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## Development of Intermodal Transport in the EU Countries

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### **Abstract:**

**Purpose:** The main purpose of the article was to present the development of intermodal transport in individual EU countries. The specific purposes were to show the situation and directions of changes in the importance of intermodal transport in terms of the use of individual modes of transport, to show the leaders in this type of transport.

**Design/Methodology/Approach:** All EU countries were selected for research using the purposeful selection method, as of December 31, 2019. In total, 28 EU countries were examined. The research period covered the years 2008-2019. The data come from Eurostat.

**Findings:** In the years 2008-2019, intermodal transport grew in most EU countries, but very quickly in just a few. The concentration of this type of transport in the EU countries has decreased and it is spread over a larger number of countries. In addition, the changes occurred faster in terms of transport performance in tkm than in the volume of cargo in tonnes.

**Practical Implications:** Intermodal transport should be developed in the future. Therefore, it is important to know the current situation and directions of changes so that one can react on an ongoing basis. Decision-makers can use appropriate instruments to influence the right directions of changes in intermodal transport.

**Originality/Value:** Intermodal transport is and will be promoted in the EU. As a rule, the articles discuss transport for one or more countries, but only for the last few years. The analysis covers 12 years, therefore changes can be noticed in the long run.

**Keywords:** Sustainable transport, containers, intermodal terminals, long distance transport.

**JEL classification:** P28, R40, R41, R42.

**Paper Type:** Research paper.

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## 1. Introduction

The transport sector, as a key to economic development, is at the same time the sector which is currently responsible for a significant share of greenhouse gas emissions in the EU. According to data from the European Environment Agency (EEA), in 2017 27% of total EU-28 greenhouse gas emissions came from the transport sector (22% excluding air and maritime transport) (Greenhouse ..., 2021). Most of the pollution comes from road transport. In the EU-28 countries, its share in the total emissions from the transport sector was approx. 75% (800 MtCO<sub>2e</sub>), while in Poland as much as 98% (Engel *et al.*, 2020).

Due to the problems with road congestion in Europe and around the world, intermodal transport has started to play an important role in recent years, also out of concern for the environment and traffic safety. For this reason, research and political interest in intermodal freight transport is growing (Agamez-Arias and Moyano-Fuentes, 2017; Demir *et al.*, 2019; Baykasoğlu *et al.*, 2019). Macharis and Bontekoning (2004) define intermodal transport as a combination of at least two modes of transport in one transport chain, without changing the container for goods, with most of the route traveled by rail, inland waterway or ocean-going ship, and with the shortest possible initial and final journey by road transport. Intermodal transport can involve different types of transport. Intermodal transport is emerging as a new mode of transport when the chain is fully integrated and can be viewed as a complete door-to-door service. In order to organize the flow of intermodal transport, an increased level of coordination is necessary (Caris *et al.*, 2008).

The development of intermodal transport in Europe should keep pace with the development of this type of transport in other parts of the world. It is important to create intermodal transport channels on the so-called New Silk Road. The UN estimates the potential of rail transport on the China-Europe route in 2030 at about 1 million containers. Estimates indicated that 5,000 container trains arrived from China each year in 2020 (Dexing, 2017). The EU legal environment in the field of transport shows that EU legal acts are aimed at supporting the development of intermodal transport, perceived as the most environmentally friendly alternative to relatively high-emission road transport along the entire transport route.

The development of intermodal transport in the EU is supported by, *inter alia*, financing projects supporting the development of railways, but also projects aimed at connecting sea ports and inland water ports with the land transport network (road and rail). Another type of development activities are projects supporting the development of the potential of logistics centers through, *inter alia*, supporting the modernization of services offered, building new centers, or supporting and retrofitting the existing ones. It is also important to reduce the impact of transport on the environment by, *inter alia*, the use of alternative propulsion systems also in intermodal transport (including the use of hydrogen locomotives or electric trucks).

Many researchers have analyzed the key goals of sustainable transport as well as tasks and performance indicators. Litman (2011; 2015) and Rassafi and Vaziri (2005) indicated that sustainable development can be divided into three main goals: economic, social and environmental. The purpose of introducing intermodal transport, in addition to economic efficiency, is the desire to reduce the external effects of transport, and thus achieve a more sustainable transport system. Externalities represent changes in welfare caused by economic activity without reflecting these changes in market prices (Weinreich *et al.*, 1998). In the field of transport, spillover effects arise when transport companies pass costs on to society rather than pay for them themselves. External costs are externalities expressed in monetary terms. In the economic literature (INFRAS/IWW, 2004), the most important external costs of transport are: accidents, noise, air pollution, climate change and overpopulation.

