Retail logistics in the UK

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Abstract

This paper analyses retail logistics in the UK, with particular emphasis on new trends in the use of intermodal transport. It is based on interviews with major retailers, intermodal logistics operators, traction providers and other industry stakeholders.

Discussions arising from the interviews include the centralisation of distribution strategies as well as the potential for decentralisation of flows to peripheral regions, including new strategies such as port centric logistics and continental consolidation hubs. The role of supply movements from the far east, Europe and the UK affect distribution patterns relating to full containers, picked loads or consolidated loads. Matching primary and secondary hauls within a single network (for instance the use of factory gate pricing) is also a key issue and is handled in different ways by different retailers.

The issues above dictate to a large degree the potential for retail flows on intermodal transport, such as achieving high train fill rates, sourcing backhauls and asset utilisation. Achieving these goals requires new relationships between traction providers, logistics operators and large shippers. Large retailers are the primary drivers of these trends due to their high volumes therefore the findings in this paper provide insights into the future of intermodal transport and modal shift.

***Index Terms*— distribution, intermodal, logistics, retail, UK.**

I. INTRODUCTION

Food and grocery retailers contribute one in four of all HGV miles travelled in the UK (IGD, 2012). This paper will examine the shift of these flows to rail. Many studies in the supply chain, logistics and business management literature have looked at the supply chain evolution of retailers, and to a lesser extent the logistics and transport implications of these changes. On the other hand, intermodal transport has been studied in detail in the transportation literature, tending to focus on operational aspects to improve efficiency and thus reduce cost, making intermodal transport more attractive to prospective users.

This paper will bring these two fields together in an investigation of large retailers as the key drivers of intermodal transport in the UK. The paper takes a particular focus on Scotland as the Anglo-Scottish route is the key corridor for these movements, providing the distance and concentration of flows required. While the retail industry is a key driver of intermodal transport in the UK, it is also a unique market sector that has specific requirements that must be met if this traffic is to grow, therefore this paper will examine the overlap between rail industry operational issues and the particular needs of the retail market.

The paper begins with the research questions for this study and the methodology adopted, followed by an overview of the rail industry and the spatial development of the retail sector in the UK. The four research questions will then be addressed in separate sections. Section nine concludes.

II. METHODOLOGY

The overall research objective for this study is to understand the key factors relating to the use of intermodal transport by retailers. This objective can be approached from two angles, for instance which issues from the retail sector are of particular relevance for rail operators to address, and which already-known rail issues will be specifically pertinent to the retail sector? This overall objective has been refined through literature review, producing four research questions to be addressed in this paper:

1. What aspects of the spatial distribution of retail logistics are relevant to the use of rail transport?
2. What is the current use of intermodal transport by retailers?
3. What operational issues from the rail industry are particularly relevant to the retail sector?
4. What is the role of collaboration in retail intermodal logistics?

The study began with desktop research and document analysis, to identify 3PLs, traction providers and retailers involved in intermodal transport. The literature was then reviewed to highlight the key issues which could then be explored in depth during the interviews. Informal scoping interviews were conducted with industry stakeholders to confirm these findings and refine the focus of the study before proceeding to the interview stage. The interviews for the study were semi-structured, in order to obtain the key points quickly and then delve in detail where relevant and possible. This research did not use a survey methodology as it was not appropriate to the research objectives, therefore the data do not permit quantitative analysis of responses. The goal of the study was to understand how the modal shift takes place rather than producing a list of key drivers that are already well covered in the literature. In this business, a few large players dominate, thus the interviewees are representative of their sector, and it can be seen from the interview list that the majority of retailers, 3PLs and traction providers involved in this small market have been interviewed for this study.

Nine organisations were interviewed, each with senior representatives of the transport and logistics department of the relevant companies, as listed in table 1.

Table 1. List of companies interviewed for this research

Business	**Company**	**Interviewees**
Retailer	Tesco	1
Retailer	Sainsbury	2
Retailer	The Cooperative	1
Wholesaler	Costco	1
3PL	JG Russell	1
3PL	WH Malcolm	2
3PL	Eddie Stobart	1
Traction provider	DRS	1
Traction provider	Freightliner	1

Interviews lasted approximately two hours each and were semi-structured and wide-ranging. Each interviewee was given a copy of the interview transcript for approval. The interviews were structured around the four research questions: distribution patterns, use of intermodal transport, operational issues and collaboration.

As well as these specific interviews, data are also drawn from other interviews and discussions with industry stakeholders conducted by the author in other contexts, in addition to data gathered by desktop research, in particular document analysis of industry, government and academic literature. Thus an overview of general practice has been obtained by triangulating data from these numerous sources and specific examples of practice from relevant actors can be added from the interviews. Furthermore, due to commercial sensitivity, the information in this paper is kept fairly general. Results will therefore be presented under relevant topic headings rather than as individual cases.

III. BRIEF OVERVIEW OF THE UK RAIL INDUSTRY

Network Rail, a nominally private but government-owned company owns and operates the track infrastructure, with intermodal terminals owned or leased by private operators. A number of private

rail operators compete to run services. There are four primary traction providers in the UK. DB Schenker (formerly EWS) is the largest rail freight operator, carrying about 90% of rail freight in the UK, including most of the bulk (coal, aggregates, etc.). Freightliner handles about 80% of the deep-sea container flows to/from ports. From the Scottish perspective, they run daily shuttles from Felixstowe, Southampton, Liverpool and Tilbury to their Coatbridge depot. Direct Rail Services (DRS) is a subsidiary of BNFL. Their main business is carrying nuclear material but they have since entered other markets and have been successful as the traction provider for a number of retail intermodal services organised by 3PLs. First GBRf (was GB Railfreight) is part of the First Group, and was recently bought by Eurotunnel. They do not operate intermodal services in Scotland.

The other main players are logistics services providers (3PLs) who charter trains from these operators and effectively run them as if they were their own trains, including John G Russell, WH Malcolm and Eddie Stobart. It is easier for a customer to switch to rail if they are already their haulage customer so they can provide a door to door service. Most customers don't want to get involved with just a rail leg; they want an empty delivered, then picked up full and taken all the way to the destination. There has therefore been a significant growth for 3PLs in supply chain management rather than just transport. Integrated solutions are required by customers so the transport provision needs to be part of the whole logistics picture.

