OVERVIEW OF THE COMBINED TRANSPORT MARKET IN THE BSR

Output 2.1

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1 INTRODUCTION

The main objective of the COMBINE project is to enhance the share of Combined Transport (CT) in the Baltic Sea Region (BSR) in order to make transport more efficient and more environmentally friendly. To achieve this objective, the first step is getting a better understanding the CT chain itself, the players involved in it as well as the technologies used for handling cargo. Hence, Output 2.1 describes the CT market in the Baltic the Sea Region.

Taking into account the special framework conditions for CT in the BSR, the present report will first suggest a definition of Combined Transport adapted to the special requirements in the Baltic Sea Region. The main part of Output 2.1 is an analysis of the cargo flows within the BSR and beyond. The basis of this analysis are publically available data provided by Eurostat on the one hand as well as information provided by the industry associations (UIC / UIRR) on the other hand. In order to present the cargo flow analysis in an appealing way, an interactive visualization of transported goods will be available on the COMBINE website.

Output 2.1 is concluded by introducing loading units and (innovative) handling technologies used in CT.

Freight transport is an essential part of the modern economy as it ensures the availability of products outside their place of production, and also the sourcing of components from the most efficient location. Without transport, today's economy and Western living standards would be inconceivable. The optimisation of this physical movement of goods is essential, not only in terms of productivity but also, increasingly, in terms of environmental sustainability. Throughout Europe, main corridors and agglomerations are regarded as "hot spots" of transport. Since years, capacity problems and environmental impacts are at the forefront of transport policy discussions. Infrastructure bottlenecks are seen as obstacles to the free movement of people and goods.

The following subchapters will describe (1) the Combined Transport Chain and its main stakeholders and (2) the different used definitions for the terms ‘Combined Transport’, ‘Intermodal Loading Unit’ and ‘Terminals’.

1.1 The Combined Transport Chain and stakeholders

Initially, in a Combined Transport Chain, an intermodal loading unit is transported by a forwarding agent or carrier by truck to a terminal. It is then transferred to another mode of transport, rail or inland waterway, for the leg to the next transhipment node. At destination, the loading unit is transshipped to a truck for the final leg to the ultimate destination (see Figure 1 for CT chain visualization with transfers between transport modes and relevant stakeholders).

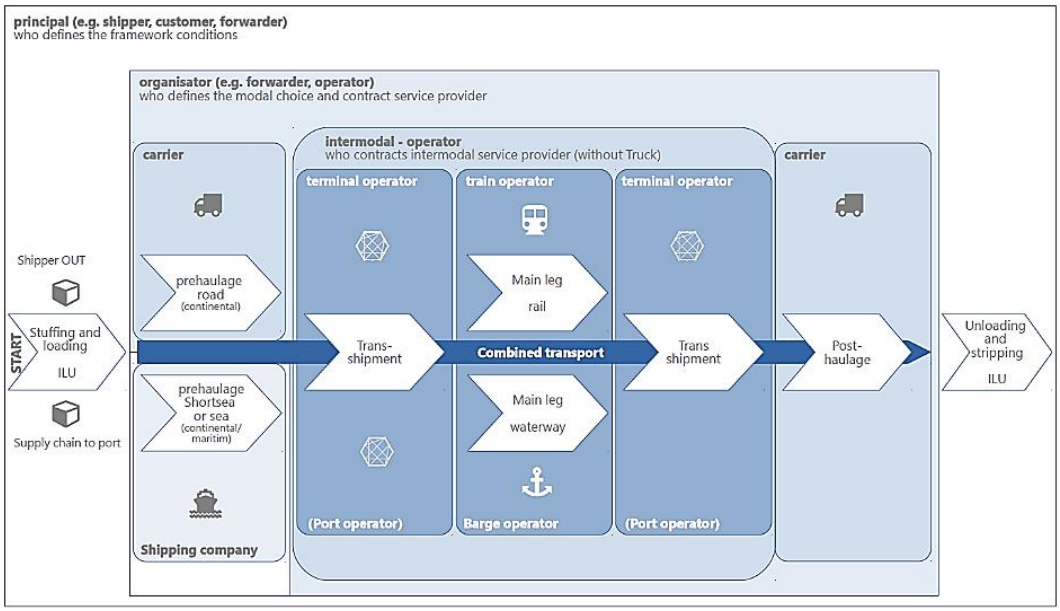


Figure 1 - CT chain and the main stakeholders (own presentation based on Eiband, (2014))

The CT chain involves operational stakeholders (a person or legal entity involved in the management of the supply chain:

- **Principal (known also as consignor/shipper and consignee):** The consignor is the entity who puts goods in the care of others (forwarder or carrier) for delivery to the consignee. The consignor can also use his own means of transport but in most cases an intermediary such as a forwarding agent or directly via an intermodal operator organises the entire transport chain for the consignor. The consignee is the entity who is entitled to take delivery of the good according to contractual arrangements
- **Forwarder (forwarding agent):** it is the entity who, as an agent of the consignor, organizes and/or provides related services for the transport of goods. Such service providers handle the shipment of goods by carriers or by sea-going carriers for the account of another (consignor) in their own name.
- **Carrier:** The carrier is the entity who is responsible for the transport of the goods (road, rail, waterway, air, sea) and who either carries them out himself or has them carried out by others.
- **Intermodal / CT Operator:** it is the entity who concludes a multimodal freight contract and is responsible for its performance as a carrier (also called combined transport operator or combi-operator). It acts as the intermediary between modes.
- **Terminal Operator**: it is the entity who transfer the loading units from one mode to another. Terminals are operated by infrastructure managers, railway undertakings or their subsidiaries as well as by private companies.
- **Shipping Companies**: shipping companies are commercial ship transport companies that professionally organise and implement the transport of goods using their own vessels or those from other companies.
- **Wagon Providers**: entities which own, purchase and/or rent/lease wagons to any interested railway stakeholder

- **Infrastructure Managers**: these entities are responsible for developing and maintaining the infrastructure (for example railway infrastructure managers responsible for the rail).

1.2 The definitions

Intermodal transport has evolved through the convergence of different "transport worlds" – some of which have been ideologically separated for a long time. These worlds have developed their own jargon, and this makes communication between them more difficult. A crucial condition for the acceptance and success of intermodal transport is that communication is as smooth as possible since system-based cooperation is required. The aim of this chapter is an attempt to harmonise the different jargons so as to ensure complete understanding of intermodal within the context of COMBINE. Properly defining and adopting terms is essential to the success of the project itself. The research activities on terminology have been focused on three terms: (1) Combined/Intermodal Transport, (2) Intermodal Loading Unit and (3) Terminal and cover for each term an analysis of regulatory framework (EU Directives), official glossary and best practices from industry associations.

1.2.1 Combined/Intermodal Transport

In Europe, different EU Directives integrate an official definition of Combined Transport or Intermodal Transport: (1) Directive 92/106 on the establishment of common rules for certain types of combined transport of goods between Member States, and (2) Directive 719/2015 laying down for certain road vehicles circulating within the Community the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic.

- Directive 92/106

For the purposes of this Directive, *'combined transport' means the transport of goods between Member States where the lorry, trailer, semi-trailer, with or without tractor unit, swap body or container of 20 feet or more uses the road on the initial or final leg of the journey and, on the other leg, rail or inland waterway or maritime services where this section exceeds 100 km airline and make the initial or final road transport leg of the journey;*

- *between the point where the goods are loaded and the nearest suitable rail loading station for the initial leg, and between the nearest suitable rail unloading station and the point where the goods are unloaded for the final leg, or*
- *within a radius not exceeding 150 km as the crow flies from the inland waterway port or seaport of loading or unloading.*

On November 2017, the College of Commissioners adopted a proposal of the Commission to revise Directive 92/106 concerning Combined Transport. Some core articles have been edited such as article 1 on definition and new articles have been drafted. The new article 1 has been amended as follows:

For the purposes of this Directive, 'combined transport' means carriage of goods by a transport operation, consisting of an initial or final road leg of the journey, or both, as well as a non-road leg of the journey using rail, inland waterway or maritime transport:

(a) in a trailer or semi-trailer, with or without a tractor unit, swap body or container, identified in accordance with the identification regime established pursuant to international

standards ISO6346 and EN13044, where the load unit is transshipped between the different modes of transport; or

(b) by a road vehicle that is carried by rail, inland waterways or maritime transport for the non-road leg of the journey.

Non-road legs using inland waterway or maritime transport for which there is no equivalent road transport alternative or which are unavoidable in a commercially viable transport operation, shall not be taken into consideration for the purposes of the combined transport operations.

3. Each road leg referred to in paragraph 2 shall not exceed the longest of the following distances in the territory of the Union:

(a) 150 km in distance as the crow flies;

(b) 20% of the distance as the crow flies between the loading point for the initial leg and the unloading point for the final leg, when it amounts to more than the distance referred to in point (a).

That road leg distance limit shall apply to the total length of each road leg, including all intermediary pick-ups and deliveries. It shall not apply to the transport of an empty load unit or to the pick-up point of the goods or from the delivery point of the goods.

The road leg distance limit may be exceeded for combined road/rail transport operations, when authorised by the Member State or Member States on whose territory the road leg takes place, in order to reach the geographically nearest transport terminal which has the necessary operational transhipment capability for loading or unloading in terms of transhipment equipment, terminal capacity and appropriate rail freight services.

The new article contains an extension of scope (domestic and cross-border), all forms of Combined Transport, all types of loading units, mandatory identification, clear definition of the road-legs and a special clause in case for road-rail combined transport.

In the annex 1, a table has been created to compare the various positions on Article 1 of the Commission (old and new proposal), the EU Parliament and the EU Council. An assessment by UIRR, as industry association of the CT sector, is also included.

In December 2019, the new Commission, under the supervision of the new President of the European Commission, Mrs. von der Leyen, has released the so-called 'European Green Deal'[1] which aim to improve the well-being of the people by making Europe climate-neutral and protecting the European natural habitat. The related roadmap[2] contains an action regarding a revised proposal for a Directive on Combined Transport to be released in 2021. By the adoption of this action, the current proposal of the Commission is no longer a topical issue.

- Directive 719/2015

For the purpose of this Directive, *"intermodal transport operation" shall mean:*

[1] More information on the Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[2] See https://ec.europa.eu/info/sites/info/files/european-green-deal-communication-annex-roadmap_en.pdf

(a) the combined transport operations defined in Article 1 of Council Directive 92/106/EEC engaged in the transport of one or more containers or swap bodies, up to a total maximum length of 45 feet; or

(b) transport operations engaged in the transport of one or more containers or swap bodies, up to a total maximum length of 45 feet, using waterborne transport, provided that the length of the initial or the final road leg does not exceed 150 km in the territory of the Union. The distance of 150 km referred to above may be exceeded in order to reach the nearest suitable transport terminal for the envisaged service in the case of:

(i) vehicles complying with point 2.2.2(a) or (b) of Annex I; or

(ii) vehicles complying with point 2.2.2(c) or (d) of Annex I, in cases where such distances are permitted in the relevant Member State.

For intermodal transport operations, the nearest suitable transport terminal providing a service may be located in a Member State other than the Member State in which the shipment was loaded or unloaded.

Definitions on Combined Transport has been also collected from official glossaries such as the UNECE Terminology on Combined Transport, EUROSTAT or terminology catalogue developed by Industry Assocation (Europe or worldwide).

Terminology on Combined Transport[3] - In 2001, the United Nations Economic Commission for Europe (UNECE), the European Conference of Ministers of Transport (ECMT) and the European Commission (EC) published a catalogue of the principal terms used in combined transport or related to it.

- Intermodal Transport is defined as *the movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes" w*hereas
- Combined Transport is *an intermodal transport where the major part of the European journey is by rail, inland waterway or sea and any initial and/or final legs carried out by road are as short as possible".*

Glossary for transport statistics — 5th edition — 2019[4] - The Glossary comprises 744 definitions and represents a point of reference for all those involved in transport statistics. In this edition, the rail, road, inland waterways, maritime, air and intermodal freight transport chapters have been substantially revised. The intermodal definitions in each transport mode were removed from all chapters and inserted into the updated Intermodal Freight Transport chapter.

- Multimodal freight transport is a transport of goods by at least two different modes of transport whereas
- Intermodal Freight Transport' is a '*multimodal transport of goods, in one and the same intermodal transport unit by successive modes of transport without handling of the goods themselves when changing modes'.*
- Combined Transport: no specific definition

[3] https://www.unece.org/index.php?id=26168
[4] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-19-004

IANA – Intermodal Glossary – 2017[5] - IANA is the industry trade association representing the combined interests of the intermodal freight industry. IANA promotes the growth of efficient intermodal freight transportation through innovation, education and dialogue. In 2017, IANA published an intermodal glossary

- Intermodal transport: *the movement of freight, in a container or on a trailer, by more than one mode of transportation. The movement can be made from rail to truck to ship in any order.*
- Combined Transport: no specific definition

1.2.2 Intermodal Loading/Transport Unit

In the EU legal framework ((see chapter 1.2.1), the terms 'intermodal loading unit' (ILU)- or 'intermodal transport unit' (ITU) are not as such defined but only an identification of the types of units: semi-trailer, trailer, swap body, container, road vehicle. The Commission proposed a Directive on intermodal loading units in 2003 which was at the end revoked. In this former proposal, "intermodal loading unit" means either a container or a swap body.

In contrast, official glossaries (UNECE, EUROSTAT), industry standards (CEN) and European projects (COSMOS) have compiled a complete set of definitions related to the equipment transported in combined transport:

UNECE glossary -2001

- Loading unit: *Container or swap body*
- Intermodal Transport Unit: *Containers, swap bodies and semi-trailers suitable for intermodal transport*

Glossary for transport statistics — 5th edition — 2019

- Loading unit: *container or swap body*
- Intermodal Transport Unit: *container, swap body or semi-trailer/goods road motor vehicle suitable for intermodal transport*

EN 13044 – Intermodal Loading Units - Marking - Part 1: Markings for identification– 2017

- Intermodal Loading Unit (ILU): *loading unit suitable for European intermodal transport on road, rail, inland waterway and sea, which is not an ISO-container according to ISO 830 (among others swap body, semi-trailer).*

COSMOS – Marco Polo project - 2014

- Intermodal Loading Unit (ILU): *ISO Container (freight container, according to ISO 668, 1161), standardized inland container (e.g. bulk, silo, tank), swap body (according DIN-EN 284, 452) and semi-trailer*

[5] https://intermodal.org/sites/default/files/documents/2017-10/Glossary_0.pdf

1.2.3 Terminal

The term 'terminal' is used in Combined Transport operations but might cover a lot of different notions and concepts that are not similar such as hub, freight terminals, intermodal terminal, freight hubs, logistic centres, freight villages…

The notion of terminal has been recently inserted in European legislative environment: (1) Directive 2012/34, (2) Implementing Regulation 2017/2177, (3) Rail Freight Corridor Regulation, (4) TEN-T Regulation. Besides official legal texts, glossaries and standards have also created definitions related to the handling of intermodal loading units (UNECE, IANA, EUROSTAT). Table 1 displays all relevant identified definitions related to the terminal.

Table 1: Definitions of Terminals

Notion	Source	Definition
Terminal	UN/ECE terminology	A place equipped for the transshipment and storage of ITUs
Freight Terminal	Directive 2012/34	Listed without definition
(Freight) terminal	Implementing Regulation 2017/2177	Mentioned without definition
Freight Terminals in 4 subcategories - Intermodal Terminals - Multifunctional rail terminals - Public sidings - Private sidings	EU Study on European portal for all rail service facilities (related to Regulation 2017/2177)	'Intermodal terminal' means an installation for transshipment of standardized loading units (containers, swap bodies, semi-trailers) with at least one of the modes served must be rail or inland waterway
Terminal Intermodal Freight Terminal	Rail Freight Corridor Regulation 913/2010	'terminal' means the installation provided along the freight corridor which has been specially arranged to allow either the loading and/or the unloading of goods onto/from freight trains, and the integration of rail freight services with road, maritime, river and air services, and either the forming or modification of the composition of freight trains; and, where necessary, performing border procedures at borders with European third countries
Terminals Freight Terminal	Regulation 1315/2013: TEN-T Guidelines	'freight terminal' means a structure equipped for transhipment between at least two transport modes or between two different rail systems, and for temporary storage of freight, such as ports, inland ports, airports and rail-road terminals
Intermodal Transport Terminal	EUROSTAT Transport Statistics (glossary)	A structure equipped for the transhipment and storage of intermodal transport units (ITUs) between at least two transport modes or between two different rail

		systems, and for temporary storage of freight, such as ports, inland ports, airports and rail-road terminals.
Intermodal terminal	IANA Intermodal Glossary	A facility designed for the loading and unloading of containers and trailers to and from flatcars for movement on the railroad and subsequent movement on the street, sea or highway

1.2.4 Selection and recommendations for BSR definition

For the purpose of the project, the COMBINE consortium partners have selected the following definitions:

- **Multimodal transport/intermodal transport/Combined Transport**: the current definition of the UNECE glossary without modifications (see Figure 2)
- **Intermodal Loading Units (ILUs):** containers, swap bodies and semi-trailers suitable for combined transport. This is a mix of current definitions on intermodal transport units and intermodal loading units. Road vehicles are considered, in the context of COMBIE, as ILUs as well.
- **Intermodal Terminal**: an installation for transshipment of standardized loading units (containers, swap bodies, semi-trailers) with at least one of the modes served must be rail or inland waterway

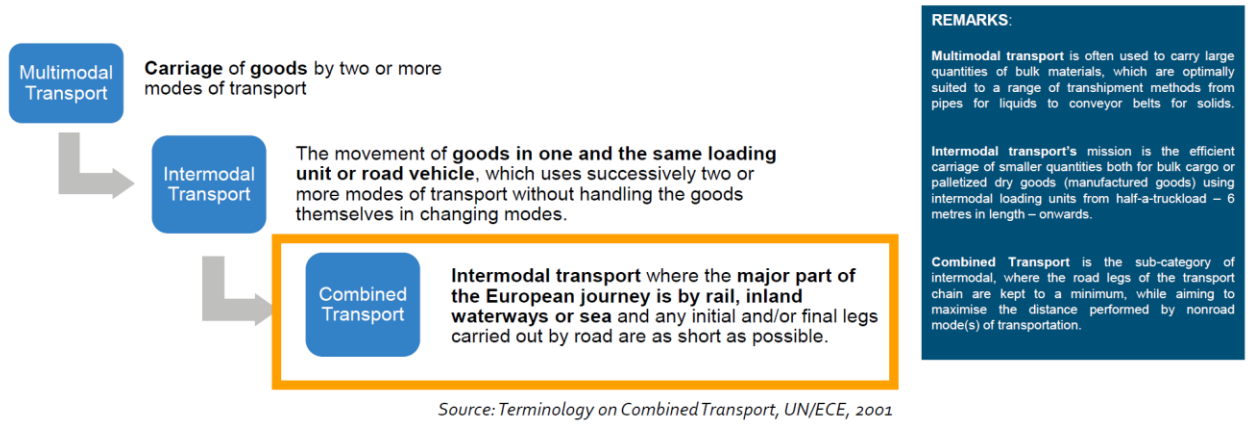


Figure 2 - COMBINE definition for Combined Transport

For a specific BSR definition, it is recommended to promote a coherent and harmonised definition on Combined Transport at European level (through the revision process that will be soon started by the Commission). This definition should consider the following elements:

- The type of legislation: Directive or Regulation
- Combined Transport and/or Intermodal Transport
- The exact scope (cross border, domestic)
- All forms of Combined Transport should be included.
- For CT, all types of loading units should be integrated including the minimum size.
- The notion of 'nearest suitable terminal' should be further explicated.

- Determine the distance for the road legs with various cases (hinterland maritime, continental)
- Special clause for road-rail transport when exceeding distances
- Temporary measures
- Special clause for terminals
- Environmental sustainability / greening aspects (use of alternative fuels for road legs and non-road legs)

2 CARGO FLOW ANALYSIS

Transport in the Baltic Sea Region is predominantly organized on road for a number of reasons: the region is to a large extent rurally coined with a correspondingly low population density, meaning that the last mile is longer than in other European regions. Although a number of large ports located in urban centers can be found along the coast line of the Baltic Sea, Hinterland traffic is mainly organized in trucks and semi-trailers. In addition, the overall transport volume in the BSR is comparatively low, spatially scattered with a long last mile as well as heavily relying on road transport, which has long tradition in the region and is accordingly well established – also in a socio-economic sense. All these factors pose several challenges to making Combined Transport more competitive and increasing the volumes that are transported via different modes.

