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BRAIN-TRAINS: Intermodal rail freight transport and hinterland connections

A SWOT analysis to assess the Belgian rail practice

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Abstract

This paper focuses on transversal research of the role and influences of rail freight transport, as a part of intermodal transport in Belgium. The scope of the research concentrates on port hinterland flows. A large SWOT analysis of the current situation is conducted, starting from the actual weak usage of this mode of transport. Five different fields have been identified, impacting the economy and society. Each field indicates critical internal strengths and weaknesses for intermodal rail transportation in Belgium, and identifies possible future developments and setbacks. A Delphi-like approach is used, including a heterogeneous panel of experts discussing and validating the SWOT results. To prioritize the characteristics, a survey on the different SWOT elements was performed, asking the experts to rate each statement on its influence and likelihood of happening (level of uncertainty).

Keywords: intermodality, rail freight, value added, sustainability, regulation, governance.

1 Introduction

In 2011, the European Commission has set some very ambitious goals within its White Paper, in order to reach a more efficient and sustainable balance between the different modes of transport. The main strategy of the Commission is to encourage rail and waterborne transport, and to lower the dominant position of road transport in Europe. By 2030, it is the ambition to decrease the share of road freight with distances over 300 km by 30%. This shift is foreseen to go up to 50% by 2050. In order to do so, the White Paper anticipates on the development of a European Single Transport Area, including optimal connections and fixed corridors, increasing the possibilities to efficiently shift from one mode to another (European Commission, 2011). Reviewing the existing literature and analyzing the available statistical data on the three major inland transportation modes, it is clear that road transport is the dominant mode in Belgium, holding a market share of 70.6% in 2012, measured as a percentage of the total ton-kilometers (tkm). Inland waterways and rail reach a market share of respectively 17.1% and 12.3%[1] (Eu-

[1]This includes conventional cargo and block trains, where rail freight trains run directly between the port and companies with an on-site rail connection, without transhipment to another mode of transport. According to Grosso (2011), Intermodal transport can be defined as "the movement of goods in one and the same loading unit or vehicle, which uses successfully several modes of transport without handling of the goods themselves in

rostat, 2014). In order to increase the use of more sustainable modes of transport, such as the latter two, an improved interoperability between the modes of transport is required, lifting the attractiveness of intermodal transport in general (European Commission, 2011; Gevaers *et al.*, 2012).

This paper is focusing on the development and results of a SWOT analysis concerning the current state of intermodal rail freight transportation in Belgium. Special attention is given to the link with port hinterland connections. In 2013, freight transport from and towards the Flemish ports generated 71.3% of the total rail freight transport of the main (national) operator in Belgium, equalling 29.3 million tonnes (Merckx and Neyts, 2013). The analysis is part of a transversal research of the role and influences of rail transport intermodality in Belgium, projected in BRAIN-TRAINS[2]. A starting point is the current relatively weak usage of this mode of transport in Belgium and the European continent in general. The goal of this analysis is to create a threshold, from which it is possible to start the identification of the impact of a changed environment, leading to a change in the use of intermodal rail freight[3]. The strengths-weaknesses analysis, as well as the opportunities-threats analysis, are therefore concentrated around five main subjects:

- Optimal corridor and hub development.
- Macro-economic impact of intermodality.
- Sustainability impact of intermodality.
- Effective market regulation for a well-functioning intermodality.
- Governance and organization for a well-functioning intermodality.

These five areas are not selected randomly, as they are linked to the different actors involved in the network of intermodal rail freight transportation, creating synergies and added value. When the relations between rail freight actors with a transport contract are analyzed from the point of view of payment flows, each logistics chain will start with a transport order from the party responsible for the delivery of the cargo. They are the demanding party in the transport market. Depending on the volume, this order can be placed directly at a rail company, but can also be distributed towards an (integrated) logistics service provider, a shipping agent or an intermodal rail freight organizer. They will organize the flow of goods until the destination. In order to execute the first mile or last mile of the transport in the hinterland, contact with transport companies will be sought by these parties. The rail terminal operator is responsible for the operations on the transhipment terminal and can be contacted directly by the rail company, as well as by the different parties involved in the organization of the most optimal cargo stream to destination. In addition, the rail company is also linked to a number of suppliers. The

transshipment between the modes". In this respect, the share of intermodal rail transport is even lower.

[2]Belgian Research Action through Interdisciplinary Networks - TRansversal Assessment of new INtermodal Strategies - https://www.brain-trains.be

[3]In the next phase of the BRAIN-TRAINS project, the presented SWOT analysis will lead to a number of plausible scenarios, as a common interdisciplinary starting point for further analysis. These results will be integrated and analyzed, in order to create indicators for intermodal rail transport development in Belgium.

infrastructure manager is in charge of the distribution of network capacity and the maintenance of the infrastructure. Rail companies have to pay a fee to the infrastructure manager for the use of the network. Banks and insurance companies deliver the necessary financial support for investment in rail equipment. This equipment is often produced by rail suppliers, who are the last important actor in the chain of rail freight transportation. It should be clear that, although all actors are crosswise related to these fields, some show stronger relationships with one or more topics. For example, the railway infrastructure manager will have a direct interest in the optimal corridor and hub development. With the current selection of research areas, all interests of the different players are incorporated in the analysis of the current state. In addition, by developing the SWOT for intermodal rail freight from an interdisciplinary approach, both scientific, sectoral as well as policy-related added value can be generated. Scientifically, as existing research is mainly focusing on one mode of transport, not taking into account the full chain perspective. Sectoral, as rail transport companies are still working in isolation, with no or little co-operation. For policy-makers, as the responsibilities for intermodal rail transportation in Belgium are split over different levels (regional, federal and European), ideally all supporting and working towards the same end result.

In section 2, an overview is given on the methodology used to establish the SWOT analysis. A variation of the Delphi method is combined with a qualitative literature study and a quantitative survey on the importance and likelihood of the different identified characteristics of intermodal rail transport. The results of this analysis are summarized in section 3. Some final conclusions are made in section 4.

2 Methodology

This section discusses the used methodology for the creation of the SWOT. An adaptation of the Delphi technique is combined with a statistical analysis of the survey results.

