

# MULTIMODAL TRANSPORT AS A SUSTAINABLE TRANSPORT FOR THE CHEMICAL INDUSTRY: PRIMARY QUALITATIVE RESEARCH

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## **Abstract**

**Purpose:** Increasing transport performance, more traffic accidents and efforts to respect sustainable development make companies look for optimal transport solutions. The paper deals with the utilization of multimodal transport in the framework of transport of chemical goods in selected Czech Republic chemical industry companies. The primary objective of the paper is to map the motivation of the selected chemical industry companies for shifting the transport to multimodal transport.

**Design/methodology/approach:** The research was executed in the format of double round primary qualitative research. The sample consisted of chemical industry companies from the Czech Republic that met the following conditions as of the date of the start of this research: they were members of the Association of Chemical Industry of the Czech Republic, they were production companies that distributed large and significant portions of their production abroad. In the case of the logistic services providers (LSPs) we addressed companies that provided logistic services to chemical industry companies and had already cooperated with the Association of Chemical Industry of the Czech Republic.

**Findings:** Companies participating in this research have significant motivation for higher utilization of multimodal transport. The main reasons for this are increased volumes of sales and expansion to new markets. Customers' demands on products transport also gradually change. Reasons for utilization of other transport modes are continuing problems in road transport. Participating companies see significant potential in increased utilization of multimodal transport in the area of continental transports. Such increased utilization would contribute to significant improvement of transport situation in Europe and to mitigation of negative impacts of transport on the environment and on public health.

**Research/practical implications:** In the framework of this research there have been identified criterions that are decisive for implementation of chemical goods transportations. For further development of multimodal transport it is essential to focus on reducing transport costs and transit times and on improving the availability of transport means.

**Originality/value:** This paper illustrates, on the example of selected chemical industry companies, the existing state of affairs in the area of utilization of multimodal transport and it maps the motivation of companies for shifting transport to multimodal transport.

**Keywords:** multimodal transport, chemical industry, sustainable transport, sustainable development.

**JEL Codes:** O18, R41.

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## **Introduction**

The transport sector is very ambivalent, which is confirmed by Naganathan and Chong (2017) too. Authors stated that transportation systems facilitate the flow of goods and services globally, creating jobs and encouraging economic growth while generating negative impacts on the environment and society. The constantly-growing transport demand is reflected according to Edenhofer et al. (2014) in traffic congestion, as well as in higher energy consumption and the associated emissions. Carbon dioxide accounts for 75% of global greenhouse gas pollution and is projected to remain the largest contributor to global greenhouse gas emissions by 2050 (Edenhofer et al., 2014).

Institutions across the world are trying to implement sustainable practices to mitigate these negative impacts at international, national and regional level (Naganathan and Chong, 2017). Sustainable practices include three areas: the economic area, the environmental area and the social area by Mikulčić, Duić and Dewil (2017). Sustainable development must be equitable (interaction between the economic and the social dimension), liveable (the link between the environment and social needs) and viable (economic development must be in accord with ecosystems capacities) (World Commission on Environment and Development, 1987).

Research on environmentally sustainable transport was initiated more than twenty years ago, but the implementation and governance of sustainable mobility remain significant challenges worldwide (Zawieska and Pieriegud, 2018). Multimodal transport was considered as a sustainable transport mode already in 2000 according to Walton and Farrington (2000). Economic Commission for Europe (2001) defined multimodal transport as a carriage of goods by two or more modes of transport. The use of multimodal transport belongs to sustainable transport tools, because the modal shift and the increased use of rail transport have lower environmental impacts (Kos, Vukić and Brčić, 2017). Chemical companies manage the

environmental aspects and impacts of their activities (Hyršlová, Vnoučková and Tomšík, 2015). They are also interested in logistics because the transport of chemical goods is connected with significant environmental risks (Cichosz, 2017). CEFIC (2007) stressed in 2007 safe and sustainable transport as a crucial condition to the future of European chemical industry. The issue of multimodal transport in the chemical industry is a very current topic, as evidenced by several studies from Poland, for example Cichosz, Nowicka and Pluta-Zaremba (2017a,b). Studies were focused on determinants of choice of multimodal transport in chemical industry in Poland and on challenges to multimodal transport in the Polish chemical industry.

This paper deals with the utilization of multimodal transport in the framework of transport of chemical goods in selected Czech Republic chemical industry companies. The primary objective of this paper is to map the motivation of the selected chemical industry companies for shifting the transport to multimodal transport.

## **1 Methods**

The research of multimodal transport of chemical goods was executed in the period from September 19, 2016 to November 11, 2016 in the format of double round primary qualitative research. A method of electronic structured questioning was used in the first round of this research and personal semi-structured questioning was used as the research technique in the second round of the primary qualitative research. The questionnaire for chemical companies and LSPs was composed of 30 open questions. Semi-structured questioning was implemented according to already prepared instructions and it was recorded; in case of need some areas were further expanded by deep and probing questions. The average length of one personal semi-structured questioning was approximately 60 minutes.

