THE IMPACT OF THE DEVELOPMENT OF THE STRATEGIC FREIGHT NETWORK ON RAIL FREIGHT ACTIVITY IN BRITAIN

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ABSTRACT

Achieving a modal shift from road to other modes for freight transport activity is seen as key to meeting economic and environmental objectives, and this paper makes a significant contribution to this debate through the examination of the impacts of targeted infrastructure funding. The British Department for Transport (DfT), in conjunction with Network Rail (the rail infrastructure operator), initiated the development of a Strategic Freight Network (SFN) in 2007 to channel infrastructure investment and improve the efficiency of the rail network for freight users. A number of schemes have now either come to fruition or are well underway, but there has been no published evaluation as yet as to the extent to which the SFN's objectives have been, or are being, met. The overall aim of this paper is therefore to assess the impact of the development of the SFN on the demand for rail freight activity in Britain. From the literature, the timeline for the implementation of the different initiatives developed within the SFN programme over the last five years is established, to clearly set out the characteristics of the work that has taken place. This provides the basis for the subsequent analysis of the impact of the SFN on rail freight activity. This analysis takes both published and unpublished data to determine the extent to which there is a correlation between the implementation of network enhancements due to the SFN and the trends in rail freight activity. Published statistics are of very limited use in such an assessment due to their limited level of disaggregation, so analysis of an original annual database of rail freight service provision and observation surveys form the basis of the detailed assessment. The findings show that, in a fairly short period of time, there have been some quite considerable benefits accruing from the SFN initiatives, not least for the movement of deep sea containers between ports and their hinterlands. The evidence from this British case study suggests that targeted network capacity and capability funding to meet key strategic objectives yields considerable benefits for rail freight. The analysis also demonstrates the benefit of using unpublished disaggregate data to understand phenomena within the freight sector, where there is a general lack of good quality data to allow evidenced-based policy decisions to be made.

Keywords: Rail freight, transport infrastructure, Intermodal freight, transport investment

INTRODUCTION

Transport infrastructure investment plays an important role in determining both the efficiency and sustainability of freight transport activity. Contemporary European Union transport policies promote co-modality, based on "optimally combining various modes of transport within the same transport chain" (European Commission, 2006, 3). The 2011 Transport White Paper (European Commission, 2011) sets out a target for 30 per cent of freight moving over 300 km by road to transfer to other modes (e.g. rail or waterborne transport) by 2030, and for more than 50 per cent transfer by 2050. The British rail industry plans to improve freight capability and performance over the next 25 years, with an expected increase from 11.5 per cent to 20 per cent in rail's share of the surface freight market (Network Rail *et al*., 2010), and the British government has emphasised the importance of rail freight in meeting the country's economic and environmental objectives. In particular, the recent establishment of the Strategic Freight Network (SFN) has led to a focus on targeted infrastructure investment for rail freight (Network Rail, 2008a; DfT, 2009). While, it is clear that the establishment of the SFN has been well received (see, for example, House of Commons Transport Committee, 2010), there has as yet been no formal evaluation of the impacts of the SFN, so the overall aim of this paper is to assess the impacts of the development of the SFN to date on rail freight activity in Britain.

The paper is based on a mix of primary and secondary research. To date, there has been no attempt to bring together the literature relating to the SFN to evince a clear understanding of how it has evolved, so this is the first key objective of the paper. To satisfy this, the paper pulls together information from a range of sources so as to provide a comprehensive review of the establishment of the SFN, establish the timeline for the implementation of the different initiatives developed within the SFN programme over the last five years, and set out the way in which the network is planned to develop in the future. The review sets out the characteristics of the work that has taken place so far and that which is planned in the period until 2018/19. The second objective is to consider each of the initiatives implemented under the SFN and to evaluate their impacts. This analysis includes both published and unpublished data to determine the extent to which there is a correlation between the implementation of network enhancements due to the SFN and the trends in rail freight activity. Published statistics are of little use in such an assessment due to their limited level of disaggregation, so analysis of an original annual database of rail freight service provision and observation surveys forms the basis of the detailed assessment.

DEVELOPMENT OF THE STRATEGIC FREIGHT NETWORK

This section reviews the literature relating to the SFN, beginning with a history of its development, highlighting its aims and principles and detailing the projects that have been funded to date. It then presents the future plans for the SFN as at the time of writing (i.e. February 2013).

The inception of the Strategic Freight Network

In its 2007 White Paper, the Department for Transport (DfT, 2007) announced that it was allowing Network Rail to allocate £200 million in Control Period 4 (CP4) (i.e. between 2009/10 and 2013/14) to establish the SFN to reduce conflicts between passenger and freight flows and to encourage rail freight growth. Specifically, the SFN "would provide an enhanced core freight trunk network, optimised to freight requirements, and providing greater capability, reliability and availability" (DfT, 2007, p.81). The SFN largely evolved out of the Transport Innovation Fund (Productivity) (TIF(P)), which had been established in 2007 to prioritise network enhancements that would benefit national productivity, not least by improving rail links to key ports. Planned measures to improve network capability, reliability and availability included loading gauge enhancements, improved axle loads, and more and better diversionary routes to allow seven day freight operations. Following an analysis of the proposed key routes for different commodity flows, the SFN proposed by Network Rail (2008a) is shown in Figure 1.