Intermodal transport should develop, especially in the case of goods transport over long distances in international relations (Liu *et al.*, 2019). It enables the synergistic use of the best features of individual modes of transport (Fang *et al.*, 2020). It creates very large opportunities that individual EU countries are not yet able to use properly (Bask and Rajahonka, 2017; Gharehgozli *et al.*, 2019).

The main purpose of the article was to present the development of intermodal transport in individual EU countries. The specific objectives were to show the situation and directions of changes in the importance of intermodal transport in terms of the use of individual modes of transport, to show the leaders in the field of this type of transport. One research hypothesis was formulated:

*Hypothesis 1. In the years 2008-2019 there was a decrease in the concentration of intermodal transport only in a few EU countries.*

The structure of the article is as follows. Section 1 provides an introduction to the research topic. The advantages and importance of intermodal transport were shown. Section 2 shows the data source and research methods. Section 3 contains the results of research on intermodal transport in each EU country. Section 4 presents the conclusions of the research.

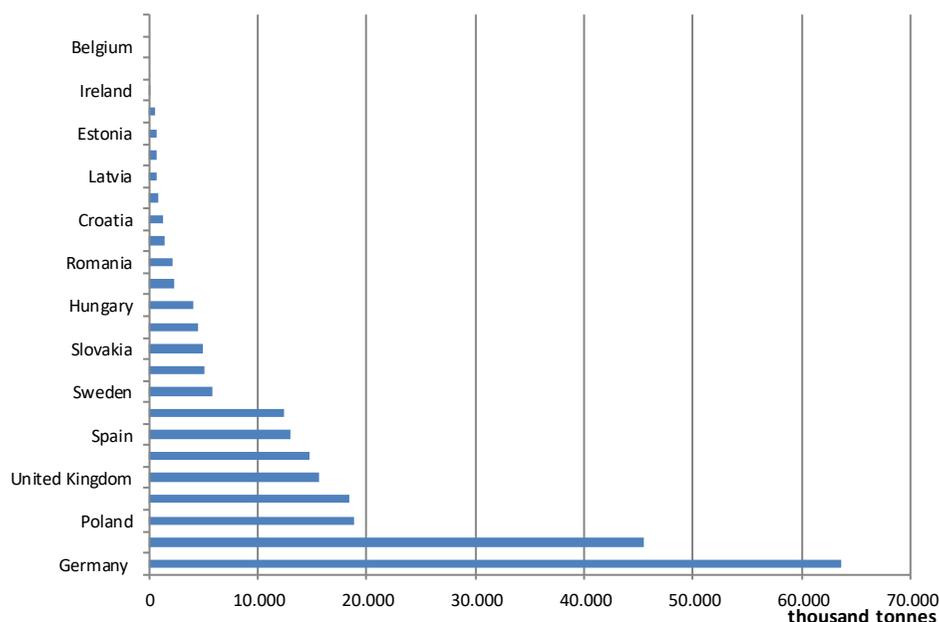
## **2. Materials and Methods**

All EU countries were selected for research using the purposeful selection method, as of December 31, 2019. In total, 28 EU countries were examined. The research period covered the years 2008-2019. Intermodal transport is a fairly new idea and has actually been developed in recent years. Adopting a 12-year period seems sufficient to observe the changes that are occurring. 2019 was the last year when full research data was available. The data used in the study come from Eurostat. Descriptive, tabular and graphic methods were used to present the research results.

### 3. Results

When describing intermodal transport, it is necessary to refer to individual modes of transport separately. In the European Union countries, there were significant differences in the volume of freight transport by rail with the use of intermodal loading units (Figure 1). Compared to other countries, Germany and Italy stood out. In 2019, the transport of intermodal units in these countries accounted for over 45% of transport in the entire EU. Another 40% of cargo was transported in seven countries (England, Poland, the Netherlands, France, Sweden and the Czech Republic). However, the shares of each of these countries were below 10% of the EU volume. In 2008-2019, intermodal rail transport increased significantly in Germany (by over 25 percentage points) and in Italy (by 18 percentage points) in the total volume in the European Union. More goods were transported in Bulgaria by 150%, Greece by less than 50%, Finland by 20% and Romania by 12%.

