MIDDLE POMERANIAN SCIENTIFIC SOCIETY OF THE ENVIRONMENT PROTECTION
ŚRODKOWO-POMORSKIE TOWARZYSTWO NAUKOWE OCHRONY ŚRODOWISKA
Annual Set The Environment Protection
Rocznik Ochrona Środowiska
Volume/Tom 15. Year/Rok 2013 ISSN 1506-218X 649–658

Eco-logistics in the Transport, Shipping and Logistics Branch: an Analysis

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1. Introduction

The concept of environmental protection in the activities of enterprises connected with transport, shipping and logistics (TSL) is currently acquiring a special significance; this is referred to as eco-logistics or "green logistics". This is testified by an increase of its importance not only in scientific circles but first of all in any work undertaken by logistics operators aimed at environmental protection. An ecological sustainable supply chain is connected with the implementation of the intermodality conception in practice. A reduction of costs connected with widely understood environmental protection is the key idea of eco-logistics. The purpose of this article is to present activities in the area of environmental protection in a sustainable supply chain, which is offered by logistics operators, and an analysis of various branches of transport in the perspective of the consumption of energy resources and carbon dioxide. The research method applied in the preparation of a comparative analysis and case study.

2. Sustainable supply chain

Environmental protection is currently a constitutional duty of every citizen and governments [2]. Furthermore, 120 legal acts are being formed on environmental protection. The most important legal acts for the logistics of enterprises and the TSL branch are as follows:

- the Act dated 27 Apr. 2001 Environmental Protection Law (Journal of Laws No. 62 Item 627),

- the Act dated 18 July 2001 Water Law (Journal of Laws No. 115 Item 1128),
- the Act dated 11 May 2001 Packagings and Packaging Waste (Journal of Laws No. 63 Item 638),
- the Act dated 11 May 2001 Obligations of Entrepreneurs in the Scope of the Management of Some Wastes as well as Product and Deposit Fees (Journal of Laws No. 63 Item 639) etc.

The concept of sustainable development is currently taking on a special significance due to an increased interest in this issue on the part of various circles including those who specialize in logistics. Sustainable development includes such research areas as ecological, philosophical, cultural, social, institutional and political, technological and economic ones [7]. The European Union policy in the area of the sustainable development of transport branches is focused on the development of intermodal transport with the participation of the most environment friendly transport branches, i.e. the railway and inland navigation, because the road transport is characterized by the greatest negative environmental impact, and the resulting social costs are the highest.

The tendencies of changes on the market of TSL services demonstrate changes in the actions undertaken by logistics operators towards environmental protection. In the formation of the transport and logistic systems of regions or states, an essential role is played by finding a certain optimum between efforts aimed at a reduction of costs in the scale of these systems and efforts aimed at an appropriate level of the service provided and the end customer service. Such an analysis covers an examination not just of the partial elements of the system but rather the provision of comprehensive solutions that offer the possibility of the streamlining of costs [3]. We may define the fulfillment of this condition when the level and quality of the services provided by the TSL sector will correspond to the customers' preferences and expectations (the 7R rule).

Problems are posed by road accidents, which account for the external costs of Euro 156 bn. per annum, yet it is car exhaust fumes that constitute an indirect reason of least 4.7% of all the deaths of people aged over 30 and of ca. 30% of respiratory system illnesses that are suffered by children aged up to 15 [1]. An unfavorable factor is constituted by the size of the terrain which is required for the transport of a specific stream

of freights by the road transport, which is over three times as large as in the case of the use the rail transport for this purpose. In connection with this, amendments are introduced to the White Book (the European Transport Policy 2010: Time to Take Decisions) in order to use multi-modal transport systems. It has been emphasized that inter-modality is of a key significance to the development of transport alternatives for the road transport, those alternatives which combine in an optimal manner the best properties of the individual transport branches and are at the same time more environmentally friendly. Modern combined transport terminals, which join the rail transport with the road transport or the inland navigation transport with the road transport, are required for the development of the inter-modal transport. The development of sea ports as a point infrastructure in the process of the realization of inter-modal transport can be observed. One needs to emphasize an increased significance of small seaports that are included in "The Strategy of the Development of Sea Ports by the Year 2015" [5], such as the seaports in Kołobrzeg, Darłowo or Ustka situated in the Middle Pomerania. This infrastructure needs to include storehouses and plants where goods will be customized, labeled, packed and kept. Logistic operators should develop conceptions of the creation of logistic centres, where large streams of freights are delivered with environment friendly means of transport (railway, navigation) and, after an appropriate preparation, they are supplied with delivery trucks to the end recipient. Goods are delivered to production plants in containers or in replacement semi-trailers; in this way, heavy car transport is eliminated from urban agglomerations. The functioning and the development of economic networks and the related tendencies in distribution currently exert an influence on the image of the chains of deliveries, which most frequently adopt the form of large logistic networks in the conceptions of the chains of deliveries to logistic networks, where ecology may be of an essential significance provided that a suitable government policy is pursued.