In order to address these challenges and attempting to shift the modal split in BSR countries towards rail and inland waterway (as well as short-sea shipping), the first step is an assessment of the cargo flows within the BSR as well as transports to and from major European trade partners located outside the region.

2.1 Methodology

One of the main objectives when analyzing the cargo flows of the Baltic Sea Region was to find information that is both as detailed and representative as possible. To fulfill this objective, the first step was evaluating 20 different publically available sources / data sets (e.g. EUROSTAT) featuring detailed information on data availability, content relevance for the cargo flow analysis as well as the currentness of data.

Although not all of the information required for the cargo flow analysis is available, particularly in case of Combined Transport, the EUROSTAT database was found to be the most eligible source nonetheless – the advantage being that EUROSTAT features recent information on multiple countries and all transport modes vital for the assessment. However, information on the type of cargo is unfortunately only available for maritime transport; information on specific cargo groups (Standard goods classification for transport statistics - NST) only for transports on barges, i.e. inland waterway.

For the reason outlined above and as shown in Figure 3, the collection of data has been conducted according to the lowest common denominator.

Source	Relation (O-D)	Mode available	details by group of goods (NST 2007) ...
Eurostat	yes	road	NST - only for cross-trade road freight
		rail	no
		inland waterways	NST
		maritime waterways	type of cargo

Figure 3: Methodological Approach to Data Collection

Before analyzing (and visualizing) the information available on EUROSTAT according to the lowest common denominator, the data sets had to be harmonized and prepared accordingly. The output of this exercise are four separate data files, each featuring on mode of transport. In addition, one file combining all four transport modes with more than one million data points was created, safeguarding the highest possible representativity mentioned in the beginning of this chapter.

2.2 Visualization and Description of Cargo Flows in the BSR

2.2.1 Official Data Sources (EUROSTAT)

In order to present the collected data in an informative as well as visually appealing way, an interactive tool has been developed for the COMBINE project. Based on the publically available Eurostat data, the tool allows its user to select:

- Import or Export
- Mode of Transport (rail, road, inland and maritime waterway)
- A specific country located in the Baltic Sea Region / several countries in the BSR as well as the entire Baltic Sea Region

Figure 4: COMBINE Visualization Tool, Selection Options (SGKV, 2019)

When these parameters have been selected, additional statistics, e.g. on the development of cargo flows (2007 – 2018), as well as the top O-D[6]-relations of the selected country can be displayed. Figure 5 illustrates the tool when the parameters mentioned above, i.e. Im- or Export, Mode of Transport and country, have been selected. On the following pages the tool and its functions will be broadly described using the example of Germany and other selected BSR countries.

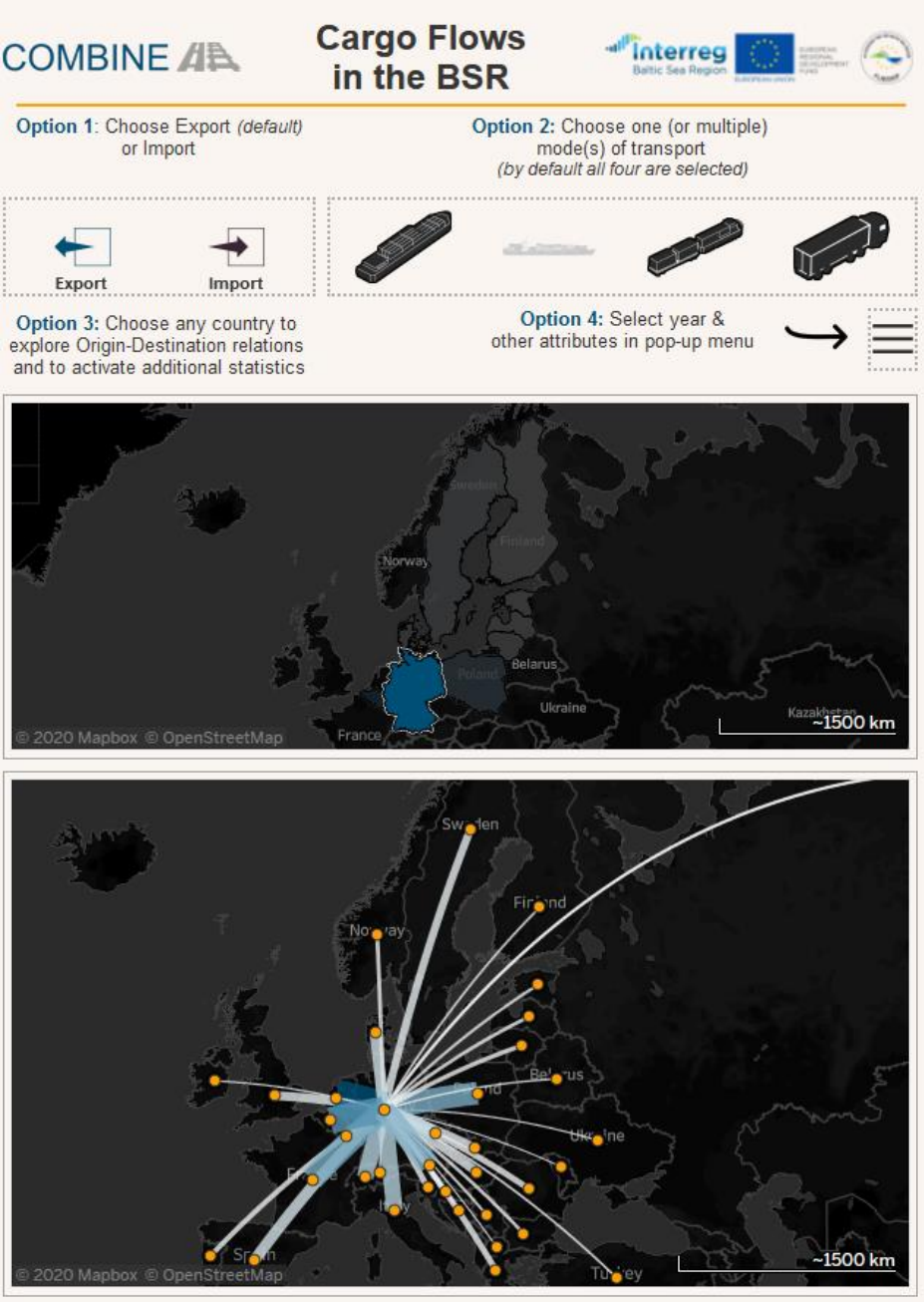


Figure 5: Cargo Flow Visualization, Export Germany 2018 (SGKV, 2019)

[6] O-D: Origin - Destination

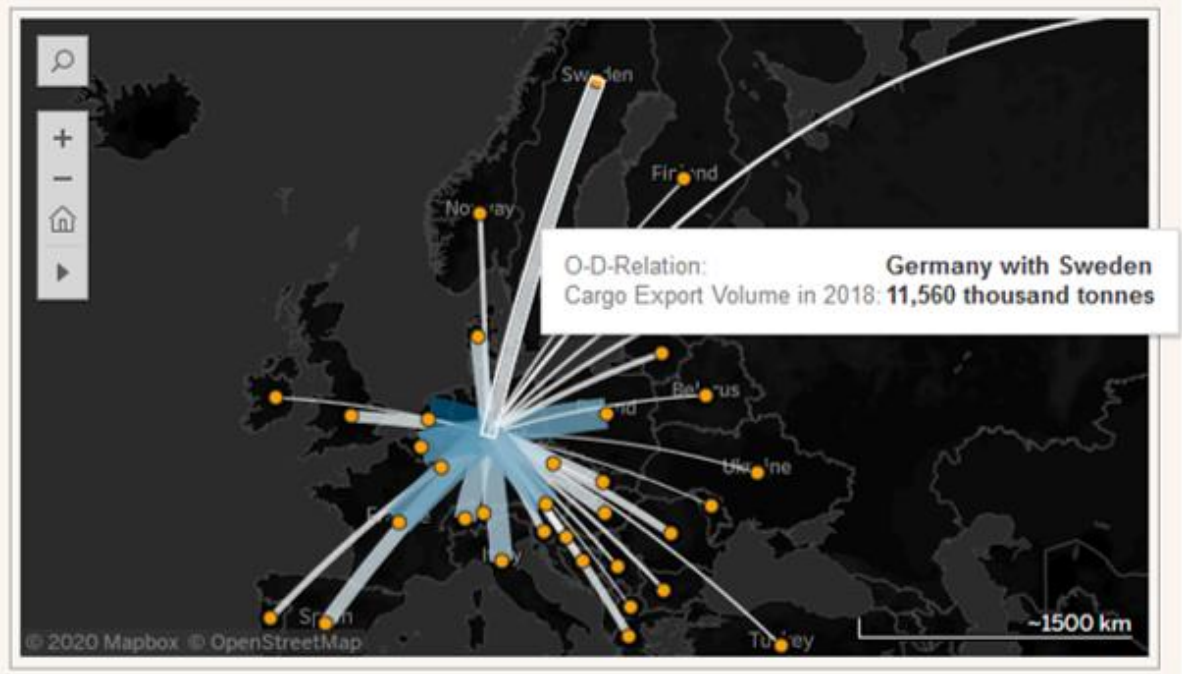


Figure 6: Cargo Flow Visualization, Export Germany to Sweden 2018 (O-D-Relation) (SGKV, 2019)

Figure 6 illustrates the exports from Germany to the countries in the Baltic Sea Region that are considered in the COMBINE project. The thicker the bar, the higher the volumes (in thousand tonnes – kt) that are being exported. When the cursor is moved over a specific connection, a pop-up window appears showing the exact volume of cargo that has been exported in 2018. In this case, 11,560 kt of cargo have been exported from Germany to Sweden – the modes of transport being rail, road as well as inland waterway.

Breaking the total amount of 11,560 kt down to the individual modes of transport reveals that the majority of the goods is transported on roads, namely 8,826 kt – compared to 2,691 kt on rail and 43 kt via inland waterway from Germany to Sweden in 2018.

With respect to the statistics on inland waterway transport it has to be noted that according to EUROSTAT "Inland waterway transport statistics provides information on the volume and performance of freight transport on EU inland waterway network. They are reported on the basis of the 'territoriality principle' which means that each country reports the loading, unloading and movements of goods that take place on its national territory, irrespective of country of origins of undertakings or place of first loading and final unloading."

Since inland waterways connections, i.e. rivers, are not existent between Germany and Sweden, this means for the connection at hand that the data on inland waterway transport are allocated to maritime transport. According to the German Federal Bureau of Statistics[7], prior to 2019 a different methodology has been used in which inland waterway as well as maritime transports have been declared separately, even if sea vessels are used for the connection between Germany and Sweden. For this reason, the

[7] Call on 17 January 2020

visualization and the EUROSTAT data it is based on, connections crossing the Baltic Sea are sometimes shown as inland waterway transports.

With 24,552 kt in 2018, maritime waterway is, however, the most important mode of transport between Germany and Sweden. A closer look at the type of cargo that is moved between Germany and Sweden reveals that with almost 40% of the overall maritime shipping volumes are realized in mobile self-propelled RoRo units (figure 7).

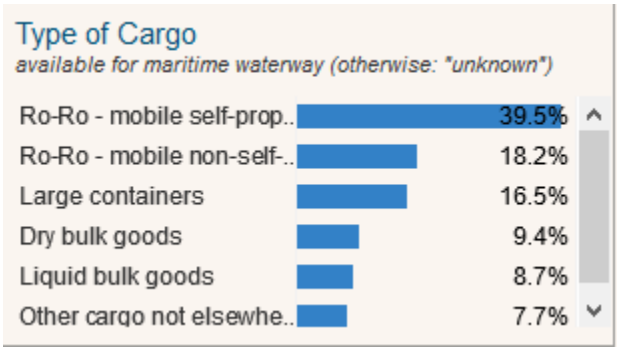


Figure 7: Export Germany - Sweden in 2018, Type of Cargo in Maritime Shipping (SGKV, 2019)

Short-Sea-Shipping, a particular interesting and widely practiced option of transporting cargo in the BSR, is included in the volumes of overall maritime transport. According to Eurostat[8], the prominence of short-sea-shipping of goods over deep sea shipping (intercontinental transport) was particularly pronounced in Finland, Sweden, Latvia, Estonia, Poland and Lithuania in 2017.

Table 2: Short Sea Shipping of freight by type of cargo in Mio. t, 2017 (Eurostat, 2019)

	Liquid Bulk	Dry bulk	Contai-ners	Ro-Ro units	Other cargo	Total
EU-28	823.0	384.5	271.0	253.4	132.8	1 864.6
Belgium	47.2	19.6	37.3	18.5	7.9	130.5
Bulgaria	12.0	8.2	2.4	0.2	2.7	25.5
Denmark	20.5	20.6	4.7	23.1	4.2	73.0
Germany	39.8	41.7	47.0	33.9	13.0	175.4
Estonia	9.9	3.6	2.0	5.1	3.6	24.0
Ireland	10.4	8.9	7.2	15.5	0.8	42.9
Greece	44.3	17.0	25.9	14.4	2.3	103.9
Spain	75.9	34.9	49.3	13.7	19.9	193.8
France	91.0	34.2	11.6	33.1	5.7	175.6
Croatia	10.3	2.0	1.2	0.1	0.7	14.4
Italy	138.1	39.1	47.3	51.3	13.7	289.5
Cyprus	2.2	2.1	2.2	0.2	0.3	7.0
Latvia	12.4	24.6	3.8	1.7	3.3	45.8
Lithuania	18.3	7.8	4.7	2.9	1.5	35.2
Malta	1.7	0.7	0.7	0.6	0.1	3.7
Netherlands	158.4	51.7	39.4	19.3	23.0	291.7
Poland	18.2	12.1	12.0	8.9	3.9	55.2
Portugal	21.2	9.1	14.6	1.2	3.4	49.4
Romania	12.0	15.3	3.4	0.2	2.6	33.5
Slovenia	3.2	2.2	4.6	0.9	0.6	11.4
Finland	32.6	21.4	11.3	18.7	12.2	96.2
Sweden	53.0	25.9	10.8	47.6	17.6	154.9
United Kingdom	115.6	60.8	29.7	94.3	15.8	316.2
Norway	71.1	59.5	5.9	3.5	8.8	148.7
Turkey	97.3	104.2	78.1	8.6	14.4	302.7

[8]https://ec.europa.eu/eurostat/statistics-explained/index.php/Maritime_transport_statistics_-_short_sea_shipping_of_goods#Short_sea_shipping_by_sea_region_and_country

Table 2 shows the volumes (in m t) of short sea shipping by type of cargo in 2017, liquid and dry bulk hereby represent the dominant types of cargo. In this context it is noteworthy that Ro-Ro units accounted for approximately 14% (253 m t) of the total short sea shipping goods.

A particularly interesting feature of the COMBINE visualization tool is the development of cargo volume by modes of transport from 2007 – 2018.

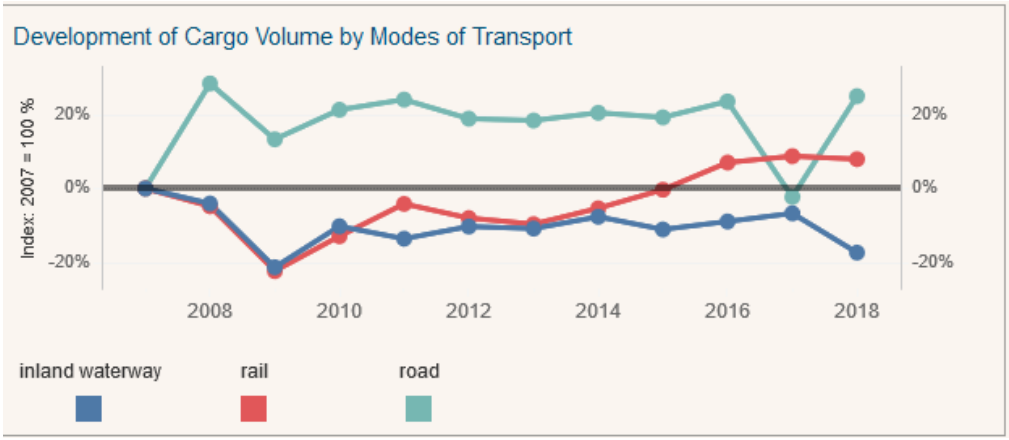


Figure 8: Development of Cargo Flow Volume by Modes of Transport (road, rail, inland waterway) Germany Export 2007 - 2018 (SGKV, 2019)

As depicted in Figure 9 below, by moving the cursor over the graph a pop-up window appears showing additional information for a specific year and mode of transport. In this case, the volumes exported by rail increased by 7.94% compared to 2007 and decreased by 0.75 % compared to the previous year, respectively. With respect to the progression of the curves in Figure 8 and 9, two things are apparent: One the one hand, the overall high volumes transported on road as well as the clear decrease in volumes across all transport modes starting in 2008. While the high volumes in road transport emphasize the importance of trucks and semi-trailer for the overall transport system in the BSR and beyond, the clear dent in the curve progressions resemble the world financial crises (2007/08) as well as the European debt crises (2007) – both events having a clear negative impact on the cargo volumes transported within and outside the Baltic Sea Region. As depicted in Figure 8 and 9, it took approximately six years until the cargo volumes reach the development prior to the crises.

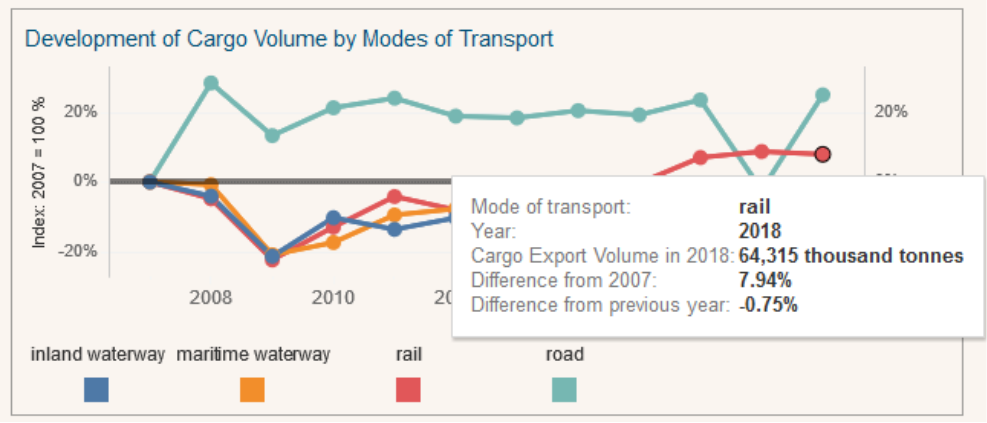


Figure 9: Development of Cargo Flow Volume by Modes of Transport, Germany 2007 – 2018, (SGKV, 2019)

Additionally and as shown in Figure 10, the tool also features a list of the top O-D-Relations as well as information on the type of cargo. This information is, however, only available only for maritime transport in the Eurostat database and therefore in the COMBINE visualization tool.