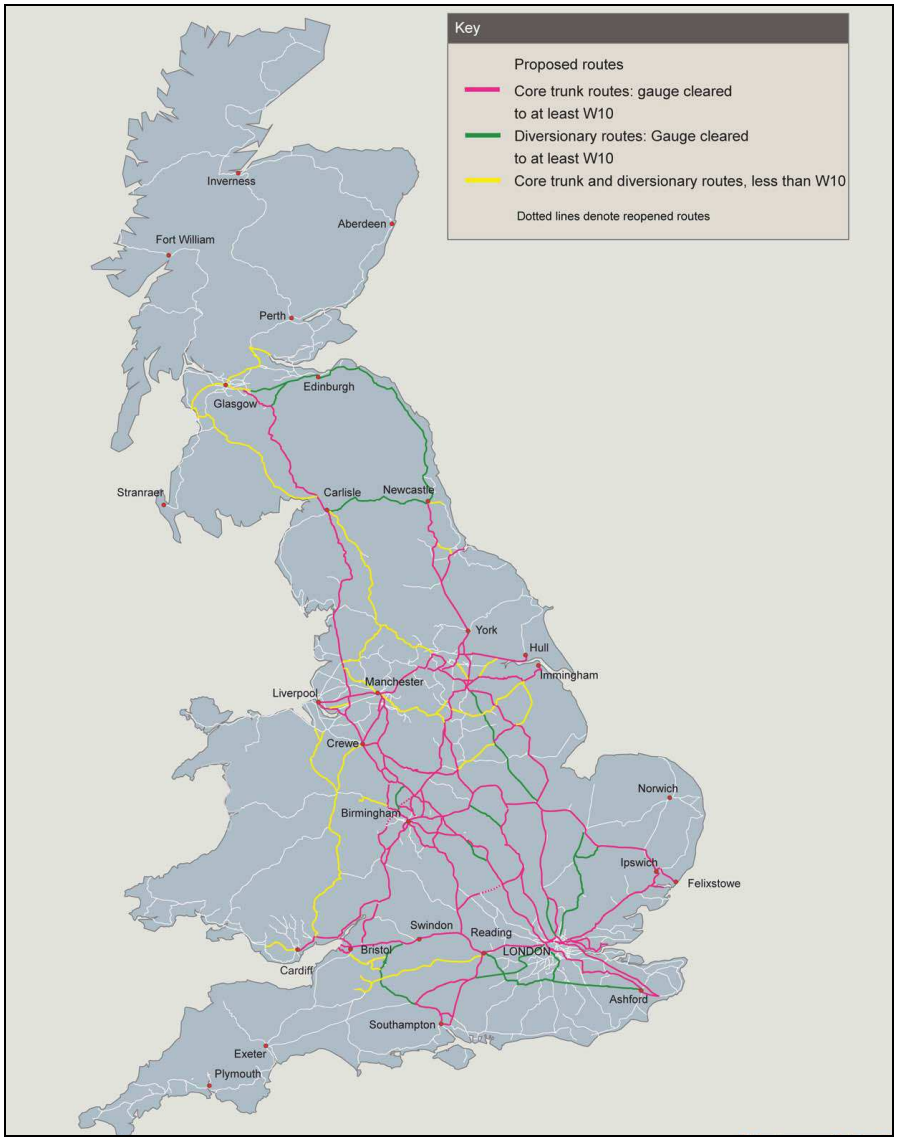

Figure 1: The proposed Strategic Freight Network (Source: Network Rail, 2008a)

The network comprises a combination of core and diversionary routes, and certain routes cleared to at least W10 gauge to allow the carriage of high cube containers on standard wagons. While the SFN itself covers England, Scotland and Wales, the funding agreed for CP4 only applied to England and Wales, with no specific funding allocation for the rail network in Scotland. Tables I and II respectively set out the allocation of funds for the 2009/10 to 2013/14 period from the SFN and the now defunct Transport Innovation Fund (Productivity). Network Rail's Control Period 4 Delivery Plan (Network Rail, 2009, p.30) shows a slightly higher planned expenditure of £220 million (in 2009/10 prices), and there are other CP4 projects, such as those funded through the High Level Output Specification (HLOS), designed to provide benefits to both passenger and freight services, so it is a challenge to derive the precise level and allocation of funding.

