

## INTRODUCING LONGER AND HEAVIER VEHICLES IN BELGIUM: A POTENTIAL THREAT FOR THE INTERMODAL SECTOR?



Dries Meers

Vrije Universiteit Brussel,  
Belgium

Department BUTO

Research Group MOBI

Dries.Meers@vub.ac.be



Prof. Cathy Macharis

Vrije Universiteit Brussel,  
Belgium

Department BUTO

Research Group MOBI

Cathy.Macharis@vub.ac.be



Tom van Lier

Vrije Universiteit Brussel,  
Belgium

Department BUTO

Research Group MOBI

Tom.van.Lier@vub.ac.be

### Abstract

Longer and heavier vehicles have been introduced in different countries because of their cost and environmental gains, compared to conventional trucks. Also the Flemish region in Belgium is setting up a trial with these types of vehicles, to evaluate their effect on different parameters. A fear of the rail and inland waterways transport sectors is however that a reverse modal shift might occur when these trucks are allowed on the transport network, reducing the price for road transport. In this paper we discuss experiences with the introduction of longer and heavier vehicles in other European countries and construct a framework to evaluate the possible extent of such a reverse modal shift in Flanders.

**Keywords:** Longer and Heavier Vehicles, Intermodal Transport, Reverse Modal Shift

## 1. Introduction

The region of Flanders – and by extension the whole of Belgium – is suffering heavily from transport-related problems. Despite the very dense road transport network<sup>1</sup> and the extensive network of rail tracks and navigable inland waterways<sup>2</sup>, severe road congestion occurs on daily basis (INRIX, 2013). And besides congestion, other negative impacts arise, such as traffic accidents, transport emission... all having an undeniable societal cost component. (See for example Delhay et al. (2010) for indicators on external costs of transport in Flanders.)

Nevertheless, different policy measures have been proposed to increase the efficiency of the current transport system and to diminish the negative societal impacts caused by transport in general. The capacity of the transport system is improved by extending the current infrastructure network, but besides, also the current network - and loading capacity can be better utilized. In the case of Flanders, this can be done by more intensively using the inland waterways for hinterland transport, but also by better employing the available road capacity. The deployment of Longer and Heavier Vehicles (LHVs) in Belgium also fits in this last perspective (Debauche, 2008). LHVs are vehicles with a maximum length of 25.25 m and a weight of 60 tons, while currently the allowed length is 18.75 m and the allowed weight is 44 tons in Belgium. Nevertheless, LHVs might compete for market share with intermodal transport (Verweij et al., 2011), leading to a reverse modal shift. Such a shift might nullify the potential environmental gains of using LHVs in freight transport. The aim of this paper is therefore to investigate if the use of these LHVs in Flanders would enhance a reversed modal shift from intermodal services to road-only LHV transport. Before this analysis, we will give an overview of the existing literature.

## 2. Literature

### 2.1. Setting the Scene

Praised by some, maligned by others: LHVs remain a hot topic in the public debate. Advocates of LHVs stress the benefits of LHVs, compared to conventional trucks. First of all, the internal transport costs can be decreased. The energy efficiency can be increased by approximately 12.45 % in terms of fuel consumption per ton-km performed, in comparison to conventional trucks (De Ceuster et al., 2008), as the loading capacity increases. Besides, LHVs can decrease the labor costs and the fuel costs per ton-km in case of sufficient loading degrees. But also society at large might benefit from LHVs when transport-related external effects decrease. When LHVs are efficiently used, the emissions per transported unit decrease. Also congestion levels might lower when the road space that has been freed by reducing the amount of trucks, is not filled up by other users.

Possible disadvantages of introducing LHVs mainly relate to their external and indirect effects. A first possible effect is on the wear and tear of road infrastructure, including pavement and bridges (De Ceuster et al., 2008), although it is assumed that for the ‘best’<sup>3</sup>

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<sup>1</sup> Belgium has a density of 504 km road per 100 km<sup>2</sup>. The neighboring countries have clearly lower densities: 187 km / 100 km<sup>2</sup> in France, 180 km / 100 km<sup>2</sup> in Germany, 111 km / 100 km<sup>2</sup> in Luxemburg and 331 km / 100 km<sup>2</sup> in the Netherlands (World Bank, 2010).

