Thierry Houé*
Mirko Kehr**
Renato Guimaraes***
Jerzy Dudek****

THE AUTOMOTIVE INDUSTRY AND THE RISE OF TRANSPORTATION COSTS: FROM AN ECONOMIC TO AN ECOLOGICAL VIEW

In a global world, the leaders of the automotive industry must think about the decisions of location of their production sites and their global transport policy. Since the end of the eighties, the „Supply Chain View" has influenced the location of the production sites in low cost countries (Christopher, 2005). The central theme of this work is to analyse the impact of a change in transport costs inside this new model of organization. This research aims to analyse the impact of the intercontinental transport costs on the car manufacturing industry till 2020. The main objective is to show the impact of an increase of the oil price in the general model of Supply Chain and provide some guidelines for the transport strategy in this sector.

Keywords: Automotive industry, transportation costs, location, sustainable development.

1. INTRODUCTION

At the end of the 20th century, the automotive industry practised a huge wave of rationalisations and consolidations (Tarondeau, 1996). The ongoing need to realise economy of scale and the increased pressure to reduce costs resulted in an extremely difficult market situation. Those who have not been taken over by their competitors and which are still operate on a global market are facing the problems of over-capacities, price wars and increasingly demanding customers (Norcliffe, 2006). The three big North American car manufacturers are struggling with declining market share and extremely high employment costs. The German manufacturer Volkswagen was not able to provide to his customers the right product mix at the beginning of the new millennium. Therefore, Nissan gained market shares in Europe. Today the car manufacturing industry consists of just a dozen global players, some local manufacturers which supply only the local market and a few niche market producers. Those produce specialist vehicles such as sport cars in volume ranges from a few

* Dr Thierry Houe, ICN Bussines School, Nancy
** Mirko Kehr, MSc Student, University of Westminster
*** Dr Renato Guimaraes, ICN Bussines School, Nancy
**** Dr inż. Jerzy Dudek, International School of Logistic and Transportation in Wroclaw

hundred to tens of thousand (Norcliffe, 2006). The global vehicle market experienced also a geographical shift. The worldwide sales of cars increased in 2007 by 2.3 millions to 49.2 millions but the biggest markets like Japan, North America and Western Europe, which account for around 65 per cent of the global car sales, were either down or stagnating. The Japanese market fell by 4.7 per cent, the North American by 2 per cent and the Western European market increased by just 0,2 per cent. The growth in the global car market was nearly only due to three countries – Russia, China and Brazil. The Indian market is also a growing market but not in the scope of these three. China is now the second largest car manufacturer after Japan with a growth of nearly 20 per cent per year (Brown, 2008). In the period from 1999 to 2007 the production capacities in Western Europe decreased by 5.7 per cent and in North America by 21.6 per cent. In the same time the car registrations increased in Western Europe by around 3 per cent and decrease by 8 per cent in North America. This shows that more cars were imported into these markets than before. All these imports involve transport operations and most of these transports are intercontinental type. It is clear that these higher logistic costs can only be compensated by a production costs reduction. Currently these transport costs are still favourable for the shipment of assembled cars but this might change over the next few years till 2020. Today there are several aspects, such as an increased oil price and the ongoing environmental awareness and its regulations, which the consequence will be, in all probability, a costs increase.

In the automotive industry, transportation is always an issue. This industrial sector has seen many movements over the past ten years. The number of alliances, agreements and partnerships has increased considerably. This reorganization has obviously had an impact on the organization of supply chains (Bowersox, 1990). While geographical proximity is sometimes presented as an advantage in supply chain management, it can sometimes be costly for firms. For example, attracting partners on a suppliers park in the automotive sector (Adam-Ledunois and Renault, 2001), it needs to convince the partners to invest by ensuring advantageous contractual terms thereby leading to the costs of stabilization, perhaps difficult to quantify (Paché, 2004). This research aims to analyse the impact of the intercontinental transport costs on the car manufacturing industry till 2020. The importance of the transport costs onto the profitability of car manufacturers shall be presented by several calculations and examples will illustrate up to which degree the car manufacturing industry benefits from the advantage of a production in countries with low labour costs and the shipment of the assembled cars afterwards around the world to the end customer. The paper will analyse the impacts of an increased oil price, the raw material to produce the fuel for deep sea ships and that is already nowadays, the main transport cost factor. Possible solutions shall be presented to reduce environmental damages and of course to reduce the financial impact. A discussion about the necessity to adopt an enlarged point of view for the transportation and ecological issues in the supply chain will be presented in the last part of the paper.

2. A BRIEF ANALYSIS OF THE AUTOMOTIVE INDUSTRY

In the following text the global situation of automotive industry and problems of transportation of the main manufacturers shall be presented briefly.

2.1. Overall situation of global car manufacturers

The American manufacturers suffer currently huge problems in the North American market. It is impossible for them to establish their prices on the market and they have huge overcapacities.

If they don't manage more efficiently their operations of production, they will not be able on a mid-to-long term to survive to the international market pressure. But the restructuring will be difficult because these manufacturers have to compete in the North American market with two Japanese firms Toyota and Honda which are highly profitable. However this challenge is possible and the rescue of Fiat shows that a company can return into an average profitability within only three years. Daimler and Volkswagen, German car manufacturers managed to improve their operations within the last three years. Volkswagen climbed from only one per cent return on sales in 2006 to nearly 6 per cent in 2007. This was possible due to a good brand and model mixture. Daimler reached his current position only because of the uncoupling from (the costly) Chrysler. The Automotive Performance Index measures the economical potential of the 17 worldwide leading car manufacturers by using a metric in the fields of finance, market and innovation performance. As a result, Toyota stays leader and so the best in class. Especially the German car manufacturers, such as Volkswagen and Daimler, managed to increase their performance and to reduce the distance to Toyota. The American manufacturers such as GM and Ford are in the group of the low performer.