Table I – Strategic Freight Network projects funded to delivery in CP4 (2009/10 – 2013/14)

Route	**Project description**	**Funding (£ million)**
Felixstowe-Nuneaton	Capacity and signalling enhancements	50
Southampton-Basingstoke	W10/W12 gauge clearance on Andover diversionary route	55
Various	In-fill gauge schemes identified by industry	40
Various	Train lengthening schemes identified by industry	40
Channel Tunnel	Signalling modifications to allow electric hauled Channel Tunnel trains to/from London via Redhill (scope since broadened to Channel Tunnel South of London route)	10
Various	Development studies for SFN next stage	5
Total		**200**

Source: based on DfT (2009)

Table II – Transport Innovation Fund (Productivity) projects for delivery in CP4 (2009/10 – 2013/14)

Route	**Project description**	**Funding (£ million)**
Peterborough-Nuneaton	W10 gauge clearance and capacity enhancements	80
Southampton-Nuneaton	W10 gauge clearance	42.8
Humber Ports-East Coast Main Line	Capacity enhancements	8
West Coast Main Line-Liverpool Docks	Port rail access improvements (new chord and W10 gauge clearance)	1.7
Gospel Oak-Barking	W10 gauge clearance and freight capacity	18.5
North London Line	Freight capacity increases	n/a
Total		**151**

Source: based on DfT (2009)

The projects that fall under the "various" categories in Table I have evolved during CP4, and can be tracked in Network Rail's regular statements relating to the CP4 Delivery Plan 2009 (see, for example, Network Rail, 2012) and the annual Route Plan Updates. The full list of

in-fill gauge and train lengthening schemes being implemented during CP4 is shown in Table III.

Table III – In-fill gauge schemes and train lengthening schemes for delivery in CP4 (2009/10 – 2013/14)

Route	**Project description**	**First mention in Delivery Plan**
Water Orton-Doncaster	W10/W12 gauge clearance	Mar 2009
London-Peterborough (via Hertford)	W10/W12 gauge clearance	Mar 2009
HS1-Barking area terminals	European (GB+) gauge clearance	Mar 2009
Temple Hirst (Yorkshire)-Berwick	W10/W12 gauge clearance	Mar 2009
Peak Forest/Hope Valley-London	Train lengthening	Mar 2009
Felixstowe-Nuneaton (via London)	Train lengthening	Mar 2010
Southampton-West Coast Main Line	Train lengthening	Mar 2010
Darlington-Teesport	W10/W12 gauge clearance	Mar 2012
Swinton-South Kirkby (Yorkshire)	W10/W12 gauge clearance	Mar 2012
Chorley Tunnel	W10/W12 gauge clearance	Sep 2012

Source: Network Rail (2012) and earlier updates; completion within CP4 not yet determined for all schemes

The Department for Transport (DfT, 2009) set out nine principles for the SFN in the longer-term:

- Longer and heavier trains, allowing for 775 metre long intermodal trains and 32 tonne axle loading for heavy trains on key routes
- Freight- and network-efficient operating characteristics, with the aim of keeping freight trains moving rather than using passing loops so often
- Seven-day/24-hour capability, through changes to engineering possession practices and the use of diversionary routes
- W12 loading gauge for core and diversionary intermodal routes, to accommodate standard short sea containers in addition to W10 gauge which caters for deep sea containers
- A European loading gauge freight link, perhaps accessing the Midlands using High Speed 1 (HS1) and the Midland Main Line (MML)
- New freight capacity, particularly on intermodal routes, and the safeguarding for freight of existing capacity released by any new high-speed lines
- Electrification of freight routes, for diversionary and network resilience reasons
- Strategic Rail Freight Interchanges and terminals, integrated with the National Networks and Ports National Policy Statements (NPSs), and providing financial support for terminal enhancements to handle 775 metre trains and/or electric traction
- Strategic Freight Capacity scheme, to protect and develop strategic freight paths, and to optimise the use of these paths

To this list, a tenth (i.e. freight routeing studies to identify and subsequently develop optimal freight corridors between London and the South East and the Midlands and North of England) has featured in some literature (see, for example, RFG/RFOA, 2009).

Current status of SFN and TIF(P) projects

While the projects funded through these initiatives are set out in the literature, as discussed earlier in this section, it is more difficult to identify the status of each project at a specific point in time. This is particularly the case for the TIF(P) projects, since that funding mechanism ceased to exist in 2010. However, Table IV summarises the status of each project based on an assessment of the published information.

Table IV – Status of CP4 SFN and TIF(P) projects (as at February 2013)

Route	**Project description**	**Status**
West Coast Main Line-Liverpool Docks	Port rail access improvements (new chord and W10 gauge clearance)	Partially completed (2009)
Gospel Oak-Barking	W10 gauge clearance and freight capacity	Completed (2009)
Peterborough-Nuneaton	W10 gauge clearance and capacity enhancements	Completed (2011)
Southampton-Nuneaton	W10 gauge clearance	Completed (2011)
North London Line	Freight capacity increases	Completed (2011)
HS1-Barking area terminals	Infrastructure work to permit larger wagons to access East London terminals	Completed (2011)
Southampton-Basingstoke	W10 gauge clearance on Andover diversionary route	Completed (2013)
Humber Ports/Immingham-East Coast Main Line	Capacity enhancements	Uncertain
London-Peterborough	W10/W12 gauge clearance	Ongoing (to 2013)
Peak Forest/Hope Valley-London	Infrastructure enhancements for train lengthening	Ongoing (to 2013)
Felixstowe-Nuneaton	Capacity and signalling enhancements	Ongoing (to 2014)
Water Orton-Doncaster	W10/W12 gauge clearance	Ongoing (to 2014)
Temple Hirst (Yorkshire)-Berwick	W10/W12 gauge clearance	Ongoing (to 2014)
Swinton-South Kirkby (Yorkshire)	W10/W12 gauge clearance	Ongoing (to 2014)
Felixstowe-Nuneaton (via London)	Train lengthening	Ongoing (to 2014)
Southampton-West Coast Main Line	Train lengthening	Ongoing (to 2014)
Channel Tunnel South of London route	Signalling modifications to allow electric hauled trains to/from London via Redhill	Ongoing
Chorley Tunnel	W10/W12 gauge clearance	Ongoing
Darlington-Teesport	W10/W12 gauge clearance	Under review