<sup>2</sup> The density of navigable inland waterways is 5 km per 100 km<sup>2</sup> and for rail 21 km per 100 km<sup>2</sup>. In comparison to the neighboring countries, only the Netherlands scores higher for inland waterways. For rail, Belgium has the highest density (Eurostat, 2013).

<sup>3</sup> ‘Best’ is here assumed to be the combinations with the lowest impact on infrastructure.

LHV combinations, the maximum load per axle will not increase as the additional weight will be spread over more axles (Leduc, 2009). Also the accident risk is an important factor, which might lead to important preconditions regarding driver selection etc., when setting up a trial (Brijs et al., 2007). But besides these arguments, which are not the focus of this research, it remains crucial how the whole transport market will react on the allowance of LHVs. When the freed up road space is used for additional freight or passenger transport, this might lead to a net societal loss, when adding up the external transport costs. Also, price changes in the road transport market might trigger a modal shift away from more sustainable transport modes such as rail, inland navigation and short sea shipping. Such a reverse modal shift might nullify the potential societal gains of using LHVs. Even small volumes shifted away from the intermodal sector, might jeopardize its competitiveness when a domino effect occurs (De Ceuster et al., 2008).

Fact is that LHVs have been used in numerous countries for decades. Notable examples in Europe are Sweden and Finland, where the use of 25.25 m long LHVs with a maximum weight of 60 tons is allowed when using the European Modular System (EMS), combining existing loading units into longer and possibly heavier vehicles. When Sweden became a member state of the European Union, a study pointed out that when reducing the vehicle length and weight to conform to European standards, this would lead to financial losses, increased emissions and industrial disadvantages (Åkerman and Jonsson, 2007). A more recent study also advocated a continued use (Ericson et al., 2010). Still, countries or regions that want to admit LHVs on their infrastructure network start with extensive studies and long-term trials, to better estimate the expected impact of the allowance of LHVs. For instance in the United Kingdom (UK), a study had been commissioned to estimate the likely effects of the introduction of LHVs (Knight et al., 2008). But up to now, LHVs are not allowed in the UK. In the Netherlands, it took three trial periods and twelve years, before a wider introduction was established, whereas the actual usage is still limited to a network of approved routes (Rijkswaterstaat – Dienst Verkeer en Scheepvaart, 2011). In Belgium, public acceptance might still be a burden for the successful introduction of LHVs and the national or regional context (*in se* the adequacy of the infrastructure and the spatial planning) determines the fit for these trucks. In this perspective, a trial has been launched to test the feasibility of LHVs in Flanders and to increase the public support. The aim is to approve 10 routes within Flanders so the actual trial can start in the autumn of 2014. The selection of possible routes is however limited by a number of constraints regarding the transport infrastructure network (e.g. not passing schools) and during the trial no reverse modal shift is allowed.

The experiences with LHVs in other countries are closely monitored, both by proponents and opponents. Based on these foreign experiences, Belgium is strongly considering the introduction of LHVs on its road network. Prior to that, Flanders will conduct a small-scale trial with LHVs. The allowed routes will be evaluated in advance on an elaborate list of conditions, regarding safety and infrastructure requirements. Obviously a list of monitoring criteria will be included in the follow-up of the trial to check for the effect on health and traffic safety. An additional precondition will be that the volumes transported by LHVs in the trial were previously not transported by other modes than road, to avoid a reverse modal shift. But this also implies that the trial won't provide profound insights in the risk on reverse modal shift when LHVs are allowed afterwards. How can this risk on a reverse modal shift be measured? This question is discussed in the next section, based on evidence from other countries. Afterwards this will be tested for Flanders, using model simulations with the Location Analysis Model for Belgian Intermodal Terminals (LAMBIT). The discussion section is supplemented with a discussion on how the danger on reverse modal shift can be countered if shown that the advantages of LHVs might induce a reverse modal shift.