3. Significance of eco-logistics: a comparative analysis

Eco-logistics, frequently referred to as secondary logistics, deals above all with the counteraction of the negative environmental impact of logistics. A. Korzeniowski and A. Skrzypek have defined eco-logistics as the realization of optimal solutions in the area of the collection, removal

and direction to recycling or liquidation of various types of wastes that are characterized by a high negative impact to the environment and society [6].

Eco-logistics as an integrated system can be described as follows:

- It is based on the concept of the management of the re-circulatory flow of material streams in the economy and the flows of information related to them,
- It guarantees the readiness and ability of an effective planning of segregation and processing as well as recycling of waste according to the accepted process rules and also technical and technological rules that fulfill the standardizing requirements and environmental protection rules,
- It facilitates decision making on technical and organizational levels with the aim of a minimization of the negative effects of the environmental impact that accompany the realization of the processes of supply logistics, re-engineering production, the logistics distributions and servicing in the logistic chains of supplies.

Reverse logistics involves the application of the conception of logistics with reference to residual wastes in order to create in this way ecological and economic flows of residues with a simultaneous spatial and temporal transformation. Reverse logistics realizes economic and ecological objectives. The economic goal consists in a reduction of logistic costs and an improvement of the level of services related to reverse logistics. The ecological objective consists in a reduction of pollutants from waste management logistics. There is an urgent need to take appropriate measures aimed at an introduction of combined and inter-modal transport, as can be observed the European Union member states (e.g. the Netherlands and Germany: the inland navigation, Austria and Switzerland: the rail transport). The rail transport in our country, considering its environment-friendly nature (60 per cent of the lines are electrified), its reliability and transport safety (very small numbers of accidents as compared with the car transport) and its wide availability, may constitute an optimal solution to the individual users of freight and logistics operators in particular. Three types of transport are of a fundamental significance to the question of the flow of goods in Europe. Table 1 presents the rail, road and inland navigation transport on the route of Wrocław – Szczecin.

Table 1. Analysis of the consumption of energy resources and carbon dioxide on the route of Wrocław – Szczecin with a transport of 24 tons of goods
Tabela 1. Analiza zużycia zasobów energii oraz dwutlenku węgla na trasie Wrocław – Szczecin przy transporcie 24 ton towarów

Kind of transport	Transport by car	Transport by train	Inland navigation transport
Consumption of energy resources in megajoules	9.878	3.587	5.235
Carbon dioxide in tons	0.62	0.28	0.33

Source: Author's own study on the grounds of calculation performed on the basis of http://www.ecotransit.org
Źródło: opracowanie własne na podstawie wyliczeń przeprowadzonych w http://www.ecotransit.org

The largest consumption of energy resources and carbon dioxide occurs in the road transport and the smallest consumption occurs in the rail transport. The standard quantity of freights for the road transport, i.e. 24 tons, was accepted. This route was accepted considering the possibility of inland navigation transport: via the Oder River, which is navigable on this section and is adapted to the transport of goods. In the case of the consumption of energy resources, the difference between the road transport and the inland navigation is 88.69%; between the road transport and the rail transport, this difference is 175.38%. In the case of pollution with carbon dioxide, the difference between the water transport and the inland transport is only 17.85% (0.05 tons), yet the difference between the road transport and the rail transport is 121.43% (0.34 ton).

For comparison, in Table 2, a higher tonnage (i.e. 100 tons) was accepted on the route of Poznań – Berlin. The assumed higher freight still demonstrated a negative environmental impact in the case of the car transport.

The smallest harmfulness is confirmed with the use of the transport of goods by train: 0.72 tons of carbon dioxide. In the inland navigation, pollution is by 69.44% lower in relation to the car transport by as much as 154.17%.

For comparison, an analysis was carried out of the transport of a freight of 24 tons on the route of Szczecin – Gdynia, where the inland transport was replaced by the sea transport.