Source: Network Rail (2012) and other Network Rail sources

The W10 gauge clearance of the route from Liverpool Docks to the West Coast Main Line (WCML) at Earlestown is due for completion in 2013 as part of the route's electrification programme (Network Rail, 2013a). The precise status of the Humber Ports/Immingham to East Coast Main Line (ECML) project is uncertain, with at least some of the funding having been spent prior to CP4 on the upgrade of the route to Hull Docks (Network Rail, 2008b).

Overall, though, it is evident that the vast majority of the completed works relate wholly or partially to W10 gauge clearance. Even the North London Line (NLL) capacity increases included the gauge enhancement of Hampstead Heath tunnel (Network Rail, 2010a). Of the smaller schemes listed in Table III, only the HS1-Barking area terminals European gauge enhancement has been completed. It appears that the Nuneaton North Chord, announced in 2010 and completed in 2012, was added to the scope of the TIF(P) Peterborough to Nuneaton project (Network Rail, 2010b; Network Rail, 2012). W10 gauge enhancement of the route from Peterborough to Doncaster via Lincoln is underway with completion scheduled for 2014 (Network Rail, 2013b), and possibly the direct route too. The precise status and funding source(s) are difficult to determine, but a combination of Network Rail and third party funding seems most likely.

Future plans for the Strategic Freight Network

In its 2012 High Level Output Specification (HLOS) for Control Period 5 (CP5) (DfT, 2012) the Department for Transport gave a commitment to continued funding for the SFN, with £200 million allocated in CP5. This period runs from 2014/15 - 2018/19, so the average allocation of around £40 million per annum that was established in CP4 (Network Rail, 2013c) is set to continue. The allocation of these funds is yet to be determined, and it is not clear whether the total will be uprated with inflation as appears to have happened in CP4, but candidate schemes mentioned are shown in Figure 2.

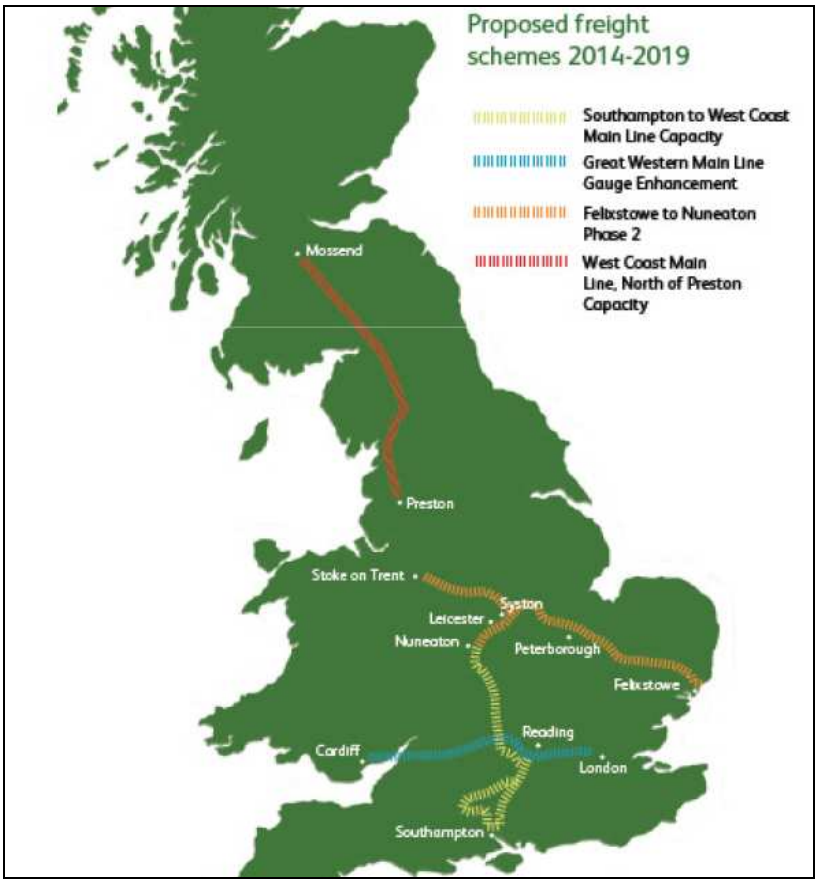

Figure 2: Planned CP5 Strategic Freight Network schemes (Source: Network Rail, 2013d)

