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Burden or opportunity for modal shift? – Embracing the urban dimension of intermodal road-rail transport

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ABSTRACT

Intermodal road-rail transport (IRRT) has a significant urban dimension, which affects the modal shift potential and the environmental benefits of rail freight. This paper explores the relevance of local policies for sustainable modal shift strategies by conceptualising the links between urban planning and rail freight. The presented framework identifies measures that local authorities can apply in order to increase the market and environmental improvement potential of IRRT. The results indicate that local urban transport planning has a significant role to play in the promotion of rail freight. Integrating rail freight into long-term urban development plans offers new possibilities for rail freight that are necessary in order to achieve a sustainable freight transport system in the face of ever-increasing road transport volumes.

1. Introduction

The imbalance in the development of inland freight modes has increased in recent decades. Road freight has become the dominant mode of transport in Europe and accounted for approximately 72 per cent of total inland freight in 2013 in the European Union, while rail, inland waterways and pipelines combined represented the other 28 per cent (Eurostat, 2015). This development is unsustainable because road freight has substantially higher externalities per ton-kilometre than rail and inland waterways. As a result, road freight is responsible for almost the entire externalities of the freight sector (96 per cent in the EU in 2008) (CE Delft et al., 2011). Therefore, a key policy objective for the freight sector's sustainable development is to reduce the imbalance in the development of the different modes and to transfer road freight to less environmentally damaging modes, such as rail and inland waterways. In its 2001 White Paper on European transport policy, the EU Commission adopted modal shift from road to rail as a general objective of European transport policy (European Commission, 2001) and, in the following years, initiated a series of policy initiatives to revitalize rail freight. These initiatives included financial support to projects that aimed to transfer cargo from road to rail and waterways (Marco Polo Programmes), as well as opening up the internal rail freight market to regulated competition and eliminating operational barriers (three Railway Packages) (EEA, 2015).

Some market segments have seen progress towards meeting the objective of modal shift. For example, for hinterland traffic of maritime containers, rail shuttles linking seaports with inland terminals recaptured market shares from road transport. The Port of Gothenburg, Sweden is a frequently cited showcase of this case of rail competition (Woxenius and Bergqvist, 2011). However, in the market segment of continental traffic, which has significantly higher requirements on transport time, precision and frequency, progress has been marginal at best. As a result, no substantial overall changes in modal shares have been observed. Between 2000 and 2013, total inland freight transport within EU-28 increased by approximately 10 per cent. Road freight accounted for the majority of the increase (+19 per cent), while rail freight only grew marginally (0.3 per cent) (Eurostat, 2015). Consequently, the 2006 White Paper Mid-term Review conceded that road was likely to remain the dominant mode of transport for inland freight (European Commission, 2006), and the 2011 White Paper envisioned possibilities for a modal shift only over distances longer than 300 km (European Commission, 2011). These examples indicate that the EU Commission has reduced its ambitious modal shift goals formulated in the 2001 White Paper.

In the light of these disappointing results of European modal shift policies, European transport policy may need some re-thinking if a sustainable freight sector is to be achieved. Current policy measures have been widely applied at the European and national levels, focusing on rail haulage and transhipments. Local policies, on the other hand, have not paid particular attention to rail freight issues. Haywood (2003) found that local transport plans in the UK increasingly include rail freight; however, little evidence was found for effective action, and Dablanc (2009) stated that most regional governments in Germany and France are

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less involved in the actual promotion of rail freight activities than they were a few years ago. In addition, Lindholm and Behrends (2012) found that, until recently, freight issues in general were rarely considered in urban and regional planning. Most urban freight research has addressed last-mile deliveries to retail stores in central business districts or other high-density areas that are the nexus of urban commercial activities, while only a few research works have looked at rail freight and logistics land-use issues (Behrends, 2016).

In this paper, we will argue that urban transport planning has an important role to play in developing promising modal shift strategies. Given the limited success of the European and national policy measures in recent decades, a better consideration of rail freight questions in local policies may offer new potentials for the improvement of rail freight. Accordingly, the purpose of this paper is to explore the relevance of local policies for sustainable modal shift strategies by developing a framework that conceptualises the links between urban planning and rail freight. To achieve this, the paper takes the form of desk research and conceptual work analysing previous research on rail freight from a local authority perspective.

The remainder of this paper is organized as follows. First, we review and structure the literature on rail freight in order to identify the critical issues of rail freight limiting its modal shift and environmental improvement potential. Second, we present a conceptual framework for integrating rail freight into urban planning, comprising five categories, and identify measures applicable by local authorities in each category to contribute to solve these critical issues. We conclude the paper by outlining theoretical contributions, implications for policy makers and list future research directions.