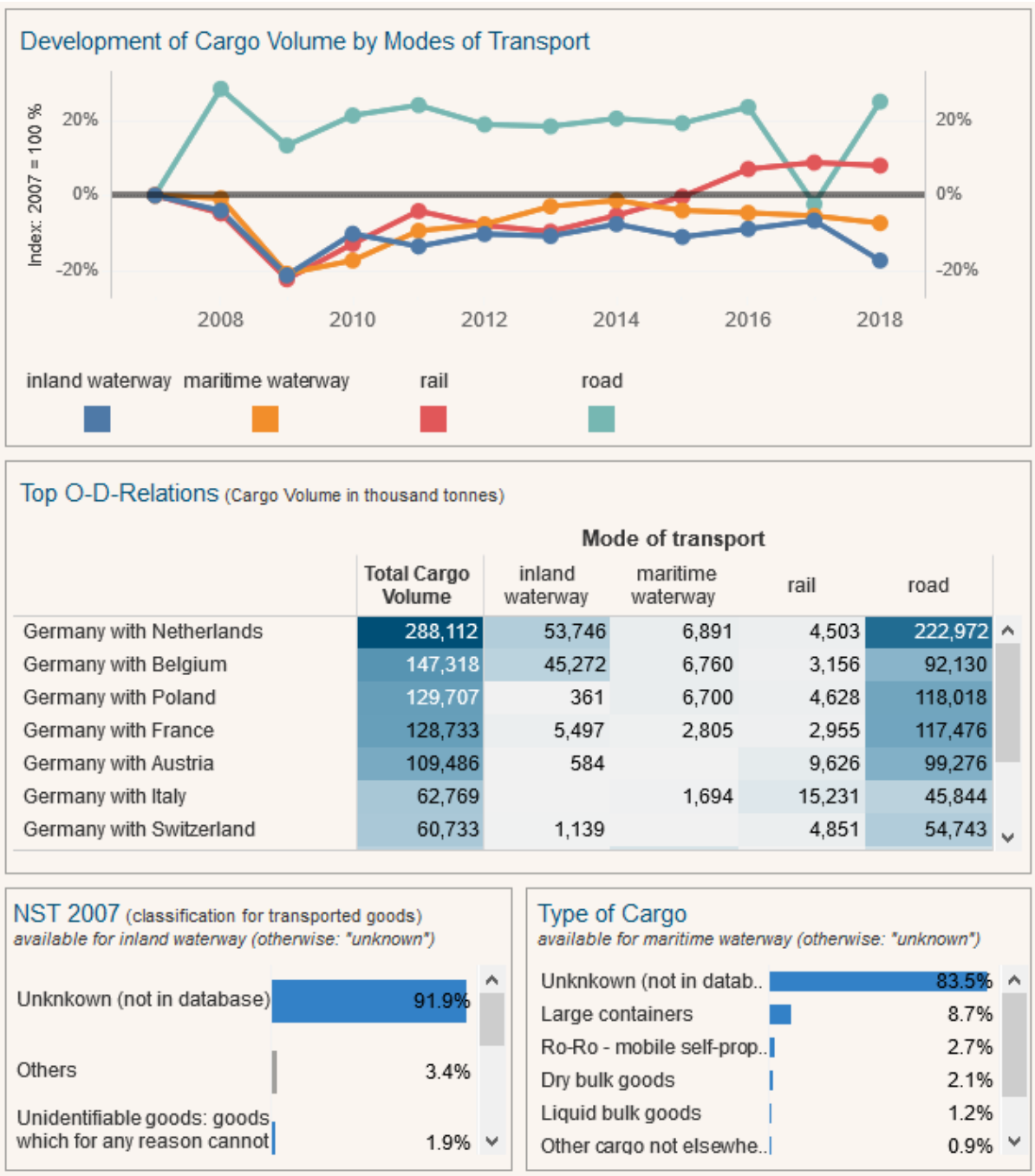


Figure 10: Top O-D-Relations Germany, Export 2018 (SGKV, 2019)

Since Germany might not be the most representative country for the Baltic Sea Region in terms of export volumes, the following figures (11 – 13) illustrate the cargo volumes of a selection of BSR countries.

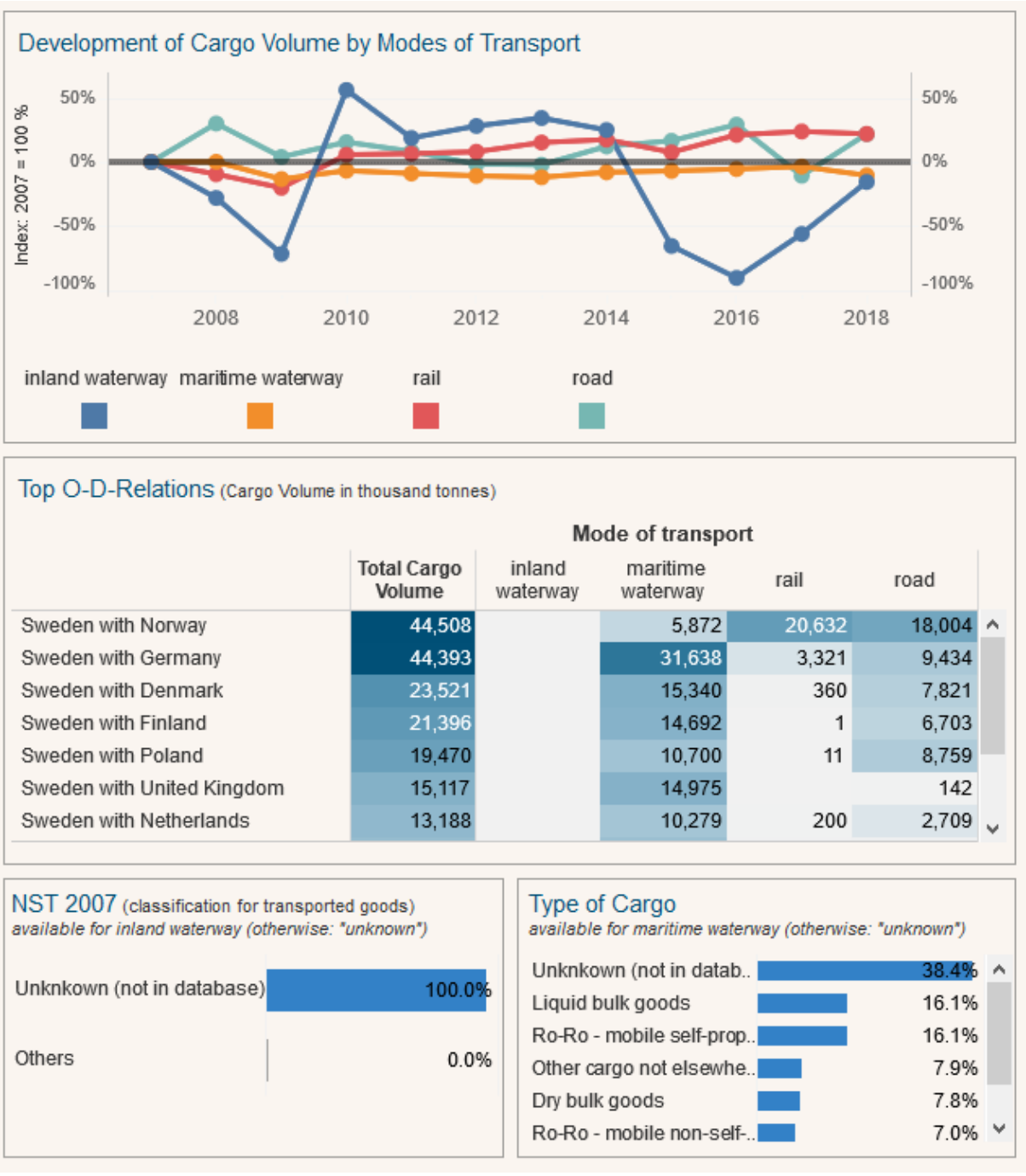


Figure 11: Development of Cargo Volume by Mode of Transport Sweden, Export (2007 – 2018), Top-O-D-Relations, Type of Cargo (SGKV, 2019)

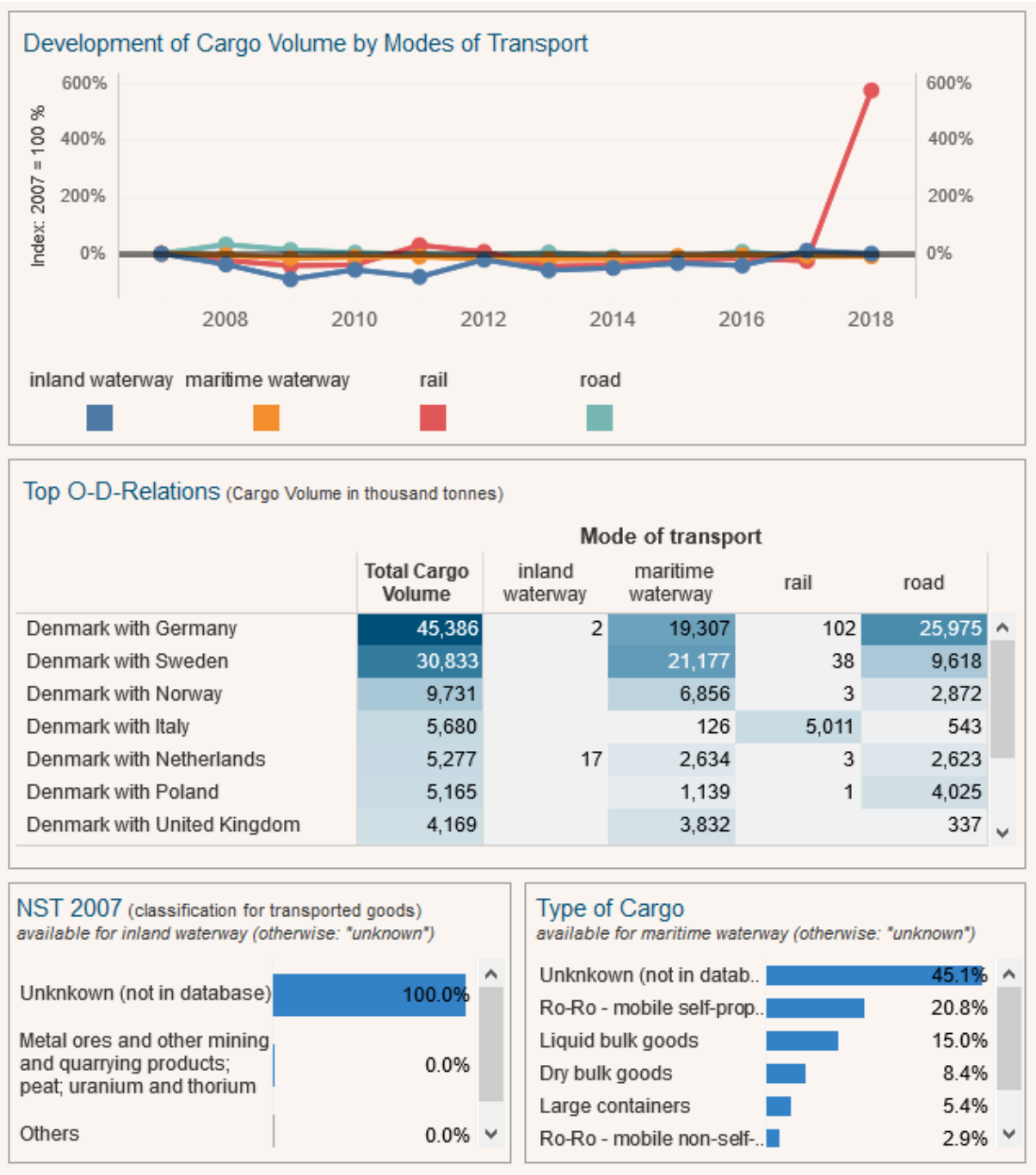


Figure 12: Development of Cargo Volume by Mode of Transport Denmark, Export (2007 – 2018), Top-O-D-Relations, Type of Cargo (SGKV, 2019)

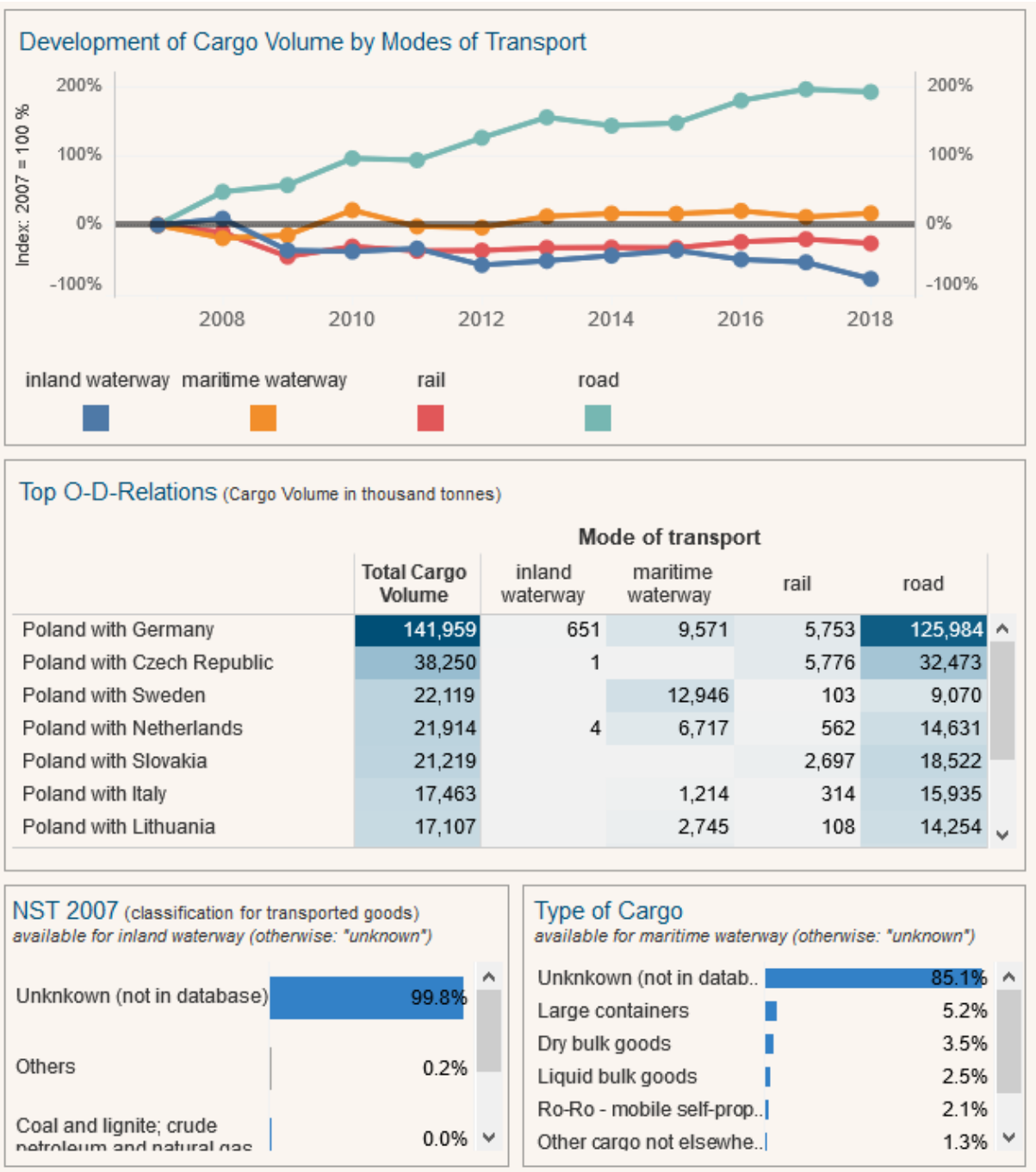
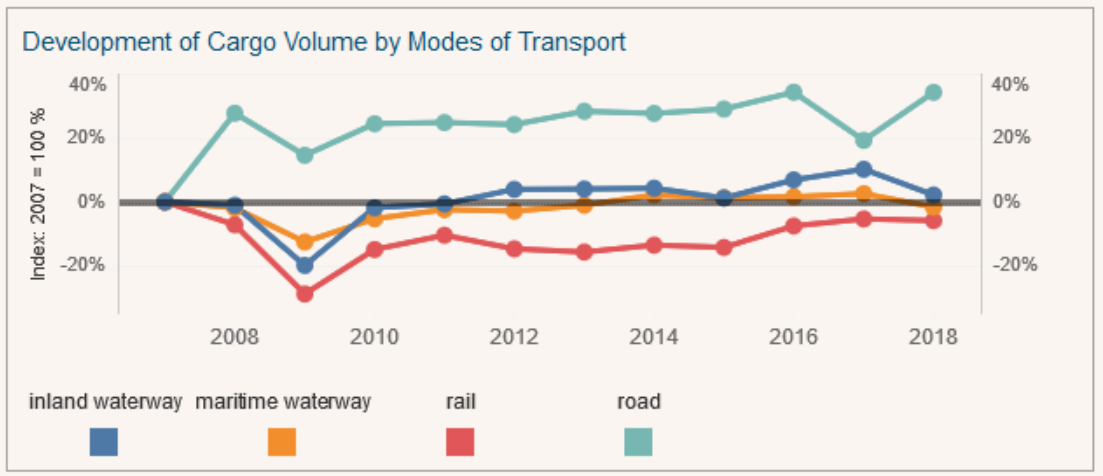


Figure 13: Development of Cargo Volume by Mode of Transport Poland, Export (2007 – 2018), Top-O-D-Relations, Type of Cargo (SGKV, 2019)

It is also possible to select the entire Baltic Sea Region (or multiple countries) by first clicking on the square in the map's sidebar (Figure 14) and then selecting the countries considered in the COMBINE project.

Figure 14: Visualization Tool: Selecting Multiple Countries (SGKV, 2019)

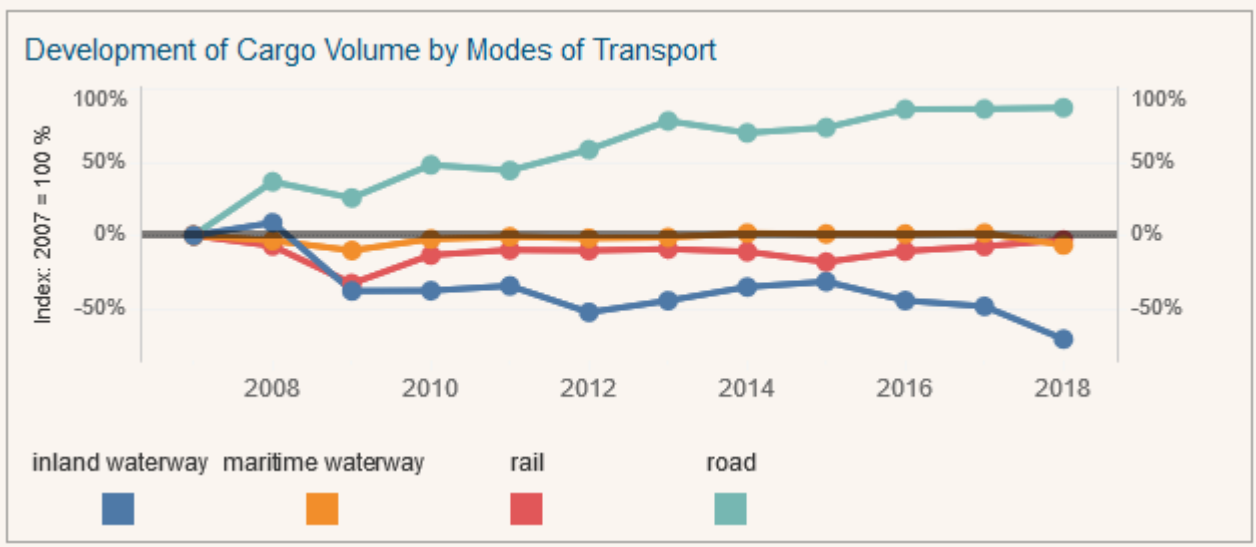


Top O-D-Relations (Cargo Volume in thousand tonnes)

		Mode of transport			
	Total Cargo Volume	inland waterway	maritime waterway	rail	road
Germany with Netherlands	288,112	53,746	6,891	4,503	222,972
Belgium with Netherlands	211,219	73,531	3,336	821	133,531
Belgium with France	161,097	10,971	6,592	3,448	140,086
Germany with Belgium	147,318	45,272	6,760	3,156	92,130
Belgium with Germany	145,867	43,547	4,339	3,659	94,322
Poland with Germany	141,959	651	9,571	5,753	125,984
Germany with Poland	129,707	361	6,700	4,628	118,018

Figure 15: Export BSR countries - Development of Cargo Volumes (2007-2018), Top O-D-Relations (SGKV, 2019)

When selecting all countries that are represented in the COMBINE project, it is evident that Germany and Belgium are the two most important exporting countries heavily coined by road transport. For this reason, Figure 16 depicts the development of cargo flows as well as the Top-O-D relations in the Baltic Sea region without these two countries.



Top O-D-Relations (Cargo Volume in thousand tonnes)

	Mode of transport				
	Total Cargo Volume	inland waterway	maritime waterway	rail	road
Poland with Germany	141,959	651	9,571	5,753	125,984
Denmark with Germany	45,386	2	19,307	102	25,975
Sweden with Norway	44,508		5,872	20,632	18,004
Sweden with Germany	44,393		31,638	3,321	9,434
Poland with Czech Republic	38,250	1		5,776	32,473
Denmark with Sweden	30,833		21,177	38	9,618
Sweden with Denmark	23,521		15,340	360	7,821
Poland with Sweden	22,119		12,946	103	9,070
Poland with Netherlands	21,914	4	6,717	562	14,631
Finland with Germany	21,659	14	21,493		152

Figure 16: Export BSR countries excluding Germany and Belgium as exporting countries (SGKV, 2019)

Comparing Figure 15 and 16 reveals that road transport is by far the most important mode of transport in the Baltic Sea Region, both in terms of absolute cargo volume (in 2018) as well as development of cargo volume. Maritime transport (including short sea shipping) represents the region Outside the BSR and particularly in case of Germany, Belgium and their neighboring countries, transport on inland waterways plays a crucial role in the movement of cargo with significantly increasing volumes starting in 2014. Apart from the difference in the development of inland waterway transport, the reliance on road transport and its considerable increase by almost 100% within the Baltic Sea Region is remarkable in

the time span from 2007 to 2018 – compared to an increase of almost 50% outside the BSR region since 2007.

