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The potential for non-road modes to support environmentally friendly urban logistics

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Abstract

Road freight transport typically dominates in urban delivery operations. However, an increasing number of trials and commercial operations have started in the past 10 years attempting to use non-road modes in a wide range of cities including: Paris, Berlin, Madrid, Amsterdam and others. The research establishes the existing scale of rail freight in two comparable cities (London and Paris/Ile de France) and compares the development process in terms of the stakeholders, the infrastructure and planning issues and the nature of the operations. The review considers the scope and opportunity for an increase in the use of rail for urban freight transport and assesses the barriers to its wider implementation.

The research is based on a mixture of desk research examining a number of cities and their use of rail freight transport combined with some interviews with the major stakeholders. The research contains an assessment of a number of pilot projects and initiatives that can be considered together and offer important insights into the potential for changes to urban distribution operations. The findings illustrate that rail plays a more important part than is often thought but that its uptake is restricted by the complex barriers to wider implementation. Planning limits and the complexity of engaging with the range of stakeholders has made it difficult to implement rail solutions for urban freight. It is clear that some of the developments can be considered as filling a rather narrow niche function. However, it is also apparent that some initiatives have the scope for wider implementation and to contribute significantly to reducing the reliance on road freight transport in cities. The analysis will support the work of urban planners and policy makers concerned with how to reach the EU target of essentially zero CO2 urban freight by 2030. In addition, the research identifies a number of barriers that need to be overcome and proposes ways to achieve this.

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Keywords: urban freight planning; rail freight solutions; sustainable freight; multimodal freight transport

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1. Introduction

Road freight transport typically dominates in urban delivery operations. However, an increasing number of trials and commercial operations have started in the past 10 years attempting to use rail transport in a range of cities. At the EU level attention on the possibility to shift at least some traffic from road to rail (or perhaps to use rail in combination with clean vehicles making the last mile delivery) has been increased by the EU White Paper on Transport (European Commission, 2011). A number of challenging goals were set, including the aim of achieving essentially CO2-free city logistics in major urban centres by 2030. The White Paper makes the point that achieving essentially CO2-free city logistics would also substantially reduce other harmful emissions.

The paper is based on a review of the use of rail within the urban supply chain. The paper begins with a brief overview of existing rail freight activity in London and Paris and this is followed by a review of current/planned and recent European urban rail freight schemes. The common barriers facing increased use of rail are then summarised. The paper ends with a discussion of the biggest potential contributions that rail could make to sustainable urban freight.

2. The importance of rail within two cities (London and Paris/Ile de France)

Table 1 summarises trends in rail movements for London between 2007 and 2011. Over that period total rail flows rose by more than 1 million tonnes per annum (an increase of 20 per cent). Most of the growth was in the increased use of rail within construction. Of the "other" category, there are some flows of less bulky and higher value products, primarily focused on the terminals in the Barking and Dagenham area. From the rail freight database developed by the University of Westminster (and based on a range of data sources), these flows include cars and car components (within the UK and to/from Spain via the Channel Tunnel), intermodal traffic to/from Poland, consumer goods for Tesco, mail services for the Royal Mail, and seasonal produce from Spain. In addition, there was a trial in late-2012 carrying retail goods from Daventry to Euston station. While these "other" flows are not significant in tonnage terms, they demonstrate rail's capabilities within an urban environment in catering for higher value products within manufacturing and retailing supply chains.

Table 1: Goods lifted by rail on journeys to, from and within London by commodity, 2007-2011 (million tonnes and percentages)

Commodity	2007	2008	2009	2010	2011
Construction	4.95 (80%)	5.83 (80%)	5.39 (80%)	4.88 (77%)	5.99 (82%)
Waste	0.65 (11%)	0.88 (12%)	0.85 (13%)	1.00 (16%)	0.64 (9%)
Other	0.54 (9%)	0.59 (8%)	0.47 (7%)	0.47 (7%)	0.72 (10%)
TOTAL	6.14 (100%)	7.29 (100%)	6.71 (100%)	6.36 (100%)	7.35 (100%)

Source: Network Rail data processed by MDS Transmodal

In the case of Paris/Ile de France the absolute volume of rail freight was broadly similar in 2011 to that of London at 6.99 million tonnes (Mairie de Paris, 2012). However this represented a significant fall from a high point in 2007 when a total of 20.14 million tonnes was carried by rail (arrival and departure tonnage). Some of this change can be explained by the relocation of industry that used rail extensively (however it is also partly explained by the growth in non-SNCF freight traffic which is not included in this data).