2.1 Adaptation of the Delphi technique

According to Hsu and Sandford (2007), the Delphi technique is often used to acquire consensus within a heterogeneous panel of experts. The Delphi process consists of a number of iterations, often started with a questionnaire, in which the panelists discuss and rate a number of items related to the subject. The goal is to make converge the different opinions. Within the current research, the panel exists of port authorities, rail freight companies, government representatives, academic contributors and private intermodal transport users. This variety in experts is crucial and renders the sample valid for further analysis. However, in this paper, the exercise starts with an extensive review of the existing literature, where both scientific publications, government studies and sector reports are taken into consideration. Kerlinger (1973) validates the use of such a modified Delphi process, as information on the concerned issue is

already available and usable. Moreover, Hasson *et al.* (2000) describes a variation on the Delphi technique process, using important qualitative data retrieved from interviews. As such, a preliminarily list of possible internal and external characteristics of intermodal rail transportation is created during a first round of consultation. These first results are taken as an input for the second round, consisting of individual interviews with different specialists and authorities, being part of the panel. A third round consists of a traditional round-table discussion with the full panel of experts, discussing and validating the previous results. Ultimately, a final version of the survey contains all identified internal characteristics and possible external trends of intermodal rail freight. The survey obtains the quantification of the impact and likelihood of the different SWOT elements, as validated by the panel at the end of the previous round. In this way, the importance of each element, as well as the level of uncertainty, can be obtained. The output of the survey is a priority ranking, which will help as an input to build plausible scenarios for further analysis.

2.2 Survey methodology

The survey methodology is a 3-step approach. First, a Likert scale needs to be decided. Secondly, frequency tables are calculated. This allows determining two common indicators for the analysis of ordinal data, namely the modus and the index. Thirdly, a priority ranking is obtained by sorting the elements based on the results of these two indicators.

Likert scale Each identified and approved SWOT element is to be rated by the experts of the panel on a Likert scale ranging from 1 to 5. For further analysis, the responses on this Likert scale have been simplified by clustering category 1 and 2 into a negative factor (-), category 3 into a neutral factor (o) and category 4 and 5 into a positive factor (+). This will allow a better interpretation of the results. Details of the survey scale and clustering are illustrated in figure 1.

Figure 1: Used Likert scale for the BRAIN-TRAINS survey analysis.

	1	2	3	4	5
Influence	No influence	Weak influence	Moderate influence	Strong influence	Very Strong influence
	-		o	+	
Likelihood	No likelihood	Weak likelihood	Moderate likelihood	High likelihood	Very High likelihood

Source: Own composition

Frequency tables, modus and H-index As the data collected from the survey are Likert scale based (ordinal data), the most common statistical approach is the use of frequency tables, the modus and the H-index. The latter defines the homogeneity of the different answers, which indicates the level of agreement of the respondents. In this way, the results can be compared on

their consistency. The same methodology was used by Acciaro *et al.* (2013) and Vanelslander and Sys (2014) to evaluate a set of actions to increase port competitiveness.

- **Frequency tables** indicate the percentage of answers for each score on a specific element. From these tables, the scores that have been selected most, can be identified. Equally, it does provide a first insight on the spread over the different scoring possibilities, indicating the level of agreement.
- **The modus** is the score with the highest frequency, i.e. most of the respondents provided this answer to the question. In case different scoring options receive the same amount of responses, an adjusted average modus is stated.
- **The H-index** is a relative homogeneity index and is calculated as the standardized value of the square sum of the percentage frequencies of the ranking. The *absolute* homogeneity index h_i is calculated for each SWOT element as follows (Acciaro *et al.*, 2013):

$$h_i = \sum_j f_{ij}^2 \tag{1}$$

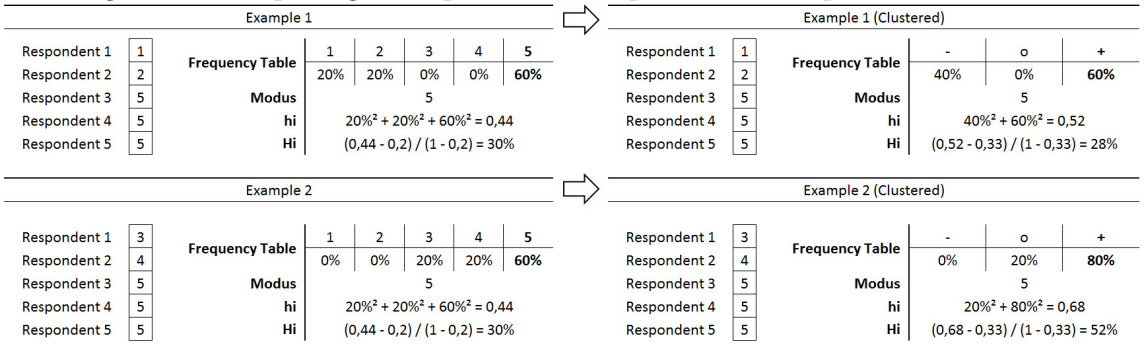
  f_{ij} is indicated as the percentage of respondents that ranked an element i with value j, with $j \in \{1, 2, 3\}$. On a 3-point Likert scale, the H-index can be interpreted as follows. When h_i equals 1, maximum homogeneity is reached, as all the elements are given the same score. When h_i equals 0.333, maximum heterogeneity is reached as all the elements are given a different score. In order to define the *relative* homogeneity index H_i, the following formula can be applied (Acciaro *et al.*, 2013):

$$H_i = \frac{h_i - min(h_i)}{max(h_i) - min(h_i)} \tag{2}$$

  On a 3-point Likert scale, the relative H-index can be interpreted as follows. When H_i equals 100%, maximum homogeneity is reached, as all the elements are given the same score (respondent agreement). When H_i equals 0%, maximum heterogeneity is reached, as all the elements are given a different score (respondent disagreement).