2.2.2 Conclusion Official Data Sources (EUROSTAT)

The visualization of the cargo flows within the Baltic Sea Region and beyond confirmed the thesis made in the beginning of this chapter that the countries representing the BSR organize the majority of their transports on roads. The increase of this transport mode by almost 100% (Figure 16) in the last decade reflected in the analyzed Eurostat data sets clearly substantiates the importance of trucks in BSR supply chains – also in absolute terms, i.e. tonnes.

The financial crisis in starting in 2007/2008 slowed down the economy in early 2009 and caused a crises at the real market with had a negative impact on trade worldwide in the following years. Accordingly, Figure 15 above graphically depicts a clear decline across all modes of transport in that year – transport on rail being impacted the most with a drop in exports by almost 24% compared to 2008, while road transport declined by approximately 10%. Until the end of the following year, however, the growth rate of rail transports was with approximately 20% the highest of all modes of transports. Road transports “only” increased by approximately 10% in 2010. The fact that growth levels in transport across all modes are partly below 2007, the statistical pre-crisis year, is also noteworthy in this context.

Transport on the Baltic Sea, including short sea shipping naturally represents the second most important mode of transport in the area. Positive form a CT point of view is that the share of RoRo units also increased in the considered time span. Sweden for example, exports approximately 15% of its goods in mobile self-propelled RoRo units and approximately 10% in mobile non-self-propelled RoRo units.

While the volumes transported on barges are almost negligible in the Baltic Sea Region, the development of rail transport has according to the Eurostat data sets stagnated in- and outside the BSR since 2007, with an overall negative development and comparably small volumes inside the BSR.

In light of the considerable gap particularly between road and rail transport in terms of cargo volumes, the question arises how the modal split can be shifted towards rail and other modes of transport in the CT chain in the Baltic Sea Region. Having in mind that a considerable share of road transport is realized in semi-trailers, economically viable innovative vertical and horizontal handling technologies could potentially unlock the potential of Combined Transport in the Baltic Sea Region. Chapter 3 will therefore give an overview of a selection of innovative handling technologies currently available in the market.

2.2.3 Data from Industry Associations

2.2.3.1 UIC – uic.org

UIC – Union Internationale des Chemins de fer is the worldwide professional association representing the railway sector and promoting rail transport.

The main missions are: (1) Promote rail transport at world level,

(2) Promote interoperability, and as a Standard-Setting Organisation, create new world IRSs (International Railway Solution) for railways,

(3) Develop and facilitate all forms of international cooperation,

(4) Support Members in their efforts to develop new business and new areas of activities and

(5) Propose new ways to improve technical and environmental performance of rail transport, improve competitiveness, reduce costs.

The UIC Combined Transport Group (CTG) is a statutory Special Group of the UIC, constituted of RUs, with the specific mission of proactively promoting their common goals and interests in the perspective of the development of Combined Transport (CT) in Europe. To this end, the CTG shall implement and coordinate discussions and joint actions in the field of combined transport by carrying out any necessary studies, taking any necessary decisions and initiating any necessary actions in the areas such as productivity improvements, communication, business facilitation and market knowledge.

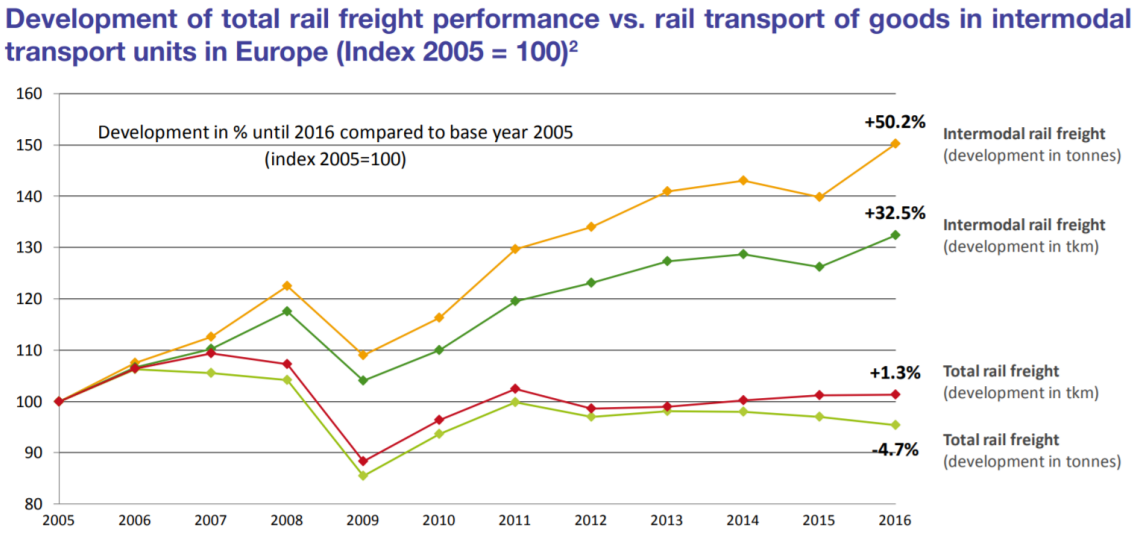


Figure 17 - Development of total rail freight performance (UIC CT Report 2018)

In this context, the CTG monitors the trends in road-rail combined transport by issuing a dedicated report very two years (all published market reports are available on the following link: https://uic.org/freight/combined-transport/#documents). In the its latest report, published in January 2019, the following elements constitute the main outline of the analysis: (1) CT at a glance (see Figure 17 as example), (2) general framework of CT in Europe, (3) the European CT market with facts and

figures), (4) spotlight analyses and (5) market assessment and outlook. Most of the data elements are expresses in TEU[9] (twenty-foot equivalent unit) and/or in tonnes, sometimes in tonne-kilometer (TKM).

For the purpose of the cargo flow analysis within the context of COMBINE project are the statistical tables on (1) the development of domestic unaccompanied CT per country, (2) the major European trade lanes in international unaccompanied CT with a detailed origin-destination matrix.

For the **domestic unaccompanied CT**, Table 3 depicts the development per country for the years 2017 and 2015. The TOP3 domestic markets for CT in Europe are Germany, Italy and the United Kingdom) with a share of 55% in terms of TEU and 56% in terms of tonnes. The ten largest European unaccompanied domestic CT markets represent more than 85% of the total European domestic market. The total share of the BSR countries in European unaccompanied domestic traffic is estimated around 12% (not including the German part of the BSR) with Poland, Sweden and Finland as major contributors both in terms of TEU and tonnes. Whereas as the traffic developments in Finland and Sweden are stable, the Polish domestic recorded between 2015 and 2017 an overall remarkable growth of 39% in TEU and 36% in tonnes. The Latvian and Danish traffic are negligible whereas no transports have been declared for Estonia and Lithuania

Table 3: Development of domestic unaccompanied CT per country (UIC Report 2018)

Unaccompanied domestic CT by country						
Country	TEU			Tonnes		
	2015	2017	Development (2015-2017)	2015	2017	Development (2015-2017)
Austria	400,993	455,234	13.5%	4,409,791	6,220,536	41.1%
Belgium	202,718	282,437	39.3%	1,273,904	2,668,353	>100%
Bosnia and Herzegowina	1,401	1,401	0.0%	14,015	14,015	0.0%
Bulgaria	32,834	5,224	-84.1%	330,059	52,501	-84.1%
Croatia	40,231	29,223	-27.4%	269,633	287,332	6.6%
Czech Republic	499,843	150,634	-69.9%	5,379,001	2,913,465	-45.8%
Denmark	287	12	-95.8%	2,837	182	-93.6%
Finland	10,717	10,717	0.0%	128,813	128,813	0.0%
France	663,419	710,053	7.0%	6,245,535	5,912,067	-5.3%
Germany	3,334,870	4,141,373	24.2%	35,629,640	41,377,684	16.1%
Greece	4,122	-		51,525	-	
Hungary	3,109	2,235	-28.1%	41,362	41,939	1.4%
Ireland	25,982	25,982	0.0%	311,790	311,790	0.0%
Italy	1,554,882	1,074,009	-30.9%	12,318,072	11,251,200	-8.7%
Latvia	589	407	-30.9%	1,300	2,290	76.2%
Luxemburg	-	2		-	24	
Netherlands	326,639	325,420	-0.4%	3,958,563	3,326,335	-16.0%
Norway	322,815	339,672	5.2%	3,172,657	3,338,976	5.2%
Poland	719,079	1,001,615	39.3%	5,913,613	8,059,205	36.3%
Portugal	290,731	351,031	20.7%	2,896,420	3,648,915	26.0%
Romania	262,407	266,521	1.6%	3,163,094	3,154,527	-0.3%
Russia	32	1,024	>100%	136	8,032	>100%
Serbia	13,892	13,892	0.0%	138,922	138,922	0.0%
Slovakia	54,112	18,930	-65.0%	482,377	183,828	-61.9%
Slovenia	66,836	95,637	43.1%	508,756	1,028,293	>100%
Spain	503,697	492,502	-2.2%	5,194,814	4,752,335	-8.5%
Sweden	438,906	438,890	0.0%	4,635,490	4,635,338	0.0%
Switzerland	351,000	399,465	13.8%	4,430,744	4,340,684	-2.0%
United Kingdom	1,446,514	1,422,974	-1.6%	24,955,867	21,709,181	-13.0%

[9] Definition (EUROSTAT statistical glossary): TEU: a statistical unit based on a 20-foot long (6.10 m) ISO container to provide a standardised measure of containers of various capacities and for describing the capacity of container ships or terminals. One 20-foot ISO container equals 1 TEU, one 40 foot ISO container equals 2 TEU, one container with a length between 20 and 40 feet equals 1.50 TEU, one container with a length of more than 40 feet equals 2.25 TEU.

For the European unaccompanied trade lanes, Table 4 depicts the major trade relations in international unaccompanied CT and their development volume in TEU and tonnes. The volumes provided for each trade relation refer to the total volume transported both directions. The BSR countries Germany, Poland and Sweden are listed in this table with the following trade lanes: Germany-Sweden (with an impressive growth of 32% in TEU and 36% in tonnes) and Germany – Poland (stable volumes between 2015 and 2017 both in terms of TEU and tonnes).

Table 4: Major European trade lanes in international unaccompanied CT (UIC Report 2018)

Trade lane		TEU			Tonnes		
		2015	2017	Develop-ment	2015	2017	Develop-ment
Germany	Italy	1,488,080	1,553,328	4.4%	19,501,043	19,915,267	2.1%
Czech Republic	Germany	659,792	756,729	14.7%	6,000,182	7,649,439	27.5%
Belgium	Italy	580,173	714,694	23.2%	7,401,498	9,156,448	23.7%
Germany	Netherlands	667,378	581,379	-12.9%	6,215,813	6,686,219	7.6%
Italy	Netherlands	288,632	458,025	58.7%	3,394,024	6,118,486	80.3%
Austria	Germany	268,860	358,729	33.4%	3,603,502	3,896,851	8.1%
Slovakia	Slovenia	258,921	319,922	23.6%	1,887,370	2,552,178	35.2%
Germany	Sweden	193,878	256,745	32.4%	2,067,542	2,813,600	36.1%
France	Italy	194,123	247,682	27.6%	2,371,238	3,259,281	37.5%
Hungary	Slovenia	179,215	217,777	21.5%	1,597,440	2,122,831	32.9%
Germany	Spain	174,381	214,299	22.9%	2,312,509	2,567,637	11.0%
Germany	Hungary	241,296	209,436	-13.2%	2,322,884	2,321,643	-0.1%
France	Luxemburg	178,766	205,037	14.7%	2,281,597	3,127,385	37.1%
Germany	Switzerland	148,188	168,742	13.9%	1,871,791	1,662,626	-11.2%
Germany	Poland	160,475	161,026	0.3%	1,274,739	1,284,398	0.8%
Belgium	France	131,878	152,626	15.7%	1,128,225	1,299,600	15.2%
Belgium	Spain	104,198	143,817	38.0%	1,432,094	1,891,514	32.1%
Austria	Italy	31,088	136,509	>100%	327,574	1,568,315	>100%
Czech Republic	Netherlands	80,865	116,105	43.6%	481,528	802,261	66.6%
Russia	Slovakia	58,984	102,090	73.1%	210,543	689,465	>100%

Based on the UIC data, an analysis of the BSR-related traffic data has been performed on two layers: (1) traffic between BSR countries (intra-BSR CT traffic) and (2) traffic of BSR countries with non-BSR Member States (extra-BSR CT traffic).

The internal BSR CT traffic, expressed in TEU, is compiled in Table 4. The total traffic is estimated around 440,000 TEU (with 99% connecting Germany) which represents less than 5% of the total international unaccompanied CT. Without Germany trade relations, the internal BSR CT traffic is quasi equal to zero.

Table 5: Internal BSR traffic (UIC 2018 report – UIRR analysis)

Country	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden
Denmark	0	0	0	3.201	0	0	0	0
Estonia	0	0	0	0	0	0	0	0
Finland	0	0	0	11.284	0	0	2	0
Germany	5.509	0	0	0	0	8	64.794	185.657
Latvia	0	1.082	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	60	0
Poland	0	0	0	96.232	0	662	0	30
Sweden	10	0	0	71.088	0	0	56	0

The complete data set of the external BSR traffic, expressed in TEU, is consolidated in the annex. In addition, the data can be visualized in the BSR statistical tool.

A country-by-country can be summarized as follows (Germany excluded):

- Denmark: 62,000 TEU, mainly from/to Italy and Austria
- Estonia: 23,000 TEU mainly from/to Russia
- Finland: 39,000 TEU mainly from Italy, from/to Netherland and France
- Latvia: 54,000 TEU, mainly from CIS
- Lithuania: 300 TEU from/to Italy
- Poland: 220,000 TEU, mainly to Netherlands, from/to Slovenia, from/to Austria
- Sweden: 276,000 TEU, mainly from/to Belgium, from/to Netherlands and from/to Italy

2.2.3.2 UIRR – uirr.com

UIRR – the International Union for Road-Rail Combined Transport - represents the interests of European road-rail Combined Transport Operators and Transhipment Terminal Managers. The mission of UIRR is to grow the pie for Combined Transport through enabling fair competition based on technical merit and management of excellence by promoting Combined Transport as the most competitive, economically and ecologically sustainable solution to long(er) distance continental forwarding.

Since more than 40 years, UIRR compiles and consolidates CT-related data regarding the traffic developments of its member companies. The publicly available data are incorporated in its annual report, published every year at its General Assembly organized in May. The statistical pages contain the following elements:

(1) general overview of the year split in European/domestic CT per type of market segment (unaccompanied / accompanied transport) and per type of loading unit (semi-trailers, containers/swap bodies),

(2) the UIRR indexes,

(3) the origin-destination matrix (for international transport) and (4) terminal-related information. All figures are expressed in UIRR consignments, tonnes, tonnes-kilometers and TEU.

For the COMBINE project, the relevant data are the figures contained in the UIRR O/D matrix with all relations deserved by the UIRR member companies (for domestic traffic: only aggregated data are published – no situation per country). Per declared relation, the following elements are publicly at disposal: country (from/to), number of UIRR consignment, consignment-km, average distance, average weight, gross weight, tonnes-km, techniques (in % of consignments). A UIRR consignment corresponds to the transport capacity of one full size truck on road (equivalent to 2 TEU), meaning one semi-trailer, two swap bodies less than 8.30 m and under 16t, one swap body more than 8.30 m or over 16t and one vehicle on the Rolling Motorway (RoLa). The UIRR O/D matrix is enclosed in the annex.

In 2018, the total number of consignments transported by UIRR operator members increased by +4.97%, whereas output when expressed in tonne-kilometres grew by +0.78%. Cross-border services have expanded substantially by +5.27% to reach 2.9 million UIRR consignments with a continuous significant transfer of semi-trailers (+10.23%) and containers (+5.19%), while domestic relations grew

by +4.30% thanks to the further expansion of semi-trailers with a positive result of 11.30% and an increase of the transport of containers with 5.88%. Rolling Motorway transport (of full trucks) suffered across-the-board with -7.37% decrease on both domestic- and cross-border relations in 2018.

In 2018, UIRR members transported in cross-border services 2.9 million consignments of which 2.4 million were containers (ISO and non-ISO containers, swap bodies), 0.4 million semi-trailers (99% craneable) and 0.1 million complete trucks. Expressed in billion TKM, the overall cross border UIRR traffic has reached more than 65 billion on an average distance of 1,020 km.

Table 6 depicts the top 20 of the most significant cross-border services sorted by the number of UIRR consignments. These relations represent about 70% of the total cross-border traffic. In loading units, it means 23% of semi-trailers, 33% for smaller containers (under 8.30m), 36% for longer containers (over 8.30m) and 9% for the complete trucks. In this top 20, only one relation includes a BSR Member State (Sweden with the relation Germany – id. 15 and 20). On this relation, the transport of semi-trailers dominates with more than 60% of all consignments (57,000 in total).

Table 6: UIRR Top20 cross-border services (UIRR analysis)

ID	From	To	Consignments	TEU	Consignments-km	Average Distance (km)	Average Weight (t)	Gross Weight (1000)	Tonnes-km (1000)	Semi-trailer	Containers (small)	Containers (long)	RoMo
1	DE	IT	408.256	816.511	335.617.902	822	27	11.084.175	9.056.515	34%	29%	25%	12%
2	IT	DE	301.471	602.942	238.822.324	792	22	6.651.780	5.041.414	30%	27%	27%	16%
3	BE	IT	141.299	282.597	158.158.785	1.119	26	3.705.561	4.135.796	19%	26%	55%	
4	IT	BE	133.115	266.230	155.487.930	1.168	23	3.003.658	3.506.834	20%	22%	58%	
5	DE	NL	61.571	123.141	32.465.332	527	22	1.381.834	722.247	6%	52%	42%	
6	NL	IT	53.883	107.765	54.804.972	1.017	26	1.401.964	1.422.284	12%	35%	53%	
7	AT	DE	52.351	104.701	52.428.564	1.001	21	1.084.598	1.098.531	11%	33%	56%	0%
8	IT	NL	51.047	102.093	63.280.560	1.240	23	1.185.434	1.468.452	20%	31%	49%	
9	NL	DE	49.958	99.915	22.094.469	442	19	964.394	435.166		49%	51%	
10	DE	AT	45.328	90.655	44.188.257	975	21	950.062	921.361	12%	37%	51%	0%
11	IT	AT	34.546	69.092	11.704.546	339	23	795.710	286.556	7%	20%	24%	49%
12	DE	CH	34.321	68.641	21.806.060	1.872	78	876.454	554.744	18%	58%	24%	
13	SI	HU	34.284	68.568	20.023.334	584	15	513.213	299.628		81%	19%	
14	AT	SI	33.126	66.252	9.958.856	301	27	883.813	274.948		55%	10%	35%
15	DE	SE	30.555	61.109	29.691.329	972	25	768.028	746.484	62%	17%	21%	
16	IT	FR	30.325	60.650	27.934.910	921	18	559.837	519.813	2%	54%	44%	
17	FR	IT	29.662	59.324	26.839.609	1.812	27	805.987	729.715	2%	54%	44%	
18	DE	CZ	27.343	54.685	21.943.209	803	19	520.968	405.570	19%	43%	38%	
19	AT	IT	26.916	53.832	10.459.022	389	27	721.715	279.992	10%	12%	16%	62%

The extract of the UIRR data related to all BSR relations (including at least one BSR Member State excluding all relations from Germany to non BSR countries as it is not possible to differentiate the German regions from the UIRR statistics) is enclosed in the annex XX. The total volume of the BSR-related relations reached 118,000 UIRR consignments (5% of the total UIRR cross-border traffic – relation Germany-Sweden with more than 50% of the total consignments). The semi-trailers market count for 36% of all BSR trade lanes whereas containers record an overall share of 64% (equal repartition for smaller and longer containers).