Based on the most recent update (Network Rail, 2012), it is likely that some of the schemes detailed in Table III, particularly those announced more recently, will not be fully implemented within CP4 and will be carried forward to CP5. The development of additional W10/W12 gauge clearance projects has recently been announced for Yorkshire diversionary routes (Network Rail, 2012), which presumably will be implemented in CP5 if approved. While the specific work to be carried out in CP5 is as yet not clear, the importance of routes serving deep-sea container ports remains evident, with two of the four major planned schemes concentrating on capacity (and some additional gauge enhancement) on the corridors inland from Felixstowe to Nuneaton/Stoke-on-Trent and from Southampton to the WCML. Another scheme focuses on W10/W12 gauge enhancement of the GWML, which carries container services to/from Bristol and Cardiff from the key ports, in conjunction with the electrification programme. The final scheme is for WCML capacity north of Preston, where a mix of passenger and freight services uses a two-track railway. In addition, CP5 will see the introduction of the Scottish Strategic Rail Freight Investment Fund, which has an allocation of £31 million and a number of potential projects under consideration (Network Rail, 2013c).

EVALUATION OF THE STRATEGIC FREIGHT NETWORK'S IMPACTS

This analysis seeks evidence from both published sources and original research to assess the degree of correlation between rail freight trends and the network enhancements resulting largely from the SFN (and TIF(P)) initiatives but focusing on the development of the SFN as a whole. As stated in the preceding discussion, the overwhelming majority of the completed projects have focused on gauge enhancement, so this forms the greatest part of the evaluation. A short sub-section then follows which assesses the impacts of the capacity-related projects. Except where specified, two elements of original research are used in the evaluation:

- An annual database of rail freight services, constructed in January each year and incorporating all freight flows except for coal
- Observation surveys of container train service provision (measuring on-train capacity provision and load factors) at all four key deep sea ports in 2007 (Woodburn, 2011) and at Southampton and Thamesport in 2012 (see later section for further details)

Impacts of gauge enhancement projects

Figure 3 shows the combined effects of the five completed W10 gauge enhancement projects since 2009, with the three most recent ones adding considerably to the pre-existing W10 network at the start of CP4 (shown in green). These projects are aimed primarily at deep sea container train services, although the Gospel Oak to Barking route is also used by other intermodal services.

