

Overview of Environmental Problems Caused by Logistics Transportation: Example of European Union Countries

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Abstract: Logistic transportation works is considered the main pollutant for the environment, with over 25 per cent CO₂ emissions in the EU. This situation has raised concerns for the EU and governments to find solutions and impose regulations to diminish the environmental impact. The purpose of this paper is to investigate two questions regarding environmental issues connected to transportation; "What are the recent trends for establishing sustainable logistics for different transportation methods?" "Which alternatives can be incentivized to decrease the environmental impact of transportation activities?" These projects among the most noteworthy environmental benefits, which are also the case studies of this research are The Viking Concept, The WestMed Bridge, Scandinavian Shuttle and Baxter Inland Sea Transport. The result highlighted in this research is that shifting transportation modes has been successfully implemented, with considerable positive outcomes in terms of environment impact, cost and lead times in several European Union funded projects.

Keywords: construction works; environmental solutions; green logistics; logistic solutions; sustainable logistics

1 INTRODUCTION

Logistic systems have been improved for over the years to become faster and more efficient with a focus on lower costs and lead times. As this approach make businesses profitable, the environmental issues are often neglected in the firm's strategy. EU governments are concentrating efforts to reduce the negative environmental impact by imposing new regulations for pollutants. As such, the transportation sector has being identified as a major source of pollutants, with 32% of total energy consumption in the EU, resulting in 44% of CO₂ emissions from fossil fuels [1]. Other issues such as the degradation of the ozone layer, noise, vibrations and atmosphere pollution are also side effects of the transportation sector [2].

Because of increased number of motor vehicles and migrations, the use of motor fuels has risen. Transport is the sector in that the most of fossil [3]. This situation threatens future generations because of damage to the environment.

Construction work to use hundreds of different materials, bringing them to the site, such as storage, transport needs. Since the environmental damage is high and the impact is large, the sector must be controlled.

In the logistics literature, sustainability and environmental issues are topics of increased interest, as more firms engage in such efforts to reduce risks and improve the competitive of the firm day by day [4-7]. It has usually claimed by these researchers that sustainability efforts in general lead to improvements in economic performance.

The purpose of this paper is to investigate environmental issues connected to logistics of sustainable transportation. The focus will be on analysing different transportation methods, considering cost, time, efficiency and environmental impact specifically. Considering the fact that the main purpose of all companies is profit, the importance of this issue is better known. Especially in recent years, it has become one of the more important issues for construction

companies. Legal regulations are also forcing companies in this regard in EU.

2 MATERIAL AND METHOD

In this paper, several academic papers were reviewed to establish the theoretical background, further complemented with four case studies. In searching relevant literature, keywords such environmental responsible logistics, sustainable logistics, sustainable transportation, green logistics were used. The cases studies helped to identify recent trends in the market towards establishing sustainable transport logistics. Moreover, the benefits and challenges of each trend supported the understanding of optimal transportations methods with the lowest environmental impact, as well as other benefits.

The paper is limited to the European Union level, considering only external logistics transportation. Another concept such as the level of centralization was recognized as a factor for sustainable logistics and briefly mentioned.

2.1 Environmental Impact of Logistics Activities

Transportation in logistic activities is considered the main pollutant for the environment. Regulations require companies to adopt environment friendly solutions for their activities and transportation methods. Therefore, the questions arise: What are the recent trends for establishing sustainable logistics for different transportation methods? Which alternatives can be incentivized to decrease the environmental impact of transportation activities?

As described above, effective distribution systems impacts air quality generates noise and contributes to the global warming. According to [8], the environmental impact by external transport causes emissions consisting mostly of nitrogen oxides, carbon monoxide, carbon dioxide, sulphur oxides, hydrocarbons and particles. These emissions are clearly presented to affect the environment locally, regionally

and globally, and the complexity of identifying and reducing them is related to the source of these emissions. Furthermore, the complexity increases with longer distances. Carbon dioxide is described to affect the environment in a longer time perspective in terms of global impact. Looking at different transportation systems (Fig. 1), it can be observed that the logistic activities involving transportation present a considerable threat to the environment [9].

Considering Cavagnaro and Cruel [10] presenting three dimensions regarding sustainable development, Jonsson [8] uses a similar approach when identifying environmental impacts into three factors. These are financial, technological and social conditions where it is described that each company need to adapt their logistics solutions to these factors with the purpose to always consider the environmental impact.