## 2.2. Reverse Modal Shift Abroad

Due to the better environmental performance in general of intermodal transport, compared to road-only transport (e.g. Ricci and Black, 2005; Kreutzberger et al., 2006), policy makers want to avoid a far reaching modal shift from rail and inland waterway transport to LHV. This is also one of the main arguments that rail lobbies use when campaigning against the introduction of LHVs. It should however be noted that a modal shift to rail and inland waterway transport should not be a goal as such, but improving the environmental performance of the transport system as a whole should be. On the other hand, LHVs could also be used for post haul transport in intermodal transport chains (Bergqvist and Behrends, 2011), leading to cost reductions in the intermodal chains.

In what follows, we list how reverse modal shift in other European countries is estimated. Due to differences among countries in spatial planning, market conditions and the spatial extent of the network on which LHVs are allowed, its implementation can have very different effects in different countries.

Åkerman and Jonsson (2007) estimate that 10-15% of all long distance transport in Sweden is performed, using the EMS. It should however be noted that 24m road trains are also allowed in Sweden, which can carry more weight. Furthermore, it is striking that Sweden and Finland, two countries allowing LHVs, have high shares of rail transport compared to other European countries. But, Åkerman and Jonsson (2007) witnessed decreases in the modal share of rail transport when weight allowance for truck increased. But when the EMS was introduced in 1997 the share of rail increased, which might be due to the fact that EMS enables intermodal transport.

For the case of the UK, Knight et al. (2008) examined the possible effects of introducing LHVs. Regarding reverse modal shift from rail to road, they estimated that 8-18% of the total ton-km would shift to 60 ton LHVs. And for the market of deep-sea containers this share could even increase up to 54%.

In the Netherlands, ARCADIS (2006) calculated that a modal shift depends on the specific characteristics of the trial. They estimated a reduction of 0.2-0.3% in the use of inland waterway transport and a 1.4-2.7% decrease in rail transport. Next, a repeated measurement tried to estimate the effect of LHVs on reverse modal shift (Ministry of Infrastructure and the Environment, 2011). In 2010, LHVs accounted for a share of 0.6% in domestic freight transport and 1.8% in the total container transport. Based on an economic analysis, it was estimated that in the following years, the share of the LHVs would remain limited. A market analysis supported that a reverse modal shift is not to be expected in the future, as certain conditions counteract a more widely usage. In 2010 LHVs were mainly used for direct transport from the sea terminal to the final destination and due to its low flexibility, LHVs are not often used to replace trucks for hinterland transport and pre- and post-haulage. Other arguments cited are: that it's easier to monitor multiple containers on a barge or train, that an exemption is required at the final destination, that the cost structure is not suited for short distances and that few combinations of containers optimally benefit of the concept due to weight restrictions (e.g. imbalance 20ft. versus 40 ft. containers). From 2013, LHVs are legally allowed on a limited network in the Netherlands.

Taking a broader perspective, Verweij et al. (2011) modeled the possible impact of a European wide introduction of LHVs with the TRANS-TOOLS model and find that the aggregate effect is modest. For rail, this would yield a 3.8% reduction expressed in ton-km while the decrease for inland waterway transport is estimated to be 2.9%.

When time-series information on modal shift is missing, or when LHV's haven't been (fully) allowed, often price cross-elasticity values are used to estimate the magnitude of a modal shift. Cross elasticity measures how the demand for a product reacts on the change in price of another product.<sup>4</sup> These price elasticity values can be found in a very broad range, depending on the calculation method but also on local market conditions. When we consider that cost savings are estimated to be between 10 and 25%, estimates on reverse modal shift are between 3.8 and 9.5% for rail and between 1.9% and 4.75% for inland waterway transport, using values scaled on Flanders (Grosso et al., 2011).