The majority of rail freight in the UK has traditionally been bulk, until containers overtook coal for the first time in 2010 (see figure 1). Bulk cargo is effectively captive as not only is it most suited to rail carriage but origins and destinations tend to have handling equipment built into the sites. Attracting containers from road to rail has always been challenging, however recently some operators have begun to achieve this goal, particularly running rail shuttles for large supermarket chains.

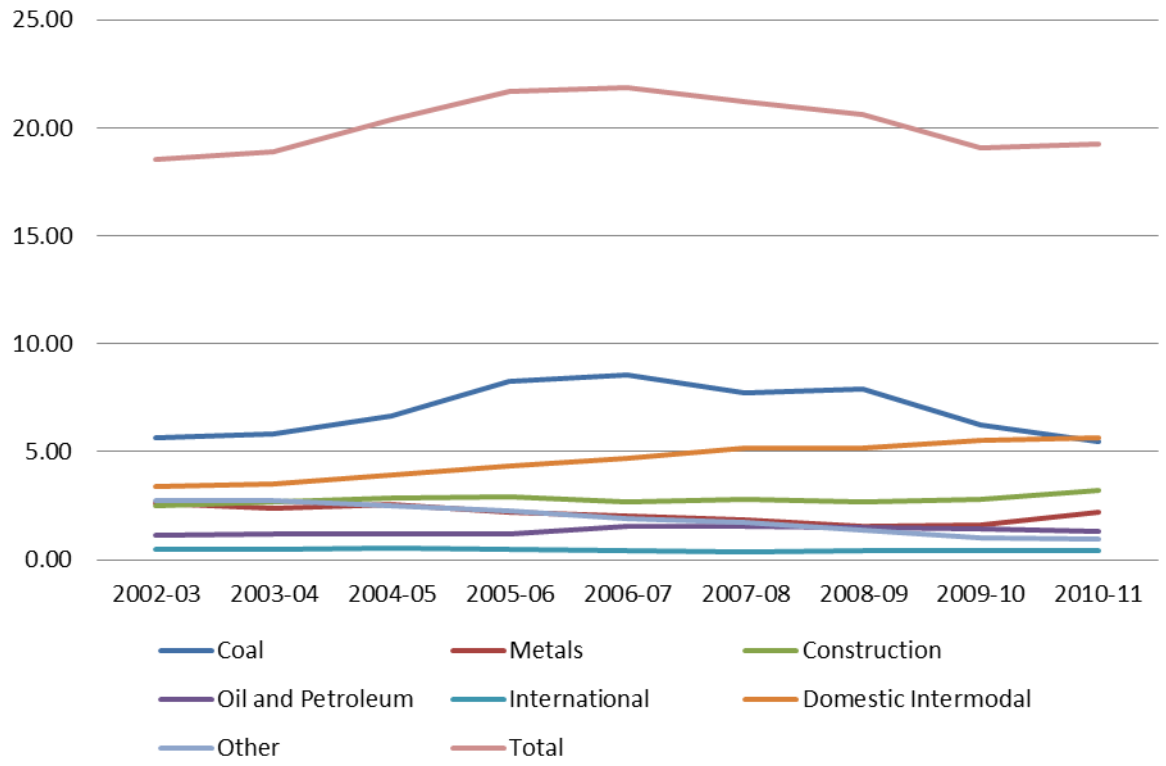

Figure 1. Freight moved by sector (billion tonne kms) (Source: author, based on ORR figures)

This paper is focused solely on intermodal flows. The key terminals for intermodal traffic in Scotland and on the Anglo-Scottish route are depicted in figure 2. The majority of inland container rail traffic between Scotland and England uses DIRFT Daventry. Currently doing around 175,000 lifts per year, it is the busiest inland intermodal terminal in the UK.