3. Examples of initiatives that make use of rail in the urban supply chain

Alessandrini et al. (2012) identified that in general rail is a little used mode for urban freight distribution, particularly in relation to flows of consumer goods towards the latter stages of the supply chain. Rail has been involved in urban freight activities for a number of years but complex requirements and obstacles have often prevented the operations from becoming a long-term success. However, although some schemes failed, others succeeded and have become valuable examples of how rail can be successfully incorporated in European urban

supply chains. It should be noted that for some schemes identified below, such as the Paris examples or the Rome Fresh Food Centre, the motivation is quite clearly to use rail to resolve urban freight problems, while others, such as those in Sweden, are rail freight terminals that influence urban freight activity but may not specifically aim to reduce urban impacts. This review deals with the potential of urban freight operations carried out by "heavy" rail only and does not include any tram or underground based schemes. Schemes that are in existence or planned are dealt with first, followed by the identification of a number of schemes that were operational but are believed to have ceased operation.

3.1 Current and planned European urban rail freight initiatives

Based on the review of literature, urban rail freight schemes currently in operation or in the planning stages include the following examples:

Paris (France)

Monoprix - the scheme has been in operation since November 2007 and was initiated by Monoprix, a French retail group owning 300 shops. The concept makes use of a logistics centre located in Paris-Bercy where rail carries 30% of flows (120,000 tonnes or 210,000 pallets a year) destined for almost 90 shops in central Paris. The key characteristics of the initiative are as follows (based on Charlier, 2008; Dablanc, 2009; Maes and Vanelslander, 2010; Alessandrini et al., 2012):

- daily service, initially serving 27 stores and increasing to almost 90 stores in 2009, and carrying homewares, personal care goods and soft drinks from two warehouses on the edge of Paris,
- service operates to a 3,700 m2 rail terminal near Bercy station in central Paris, with vans powered by natural gas used for onward road distribution of goods to stores,
- availability of a suitable inner city rail terminal was critical to the launch of the initiative,
- the city terminal only needs enough space for direct transhipment from rail to road, with other activities taking place at the out-of-town end of the rail route,
- currently more expensive option than road-only solution, but environmental and social benefits are substantial. Financial viability is dependent on the extent to which road's external costs are internalized. The scheme is technically acceptable but its operation is about 25% more expensive than the previous all road solution, but taking into account fuel prices and road pricing, the balance can quickly change – who pays the additional costs of the rail-based solution is not apparent from the literature, and
- annual savings of 70,000 litres of fuel, 337 tonnes of CO2 emissions, 25 tonnes of NOx emissions, and 12,000 fewer lorry journeys entering the city centre of Paris.

Sogaris - Sogaris is a public-private organisation, 80% owned by local government, which specialises in urban logistics facilities (Sogaris, 2012). The organisation has a number of ongoing initiatives in Paris (and elsewhere in France, Luxembourg and Belgium) which are aimed at meeting local government sustainability and business objectives. Sogaris is aiming to develop urban logistics facilities based on the following integrated strategy:

- whole urban areas, with logistics platforms as points of entry
- consolidation centres (known as 'logistics hotels') in the densest parts of urban areas
- final delivery points within neighbourhoods

Multimodal terminals feature as components of the first two categories of facilities with the large Sogaris Rungis (Paris) logistics gateway as an example of the former and the planned logistics hotels in Brussels and Paris are examples of the latter. While multimodal urban logistics gateways are reasonably well established, and usually located at the edge of large urban areas, the logistics hotel concept is more innovative and aims to bring rail freight closer to the city centre areas. The Brussels proposal includes 30,000 m2 of warehousing, together with around 20,000 m2 of other activities including parcel docks, offices and craft industries, within an inner city area. The Paris

Chapelle International proposal (in the vicinity of Gare du Nord) includes 20,000 m2 of land and 40,000 m2 of buildings housing logistics activities, offices and community facilities.