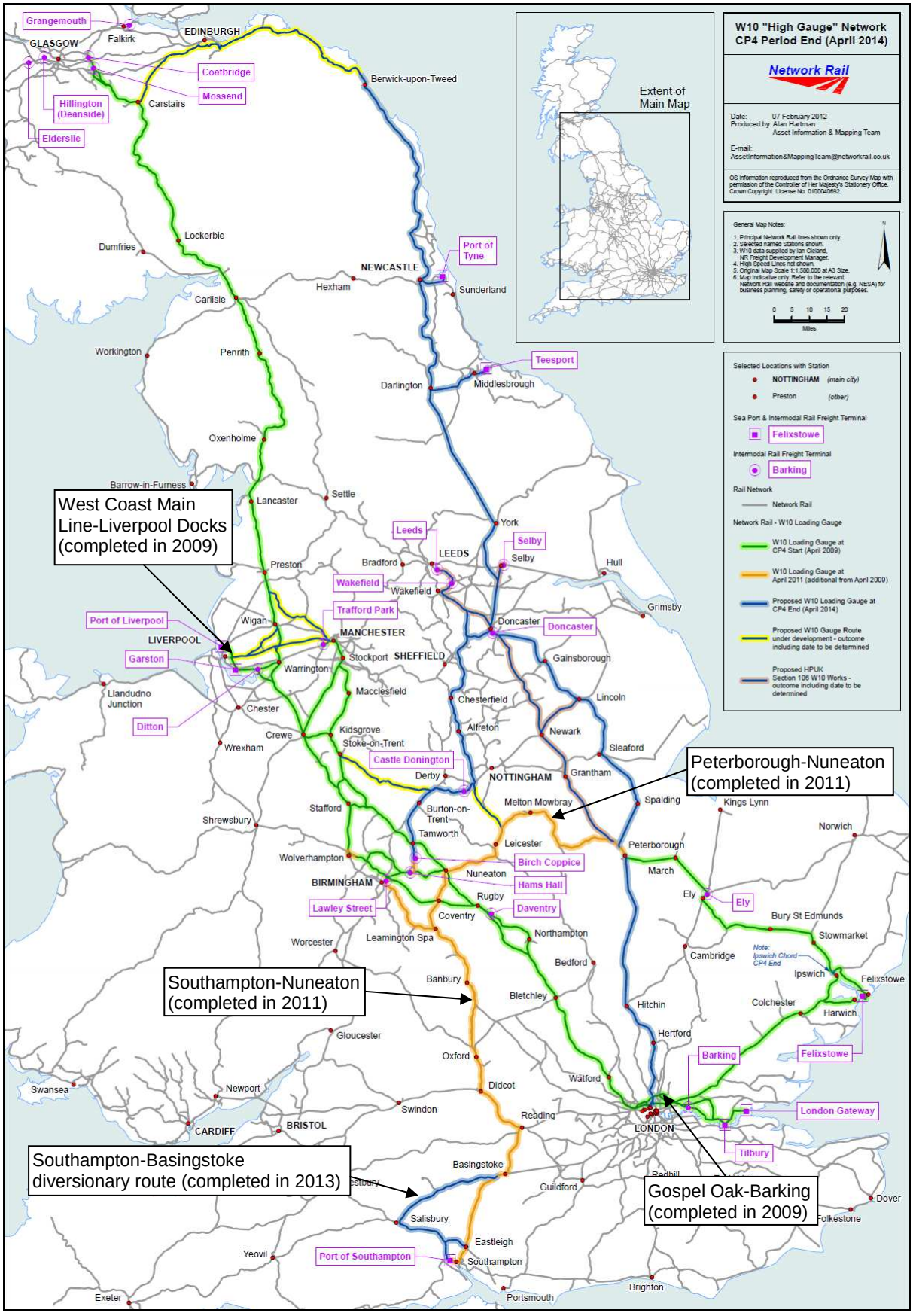

Figure 3: Completed W10 gauge enhancement projects as at Feb 2013 (based on map provided by Network Rail)

Despite the global economic slowdown, the 'domestic intermodal' category in the official statistics witnessed growth in volumes of 22 per cent in absolute terms between 2008/09 and 2011/12, representing an increase from 25 per cent of the rail freight market in 2008/09 to 30 per cent in 2011/12, and increasing further to 31 per cent in the most recent quarter (i.e. 2012/13 Q2) (ORR, 2013). In previous research, it was shown that more than 80 per cent of domestic intermodal services are container trains to/from the four key deep sea ports (i.e. Felixstowe, Southampton, Tilbury and Thamesport) (Woodburn, 2012). The Southampton to Nuneaton project has had the greatest impact on intermodal rail freight, with all container train services to/from Southampton using it at some point, and around 13 services per day in each direction typically using it in its entirety between the port and the WCML at Nuneaton or the terminals in the Birmingham area. The Gospel Oak to Barking route is used by several daily trains to/from Tilbury and Felixstowe, while the Peterborough to Nuneaton route sees two or three container trains per day in each direction serving Felixstowe. There has been no container train provision at Liverpool Docks since the implementation of the W10 route in 2009.

The completion of the projects shown in Figure 3 has led to a substantial increase in the proportion of deep-sea container services that operate wholly over routes cleared to W10 gauge, as shown in Table V. In 2007, just 39 per cent of the total weekly departures from the key deep sea ports could convey high cube containers on standard wagons, with no services from Southampton or Thamesport able to do so. By 2012, this had increased to 66 per cent, with broadly equal percentages at each of Felixstowe, Southampton and Tilbury. There have been slight variations since 2007 in the percentages at Felixstowe and Tilbury due to minor changes in service provision (e.g. the addition of a four times per week Felixstowe to Bristol service which is not W10 enabled). Southampton has clearly benefited the most from the expansion of the W10 gauge network, with only the routes to Cardiff, Wakefield and Leeds not being W10 enabled by 2012.

Table V – Proportion of deep-sea container services using W10 gauge routes (2007 and 2012)

	% of departures using W10 gauge routes	
From port	**2007**	**2012**
Felixstowe	73	69
Southampton	0	70
Tilbury	71	74
Thamesport	0	0
Total	**39**	**66**

Source: author's database

Given the significance of the change to the gauge capability for container trains servicing Southampton, an original "before and after" survey (in 2007 and 2012) of on-train capacity provision and load factors was conducted to assess the impacts of the gauge enhancement. The "after" survey phase was more than one year after completion of gauge enhancement. Details of the 2007 survey methodology, which was representative of a week's service provision, can be found in Woodburn (2011). To ensure comparability, the same survey approach and sampling method was used in 2012. Table VI compares four key variables in

the two survey periods. In the 2012 survey, the data are disaggregated based on the gauge characteristics of the routes after the 2011 gauge enhancement project, to give greater insight into the effects of the change. Overall, there was a 28 per cent increase in the average train load between 2007 and 2012, based on a 19 per cent increase in the average capacity per train and a 9 per cent increase in the average load factor.

Table VI – On-train capacity provision and utilisation for Southampton container trains (2007 and 2012)

	2007 survey	**2012 survey**		
	Total	**W10**	**Non-W10**	**Total**
Average capacity per train (TEU)	57.93	73.28	59.49	69.08
Average load factor (%)	66.73	69.01	81.25	72.74
Average train load (TEU)	38.64	50.04	47.75	49.34
High cube TEU as % of total TEU	24.90	46.58	49.93	47.58

Source: author's survey (n = 231 in 2007; n = 187 in 2012)

Unsurprisingly, since they have benefited directly, the routes that have become W10 enabled have seen the greatest increase in average train load, with a 33 per cent increase. By contrast, the rate of growth in average load for trains on the non-W10 routes has been a more modest but not insignificant 11 per cent. The non-W10 routes tend to have a lower average train capacity than the W10 routes since the former need to use specialist wagons to carry high cube containers, and some types of these wagons are less space-efficient.