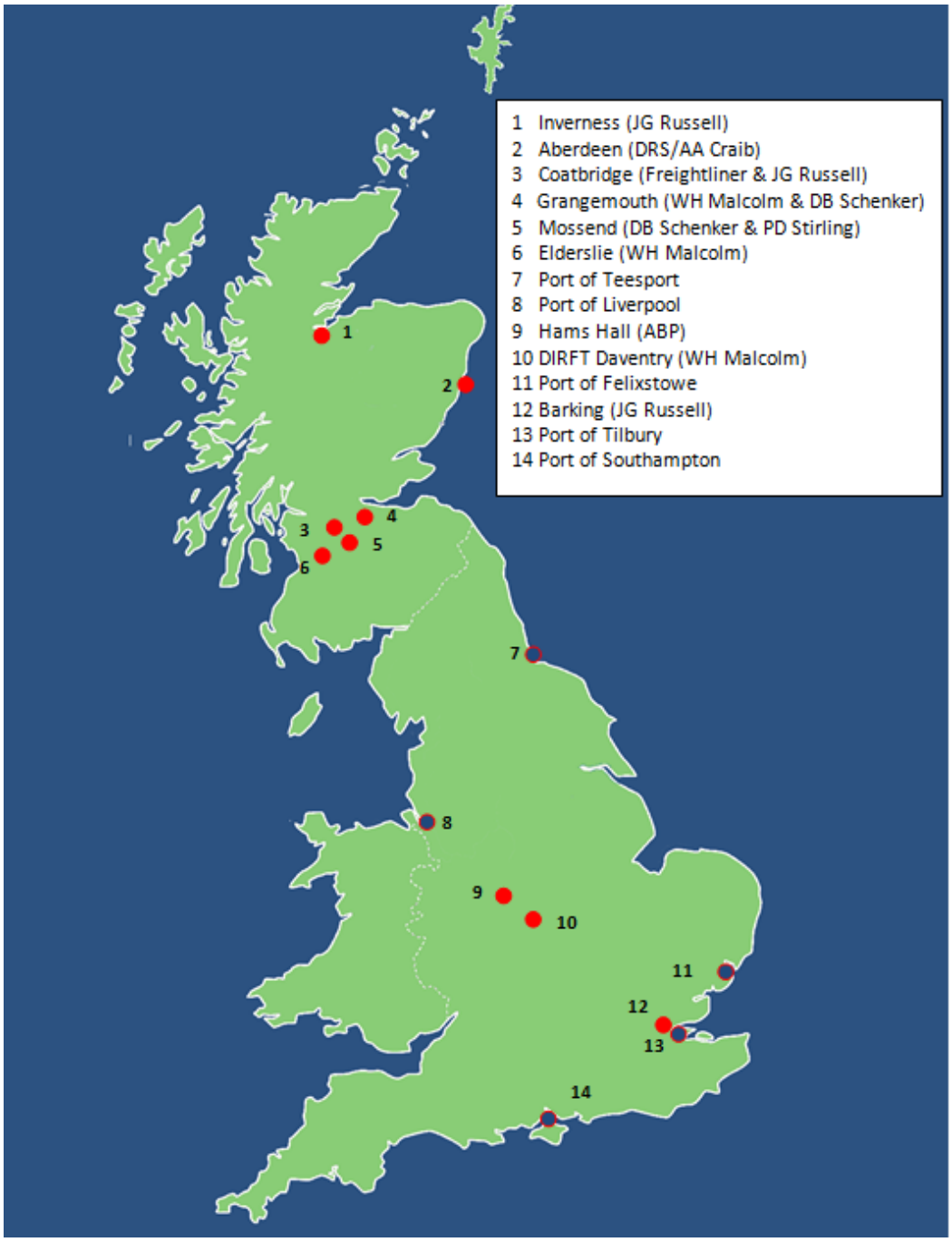

Figure 2 Map showing intermodal terminals in the UK with relevance for Scottish and Anglo-Scottish flows

Table 2 lists the current intermodal rail services in Scotland, divided into three categories: 5 ex port (direct service between a port and a Scottish terminal), 6 Anglo-Scottish (between inland terminals in England and Scotland) and 3 intra-Scotland (between inland terminals in Scotland).

Table 2. List of current intermodal rail services running to/from and within Scotland

Type	Service	Traction	Management	Frequency per week
Ex port	Coatbridge – Felixstowe	Freightliner	Freightliner	5
	Coatbridge – Southampton	Freightliner	Freightliner	5
	Coatbridge – Tilbury	Freightliner	Freightliner	5
	Coatbridge – Liverpool	Freightliner	Freightliner	5
	Grangemouth – Teesport[1]	DRS	WH Malcolm	1
Anglo-Scottish	Tilbury-Barking-Daventry-Coatbridge	DRS	JG Russell	2 daily x 5/6
	Daventry – Mossend (DB Schenker)	DB Schenker	Stobart	6
	Daventry – Mossend (PD Stirling)	DRS	WH Malcolm	5
	Daventry – Grangemouth	DRS	WH Malcolm	6/7
	Hams Hall – Mossend	DB Schenker	DB Schenker	5
Intra-Scotland	Mossend (DB Schenker) – Inverness	DRS	Stobart	6
	Grangemouth – Aberdeen	DRS	DRS	6[2]
	Grangemouth (port) – Elderslie	DRS	WH Malcolm	2/3

These intermodal services are mostly shared user. The ex port services are majority booked by shipping lines as carrier haulage is dominant in the UK for port flows, but smaller users can also book space on these trains directly with Freightliner or through a 3PL or freight forwarder. The other flows are generally managed by 3PLs serving a variety of customers. The largest sector utilising these trains is the retail sector, therefore this paper will focus on these users as instructive of the larger issues at play. In this research the focus is primarily on grocery retailers rather than other retail sectors such as fashion.

IV. THE SPATIAL DEVELOPMENT OF RETAIL LOGISTICS IN THE UK

UK retailers employ approximately 3 million people and account for almost 6% of UK GDP (Forum for the Future, 2007; Jones et al., 2008). Figure 3 shows that nearly 83% of the retail market of grocery trade in the UK is controlled by five supermarket retailers: Tesco (31%), Asda (17%), Sainsbury (16%), Morrison (12%) and the Co-operative (7%).

[1] Update March 2012. This service has now been suspended due to lack of demand, which is frustrating as demand is known to exist on this route.
[2] About to increase to 7 days (April 2012).

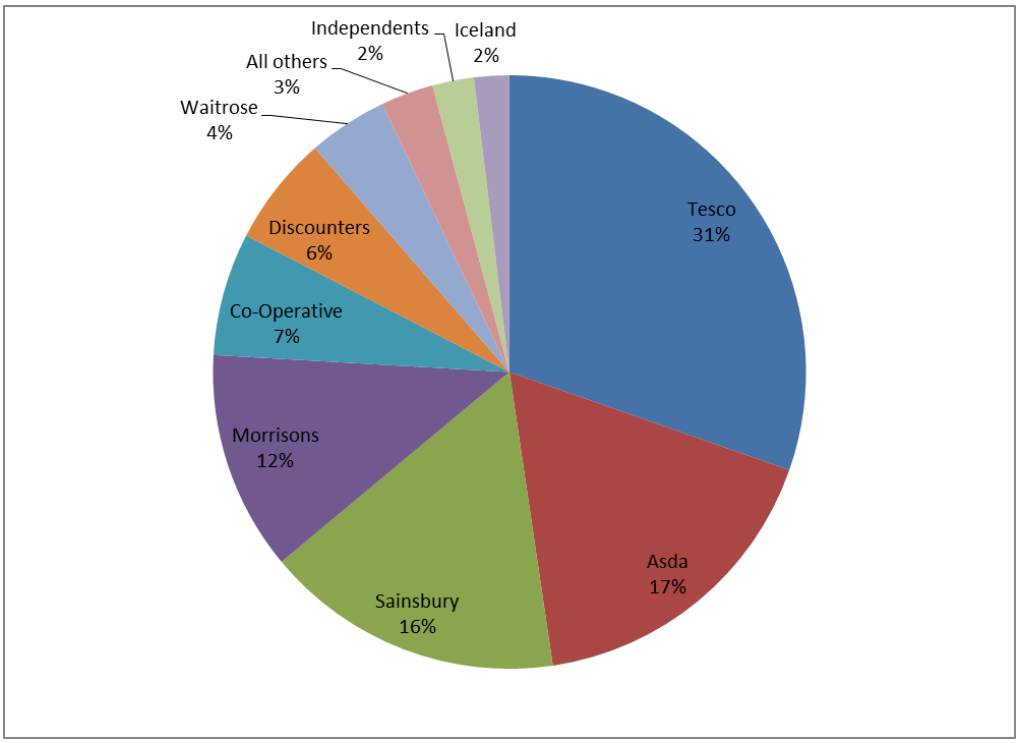

Figure 3. 2010 retail market share in the UK (Source: Scottish Government, 2012)

