea transport in Russia is already evident. Large goods flows come to Russia trough the Baltic Sea and the area is starting to be

"congested". Especially the Russian ports facing the Baltic Sea need to increase capacity and lower the turnaround time for ships. The inland waterways in Russia are not used for inland water transport and that option will hopefully be explored in the future.

7.3 How do the factors affect each other?

The factor listed above, both regional and global, are affecting each other and their interactions will lead to further extended costs. An illustration is shown bellow;

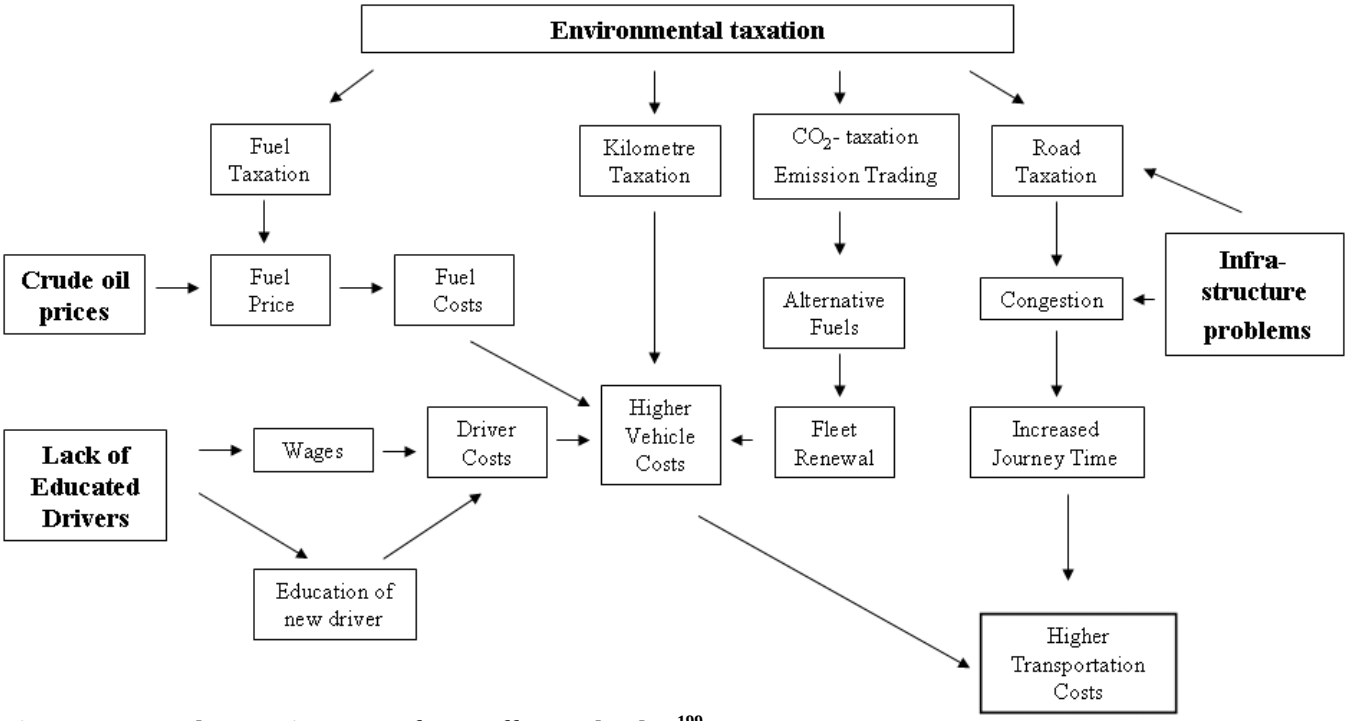


Figure 7-1 How the most important factor affect each other[199]

After looking at how the factors affect each other another ranking is done since the factors are so closely connected:

1. The most important combined factor will be the price on fuel and environmental taxation, like fuel taxation, kilometre taxation and CO_2-taxation. As they are closely linked they will together make a "single" most important factor. Fossil fuels are affecting the climate and forcing a need for environmental taxation. If there were an unlimited amount of crude oil the world would still need to address the climate changes. The other way around, limit the amount of crude oil would result in the need to take action to keep the consumption down, leading to taxation and other charges.

2. The second most important combined factor will be issues regarding the infrastructure and taxation that affect the infrastructure, road taxation and kilometre taxation. The external costs caused by the transport industry will in a near future be put more and more on the vehicles.

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3. Lack of educated personnel will be a problem starting in the US but soon spreading to the rest of the target areas, first to the EU. It will be a necessity for the transport companies to secure their drivers and educate new ones. The driving profession will need to be more appealing to young people and change in wages and driving times; in order to attract more people to the industry, transport costs may increase.

7.4 Uncertainties in the analysis above

The main uncertainties in the analysis above is mainly how large the impact of the factors mentioned will be and how soon they will affect the transport industry. The EU is far ahead of the rest of the globe when it comes to environmental policies. New legislations and taxation that are starting to affect Europe today, will probably take place in the US in a few years and in the developing countries after that. The environmental "thinking" is starting to affect the US but it will probably be years before they reach the European level. When the importance of the environment reaches the developing countries is very uncertain. It is very difficult to predict.

8 Conclusions

- The most important factors to take into consideration and that will probably affect transportation cost the most is fuel prices and different taxation.

- The second most important factor will be infrastructure issues and taxation related to the infrastructure.

- The lack of educated personnel will also be a factor that needs to be taken into consideration.

- There will be an increasing demand for all types of transport. Road will continue to be the dominating mode. However, the external costs will, to a larger extent, be put on especially road transports.

- The political situation and certain incidents also affect the price of crude oil. Terrorism and war has historically driven up the price of fuel.

- The US will be more sensitive to changes in crude oil prices since the largest part of the gasoline prices is based on crude oil. Furthermore a weak dollar is also an important factor that affects the transport industry.

- China and India are one of the reasons for the increasing fuel price. An increasing demand in these countries will lead to a severe imbalance in supply and demand of crude oil.

- The infrastructure is one of the essential problems that need to be addressed in the developing countries.

- Inter-modal solutions will probably be used more in transport solutions in the future. The challenge is to make terminals and ports more efficient, in order to save time and reduce costs.

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Appendix 1

Intervjuguide

- Vilka parametrar påverkar idag transportkostnaderna? Är det skillnad mellan de olika regionerna?
- Framtida parametrar? Vilka kommer att få ökad betydelse? Tillkommer några nya?
- Vilka transportslag kommer att växa/krympa inom de olika regionerna?
- Kommer Kina, Indien och Ryssland att öka andel vägtransporter? Hur påverkas exempelvis utsläpp av koldioxid och så vidare?
- Vilka är/kommer att bli framtida lagstiftningar och regler?
- Hur påverkar bensinpriset?
- Hur kommer ökat välstånd i utvecklingsländerna att påverka transportkostnaderna?
- Hur stor potential har järnvägen i framtiden jämfört med idag?
- Vad krävs för att minska vägtransporterna? Hur högt kan bensinpriset bli innan det år någon slående effekt?
- Hur snart kommer de externa kostnaderna att börja påverka vägtransporter?
- Hur kommer globaliseringen att fortsätta? Kommer Afrika att bli mer aktuellt i framtiden? Närhet till större marknader (EU och USA) är ju minst lika bra som exempelvis Kina och Indien.