THE CHALLENGE OF HIGH CUBE ISO CONTAINERS FOR BRITISH RAIL FREIGHT OPERATIONS

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Abstract
Rail freight activity in Britain has increased by almost 50% in the last ten years, with the movement of deep sea ISO containers between ports and inland terminals being a significant growth sector, with considerable further growth potential. High cube (9'6" height) ISO containers have become more prevalent, posing a considerable challenge for rail freight operators since much of the rail network has insufficient loading gauge clearance to carry them on standard wagons. This paper investigates the extent to which rail currently handles high cube container movements to/from ports through the analysis of a representative survey of container trains in 2007. The incidence of high cube containers carried by services on gauge-cleared and non-gauge-cleared routes is identified to assess the extent to which a lack of gauge enhancement affects the movement by rail of high cube containers and to identify the impacts of the lack of gauge clearance on operating efficiency. The paper concludes with an evaluation of the likely consequences of the gauge enhancement schemes for which funding is now committed, assessing the extent to which they will reduce or remove the barriers associated with carrying high cube containers between ports and their hinterlands.

Keywords: rail freight, ports, intermodal, freight efficiency

Introduction

Rail freight activity in Britain, measured in tonne kilometres, increased by almost 50% between 1996/97 and 2006/07 (SRA, 2005; ORR, 2007). The deep sea ISO container market[1] is an important one for rail freight in Britain, and one which has been gaining in importance in recent years. The 'domestic intermodal' category, which consists mainly of deep sea container movements to/from ports, has increased its share of the market from 18% in 2002/03 to 21% in 2006/07, representing absolute growth of more than one-third in this four year period (ORR, 2007). The most recent data available show continued strong growth, with an annual increase of 13% for Quarter 3 in 2007/08 over the same quarter a year earlier (ORR, 2008). There are many reasons for this rapid growth, relating both to factors external and internal to the rail industry. The continued expansion of international trade, and particularly of containerised goods, has led to a bigger potential market for rail. Within the industry, the deep sea container market has become one of the most competitive rail freight sectors. It remains dominated by Freightliner, the incumbent operator at the time of rail privatisation in 1996, but there has been growing competition from other operators (i.e. EWS, First GBRf and Jarvis Fastline).

For historical reasons, the British rail network generally has a much more constrained loading gauge than in other countries. The loading gauge refers to the maximum physical dimensions of railway vehicles and their loads that are allowed to travel on a particular route (Network Rail, 2008a), and is dependent upon the characteristics of infrastructure such as bridges, tunnels and station platforms along the route. The loading gauge constraints are a particular issue for the movement of deep sea containers, since much of the core network linking ports to inland terminals is only W8 loading gauge, meaning that containers of no more than 8'6" height can be carried on standard rail wagons. However, high cube (9'6" height) containers are becoming increasingly important. By 2006, they made up 40% of the deep sea market (measured in TEU[2]), and are expected to increase to 65-70% by 2023 (Network Rail, 2007). To be able

[1] These are containers of internationally agreed dimensions, giving compatibility that allows them to be moved, handled and stored in a standardised manner (CMA CGM, 2008)
[2] TEU = twenty-foot equivalent unit, the standard unit of length for ISO containers; the most common container length is 40', which is equal to 2 TEU

to carry these high cube containers on standard wagons, the enhanced loading gauge known as W10 is required. Alternatively, specialist wagons with lower decks are required to enable the high cube containers to sit closer to the track level. These specialist wagons are typically more expensive to purchase and maintain, and they reduce the available train payload, thus making them economically undesirable for freight operators (Network Rail, 2007). This paper investigates the extent to which rail currently handles high cube container movements to/from ports through the analysis of a representative survey of container trains in 2007. The incidence of high cube containers carried by services on gauge-cleared and non-gauge-cleared routes is identified to assess the extent to which a lack of gauge enhancement affects the movement by rail of high cube containers and to identify the impacts of the lack of gauge clearance on operating efficiency. The paper concludes with an evaluation of the likely consequences of the gauge enhancement schemes for which funding is now committed, assessing the extent to which they will reduce or remove the barriers associated with carrying high cube containers between ports and their hinterlands.