Validation of a simplified Likert scale The advantage of a 5-point Likert scale over a 3-point Likert scale, is that respondents receive less stimulation to select the neutral option. However, for analysis with the H-index, a degree variation in a selection of similar options might lead to false conclusions. This is illustrated in the examples in figure 2. Using a 5-point Likert scale leads to the impression that both examples result in an equal H-index of 30%, and as such a similar agreement rate between the respondents. However, when the answers from similar selection possibilities are clustered into a 3-point Likert scale, as illustrated in figure 1, the intuitive difference between both examples becomes clearer. As the answers in the second example are spread only over the neutral and positive selection options, the homogeneity rises to 52%. In order to define the priority for each element, the modus and the H-index are

Figure 2: Comparing examples with a 3-point and a 5-point Likert scale.



Source: Own composition

calculated. The elements are then sorted according to the modus, positive to negative, and sub-ranked according to the calculated homogeneity. By doing so, a ranking is obtained, indicating the answers with the highest modus and level of agreement between respondents. Priority is given to the elements with the biggest influence and the highest likelihood of happening. The results of this analysis are summarized in the next sections[4].

3 Results

The results in this section are a summary of the elements that have been identified, and indicated with an important impact on intermodal rail freight developments and/or a considerable likelihood of happening in the future.

3.1 Strengths

High payload capacity and reduced costs One of the main identified strengths of intermodal rail freight, is the reduced costs that can be obtained in the total chain of logistics, mainly due to the concept of freight consolidation and flow bundling (Kreutzberger *et al.*, 2003). Thanks to the important capacity of trains, rail transport is able to move large quantities of goods. Moreover, intermodal rail transport offers higher payload of containers in comparison to trucks. Indeed, freight consolidation at the terminal allows intermodal transport to benefit from the advantages of mass transportation and thus to generate economies of scale. This leads to reduced operational costs per unit transported (Rodrigue *et al.*, 2006).

[4]The results of the part on governance and policy-making are based upon a case study of the development of rail in Belgium. This policy analysis draws on a detailed process-tracing, based on an analysis of parliamentary documents and a series of interviews with government officials. It is difficult to rank the outcomes of the policy analysis according to the methodology mentioned above. Therefore, the results of this case study are not presented in sections 3.1 to 3.4, but instead summarized in section 3.5.

Reduced externalities External costs arise from influences on the environment due to the development of infrastructure, accidents, congestion and the emission of noise and air pollutants. Although regulation over the past decades has forced the transport industry to decrease emissions and increase safety measures, the studies of Grosso (2011) and Fries and Hellweg (2014) show that the marginal external cost of rail transport is considerably lower compared to that of road transport, making it a sustainable mode of transport. This is especially the case when an electrified railway is used (Spielmann and Scholz, 2005). This strength of intermodal rail freight also holds opportunities, as indicated by Finger (2014) and Buyse (2014), as the social pressure on governments to internalize the external costs, is still increasing. Nevertheless, intermodal rail transport should still take it as a goal to prove that it can provide a profitable and cheaper alternative by itself. The length of the pre- and post-haulage operations will be of great interest in this exercise, as well as the importance of pre-combustion processes and the introduction of new engines and emission reduction technologies (Spielmann and Scholz, 2005). The sustainability advantage of intermodal over road transport is mainly observed on long-haul distances. Therefore, the travel by rail has to be long enough for counterbalancing the additional externalities related to the transhipment and pre-and post-haulage of goods by truck, in order to compensate for the generally higher external road costs during the short-haul travels to and from the terminals (Kreutzberger *et al.*, 2003; Maibach *et al.*, 2008).

Figure 3: Economic growth and freight traffic in Europe before and after the 2008 crisis.

Source: Crozet *et al.* (2014)

Relation with GDP The correlation between the Gross Domestic Product (GDP) and logistics works in both ways. On the one side, an increase in logistic activities will impact the growth of GDP. Depending on the source consulted, the global logistics industry is contributing by 14% to the world's GDP. At European and Belgian level, the logistics sector is representing 5 to 8% of the corresponding GDP (Flanders Logistics, 2006; European Commission, 2006). On the other side, following the trend of increasing globalization, a change in GDP also affects the demand for mobility and as such the logistics industry performance. This correlation is illustrated in figure 3. A small increase or decrease in GDP, results in a rapid growth or decline of the transported volume of goods, measured in tkm. For Belgium, the same relation has been

defined by Meersman *et al.* (2013). Since 1999, this relationship has undergone a decoupling, also illustrated in figure 3. There is a clear positive influence between the two variables, but the GDP has increased faster throughout the years compared to the rise of tkm of freight transport. This could be explained by internal factors such as a more efficient usage of transport modes and the objective of decoupling to reduce negative impacts of road transport (Hilferink, 2003; Hoornaert, 2015), as well as external factors such as EU enlargement and the rise of the service sector and IT industry (McKinnon, 2007).

Belgium is also enjoying a unique geographical position on the European continent, as it is situated in the middle of the 'Blue Banana'-region. This region has the greatest GDP intensity per capita and contains 28% of the total European population. In addition to this, the container market in Flanders, measured in origin and destination locations, is bigger than the entire container market in France, which enforces the strength and opportunities for intermodal rail transport developments (Port of Antwerp, 2013). Although the purchasing power per person in Eastern Europe has been rising over the last decade, proving that this rising market is to be taken into account in current and future railway expansions, Mitusch *et al.* (2014) state that, due to the absence of large first-call ports, Eastern Europe is to be found a good location for low-cost manufacturing, but the distribution benefits for this region remain of a local or sub-regional nature (Colliers International, 2013). The opportunity of the growing market in Eastern Europe will be further discussed in section 3.3.

A better modal split As the hinterland is gaining importance, some challenges for the transport industry such as congestion and emissions are aggravating. Besides a sustainable modal split for new future volumes, attention is to be given to the need of a modal shift from road to rail or inland waterways transportation. These modes of transport are more sustainable, but require a high volume in order to become beneficial compared to road transport. Cooperation and bundling of flows is possible, but will entail a mind shift of all actors involved (Buyse, 2014). The dominance of road transport is leaving little room for alternatives and as such limited flexibility is offered to transport users. Therefore the aim of the policies is to expand port capacity together with the accessibility of the hinterlands. This is to be considered a strength, inherent to intermodal rail transportation (Cuypers, 2014). Translating the goals of the White Paper (European Commission, 2011), the reduction of road transport over 300 km by 30% will lead to a decrease in the share of road transport, measured in tkm, from the current 75% to 52%. At European level, this will result in an increase of the rail share from 21% to 39%, and an increase of the inland navigation share from 4% to 8%, when the shifted volumes are spread equally over both modes of transport. In Belgium, the modal share for inland waterways will be higher, due to the unique geographical position with the presence of several waterways (Tavasszy and Van Meijeren, 2011; Crozet *et al.*, 2014).