The automobile industry continues to experience dynamic changes that cross national borders and continents. Nowadays manufacturing is already the most global of all sectors and every company, needs to constantly review its international configuration. The globalisation does not pass by the car manufacturing industry and therefore this sector experienced already during the last 15 years tremendous changes. From 1999 till 2007 the global capacity increased by more than 33 per cent. The emerging markets, such Brazil, Russia, India and China have grown during the last years with more than 10 % per year on average. These new markets give many opportunities to the big consortiums but also many threats (Humphrey, 1999). New car manufacturers from China for example start slowly to penetrate into the domestic market such as North America and Western Europe. Currently these manufacturers are not yet totally competitive but this will change quickly. Then again some old markets such as the Western Europe and the North American market experienced a slowdown in the last years and will experience this again during the next decade. Next to this general slowdown of the markets, the customer requirements have changed over the last few years. Nowadays, the customers require smaller, more economic and environmental friendly cars. Not all manufactures are well prepared for this change in demand and especially the North American manufacturers such as GM, Ford and Chrysler suffer massive reductions in their sales figures. The Asian manufactures had all the time rather smaller environmentally friendlier cars in their portfolio and therefore they are well prepared for the new changing markets.

2.2. The close relation between the automotive industry and the sea shipping

A very close relation exists between the automotive industry and the sea shipping. The transported goods by these ships are estimated to have reached 7.4 billion tons in 2006. This represents an increase of 4.3 per cent compared to the previous year. In the same period the global economy grew by 4.0 per cent. Crude oil represented 26.9 per cent, petroleum products 9.2 per cent and 63.9 per cent was made up of dry cargo such as bulk, break-bulk and containerised goods (United Nations, 2007). The car manufacturing industry is nowadays a worldwide operating industry. All global players produce in multiple countries to serve their worldwide customers. To improve economy of scales, each plant is focusing on the production of a few models only. Therefore, it is still necessary to transport all models which are not manufactured in the country where they will be sold. Often one model is just produced in one or two plants worldwide. However most of the big international consortiums sell their cars on more than just two continents. This is one of the reasons

that it is necessary to use sea shipping to transport the finished cars. Such transports are mainly done by Roll on Roll off ships (RoRo). This system is fastest and safest for the cars than any other transportation mode. More than 17 million units were shipped from one continent to another. This is nearly one fourth of the global production. The transport between Asia and Europe accounted for 5.6 million units. The export of Japanese and Korean vehicles to the North American market is making the biggest part of the 4.6 million vehicles shipped between these two continents. Between 1996 and 2004 the overall transport of vehicles increased by 54 per cent. In 1996 almost 38.7 million passenger cars were built and it increased till 2004 to 44.5 millions passenger cars and 20.5 million commercial cars (OICA, 2008). The global economy is requiring continuously requires more intercontinental transport capacities. During the last ten years this demand increased dramatically and it can be expected that the demand will grow in future with a similar rate. The international sea carriers managed to cope with this demand by increasing their capacities even if the surplus decreased during the last years. However the increased demand does not lead to a reduction in price because the carriers can not profit from economy of scales as other industries. The carriers have to deal with congestion in certain areas such as the Panama Canal or the Suez Canal. In addition the operation costs increase continuously and also the price for maritime fuel increased in 2007 by nearly 60 per cent. The automotive industry is also influenced by the changing conditions on the sea shipping market. Cars are mainly shipped by special RoRo ships but also normal container ships transport cars inside a container. Therefore all inter - continental transports of car manufacturers are affected by the price increase and the higher demand on the market (Kehr, 2008). This might lead in future to shortages in capacity and this can lead to higher prices. Almost 26 per cent of all passenger cars manufactured in 2004 were shipped by sea carriers and therefore the success and the profit of the car manufacturing industry is heavily depends on stable transport costs.

3. WHEN THE OIL PRICE WILL BECOME CRAZY

In this part, we suggest that the oil price will rise till 2020 to 400 US-Dollar per barrel. At the same time, it seems that humanity is still not able to develop new technologies to effectively replace oil as the main source of energy for transport activities. And unfortunately, it will not happen for many years according to some economists (Chevallier, 2006). This hypothesis is not so fanciful and this scenario is quite ultimately realistic. Before we can analyse the impact of such a scenario on the outbound logistic operations of a car manufacturer, we have to analyse briefly the oil supply situation to answer the following main questions:

- Who are the main oil producers?
- How many oil reserves do we have?
- How is crude oil used?
- How is the price building process on the oil market?

3.1. An overview of the oil supplying

Energy has been for centuries the basis of the world's economy development. Even nowadays it is still crucial to expanding economic opportunities, providing light, heat and mobility and enhancing the welfare of the world's population. Fossil fuels provide more than 90 per cent of the worlds total commercial energy need. Oil is in this mix the most important source. The worldwide biggest oil exporting countries are regrouped in the Organisation of the Petroleum Exporting Countries (OPEC). This organisation was founded in 1960 and its main goal is to support a market stability to

avoid harmful price fluctuations. Currently this organisation consists of 13 members, which are Algeria, Angola, Ecuador, Indonesia, the Islamic Republic of Iran, Iraq, Kuwait, Nigeria, Qatar, Saudi Arabia, Socialist People's Libyan Jamahiriya, the United Arab Emirates and Venezuela (OPEC, 2008a). These 13 countries combine nearly 80 per cent of the world wide oil reserves.