Distribution systems has their own different level of environmental impact and important to consider both direct environmental impact as the indirect impact [8]. Distribution by railways constitutes of direct effects when diesel is used instead of electricity. However, using electricity will affect the environment indirect through its production. Looking at air transport the emissions of greenhouse gases is seen as the most serious problem. Finally, sea transport consumes relatively low energy per transported ton-kilometer where the emissions are small. Moreover, sea transport exploit less areas and gives therefore more advantage in an environmental perspective.

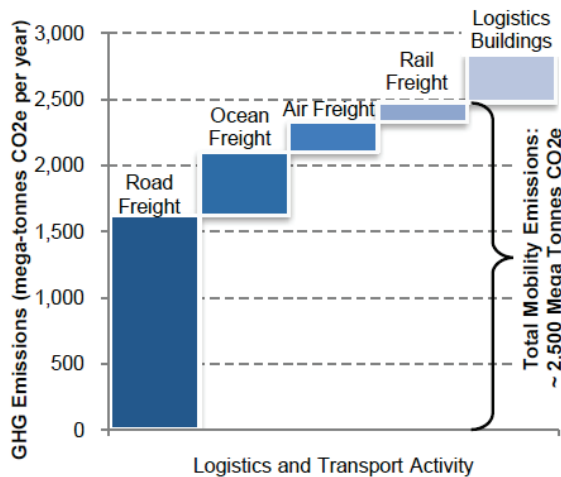


Figure 1 Logistics and Transport Activity [8]

According to Kohn and Bordin [11], the performance of logistics can be measured and expressed in terms of service level and costs with the overall goal to achieve a service that is cost efficient. Namely, the traditional view of logistics is to maximize profit and minimizing lead-times and costs. This view of logistics has to change in order to become more environmentally friendly and sustainable. The total environmental impact of the logistics system should be added to the traditional view. In addition, to create a sustainable logistic system the different variables should be considered together [11].

There is an inherent conflict between the different variables that determine the logistics systems performance.

Therefore, trade-offs are necessary to create the best overall performance and not focus on optimizing one variable at the expense of another. The goal should be to create a balance between the different variables without compromising the total overall performance [8].

To create a logistic system that balances the different variables requires management. One study carried out by Aronsson and Brodin [2] discusses how logistic systems environmental performance can be improved without compromising the performance in terms of service delivery and costs through centralization. They suggest that centralization creates opportunities that do not exist in a decentralized system such as consolidation and changes in transport modes. This is also supported by Kohn and Brodin [11] who state that centralization enable consolidation which has a positive impact on CO₂ emissions and costs. An increased level of centralization results in more transportations than a decentralized system. However, with appropriate strategic decisions, it is possible to improve the environmental performance of the logistic system without impairing the costs and service.

2.2 Policies of the European Union in Environmental Logistics

Logistics and transportation sector have direct interaction with sustainable environment issues in various aspects. Main problems arise from the mentioned sectors can be listed as follows:

- Fast increase in the number of vehicles
- Insufficient maintenance and misuse
- Old and inefficient vehicle stock
- Lack of air pollutant gas control
- Air pollution and vehicle traffic
- Urbanization around highways.

The first remarkable efforts towards establishing a common policy towards establishing a transportation mechanism within EU started at 1993 with the Maastricht Agreement. In this agreement, the basis of Trans-European Transport Networks (TEN-T) has been discussed, principles are set and legal documents have been prepared. The aim with this project was connecting the isolated regions to the rest of union and eliminating the bottlenecks which prevent the socio-economic de-fragmentation of the member countries [12].

Another purpose of the mentioned project was the integration of the logistics and transportation to the plans of sustainable development. Logistics is the leading sector within EU, in terms of influencing the sustainability policies. 25% of the CO₂ emission is caused just from the logistic related activities. Also, according to the data, 44% of the load transportation is done by highways, while the share of sea freight and rail freight are 39% and 10% respectively [13]. When the constant increase in the traffic population, deterioration in the services and air pollution are considered, it was evident that new precautions were necessary. The council defined restructuring of the motorways, development of railway network and prevention of the delays in airways

and more effective use of sea transportation as the new goals and started to incentivize projects which are serving for these purposes.

In the scope of TEN-T, 30 new projects have taken to evaluation which are believed to be finding solutions to the adaptation problems of recently joined countries to the European environmental standards and long term sustainable logistics. These projects included motorways, high speed trains, river transportation, and multi-mode methods. Apart all these different suggestions, the most remarkable one was the "Marco Polo Program" [14].