Liberalization In accordance with European regulation, the process of liberalization for the Belgian rail freight market has started in 2005. The goal of liberalization is to stimulate cross-border competition, as each European railway company with the needed licenses and

safety certifications can apply for capacity on each national and international freight service desired. As seen with the liberalization of the road freight, this process could bring increased competition and as such render the industry more efficient and attractive, as service-levels tend to increase in the long-run (Paardenkoper, 2009). An independent infrastructure manager is managing the division of the network capacity over the active operators. In Belgium, as from 2011, fourteen players obtained all necessary licenses and permits in order to be active on the network. Nevertheless, not all of these players are also effectively using this possibility. The infrastructure and capacity allocation is managed by INFRABEL (INFRABEL, 2011). According to the figures of the European Commission (2014a), non-principal undertakings in Belgium obtained a considerable market share of 13.39% in 2012.

Nevertheless, Belgium is still scoring average in terms of the Rail Liberalization Index (Crozet *et al.*, 2014). In addition, users of rail freight transport in Belgium also have the feeling that, up to now, liberalization has not made the market more dynamic. The sector is still faced with a number of weaknesses, creating high barriers for new players that desire to enter the market, holding back the competition and as such the expected increase in efficiency (Buyse *et al.*, 2014). These weaknesses will be discussed in the next section.

3.2 Weaknesses

High operating costs The intermodal operating (or internal) cost structure consists of several components, reflecting the transport chains complexity. According to Janic (2007), it incorporates the costs of moving units between shippers and receivers through the stages of collection, distribution, line hauling and transhipment. Drayage operations, in particular, contribute by 25-40% to the total origin-to-destination expenses (Macharis and Bontekoning, 2004). A basis for economic evaluation is given through the concept of break-even distance, defined as the distance at which the costs of intermodal transport equal those of all-road transport.

Complex pricing strategies The intermodal transport position, and modal choice for that matter, is greatly sensitive to the determination of the right service tariffs, known as the pricing strategy and commonly considered at the tactical decision horizon. Striking the balance between competitiveness and profitability through pricing decisions is a complex process, requesting an accurate cost estimation and a clear insight of the market situation. Bontekoning *et al.* (2004) identify two levels at which an intermodal pricing strategy operates: the individual actors (drayage and main haul operators), and the whole door-to-door chain level.

Missing links According to Schwab *et al.* (2014), transport infrastructure is to be considered one of the twelve pillars determining competitiveness of a country. In the case of Belgium, a moderate quality of the infrastructure is observed, leading to an average world competitiveness index score. Most gateways and corridor infrastructure currently in place could not handle a

50% increase, let alone a possible doubling or tripling of volumes of passengers and freight in 20 years from now. Hence, capacity is to be considered a weakness for intermodal rail transport development (OECD, 2012). Although the Belgian railway network is over 3.500 km long, holding one of the highest densities within the European Union, many rail connections have been abandoned or even (continue to be) dismantled over the past decades (Vannieuwenhuyse *et al.*, 2006). In addition, there is currently still the absence of reliable railway connections and railway hubs towards the Eastern part of Europe (Grisilla *et al.*, 2013). A possible solution in the form of European rail freight corridors will be addressed in section 3.3 on opportunities.

A lack of flexibility As indicated in the previous paragraph, rail freight transportation is highly dependent on rail equipment with a long life-cycle and the specific existing infrastructure with connection points to the network. As door-to-door delivery possibilities are therefore limited, the level of flexibility for this mode of transport is much lower compared to road transportation (Grosso, 2011; Vandressen *et al.*, 2012). In addition, the lack of flexibility for intermodal rail transportation is also to be explained due to the following reasons:

- Passenger traffic and freight transportation share the same network infrastructure. In addition, passenger trains, even when delayed, receive priority over freight trains (Crozet *et al.*, 2014; Buyse *et al.*, 2014).
- Rail punctuality in Belgium is low (Nederlandse Spoorwegen, 2013).
- Low interoperability is causing disruptions and time-loss (De Rocker, 2014).
- Fixing rail paths can take up to 18 months (Cuypers, 2014; De Rocker, 2014).
- Intermodal rail transport is depending on flows in both directions (Cuypers, 2014).
- The multitude of actors, involved in a typical intermodal transport chain, greatly contribute to the complexity of ensuring synchronized and seamless operations to the shippers.
- As a result of the current fragmented standardization, the intermodal network operators are potentially obliged to offer limited back-up options, in case of fall back.
- The intermediate bundling operations pose a risk to reduce the door-to-door reliability. This is caused by the larger route detours, compared to direct services, resulting in turn in additional money and time costs.

A lack of sustainability data Currently, there is no available publication related to the state-of-the-art of sustainability for Belgian freight transportation. Also technical data on for example the type of machines, roads, capacity and energy supply, are rarely obtainable. This results in a lack of data concerning direct emissions such as CO2, NOx, SOx, NMVOC and particles. Even with existing generic commercial databases like Ecoinvent (Weidema *et al.*, 2013), no specific Belgian commercial transportation data can be found. The development of

a transportation database specific to Belgium, will allow a better modelling of the obtained environmental impacts and improve the specificity of the results. Moreover, these results will enhance the accuracy of transport databases, and potentially improve the environmental impact of transport, also reducing associated costs.

High investments and weak network access In order to enter the liberalized market of rail freight transportation, high capital expenditures are required to start up operations. This gives the existing and already dominant historical national rail companies a competitive advantage (Pham, 2013; Crozet *et al.*, 2014). In addition, network access is much weaker compared to that of road transportation, as this mode is less depending on network infrastructure and benefits from increased flexibility. According to Finger *et al.* (2014), the weakness of network access is mainly driven by regulatory obstacles, monopolistic positions, insufficient bundling opportunities and unfair competition.