The most of the worldwide crude oil reserves are in the Middle East. Each decade more and more oil reserves have been discovered and also today not all reserves might be discovered. Therefore all estimations concerning the amount of crude oil reserves will change by each new discovery. During the last 50 years the discovered oil reserves have increased nearly four times. That is why it is possible that all current estimations when the humanity will run out of oil are false. Nevertheless all these estimations and declarations how big the oil reserves of each country are have to be seen with caution. The OPEC allows his members to flow oil considering their oil reserves. This means that if a country has low reserves they have only the permission to produce a low quantity. By doing this, the OPEC what to assure that all members are capable to produce over the same period of time. Unfortunately this leads to the fact that each member is changing the amount of his oil reserves each year. So it is nearly impossible to say with certainty how many oil is available worldwide and how long it will last (OPEC, 2006; OPEC, 2008). The OPEC member countries have 80 per cent of the worldwide oil reserves but currently they flow only about 45 per cent of the worldwide production. This decision is made by the member countries to keep the market in balance and to profit for a longer time by their limited raw materiel. If they would increase the production now, the market price would fall because of a surplus on the market. By producing more they might be capable to sell more oil and to make more money right now but on a long term view this would probably reduce their profit (OPEC, 2006). Russia has with 11.8 million barrel per day the biggest crude oil production even before any single OPEC member the country. Than the USA and China are on place two and three of the non-OPEC member countries. The current discovered oil reserves will last for the next 41 years, if the production and consumption stays at the level of 2007 (OPEC, 2008). In 2007 nearly 71.5 million barrel has been produced per day. In comparison the refinery capacities were nearly 79 million barrel per day. This shows that there were overcapacities in 2007. Although refineries are long time investments and capacities can not be increased as quickly as the crude oil production can be increased. Therefore it is necessary to have some over capacities. Now that the worldwide crude oil production and the refinery capacities have been described briefly, the global oil price development and the facts which influence it will be analysed.

3.2. Global oil price development and geopolitical risks

With the foundation of the OPEC the member countries decided that they want to receive more than before from the profit made with crude oil. From this time on the OPEC dominated the formation of prices on the oil markets. A good example for their market power was the boycott in 1973 against the USA and the Netherlands after the beginning of war in the Mideast. During the next six months the price increased by more than 400 per cent. From the eighties, the OPEC lost their influence due to restructuring on the oil markets and the Iran-Iraq war. This restructuring leaded to a price decrease to only 10 US-Dollar per barrel. To compensate this low price the OPEC decided to implement crude oil production rates. Thereby they limited the worldwide oil supply and created an artificial shortage. Since the new millennium the OPEC lost most of their influence on the oil price because nowadays these countries flow only 45 per cent of the worldwide crude oil production per year (OPEC, 2008). However the OPEC and the non-OPEC countries have one common goal. This is a stable oil price on a moderate level. A too elevated oil price is slowing down the world economy and this reduces the demand for crude oil and this will lead to over capacities and reduce the profit of the oil exporting countries.

Since the eighties, oil is traded at the New York Mercantile Exchange (NYMEX) and the International Petroleum Exchange (IPE) in London. At these stock exchanges the traders trade only Future-Contracts. These are certificates which oblige the buyer and seller to buy or sell a certain product in future at a certain price. This means that the oil is sold before it even leaves the exporting country and between all these traders, the physical good is never moved. This gives hedgers and speculators the possibility to trade with oil without any transport possibilities or storage places. The oil price increased dramatically in august 2008. This development can hardly be explained by a change in the normal price mechanism (demand vs. supply). Most likely this increase is caused by such hedgers and speculators. However the currency devaluation of the US-Dollar compared to the Euro reduced these effects for the European market. On the other hand this devaluation lead to the fact that the OPEC countries have less purchasing power in Europe or other regions and therefore they need to increase the crude oil price to compensate this lost of purchasing power. This effect can quickly run out of control and the oil price will increase more and more (Financial Times, 2008).

s soon as the political situation changes in one of the big oil exporting countries such as Nigeria or Venezuela, the oil price experience high fluctuations. Also some presidents, such as Iranians president, are using oil as a modern weapon. By threat to stop the oil supplies to the USA and the EU, he stoked fear in these countries and the global oil price increase immediately. When the oil reserves diminish more and more each industrial country has to ensure that they can supply their local industry and population with sufficient oil. Therefore each country starts already today to make arrangements to ensure the oil supply over the next decades. An example is the negotiation of the EU with Russia to ensure a stable supply. However, all these plans can change so quickly with different global political situations. The war between Georgia and Russia leads to a cooling down of the relations between Russia and the EU. Other countries such as the USA are maybe not willing to depend on such negotiations and therefore, they try to control more directly the existing oil reserves and production capacities.

3.3. The impact on the automotive industry

In the previous parts, the production of oil products and the oil price building mechanism have been quickly explained. Now the impacts of an oil price of 400 US-Dollar per barrel for the outbound logistic activities of the car manufacturing will be analysed. The focus will be on the intercontinental transports because there the increased oil costs have a main impact on the total transport costs. Currently the fuel costs are between 50-60 per cent of the total deep sea shipping transport costs (Transpacific Stabilization Agreement, 2007).