Rome (Italy)

A new initiative is planned for the Fresh Food Centre S.p.A. (FFC) which provides logistics services for the distribution of fresh food to supermarket chains (SMA, Auchan, Cityper) in central Italy and, in particular, in Rome. The FFC's logistics platform is located 30 kilometres south of Rome in the area of Santa Palomba from where it is planned to distribute fish to stores in Rome (Alessandrini et al, 2012). The centre of the operation will be a multi-modal urban distribution centre (MUDC) located at an existing rail freight terminal situated in the eastern inner area of Rome called Scalo San Lorenzo. It is planned to move the fish by shuttle trains from the existing rail terminal of Pomezia Santa Palomba (located near to the FFC platform) to the MUDC in Scalo San Lorenzo, where the product will be transferred to road vehicles, preferably low-pollution trucks, for the delivery to stores in Rome. Since passenger traffic dominates at Scalo San Lorenzo during the day, the train shuttle linking the two terminals will have to operate at night. It is expected that 2.2 tonnes of fish will be delivered daily to the MUDC, replacing four separate lorry journeys and saving 287 kilometres travelled by road per day, with 18 supermarkets served (Alessandrini et al, 2012).

Dusseldorf (Germany)

The success of heavy rail freight operations in the city is a result of freight policy in which Dusseldorf supports rail and intermodal transport in order to achieve a desired modal shift from road to rail. The most important decision was to secure the railway infrastructure by stopping the decline in the number of rail-connected sites and the loss of any future rail traffic. This has been done as an integral part of the wider city planning process (Robinson and Mortimer, 2004a). In order to improve productivity, shorten the transit times and create new connections, the city's plan included the following (Robinson and Mortimer, 2004b):

- Completing an efficient central goods sorting point and increasing the number of its connections with local shunting yards, and
- Elimination of bottlenecks on capacity-constrained routes in order to increase the number of train paths and make the freight route more independent of the passenger network.

Hannover and Bremen (Germany)

The intermodal terminals in the cities are located within close proximity to the urban core but the freight forwarders' distribution terminals are situated in urban fringe areas which results in relatively long pre and post haulage (PPH) distances in urban traffic conditions. In order to improve the situation in Stockholm, there are plans to build an alternative terminal north of the city. This new location would increase the total PPH distance but the trip would be carried out in less sensitive urban areas (Behrends, 2012a).

Stockholm and Gothenburg (Sweden)

An intermodal terminal in Bremen is located in the north-western part of Bremen. In Hannover the intermodal terminal is situated within close proximity to the urban core while the logistics areas are based to the north and east of the city. There are plans to establish a hub for a national intermodal network east of Hannover to allow easy access to the logistics areas (Behrends, 2012a).

3.2 European urban rail freight initiatives believed to have ceased operation

The following schemes that operated or were trialled in the recent past have also been identified but which, for various reasons, are believed (on the basis of the literature review) to have ceased to operate.

Berlin (Germany)

Zapf, one of the biggest German moving companies was using rail to carry out much of its long-distance house moving business. The containers were loaded onto rail at the inner-city logistics centre in Berlin Treptow-Neukolln

and by 2002 up to 500 containers were in service with Zapf's further plans to shift more of its operations to rail. This was dictated mainly by the expected cost reduction when compared with long-distance road transport. However, by June 2003, Kombiverkehr, a subsidiary of German Railways (DB AG), discontinued the container rail line to and from both inner-city logistic centres in Berlin. As a result, Zapf moved all of its long-distance operations to a road haulage company (TELLUS, 2005).

In April 2005 a private railway company (DHL) started a daily container train service between Unna and a tri-modal (road, rail and water) logistic centre in Berlin-Westhafen. The operation was set up for Karstadt GmbH which is a German department store chain and its objective was to supply the retailer's stores in Berlin with goods brought daily to the centre by 40 swap bodies (TELLUS, 2005).

Germany also hosted another initiative called Cargo Sprinter. It was set up in the mid-1990s and designed to service smaller flows into and between urban areas more cost–effectively than orthodox trains. However, the employed technology of the trains did not quite meet the expectations and was compromised by track access costs that were equated to those of larger, heavier and slower orthodox trains (Robinson and Mortimer, 2004a).