Table 2. Analysis of the consumption of energy resources and carbon dioxide on the route of Poznań – Berlin with the transport of 100 tons of goods
Tabela 2. Analiza zużycia zasobów energii oraz dwutlenku węgla na trasie Poznań – Berlin przy transporcie 100 ton towarów

Kind of transport	Transport by car	Transport by train	Inland navigation transport
Consumption of energy resources in mega joules	28.896	10.285	17.134
Carbon dioxide in tons	1.83	0.72	1.22

Source: Author's own study on the grounds of calculation performed on the basis of http://www.ecotransit.org
Źródło: opracowanie własne na podstawie wyliczeń przeprowadzonych w http://www.ecotransit.org

When analyzing the data as presented in Table 3, the best results of the sea transport are observed in relation to the consumption of energy resources (only 1.739 mega joules), and the smallest pollution, i.e. 0.118 tons is noted. The rail transport is 1.6 times more expensive in the context of the consumption of energy resources, and pollution with carbon dioxide is twice as high. The same tonnage on a different route: Szczecin – Hamburg confirms the previously obtained results (cf. Table 4).

Table 3. Analysis of the consumption of energy resources and carbon dioxide on the route of Szczecin – Gdynia with the transport of 24 tons of goods
Tabela 3. Analiza zużycia zasobów energii oraz dwutlenku węgla na trasie Szczecin – Gdynia przy transporcie 24 ton towarów

Kind of transport	Transport by car	Transport by train	Sea transport
Consumption of energy resources in mega joules	14.364	4.533	1.739
Carbon dioxide in tons	0.907	0.36	0.118

Source: Author's own study on the grounds of calculation performed on the basis of http://www.ecotransit.org
Źródło: opracowanie własne na podstawie wyliczeń przeprowadzonych w http://www.ecotransit.org

Being guided by the results obtained, logistics operators should in the first order use the sea transport. This is confirmed by the widely used inter-modal transport in the case of containers that are transported from

the Far East, where in the first order they are trans-shipped to those vessels that travel from Hamburg to Polish ports. In the second order, the rail transport is used. As the last resort, the road transport is used, where the end customer has to pay an extra of over PLN 1,000.00 of the freight in connection with the change of the means of transport. In Poland, in the case of inland navigation freights, in spite of the calculations, the road transport is most frequently used; next comes the rail transport, and the inland navigation transport is used a minimum extent only.

Table 4. Analysis of the consumption of energy resources and carbon dioxide on the route of Szczecin – Hamburg with a transport of 24 tons of cargo
Tabela 4. Analiza zużycia zasobów energii oraz dwutlenku węgla na trasie Szczecin – Hamburg przy transporcie 24 ton towarów

Kind of transport	Transport by car	Transport by train	Sea transport
Consumption of energy resources in mega joules	14.521	5.574	2.222
Carbon dioxide in tons	0.917	0.308	0.151

Source: Author's own study on the grounds of calculation performed on the basis of http://www.ecotransit.org
Źródło: opracowanie własne na podstawie wyliczeń przeprowadzonych w http://www.ecotransit.org

4. Logistic operators: environment-friendly activities

1. DB Schenker: environmental action

The issue of sustainability has become an integral part of the DB Group's corporate strategy and is firmly anchored in the corporate mission statement. DB Schenker will offer to their customers an innovative and individualized mobility and logistics solutions from a single source. The firm will intelligently link together the various modes of transport in an economical and ecological way.

DB Schenker Logistics records its environmental figures for overland transport, for air and maritime transport, for contract logistics, and for its operating facilities. These figures include all greenhouse gases and air pollutants. All the data were collected and recorded by the central environmental management team, and then sent to an external consultant, i.e. the Institute for Applied Ecology in Berlin, in order to calculate the carbon footprint of DB Schenker Logistics in accordance with the ISO

14064-1 standard. The methodology was validated by Deloitte Cert., Düsseldorf, Germany, in accordance with DIN ISO 14064-3.

DB Schenker is on its way to becoming the leading provider of Green Logistics services.[8]

DB Schenker is realizing enormous possibilities for carbon savings above all by intelligently linking together the various modes of transport. Further carbon reduction can also be achieved by: conserving the environment by offering new green solutions, combating global warming by increasing energy efficiency, reducing dependency on fossil fuels by expanding the use of renewable energy sources.

2. Environmental protection with Deutsche Post DHL

Their green solutions are designed to help our customers reach their own environmental targets. Their range of climate-friendly products and services.

Green products and services

1. Carbon Reporting - DHL produce reports on carbon emissions arising from products and services used by the customer, providing an account of the customer's carbon footprint.
2. Carbon Consultancy - DHL analyze their customer's entire supply chain and offer strategies for optimizing transport routes and reducing carbon emissions.
3. Carbon Reduction - DHL offer our customer measures for reducing emissions and saving costs.
4. Carbon Offsetting - DHL offset carbon emissions by investing in officially recognized climate protection projects.