For the following cost calculations standard 20" and 40" container prices are used. Even if these containers are not mainly used to transport new cars, nowadays nearly all freight rates are expressed in standard container and this will make a comparison and calculation much more accurate and easier. Within the scope of this paper, we were not capable to collect true transport costs of any global car manufacture. All of the contacted companies denied publish their costs. To obtain transport costs as accurate as possible we contacted some major automotive suppliers. The table 1 provides some examples of costs (Kehr, 2008).

Table 1. Some examples of sea freight costs

From	To	Price in US$ for 40" container	Fuel costs (55%)
Port Elizabeth, South Africa	Europe North Coast	1500	825
Port Elizabeth, South Africa	US East Coast	3800	2090
Salvador, Brazil	Europe North Coast	1825	1004
Salvador, Brazil	US East Coast	2050	1128
Singapore	Europe North Coast	2625	1444
Mumbai, India	Europe North Coast	3065	1686
Shanghai, China	Europe North Coast	3525	1939

This table shows several trade lines from so called low cost country to Western European and North American harbours. In the low cost countries, the automotive industry has settled down mainly in these regions, except from Shanghai and Singapore. Column four of table 4 indicates the fuel costs for the intercontinental shipment, under the current situation that 50-60 per cent of the total costs are fuel costs. Therefore a mean value of 55 per cent has been used. These values in column four represent the costs for a 40" container. So the fuel costs for the transport of one single car are only 25 per cent of this value because in each container fits four cars on average. Depending on the destinations we have transport costs of 375 up to 881 US-Dollar per car.

The next table presents the transport costs for the same routes if the oil price would increase till 2020 to a price of 400 US-Dollar (Kehr, 2008). The following calculations are done under the assumption that all other costs related to the intercontinental transport such as harbour costs and customs clearance stay at their current level. This increase of 233 per cent of the crude oil price leads to a price increase of 128 per cent for the transport of one container. This means that the transport price for a single car will increase depending on the destination between 481 and 1219 US-Dollar.

Table 2. The sea freight costs in 2008-2020

From	To	Transport in US$ for 40" container 2008	Transport in US$ for 40" container 2020	Transport in US$ for one car 2008	Transport in US$ for one car 2020	Difference for one car 2008 to 2020
Port Elizabeth, South Africa	Europe North Coast	1500	3425	375	856	481
Port Elizabeth, South Africa	US East Coast	3800	8677	950	2169	1219
Salvador, Brazil	Europe North Coast	1825	4167	456	1042	586
Salvador, Brazil	US East Coast	2050	4681	513	1170	658
Singapore	US West Coast	2150	4909	538	1227	690
Singapore	Europe North Coast	2625	5994	656	1498	842
Mumbai, India	Europe North Coast	3065	6998	766	1750	983
Shanghai, China	Europe North Coast	3525	8049	881	2012	1131

Such increased transport costs will lead to lower profit if the car manufacturers are not capable to pass on these costs to the end customer. Although with an oil price of 400 US-Dollar, the petrol costs will increase also and therefore the car sales figures will decrease because driving a car will become a luxury. After the Harbour Report, which collects information from most of the big car manufacturers worldwide, the best in class manufacturer Honda and Nissan made a pre-tax profit on every assembled vehicle of 1641 US-Dollar, followed by Toyota with 922 US-Dollar in 2007. The North American car makers are losing money with each assembled car. Ford is losing 1467 US-Dollar, GM 729 US-Dollar and Chrysler 412 US-Dollar (Caranddriver.com, 2008). Today, the North American manufacturers are not capable to pass on their production costs to the customers and therefore they will not be capable to operate any longer at an oil price of 400 US-Dollar if they can not change completely their production system. To avoid passing on these higher transport costs to the end customer, the car manufacturing industry has to evaluate if it is still profitable to produce in the countries which are today low cost countries and to deal with the higher transport costs. Therefore the impact of labour costs on the car manufacturing will be illustrated at the example of Brazil, Czech Republic, Malaysia and South Africa compared to a production in a high labour cost country such as Germany or the USA (Barns and Morris, 2008). As basis for the labour costs, the provided labour costs by an automotive supplier are used because no trustful values were available from any global car manufacturer. Therefore these values are used and these figures represent the average labour costs in the presented countries in the automotive industry.

The labours costs between the selected countries have a significant variation. The costs in Germany and USA are six times higher than in Malaysia and five times higher than in Brazil. The question is now : how much does this influence the manufacturing costs? This question can not be answered generally because each concern has a different production performance and need therefore different production hours. The best in class in the assembling of middle class vehicles – including the number of hours it takes for stamping, building transmissions, engines, and assembling vehicles – is Chrysler and Toyota with only 30.37 hours per assembled vehicle. Followed, in descending order, by Honda (31.33 hours), GM (32.29), Nissan (32.96), Ford (33.88) and Hyundai (35.10) (Caranddriver.com, 2008). The European manufactures are somewhere in the midfield, so needed Volkswagen for example 32.60 hours to assemble the VW Passat. To compare the savings in labour costs, a conversion of the labour costs per hour in 2007 from Euro to US-Dollar has been made with the exchange rate from the 01.08.2008 at a level of 1 Euro = 1.55 US-Dollar (Kehr, 2008).