A BSR country analysis of the UIRR extract can be summarized as follows:

- Denmark: 14,000 consignments mainly from/to Germany and from/to Italy (intermodal loading unit mix: 99% containers/swap-bodies, 1% semi-trailers)
- Estonia: no traffic
- Finland: no traffic
- Germany: see other BSR countries
- Latvia: no traffic
- Lithuania: negligible
- Poland: 33,000 consignments, mainly from/to Germany, from/to Slovenia and from/to Belgium (intermodal loading unit mix: 99% ISO containers, 1% semi-trailers)

- Sweden: 71,000 consignments, mainly from/to Germany and from/to Italy (intermodal loading unit mix: 60% semi-trailers, 40% containers).

All the data can be visualized with the BSR statistical tool presented above..

2.2.4 Conclusion Cargo Flow Analysis (UIC Data)

Two industry associations are publishing regularly figures and trends in combined transport:

UIC monitors the trends in road-rail combined transport by issuing a dedicated report every two years (https://uic.org/freight/combined-transport/#documents). The report consolidates European CT data split in domestic and cross-border traffic. An O/D matrix is available to identify the traffic flows between EU countries (either expressed in TEU or in tonnes – depending on the years).

UIRR releases the traffic evolution of its members in its yearly annual report (http://www.uirr.com/en/media-centre/annual-reports/annual-reports.html). The statistical overview resumes the CT traffic by type of segment (domestic, cross-border) and by type of loading unit (semi-trailers, small containers, long containers and complete road vehicles). The figures are expressed either in UIRR consignments, TEU, tonnes, tonnes-kilometres and loading unit mix. An O/D is also available to visualize the traffic flows of the UIRR member companies.

For both statistical sources, it has been decided to develop a specific visualization tool to ease the consultation of those two important data sources for the BSR cargo flow analysis.

The following main conclusions can be drawn from these data:

European Domestic Unaccompanied Combined Transport: the total share of BSR countries represent around 12% of this market with Poland, Sweden and Finland as major contributors both in terms of TEU and tonnes. Whereas as the traffic developments in Finland and Sweden are stable, the Polish domestic recorded between 2015 and 2017 an overall remarkable growth of 39% in TEU and 36% in tonnes. The traffic of the other BSR countries are either negligible or no traffic at all.

European Cross-border Unaccompanied Combined Transport: (1) The internal BSR CT traffic is estimated around 440,000 TEU (with 99% connecting Germany) which represents less than 5% of the total European cross-border unaccompanied CT. Without Germany trade relations, the internal BSR CT traffic is quasi equal to zero. (2) The external BSR CT traffic is evaluated at about 680,000 TEU which is around 7% of the total current European cross-border unaccompanied CT.

Intermodal Loading Unit Mix: the overall UIRR mix is 82% containers (including ISO and non ISO loading units), 11% semi-trailers (craneable or not) and 7% complete vehicles. This UIRR mix varies according to the market segment (domestic versus cross-border). A country-by-country shows a large variety of ILU mix in the BSR countries: for Denmark and Poland, mainly containers are transported whereas in Sweden most of the consignments are based on the use of semi-trailers. When analyzing the mix on all cross-border lanes with the BSR, 36% of all BSR trade lanes are based on semi-trailers whereas containers record an overall share of 64%. It is therefore essential to understand the logistics needs in terms of equipment by the various BSR countries.

2.2.5 Data from the 2030 forecast of traffic interconnectivity (BMVI Data)

In the previous sections, cargo flow in Baltic Sea Region (BSR) analyses was done based on databases from the statistical office of the European Union (EUROSTAT) and industry associations of International union of railways (UIC) and International Union for Road-Rail Combined Transport (UIRR) and a dashboard was created to visualize the volumes. To further strengthen the cargo flow analysis, the traffic interconnectivity forecast 2030 developed by the German Federal Ministry of Transport and Digital Infrastructure (BMVI) was chosen as the fourth data source. The data basis was chosen as it was an up to date and comprehensive traffic forecast for the year 2030. It accumulated the regional data forecasts based on economic, demographic, and maritime transport trends according to BMVI (2015). These data were then organized as origin destination matrices for the freight traffic with 2010 as the base year and 2030 as the forecast year.

This database was chosen to estimate specifically the CT affinity traffic volumes in Baltic Sea Region due to its detailed focus on all modes of transport in freight sector not only within different districts of Germany but also between various European countries. Furthermore, the forecasting was made as origin-destination traffic for specific types of goods in the freight transport sector enabling the identification of combined transport affinity volumes. The key findings of the study also concluded a dynamic growth for the combined transport segment and high dynamism of international trade, both in terms of transit and cross-border traffic.

The data labels utilized for this cargo flow analysis is as follows:

- Type of cargo
- Loading country and geo-location
- Unloading country and geo-location
- Import, Export, or Domestic
- Modes of transport
- Origin-Destination relations
- Unit of transported volumes
- Year of data

The CT volumes are derived from the analyzed data for traffic flows between European Union states in the Baltic Sea Region. This data was deduced for the different countries of the Baltic Sea Region from the traffic interconnectivity forecast 2030 and added to the existing cargo flow analysis dashboard on the COMBINE project website for the benefit of different stakeholders of this region. As a valuable addition to the existing dashboards based on EUROSTAT, UIC, and UIRR data, this additional data source provides the users a direct outlook into the combined transport volumes of today and future. The different visualizations created based on these data analysis is described in the following section.

2.2.6 Conclusions from the 2030 forecast of traffic interconnectivity (BMVI Data)

The cargo flows in BSR dashboard were updated with the new database of traffic interconnectivity forecast 2030 created by the German Federal Ministry of Transport and Digital Infrastructure. Therefore, the users are provided with an option to switch between the existing data source of EUROSTAT and the Traffic Interconnectivity Forecast 2030 before selecting the already existing data manipulation options like the following:

- Export or Import
- Modes of transport
- Origin-Destination relations
- Year and additional attributes

The option to switch between different data sources are shown in Figure 18 below along with the other data manipulations options listed above.

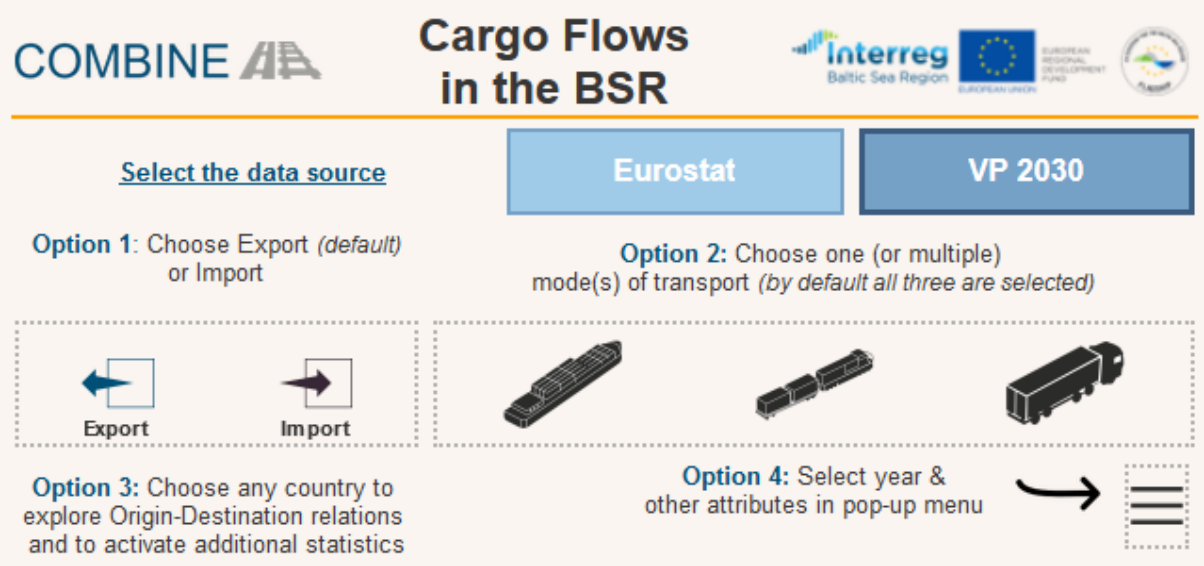


Figure 18: COMBINE Visualization Tool, Data source selection options-Eurostat and VP 2030

As an example, a representation of results for the CT affinity cargo flow export from Sweden to Germany is presented below. Based on this selection of origin and destination the dashboard results are presented to the user as shown in Figure 19 below. Furthermore, the Figure 20 shows the cargo volumes development forecast for Sweden till 2030, its top origin-destination relations, and the type of cargo. Therefore, the presentation of the traffic interconnectivity forecast 2030 and its associated data analysis improves the transparency in the combined transport sector of the Baltic Sea Region. It provides various stakeholders from the region, a level playing field to develop their capacities for combined transport and promote modal shift.

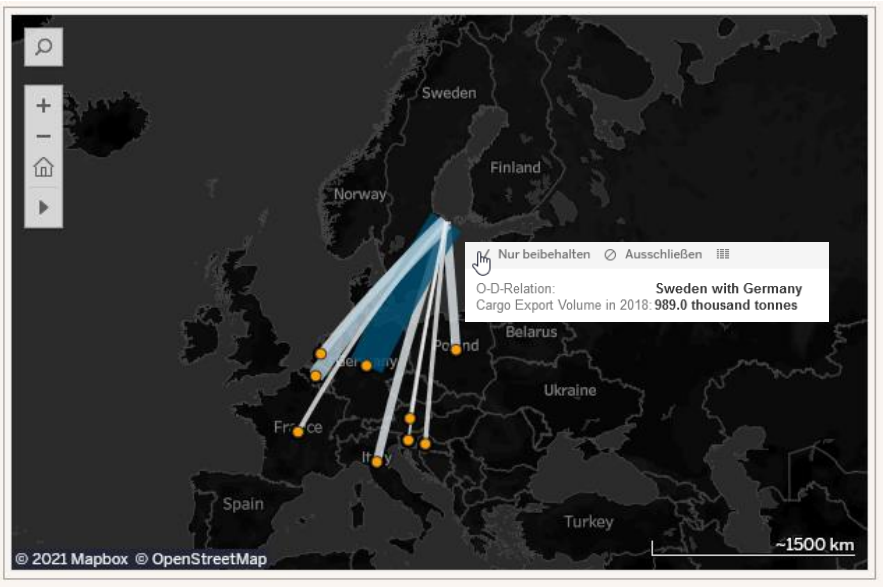


Figure 19: Cargo Flow Visualization-VP 2030, Export Sweden to Germany 2018 (O-D-Relation)

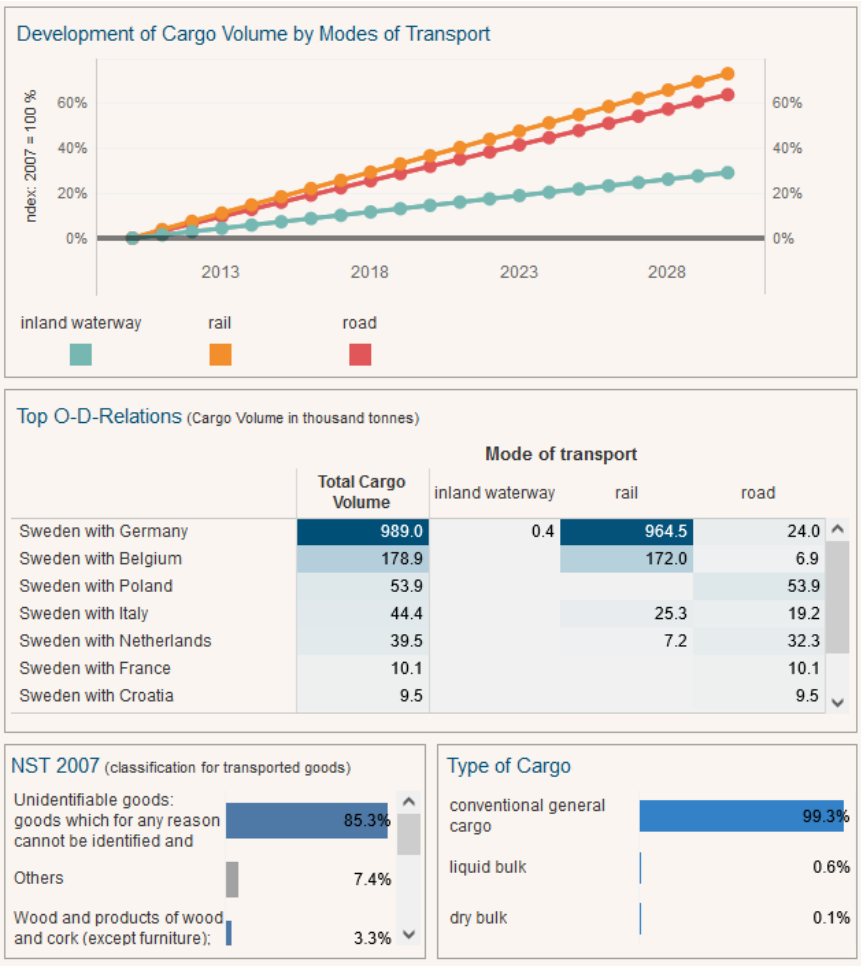


Figure 20: Development of Cargo Volume by Mode of Transport Sweden, Export (2010 – 2030), Top-O-D-Relations, Type of Cargo – VP 2030

3 CT HANDLING TECHNOLOGIES

Before introducing handling technologies used in Combined Transport, a brief overview of the loading units (LU) goods are transported in will be given in the following chapter.

3.1 Loading Units in Combined Transport

In Combined Transport, loading units (LU) represent the object of transshipment while protecting the goods to be transported. The most common and widely known type of loading units are containers, as these can be transported across all modes in CT, i.e. road, rail and barge. A vehicle itself can also be loading unit, which will be the focus of this chapter.

In course of various innovations of transport modes, different forms of LU as well as corresponding specific handling systems have been developed and adapted to the individual requirements of LU.

Due to bulk freight transport, particularly as a consequence of international / intercontinental maritime transport, standardization with respect to the size and feature of LU has prevailed. As a consequence of said standardization, loading units ensure:

- economically viable and easy handling
- beneficial utilization of space
- easier storage
- better options for gathering information, statistics and accounting

However, the advantages outlined above only apply if transport, handling and storage operations are generally recognized and internationally standardized.

Within global cargo flows, several LU systems have been developed that support various types of transport and handling. Characteristic are hereby maritime and continental LU, each having different technical properties, possible applications and variations due to their respective use.

Examples of maritime and continental LU as well as their respective advantages and disadvantages are given below.

Since containers can be moved by all transport modes, they represent the most important loading unit in CT. According to Rodrigue (2017), containers can be regarded as the driver of intermodal / combined transport as they allow for easy handling between modal systems and are designed to be moved with common handling equipment, thereby enabling high-speed intermodal transfers in economically large units between ships, railcars, truck chassis, and barges using a minimum of labor.

Handling of loading units takes place in terminals and is a central component within combined transport chains. Transshipment systems are used to switch consignments from one mode of transport to another (road, rail, waterway).

Table 7: Maritime & Continental Loading Units (SGKV, 2019)

Maritime Loading Unites	Continental Loading Units
Container	Cranable and non-cranable Semi Trailer / Swap Body
 	  

Advantage	Disadvantage	Advantage	Disadvantage
Standardization	Lack of compatibility with Euro pallets	European dimension requirements	Limited stackability
Robust	Difficult loading and unloading (parking only possible on the ground)	Compatible with European pallets	Partly no intercontinental transport from overseas possible (e.g. semi-trailer)
Stackable		Europe-wide application and in continental non-European countries (e.g. China)	
Space-saving storage			
Worldwide application			

Thus they bundle and distribute the loading units for the further transport route in CT. The most important transshipment systems are divided into horizontal and vertical functions (type of movement or transshipment). They determine how the different loading units are handled. Which transshipment system is used depends on the infrastructure of the terminals:

- Location (regional characteristics)
- Market segment (maritime or continental CT)
- Characteristics of the loading units (container, swap body, cranable or non-cranable semi-trailers)

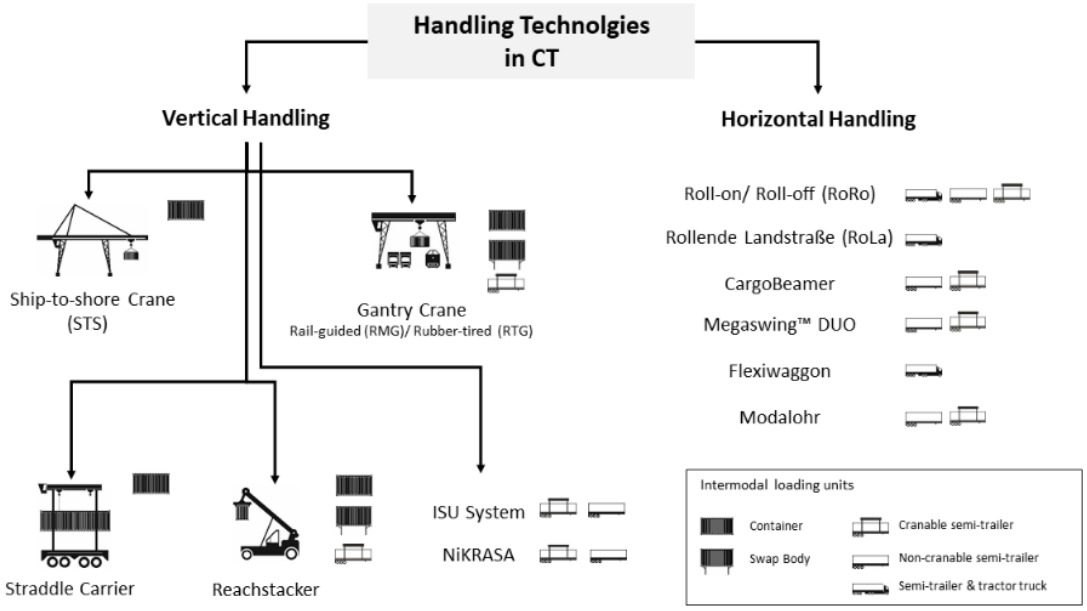


Figure 21: Handling Technologies in Combined Transport

3.2 Vertical Handling

In vertical transshipment, CT loading units are lifted from or onto various modes of transport by means of a lifting system, transshipped or stacked for intermediate storage.

Typical vertical handling systems include cranes, forklifts and straddle carriers. Due to the size and throughput of terminals, different types of equipment is used. Because of its high efficiency, vertical handling is often regarded as a prerequisite for CT. This type of transshipment is part of the standard equipment in many terminals and has proven its viability.

Almost all CT units can be handled vertically. Specific vertical transshipment technologies, such as the ISU system and NiKRASA, have been developed for non-cranable semi-trailers and non-ISO standardized LU.

3.2.1 Vertical Handling Equipment

Vertical handling systems are particularly suitable for:

- Cranable loading units (ISO containers, swap bodies, cranable semi-trailers)
- High handling volumes
- sufficient space capacity in rail- and/or water-sided terminals
- maritime CT

The systems are designed for handling higher weights (tonnages) and are characterized by a high handling frequency (per minute). The possibility of mass transshipment is guaranteed. From an economic perspective, the use of vertical transshipment systems requires a minimum volume of transshipments.