In total 19 questionnaires were sent out to chemical industry companies from the Czech Republic and to providers of logistic services in the first round of the primary research. Regarding the chemical industry companies this research includes those companies that met the following conditions as of the date of the start of this research: they were members of the Association of Chemical Industry of the Czech Republic, they were production companies that distributed large and significant portions of their production abroad. In the case of the LSPs we addressed companies that provided logistic services to chemical industry companies and had already co-operated with the Association of Chemical Industry of the Czech Republic for a long period of time. The response rate for the electronic

structured questioning was 53%; 10 companies participated in this research – respondents were located across the entire Czech Republic.

30 experts from chemical companies and logistic services providers (LSPs) participated in the personal semi-structured questioning that followed the electronic structured questioning (second round of the primary qualitative research). These 30 people were top management representatives (5 respondents) as well as experts from the area of trade and logistics management (25 respondents). Semi-structured questioning was realized in the form of a dialogue between two people (the respondent and the inquirer) in the companies participating in this research.

Research dealt with these questions:

- What is the importance of multimodal transport for respondents?
- What is the current share of multimodal transport in the total transport performance of the respondents?
- Is there existence of motivation for shifting the transport to multimodal transport among respondents?
- What criteria are important for shift the transport to multimodal transport among respondents?
- What are the most important arguments when LSPs promoting multimodal transports?

There are summarized the basic results of the research focused on the above-mentioned research questions in the following chapters.

## **2 Results**

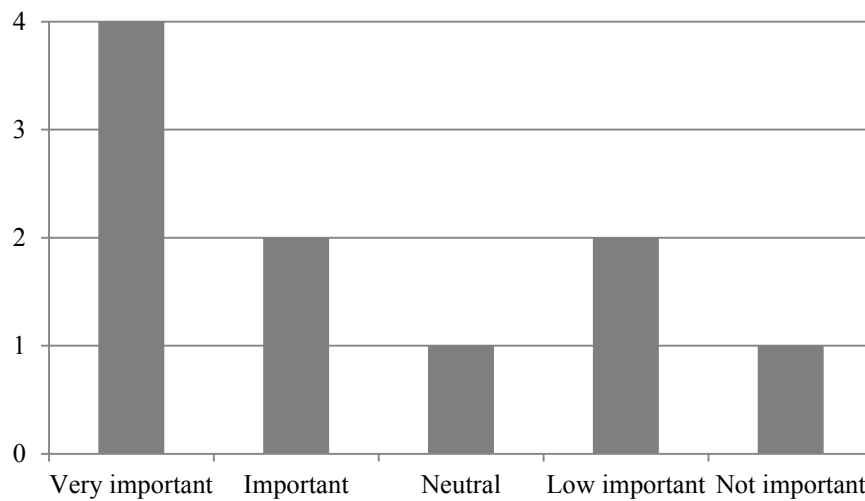
The results are divided according to individual research questions into subchapters 2.1 – 2.5.

### **2.1 Importance of multimodal transport**

Figure 1 illustrates the importance of multimodal transport from the point of view of all respondents (that is chemical industry companies and LSPs).

Overall six respondents find multimodal transport important. Out of that four respondents find it very important. One respondent has neutral position towards multimodal transport (currently the relevant company changes its owner, strategy for logistics area was not known in the time of the research).

**Fig. 1: Importance of multimodal transport (frequency of responses)**



Source: authors

Three respondents do not find multimodal transport issues to be an important area for their business activities. They put forward the following main reasons for that:

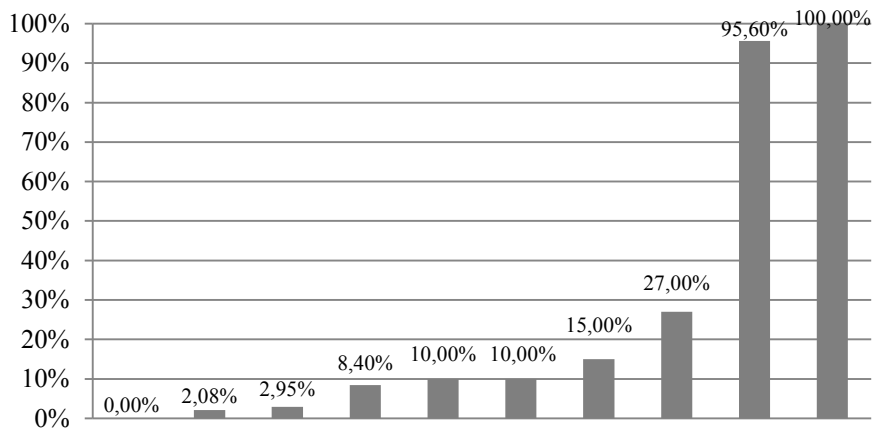
- Raw materials and other materials are transported into the company from nearby destinations. Utilization of multimodal transport is thus not possible or it is not effective.
- Final products are distributed to customers located in nearby destinations. Also in this case utilization of multimodal transport is not possible at all or it would not be effective (with respect to time and economic aspects).
- In the sector in which the company operates multimodal transport is not utilized (and it is not expected that multimodal transport will be used in the future).