Table 3. The labour costs for a car production: the example of Toyota

Country	Labour cost per hour in 2007 in US$	Labour costs for Toyota at 30.37 h/car
Brazil	8.14	247.14
Czech Rep.	16.28	494.27
Malaysia	6.42	195.11
South Africa	12.00	364.44
Germany	42.83	1300.72
USA	40.69	1235.68

As visible in the previous table, the labours costs to assemble vehicle are relatively low and so only a small part of the overall costs. The best in class manufacturer like Toyota would have costs of 195 US-Dollar if he assembles a middle class car in Malaysia and 1301 US-Dollar if he

would assemble the same car in Germany. This gap of 1106 US-Dollar is probably the main reason why most of the worldwide operating companies decide to transfer their production into low cost countries. Such a step is even more profitable for industries which have more manual work during their production. But even for car manufactures, where labour costs are only a smaller part in the overall costs, can this step be profitable. Above average does companies profit which have a lower production performance such as Hyundai because their higher labour force demand in the assembling process increases much more their costs in high cost countries.

The Czech Republic and many other Eastern European countries have a supreme advantage to the low cost countries all over the world for deliveries to Western Europe. Their labour costs are relatively low and the transport costs to the end customer are negligible. In the current calculation the transport costs are listed as 0 because in all calculations only the intercontinental transport is taking into account to a major harbour at the continent of destination. All goods will have to be transported to the end customer by truck or train but the costs from a harbour or from the Czech Republic might be equal or not vary a lot.

Table 4. The difference between savings in labour cost - transport cost 2008 for best in class manufacturer

From\To	Europe (Germany)			USA		
Port Elizabeth, South Africa	Transport costs 2008	Savings in labour costs	Difference	Transport costs 2008	Savings in labour costs	Difference
Brazil	456	1053.58	597.58	513	988.54	475.54
Czech Rep.	0	806.44	806.44	n.a.	741.41	n.a.
Malaysia	656	1105.61	449.61	538	1040.57	502.57
South Africa	375	936.28	561.28	950	871.24	-78.76

As described in the previous text, the labour costs vary between the different countries. Even if these costs are only a small part in the whole cost for a finished passenger car use most of the global car manufactures labour cost advantages to reduce their production cost. Table 4 shows the savings which the best in class manufacturer (Toyota for example) can achieve if they produce for example in Brazil and ship their cars to Germany or to the USA (Kehr, 2008). In this case he can save 598 US-Dollar to Germany and 476 US-Dollar to the USA. However it is not all the time worth to produce in low cost countries. This shows the example of a car manufactured in South Africa and shipped to the USA. Here the best in class manufacturer would loose 79 US-Dollar. Therefore, it is in this case more profitable to produce in the USA. The Czech Republic has again a cost advantage compared to the other low cost countries to deliver to Germany because no sea transport costs accrue there.

In the previous passages, we saw that, in most of the cases, it is nowadays profitable to produce in low cost countries and to ship the assembled cars afterwards to the end customer. But will this situation change in 2020 when the oil price will raise to 400 US-Dollar, as described at the beginning on the paper? To answer this question the same calculations which were made for the current situation, will be done with the increased transport cost in the following passages. All other variables such as labour costs and needed hours to assemble a vehicle will be kept at the level of 2008. Even if this it not realistic and a change in these costs will appear. It is done this way to better demonstrate the impact of the increased oil price.

The next table shows that in 2020, with an oil price of 400 US-Dollar, the production in a low cost country on another continent and the sea transport to the end customer will not be favourable anymore for the best in class manufacturer (Kehr, 2008). Nearly all cost savings due to lower labour costs were compensated by the higher transport costs. Thus all transports to the USA are too expensive. The savings achieved by the transport from Brazil and South Africa to Germany are so minimal, that it would probably not be profitable anymore.

Table 5. Difference between savings in labour cost - transport cost 2020 for best in class manufacturer

From\To	Europe (Germany)			USA		
Port Elizabeth, South Africa	Transport costs 2008	Savings in labour costs	Difference	Transport costs 2008	Savings in labour costs	Difference
Brazil	1042	1053.58	11.58	1170	988.54	-181.46
Czech Rep.	0	806.44	806.44	n.a.	741.41	n.a.
Malaysia	1498	1105.61	-392.39	1227	1040.57	-186.43
South Africa	856	936.28	80.28	2169	871.24	-1297.76

The currently discovered oil reserves, the main producing countries and the oil price building mechanism have been explained briefly. In these passages it was clarified that the currently discovered oil reserves will last again 41 years, if the oil consumption and so the production stays at the level of 2007. However the demand of crude oil and his products will increase again during the next years but it is also possible that new reserves will be discovered in the next years. If this is not the case and the demand increases continuously, the oil price will due to higher demand, lower supply and speculations by hedgers increase to maybe 400 US-Dollar. Only the intercontinental transport costs have been taking into account. And only the oil price and so the transport costs has been changed. All other costs such as increase in labour costs, different exchange rate, etc. have not been considered. This is important and might have an impact on the plausibility of such a scenario because the labours costs raise fare quicker in Eastern Europe than in Western Europe. Such a development can be observed for nearly all low cost countries. In the analysis, it appeared that today it is favourable for all car manufacturers to produce in low cost countries and to ship their assembled cars to their destination. The only exception was the production in South Africa and the shipment to the USA. This option is not favourable for the best in class manufactures which need fewer labour hours to assemble the car. It appeared also that the Eastern European region, with the Czech Republic as example in the calculations, is the best option to deliver the Western European region.