### **3. Methodology**

Within this study, we analyze the effect of LHVs on the market areas of intermodal terminals in Belgium. The basic change that will happen to the price structure, is simulated within the LAMBIT model (developed by Macharis (2000)). LAMBIT stands for Location Analysis Model for Belgian Intermodal Terminals and is a GIS-based model that is mainly used for policy analysis (e.g. Macharis et al., 2010). Based on a shortest path algorithm, the model calculates the shortest network routes for all modal combinations, i.e. road-only transport, intermodal rail transport and intermodal barge transport, for the maritime-based hinterland transport in Belgium. The route-specific information, derived from the GIS-model, is inserted into price functions, which are derived from market surveys and therefore based on real-world market prices. LAMBIT visualizes the cheapest transport alternative for transport between selected origin-destination couples.<sup>5</sup> To include LHVs in the model, the price function of unimodal road transport is altered. LAMBIT allows calculating the potential for reverse modal shift, but also additional scenarios can be elaborated. We assume in this simulation that, in contrast to the trial, reverse modal shift is allowed and that the use of LHVs is not restricted to the routes allowed in the trial. The major market for domestic intermodal transport in Belgium is for maritime-based container transport to and from the Port of Antwerp. For its hinterland transport of containers, the Port relies for 9% on rail transport and for 35% on inland waterways transport (Port of Antwerp, 2014). The other 56% of the containers are transported via road-only transport. Domestic intermodal transport in Belgium is mainly focused on inland waterway transport instead of rail transport, due to the short transport distances, and therefore mainly concentrated on container transport. Introducing LHVs would mean that one truck can carry one 40ft. and one 20 ft. container or three 20ft. containers at the same time, while a conventional truck can only carry one 40ft., one 20ft. or two 20 ft. containers, if their added weights do not exceed the predefined weight limitations. Obviously, LHVs can also be used for transporting semi-trailers and swap-bodies which are currently transported via rail. Aarts and Feddes (2010) state that using LHVs can result in cost savings of up to 25% for a LHV roundtrip. In the next section, we will estimate the spatial effect of cost reductions in the road transport sector on the market areas of the current Belgian Intermodal Terminals.

### **4. Results and Discussion**

To estimate the potential impact of the introduction of LHVs on the use of intermodal transport, we simulated the impact of price reductions in the road transport sector. The effect of price reductions of 5%, 15% and 25% were simulated using the LAMBIT model, based on

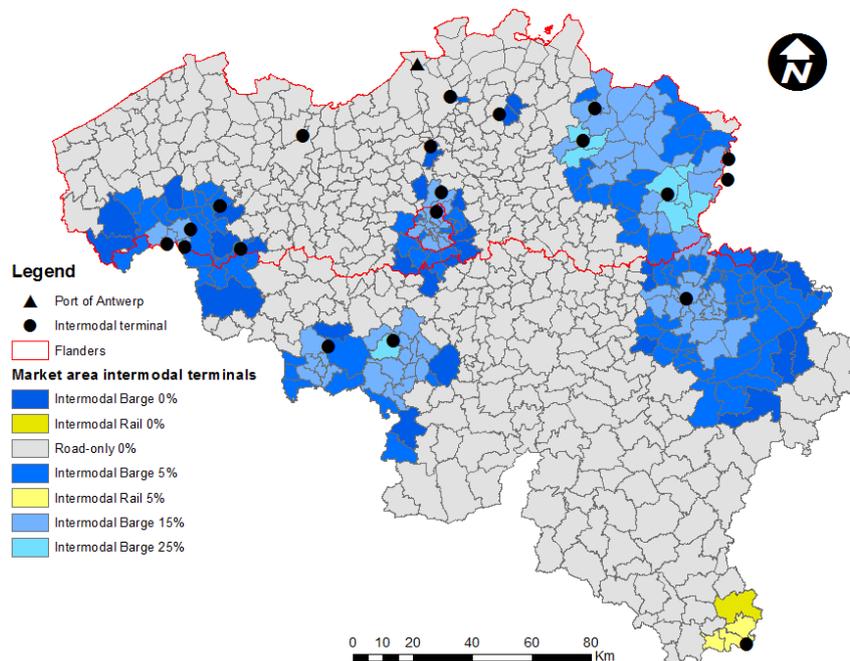
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<sup>4</sup> For an overview on these price elasticity values, see Beuthe et al. (2014)

<sup>5</sup> For more elaborate information on the cost functions used in the model, we refer to Pekin et al. (2012).

the 25% cost savings estimated by Aarts and Feddes (2010). When the first results of the planned Flemish trial are available, more accurate simulations can be performed. We assume here that LHV's can also be used for the post haulage of intermodal transport, although the distances are rather short and possibly passing secondary roads and to use LHV's would require a good distribution of 20ft. and 40ft. containers.