3.3 Opportunities

Single European Transport Area The White Paper of the European Commission (2011) indicates that the creation of a unified market could reduce costs, increase the sustainability of transport in Europe, increase the number of quality jobs and set up a framework for safer transport. In addition, as Central and Eastern Europe's economies grow further and GDP per capita rates are increasing, the need for more than one European logistics center will arise. The current dominance of Western Europe will be increasingly challenged by possible hubs such as Prague or Bratislava. Nevertheless, the shift to the East will not be rapid, as indicated in section 3.1. In order to capture the opportunity of the growing Eastern European market, some efforts are being taken in the field of connecting the different corners of Europe (Colliers International, 2013; Mitusch *et al.*, 2014). This is being achieved with the aid of the Trans-European Transport Network (TEN-T) development, resulting in nine major Rail Freight Corridors (RFCs) on the European continent. On the territory of Belgium, three of these corridors are connected to the Belgian rail network, all linked with the Port of Antwerp (INFRABEL, 2014):

- North Sea - Baltic Corridor, connecting Belgium with (North-)Eastern Europe.
- North Sea - Mediterranean Corridor, connecting Belgium with the south of France.
- Rhine-Alpine Corridor, connecting Belgium with northern Italy.

By 2030, all infrastructure in Belgium being part of the core network will be in accordance with the criteria of the European framework. Cooperation with road transportation will remain necessary to overcome the last mile for door-to-door delivery services and a number of technical, administrative and legal obstacles will need to be overcome (United Nations Economics Commission for Europe, 2013).

Standardization and interoperability Unlike road transport, rail equipment has a long life-cycle, up to 40 years, slowing down the process of standardization (Buyse, 2014). According to Mitusch *et al.* (2014), the upgrade of the European fleet and rail network should be executed with the goal of increasing interoperability, and obtain standardization on the European continent. This will make intermodal transport more attractive and lower access barriers. The main upgrades should take place in the automatic central couplings, the use of similar wheel brakes and coherent chassis and superstructures. In addition, currently only 20% of the different truck trailers can be loaded on a train. In light of the earlier mentioned importance of pre- and post-haulage, this leaves a wide range of improvement opportunities for intermodal transport development (Bulc, 2014). The development of the nine RFCs should be grasped as an opportunity to increase standardization and interoperability in rail transport and intermodal transport in general. The gradual introduction of the new global ERTMS and ETCS signaling and safety systems are a good and known example of these new developments (UNIFE, 2013). In terms of the continuous globalization and the need of faster just-in-time deliveries and track and tracing opportunities, Grisilla *et al.* (2013) are also addressing the importance of investments in IT. Benchmarking tools and logistics planners will allow transport users to identify their optimal selection of transport modes on a certain route, convincing them about the advantages of intermodal transport, when the full logistics chain is taken into consideration (Bozuwa *et al.*, 2012). Also harmonization of the different legislation acts and technical standards between EU member states hold opportunities to decrease the barriers to enter the market and to increase competitiveness for intermodal transport (Crozet *et al.*, 2014). The application of more homogenous standards, specifically at the level of network operators, presents promising opportunities in terms of network reliability. A great benefit would be the ability to create multiple fall back corridors, serving as back-up solutions. In todays logistics chains in Europe, a blockage on a main line could result in blocking a serious amount of trains, and potentially a complete halt of a certain traffic direction. However, in a future optimal corridors scenario, affected products may be directed through alternative corridors/routes, when given the fact that the same staff and equipment can still be used.

Promotion of intermodal transport at European level The harmonization and standardization between EU Member States could be one of the biggest promotional moves for EU railway logistics. As the market will be similarly restricted, small providers will be able to efficiently use the entire rail network. Depending on the willingness of Europe to promote intermodal rail transport, the results from the analysis of external costs of rail transport and monetization of impacts can be used to increase its attractiveness. The results obtained in this study could be used as criteria to help deciding on the development of intermodal transportation in Belgium including environmental aspects for the future and allowing the pollution reduction of direct emissions.

Consolidation Container transport by rail need a certain distance in order to become attractive. In this sense, the Eastern market is to be considered an opportunity for rail transportation

from Western European countries, as this will increase the average transport lengths. The development of the European corridors described above will therefore strengthen the position of intermodal rail freight, supported by increased bundling possibilities due to an increased attractiveness of new or existing flows, once the delivery points become connected to the rail network (Crozet *et al.*, 2014; Mitusch *et al.*, 2014). These delivery points are built in the form of multimodal freight terminals, acting as regional hubs where flows are bundled and shifted from one transportation mode to another. According to Santos *et al.* (2015), the current distribution of these terminals in Belgium seems to be rather optimal, although combination of cargo streams is not optimized, mainly due to organizational reasons as there is a lack of cooperation between the different actors involved (Buyse *et al.*, 2014). The consolidation of flows at the intermodal terminal is a real opportunity for the development of intermodal rail transport. Indeed, flows bundling leads to a better loading of the trains and thus to higher load factors. This means that the total transportation operational and external costs can be optimally split between the different units transported. The rail unit cost therefore decreases, which improves the attractiveness of rail transport, compared to door-to-door transport.

Future road taxes There is currently a growing political consent to shift the costs of the infrastructure to the user. Imposing taxes on motorways is one example of such kind of policy. In Belgium, in 2016, trucks will be charged for each kilometer performed on motorways. These future road taxes, which penalize transport by truck (UPTR, 2015), can also indirectly benefit to intermodal rail transport, from the cost competitiveness perspective. Taxes on trucks mean higher costs for road transport and thus relatively lower costs for intermodal transport, at the condition that the road pre- and post-haulage are not too long.

3.4 Threats

Impossibility of consolidation As a counterpart of the opportunity represented by the consolidation of flows, the impossibility of consolidating freight is clearly a threat for intermodal rail transport. Indeed, if the bundling of goods is not possible, the high fixed costs and emissions have to be borne by the few units loaded on the train. The unit costs and emissions of intermodal transport thus increase, which makes it relatively less interesting in relation to road.