**Figure 1.** Goods transported in intermodal transport units by railway in EU in 2019 (thousand tonnes).

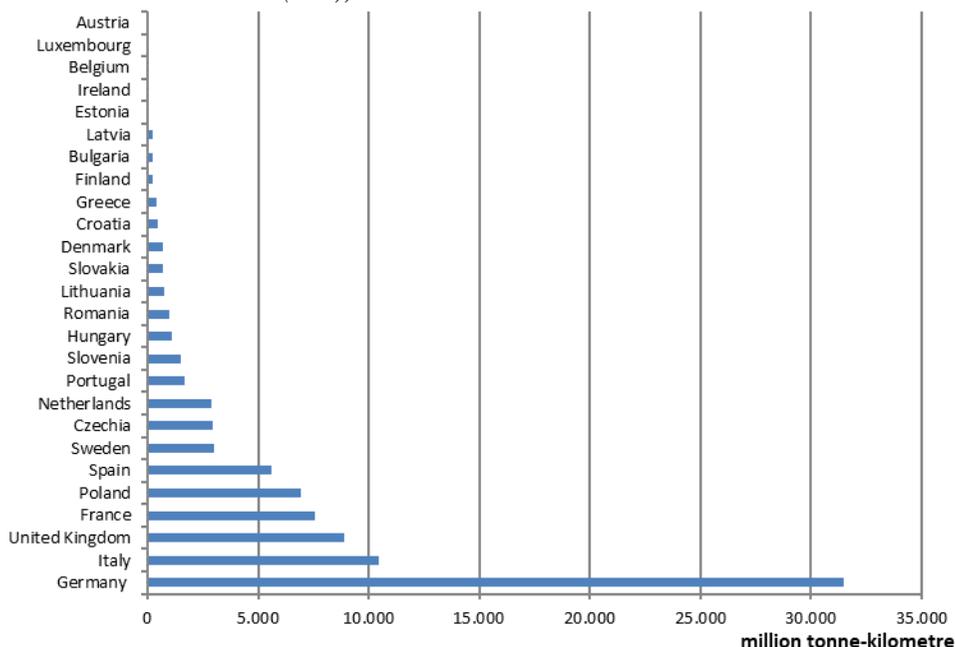


**Source:** Eurostat (online data code: tran\_hv\_fmmod).

In 2019, greater diversification of freight transport by rail in intermodal loading units in the EU was taking into account transport performance in millions of tonne-kilometers (tkm) (Figure 2). Compared to the EU countries, only Germany stood out with a 35% share. The transport of goods in tkm was more evenly distributed than in terms of the weight of the transported loads. The shares of individual countries did not exceed 10% of the transport performance in the entire EU. In the years 2008-2019, the transport performance in the transport of intermodal loading units by rail increased by

30%. The fact that in the analyzed period the differences between individual countries decreased (even their share in German transport decreased by nearly 17 pp.). This proves a lower concentration of this type of transport in one or several countries.

**Figure 2.** Goods transported in intermodal transport units by railway in EU in 2019 (million tonne-kilometre (tkm)).



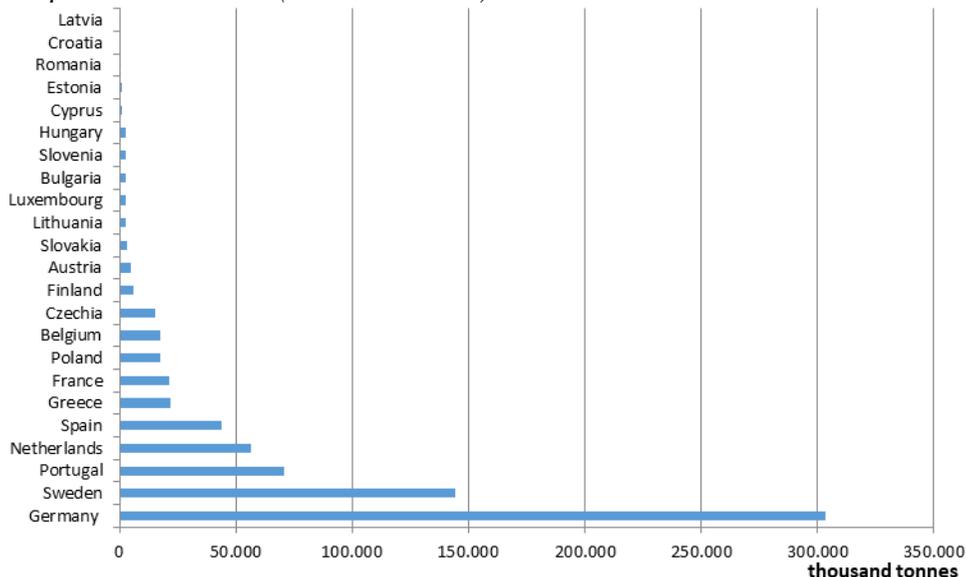
**Source:** Eurostat (online data code: tran\_hv\_frmo).