3.2.1.1 Cranes

Crane systems are well-established vertical handling equipment in CT terminals and are used both in continental and maritime CT. Cranes work in a space-optimized manner, since long routes as well as turning and shunting possibilities can be discounted. The loading units can be turned or rotated completely by the crane movement. Based on technical characteristics, two classic crane system types can be distinguished for the use in CT:

- **Ship-to-Shore Cranes (STS)**: Conventional lifting crane that lifts the load with the aid of a rope over a slewing arm. The handling of intermodal transport units (ITU) requires that the rope can be connected to its corners. As the name suggests, STS represent the direct switching point between the ship and the quay edge.
- **Gantry Crane:** Lifting device for vertical handling that bridges the loading tracks by means of a portal mounted on lateral supports. These outriggers (‘support legs’) can be moved on rails or by means of tires, usually in a limited space. The cargo can be moved in 3 dimensions of height, width and length. Such cranes are usually used for road-rail and/or [inland] ship-port handling. A distinction is made between rail-mounted gantry cranes (RMGs) and gantry cranes with rubber tires (RTGs)**.**

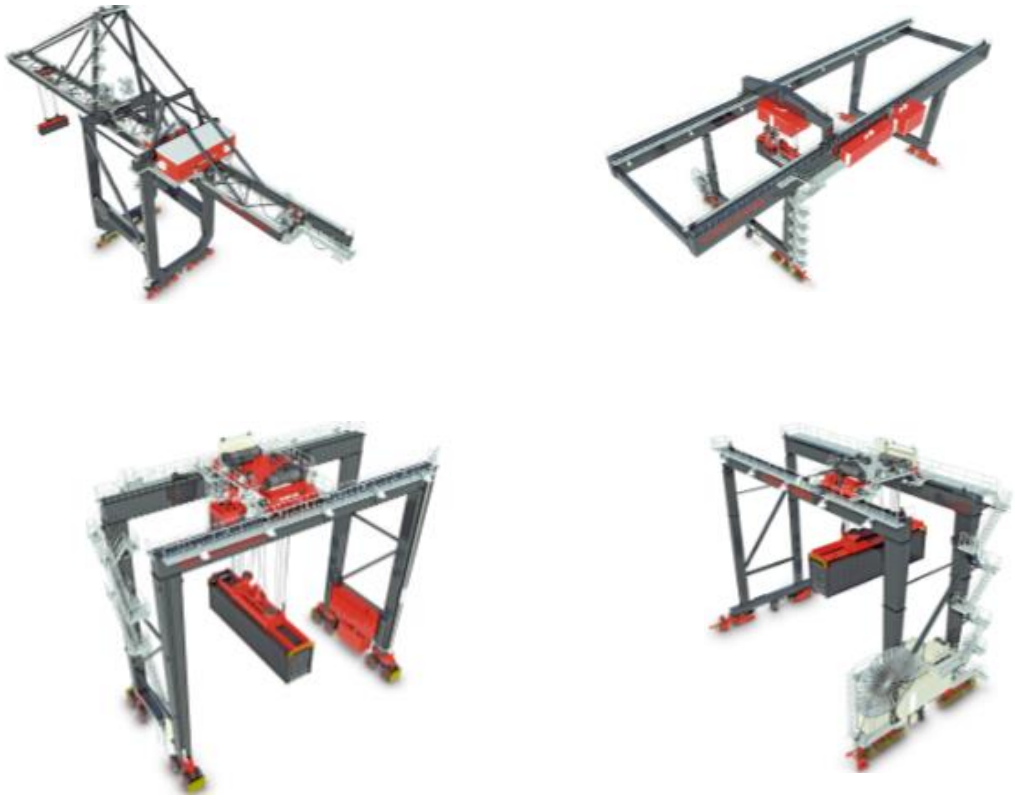


Figure 22: Crane systems used in CT (Krone Cranes, 2020)

3.2.1.2 Stacker / Lifter / Stapler

Stackers or lifters are handling equipment that operate with vertical technology. With freely movable wheels, they can reach higher speeds and thus prevent waiting times at the terminal. They are suitable for both transshipment and transport on the terminal site. The technical equipment of a forklift truck includes top and side spreaders as well as grippers and forks. The vehicles are powered by diesel (outside), gas (inside and outside) or electricity and petrol (hardly any more available). Stackers are divided into full and empty container forklifts, which are offered in different versions.

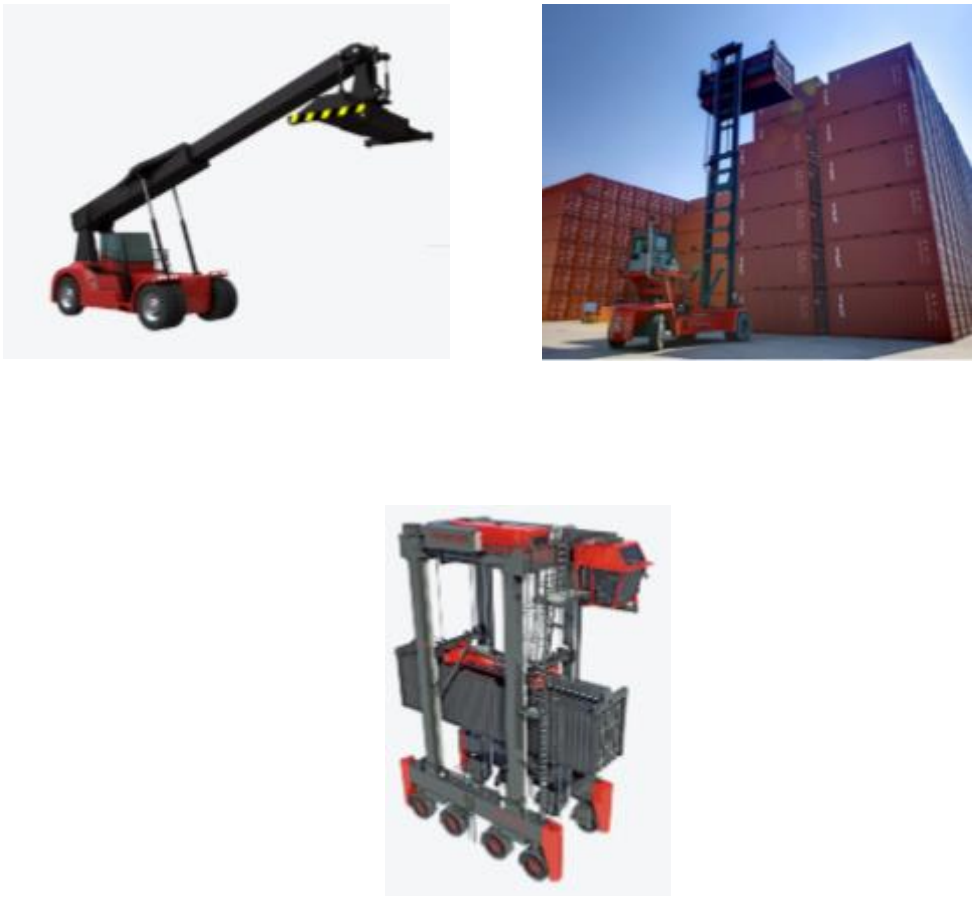


Figure 23: Stackers and Lifters (Krone Cranes, 2020)

3.2.2 Innovative Vertical Handling Technologies

As outlined in the previous chapter, semi-trailers are used in continental logistic chains due to their compatibility with Euro Pallets and make up the majority of the overall cargo flow within Europe. However, the fact that only a fraction of semi-trailers are cranable poses several challenges for utilizing them in combined transport. In addition, specific handling technologies are not common in European terminals, which in turn poses another bottleneck for unlocking the potential of continental CT. Nevertheless, available innovative vertical transshipment solutions will be briefly introduced.

3.2.2.1 Innovative Transshipment of Semi-Trailers (ISU-System: Innovativer Sattelanhänger Umschlag)

[10]

Manufacturer	Rail Cargo, Austria
Applicability	Cranable and non-cranable semi-trailers (3-axle, max. 4 m height and 2.6 m width, tire sizes from 850 mm to max. 1150 mm diameter), Megatrailer
Functional Principle	A semi-trailer is driven onto the loading ramp by the corresponding truck or a terminal tractor. On this ramp, the truck is separated from the semi-trailer. The wheel grab (rear) and the supporting beam traverse (front) are located in the recesses of the ramp. A stacker is required for handling the LU. The lifting cables of the stacker are then connected to the wheel grabs. Subsequently, the lifting traverse is brought together with the kingpin and secured. The semi-trailer is lifted in standard pocket wagons and the cross beam is locked with the support frame. The lifting ropes are removed. The wheel grabs and the cross beam remain on the semi-trailer and are used for securing. The train is now ready to leave.
Parallel handling	No
Fully automated	No
Special terminal infrastructure	No
Correspondence terminal	No
Further Information	https://www.railcargo.at/de/Leistungen/Operator/ISU/index.jsp

[10] https://www.verkehrsrundschau.de/nachrichten/neues-rca-umschlagssystem-wenig-erfolgreich-1229376.html

3.2.2.2 NIKRASA

[11]

Manufacturer	Project Consortium consisting of Bayernhafen Group, TX Logisitk AG and LKZ Prien, Germany	
Applicability	Cranable and non-cranable , Megatrailer	
Functional Principle	The NIKRASA system consists of two parts: the terminal platform and the integrated transport platform. A terminal tractor drives onto the terminal platform and positions the semi-trailer centrally on it. The gripper harness of the gantry crane or reachstacker reaches into the gripping edges of the transport platform and then lifts the transport platform including the semitrailer truck. Both are positioned in the train's pocket wagon exactly matching the support frame. The kingpin is locked there. Now the handling of the semitrailer is completed.	
Parallel handling	No	
Fully automated	No	
Special terminal infrastructure no	No	
Correspondence terminal	No	
Further Information	http://www.nikrasa.eu/de/startseite.html	
In operation at:	**Terminal**	**Country**
	Padborg	Denmark
	CTH Herne	Germany

[11]https://www.zukunft-mobilitaet.net/163171/konzepte/nikrasa-umschlag-sattelauflieger-bahn-kombinierter-verkehr/,

	Lübeck Nordlandkai	Germany
	Verona Intermodal QE	Italy
	Trieste Intermodal Maritime Terminal	Italy
	Novara CIM	Italy
	Terminal Intermodal de Bettembourg	Luxemburg
	Lyon Terminal 1	France
	Mercatordok Multimodal Termina	Belgium
Planned:	Budapest	Hungary
	Curtici or Oradea	Romania
	Cologne	Germany
	Çerkezköy	Turkey

As shown in the picture above, the NIRKASA technology makes it possible to handle non-cranable semi-trailers, but also requires specific wagons (possibly modified pocket wagons). The frame is usually carried along, resulting in additional dead load during transport in order to enable crane removal at the destination as well as an increased disposition effort for the racks.

In general, these niche solutions are designed for small and medium quantities, their utilization for large cargo quantities is not focused on. Some disadvantages particularly in handling (duration of the handling process, staff training, storage of shelves, etc.) are leading to efficiency losses when transshipment is conducted with these technologies. Depending on the framework conditions, systems such as NIRKASA or ISU are valuable for terminals that, in addition to their container business, want to supply a low to medium demand for trailer handling and incorporate these systems into their portfolio.

3.3 Horizontal Handling Technologies

Comparable to the innovative vertical handling technologies, horizontal systems are mainly used for non-cranable loading units. In light of the increasing demand for transport of semi-trailers by rail, these horizontal technological systems have been developed to facilitate and increase the efficiency of transshipment – although cost-effectiveness and compatibility of the systems have to be evaluated on a case-to-case basis.

The main characteristic of horizontal transshipment systems is that during the handling process the loading units are not raised at all or just slightly in order to be removed from the attachment of the transport carrier. Horizontal here means that the LU is handled transversely, longitudinally or diagonally to the transport carrier. This system is particularly suitable for transshipment between trucks and trains.

No special equipment is required for horizontal-longitudinal transshipment, as the loading unit either travels independently onto the means of transport (truck) or is driven by means of a special terminal tractor (semi-trailers in the RoRo process). Special handling equipment is required for horizontal-

parallel and diagonal handling. Horizontal-diagonal transshipment is a special requiring specific terminal infrastructure. In addition, special wagons are needed.

Horizontal handling according to type of movement

Longitudinal	Parallel	Diagonal
Rolling Motorway (RoLa)	CargoBeamer	Modalohr
Roll-on Roll-off (RoRo)		MegaSwing™ Duo

Before introducing a selection of horizontal handling technologies, it should be noted that in context of the project “AlpInno CT” funded by the Interreg Alpine Space Program gives an exhaustive analysis[12] of transshipment technologies in Combined Transport. The following tabular overview can therefore be seen as a supplement to the work that has been done in the AlpInno CT project.

CargoBeamer	
Manufacturer	CargoBeamer Ag, Germany
Picture	 [13]
Applicability	Cranable and non-cranable semi-trailers, Megatrailer, Tank-, silo- and refrigerated trailers
Functional Principle	The core of the system is a special tub-shaped wagon attachments, which can be loaded and unloaded at the same time. In a CargoBeamer terminal, the loading unit is delivered by truck, which drives with the semi-trailer onto the waiting CargoBeamer wagon attachment, saddles off and drives out. The tank-shaped wagon attachments are pushed onto the wagon by a special conveyor system known as the CargoBeamer Jet. The loading and unloading of the wagon attachments can take place simultaneously. After the

[12] https://www.alpine-space.eu/projects/alpinnoct/outputs/deliverable-d.t1.2.1.pdf
[13] https://www.cargobeamer.com/Technologie-758631.html

	side walls of the wagon have been closed, the wagon top including the semi-trailer is lowered and secured at the kingpin. The side walls lock automatically. Subsequently, the side wall swivel units move out of the clearance gauge. The train is now ready to leave. The wagon attachments are cranable (by crane, reach stacker, etc.) and can therefore be handled in conventional CT terminals. This system is a modular construction: 36 modules or semi-trailers form a 700 m track.
Capacity (handling time)	With approximately 9 minutes, the loading time for an entire train is short. This involves the loading and unloading of 76 (non-) cranable units or 36 handling modules.
Area required	21,4 x 750 m, approximately 16.000 m^2
Energy required	36 kWh per transshipment of an entire train
Investment costs	Approximately 16.5 million € for 36 modules (700 meters of track). However, these values are location-dependent and fewer modules can be installed. Transport costs per loading unit approx. between 0,35 and 0,65 €/Km (manufacturer's data)
Personnel	Personnel costs are low because the system is fully automated, one person is sufficient for the handling process. One additional driver might be necessary who parks the trailer correctly.
Parallel handling	Yes
Fully automated	Yes
Special terminal infrastructure	Yes, CargoBeamer Terminals
Correspondence terminal	No
Pro's	Time savings during transshipment; delivery and transshipment of the trailers are decoupled from each other since the truck does not have to wait for the train and vice versa. The exchange concept of the tubs enables fast transshipment at borders to countries with broad gauge. Furthermore, no correspondence terminal is necessary, as the tubs can be craned (gantry crane or reach stacker). Compared to pure road traffic, the CargoBeamer reduces costs by more than 10% per transport unit, depending on the route.
Con's	Relatively high investment costs; the system is designed for block train line traffic / haul and thus dependent on certain infrastructure; exchange wagons have to be carried along (dead weight).
More information	https://www.cargobeamer.eu/

Modalohr[14]	
Manufacturer	Groupe LOHR, France
Picture	 15
Applicability	Cranable and non-cranable semi-trailers (max. 4.04 m corner height, max. 13.7 m length, max. 38 t), Megatrailer, Tractor unit
Functional Principle	The LOHR Railway System (Modalohr) has a lift-swivel system installed between the rails. After the train has entered, the wagon pockets are unlocked by this system and swung out for loading (30°) using hydraulically driven idlers. The truck or a terminal tractor drives over the ramp into the swing-out tub of the special wagon, places the semi-trailer and leaves the tub in the direction of traffic. The pocket wagon then swings in again and the loading unit is loaded. Instead of two ramps, the track can also be lowered, i.e. to the asphalt surface of the terminal. The third generation of the LOHR UIC wagon is already available.
Capacity (handling time)	Fast transshipment possible as complete train can be loaded and unloaded at the same time (depending on existing terminal structure); if sufficient personnel is available, the complete train can be loaded and unloaded in less than 15 minutes. Assuming a loading time between 30 and 60 minutes, unloading takes approximately 60 to 90 minutes is, however, more realistic. This results in a capacity of 9 to 16 trains or 345 to 576 trailers per day for a load of 36 trailers per train.
Area required	High, 57 m x 800 m for a 750 m train, approximately 45.600 m^2
Energy required	N/A
Investment costs	An average of 11.000.000 € is estimated for the construction of a new Modalohr terminal

[14] A table listing terminals in Europe where the Modalohr technology is in operation including the corresponding handling volumes can be found in the appendix.
[15] https://lohr.fr/de/lohr-railway-system/

Personnel in three-shift operation	12
Parallel handling	Yes
Fully automated	No
Special terminal infrastructure	yes
Correspondence terminal	yes
Combination with other systems	The system is designed for block train service within the Modalohr network. It can also be combined with regular pocket wagons.
Parallel handling	Yes
Pro's	All standard semi-trailers (incl. mega-trailers) can easily be transported; Fast loading and unloading; Tested system that has proven its viability; transshipment under overhead / contact wire possible; trailers can drive in the direction of traffic on pocket wagons.
Con's	Low flexibility (only block train line traffic); high investment in infrastructure required; relatively complex technology, very high area requirement (57m x 800 m for 750m train); correspondence terminal necessary
More information	https://lohr.fr/de/lohr-railway-system/das-lohr-system/

MegaSwingTM Duo	
Manufacturer	Helrom
Picture	 1617
Applicability	Cranable and non-cranable semi-trailers
Functional Principle	The Megaswing system is a special pocket wagon with a swiveling tub-receptacle for semi-trailers. Hydraulic supports serve as stabilization when the tub swings out to the left or right. The tub is loaded backwards with a semi-trailer. After the semi-trailer has been uncoupled, the hull is lifted and swivels back in again. The semi-trailer is slightly lowered and firmly connected to the wagon; it is now securely stowed on the wagon. The technology is built into the wagon.
Capacity (handling time)	With the MegaSwing system it takes approximately 4,5 minutes handling one semi-trailer. A complete train is transshipped within 60-90 minutes, depending on personnel expenditure / availability
Area required	Low
Energy required	Low, comparable to container handling
Investment Costs	With 270,000-340,000 €, Megaswing wagons are considerably more expensive than conventional pocket wagons. The costs for the terminal infrastructure, however, are largely eliminated.
Personnel	Personnel requirements are low since the MegaSwing can (theoretically) be operated by the truck driver.
Combination with other systems	The system is suitable for block train and single wagon traffic and can be carried with other wagons.
Parallel Handling	Yes, at high personnel deployment

[16] https://helrom.com/
[17] https://www.zukunft-mobilitaet.net/1400/konzepte/megaswing-das-eigene-intermodale-terminal/

Fully automated	No
Special terminal infrastructure	no
Correspondence Terminal	no
Pro's	Flexible applicability, since the wagons can be used on almost any loading track (paved area required, loading and unloading also possible under overhead wires); all standard truck trailers can be transported; no terminal infrastructure required; the entire train is not affected if one wagon fails.
Con's	High investment costs for the purchase of the special freight wagons; The receiving pocket of the MegaSwing pocket wagon can only be loaded backwards and requires high precision; technology installed on the wagon side which may be susceptible to maintenance; mutual obstruction possible when unloading in terminals with gantry cranes.
More information	http://www.kockumsindustrier.se/en-us/start/

Flexiwaggon	
Manufacturer	Flexiwaggon AB, Sweden
Picture	 18
Applicability	Truck (from 9 m to 18.75 m length, max. 80 t)
Functional Principle	The swivel wagon is operated by hydraulics. Fully automated loading of the complete vehicle (incl. tractor). Unloading is also possible without a terminal. In contrast to MegaSwing, the trailers can be loaded forwards on the wagon and the tractor is carried along.

[18] https://www.flexiwaggon.se/what-does-the-mobile-truckstop-really-mean/

Capacity (handling time)	approx. 15 min per train (loading and unloading); loading and unloading on both sides possible (according to the manufacturer)
Area required	8m x length of the train (appr. 6.000 m^2)
Energy required	N/A
Investment Costs	Approximately 300.000 € per wagon, depending on equipment. More expensive than regular wagons: 0,45 €/km (according to the manufacturer)
Personnel	Personnel costs are low since the system is fully automated. One person can extend / swing out the wagon and, if necessary, another one can be deployed to drive the truck onto the wagon.
Parallel Handling	Yes
Fully automated	Yes
Special terminal infrastructure	No
Correspondence terminal	No
Combination with other systems	The system can be integrated in wagon group- and single wagon traffic
Parallel handling	Yes
Pro's	No additional terminal and no additional terminal infrastructure required. Loading and unloading on gravel possible. The vehicle can additionally be loaded and unloaded via three divergent options as well as under power lines. 80t vehicle load capacity.
Con's	Tractor unit accompanies the wagon, meaning that fewer semi-trailers can be transported and the proportion of dead load per container increases. The hydraulics of the wagons may be susceptible to maintenance; Experienced drivers required; Either time or personnel-intensive (depending on alignment)
More Information	http://www.flexiwaggon.se/

3.4 Conclusion Innovative Vertical and Horizontal Handling Technologies

The previous overview has shown promising technologies for handling semi-trailers that could potentially contribute to shifting the modal split in the Baltic Sea Region towards C, thereby strengthening CT and making the overall system less CO_2-intensive and therefore more environmentally friendly.