Nuremburg (Germany)

In the past, heavy industry used a circular rail route within Nuremburg to transport mainly low value commodities such as aggregates, cement and fuels, but over time the industries declined and so did the level of rail freight traffic they moved. The largest freight terminal in the city was situated within a residential area but it is not possible to use it for goods movement by rail. Any future potential for rail freight operations has been weakened while significant investment is required in order to restore and maintain the existing infrastructure (Robinson and Mortimer, 2004a). The lack of freight trains operating in Nuremburg led to an increase in road freight traffic and had a negative impact on the city in the form of higher traffic congestion, increased noise and higher danger to pedestrians (Motraghi and Marinov, 2012).

Vienna (Austria)

The Vienna concept was planned to become a truly intermodal solution with heavy rail offering long-distance freight service into one of three city terminals linked by a cargo tram circle line while a final delivery into the city centre was to be completed from the most convenient transfer point by small environmentally friendly trucks. However, the implementation of the concept proved difficult for the following reasons (Robinson and Mortimer, 2004b):

- Perceived systems and level of service disadvantages,
- The continuous requirement for road vehicles carrying out list mile operations,
- It required co-operation between parties who could also be competitors,
- The expected environmental benefits did not materially influence commercial decisions, and
- Higher cost and complexity when compared with road transport.

Rome (Italy)

Omnia Logistica was running a door-to-door service for the La Rinascente group providing a transport solution between its supplier in Emilia Romagna and its department stores in Rome. The scheme consisted of road transport from the supplier to the intermodal freight centre in Bologna, a rail shuttle service (operating three times a week) between the centre in Bologna and the Scalo San Lorenzo rail freight terminal located in the central area of Rome and finally the delivery of products to the department stores in Rome using conventional diesel trucks. The scheme involved a wide range of goods including water, textile and home and leisure products which were consolidated in pallets and roll containers. In 2005, the total number of transported pallets and roll containers ranged between 1,800 and 5,800 per month (Alessandrini et al, 2012).

4. Barriers preventing successful urban rail freight operations

The available literature provides some arguments about potential barriers preventing urban rail freight operations from becoming a widespread success story.

Limited modal shift potential of rail freight is one of these arguments as the rail transport is not accessible for a substantial part of the market due to the limited opportunities for railway network extension as well as expensive shunting of wagons into private sidings. As a result, intermodal road-rail transport (IRRT) is set up using both road and rail as goods stowed in unit loads move along a supply chain. Often the volumes moved by individual shippers are not big enough for IRRT but the total transport demand of several shippers in the same urban area may be sufficient to achieve the required volumes which are economically viable for intermodal operations. This can be achieved by consolidating the less-than-trainload shipments from different sources located in close proximity to each other (Behrends, 2011). A city is usually provisioned by many supply chains as it hosts shippers from various economic sectors (Dablanc, 2011 cited in Behrends, 2011, p.5).

On the other hand, space and infrastructure limitations present in urban areas also pose a barrier to a potential intermodal operation while limited relative environmental advantage of rail over road, are also often argued. A higher level of rail freight causes more local air pollution, noise and congestion. (Behrends, 2011). Often strong local opposition use arguments about old and noisy locomotives, poorly looking industrial areas and the generation of truck movements (Dablanc, 2009). Due to the superior energy efficiency and easier access to renewable energy that rail has over road, a modal shift from road to rail mainly decreases CO2 emissions but at the same time it may increase air pollution and have a negative traffic impact at the local level (Behrends, 2011). Also often rail freight terminals are situated close to the city centres while the shippers and receivers of intermodal freight are based in the outer areas of the city with good connection to highway intersections (Hesse, 2008 cited in Behrends, 2011, p.6). For these reasons rail freight terminals should be relocated to urban peripheries as argued by Behrends (2011). These areas provide the space and infrastructure needed for effective transhipment operations, reducing the negative impact on the local environment and affecting less people. Some cities such as Gothenburg and Hannover are already planning the move of their rail freight terminal out of the urban core but it is expensive and leads to local protests at the proposed locations of the new terminals.

Other barriers leading to limited opportunities for urban rail freight include perceived high costs of rail infrastructure and related systems, limited physical flexibility, land pressure and the lack of available capacity on the infrastructure due to growing passenger rail traffic (Alessandrini et al, 2012 and Dablanc, 2009).