In the case of intermodal transport, there were greater disproportions in road transport than in rail transport. There was a great variation in the type of cargo, class and distance (Figure 3). In 2008-2019, the disparities between countries were slightly reduced. In 2019, approximately 60% of all intermodal loads using road transport were transported in two countries (in Germany, approximately 40% and Sweden, over 18%). It was followed by Portugal (9%), the Netherlands (7%) and Greece (5%). In other countries, the volume of intermodal cargo transported by road was much lower, and their share did not exceed 3%. Overall, the volume of intermodal cargo transported by road has increased in the EU (by 30%). Most countries saw an increase in the volume of these transports. The exceptions were Croatia (same level), Cyprus (decrease by 16%), France (by 48%), Finland (by 50%), Belgium (by 68%) and Estonia (by 24%).

Similar differences were observed in the annual road transport of intermodal loads by type of cargo, class and distance converted to tonne-kilometers (Figure 4). The share of transport performance in Germany accounted for over 45% of all transport in the EU in 2019, despite its decrease by over 8 pp. in the years 2008-2019. Transport

performance in tonne-kilometers was more evenly distributed among individual countries as compared to the volume of transport. In other countries, except for Germany, the transport performance did not exceed 9% of the share in the entire EU.

**Figure 3.** Annual road freight transport by type of cargo and distance class by car transport in EU in 2019 (thousand tonnes).

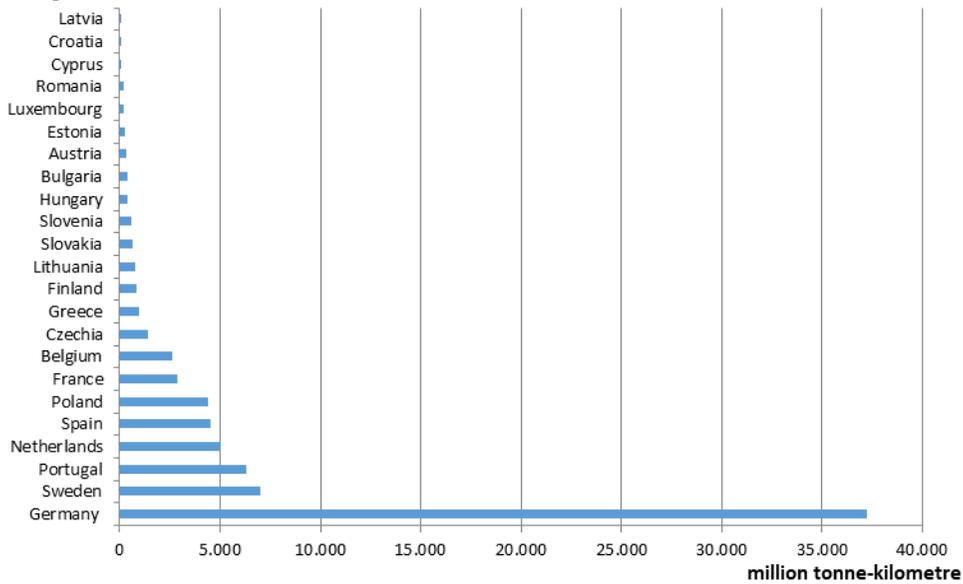


**Source:** Eurostat (online data code: tran\_hv\_frmod).

Then, the volume of container transport by inland waterways was taken into account, converted into tons in the period from 2008 to 2019. The total volume in the EU for this type of transport increased by 25% (Figure 5). However, this form of transport has only been used in intermodal transport in a few countries. In 2019, less than 97% of transports were carried out in three countries: the Netherlands (53%), Germany (21%) and Belgium (21%). In the period 2008-2019, an over 30% increase in the volume of goods transported in the Netherlands was observed. This was due to the specificity of this type of transport, strongly dependent on the natural conditions of individual countries. Building new waterways is costly and time-consuming.