Marco Polo program is the most significant effort among the activities of European Union to solve the environmental problems related to logistics. It strives for offering alternatives to conventional motorway transportation with seaways, railways and inland waterways. Marco Polo as a whole is a funding program, which collects proposals for environment friendly transportation methods every year and provides funding for them. While the initial budget between 2003 and 2006 was 115 million Euros, it is increased up to 400 million later on, with the introduction of Marco Polo II program [12].

As stated before, the main purpose of the program is shifting the land transportation to the sea as much as possible. The researches show that especially the inland waterways are much safer and environment friendly compared to all other methods. Still, it is believed that inland waterways are not used as much as desired and Marco Polo wants to incentivize such methods with its funding. Under the scope of Marco Polo, there are several projects completed successfully. The term success here both satisfies the profitability and efficiency as well as environmental awareness. There are two examples of such projects you will find below with further details.

3 ANALYSIS: TRENDS FOR SUSTAINABLE LOGISTICS TRANSPORTATION

Reducing transport emissions is an important measure for companies in achieving greener logistics. As with the focus to stay competitive on the market with shorter lead times and cost benefits, it is argued that 'greening' efforts may affect logistic effectiveness and efficiency (Huaccho et al., 2013). Yet, leading companies are gradually implementing environmental principles in their supply chain, to the extent of a win-win situation, satisfying governmental policies but also focusing on the competitive advantage [15]. Looking on how companies have adapted new transportation solutions shows that environmental and cost requirements can be satisfied.

An effective trend is shifting the traditional road transportation to sea, inland or rail transportation. This solution has been adopted by several international shipping providers with great benefits. In the case of Baxter, switching transportation modes resulted into 40% cost savings and reduced environmental impact. The fuel consumption for barges was less with 20% per kg than the truck transportation, also having the advantages of reduced CO₂ emissions and eliminating trucks of the roads. This solution

also increased certainty and faster delivery times, avoiding the high risk of road congestions [15]. Another approach of lowering transportation costs and environmental impact is the Viking Rail project, which focused on shifting 35 to 40% road transportation to rail by using an intermodal solution. This approach resulted in lowering CO₂ emissions by 63% as well as decreasing lead times for about 12 hours for some routes. As in the previous case, fewer trucks were used and this meant a reduction of -15 tonnes per year of CO₂, less fuel consumption by 3.5 million litres per year as well as considerable reduction of other pollutants e.g. nitrous oxide, sulphur oxide emissions. From a cost perspective, the benefits were less considerable with only 5% improvements [16].

3.1 The WestMed Bridge Project

Project Name: The WestMed Bridge

Funds: 4.5 Million Euros

Duration: April 2008 – March 2011

Contractor: Atlantica S.P.A di Navigazione, Italy



Figure 2 The WestMed Bridge Project

Shifting transportation modes proved also to be a wise choice in the case of The WestMed Bridge project as shown Fig. 2. It aimed at shifting the motorway transportation towards the sea, thus increase the environmental benefits and decrease the transportation costs. Using larger capacity barrels to carry the liquids, the total transportation capacity has been increased by 65%. The travel time of the products has become 1.3 times faster than before and the cost of transportation has been reduced by 40% compared to the former method. During the lifetime of the project, it is expected to shift 72585 trucks worth of load to be shifted to sea transport. While the fund given for WestMed Bridge was 4.5 million Euros, the environmental benefit is estimated to be around 66.5 million Euros. The numbers show that the project was successful from every aspect [12].

3.2 The Scandinavian Shuttle Project

Project Name: Scandinavian Shuttle
 Funds: 2.5 Million Euros
 Duration: June 2006 – May 2010
 Contractor: UBQ AB of Malmö, Sweden
 Total load shifted from motorway:
 923 million tons/km
 Estimated Environmental Benefit:
 27,5 Million Euros



Figure 3 The Scandinavian Shuttle Project

A similar project, the Scandinavian Shuttle as shown Fig. 3, had also considerable benefits in terms of environmental and cost benefits. It aimed at building a long lasting railroad between central Europe and Scandinavia and shifting the traffic load caused from logistic activities between those two regions to railroad. The project started train expeditions between Sweden and Germany through Denmark. Since the contingencies are minimal in railroad transportation, the arrival times of the train to its destinations are planned with “just in time” principle. With the introduction of the railway, an alternative opportunity has been given which is also as flexible and reliable as the former methods. Overall, the Scandinavian Shuttle project managed to shift 923 million tons of loads from motorway and generated 27.5 million Euros worth of environmental benefit by the time of May 2010 [12].