Cancellation of investments and subsidies Due to the current restricted budgetary context, resulting in severe savings in many European countries, a number of projects from the previous investment term have been or are at the risk of being frozen or delayed (Mobiliteitsraad, 2012). Over the period 2007 - 2013, public investments have declined by 20%, indicating that the economic crisis might leave a long lasting impact on the investment climate (European Commission, 2014b). In Belgium, SNCB and Infrabel will both need to cut back on costs and expenses with 1.5 billion Euro, equalling also 20% of the budget, over the period 2015 - 2020 (Houtman, 2014). In terms of subsidies, it should be mentioned that the financial support for

single wagon transport in Belgium has been cut down over the last few years. Although SNCB logistics (2014) claims that they will continue to invest in the single wagon transport, the lack of subsidies might eventually result in the disappearance of this type of rail transport, threatening the service and as such the competitiveness of the ports. Subsidies for intermodal freight traffic in Belgium have been halved over the past seven years, from 30 million Euro in 2007 to only 15 million Euro in 2014 (Santos *et al.*, 2015). Another threat linked to subsidies is the risk of an unintended and undesired shift from one sustainable mode of transport to the other. In addition, artificial support can keep activities alive without creating a healthy self-sustaining action in the long run, but can be necessary in order to maintain a desired market service level. Therefore, subsidies should be used as a catalyst and should be diminished after the line of profitability has been reached. Caution should be given to the perverse effect of slowing down the development of the initiative, becoming reliant on the subsidy to remain operational (Buyse *et al.*, 2014; Hoet, 2014).

Passenger traffic The threat of increasing passenger traffic, receiving priority and sharing the network with freight trains, has already been mentioned in section 3.2. According to Deville and Verduyn (2012), the amount of passenger-kilometers has risen with almost 60% over the period 1990 - 2012, increasing the impact on the rail infrastructure network. A growth in intermodal freight might also impact future passenger rail traffic, resulting in more delays and network failures and as such impacting the rail freight sector itself again.

Monopoly or duopoly Due to the liberalization and the creation of a Single European Transport Area, a number of well-established European players such as DB Schenker, SNCF and Trenitalia, are eager to sweep the European market, by taking over the existing smaller companies. This trend is already going on in many European countries, such as The Netherlands, Denmark and Switzerland, who no longer have national railway companies operating in the rail freight sector, but left these activities to the main European operators (Crozet *et al.*, 2014; Finger, 2014). Whether the development to a market of two or three rail companies would be a good or a bad evolution is not commonly agreed upon. The level of regulation and competition between the remaining players will prove essential if this trend continues, and a limited number of market players brings the advantage of an equal service being continuously provided. On the other hand, caution should be given to some niche markets, where the nature of the goods only allows rail transportation, risking intolerable price increases in the situation of a monopoly or duopoly (Crozet *et al.*, 2014; Buyse *et al.*, 2014). According to Crozet *et al.* (2014), the most likely scenario for Belgium will be a de facto duopoly with room for some small railway operators, although they would not be able to influence the decisions taken in the rail sector.

3.5 Governance and policy-making

The policy-analysis demonstrates that already in 1997, the idea of rail freight intermodality was high on the political agenda of the Belgian federal state. In order to make rail freight intermodality an integral part of the transport domain, it was, for two (interrelated) reasons, necessary to create unison among a wide nexus of actors. First of all, competences[5] in the transport domain are spread over a multitude of departments and agencies from both the federal and the regional level. Second, the field of transport is not an autonomous policy field. Actors from other policy domains[6] are also involved. These organizations either have an interest in transport policies or are necessary for the execution of agreed actions. Hence, only a transversal policy that exceeds the different policy fields and levels of government could turn rail freight intermodality into reality. However, establishing a transversal policy has been rather difficult (Stevens and Verhoest, 2014). There were several *structural determinants*, which refer to the impact of formal structures and procedures on coordination, which stifled policy integration. Quick wins were requested as it was believed that a transversal strategy could root overnight. The strict policy cycle, which in turn was established, left little room for the stakeholders to negotiate terms and compromise on policy solutions. Additionally, not all relevant actors were a part of the deliberation processes. Also *cultural determinants*, understood as the perceptual traits of actors, withheld a transversal strategy from emerging. Among actors, there were insurmountable differences with regard to the nature of the transversal policy and the necessity to create unison. A surreptitious discussion that simultaneously affected the governance of rail freight intermodality, was the call for delegating federal transport competences to the regional level. In consequence, some regional actors did not recognize the position of the federal departments and thereby blocked any attempt for collaboration. Lastly, *exogenous determinants* influenced the establishment of a transversal policy. In the first place, there is the growing interference of the EU in the transport domain. Although the EU has outlined an all-comprehensive transport vision, the concrete actions that over the years have been launched did not link the different transport modes. Domestic actors have, as such, not been encouraged to holistically look at the transport domain when transposing the EU legislation into domestic law. In sum, rail freight intermodality has not yet attained a firm foothold in the Belgian transport domain. There has been mere negative coordination between federal and regional actors regarding rail freight intermodality. This means that every department or agency could see for itself how much effort would be invested in stimulating an intermodal rail freight transition, without being pressured by peer organizations or some shared objectives.

[5]These competences are exclusive, equivalent material competences, which means that there is no hierarchy between a federal or regional legal norm.

[6]Economic affairs, spatial planning, environment, finance and justice.

4 Conclusions

Intermodal transport and rail freight transport are faced with a weak usage in Belgium and by extension the European continent in general. In this paper, different internal strengths, weaknesses and external opportunities and threats are identified, impacting on intermodal rail freight development in Belgium. By consulting a heterogeneous panel of experts in the field of intermodal transport, both public and private, the impact and likelihood of happening of these elements have been defined, in order to make a selection of the most impacting elements. Intermodal rail transport in Belgium has substantial opportunities and as such possibilities to grow, due to the high payload and reduced costs, as rail transport is linked to reduced externalities compared to road transport. Due to the liberalization of the rail freight market, the European Union is ambitioning a better modal split and a boost for the economy due to the relationship between transport and the GDP. However, due to a number of weaknesses inherent to intermodal rail freight transport, such as high operating costs, complex pricing strategies, missing network links, a lack of flexibility, a lack of sustainability data, the need for high investments and weak access to the network, the anticipated effects of the market liberalization are not yet revealed. As competition is held back due to market entry barriers, the expected increase in efficiency has not come true yet. Intermodal rail freight also needs to take into account a number of external opportunities and threats, which might impact on its development. In order to stimulate the option of intermodal rail freight transportation, the Single European Transport Area needs to increase standardization and interoperability on the European continent. Together with the promotion of intermodal transport at European level, this needs to result in an improved consolidation of flows, in order to obtain the necessary volumes to make rail freight a valuable option. Also the future of road taxes might impact the use of intermodal rail freight in the future. Nevertheless, some factors might also negatively impact the development of rail freight. The threat of impossibility of consolidation and cooperation, the cancellation of investments and subsidies in the current restricted budgetary context, the interference with passenger traffic and the possibility of a European monopoly or duopoly can seriously impact the evolution of intermodal rail freight transportation in the future.