The spatial distribution of the retail sector has evolved over the last few decades from a system whereby suppliers delivered directly to stores to the introduction of distribution centres in the 1970s and 80s to the arrival in the 90s of primary consolidation centres (Fernie et al., 2000). Lead times and inventories were greatly reduced as part of impressive efficiency advances over this period. Figure 4 illustrates the intersection of spatial developments with operational evolution, with the unbroken line representing retailer control and the broken line representing supplier control.

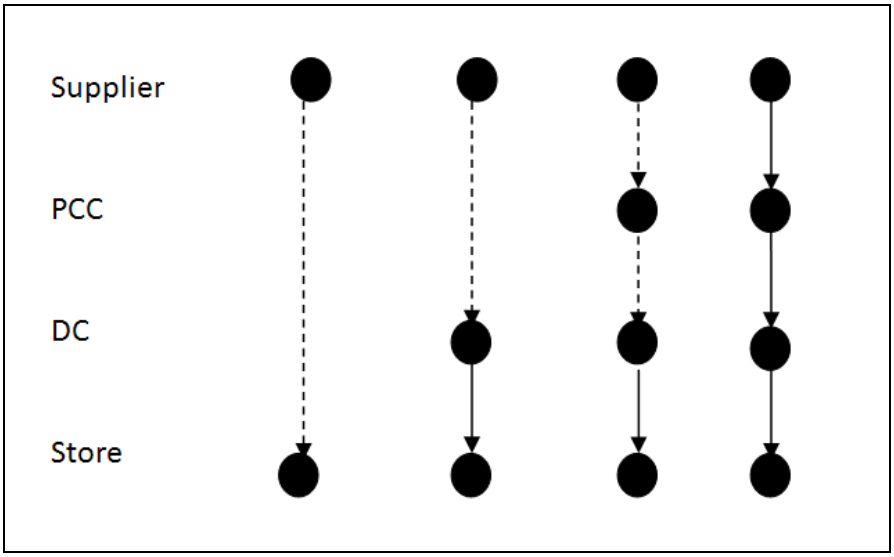

Figure 4. Spatial and operational evolution of grocery supply chains in the UK (Source: Potter et al., 2007; Fernie et al., 2000)

While the industry deals with external pressures such as market saturation, competition and demographic shifts (Kumar, 2008), a number of operational trends have been observed in the literature, such as the centralisation and relocation of plants and distribution centres, reduction in the supplier base and consolidation of the carrier base (Lemoine & Skjoett-Larsen, 2004; Abrahamsson & Brege, 1997; O'Laughlin et al., 1993). Market power has also been concentrated

amongst a few large retailers due to mergers and acquisitions (Burt & Sparks, 2003). Distribution centres are being optimised and new purpose-built facilities are appearing. This ongoing process of rationalisation means that trying to embed them in intermodal chains is difficult. In any case, very few retail DCs in the UK are rail-connected. Figure 5 illustrates the location of the distribution centres for the five major grocery retailers in the UK (PCCs are not shown).