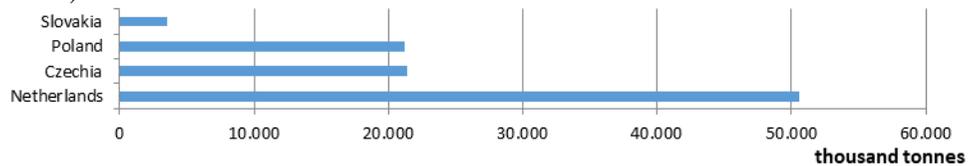
Taking into account the freight turnover in the transport of containers with the use of inland waterways, there were even greater differences between countries than in the case of volume (Figure 6). In 2019, almost 90% of the transport performance with the use of inland waterways in the European Union was carried out in two countries: the Netherlands (49%) and Germany (41%). In the years 2008-2019, an almost 25% increase in this measure was observed in the Netherlands. During the same period, its size for the entire EU increased by more than 12%.

**Figure 4.** Annual road freight transport by type of cargo and distance class by car transport in EU in, 2019 (million tonne-kilometre (tkm)).



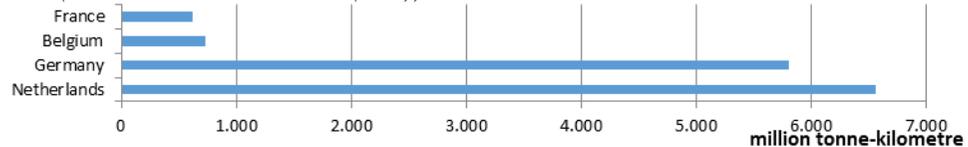
Source: Eurostat (online data code: tran\_hv\_frmod).

**Figure 5.** Container transport in EU by inland water transport in 2019 (thousand tonnes).



Source: Eurostat (online data code: tran\_hv\_frmod).

**Figure 6.** Container transport by size of container EU by inland water transport in 2019 (million tonne-kilometre (tkm)).

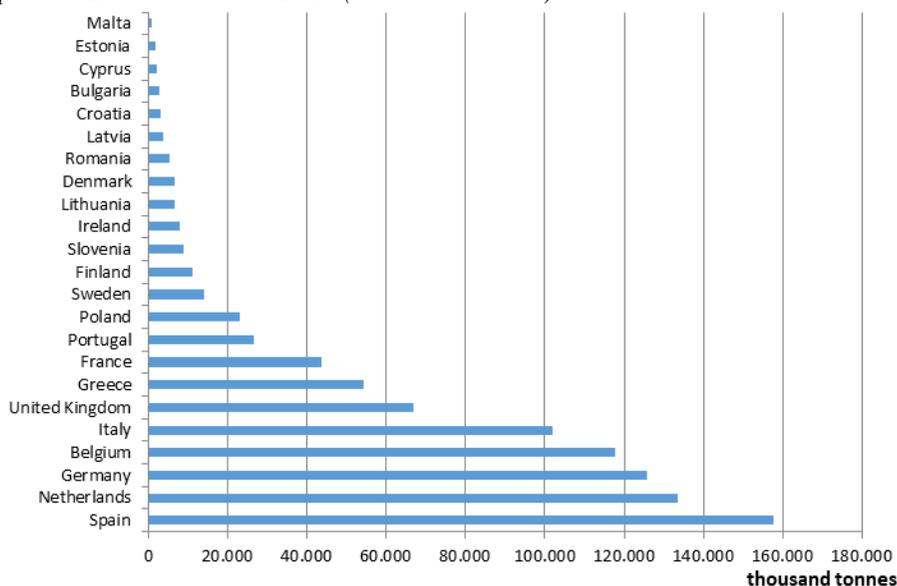


Source: Eurostat (online data code: tran\_hv\_frmod).

Figure 7 shows the volumes of cargo handling in intermodal transport in the ports of the EU countries. Over 80% of such transhipments in the European Union were carried out in ports located in seven countries: Spain (17%), the Netherlands (14%), Germany (13%), Belgium (12%), Great Britain (8%) and Greece (7%). In other countries, the share of this type of transhipment was marginalized, as it did not exceed 3% in any of the countries. In 2008-2019, the volume of goods transported in

intermodal transport using sea transport increased by 25%. Increases occurred in all EU countries, except Finland, where the volume did not change. During this period, the largest increase in the structure of intermodal transshipments in EU seaports was recorded in Spain and the Netherlands, about 7 percentage points each.