These results will be used in future research to build plausible scenarios for rail freight development, in order to define the macro-economic impact, the optimal corridor and hub development and the sustainability impact of future intermodal transport. In addition, these scenarios will lead to indicators for an effective market regulation, governance and organization for a well-functioning intermodality.

References

Acciaro, M., Vanelslander, T., Sys, C., Ferrari, C., Roumboutsos, A., and Giulano, G. et al. (2013). "A framework for successful implementation of green innovation in seaports." *Maritime Policy and Management* 41.(5), pp. 480–500.

Bontekoning, Y.M., Macharis, C., and Trip, J.J. (2004). "Is a new applied transportation research field emerging?A review of intermodal railtruck freight transport literature." *Transportation Research Part A* 38, pp. 1–34.

Bozuwa, J., Jorna, R., Recagno, V., and Zografos, K. (2012). "BE LOGIC: Benchmarking Logistics Chains." *Procedia - Social and behavioral sciences* 48, pp. 2422–2432. DOI: 10.1016/j.sbspro.2012.06.1213.

Bulc, V. (2014). *European Rail Freight Days Conference*. Speech by the EU Commissioner for Transport.

Buyse, F. (2014). "InterFerry Boats". Personal Interview, 16 December 2014.

Buyse, F., Serbruyns, M., Deketele, L., De Rocker, D., Cuypers, K., Wolters, P., and Hoornaert, B. (2014). "Brain-Trains: A SWOT analysis of intermodal hinterland rail transport in, from and towards Belgium". Panel meeting, 2 December 2014, Brussels.

Colliers International (2013). *Top European Logistics Hubs*. White Paper Q2-2013.

Crozet, Y., Haucap, J., Pagel, B., Musso, A., Van de Voorde, E., Vanelslander, T., and Woodburn, A. (2014). *Development of rail freight in Europe: What regulation can and cannot do*. Discussion Paper. Centre on Regulation in Europe (CERRE).

Cuypers, K. (2014). "Port of Antwerp". Personal Interview, 19 November 2014.

De Rocker, D. (2014). "ArcelorMittal Gent". Personal Interview, 18 November 2014.

Deville, X. and Verduyn, F. (2012). *Implementation of EU legislation on rail liberlization in Belgium, France, Germany and The Netherlands*. Working paper document 221. Brussels: National Bank of Belgium.

European Commission (2006). *Freight transport logistics in Europe*. Communication COM(2006) 336 final.

– (2011). *Roadmap to a Single European Transport Area: Towards a competitive and resource efficient transport system*. White Paper COM(2011) 144 final. European Commission.

– (2014a). *EU transport in figures*. Statistical Pocketbook 2014. Publications Office of the European Union, Luxemburg. DOI: 10.2832/63317.

– (2014b). *Investment for jobs and growth, promoting development and good governance in EU regions and cities*. Date accessed: 17/03/2015. URL: http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion6/6cr_en.pdf.

Eurostat (2014). *Table 1: Modal split of inland transport*. Date accessed: 12/04/2015. URL: http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Table_1_Modal_split_of_inland_transport.png.

Finger, M. (2014). "École polytechnique fédérale de Lausanne". Personal Interview, 16 December 2014.

Finger, M., Bert, N., and Kupfer, D. (2014). "Rail infrastructure and rolling stocks: investments, asset renewal and regulation." *FSR Transport* 3, pp. 1–14.

Flanders Logistics (2006). *Economisch belang van de logistiek*. Date accessed: 13/03/2015. URL: http://www.flanderslogistics.be/over-fl/overfl-thema1.php.

Fries, N. and Hellweg, S. (2014). "LCA of land-based freight transportation: facilitating practical application and including accidents in LCIA". *The International Journal of Life Cycle Assessment* 19.(3), pp. 546–557.

Gevaers, R., Maes, J., and Van de Voorde, E. (2012). *Vrachtvervoer per spoor: marktstructuur, vervoerbeleid en havens*. Working Paper. University of Antwerp.

Grisilla, A., Cuccu, C., and Le Corf, C. (2013). *EIA Intermodal achievements 2013 - Trend-Watch 2030*. Annual Report 2013. European Intermodal Association, Brussels.

Grosso, M. (2011). "Improving the competitiveness of intermodal transport: applications on European corridors." PhD thesis. University of Antwerp and Univeristy of Genoa.

Hasson, F., Keeney, S., and McKenna, H. (2000). "Research guidelines for the Delphi survey technique". *Journal of Advanced Nursing* 32.(4), pp. 1008–1015.

Hilferink, P. (2003). *The correlation between freight transport and economic growth*. 16th international symposium on theory, practice in transport eeconomic: 50 years of transport research - experience gained, and major challenges ahead, Budapest.

Hoet, I. (2014). "Vlaanderen, Departement Mobiliteit en Openbare Werken". Personal Interview, 18 December 2014.

Hoornaert, B. (2015). "Federal Planning Office". Personal Interview, 7 January 2015.

Houtman, E. (2014). "INFRABEL". Personal Interview, 20 November 2014.

Hsu, C. C. and Sandford, B. A. (2007). "The Delphi technique: making sense of consensus". *Practical assessment, research & evaluation* 12.(10), pp. 1–8.

INFRABEL (2011). *Liberalization of railroad traffic in Belgium: an update 03-11-2011*. Date accessed: 11/03/2015. URL: http://www.infrabel.be/en/news/liberalisation-railroad-traffic-belgium-update.