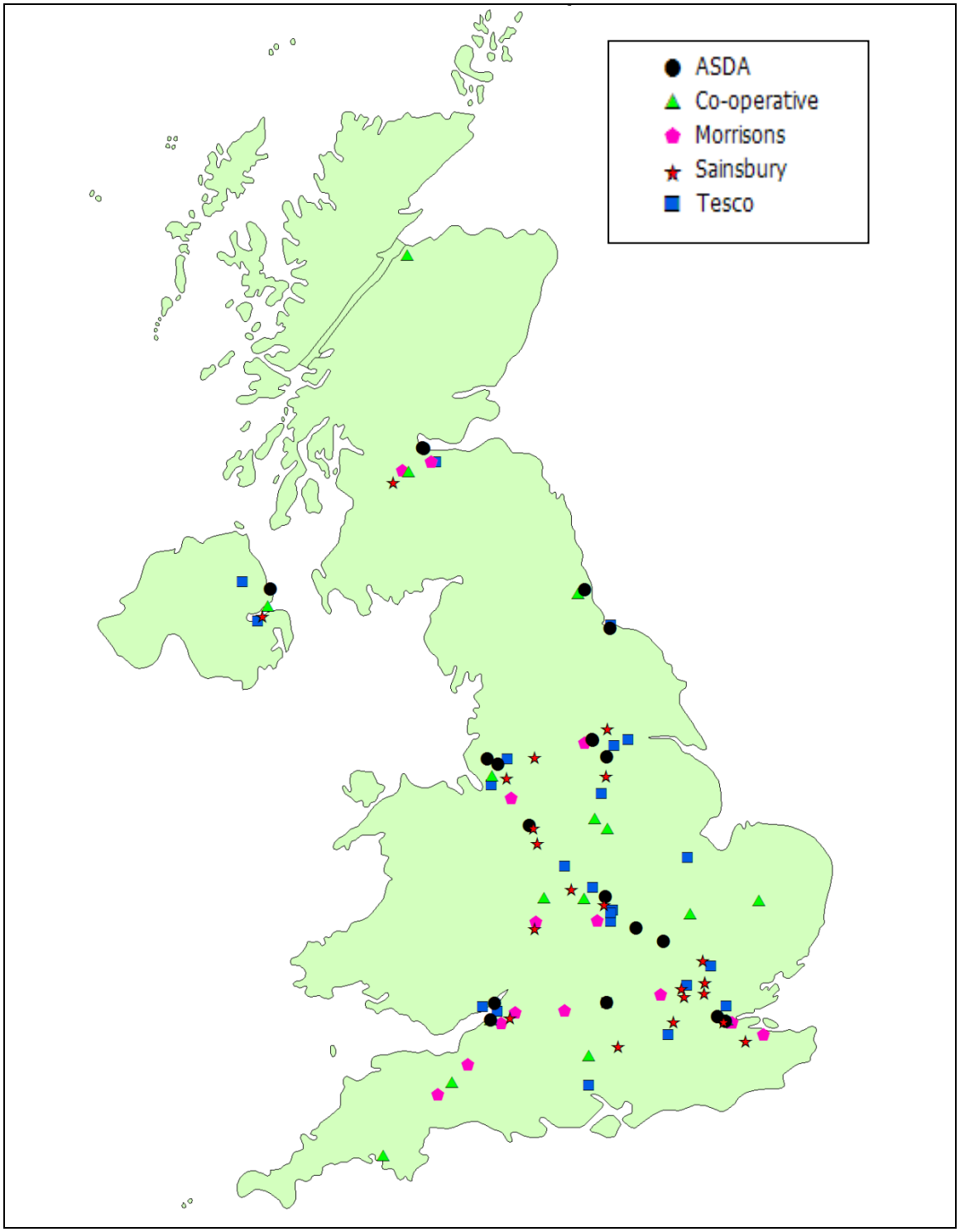

Figure 5. Distribution centres of major supermarkets (Source: author, based on data obtained from retailer websites).

This paper will look primarily at the Anglo-Scottish movements from DCs in the midlands to Scotland, as representative of both successful intermodal transport and trends towards greater centralisation.

McKinnon (2009) found that "since 2004, roughly 60% of the demand for large DCs has come from retailers" (p. S295). Large firms are reducing the number of their DCs while increasing the size and efficiency of those that remain. Fewer, larger DCs means greater centralisation and potentially greater miles travelled.

From an operational point of view, greater use of ICT has allowed more accurate forecasting and more responsive ordering (thus a move from push to pull), which in turn required a more tightly optimised spatial distribution of facilities, as well as greater integration between primary and secondary networks. Thus some retailers work with hauliers to optimise their distribution (e.g. reducing empty running or reducing inventory holding requirements) or work with suppliers to optimise product flows (e.g. forecasting, planning and ordering). The result of these spatial and operational evolutions has been increasing integration of operations, ranging from increasingly efficient use of backhauling to the implementation of factory gate pricing, both of which give the retailer greater control over primary distribution this strengthening its negotiating position (Mason et al., 2007; Potter et al., 2007; Burt & Sparks, 2003; Towill, 2005).

This period also saw increased use of 3PLs to handle the growing and increasingly complex transport requirements resulting from these developments, as well as more frequent, smaller deliveries from suppliers to reduce inventories, which also encouraged suppliers to make use of PCCs (Smith & Sparks, 2009; Fernie & McKinnon, 2003). Distribution facilities continued to evolve, from single product warehouses to composite environments housing ambient, chilled and fresh produce, all scanned in and out using barcodes that were integrated within the IT system used for forecasting, planning and ordering (Fernie et al., 2010; Smith & Sparks, 2009).

Collaboration with competitors is also a key theme in the literature. It can bring efficiencies in transport operations, and Schmoltzi & Wallenburg (2011) found that while almost 60% of 3PLs in their study operated at least one horizontal partnership, the failure rate was below 19%, against an average failure rate for horizontal collaborations in many industries ranging from 50% to 70%. This is an encouraging result, but to what extent retailers can put aside their intense rivalries and collaborate on transport, particularly filling trains, will be a key determinant in the future potential of intermodal transport. Schmoltzi & Wallenburg (2011) also found that, while horizontal collaboration might be thought to be based on cost reduction, the primary motivations revealed in their study were service quality improvement and market share enhancement. Similarly, Hingley et al., (2011) found that cost efficiencies from horizontal collaboration were less important to grocery retailers than retaining supply chain control.

The spatial development just described was built around the motorway network. Food and grocery companies contribute one in four of all HGV miles travelled in the UK (IGD, 2012), so any attempt to fit rail into that system faces a number of challenges. Woodburn (2003) investigated the relationship between supply chain structure and potential for modal shift to rail, and found that "for rail freight to become a much more serious competitor to road haulage would require considerable restructuring of either the whole logistical operations of companies within supply chains or far-reaching changes to the capabilities of the rail industry to cope with the demands placed upon it" (p244).

Cooperation is needed to achieve economies of scale on certain routes, but research has found industry reluctant to pursue such a strategy (Van der Horst & de Langen, 2008). Similarly, a service needs to be well-developed before shippers will use it (Van Schijndel and Dinwoodie, 2000). There is also a severe inertia in the industry. Runhaar & van der Heijden (2005) found that over a proposed ten-year period, even a 50% increase in transport costs would not make producers any more likely to relocate their production or distribution facilities. This inertia can in some ways be considered a bigger obstacle than infrastructural problems, and requires a restructuring of the transport chain in order to change transport requirements.

Eng-Larsson & Kohn (2012) found that when making a decision to use intermodal transport, the convenience of the purchase was more important than the price. From an operational perspective, they found that other supply chain decisions had to be made to incorporate intermodal transport, such as increasing inventory, extended delivery windows, and improvements in planning and ordering due to less flexible departure times of intermodal transport.

While the sector continues to evolve, it is generally considered that retail logistics in the UK has largely reached the maturity stage. Thus the current situation is more a process of perfecting the system rather than major qualitative restructuring.

V. DISTRIBUTION PATTERNS RELEVANT TO THE USE OF RAIL

A. Primary distribution

Primary distribution refers to inbound flows into the DC. These flows can come from overseas through ports, the channel tunnel or by air, or they can come from within the UK. Generally, port flows are non-food lines such as clothes or electronics from the Far East moving through UK deepsea ports such as Felixstowe and Southampton. Tesco is the largest retailer and imports roughly 20,000 containers per year from the Far East through these two ports. This translates to about 400 loads per week.