Objectives and Methodology

This paper has three objectives:

- To identify the incidence of high cube containers on rail services to/from Britain's deep sea ports
- To estimate the effects on efficiency of the carriage of high cube containers on specialist wagons on non-gauge-cleared routes
- To assess the impacts of the planned loading gauge enhancements on existing operating constraints

The analysis makes extensive use of original data sources, notably the author's annual rail freight service provision database and a large observational survey (using video) of container trains serving the four main rail-served ports (i.e. Felixstowe, Southampton, Tilbury and Thamesport). The fifth port, Seaforth (Liverpool) was excluded for practical reasons, but in any case accounts for just 2% of container train services. The survey was primarily aimed at identifying service provision and utilisation, but has been further developed in this paper to consider issues relating to the carriage of high cube containers. A total of 578 container trains were surveyed between February and August 2007, with 559 of them being suitable for inclusion in this analysis. A small number of observed trains had to be excluded due to problems in accurately identifying container heights. Considerable attention was paid to ensuring that the sampling framework was representative of the service provision to and from the four ports. As a consequence, the sample is wholly representative with respect to port, freight operating company and direction of flow (i.e. import or export). Despite the exceptions outlined, the survey covers 95% of all scheduled container trains arriving at and departing from British ports in a typical 'week' (averaged over the six month survey period) and allows analysis of wagon composition and type of container carried on each service included in the sample. This provides the basis for the subsequent strategic assessment of the likely impacts of proposed infrastructure enhancement schemes.

The Existing Situation

British Rail recognised the need to be able to carry high cube wagons approximately 20 years ago and, in the early-1990s, introduced its first 'lowliner' flat wagons to carry the newly emerging high cube container on the British Rail network, given that no routes at that time offered sufficient gauge clearance to carry these units on existing wagon designs. Since privatisation, Freightliner has added additional lowliner wagons, together with pocket wagons, to its fleet and EWS also operates low floor wagons on its services for deep sea containers. The other operators, First GBRf and Jarvis Fastline, do not have any such specialist wagons for conveying high cube containers on non-gauge-cleared routes. While it is difficult to isolate the wagon fleet used for deep sea containers, it is evident that the specialist wagons make up only a relatively small proportion of the total fleet deployed on routes serving deep sea ports. For example, just 15% of Freightliner's intermodal wagon fleet consists of lowliner or pocket wagons (Buck and Rawlinson, 2008). As identified earlier, five deep sea container ports are served by rail freight services, dominated by Felixstowe and Southampton with 44% and 39% of departures to inland terminals respectively. The other three ports, Tilbury, Thamesport and Seaforth account for just 17% between them. In recent years, infrastructure enhancements have led to W10 clearance on a number of routes. Most significantly, in 2004, Felixstowe and Tilbury obtained W10 links to the West Coast Main Line (WCML) via north London (Network Rail, 2008b). These two ports remain the only ones with W10 network connections. Seven of

the 15 inland terminals used to handle deep see containers have a W10 connection to/from those two ports, all of them located in the West Midlands, North West or Scotland, on branches from the WCML. Table 1 reveals that 39% of all container train departures from ports operate over W10 routes, allowing high cube containers to be conveyed on standard wagons, with both Felixstowe and Tilbury offering W10 clearance on between 70 and 75% of services operated.

From port	% of departures using W10 cleared routes	High cube containers (in TEU) as % of total TEU on:		
		All routes	W10 cleared routes	Non-cleared routes
Felixstowe	73	31.1	36.9	12.7
Southampton	0	26.9	0	26.9
Tilbury	71	16.4	20.3	5.3
Thamesport	0	16.8	0	16.8
Seaforth	0	n.a	n.a.	n.a.
Total	**39**	**27.2**	**34.3**	**22.4**

Source: author's database; author's survey *(Note: Seaforth services were not included in the survey)*

Table 1: W10 gauge clearance and incidence of high cube containers (by port and route type)

Table 1 also shows the survey findings relating to the carriage of high cube containers from each of the four ports, revealing the difference between services on routes that have W10 clearance and those that do not. Overall, high cube containers accounted for 27% of TEUs, though with considerable variation between ports. On average, services on W10-cleared routes carry in excess of than 50% more high cube containers than do those services operating on non-cleared routes. Felixstowe and Tilbury, with the majority of services operating over W10-cleared routes, display lower proportions of high cube containers on non-cleared routes than is the case at either Southampton or Thamesport, where no W10 routes exist. The proportion at Felixstowe is likely to be limited by First GBRf, which operates one third of services over non-cleared routes: it has no specialist wagons to cater for high cube containers. At Thamesport, one quarter of the services are provided by Jarvis Fastline, which similarly has no high cube capability, so this is likely to have an impact on the total proportion of high cube containers handled there. Further, care needs to be taken with the interpretation of the low proportion of high cube containers at Tilbury, since this is based on just 12 observations, given the relatively small number of services operating over non-cleared routes.

Focusing specifically on the second objective, it is difficult to categorically identify the effects on efficiency of the carriage of high cube containers on specialist wagons on non-gauge-cleared routes. When comparing the two largest container ports, Felixstowe and Southampton, the former performs better in terms of the capacity provided per train and the average number of TEU carried per train (see Table 2). The latter is considerably less at Southampton, which may reflect the more limited scope for carrying high cube containers, while the lower average capacity per train appears to reflect the greater number of specialist wagons in use, since these often result in the ability to carry fewer TEU for a given train length. Considering the other two ports contradicts this interpretation, however, since Thamesport performs better than Tilbury despite the lack of gauge-cleared routes at the former port. The smaller samples and different mix of train operators may influence these findings, making valid comparison difficult.