– (2014). *INFRABEL in het hart van de Europe goederencorridors*. Date accessed: 02/04/2015. INFRABEL. URL: http://www.infrabel.be/sites/default/files/documents/brochure_corridors_nl.pdf.

Janic, M. (2007). "Modelling the full costs of an intermodal and road freight transport network." *Transportation Research Part D* 12, pp. 33–44.

Kerlinger, F. N. (1973). *Foundations of behavioral research: 4th edition*. New York: Holt, Rinehart, and Winston, Inc.

Kreutzberger, E., Macharis, C., Vereecken, L., and Woxenius, J. (2003). *Is intermodal freight transport more environmentally friendly than all-road freight transport? A review*. NECTAR Conference N7, Sweden.

Macharis, C. and Bontekoning, Y.M. (2004). "Opportunities for OR in intermodal freight transport research: A review." *European Journal of Operational Research* 153, pp. 400–416.

Maibach, M., Schreyer, C., Sutter, D., Van Essen, H. P., Boon, B. H., Smokers, R., and Bak, M. (2008). *Handbook on estimation of external costs in the transport sector - Produced within the study Internalisation Measures and Policies for All external Cost of Transport (IMPACT)*. CE Delft, Delft.

McKinnon, A. C. (2007). "Decoupling of road freight transport and economic growth trends in the UK: An exploratory analysis". *Transport Reviews: A transnational transdisciplinary journal* 27.(1), pp. 37–64. DOI: 10.1080/01441640600825952.

Meersman, H. *et al.* (2013). *Indicatorenboek 2012: Duurzaam goederenvervoer Vlaanderen*. Universiteit Antwerpen, Departement Transport en Ruimtelijke Economie, Steunpunt Goederen- en personenvervoer.

Merckx, J.-P. and Neyts, D. (2013). *De Vlaams havens: Feiten, statistieken en indicatoren voor 2013.* Vlaamse Havencommissie. Brussels.

Mitusch, K., Liedtke, G., Guihery, L., and Balz, D. (2014). "The structure of freight flows in Europe and its implications for EU railway freight policy". *EconPapers* 61. Working Paper Series in Economics, Karlsruher Institut fur Technologie (KIT).

Mobiliteitsraad (2012). *Advies met betrekking tot de conceptnota Vlaams strategisch spoorbeleid.* Brussels. URL: http://www.vlaanderen.be/nl/publicaties/detail/advies-met-betrekking-tot-de-conceptnota-vlaams-strategisch-spoorbeleid.

Nederlandse Spoorwegen (2013). Annual Report 2013. Utrecht.

OECD (2012). *Strategic Transport Infrastructure Needs to 2030: Main findings.* Date accessed: 02/04/2015. URL: http://www.oecd.org/futures/infrastructureto2030/49094448.pdf.

Paardenkoper, K. M. (2009). *The liberalization of the European railway market: the role of Infrastructure managers and port authorities.* Conference of TU Delft.

Pham, V. (2013). *The liberalization of rail transport in the European Union.* Economics Honors Papers. Economics Department of Connecticut College.

Port of Antwerp (2013). *Port of Antwerp Intermodal Event.* Date accessed: 06/03/2015. URL: http://www.portofantwerp.com/sites/portofantwerp/files/imce/20131016_Presentatie_intermodal%20event%20%5BAlleen-lezen%5D.pdf.

Rodrigue, J.-P., Comtois, C., and Slack, B. (2006). *The Geography of Transport Systems.* Routledge, New York.

Santos, B. F., Limbourg, S., and Carreira, J. S. (2015). "The impact of transport policies on railroad intermodal freight competitiveness - The case of Belgium". *Transportation Research Part D: Transport and Environment* 34.(1), pp. 230–244.

Schwab, K., Martin, X. Sala-i, Eide, E., and Blanke, J. (2014). *The global competitive report 2014-2015.* Report. Geneva: World Economic Forum.

SNCB logistics (2014). *Spoorcafé 4 Juni 2014 - NMBS Logistics: investering in verspreid vervoer.* Date accessed: 16/03/2015. URL: http://www.portofantwerp.com/sites/portofantwerp/files/imce/NMBS%20Logistics_Spoorcafe%20201406.pdf.

Spielmann, M. and Scholz, R. (2005). "Life Cycle Inventories of Transport Services: Background Data for Freight Transport". *The International Journal of Life Cycle Assessment* 10.(1), pp. 85–94.

Stevens, V. and Verhoest, K. (2014). *Mission impossible? Drafting a holistic government strategy for smart green freight transport in a highly conflictive multi-level governance system.* Conference Paper. 2nd WIPCAD Conference, 4-6 december 2014, University of Potsdam.

Tavasszy, L. A. and Van Meijeren, J. (2011). *Modal Shift Target for Freight Transport Above 300 km: An Assessment.* Discussion Paper. Brussels: 17th ACEA SAG Meeting.

UNIFE (2013). Annual Report 2013. Brussels.

United Nations Economics Commission for Europe (2013). *Financing transport infrastructure: transport links between Europe and Asia, new challenges.* Informal document on the eighth session of the working party on transport trends and economics, the group of experts on Euro Asian transport links 1. Geneva: Inland Transport Committee as Economic Commission for Europe.

UPTR (2015). *Prélèvement kilométrique : Position UPTR.* Date accessed: 03/04/2015. URL: http://www.uptr.be/theme/medias/upload/1Pr%C3%A9l%C3%A8vement%20kilom%C3%A9trique%20-%20position%20UPTR.pdf.

Vandressen, M., Gusbin, D., Hertveldt, B., and Hoornaert, B. (2012). *Vooruitzichten van de transportvraag in Belgie tegen 2030.* Verslag. Federaal Planbureau, Brussels.

Vanelslander, T. and Sys, C. (eds.) (2014). *Port business: market challenges and management actions.* University Press Antwerp, Brussels.

Vannieuwenhuyse, B., De Wachter, H., and Misschaert, M. (2006). *Het spoorvervoer, uitbouwen tot sterke schakel in het logistieke process.* Antwerpen. Vlaams Instituut voor de Logistiek (VIL).

Weidema, B. P. *et al.* (2013). *Overview and methodology: data quality guideline for the ecoinvent database - version 3.* Ecoinvent Report 1 (v3). St. Gallen: The ecoinvent centre.