The purpose of this paper was to investigate environmental issues connected to logistics of sustainable transport solutions. With theory that stresses the transportations’ actual impact on the environment, combined with transportation solutions reviewed in four different cases, the conditions to begin with the analysis have now been established.

The number of pollution of 25% caused through logistics activities and where transportations represent 32% of total energy consumption, it has been clearly stated by Aronsson and Brodin [2] the serious and actual impact in the society. European Commission [12] presented common policies which become established in the early 90’s and one thing to notice is the relation of the Maastricht Agreement with the

socio-economic de-fragmentation. Equally with this agreement [17] emphasized almost two decades later the social dimension as an important part for sustainable society, together with the economic and the environmental perspective. Alänge et al. [18] identified sustainability as a starting principle for innovation and business development and this principle has actually been found in each of the four reviewed cases in this paper.

The Viking concept, the WestMed Bridge project, Scandinavian Shuttle project and Baxter inland sea transport, are all cases where environmental issues connected to sustainable transport solutions have been analysed and where recent trends have been reviewed. However, the positive outcome from these cases as acting beneficial to the environment additionally variables need to be considered, mentioned in theory as environmental management. As a matter of fact, Khon and Brodin, [11] emphasizes the importance of considering different variables together such as cost, time, efficiency. Based on that, several performance variables need to be considered when developing and evaluating new transportation solutions.

As has been mentioned actual cases bring up challenges and can be related to how to manage performance variables in order to reach the most beneficial outcome of new implemented sustainable transportation system. The analysis shows that sustainability is the driven action for new transportation solutions. However, what should be further analysed is if the success behind these presented cases is only connected to the indirect initiative by findings from the European Union.

4 CONCLUSION

In conclusion, it is evident that as a result of increasing globalization, the competitiveness of the market, intensity of environmental laws, customer expectations and social responsibilities of the companies are rising. Furthermore, considering the increasing attraction on the environmental issues today by individuals, organizations and companies from different industries makes it inevitable that some changes are going to take place in logistics industry to contribute the solution of this global problem. The numbers shown from various researches indicate that logistics industry has a major responsibility to carry out this change process, since it has a major role in the root of the problem. Recent trends in the approach of EU and the sector itself show that awareness is actually there, which is being the driving force to make both companies and authorities to step up their environmental efforts and revise their strategic plans accordingly.

On the legal side of the transformation of logistics into a more environmental friendly sector, biggest responsibility lies upon European Commission, as well as the particular authorities from the related countries. Looking at the recent efforts, it is observable that the commission is actively incentivizing the companies to take part in the resolution by shifting into greener logistic solutions. TEN-T program as a whole and Marco Polo program in particular are outstanding examples of collaborative handling of the common problem. Given that the mentioned cases in this paper are just a mere start and the programs themselves are looking for a 30-year

period, it is possible to make optimistic estimations about the future state of the industry.

On the sectorial side, it is encouraging to see that companies are taking the initiative to lead the change in accordance to the legal regulations. The decisions taken on the strategic level show their effects on the different faces of logistic activities throughout the supply chain, especially on the material transportation. The Viking concept, West-Med Bridge, Scandinavian Shuttle and Baxter inland sea transport can be regarded as major steps taken towards making a more green future for logistics and hopefully more projects will follow as it is seen that both environmental and monetary profits are remarkable. However, there are other concerns as well for logistic companies as mentioned such as cost, lead times, and flexibility and so on. Shifting their current practices with more environmental friendly ones may tackle them in those departments initially but, as new methods are established better over time, they would not be an issue any further.

To sum up, although there is still plenty of room for improvement, current efforts are giving the signal that the sector is on the right track. Emphasizing the importance of alternative transportation methods other than land freight (especially in-land water ways) seems to be the key factor for greener logistics in Europe. Maintaining the combination of incentives from the authorities and sense of responsibility from companies, will let the common understanding to be transferred to future generations for minimized environmental impact from logistics transport activities.

In all cases where environmental issues connected to sustainable transport solutions have been analysed, it is observed that the monetary value of the environmental benefits far outweighs the shifting costs. In the evidence of successful implementations in EU, the authors of this piece aspire to raise awareness locally on the same subject by arguing that it is possible to maintain the same productivity in alternative transportation while simultaneously earning major environmental benefits.

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