2. Intermodal road-rail transport: modal shift and environmental improvement potential

Since the extension of the railway network is limited, rail is not accessible for substantial shares of the transport market. Therefore, increasing the reach of rail freight requires intermodal road-rail transport (IRRT); that is, the combination of rail and road transport in a single transport chain. Macharis and Bontekoning (2004) defined four major IRRT activities (a) PPH operations for pick-up and delivery, (b) transhipment operations, (c) long-haul transport, and (d) route selection for a shipment through the whole intermodal network. The greatest distance of the transport chain is performed by rail, where the units are consolidated with other shipments and economies of scale are being achieved, while road transport is assigned to the collection and distribution of freight (Niérat, 1997). In this way, IRRT increases the reach of rail, which enhances the efficiency of the transport system and reduces its environmental impact. For example, Craig et al. (2013) estimated that the average carbon intensity of IRRT in the USA was 46 per cent lower than road transport. However, other studies are more pessimistic about its potential contribution to energy usage reduction and environmental improvement (McKinnon, 2003). Kreutzberger et al. (2006) showed that IRRT actually has a higher environmental impact than road freight when several factors cumulate, including long PPH distances, unfavourable shippers' locations in relation to terminals and rail route, and electricity production from non-energy-efficient fossil power plants. Promising modal shift policies must address these critical issues for the economic and environmental performance of IRRT. This section analyses the economic and environmental performance of each activity related to the production of IRRT; that is, PPH, rail haul and transhipments.

2.1. Pre- and post-haulage

PPH operations involve the provision of an empty trailer or container to the shipper and the subsequent transportation of a full trailer or container to the intermodal terminal (Macharis and Bontekoning, 2004). These operations are highly fragmented, with various PPH companies serving each terminal, while distribution and pick-up trips to and from shippers are seldom coordinated, resulting in a high share of empty driving (Morlok et al., 1995). Furthermore, PPH flows are locally and temporarily concentrated at the terminals, which can result in congestion and waiting times. In addition, since terminals as well as consigner and consignees are usually located in or in the vicinity of urban areas, PPH is affected by urban traffic congestion. Due to the rail production principle based on night jumps, PPH trips usually take place in the morning and in the afternoon during commuting peak-hours. PPH by diesel trucks is also responsible for a significant share of the transport chains' externalities. Since PPH operations usually takes place in urban areas, where they share the infrastructure with passenger traffic, their congestion, noise, accidents and air pollution impacts are much higher than for intercity traffic outside urban areas (CE Delft et al., 2011). Additionally, because of the low capacity utilization due to empty driving, which is inherent in pick-up and delivery traffic, the distance travelled in urban areas is generally higher than for all-modal road transport. As a result, PPH can account for up to 50 per cent of both the intermodal chain's externalities (Behrends, 2012) and costs (Macharis and Bontekoning, 2004; Santos et al., 2015). Therefore, PPH plays a significant role in both the economic and environmental performance of the intermodal chain, despite its relatively short distance compared to the rail haul.

2.2. Rail haul

Rail operations involve the movement of the loading units between terminals. In order to be competitive to road freight, trains must carry certain volumes and cover a certain transport distance in order to compensate for the additional costs of PPH and transhipments. As a general rule, therefore, modal shift strategies are only promising for large transport flows over long distances, rather than for short-distance transports, where the rail distance is too short to compensate the additional costs from PPH and transhipment operations. The break-even distance for IRRT obviously depends on many factors (such as rail pricing, road transport costs, freight volume, balance of traffic and location of rail terminals (Niérat, 1997)), but for European intermodal transport it is usually defined as 500 km or larger (Kreutzberger, 2008). On corridors where freight volumes allow for full trainloads with the required frequency, direct terminal-to-terminal shuttle services provide good transport quality and economy. If freight flows are too small for direct rail services, the required volumes can be achieved by consolidating freight belonging to different origin and/or destinations regions along a corridor. However, the transhipments add additional handling cost and time along the corridor, and this additional impedance of consolidation has been an incentive for intermodal rail freight operators to simplify their networks. As a result, intermodal operators only provide services where the conditions are extremely favourable (Kreutzberger, 2010), resulting in a situation whereby rail freight lines link larger cities with one another but do not link to the small towns situated along the line. These direct links are the best rail product wherever full trainloads with the required frequency can be organized. This is one of the most often employed production system in Europe, connecting agglomerations, centres of industrial production and container ports with major inland locations (UIC, 2007). This reorganisation of major railway networks, driven by the need to improve their financial performance, caused a withdrawal of railway services in regions with low traffic volumes (Dablanc, 2009). Gouvernal and Daydou (2005) found that the use of dedicated trains has increased dramatically in the United Kingdom. Woodburn (2015) also stated that many freight trains in the UK are operated directly from origin to destination. As a consequence, transport customers located in peripheral regions lack access to rail freight services and are dependent on road freight. Rich et al.'s (2011) analysis of the Scandinavian region showed that a majority of all transports shorter than 500 km have no alternative to road freight. Therefore, the economic and environmental benefits of rail can only be realised for a minor share of the transport market.

From an environmental perspective, rail operations are generally