Given that the gauge enhancement projects have been justified on the basis of catering for high cube containers, and indeed this is a major plank of the SFN, the trend in the movement of such containers is of particular interest. The high cube TEU as a percentage of total TEU measure has almost doubled between 2007 and 2012, suggesting that there was considerable latent demand for carrying high cube containers by rail. It is notable that this increase has been similar for both route types, rather than applying to a greater extent to W10 routes. The fact that high cube containers can now be carried on standard wagons on W10 routes has allowed the fleet of specialist wagons to be redeployed to non-W10 routes, providing secondary benefits to non-W10 gauge routes across the British rail network. The impacts at Southampton are very evident as it would simply not have been possible to carry so many high cube containers without either the gauge enhancement or a large number of extra specialist wagons.

Grossing up the Southampton survey results to estimated annual TEU by rail totals suggests that rail's mode share increased from 24 per cent of port TEU throughput in 2007 to 29 per cent in 2012 (using 2011 port throughput statistics as the base for the 2012 calculation as these are the most up-to-date available at the time of writing), with a slightly greater number of TEU now being carried in 19 per cent fewer trains. By contrast, an equivalent "before and after" survey of service provision at Thamesport, where there has been no gauge enhancement, reveals a reduction in rail's mode share from an estimated 18 per cent to 15 per cent between 2007 and 2012. The redeployment of specialist wagons as a consequence of W10 gauge enhancement to Southampton and elsewhere led to an increase on surveyed Thamesport services from 20 per cent in 2007 to 37 per cent in 2012 of on-train capacity

capable of carrying high cube containers on non-W10 routes. This is further evidence of the indirect impacts of gauge enhancement across the wider network of container train services.

A separate, smaller, example of the impact of gauge enhancement is provided by the localised project in the Barking area to connect a number of rail freight terminals to HS1, the high speed line from the Channel Tunnel, with a European gauge link to allow mainland European sized wagons and intermodal units to access these terminals. DB Schenker commenced a weekly service between Wroclaw (Poland) and Barking in November 2011, increasing to twice weekly in October 2012 and with a target for expansion to five trains per week (DB Schenker Rail, 2012). As yet, other Channel Tunnel services that could potentially use HS1 to the Barking area, notably the Ford automotive components service between Dagenham and Spain, have not changed their routeing or type of intermodal unit to take advantage of the European gauge.

Impacts of capacity projects

The effects of the implementation of the capacity-related projects are more difficult to establish, since they tend not to be as visible and quantifiable as those relating to gauge enhancement. The scale of change with the capacity projects is more limited than with the gauge enhancement ones, but there are some identifiable impacts. For bulk freight services, the new Olive Mount chord sees regular use, providing operational benefits resulting from a more direct route to/from Liverpool Docks. The chord is typically used by several coal trains per day and less frequent services carrying steel and scrap metal. Capacity increases on the Gospel Oak to Barking route and the North London Line have largely maintained the provision of rail freight capacity in light of the increasing intensity of London Overground passenger services (Network Rail, 2010b). On the Peterborough to Nuneaton route, the programme of works for the gauge enhancement funded by TIF(P) and discussed earlier also included incremental capacity improvements to allow extra freight train activity, with a mix of signalling enhancements and the add-on Nuneaton North Chord which provides a link from the Peterborough line to the northbound WCML without conflicting with train movements on the WCML itself (Network Rail, 2010a). The new chord currently sees limited use, with one intermodal train per day in each direction and some other freight trains, but greater use can be expected as other enhancements are completed on the route from Felixstowe.

Despite the ongoing nature of the train lengthening projects (see Table IV), the evidence from the Southampton “before and after” survey suggests that some lengthening has taken place already, most likely on a trial basis as set out by Network Rail (2011) in its mention of 30-wagon trials. In the 2012 survey, a number of trains to/from terminals in the Midlands were operating with a consist of 30 standard wagons, whereas in 2007 no trains had more than 26 wagons (of which some were shorter lowliner wagons). The infrastructure measures being progressed on this corridor will allow 30-wagon container trains on a more widespread basis.

DISCUSSION OF FINDINGS

This section presents the findings and their implications within the context of the two objectives for this paper. Issues relating to the evolution of the SFN are discussed first, followed by an assessment of the impacts of the implementation of the SFN initiatives completed to date.