Cost seems to be an important hindrance to any urban rail freight operation as the initial investment cost is high (Motraghi, 2012). Rail normally requires a dedicated logistics infrastructure in the form of tracks, sidings, yards and terminals and it is expensive. Furthermore, operating costs should also decrease while the level of service is improved. Currently, rail is often perceived as slow moving and unreliable so changing this image is important for any future success of urban rail freight schemes. However, political support is also significant and can be offered in the form of incentives, new legislation or commitment to the system or project (Motraghi, 2012), while sites that offer potential for intermodal terminals should be protected for any future developments (Behrends, 2012b).

The success of heavy rail freight operations in the city is a result of the freight policy in which Dusseldorf supports rail and intermodal transport in order to achieve a desired modal shift from road to rail. The most important decision was to secure the railway infrastructure by stopping the decline in the number of rail-connected sites and the loss of any future rail traffic. This has been done as an integral part of the wider city planning process (Robinson and Mortimer, 2004a). In order to improve productivity, shorten the transit times and create new connections, the city's plan included the following (Robinson and Mortimer, 2004b):

- Completing an efficient central goods sorting point and increasing the number of its connections with local shunting yards, and
- The limination of bottlenecks on capacity-constrained routes in order to increase the number of train paths and make the freight route more independent of the passenger network.

5. Discussion and Conclusions

Taking account of rail's key characteristics, its biggest potential contributions to sustainable urban freight seem to be:

- Maximising its use for bulk flows, typically construction materials moving inwards to cities and domestic and industrial waste moving outwards,
- Developing 'green' solutions for the flow of consumer goods for customers in urban areas, which combine the use of rail for the trunk haul from distribution centres to a location within the urban area with the use of 'green' road vehicles for the local deliveries
- Even where rail itself is not directly used, potentially using existing or new rail infrastructure (e.g. key stations) as hubs for urban freight distribution

For the first of these categories, rail often has natural strengths due to the volumes involved, but its role could often be enhanced through the adoption of policy measures and funding opportunities that extend its reach. For example, major new urban developments such as offices, shopping centres, transport infrastructure and sporting facilities typically require the movement of large volumes of construction materials to the site, and sometime also the movement of extracted materials away from the site (e.g. contaminated land). In granting planning permission for such developments, the potential use of rail (and water) should be considered and possibly built in as a planning condition. The availability of suitable rail terminals within urban areas can also be an issue, so public sector funding contributions may be appropriate given the wider environmental and societal benefits generally associated with a switch to rail.

The second category is generally more challenging when it comes to integrating rail into the flows. In some cases, particularly for large retailers, it may be possible to operate dedicated freight trains as in the Paris Monoprix example, where the loads are transhipped from rail to road for the final delivery to stores. In many cases, however, to make the rail freight leg viable, a combination of consignments for multiple customers is likely to be needed. Such rail flows are most likely be an intermodal operation, with simple unit transfer at the rail terminal, although the London trial referred to earlier used roll cages in traditional rail vans, is as another possibility. Terminal requirements would depend on the proposed nature and scale of operations, volume throughput and on-site activities but, with inner city (but not city centre) sites most likely to be feasible. In some cases, the use of city centre termini may be possible if there is direct transhipment to road vehicles. By using rail for the trunk haul, instead of HGV from the distribution centre to retail outlet, the opportunity arises to separate out the longer distance transport leg to the urban area from the last mile delivery. As a consequence, the development of an integrated solution that combines rail and 'green' road vehicles in an overall package may be possible.

The development (or redevelopment) of rail infrastructure within urban areas may offer scope for the coordination of freight flows in a wider sense, by acting as a hub where certain activities can be focused. Coordination opportunities are likely to be greatest for smaller freight generators, where deliveries are typically small and fragmented and lead to inefficient use of transport resources. Even without the use of rail freight, major stations, for example, could act as consolidation points for goods destined to the surrounding areas or could host locker banks where customers could collect their goods while passing through to/from trains.

When evaluating the use of rail for freight movement in urban areas, care needs to be taken to mitigate any negative localised consequences of the use of rail hubs within the city, since these consequences may generate local hostility even if the benefits for the urban area as a whole considerably outweigh these negative local impacts.

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