In 2020 the situation will change and it is not favourable anymore to produce in the low cost countries such as Brazil or Malaysia and to ship the assembled cars to the USA. For Western Europe the situation is slightly different. Here it is still profitable to produce in Brazil or South Africa but a production in a country in Fare East, such as Malaysia, is not profitable anymore. However, the most beneficial production location will be Eastern Europe because there the higher oil price has no effect on the production costs under the already mentioned assumptions.

4. THE ECOLOGICAL PERSPECTIVES

Within this chapter, we leave the purely economic perspective of our problem to talk about alternative transport with environmental impact. It is also to show that these choices cannot be independent of other organizational decisions in the supply chain.

4.1. The initial situation

The International Maritime Organization is responsible for the security of the naval shipping and the protection of the oceans. To fulfil these tasks this sub organisation of the UN has decided that all ships have to reduce their sulphur oxide emissions from currently 4.5 per cent to 3.5 per cent from the 1 January 2012. In 2020 these emissions have to be reduced to only 0.5 per cent. This results for the shipping companies in additional costs because the distillates have reduced sulphur oxide rates but they are much more expensive than the currently used heavy oil. This means, even under the assumptions that the oil price will stay at the current level that the fuel costs to operate sea carriers will increase dramatically (International Maritime Organization, 2005). Some nations are tightening these regulations and therefore they created the so called Sulphur Emission Control Areas. Currently the North Sea and the Baltic Sea are such areas. In these areas the shipping companies have to operate their ships with "clean-fuel". This means that the sulphur oxide level has to be below 1.5 per cent. In 2012 the critical value is decreased to 1 per cent and in 2015 to just 0.1 per cent. These values are not reachable with heavy oil and therefore the ship owners have to switch to diesel as fuel. This increased demand will probably result in an increased diesel price. It also requires additional investments in refineries to cope with this massive new demand (International Maritime Organization, 2005).

The two previews presented environmental aspects focus only on the sulphur oxide issue. Also the CO_2 emissions will probably soon been taken into consideration for the sea freight operators. The IMO could not achieve any agreements how this issue can be regulated. Therefore the European Union considers including the sea freight operators into the European emission trade system (EU-ETS). Latest studies of the CO_2 emissions have calculated that the shipping industry is responsible for 1.12 billion tons of CO_2 per year. These are nearly 4.5 per cent of all global CO_2 emissions. Compared to the highly criticised aviation industry, which is responsible for "only" 650 million tons per year, the shipping industry is not yet regulated but this will probably be only a matter of time (Guardian, 2008).

The following sections will present possible solutions to deal with the environmental issues. These solutions have the goal to fulfil the legal requirements and to keep the transport costs on a stable level.

4.2. For an increased use of inland waterway transport

Probably one of the most challenging issues nowadays is environmental pollution. The European Union has a developed waterway network. The center of Europe is crossed by the famous axis Rhine-Main-Danube. Germany is within Europe one of the leading countries to reduce environmental damages. Therefore impact of pollution caused by the transport industry is becoming more important for the end customers. For the average cost for external transport of the four transport modes used in all European countries, the costs for road transport are 5.6 times higher than those for inland waterways and those of railway still 1.4 times. The costs for road transport in Germany would increase and this could lead to a higher demand in railway and inland waterway transport. The European transport industry realised that they have to change their current transport methods to reduce the environmental impact. Therefore the growth rate of inland waterway transports increased to an average of 13.9 per cent from 2003 to 2004. This increase is higher than the increase in the period from 1990 till 2002. During this long period, the total traffic increase by only eight per

cent (Eurostat, 2004). The countries with the fastest growing inland waterway transportations are Hungary, Luxemburg, Netherlands and Germany (Houé and Guimaraes, 2008). Currently nearly five per cent of all goods are transported within the European Union by inland waterways. Russia has one of the largest waterway networks worldwide with 102,000 km. Only four per cent of all goods are currently transported by this way. This clarifies that there is still a big potential to improve. The leader in the use of inland waterways is the USA. Nearly 18 per cent were shipped in 2006 by inland waterways (2 billion tons). Although these 18 per cent were mainly bulk / raw materials and only a small amount of containers (US Army Corps of Engineers, 2008). China has an even bigger inland waterway network than the USA but they only shipped around 1.5 billion tons in 2005. To improve the capacities China launched in 2004 a plan to modernise his inland waterway system and to increase its capacity. Thereby the volume shall be increased till 2010 by 40 per cent and till 2020 it shall double compared to 2004. This is the biggest inland waterway project ever seen in China. It will connect 20 provinces, 56 cities with a population over 500,000, and linking 27 national class 1 land ports. Thereby China will improve its logistic infrastructure and be capable to cope with the increasing demand in transportation (China.org, 2008). This increased capacity will help China also to reduce their environmental damage due to transportation because as shown in figure 20, the inland waterway transport is the less polluting method of transportation.

By using increasingly inland waterways, some goods could be unloaded from deep sea ships at one end of the continent and transported inland to the end customer or to the other end of the continent. So would it be possible to unload ships from Asia in the South East of Europe and transport the goods via inland waterways to the North West. This could reduce of course the environmental impact.