Understanding how the SFN has evolved

The first part of the paper consolidated the published information relating to the inception and early development of the SFN, then summarised its current status and the projects proposed for CP5. In doing this, it became evident that the geographical extent and the principles of the SFN are clear, but that there is some fluidity in the funding for and deliverables of specific projects. Despite recent official documents still referring to the SFN as "The proposed Strategic Freight Network", as it was described when first defined in 2008 (and shown in Figure 1), the routes that combine to form the network now appear to be fixed. The SFN is referred to in other government guidance such as that for Strategic Rail Freight Interchanges, where the expectation is that major new interchanges will be located on the SFN (DfT, 2011). Rail freight planning for CP5 and beyond is clearly based on developing the network as defined back in 2008, with the SFN being "the vision for accommodating freight growth over the next 30 years (Network Rail *et al.*, 2010, p.9). The SFN is now a firmly established and important component of the future plans for the rail network. Despite this, the combination of TIF(P) and SFN funding in the initial projects has led to some lack of clarity in the documentation, perhaps as a consequence of switching funds between specific initiatives. At times, this has made it difficult to track outputs in relation to the specific funding commitments shown in Tables I and II, and to the mechanisms by which other initiatives (such as the gauge enhancement from Peterborough to Doncaster) have been funded. In general, commitments from the SFN budget are often just one source of funds for a project, which further complicates the analysis of the works funded under the SFN banner. To some extent, the specifics of the funding mechanism, particularly the relationship between SFN funding and other sources, is not a material consideration for the outcomes identified, and what is important is the focus that the development of the SFN has given to the promotion of rail freight and the targeted improvements to network capacity and capability. By bringing together the published information into this analysis, the evolution and importance of the SFN has become clearer.

Understanding the impacts of the development of the SFN

The paper's second objective was to consider the initiatives implemented under the SFN and to evaluate their impacts. As Table IV showed, seven of the 19 projects are wholly or partially completed, with many others due for completion by the end of CP4. Approximately two thirds of the £351 million funding outlined in Tables I and II related to the two key corridors from Felixstowe and Southampton to the WCML at Nuneaton, and SFN projects funded from other sources have also been targeted at corridors serving deep sea container

trains. Works on the Felixstowe to Nuneaton corridor are ongoing, and the impacts to date have been limited. With the recent completion of the Nuneaton North Chord, the planned implementation of the Ipswich North Chord in 2014 and the subsequent planned gauge enhancement between this corridor and Stoke-on-Trent, the capability will exist to transfer many of the existing Felixstowe to WCML container trains that currently travel via London. This will free up train paths for the development of additional container train services, notably from London Gateway which is now under construction (Network Rail, 2011).

While the impacts of the enhancements on the Felixstowe to Nuneaton corridor are mostly unrealised at the present time, the completed W10 gauge works on the Southampton to Nuneaton corridor have made a considerable impact in a short period of time. The 2012 survey, which took place one year after completion of W10 gauge clearance of the core route, revealed that a slightly greater number of TEU is now being carried in considerably fewer trains, implying a fairly dramatic improvement in rail performance despite the lower container throughput at the port, and an almost doubling of high cube TEU as a proportion of total TEU carried. The more recent gauge clearance of the route between Southampton and Basingstoke, and the clearance in 2011 of the second route between Felixstowe and Nuneaton, is starting to provide network (rather than corridor) benefits that help rail to provide a more resilient service offering to customers. The completion in 2014 of gauge enhancement of routes between Water Orton/Peterborough and Doncaster routes will allow the deep sea container trains serving Yorkshire terminals to carry high cube containers on standard wagons, further increasing the W10 coverage shown in Table V and with further operating benefits likely as a result. An increasing number of diversionary routes are available for use during times of planned or unplanned blockage of the main route, or to operate additional services where capacity is constrained on the main route. Significant further benefits for deep sea container train services are therefore expected, and the growing gauge enhanced network will offer scope for greater development of other intermodal services. The recent focus on going beyond W10 gauge and providing W12 gauge clearance, which caters for slightly wider unit loads more commonly used within Europe may be of benefit to domestic and Channel Tunnel intermodal services. Even before these additional direct benefits are felt, the 2007 and 2012 survey results from both the remaining non-W10 services at Southampton and the trains serving Thamesport demonstrate that the projects completed so far have provided benefits to many services not directly affected. This highlights the importance of considering indirect as well as direct benefits of specific projects.

CONCLUSION

This paper has shown that, in a fairly short period of time, there have been some quite considerable benefits accruing from the development of the SFN, particularly for the movement of deep sea containers between ports and their hinterlands as a consequence of W10 gauge clearance and, to a lesser extent, capacity enhancements. It seems inconceivable that the growth in the movement of high cube containers witnessed since 2007 would have happened without the gauge clearance projects, and the ongoing rapid expansion of the W10 network augers well for rail's future role in this market. At this stage, though, it is harder to identify the impacts of the SFN on traditional bulk flows, or on other

types of intermodal flows. Overall, the evidence from this British case study suggests that targeted network capacity and capability funding to meet key strategic objectives yields considerable benefits for rail freight. The analysis has also demonstrated the advantages of using unpublished disaggregate data to understand phenomena within the freight sector, where there is a general lack of good quality data to allow evidenced-based policy decisions to be made.

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