**Figure 7.** Gross weight of intermodal goods handled in main ports by maritime transport in EU countries in 2019 (thousand tonnes).



*Source:* Eurostat (online data code: tran\_hv\_frmod).

#### 4. Concluding Remarks

The conducted research allowed for drawing several conclusions:

1. There was a large concentration of intermodal transport in several EU countries. In 2019, the leaders in rail transport were Germany and Italy (45% of the entire EU volume), in road transport - Germany and Sweden (58%), in inland water transport - the Netherlands (53%), in transshipments at sea ports: Spain, the Netherlands, Germany and Belgium (56%).
2. Taking into account the transport performance in tonne-kilometers, the concentration level was usually lower, because the leaders in rail transport were Germany (35% of transport performance in the entire EU in 2019), and in road transport - Germany (45%). The situation was different only in inland waterway transport, as the Netherlands (49%) and Germany (53%) were the clear leaders.
3. In the years 2008-2019, intermodal transport grew in most EU countries, but very quickly in just a few. The concentration of this type of transport in the EU countries has decreased and it is spread over a larger number of countries. The research hypothesis has been positively verified. In addition, the changes

occurred faster in terms of transport performance in tkm than in the volume of cargo in tonnes.

## **References:**

- Agamez-Arias, A.D.M., Moyano-Fuentes, J. 2017. Intermodal transport in freight distribution: a literature review. *Transport Reviews*, 37(6), 782-807.
- Bask, A., Rajahonka, M. 2017. The role of environmental sustainability in the freight transport mode choice: A systematic literature review with focus on the EU. *International Journal of Physical Distribution & Logistics Management*, 47(7), 560-602.
- Baykasoğlu, A., Subulan, K., Taşan, A.S., Dudaklı, N. 2019. A review of fleet planning problems in single and multimodal transportation systems. *Transportmetrica A: Transport Science*, 15(2), 631-697.
- Caris, A., Macharis, C., Janssens, G.K. 2008. Planning problems in intermodal freight transport: accomplishments and prospects. *Transport Plann Tech*, 31(3), 277-302.
- Demir, E., Hrušovský, M., Jammerneegg, W., Van Woensel, T. 2019. Green intermodal freight transportation: bi-objective modelling and analysis. *International Journal of Production Research*, 57(19), 6162-6180.
- Dexing, S. 2017. Prezentacja New Eurasian Land Bridge: Achievements & Challenges. II Spotkanie Ministrów Transportu (TMM) & Forum Biznesu. Warszawa.
- Engel, H., Purta, M., Speelman, E., Szarek, G., van der Pluijm, P. 2020. Neutralna emisyjnie Polska 2050. Jak wyzwanie zmienić w szansę. Raport McKinsey & Company.
- Fang, X., Ji, Z., Chen, Z., Chen, W., Cao, C., Gan, J. 2020. Synergy degree evaluation of container multimodal transport system. *Sustainability*, 12(4), 1487.
- Gharehgozli, A., de Vries, H., Decrauw, S. 2019. The role of standardisation in European intermodal transportation. *Maritime Business Review*, 4(2), 151-168
- Greenhouse gas emissions from transport in Europe. <https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-12>.
- INFRAS/IWW 2004. External costs of transport: update study. INFRAS/IWW, Zürich.
- Litman, T. 2011. Well measured. Developing indicators for comprehensive and sustainable transport planning. Victoria Transport Policy Institute.
- Litman, T. 2015. Developing indicators for sustainable and livable transport planning. Victoria Transport Policy Institute, 250-360.
- Liu, D., Deng, Z., Sun, Q., Wang, Y., Wang, Y. 2019. Design and freight corridor-fleet size choice in collaborative intermodal transportation network considering economies of scale. *Sustainability*, 11(4), 990.
- Macharis, C., Bontekoning, Y.M. 2004. Opportunities for OR in intermodal freight transport research: a review. *Eur J Oper Res.*, 153, 400-416.
- Rassafi, A.A., Vaziri, M. 2005. Sustainable transport indicators: definition and integration. *Int J EnvironSci Tech.*, 21, 83-96.
- Weinreich, S., Rennings, K., Schlomann, B., Geßner, C., Engel, T. 1998. External Costs of Road, Rail and Air Transport-a Bottom-Up Approach, No. 98-06. ZEW-Leibniz Centre for European Economic Research.