## 2.2 Share of multimodal transport

The following Figure 2 presents the current share of multimodal transport in the total transport performance of the respondents. The shares relate only to such transports that are implemented in relation with final products. Results for all respondents are included in this evaluation; it is both for chemical industry companies and for LSPs.

The share of multimodal transport in the transport performance differs significantly. Figure 2 includes graph from which it issues that 80% of the respondents report the multimodal transport share in total transport performance be smaller than 30%. Only 20% of the respondents utilize multimodal transport for more than 95% transports; one respondent does all transports in the multimodal transport regime.

**Fig. 2: Share of multimodal transport according to individual respondents**



Source: authors

The average share of multimodal transports corresponds with the value 27.10%; higher share of multimodal transport is reported by only 20% respondents. The median value is equal to value 10%.

The following are the most used alternatives of multimodal transport of final products: road, rail and sea transport; road and rail transport; road and sea transport and rail and sea transport.

### **2.3 Existence of motivation of the chemical companies for shifting the transport to multimodal transport**

For the chemical industry sector companies there exists a very strong motivation (for seven out of eight respondents) for more extensive use of multimodal transport; only one respondent does not consider utilization of multimodal transport since multimodal transport is not suitable for his type of business. Respondents provide the following main reason for use of multimodal transport:

- increasing volumes of imported raw materials,
- increasing volumes of exported final products,
- widening of their portfolio of customers,
- changing requirements of the side of customers regarding logistics solutions of transport,
- improving services provided by logistics terminals (more flexible loading and unloading),

- in many cases multimodal transport is the only possible solution in particular with orientation to out-of-Europe (more geographically distant) markets (like Asia, America and similar),
- effort to reduce transport costs,
- existing problems in road transport (insufficient transport capacity, congestions, traffic accidents and more dramatic impacts of such accidents, lack of qualified drivers and similar).

From the results it issues that the main reason for the development of multimodal transport are first of all growing volumes of sales and expansion to new markets; gradually also customers' requirements regarding transport of products has been changing. Further reasons why other transport modes are used are lasting problems in road transport and improving availability and services provided by logistics terminals.

#### **2.4 Importance of criterions for shift the transport to multimodal transport**

The following Table 1 summarizes the importance of the individual criterions for the decision about higher utilization of multimodal transports. This table shows responses provided by chemical industry sector companies.

The respondents evaluated the importance of the individual criterions. Value 1 means that the given criterion is seen by the respondent as not important at all, value 5 means that the given criterion is seen by the respondent as very important. Arithmetic averages, medians respectively, have been constructed based on the evaluation of the importance of the individual criterions by the individual respondents. Table 1 summarizes the results of the research into this area.

**Tab. 1: Importance of criterions for shift the transport to multimodal transport (arithmetic averages and medians)**

<b>Criterion</b>	<b>Average</b>	<b>Median</b>
Costs	4.750	5.000
Transit time	3.875	4.000
Availability of means of transport	3.875	4.000
Corporate social responsibility (CSR) strategy	3.250	3.500
Lowering CO <sub>2</sub> emission	3.000	3.000
Sector's regulations	2.375	2.500

Source: authors

It is the view of the respondents that for the development of multimodal transport it is essential to focus on transportation costs, transit time and availability of means of transport.

Motivation for multimodal transport development is also the effort to profile respondents' companies as socially responsible companies. The respondents see production of CO<sub>2</sub> emissions and sector's regulations to promote multimodal transport to be of less importance.

## 2.5 Most important arguments when LSPs promoting multimodal transports

LSPs when promoting multimodal transports in their business offers use most often the following arguments: transport costs decrease (average grade 5.0), transit time reduction (average grade 5.0), supporting CSR strategy (average grade 4.5), CO<sub>2</sub> emissions lowering (average grade 4.0), bigger transport safety (average grade 3.0).

In the following Table 2 there is done comparison of the most important factors for motivation to use more of multimodal transport from the point of view of chemical industry companies and LSPs.