Although some of the handling technologies introduced above are in operation, particularly in France and Germany, the majority of these technologies is neither in the BSR nor in the rest of Europe in operation.

The main reasons for the lack of application of these technologies in the highly competitive freight market are the high investment, operation and maintenance costs. Particularly the horizontal technologies are often lacking economic competiveness compared to well-established vertical handling technologies, meaning that without subsidies from national governments and / or the European Commission most terminal operators are likely to decide against investing in innovative technologies.

Another bottleneck in terms of incorporating innovative transshipment systems in the terminal operation is the lack of compatibility with existing infrastructure in the terminal itself, especially with respect to track infrastructure and the wagon fleet since tailored wagons have to be purchased. Furthermore, the partly considerable space requirements of horizontal systems pose challenges concerning their implementation in existing terminal infrastructure. From an operational point of view, another challenge are dead weights, particularly in case of the RoLa system.

Despite the arguments outlined above, innovative vertical and horizontal systems capable of handling semi-trailers will have to play a vital role in pushing CT in the Baltic Sea Region. In light of the Green Deal recently introduced by the European Commission as well as other market instruments such as CO_2 prices on Greenhouse Gas emissions across all sectors soon to be introduced by several national governments, will help increasing the economic competitiveness of innovative handling technologies as well as Combined Transport as a whole.

A guideline featuring recommendations on the implementation of CT chains in the Baltic Sea Region will be drafted in context of Activity 2.2.

4 CONCLUSION

The cargo flow analysis has demonstrated that a significant road traffic exists with the BSR countries but also externally with other European countries. It proves that Combined Transport could play an essential role in the greening of transport, as expected at European level (with the newly adopted Green Deal) but also at national level (with the publication of national plans on logistics and transportation).
For the COMBINE project, it is essential that the results of this report are taken into consideration in the following other COMBINE activities:

- Activity 2.2 – concept for national and international combined transport chains with the BSR: (1) key requirements on the use of different types of equipment should be extracted with some key players of the different BSR countries (a workshop should be organized to collect the market requirements on this topic), (2) the design of supply chains should integrate at least several cases with semi-trailers and with containers/swap bodies.

- Activity 3.1 – benchmark analysis of terminal operation in the BSR: (1) the consultation with the terminals should integrate a qualitative assessment on the use of various types of units

(pros/cons) and verify with selected terminals the relevance (or not) of integrating innovative handling solutions such as listed in this report. (2) the consultation with the customers to collect their requirements should also point out the use of various types of loading units

- Activity 3.2 – increasing awareness, knowledge and acceptance of terminal handling and operation innovations: (1) creation of a video to visualizer the options in terms of ILU equipment and handling technologies (2) the developed visualisation tools should be made publicly available and also promoted in some PR materials

- Activity 4.3 – Feasibility of cross-border operation of innovative solutions: (1) the potential of EMS should include an analysis of the best combination possible with a mix-neutral combination (based on semi-trailer only and on container only) (2) the transport demand should be expressed in road consignments and in types of loading units

- Activity 5.1 – benchmarking of existing combined transport funding schemes: (1) one of the benchmark parameters should be the identification of financial support for ILU equipment (2) the same for the financial support of operations (terminals for example)

- Activity 5.2 – non-financial support to boost combined transport: (1) comparison of the BSR legal environment concerning road vehicles and combinations (2) collection of rules in terms of weights

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7 APPENDIX

EU Directive on Combined Transport – Comparison Table

Council Directive 92/106/EEC on the establishment of common rules for certain types of combined transport of goods between Member States *~ Consolidated text of 01/05/2004 ~*	**COM proposed revision text 2017/0290 (COD)**	**Aiuto Report (European Parliament position)**	**Austrian Presidency Compromise (European Council General Approach)**	*UIRR notes, comments, explanations*
Article 1 1. This Directive shall apply to combined transport operations, without prejudice to Regulation (EEC) No 881/92([1]). For the purposes of this Directive, 'combined transport' means the transport of goods between Member States where the lorry, trailer, semi-trailer, with or without tractor unit, swap body or container of 20 feet or more uses the road on the initial or final leg of the journey and, on the other leg, rail or inland waterway or maritime services where this section exceeds 100 km as the crow flies and make the initial or final road transport leg of the journey; — between the point where the goods are loaded and the nearest suitable rail loading station for the initial leg, and between the nearest suitable rail unloading station and the point where the goods are unloaded for the final leg, or	Article 1 1. This Directive applies to combined transport operations. 2. For the purposes of this Directive, 'combined transport' means carriage of goods by a transport operation, consisting of an initial or final road leg of the journey, or both, as well as a non-road leg of the journey using rail, inland waterway or maritime transport: (a) in a trailer or semi-trailer, with or without a tractor unit, swap body or container, identified in accordance with the identification regime established pursuant to international standards ISO6346 and EN13044, where the load unit is transhipped between the different modes of transport; or	(a) in a trailer or semi-trailer, with or without a tractor unit, swap body or container, identified in accordance with the identification regime established pursuant to international standards ISO6346 and EN13044, ***including cranable semi-trailers with a maximum gross weight allowance of 44***	1. This Directive applies to ***international*** combined transport operations. 2. For the purposes of this Directive, '***international*** combined transport' means carriage of intermodal loading units ***(loaded or empty)*** by a transport operation ***between Member States, or between Member States and a third country***, consisting of an initial or final road leg of the journey, or both, as well as one ***or more*** non-road legs of the journey using rail, inland waterway or maritime transport: ***Intermodal loading units shall be understood to be:*** (a) ***a*** trailer or semi-trailer, ~~with or~~ without a tractor unit, swap body or container, identified, in accordance with the identification regime established pursuant to international standards ISO6346 and EN13044, where the ***unaccompanied intermodal*** load***ing*** unit is	*While we disagree with sacrificing scope extension to domestic combined transport operations, we reluctantly accept this sacrifice* *44t semi-trailer can be omitted… otherwise EP language clearer than Council text*

— within a radius not exceeding 150 km as the crow flies from the inland waterway port or seaport of loading or unloading.	(b) by a road vehicle that is carried by rail, inland waterways or maritime transport for the non-road leg of the journey.	***tonnes,*** where the ***unaccompanied intermodal*** load unit is transhipped between the different modes of transport ***(unaccompanied combined transport operation)***; or (b) by a road vehicle that is ***accompanied by its driver and*** carried by rail, inland waterways or maritime transport for the non-road leg of the journey ***(accompanied transport operation)***.	transhipped between the different modes of transport; or (b) ***a*** road vehicle ***(a lorry with or without a trailer, or a semi-trailer with a tractor unit), or a non-cranable semi-trailer*** ~~that is~~ carried by rail, inland waterways or maritime transport for the non-road leg of the journey.	
	Non-road legs using inland waterway or maritime transport for which there is no equivalent road transport alternative or which are unavoidable in a commercially viable transport operation, shall not be taken into consideration for the purposes of the combined transport operations.	***By way of derogation, point (a) of this paragraph shall until [OJ please insert date 5 years after entry into force of this Directive] also cover non-cranable trailers and semi-trailers in unaccompanied combined transport that are not identified in accordance with the identification regime established pursuant to international standards ISO6346 and EN13044.*** Non-road legs using inland waterway or maritime transport for which there is no equivalent ***or commercially viable*** road transport alternative shall not be taken into consideration for the purposes of the combined transport operations.		*Derogation has been duly negotiated (LU, FR supports it…)*
			[NEW] ***2a. This Directive shall only apply to those combined transport operations in which at least one of the non-road legs has an equivalent viable road transport alternative and thus the total operation brings along modal shift in the Union.***	

	3. Each road leg referred to in paragraph 2 shall not exceed the longest of the following distances in the territory of the Union: (a) 150 km in distance as the crow flies; (b) 20% of the distance as the crow flies between the loading point for the initial leg and the unloading point for the final leg, when it amounts to more than the distance referred to in point (a). That road leg distance limit shall apply to the total length of each road leg, including all intermediary pick-ups and deliveries. It shall not apply to the transport of an empty load unit or to the pick-up point of the goods or from the delivery point of the goods. The road leg distance limit may be exceeded for combined road/rail transport operations, when authorised by the Member State or Member States on whose territory the road leg takes place, in order to reach the geographically nearest transport terminal which has the necessary operational transhipment capability for loading or unloading in terms of transhipment equipment, terminal capacity and appropriate rail freight services.	Each road leg referred to in paragraph 2 shall not exceed ***150 km in distance*** in the territory of the Union. ***Exceeding the road leg distance limit specified in this paragraph for combined road/rail transport operations shall be allowed by the Member State or Member States on whose territory the road leg takes place, if this is necessary in order to reach the geographically nearest transport terminal or transhipment point which has the necessary operational transhipment capability for loading or unloading, in terms of transhipment equipment, terminal capacity, terminal opening times and appropriate rail freight services, in the absence of a transhipment terminal or point fulfilling all of these conditions within the distance limit . Such excess should be duly justified in accordance with Article 3 paragraph 2, point ea.*** ***Member States may reduce the 150 km length of the road leg by up to 50% in the case of combined road/rail operations on a precisely defined part of their territory on the grounds of environmental reasons provided that a suitable terminal is located within that distance limit.***	***Each road leg referred to in paragraph 2 shall not exceed 150 km in distance as the crow flies;*** ***That road leg distance limit shall apply to the total length of each road leg, regardless of any intermediary pick-ups on the initial leg and deliveries on the final leg of the journey. The transport of empty loading units before an initial or after a final road leg (such as from or to a container depot) is not considered as part of a combined transport operation.***	*"crow flies" should stay… otherwise EP text is clearer* *Exceeding the maximum allowed distance should be possible on the prerogative of the CT Operator if there is no suitable terminal within 150km from the point of origin or to the final destination.* *The CTO should be obliged to justify the need to exceed in writing – and attach the justification to the transport documents that accompany the shipment..* *The suitability criteria should minimally conform to the four listed in the EP text.* *IN CASE the above two conditions (exceeding the maximum allowed fixed distance on the prerogative of the CTO – with justification – and the the 4 suitability criteria of the EP) are accepted: THEN the MS could be allowed to reduce the maximum allowed fixed distance by up to 50% with the EP conditions of (i) defining a finite part of their territory and (ii) reasons are provided. (+ notification to Commission)*

			[NEW] ***3a. If a road/rail terminal suitable in terms of transhipment equipment and/or terminal***	*NO*

			capacity cannot be found within a distance of 150 km as the crow flies, this road leg distance limit may be exceeded for combined transport operations, in order to reach the geographically nearest suitable transport terminal which has the necessary operational transhipment capability in accordance with rules specified by the Member States. For this purpose, Member States shall identify if the necessary operational transhipment capability is not available and identify the suitable alternatives. Member States shall publish these rules.	
			[NEW] ***3b. A Member State may decide not to apply the support measures provided in Article 6 of this Directive to a road leg which is transiting its territory without loading or unloading freight.***	*NO*
	4. A combined transport operation shall be deemed to take place in the Union where the operation or the part thereof taking place in the Union fulfils the requirements laid down in paragraphs 2 and 3.	4. A combined transport operation shall be deemed to take place in the Union where the operation or the part thereof taking place in the Union fulfils the requirements laid down in paragraphs 2 and 3. ***For the purpose of this Directive, the road leg and/or non-road leg or the part thereof taking place out of the territory of the Union shall not be considered to be part of the combined transport operation.***	***4. Where a combined transport operation starts and/or ends outside of the Union, this Directive shall apply to the part of the operation in the Union if:*** ***(a) the part of operation taking place in the Union fulfils the requirements laid down in paragraphs 2, 2a and 3, 3a and 3b and*** ***(b) the non-road leg that crosses a Union border is at least 100 km long in the Union.***	

Appendix - External BSR unaccompanied traffic (highlighted in yellow = relevant traffic)

Country	Austria	Belarus	Belgium	CIS	Croatia	Czech Republic	Denmark	Estonia	Finland	France	Greece	Hungary	Italy (Total)	Latvia	Lithunia	Luxemburg	Netherlands	Norway	Poland	Portugal	Romania	Russia	Slovakia	Slovenia	Spain	Sweden	Other World
Austria	23	0	12.671	0	0	7.555	0	0	7.368	2.915	13.861	326	75.303	0	0	22	27.336	0	25.127	0	13.942	0	4.138	47.661	24	78	0
Belarus	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0
Belgium	4.322	0	0	56	858	5.949	314	0	952	9.526	0	4.994	412.856	0	20	51	113	8	887	0	24.219	702	628	0	57.366	64.656	168
Bosnia and Herzegowina	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Bulgaria	-	0	443	0	0	0	0	0	0	2	0	0	0	0	0	2	372	0	0	0	2.245	0	0	0	0	0	0
CIS	-	0	128	0	0	0	0	0	0	0	0	0	0	54.329	0	0	0	0	28	0	0	0	0	0	0	0	0
Croatia	-	0	0	0	0	0	0	0	0	0	0	20.768	0	0	15	0	0	2	0	0	0	0	0	1.985	0	0	0
Czech Republic	84.861	0	528	0	0	0	0	0	226	40	13.902	803	22.027	0	0	2	112.715	0	923	0	162	0	5.176	31.567	0	66	0
Denmark	1.852	0	0	0	0	0	0	0	0	0	6	6	35.229	0	0	0	0	0	0	0	12	0	0	0	4	0	16
Estonia	-	0	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.182	0	0	0	0	0
Finland	-	0	0	0	0	0	0	0	0	4.224	132	332	0	0	0	0	1.504	0	2	0	10	0	0	0	1.896	0	10
France	1.771	0	57.366	0	0	49	102	0	0	0	26	154	150.875	0	0	132.668	8.887	74	132	0	0	31.052	72	20	600	3.452	12
Greece	959	0	840	0	0	4.364	0	0	0	0	0	573	0	0	0	12	0	4	0	0	0	0	798	0	0	120	0
Hungary	7.574	0	0	0	14.792	101	0	0	0	0	3.845	9	26.799	0	0	6	697	600	82	0	7.199	204	0	46.832	0	0	0
Latvia	-	0	0	0	0	0	0	1.082	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithunia	-	0	10	0	20	0	0	0	0	0	0	0	112	0	0	0	0	0	60	0	0	0	0	0	0	0	0
Luxemburg	-	0	43.521	0	6	0	0	0	90	72.369	0	0	35.463	0	0	0	0	0	0	0	0	0	4	0	0	0	2
Netherlands	13.129	0	14	0	664	339	0	0	0	4.866	554	3.146	201.365	0	0	0	0	0	909	0	7.459	258	388	1.676	819	35.657	0
Norway	554	0	0	0	0	0	0	0	0	0	0	0	12	0	0	2	7.726	0	0	0	0	0	0	0	44	721	0
Poland	25.111	152	6.453	22	0	15.668	0	0	0	61	0	0	1.062	0	662	0	42.955	0	0	0	0	400	0	7.687	319	30	0
Portugal	-	0	0	0	0	0	0	0	362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.629	24	0
Romania	12.626	0	24.422	0	0	0	0	0	0	3.734	0	367	5.954	0	0	212	254	262	6	0	0	9.295	0	0	0	3.828	0
Russia	-	0	638	0	0	309	309	1.794	0	0	0	318	64	0	0	0	412	0	198	0	0	0	3.989	318	4	0	0
Slovakia	45.537	640	2.155	237	12	17.005	0	0	464	211	5.309	2.275	630	0	0	0	0	1.574	916	0	6	622	0	162.888	0	0	0
Slovenia	20.248	0	108	0	440	53.852	0	0	48	0	0	170.945	1.449	0	0	22	0	54	11.819	0	0	400	157.034	0	0	0	0
Spain	-	0	86.451	0	0	0	0	0	0	0	0	0	15.003	0	0	90	5.446	0	188	35.828	108	10	0	0	0	2	0
Sweden	-	0	466	0	20	0	10	0	0	0	0	5.824	14.442	0	0	184	5.189	8.194	56	0	0	0	1.852	2.236	176	0	182
Switzerland	11.406	0	32.201	185	0	834	13	0	167	22	0	6	9.798	0	0	0	13.916	336	0	0	0	0	6	0	224	6	0
United Kingdom	-	0	0	0	0	8	0	0	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	13.474	0	0	
Other World	-	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	122	0	0	0	0	0	0	0	0	0	16.583
Italy (Total)	61.206	258	301.838	21	0	21.751	17.872	0	17.962	96.807	0	27.677	0	0	63	613	25.666	3.824	9.591	0	8.067	2	947	0	703	42.516	0

COMBINE

Interreg Baltic Sea Region

EUROPEAN UNION

EUROPEAN REGIONAL DEVELOPMENT FUND

Appendix – UIRR O/D Matrix (UIRR annual report 2018)