The map indicates that the market areas of intermodal transport shrink drastically due to the price decreases in road transport (Figure 1). In Flanders, the number of municipalities served cheaper by intermodal barge transport would reduce by 15% for a 5% price decrease, by 63% for a 15% price decrease and by 91% for a 25% price decrease. The numbers for Belgium are very alike. The Flemish inland waterway terminals had a total transshipment volume of around 530,000 TEU in 2013 (Promotie Binnenvaart Vlaanderen, 2014) of which most of it is transported to or from the Port of Antwerp, providing a great potential for reverse modal shift.



**Figure 1 – The market areas of intermodal terminal shrink drastically when prices of road transport decrease. The 0%, 5%, 15% and 25% refer to the decrease in the road transport market prices.**

It should nevertheless be obvious that these numbers are to be interpreted with caution. First, price is not the only factor determining modal choice between road transport and intermodal transport. Other, often quality-related factors such as transport reliability and the additional services offered at an intermodal are relevant in decision making. Also, the big volumes transported via inland terminals in Flanders are delivered close the terminal, leaving the biggest volumes in the heart of the market area. But, intermodal transport might suffer from the loss of small transshipment volumes when critical transshipment volumes are not met.

Next, it is crucial to find out which type of transport operations exactly qualify exactly for both transport by LHV's and by intermodal transport and are thus eligible for reverse modal shift. Coupling this information to the spatial information derived from LAMBIT could provide an estimate on the extent of a possible reverse modal shift. As already mentioned, price is a determining factor, and it has to be considered that an additional exemption has to be installed for loading/unloading. The Dutch trial also pointed out that the cost structure of

LHVs is usually less interesting on short distances (Ministry of Infrastructure and the Environment, 2011). Therefore it would be necessary to calculate the break-even distance between conventional trucks and LHVs. Following McKinnon (2008), LHVs will mainly be used for transport operations, which take advantage of the increased loading capacity of LHVs, relating to the weight and the volume of the transported goods. The weight of the goods but also the additional weight of the containers, can limit the potential for reverse modal shift together with the ratio of 20ft./40ft. containers. Also the types of goods transported can be relevant when for instance hazardous goods are not allowed on LHVs. Also the transport network can restrict the use of LHVs, as in the Flemish trial is determined. These are all elements that should be closely monitored when a reverse modal shift is to be anticipated upon.

## 5. Conclusion and Outlook

This paper aimed to explore possibly consequences on the use of intermodal transport following the introduction of LHVs in Flanders. In other countries, where LHVs have been introduced, no major reverse modal shifts seemed to occur, while different studies warn for far reaching consequences for the rail sector in particular. We found that when the prices for road transport decrease, the competitiveness of intermodal transport within Belgium strongly declines. It should however be noted that the transport flows which are eligible for a reverse modal shift should be estimated in detail, based on the preconditions mentioned in section 4, to better predict the possible impact. More specific data coming from the Flemish trial could already increase the insight in a possible reverse modal a shift.

Another element which should be considered is the possible reverse modal shift if LHVs are allowed to cross borders with for instance the Netherlands. The advantages of LHVs can possibly be exploited better on longer distance transport. This can also strongly influence the competition with intermodal rail services, as these are mainly competitive on longer transport distances. Finally, not only reverse modal shift should be monitored when introducing LHVs, also the modal shares of the different modes need to be checked, when cheaper road transport services can convince shippers to use LHVs for the transport of new volumes. An external costs analysis can also provide insight in the broader societal impact of the introduction of LHVs.

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