4.3. The railway idea for the automotive industry

Another interesting way for transport is the train connection from Western Europe to China. This cooperation between China and Germany and the four transit countries Mongolia, Russia, Belarus and Poland enables the transport of goods within only 15 to 18 days over a distance of nearly 10,000 km. The German rail operator is the second biggest freight forwarder and logistic company worldwide and an important partner of the German and European export industry. Based on this position and the growing demand for other ways to deliver to and from the Chinese market the DB realised this project. To complete the transport, the train has to be changed twice due to different track sizes. So each container has to be loaded onto a new wagon on the Chinese-Mongolian and again once it reaches the Belarus-Polish frontier. These procedures reduce the transit time and increase the costs. Unfortunately it is at the current stage impossible to change the track size in any country. Although the DB will in cooperation with its partners increase the efforts to renew the tracks and to enable faster transports and higher capacities. It also does not exist any wagon which can role on both track sizes. Currently the DB is working in cooperation with the German government and the other participating rail operators and governments to solve these problems. This simplification will reduce the transit time again by three days and so the transport will be possible within only 15 days.

The rail transport is compared to the sea freight transport more expensive due to the track changes and the fact that, at the current stage, the wagons have to role empty back more expensive. The train is operating only 2 times a week and once the wagon brought the container to the next track changing station they can not pick up other containers. To solve these problems, the trains

has to run more frequently. In comparison with the air freight the rail is fare less expensive. The DB identified especially companies with the following requirements as future customers (Deutsche Bahn, 2008):

- companies which produce or deliver in the northern or western region of China. These goods have under current transport methods to be brought under many difficulties to or from the harbours situated in the south-east of China ;
- goods which have to be delivered quickly but cheaper than air freight such as special offers in the clothing industry, electronic goods as well as urgent needed heavy machinery ;
- goods which have to be transported to compensate bottlenecks in the supply chain ;
- establish a supply chain connection by using the rail transport to minimise the lead time compared to the sea transport and to minimise the risk of delays.

4.4. A global perspective for a sustainable supply chain in automotive industry

Isolated actions in the supply chain are useless because transport, warehousing, supply, production and product design are linked by cross-cutting process. It is therefore necessary to address the issue of transportation as part of a global vision. Many initiatives try to develop a „Sustainable Supply Chain" view in the industry (Schmidt, 2005). One of them is based on the creation of general guidelines promoted by associative structures. In most cases, these guides go well beyond environmental concerns. For example, the association „The Nordic Partnership" includes the car manufacturer Volvo and the World Wide Fund (WWF). This organization aims to support and disseminate specific models of sustainable development. Among the many tools presented, some talking about the management of the supply chain and transportation too.

However, all the ecological practices on the management of flows in the automotive industry must be collectively thinking, even the transportation. The performance of the supply chain depends on it. Ummenhofer (1998) proposed the concept of eco-integrated logistics and considers this as an example of efficient management in the supply chain. It is a strategy involving all stakeholders. The company must identify the multiple environmental referrals to pro-actively decisions and logistics industry to adopt the best solutions that will reduce from the start, impacts on the environment. Cassio (1998) considers eco-integrated logistics as a management tool of Kaizen and for the reduction of environmental pollution. For Gherra (2005), eco-design is an extension of eco-integrated logistics. Here, all functions of the company and all stakeholders in the supply chain, work together to design a product or a packaging must meet strict environmental specifications. The process of eco-design requires a global management view of the supply chain taking into account all product life cycles.

CONCLUSION

The different options presented in this paper show how to reduce nuisances for the environment in automotive industry. But they will not be able to keep the current transport costs level. Therefore, car manufacturers can not decide in future just based on labour costs where they want to produce. Each manufacturer has to take into consideration also the fact that transport costs will increase. These solutions will only improve the situation but not solve the whole problem. For example, the inland waterways have only a limited capacity and enlargements are only possible

under limited circumstances and take time as visible on the example of China. Consequently, it is to be expected that the transport costs will increase slower than without these two ways of transport. It also has to be said that these are only two possible changes in the supply chain and it exist more. But, it is also necessary to develop news research to find an answer to this kind of problem. In addition, it is essential for all supply chain managers, to adopt an overview of flows and also risks and of course, costs, if they want to apply these different options.

REFERENCES

[1] Adam-Ledunois S., Renault S. (2001), « Les enjeux stratégiques de la création de parcs fournisseurs dans le secteur automobile », Revue Française de Gestion Industrielle, vol. 20, n°1, pp. 5-15.

[2] Barns J. and Morris M. (2008), « Staying alive in the global automotive industry: what can developing economies learn from South Africa about linking into global automotive value chains? », The European Journal of Development Research, vol. 20, n°1, March, pp. 31-55.

[3] Bowersox D.J. (1990), « The strategic benefits of logistics alliances », Harvard Business Review, vol. 68, n°4, pp. 36-45.

[4] Brown, S. (2008), « BRIC builds in 2007 », Automotive Engineer, vol.33, issue 2.

[5] Caranddriver.com (2008), « Chrysler ties Toyota for top productivity says 2008 Harbour Report - Car News », [online]. Available from: http://www.caranddriver.com/reviews/hot_lists/car_shopping/latest_news_reviews/chrysler_ties_toyota_for_top_productivity_says_2008_harbour_report_car_news/(page)/

[6] Cassio A.L. (1998), « La logistique : un levier du management de la protection de l'environnement », Actes des deuxièmes Rencontres Internationales de la Recherche en Logistique, Logistique et Interfaces Organisationnelles, pp. 519-535.

[7] Chevallier M. (2006), « Vivre sans pétrole ? », Alternatives Economiques, special issue, n°68, February.