Not all retailers have the resources or the desire to manage primary distribution, as there are pros and cons to managing it in-house or sub-contracting to one or more firms. For example, Sainsbury manages about 90% of their inbound produce, 60% of chilled and 10% of ambient, whereas Tesco has a larger focus on primary distribution, with 60% of ambient/grocery and 70% of fresh flows moving through their primary network.

It should be noted that these decisions are different for different companies. For example a wholesaler like Costco has a simpler model. They only have about 3,200 SKUs, so this is very different to a supermarket retailer, as it allows Costco to maintain a far simpler operation. They have global buyers overseas, who make decisions for the whole global company (based in the US, Costco is one of the largest retailers in the world). Then the USA division will order so many containers of each product, as will the UK. The products are shipped as FCL for each product, not mixed. For foreign supplies, Costco always buy delivered, so they are not involved directly with the transport element of supply.

The role of shipping lines should also be considered. The UK is unusual in Europe in having a high proportion of carrier haulage (about 70%), which means that the shipping lines control distribution from the port to the inland destination. When this is done by rail, it is usually with Freightliner on their ex port services, although DB Schenker has been competing successfully in this market. As carrier haulage gives less control to the retailers, this is one area in which a large company like Tesco, with growing experience at managing their primary network, can negotiate port-only prices and manage the inland leg themselves. The flows that they currently manage in this way are going by road, but their next step is to shift some of these flows (mostly Felixstowe/Southampton to Daventry) to rail.

B. Secondary distribution

Secondary distribution refers to the movement from the DC to the store. This move is more likely to be done in-house by the retailer or sub-contracted on a closer relationship. Tesco, Sainsbury and the Co-operative all run their own trucks for secondary distribution but will sub-contract occasionally where required (see table 3).

Table 3. Distribution structure of each retailer

Company	Sector	Manage primary distribution	Manage secondary distribution	Use of rail	DCs
Tesco	Retailer	Partial – high	Yes	High	24
Sainsbury	Retailer	Partial - med	Yes	Low	22
The Cooperative	Retailer	No	Yes	Low	16
Costco	Wholesaler	No	Yes	Medium	1

Whether these flows are suitable for rail will depend to a large degree on the distribution strategy of the retailer, for example which product lines are stored at the RDC and which require trunking from the NDC to the RDC.

Lead time is crucially important for all movements between DCs and stores. An ideal scenario would involve overnight picking and morning departure from the DC to reach the store by mid-afternoon, but this cannot always be done because of passenger trains on the line during the day. So in order to develop rail it is not necessarily upgrades or more paths but the requirement for paths during the day. Until this can be solved, intermodal growth will be constrained by operating mostly

at night, which requires stores to order from DCs in the morning so that the load can be picked in the afternoon, loaded at the DC at say 1600 to catch a 2000 departure on the train, which will then arrive at its destination in the early morning (say 0400-0500) for trucking to the store.

C. Centralisation and other models

The geographical coverage of distribution facilities is being rationalised by the leading retailers in a bid to improve the efficiency of their supply chains, however legacy issues determine to a large extent where the DCs are located, meaning that they do not begin today with a blank map. Most retailers prefer a centralised model but other models have some potential, such as port centric logistics and continental hubs.

Port centric logistics has been discussed elsewhere in more detail (Mangan et al., 2008; Pettit & Beresford, 2009; Monios & Wilmsmeier, 2012a). From an operational perspective, the backhaul and container type issues will be difficult to overcome. If the DC is in the port then imports arrive in maritime containers, are emptied in the DC then the empty goes back to the shipping line. The goods are then distributed from the DC to the stores in 45ft lorries, but the only lorries coming to the port will be bringing maritime containers, so it can be difficult to match these flows. The result could be empty lorries coming to the DC. Another downside is that the company is anchored at that port with little option if a shipping line raises their prices or moves to another port. It also depends on the store location model for a particular company. Asda has more stores in the northeast than Tesco therefore of the two port centric operations at Teesport, Asda seems the more natural fit.

Another option is to make use of a continental hub to consolidate flows then bring them to the UK by rail or ferry. Tesco/Stobarts work with 2XL in Zeebrugge to consolidate loads there (Red Bull for example). Similarly, French wine used to come in full loads but now Tesco de-stuffs them at Zeebrugge and consolidates many different loads into one container which can then go direct to the store in the UK. This means they also reduce their inventory from six weeks down to one week. There are difficulties in this model, however. The Channel Tunnel rates are considered by some interviewees to be high, part load patterns are complex, and the ferry also has constraints such as time, frequency and imbalance of flows.

Tesco is also looking at a consolidation centre in China. So instead of bringing full containers of each product to the UK which then must go to the NDC for de-stuffing, they could put say 5 different products in the container before it leaves China. Then it might be able to go straight to a regional DC or even a store, thus removing a leg from the UK distribution. If all importers of freight from the Far East picked loads there before sending them to the UK, the centralised pattern of DCs in the UK could be altered somewhat. However as these products are mostly non-time sensitive products, they do not constitute the majority of product lines discussed in this paper.

VI. USE OF INTERMODAL TRANSPORT BY RETAILERS

Woodburn (2003) noted that "it is notoriously difficult to identify specific rail freight users and volumes from public sources, particularly in the non-bulk sectors" (p245). For this research a list has been compiled from interviews with rail operators, logistics providers and retailers (see table 2 above), as well as using a recent report by the FTA that highlighted recent successes by large retailers in the UK in adopting intermodal transport (FTA, 2012). Results are presented in table 4.

Tesco has four dedicated services (Daventry-Mossend, Mossend-Inverness, Daventry-Thurrock/Tilbury and the recently started Daventry-Magor). These are mostly secondary distribution except for the service from the port of Tilbury to Daventry. Tesco is about to start using the existing Grangemouth-Aberdeen service (already used by Asda), as well as planning some more potential services, only one of which is likely to be a dedicated service.