Relations from	to	Consignments C	Consignments-km S*km	Average Distance	Average Weight t/C	Gross Weight t	Tonne-km	Techniques, % consignments ST	SB/CT <8,30m	SB/CT >8,30m	RoMo
Country							1,000 tkm				
AT	BE	2,247	2,579,665	1,148	15	33,153	37,972		20%	80%	
BE	AT	2,892	3,388,788	1,397	45	72,059	84,392		28%	72%	
AT	CH	8,475	4,915,500	580	15	127125	73733		50%	50%	
CH	AT	8,456	4,904,480	580	15	126840	73567		50%	50%	
AT	DE	52,351	52,428,564	1,001	21	1,084,598	1,098,531	11%	33%	56%	
DE	AT	45,328	44,188,257	975	21	950,062	921,361	12%	37%	51%	
AT	ES	6	11,370	1,895	31	186	351			100%	
AT	FR	120	240,000	2,000	29	3512	7024			100%	
FR	AT	10	20,000	2,000	16	163	326			100%	
AT	HU	2,384	1,084,720	455	15	35760	16271		50%	50%	
HU	AT	6,200	2,980,940	336	15	93,000	31,208		50%	50%	
AT	IT	26,916	10,459,022	389	27	721,715	279,992	10%	12%	16%	62%
IT	AT	34,546	11,704,546	339	23	795,710	286,356	7%	20%	24%	49%
AT	NL	3,307	3,370,412	1,019	17	54,741	56,438	1%	47%	52%	
NL	AT	6,704	6,343,207	946	16	107,729	104,295	1%	49%	50%	
AT	RO	1	1,270	1,270	28	28	36		100%		
RO	AT	2	2,217	1,478	8	11	17		100%		
AT	RS	1,628	742,368	456	19	3146	14346		6%	94%	
RS	AT	1,690	770,640	456	33	55,770	25,431		13%	87%	
AT	SI	33,126	9,958,856	301	27	883,813	274,948		55%	10%	35%
SI	AT	21,489	6,403,361	298	30	638,252	201,864		36%	10%	54%
AT	SK	88	23,320	265	15	1320	350		50%	50%	
AT	IT	31	88,128	2,889	14	437	1261		71%	29%	
BE	BG	49	125,386	2,559	29	1414	3617		100%		
BG	BE	15	36,365	2,508	7	97	243		100%		
BE	CH	17,785	12,801,340	720	22	386,870	277,578		67%	33%	
CH	BE	17,196	12,395,264	721	14	240,543	173,855		55%	45%	
BE	CH	10	8,318	8,132	27	273	2,218			100%	
BE	CZ	442	430,021	974	13	5425	5478		52%	48%	
CZ	BE	455	443,170	974	26	11762	11456		76%	24%	
BE	DE	14,322	8,968,792	626	24	344,076	215,840		62%	38%	
DE	BE	15,965	11,062,808	697	19	297,292	207,153		64%	36%	
BE	ES	15,216	22,525,730	1,480	28	424,242	628,062		62%	38%	
ES	BE	12,581	20,193,439	1,605	21	263,447	424,663		66%	34%	
BE	FR	23,929	11,062,844	677	20	480,570	353,684		42%	58%	
FR	BE	21,452	14,640,577	682	20	428,128	292,738		37%	63%	
BE	IE	1	5,852	5,852	7	7	41		100%		
BE	IT	141,299	158,158,785	1,119	26	3,705,561	4,135,796	19%	26%	55%	
IT	BE	133,115	155,487,930	1,168	23	3,003,658	3,506,814	20%	22%	58%	
BE	KZ	43	228,983	5,325	28	1,217	6,478		100%		
KZ	BE	12	70,680	5,890	8	90	532		100%		
BE	LT	1	2,642	2,642	11	11	30		100%		
BE	LU	18,010	5,852,876	325	19	341,630	111,760	2%	68%	30%	
LU	BE	15,016	4,879,680	325	13	197,777	66,540	3%	59%	38%	
BE	NL	253	43,803	173	16	4,150	722		71%	29%	
NL	BE	643	76,559	119	28	17,902	2,127		73%	27%	
BE	PL	5,055	5,838,439	1,155	28	143,201	165,481		54%	46%	
PL	BE	3,782	4,931,781	1,304	10	39,534	51,553		56%	44%	
BE	RO	12,864	21,778,005	1,693	24	308,763	522,691	12%	14%	74%	
RO	BE	11,656	19,815,199	1,700	20	231,878	391,986	11%	4%	85%	
BE	BU	450	1,069,557	2,377	31	13933	33117		95%	5%	
RU	BE	303	670,318	2,212	16	4,995	11,051		97%	3%	
BE	SE	2,081	1,986,878	955	26	55053	52538	12%	47%	41%	
SE	BE	1,104	1,053,843	955	10	10588	10112	6%	27%	67%	
BE	SK	277	357,238	1,292	28	7840	10129		99%	1%	
SK	BE	91	116,280	1,292	8	712	915		96%	4%	
BE	UZ	4	21,284	5,321	28	112	594		100%		
UZ	BE	3	17,424	5,808	8	23	134		100%		
BG	DE	7	16,341	2,514	8	49	124		75%	25%	
DE	BG	18	37,181	2,065	29	517	1067		65%	35%	
CH	DE	21,702	13,430,193	619	15	322,987	200,060	26%	46%	28%	
DE	CH	34,321	21,806,060	1,872	78	876,454	554,744	18%	58%	24%	
CH	DK	19	22,287	1,173	25	483	567		100%		
DK	CH	33	38,709	1,173	7	242	284		100%		
CH	ES	143	256,448	1,800	27	3838	6908		99%	1%	
CH	FR	18	20,988	1,166	19	348	405		100%		
CH	IT	803	267,231	296	13	11,771	3,485		54%	46%	
IT	CH	1,892	549,850	291	25	46,870	13,621		55%	45%	
CH	NL	8,258	7,546,586	914	20	165,623	151,364	1%	67%	32%	
NL	CH	8,393	7,439,414	886	19	167,555	144086		62%	38%	
CH	NO	43	71,314	1,798	30	1306	2348	100%			
NO	CH	12	21,576	1,798	20	237	427	67%	33%		
CH	SE	6	8,822	1,137	29	172	195	100%			
SE	CH	2	4,702	1,404	27	82	115		100%		
CN	IE	19,360	204,584,500	10,568	21	397,280	4,224,892		9%	91%	
DE	CN	21,124	224,921,959	10,648	21	433,718	4,663,088		10%	90%	
RU	3	23,118	7,706	11	34	259		100%			
RU	CN	10	78,530	7,853	28	283	2220		100%		
CZ	SK	5,092	1,879,936	768	15	75780	58199		50%	50%	
IT	CZ	4,944	3,796,992	768	15	74160	56955		50%	50%	
CZ	PL	1,331	918,390	690	15	19965	13776		50%	50%	
PL	CZ	1,330	917,700	690	15	19950	13766		50%	50%	
CZ	RU	9,744	8,282,400	850	15	146160	124236		50%	50%	
RU	CZ	9,744	8,282,400	850	15	146160	124236		50%	50%	
CZ	SI	6,003	5,129,023	854	14	83220	71104		100%		
SI	CZ	5,922	5,061,297	855	13	79,757	68,166		100%		
CZ	DE	26,552	21,089,917	794	16	417980	329,213	15%	50%	35%	
DE	CZ	27,143	21,943,209	803	19	520,968	405,570	19%	43%	38%	
CZ	SK	7	2,730	390	20	137	53		100%		
DE	BY	3	1,805	1,805	23	23	41		38%	62%	
DE	SK	2,773	3,048,098	1,099	36	98,758	108,760	12%	42%	46%	
DK	DE	1,869	1,282,095	686	7	12,399	8,755	9%	21%	68%	
DE	ES	14,201	29,082,404	1,307	26	496,050	1,016,148		62%	38%	
ES	DE	21,591	29,411,192	1,362	18	388,679	529,483		95%	5%	
DE	FR	16,497	14,610,745	886	20	325,191	314,488		58%	42%	
FR	DE	14,737	12,934,679	878	18	311,862	262,637	1%	54%	45%	
DE	GR	707	1,717,117	2,429	30	21309	51755	2%	89%	9%	
GR	DE	310	761,085	2,455	9	2900	7119	1%	95%	4%	
DE	HR	1	475	950	8	4	4		100%		
HR	DE	4	3,748	937	7	29	29		100%		
DE	SI	5,505	6,308,489	1,146	17	93,250	106,688		52%	48%	
HU	DE	15,123	19,006,877	1,257	18	277,527	350,789		71%	29%	
DE	IT	408,256	335,617,902	822	27	11,084,175	9,056,515	34%	29%	25%	12%
IT	DE	301,471	238,822,324	792	22	6,651,780	5,041,414	30%	27%	27%	16%
DE	KZ	9	44,589	4,954	27	242	1,198		100%		
KZ	DE	2	9,065	4,533	8	15	68		100%		
DE	NL	48,571	32,465,332	527	22	1,181,834	722,247	6%	52%	42%	
NL	DE	49,958	32,094,469	442	19	964,394	435,166		49%	51%	
DE	NO	560	836,066	1,493	27	15,198	22690	3%	67%	30%	
NO	DE	603	826,950	1,371	21	12,773	17,845	7%	58%	35%	
DE	PL	7,865	6,991,065	889	30	234,895	209,897	4%	48%	48%	
PL	DE	4,583	5,260,336	1,148	10	45,602	52,074	2%	55%	43%	
DE	PT	132	342,737	2,596	27	3567	9262		65%	35%	
PT	DE	60	163,947	2,732	7	402	1098		70%	30%	
DE	RO	910	1,244,032	1,368	28	25445	34393			100%	
RO	DE	605	546,404	903	16	9388	8479			100%	
DE	RS	77	145,373	1,900	23	1788	3,360		100%		
RS	DE	132	321,707	2,446	15	2,037	5,019		100%		

Relations from	to	Consignments C	Consignments-km S*km	Average Distance	Average Weight t/C	Gross Weight t	Tonne-km	Techniques, % consignments ST	SB/CT <8,30m	SB/CT >8,30m	RoMo
Country							1,000 tkm				
DE	RU	3,738	10,701,086	2,864	16	61,392	177,464		42%	58%	
RU	DE	3,709	10,607,901	2,860	16	61,120	172,583		31%	69%	
DE	SE	30,555	29,691,329	972	25	768,028	746,484	62%	11%	21%	
SE	DE	26,829	26,633,617	993	21	571,671	566,825	64%	16%	20%	
DE	SI	7,924	7,702,798	972	20	158,749	148,954		58%	42%	
SI	DE	7,191	6,929,424	965	13	95,132	94,446		63%	37%	
DE	SK	1,170	1,290,428	1,103	20	23,862	31,844		57%	43%	
SK	DE	1,022	981,168	968	15	15,142	14,471		51%	49%	
DE	TR	6,761	16,958,648	2,508	22	150,392	400,476		70%	30%	
TR	DE	5,121	12,132,988	2,369	13	64,558	145,100		67%	33%	
DE	UZ	5	23,045	4,609	26	132	607		100%		
UZ	DE	1	4,438	4,438	8	8	34		100%		
DK	IT	4,767	5,535,083	1,161	29	136945	159090		100%		
IT	DK	4,573	6,508,950	2,887	57	21,700	173,266		97%	3%	
ES	IT	1,933	2,150,122	1,112	27	52393	58278		80%	20%	
IT	ES	1,318	1,487,999	1,129	21	27769	31351		100%		
ES	NL	352	621,608	1,766	12	4,144	7,095				
NL	ES	920	1,891,861	2,056	29	26,423	54,567		75%	25%	
ES	PL	48	116,016	2,417	29	1391	3363			100%	
PL	ES	25	57,599	2,304	28	690	1589		24%	76%	
ES	RO	32	108,640	3,395	29	914	3103	9%	91%		
ES	RU	3	6,751	2,700	26	66	178		75%	25%	
RU	ES	2	4,134	2,067	30	59	121		97%	3%	
ES	SE	3	6,166	2,055	27	81	168		67%	33%	
SE	ES	2	3,983	1,994	27	82	164		67%	33%	
FR	IT	29,662	26,839,609	1,812	27	805,987	729,715	2%	54%	44%	
IT	FR	30,325	27,934,910	921	18	559,837	519,813	2%	54%	44%	
FR	LU	9,301	3,269,637	352	17	156,132	47,343	35%	35%	30%	
LU	FR	10,509	3,803,077	362	24	252,738	98,020	31%	41%	28%	
FR	NL	2,028	2,536,669	1,251	15	31,233	39,544		80%	20%	
NL	FR	1,593	1,959,982	1,230	20	40,304	49,862		57%	43%	
FR	PL	69	94,128	1,367	31	2130	2912		100%		
PL	FR	30	47,495	1,600	4	117	188		100%		
GR	CZ	4,429	2,878,850	650	15	66435	43183		50%	50%	
GR	HU	4,174	7,095,800	1,700	15	62610	106437		50%	50%	
HU	GR	3,786	6,436,200	1,700	15	56790	96543		50%	50%	
HR	HU	5,034	3,021,060	600	8	37,854	23,099		63%	37%	
HU	HR	5,657	3,388,630	599	7	36,785	22,468		48%	52%	
HR	RS	604	362,400	600	13	7852	4711		42%	58%	
RS	HR	719	431,400	600	14	10069	6040		38%	62%	
HR	SI	866	208,509	241	10	8,929	2,346		71%	29%	
SI	HR	220	16,405	75	15	3,278	244		100%		
HU	BE	1	1,296	1,592	7	3	9		79%	21%	
HU	IT	19,630	11,292,289	575	15	287,820	166,132		50%	50%	
IT	HU	16,882	9,697,744	574	15	257,363	148,074		50%	50%	
HU	NL	1,107	1,801,104	1,628	21	23,548	38,650		74%	26%	
NL	HU	2,128	2,971,525	1,397	23	48,506	67,704		61%	39%	
HU	RO	936	596,413	637	21	19,022	9,334	13%	28%	59%	
RO	HU	1,245	844,167	678	12	15,245	11,843	2%	37%	60%	
HU	RS	7	3,549	353	29	205	2		100%		
RS	HU	2	1,059	706	8	12	8		100%		
HU	SI	3	7,035	2,345	23	69	162		78%	22%	
SI	HU	7	12,846	1,976	13	86	163		62%	38%	
HU	SI	11,893	7,872,474	662	14	170,196	112,489		96%	4%	
SI	HU	34,284	20,021,334	584	15	513,213	299,628		81%	19%	
HU	SK	10,010	2,652,650	265	15	150150	39790		50%	50%	
SK	HU	4,642	1,202,650	259	15	69,630	18,040		50%	50%	
HU	TR	7,979	9,574,800	1,200	15	119685	143622		50%	50%	
TR	HU	8,144	9,772,800	1,200	15	122160	146592		50%	50%	
IE	PL	1	3,947	3,947	7	7	28		100%		
HU	BY	135	83,920	624	20	2,685	1,675		38%	62%	
IT	CN	2	22,122	11,061	23	47	517			100%	
IT	LU	8,704	10,671,104	1,226	19	162796	199588	98%		2%	
LU	IT	8,461	10,373,186	1,226	24	202,831	248,671	98%		2%	
IT	NL	51,047	63,280,560	1,240	23	1,185,434	1,468,452	20%	31%	49%	
NL	IT	53,883	54,804,972	1,017	26	1,401,964	1,422,284	12%	35%	53%	
IT	PL	207	382,545	1,848	28	10,556	5,776		2%	98%	
PL	IT	19	39,549	2,082	25	477	993		7%	93%	
IT	RO	3,009	3,830,144	1,273	26	78262	100256			100%	
RO	IT	3,117	3,972,050	1,274	8	33212	42323			100%	
IT	SE	5,346	9,786,154	1,831	27	145,252	266,151	48%	21%	25%	
SE	IT	5,348	8,471,265	1,584	30	159,240	253,951	52%	28%	20%	
IT	TR	1,257	2,322,779	1,848	28	35821	66193		17%	83%	
TR	IT	1,286	2,772,292	2,160	5	6474	13981		4%	96%	
KZ	NL	1	1,875	3,750	8	4	15		100%		
NL	KZ	1	3,321	3,321	28	28	92		100%		
KZ	PL	20	88,561	4,428	8	155	685		100%		
PL	KZ	20	87,272	4,364	28	565	2466		100%		
MK	RS	2,462	2,090,238	849	26	64077	54391		4%	96%	
RS	MK	2,742	2,327,958	849	22	59118	50,191		2%	98%	
NL	BG	8	11,816	1,477	26	205	303		64%	36%	
NL	PL	530	668,860	1,262	16	8,243	10403		64%	36%	
PL	NL	234	336,294	1,437	8	1866	2682		56%	44%	
NL	RO	628	845,288	1,346	27	17026	23052		64%	36%	
RO	NL	53	57,902	1,092	8	420	459			100%	
NL	RS	128	168,576	1,317	29	3693	4863		100%		
RS	NL	5	8,530	1,706	9	39	66		100%		
NL	RU	145	307,255	2,119	31	4549	9640		100%		
RU	NL	150	497,181	3,315	29	4429	14,697		97%	3%	
NL	SE	1	1,046	1,046	31	31	32		100%		
SE	NL	24	21,600	900	30	720	648		100%		
NL	TU	2	4,434	2,217	27	54	120		75%	25%	
NO	IT	19	29,840	1,613	29	534	862		80%	20%	
PL	RU	180	636,090	3,534	28	4963	17538		100%		
RU	PL	88	307,177	3,491	8	666	2325		97%	3%	
PL	SE	9	14,490	1,610	4	36	57		58%	42%	
SE	PL	18	32,490	1,805	31	557	1005		58%	42%	
PL	SI	2,600	2,633,800	1,013	15	39000	39507		5%	95%	
SI	PL	3,880	3,930,440	1,013	20	77600	78609		5%	95%	
PL	TR	235	493,500	2,100	15	3525	7403		50%	50%	
TR	PL	328	688,800	2,100	15	4920	10332		50%	50%	
RS	SI	159	84,976	534	3	544	291		100%		
SI	RS	200	86,320	432	20	3,914	1689		100%		
RU	IT	53	103,515	1,953	30	1569	3064		97%	3%	
RU	SK	17,974	35,049,300	1,950	15	269610	525740		50%	50%	
SK	RU	21,460	41,847,000	1,950	15	321900	627705		50%	50%	
SK	DK	1	591	591	30	30	18		100%		
SI	IT	365	96,572	265	3	1,109	293		100%		
SI	SK	14,748	11,768,167	798	13	186031	148444		100%		
SK	SI	11,084	9,079,791	819	2	82354	67463		100%		
UZ	NL	3	20,424	6,808	8	23	155		100%		

TOTAL	2,451,080	2,588,518,636	1,056	22	54,122,332	56,391,587	17%	39%	38%	6%

Note: The total figure does not reflect the cross-border volumes of Metrans

Appendix – UIRR O/D Matrix – extract on BSR countries

from	to	Consignment	TEU	Consignments-km	Average Distance	Average Weight	Gross Weight	Tonnes-km	Semi-trailer	Containe	Containe	RoMo
BE	LT	1	2	2.642	2.642	11	11	30		100%		
BE	PL	5.055	10.109	5.838.439	1.155	28	143.201	165.411		54%	46%	
PL	BE	3.782	7.564	4.931.781	1.304	10	39.534	51.553		56%	44%	
BE	SE	2.081	4.161	1.986.878	955	26	55013	52538	12%	47%	41%	
SE	BE	1.104	2.207	1.053.843	955	10	10588	10112	6%	27%	67%	
CH	DK	19	38	22.287	1.173	25	483	567		100%		
DK	CH	33	66	38.709	1.173	7	242	284		100%		
CH	SE	6	12	6.822	1.137	29	172	195	100%			
SE	CH	3	6	4.212	1.404	27	82	115		100%		
CZ	PL	1.331	2.662	918.390	690	15	19965	13776		50%	50%	
PL	CZ	1.330	2.660	917.700	690	15	19950	13766		50%	50%	
DE	DK	2.773	5.545	3.048.098	1.099	36	98.758	108.760	12%	42%	46%	
DK	DE	1.869	3.737	1.282.095	686	7	12.399	8.755	9%	23%	68%	
DE	PL	7.865	15.730	6.991.065	889	30	234.895	209.897	4%	48%	48%	
PL	DE	4.583	9.165	5.260.336	1.148	10	45.602	52.074	2%	55%	43%	
DE	SE	30.555	61.109	29.691.329	972	25	768.028	746.484	62%	17%	21%	
SE	DE	26.829	53.657	26.630.617	993	21	571.671	566.825	64%	16%	20%	
DK	IT	4.767	9.534	5.535.083	1.161	29	136945	159010		100%		
IT	DK	4.573	9.145	6.508.950	2.887	57	121.700	173.266		97%	3%	
ES	PL	48	96	116.016	2.417	29	1391	3363			100%	
PL	ES	25	50	57.599	2.304	28	690	1589		24%	76%	
ES	SE	3	6	6.166	2.055	27	81	168		67%	33%	
SE	ES	3	6	5.983	1.994	27	82	164		67%	33%	
FR	PL	69	138	94.328	1.367	31	2130	2912		100%		
PL	FR	30	59	47.495	1.610	4	117	188		100%		
IR	PL	1	2	3.947	3.947	7	7	28		100%		
IT	PL	207	414	382.545	1.848	28	5.711	10.555		2%	98%	
PL	IT	19	38	39.549	2.082	25	477	993		7%	93%	
IT	SE	5.346	10.691	9.786.154	1.831	27	145.252	266.151	48%	27%	25%	
SE	IT	5.348	10.695	8.471.265	1.584	30	159.240	253.951	52%	28%	20%	
KZ	PL	20	40	88.561	4.428	8	155	685		100%		
PL	KZ	20	40	87.272	4.364	28	565	2466		100%		
NL	PL	530	1.060	668.860	1.262	16	8243	10403		64%	36%	
PL	NL	234	468	336.294	1.437	8	1866	2682		56%	44%	
NL	SE	1	2	1.046	1.046	31	31	32		100%		
SE	NL	24	48	21.600	900	30	720	648		100%		
PL	RU	180	360	636.090	3.534	28	4963	17538		100%		
RU	PL	88	176	307.177	3.491	8	666	2325		97%	3%	
PL	SE	9	18	14.490	1.610	4	36	57		58%	42%	
SE	PL	18	36	32.490	1.805	31	557	1005		58%	42%	
PL	SI	2.600	5.200	2.633.800	1.013	15	39000	39507		5%	95%	
SI	PL	3.880	7.760	3.930.440	1.013	20	77600	78609		5%	95%	
PL	TR	235	470	493.500	2.100	15	3525	7403		50%	50%	
TR	PL	328	656	688.800	2.100	15	4920	10332		50%	50%	
SE	DK	1	2	591	591	30	30	18		100%		

Terminal	Main City nearby	Country	Opening year	Number of opening LOHR stations	Semi-trailers transport Services from the Terminal	Number of Semi-Trailers handled in 2018	TEU loaded in 2018 (twenty-foot Equivalent Unit) (1 Semi-Trailer = 2,25 TEU)	Maximum capacity in number of Semi-Trailers per year
Aiton	Chambery	France	2003	28 stations	Aiton – Orbassano	32.200 S.T./year	72.450 TEU/year	134.400 S.T./year
Orbassano	Torino	Italy	2003	28 stations	Orbassano – Aiton Orbassano – Calais	40.000 S.T/year	90.000 TEU/year	134.400 S.T./year
Bettembourg	Luxembourg	Luxembourg	2007	20 stations	Bettembourg – Le Boulou	*traffic transferred to Dudelange in 2017*	-	-
Le Boulou	Perpignan	France	2007	20 stations	Le Boulou – Bettembourg Le Boulou – Calais Le Boulou – Mâcon	49.400 S.T./year	111.150 TEU/year	120.000 S.T./year
Calais	Calais	France	2015	10 stations	Calais – Le Boulou Calais – Orbassano Calais – Mâcon	16.200 S.T./year	36.450 TEU/year	96.000 S.T./year
Dudelange	Luxembourg	Luxembourg	2017	84 stations	Dudelange – Le Boulou Dudelange – Port de Sète Dudelange – Barcelona	51.800 S.T./year	116.550 TEU/year	300.000 S.T./year