[8] Christopher M. (2005), Logistics and Supply Chain Management: creating value-adding networks, 3rd edition, FT-Prentice Hall, London.

[9] Datamonitor (2003), « Automotive Industry update », [online]. Available from: http://web.ebscohost.com/bsi/pdf?vid=1&hid=5&sid=1ec4e071-cb21-450b-9b659fb840664842%40SRCSM2.

[10] Deutsche Bahn (2008), « Peking-Hamburg-Container-Express bewältigt 10.000 Kilometer in nur 15 Tagen », [online], Available from: http://www.db.de/site/bahn/de/unternehmen/presse/presseinformationen/ubh/h20080124.html

[11] Eurostat (2004), « Güterbeförderung der Binnenschifffahrt in der Europäischen Union 1990-2002» [online]. Available from: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1073,46587259&_dad=portal&schema=PORTAL&p_product_code=KS-NZ-04-009

[12] Financial Times (2008), « Toyota Forecast go into reverse », [online]. Available from: http://www.ft.com/cms/s/0/f6148d86-1ccc-11dd-82ae-000077b07658.html?nclick_check=1

[13] Guardian (2008), « True scale of C02 emissions from shipping revealed », [online]. Available from: http://www.guardian.co.uk/environment/2008/feb/13/climatechange.pollution

[14] Gherra S. (2005), « Développement durable, supply chain management et stratégie : les cas de l'éco-conception », Logistique et Management, vol. 13, n°1, pp. 37-48.

[15] Houé T., Guimaraes R. (2008), « Les enjeux d'une intégration optimale du mode fluvial dans la supply chain », Conference : The role of waterway transport in the European development, 19-20 June, Wroclaw, Poland.

[16] Humphrey J. (1999), « Globalisation and Supply Chain Networks: the Auto Industry in Brazil and India », in: Gereffi G., Palpacuer F., Parisotto A. (eds): Global Production and Local Jobs, International Institute for Labour Studies, Geneva.

[17] International Maritime Organization (2005), « North Sea ship emissions control area adopted at environment meeting », [online]. Available from: http://www.imo.org/Safety/mainframe.asp?topic_id=1018&doc_id=5079

[18] International Maritime Organization (2007), « A statistical overview of ship recycling », [online]. Available from: http://www.imo.org/includes/blastDataOnly.asp/data_id%3D19934/200709SSE07Astatisticaloverviewofshiprecycling.pdf

[19] Kehr M. (2008), The intercontinental outbound logistic costs of the car manufacturing industry in 2020 and its impacts on the production location, Master Thesis, University of Wesminter, 61 p..

[20] Norcliffe M. (2006), Investors' Guide to the United Kingdom, pp. 143-154.

[21] OICA (2008), « Production Statistics», [online]. Available from: http://oica.net/category/production-statistics/

[22] OPEC (2006), « Long-Term Strategy», [online]. Available from: http://www.opec.org/library/Special%20Publications/pdf/OPECLTS.pdf
[23] OPEC (2008), « Annual Statistical Bulletin », [online]. Available from: http://www.opec.org/library/Annual%20Statistical%20Bulletin/pdf/ASB2007.pdf
[24] Paché G. (2004), « Proximité spatiale et gestion des supply chains : une approche critique à partir des logiques de radialisation », Quatrièmes Journées de la Proximité, Marseille, 17-18 juin, 18 p..
[25] Schmidt J. (2005), « Le développement d'une logistique en accord avec le développement durable », Logistique et Management, vol. 13, n°1, pp. 31-36.
[26] Tarondeau J-C. (1996), Stratégie industrielle, Paris, Dunod.
[27] Transpacific Stabilization Agreement (2007), « Markets », [online]. Available from: http://www.tsacarriers.org/markets.html
[28] United Nations (2007), « Review of Maritime Transport 2007 », [online]. Available from: http://www.unctad.org/en/docs/rmt2007_en.pdf
[29] US Army Corps of Engineers (2008), « Inland waterway navigation value to the nation », [online]. Available from: http://www.mvr.usace.army.mil/Brochures/InlandWaterwayNavigation.asp
[30] Ummenhofer M. (1998), La logistique dans une perspective d'écologisation : vers l'éco-logistique intégrée, Thèse de Doctorat en Sciences de Gestion, Université de la Méditerranée, Aix-Marseille II, 317 p..

LOKALIZACJE PRODUCENTÓW SAMOCHODÓW Z UWZGLĘDNIENIEM KOSZTÓW LOGISTYCZNYCH: OCHRONY ŚRODOWISKA I EKONOMICZNYCH

W zglobalizowanym świecie, liderzy przemysłu samochodowego muszą planować lokalizację miejsc produkcji oraz prowadzić globalną politykę transportową. Od końca lat 80. organizacja i zarządzanie łańcuchem dostaw wpływały na wybór lokalizacji produkcji samochodów w krajach o niskich kosztach wytwarzania. Głównym tematem tej pracy jest analiza wpływu zmiany w kosztach transportu wewnątrz tego nowego modelu organizacji. W pracy przedstawiono analizę wpływu kosztów transportu między kontynentami na cenę końcową wyrobów przemysłu samochodowego w perspektywie do roku 2020. Głównym celem jest pokazanie wpływu wzrostu cen ropy w ogólnym modelu łańcucha dostaw oraz kilku sugestii odnośnie strategii transportowej w tym sektorze.

Recenzent: dr hab. inż. Tomasz Nowakowski