Sainsbury uses rail on primary hauls to bring product of Scottish suppliers to their midlands DCs, using the shared JG Russell service. Morrisons use the JG Russell service in the opposite direction to move loads of picked pallets from Northampton to Bellshill. In the past, they have trialled services between Trafford Park and Glasgow, and Coatbridge to Inverness. Waitrose uses the WH Malcolm Anglo-Scottish service, as does DHL for M&S. M&S is building its own rail-connected DC at Castle Donnington (see below for discussion). Asda also uses the WH Malcolm Anglo-Scottish service, and the DRS service onwards to Aberdeen. With the additional Tesco volume, the Grangemouth-Aberdeen service is now fully utilised and is about to extend to 7-day operation. In fact, DRS has

noted that they have received additional interest from retailers due to the visible success of their Tesco trains, which is extremely encouraging. The Co-operative is currently running a trial on the WH Malcolm Anglo-Scottish service, taking 2 containers per night, 5 nights per week from the midlands to their Scottish DC at Newhouse.

Costco use the JG Russell service to Scotland. They send about 10-15 containers per day on the train. They also used to send the Aberdeen deliveries on this train (just to Coatbridge then by lorry to Aberdeen), but because of the timings it is actually quicker to send it by road. The train arrives early enough to suit the central belt stores but there would not be enough time to drive it up to the Aberdeen store.

Table 4. Retailer use of intermodal transport

Retailer	**Route**	**Traction provider**	**Management**
Tesco	Anglo-Scottish	DB Schenker	Stobart
Tesco	Scotland to north	DRS	Stobart
Tesco	Daventry-Tilbury	DRS	Stobart
Tesco	Daventry-Magor	DRS	Stobart
Sainsbury	Anglo-Scottish	DRS	JG Russell
Morrison	Anglo-Scottish	DRS	JG Russell
Waitrose	Anglo-Scottish	DRS	WH Malcolm
M&S (DHL)	Anglo-Scottish	DRS	WH Malcolm
Asda	Anglo-Scottish	DRS	WH Malcolm
Asda	Scotland to north	DRS	DRS
Co-operative	Anglo-Scottish	DRS	WH Malcolm
Costco	Anglo-Scottish	DRS	JG Russell

VII. OPERATIONAL ISSUES

A. General rail issues

Loading gauge restrictions on the UK network is a well-known issue, mostly north of the central belt in Scotland and on the ECML (which is used when services are diverted from the WCML). This is generally more of an issue for maritime containers coming through ports, as these are gradually moving towards a standard of high cube (i.e. 9ft6 height rather than the old standard of 8ft6). While the major parts of the network can now take these containers on standard wagons (W10 loading gauge), significant portions can only take them on special low wagons (W9 or W8 gauge). Containers designed for purely domestic flows (e.g. the Tesco rail containers designed in conjunction with Stobart Rail) are more likely to be standard 8ft6 height, thus avoiding this problem.

While some reports still claim a negative perception of rail amongst hauliers (RHA, 2007), all rail users interviewed for this paper stated that their use of rail had been extremely reliable. In fact, rail had proved more reliable than road during the hard winter in 2010/11. As shippers gain experience using rail, they know that they can contact a freight forwarder or rail operator and put even a single container on a timetabled rail service. However to achieve this position (and extend it) has required and will require work on behalf of 3PLs who can provide a door to door solution to customers, providing the responsiveness of a road haulier.

The common opinion in the industry is that Network Rail is very good to work with, but more effort is needed in areas such as path flexibility. For example, not all paths are utilised but incumbent operators are loath to give them up, and need only run a train once a year to retain the path. Some of these could be freed up, and it has also been suggested that some paths are in reality a higher gauge than listed, and this could be cleared up with only some paperwork and a trial run. One interviewee said that they have had to pay double for a terminal to open on a Sunday, so increased Sunday operations would be welcomed by shippers, particularly retailers. Night time deliveries to stores would also help, and the London Olympics may open the door for that to be tested.

Government grants (FFG for infrastructure and MSRS for operating subsidies) have been essential in supporting the shift of retail (and other) flows from road to rail, but economic and operational realities of the freight business can make it difficult to use this funding strategically. Setting up a rail service is a complicated task, which is a barrier to intermodal growth and also a barrier to market entry for new traction providers (Slack & Vogt, 2007). A path must be booked and paid for, a locomotive bought or leased, likewise with wagons. It is general practice that more paths than needed must be booked to provide flexibility for the operator, which costs more money and reduces paths for others. Backhauls must be sourced and high utilisation of the assets is very important. An operator will only make this up-front investment if the customer will commit, and in terms of small loads, they will need enough customers to fill the train. A modern operator will not set up speculative services like in the old British Rail days.

Break-even estimates for a route that requires no road haulage have been estimated as low as around 90km. With a road haul at one end only, the figure is roughly 200km, and if both pre- and end-hauls are required, the distance is approximately 450km (MDS Transmodal, 2002). However the interviewees in this study claimed that asset utilisation is more important, even if made up by a number of short distance services. One interviewee said to "beware of management accountants" because they look at the individual costs of running a train, without considering factors such as utilisation and cross subsidy across their service portfolio. Most freight trains run at night, due to path restrictions during the day, with the result that a locomotive and wagon set may sit idle all day. Daytime running is generally possible in Scotland because the lines are not as busy but this is difficult in England. The view of rail operators in interviews conducted for this paper is that if you can keep a train running most of the day then it will make money, so if a train is just sitting idle in a siding then any service, no matter how short, is worth running.

Handling charges involved in changing modes have always been a barrier to greater use of intermodal transport. However it was found in the interviews that the price paid by shippers for handling is something of a contentious topic. Users feel that they are being quoted a nominal price without evidence of a relation to the actual cost to the terminal operator of providing this service. Tesco has been able to make intermodal transport more affordable by bargaining this price down, but rail operators feel that they cannot go any further or they will not be able to provide the service. Moreover, this is related to a wider issue of visibility of the true cost of rail movements. A report from ten years ago noted that "There are no published rates for rail freight charges and rail freight users have only a poor understanding of their suppliers' cost structures as there are dominant operators in the market and little on-rail competition" (MDS Transmodal, 2002; p49). It was suggested by one retailer that the quote they are given is simply based on being "slightly cheaper than road" rather than being based on the actual costs of the rail service. Some shippers say that they would like greater visibility of the cost to the provider of the entire rail service, including the trunk haul. This is similar to the greater control over primary distribution sought through use of factory gate pricing. It is a way of removing the need for the retailer to pay a profit margin on top of the base cost of the transport service.