Port	Available capacity per train (in TEU)	Average TEU carried per train	Average load factor (% of TEU spaces filled)
Felixstowe	62.7	50.7	80.3
Southampton	57.9	38.6	66.7
Tilbury	54.2	29.9	54.7
Thamesport	61.6	45.8	73.8
Total	**60.0**	**43.8**	**72.2**

Source: author's survey

Table 2: Train capacity and average load factor (by port, both directions)

The data summarised in Table 3 attempt to overcome some of the vagaries caused by the different operations at the various ports. The table focuses solely on Freightliner services operating on non-cleared routes, and shows the utilisation of standard wagons and each of the specialist wagon types. Overall, the specialist wagons on an average train are more likely to be loaded with containers than are the standard wagons, most notably for Southampton- and Thamesport-based services. The number of specialist wagons, particularly of the lowliner type, observed on Tilbury services was very small, so the contrary trend there is not significant.

Port	No. of observations	% wagon utilisation		
		Standard	Pocket	Lowliner
Felixstowe	32	84.8	83.0	85.2
Southampton	158	62.9	84.7	81.0
Tilbury	10	66.5	68.6	12.5
Thamesport	29	76.8	100.0	91.1
Total	**229**	**67.9**	**85.7**	**79.9**

Source: author's survey

Table 3: Wagon utilisation on Freightliner services on non-cleared routes (by port, both directions)

It should be noted that the specialist wagons, when loaded, do not always carry high cube containers, so the figures in Table 3 may not accurately represent the situation with regard to the effects of such containers on efficiency. At each of Southampton, Tilbury and Thamesport, very few examples were observed of standard height containers on specialist wagons, so there is only a small drop in the percentage wagon utilisation if the standard height containers are excluded from the analysis. For both Southampton and Thamesport, the utilisation of specialist wagons for high cube containers is considerably higher than the utilisation of standard wagons. Tilbury remains an anomaly, with the utilisation of pocket wagons for high cube containers being slightly lower than the utilisation of standard wagons. Felixstowe also displays a different trend when only high cube containers are considered, with pocket and lowliner wagon utilisation dropping to 60% and 58% respectively, much lower than the utilisation rate for standard wagons. Further investigation is required to establish whether or not the enforced use of specialist wagons to carry high cube containers on non-cleared routes categorically impacts negatively on the efficiency of container train operations, but on balance the evidence suggests that this probably is the case, certainly when comparing W10-cleared services at Felixstowe with non-cleared services at Southampton, the two largest groups of services in the sample.

Committed and Planned Gauge Enhancement Schemes

Various gauge enhancement schemes have been approved recently, and funding has been committed from a number of different sources, including the government's Transport Innovation Fund (TIF) for Productivity, Network Rail's Discretionary Fund (NRDF) and Out-Performance Fund, and from third parties such as Hutchison Ports, the owner of Felixstowe. Table 4 summarises those schemes that are scheduled to be implemented during Network Rail's Control Period 4 (CP4), the regulatory period that runs from April 2009 to March 2014.

Scheme	Key funding source(s)
Ipswich – Yorkshire terminals	Third party
Peterborough – Nuneaton (West Coast Main Line (WCML))	TIF
Southampton – Birmingham/Nuneaton (WCML)	TIF
Gospel Oak – Barking (London)	TIF, Network Rail
WCML – Seaforth (Merseyside)	TIF, Network Rail, third parties
Sutton Park (West Midlands)	Network Rail

Source: Network Rail (2008b)

Table 4: Gauge enhancement schemes expected to be implemented during CP4 (2009-2014)

There now appears to be greater coordination between the schemes, not least through the government's decision to support a Strategic Freight Network (SFN), which has been allocated £200 million during CP4 in addition to the funding already committed to freight schemes such as the gauge enhancement ones shown in Table 3 (DfT, 2007). Network Rail has now recommended schemes for development with this SFN money (Network Rail, 2008c), with two major projects relating to container traffic:

- Southampton – Basingstoke (via Laverstock): diversionary route for container services to/from Southampton, supplementing the clearance of the direct route via Winchester funded through TIF
- Ipswich – Nuneaton (via Peterborough): this is additional to the enhancements already funded by Hutchison Ports and through TIF, and will be capacity- rather than gauge-related, to increase the number of daily paths available for container trains on this route

A map showing the committed and planned gauge enhancement schemes can be found in the SFN document (Network Rail, 2008c). It is anticipated that the SFN will be further developed over time but, given that the precise schemes are not yet identified, timescales have not been established and funding has not been confirmed, no consideration of any additional schemes is made in the subsequent analysis.