DHL acknowledge that their business has other impacts on the environment such as local air pollutants, their waste production as well as our use of water and paper. Unlike the global impact of carbon emissions, these environmental factors typically impact the environment at the local level. The DHL Group-wide energy efficiency program, together with our ongoing fleet renewal initiative, is helping to minimize our emissions of local air pollutants. [9]

The firm are committed to improving the carbon efficiency of our own operations and those of their transportation subcontractors by 30 % compared to our 2007 levels by the year 2020.

5. Conclusions

TSL branch enterprises take into consideration legal acts concerning environmental protection in the sustainable supply chain. When analyzing the road, rail and inland navigation transports for the transport of goods, the smallest consumption of energy resources and carbon dioxide is to be observed with the rail transport, while the highest consumption is to be observed with the road transport. Taking into account the road, rail and sea transports, we receive the highest parameters of the consumption of energy resources and carbon dioxide with the road transport, while these parameters are the smallest in the case of the sea transport. Logistics operators have introduced a number of solutions with the aim to improve environmental protection. Those logistics centres which are fundamentally operated with the use of the rail transport and which work within a network will certainly contribute to a facilitated flow of the stream of freights. The use of inter-modal transport by logistics operators could be realized at relatively small financial expenditures through the streamlining and modernization of the flow of freights in the network of railway lines, using combined transports in an optimal manner. Logistics operators should first use inland, next by rail and delivery road transport should be implemented transport. Lack of Polish state policy in this matter as Switzerland and Austria, causing excessive use of road transport, including by logistics operators.

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Ekologistyka w branży TSL – analiza

Streszczenie

Koncepcja zrównoważonego rozwoju obejmuje procesy związane z przemieszczaniem się ładunku przy uwzględnieniu transportu intermodalnego. Celem artykułu było zaprezentowanie działań w zakresie ochrony środowiska w zrównoważonym łańcuchu dostaw, który oferowany jest przez operatorów logistycznych oraz analiza różnych gałęzi transportu pod kątem zużycia zasobów energii oraz dwutlenku węgla. Metoda badawcza zastosowana przy opracowaniu to analiza porównawcza oraz studium przypadku. Polityka Unii Europejskiej w zakresie zrównoważonego rozwoju gałęzi transportu koncentruje się na analizie najbardziej ekologicznych gałęzi transportu – żegludze morskiej i śródlądowej oraz transporcie kolejowym. Określono, że intermodalność ma kluczowe znaczenie dla rozwijania alternatyw transportowych dla transportu kołowego, który jest najmniej przyjazny dla środowiska naturalnego. Tematyka ekologistyki podejmuje techniczne i organizacyjne decyzje w kierunku minimalizacji negatywnych skutków oddziaływania na środowisko, towarzyszących realizacji procesów logistyki zaopatrzenia, reinżynierii produkcji, logistyki dystrybucji i serwisowych w logistycznych łańcuchów dostaw. Z przeprowadzonej analizy przewozów towarów różnymi środkami transportu najlepszym rozwiązaniem dla logistyki byłoby, gdyby odwóz niektórych towarów realizowany był ekologicznym środkiem transportu, jakim jest żegluga śródlądową lub koleją. Budowanie łańcuchów dostaw w oparciu o transport kolejowy czy wodny może mieć duże znaczenie dla ochrony środowiska naturalnego. Przedstawiona analiza zużycia zasobów energii i dwutlenku węgla na trasie Wrocław – Szczecin pokazuje najniższe wyniki transportem koleją, a następnie żeglugą śródlądową. W przypadku możliwości porównania transportu kołowego, kolejowego i morskiego – najniższe wyniki są przy zastosowaniu transportu morskiego a najwyższe zużycie zasobów energii i dwutlenku węgla przy wykorzystaniu transportu kołowego. Operatorzy logistyczni kierują się wynikami wykorzystując w pierwszej kolejności transport morski przy maksymalnym wykorzystaniu transportu intermodalnego. Niestety w Polsce przy przewozie ładunków najbardziej popularny jest transport kołowy, a następnie kolejowy i w minimalnym stopniu żegluga śródlądowa (około 7%). Operatorzy logistyczni, jakimi są DB Schenker i Deutsche Post DHL wdrażają szereg rozwiązań w celu maksymalnej ochrony środowiska, ale brak zdecydowanej polityki państwa w tym zakresie.