**Tab. 2: Comparison of criterion importance for shifting the transport to multimodal transport (arithmetic averages and medians)**

Respondents	Companies of chemical industry sector		LSPs	
	Average	Median	Average	Median
Criterion				
Costs	4.750	5.000	5.000	5.000
Transit time	3.875	4.000	5.000	5.000
Availability of means of transport	3.875	4.000	--- ---	--- ---
CSR strategy	3.250	3.500	4.500	4.500
Lowering CO <sub>2</sub> emission	3.000	3.000	4.000	4.000
Sector's regulations	2.375	2.500	--- ---	--- ---
Safety	--- ---	--- ---	3.000	3.000

Source: authors

It issues from Table 2 that chemical industry companies and LSPs see the individual criterions for the selection of transport mode in a similar way. Arguments provided by LSPs for selection of multimodal transport are in agreement with those criterions that are important for chemical industry companies. Both groups of respondents see as the most important the issue of transport costs (the average for chemical industry companies is 4.750 and for LSPs it is 5.000) and the issue of transit time (the average for chemical industry companies is 3.875 and for LSPs it is 5.000). Chemical industry companies, on top of this, point out the issue of availability of transport means for transport of chemical goods with use of multimodal transport (the average value is 3.875). LSPs also present multimodal transport as a logistics solution that contributes to increase chemical goods transportation safety. This safety criterion used as a motivation to use more of multimodal transport is seen as less important by the chemical industry companies.



## Conclusion

The objective of this paper was to map the motivation of the selected chemical industry companies for shifting transport to multimodal transport. Ten important companies operating their business activities in the Czech Republic participated in this research. All of the production companies are members of the Association of Chemical Industry of the Czech Republic. They are significant chemical goods producers. Also LSPs that provide logistic services to chemical industry companies participated in this research. Companies have significant motivation for higher utilization of multimodal transport. The main reasons for this are increased volumes of sales and expansion to new markets. Customers' demands on products transport also gradually change. Reasons for utilization of other transport modes are continuing problems in road transport. Participating companies see significant potential in increased utilization of multimodal transport in the area of continental transports. Such increased utilization would contribute to significant improvement of transport situation in Europe and to mitigation of negative impacts of transport on the environment and on public health. For further development of multimodal transport it is essential to focus on transport costs, transit times and on availability of transport means.

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## References

- Cichosz, M. (2017). Collaborating on green logistics in chemical supply chains: insights from Poland. *Business logistics in modern management*, 507-522.
- Cichosz, M., Nowicka, K., & Pluta-Zaremba, A. (2017a). Determinants of choice of multimodal transport in chemical industry in Poland. *Przemysl chemiczny*, 96(7), 1435-1439.
- Cichosz, M., Nowicka, K., & Pluta-Zaremba, A. (2017b). Challenges to multimodal transport in the Polish chemical industry. *Przemysl chemiczny*, 96(1), 26-31.
- Economic Commission for Europe. (2001). *Terminology on combined transport*. [ONLINE] Available at: <http://www.unece.org/fileadmin/DAM/trans/wp24/documents/term.pdf>. [Accessed 1 January 18].

- Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., Savolainen, J., Schlömer, S., Von Stechow, C., Zwickel, T., & Minx, J. C. (2014). *Climate Change 2014: Mitigation of Climate Change*. Cambridge University Press.
- Hyršlová, J., Vnoučková, L., & Tomšík, P. (2015). Concept of sustainable development and competitiveness of enterprises in chemical industry. *Chemické listy*, 109(4), 319-326.
- Kos, S., Vukić, L., & Brčić, D. (2017). Comparison of external costs in multimodal container transport chain. *Promet-Traffic & Transportation*, 29(2), 243-252.
- Mikulčić, H., Duić, N., & Dewil, R. (2017). Environmental management as a pillar for sustainable development. *Journal of Environmental Management*, 203, 867-871.
- Naganathan, H., & Chong, W. K. (2017). Evaluation of state sustainable transportation performances (SSTP) using sustainable indicators. *Sustainable Cities and Society*, 35, 799-815.
- The European Chemical Industry Council (CEFIC). (2007). *Safe and Sustainable Transport in the European Chemical Industry*. [ONLINE] Available at: <http://www.cefic.org/Documents/IndustrySupport/Transport-and-Logistics/safe%20and%20sustainable%20transport%20in%20the%20european%20chemical%20industry.pdf>. [Accessed 2 January 18].
- Walton, W., & Farrington, J. (2000). The Sustainable Transport Study for Aberdeen: a pioneering attempt at a 'multimodal study'. *Environment and planning c-government and policy*, 18(5), 609-627.
- World Commission on Environment and Development (1987). *From one Earth to one World: an overview*. United Kingdom.
- Zawieska, J., & Pieriegud, J. (2018). Smart city as a tool for sustainable mobility and transport decarbonisation. *Transport Policy*, 63, 39-50.

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