Predicted Impacts of the Gauge Enhancement Programme

When all of these schemes identified in the previous section are implemented, the rail network's W10 capabilities will be considerably greater than at present. As Table 5 shows, there will be an almost doubling of the proportion of port departures able to carry high cube containers on standard wagons, so the impacts of the gauge enhancement programme will be substantial with three quarters of services able to operate over W10-cleared routes. In terms of the absolute increase in W10 coverage, Southampton will be the biggest beneficiary since approximately two thirds of services leaving the port will operate over gauge-cleared routes by 2014, serving the terminals in the West Midlands and on the WCML branches further north. Felixstowe will also benefit greatly, gaining W10-cleared services to the cluster of terminals in Yorkshire; only its daily service to the North East of England will remain gauge restricted. Finally, the daily train from Seaforth will gain W10 clearance. There will be no increase in Tilbury's W10 capabilities, and Thamesport will still lack any W10 routes.

Port	% of departures per week with W10 gauge clearance	
	Current	With 'committed' and 'planned' schemes
Felixstowe	73	96
Southampton	0	63 (71*)
Tilbury	71	71
Thamesport	0	0
Seaforth	0	100
Total	**39**	**74 (77*)**

* - if Birch Coppice services are W10 enabled: this is not clear from existing documentation

Table 5: Percentage of services in 'before' and 'after' scenarios using W10 gauge-cleared corridors

Despite the significant growth in the extent of the W10 network over the next six years, a number of important gaps will remain. The most notable routes that will still not have W10 capabilities are:

- Southampton – Leeds/Wakefield
- Tilbury – Leeds/Wakefield
- Thamesport – all destinations

In addition, a number of other specific services will still require specialist wagons in order to carry high cube containers. The existing fleet of specialist wagons, when cascaded to focus on the remaining non-cleared services, would be able to cater for considerable growth in the movement of high cube containers. Discounting the operational inefficiencies associated with specialist wagons, the combination of a doubling of W10 route coverage and redeployment of these specialist wagons to the remaining gauge-constrained routes should enable Freightliner and EWS to cope with the growth in high cube containers, assuming the

existing level of service provision. Jarvis Fastline, however, will still be incapable of carrying high cube containers unless it procures some specialist wagons for its Thamesport service.

However, two concerns remain, relating to diversionary routes and the future growth of container services. For many of the origin-destination pairs involving Felixstowe, a diversionary route will be available when the core route is blocked. This is an important consideration given the unavailability of core routes due to planned maintenance and unplanned route closures resulting from infrastructure problems, train failures, weather disruption, etc. For example, despite the major gauge enhancements planned for Southampton services, there will be no W10 diversionary route between Basingstoke and the West Midlands/WCML, a corridor currently used by approximately 100 container services per week in each direction. While planned route closures during normal operating periods are very rare, unplanned blockages do occur. In summer 2007, for instance, the route was closed for several days due to flooding near Oxford. On the second point, this analysis has assumed the status quo in terms of routes operated, but there has been considerable expansion in recent years and the market is expected to continue to expand. It is therefore likely that further growth will result from links between existing ports and inland terminals (where no services currently exist), the establishment of new inland terminals and, possibly, the development of new services from additional deep sea ports. Each of these will have implications for rail's abilities to cater for the high cube container market.

Conclusions

The analysis of the container train survey reported in this paper has identified that over one quarter of container volumes (measured in TEU) moved by rail are high cube. In unconstrained circumstances, the general trend towards the use of high cube containers in the deep sea shipping market would be expected to further increase their share of the rail container market. On average, services on W10-cleared routes carry a higher proportion of high cube containers than do those services operating on non-cleared routes, and there are signs that rail's efficiency suffers when high cube containers need to be conveyed in specialist wagons. The gauge enhancement programme scheduled to be implemented between now and 2014 will overcome many of the obstacles, doubling the proportion of existing services operating over W10-cleared routes and allowing three quarters of current port departures to carry high cube containers on standard wagons. Two specific concerns remain, relating to diversionary routes and the future growth of container services. Diversionary routes are an important component of network resilience, given the planned and unplanned blockages that occur on core routes. For rail to be as competitive in the market place as possible it is vital that W10-cleared diversionary routes are available for the main corridors, otherwise rail's ability to reliably carry high cube containers will be compromised. Further, the gauge enhancement programme is sensibly focusing initially on the main existing gauge-restricted routes, but account should be taken of potential additional routes. It is therefore important to maintain the momentum, since further gauge enhancement will be required to maximise efficiency, ensure network resilience and allow for further growth in container volumes by rail.

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