Rail is considered to be cheaper than road if there are flows in both directions, therefore the backhaul is often the key issue in making intermodal work. By integrating their primary and secondary distribution, Tesco has been able to match supplier deliveries inbound to their Daventry NDC with outbound distribution to RDCs. For example, they sell space on their dedicated trains to their suppliers, thus inserting themselves in a chain of vertical cooperation that draws the traction provider, 3PL and supplier together. JG Russell matches flows on rail by sending French wine to Daventry, then the Costco loads to Scotland, then returning from Scotland to the continent with whisky.

More backhauls from Scotland to England are needed to support the Anglo-Scottish services. The feeling from the interviewees is that the loads are there: "it is just a matter of making it work," sometimes just convincing a company that has not used rail before to give it a try. There are many companies with a few containers a day that could use it, or that may require consolidation of LCL loads then send them south by rail. Therefore consolidation could be a key issue to promote further use of intermodal transport and integrate road and rail more seamlessly.

Road operations also need to be understood in order to contribute to supporting the growth of intermodal transport. Road is built into supply chains because of its inherent qualities. For example, with road haulage the deliveries can be staggered. If 30 containers arrived together it could be difficult to handle. "Staggered delivery is easier to manage," one retailer said.

B. Operational issues - containers

As well as terminal access and handling charges, the economics of the trunk haul based on asset utilisation and the role of the last mile, the issue of wagon management must also be considered. Taking high cube containers on non gauge cleared routes means using special wagons such as Megafrets and Lowliners, which are more expensive to buy and to maintain. Similarly, these wagons are generally 54ft and carry 45ft domestic boxes, meaning 9ft of length is wasted per wagon. This is now being addressed by new low wagons that are 45ft long. There is also the conflict between port flows (generally hauled by Freightliner on 60ft wagons to cater for 20ft and 40ft boxes) vs domestic flows which are primarily 45ft boxes).

The key issues in terms of container dimensions relate to pallets and retail cages. A standard lorry will take 26 UK pallets (or 52 if pallets are loaded less high so they can be stacked double). The internal width of a lorry is 2.48m, which means UK pallets can fit 2x 1.2m across, whereas an ISO container has an internal width of 2.35m which prevents this configuration. UK vs Euro pallets is a big issue in terms of getting the maximum value from a container. UK pallets (GKN or CHEP) measure 1200mm x 1000mm, thus fitting into a trailer more efficiently whereas European pallets measure 800mm x 1000m. Thus a road trailer takes 26 UK pallets or 33 Euro pallets, whereas a 40ft maritime container takes only 22 UK pallets or 25 euro pallets.

Imports from the Far East are generally not palletised; the contents are loaded loose or break bulk in the deepsea container. This will be de-stuffed in the importing country and then put into a trailer for domestic movement. For intra-European loads, this is not practical therefore "pallet wide" containers have been developed on European short sea routes. These are 2.4 inches wider than standard containers (i.e. just over 8ft2 rather than 8ft wide), giving an internal width of 2.44m, similar to a road trailer. A pallet wide 40ft container will take 30 euro pallets rather than 25 in standard width or 33 in a road trailer. 45ft length is the preferred option, taking the same pallet loading (UK or Euro) as a road trailer.

There is a move in Europe to make 45ft pallet wide maritime containers the industry standard (Bouley, 2012). Problems exist because most deepsea ships cannot accommodate these containers in their cellular holds and EU directive 96/53/EC forbids standard 45ft long containers on lorries (although modified designs with chamfered corners can fit within this; it is only standard non-chamfered containers that are outside the regulation). It must also be considered that pallet-wide containers require a wider loading gauge (W12) thus their suitability for rail is limited to certain routes. This width is also required for refrigerated units.

The next issue is retail cages. Retail movements to stores are generally done in cages, and greater economies can be achieved by transporting these in double decker lorries. A standard lorry takes 45 retail cages, as does a 45ft rail container, whereas a double decker lorry can take 72 cages. As confirmed by a retailer in an interview: "because we run double-deck road trailers, it is difficult for the rail operators to compete on price." Double deckers currently form about 20% of the Tesco fleet. That might eventually get up to around 40-50% but it will never be 100% because of operational reasons. As a wholesaler, Costco uses pallets rather than cages, but they insist that all pallets are max 1.4m high (with the occasional exception), so they can always stack them two high in the trucks.

Most domestic intermodal containers used by 3PLS such as Stobart, WH Malcolm and JG Russell are 45ft pallet-wide to deal with the issues noted above. However their design differs across companies. The Stobart/Tesco containers are curtain siders, which is common on lorries but not on trains. As trains are often required to stop on the line, they can be targets for pilferage, therefore generally rigid boxes are preferred (though not immune themselves). Similarly, curtain siders, like swap bodies, cannot be stacked as standard ISO maritime boxes can. Another difference between road trailers and rail containers is that HGVs can be compartmentalised for chilled, frozen, ambient but current rail containers cannot, which limits their flexibility. All of these operational issues contribute to the decision to use rail (or not).

It is well known that the container imbalance in the UK, in particular on the Anglo-Scottish route, is acute. Northbound imports to Scotland come mostly as 45ft pallet-wide road trailers or swap bodies (and now rail containers) as they are retail movements from DCs in the midlands. The majority of Scotland's exports leave as 20ft/40ft maritime containers either through ports or on rail. This equipment mismatch is also a problem in countries such as the United States where 40ft

deepsea boxes are transloaded into 53ft domestic containers. However 53ft maritime containers are now being constructed in China, so this may soon come to influence global standards.

Deep sea boxes are 20ft and 40ft, 8ft wide, either 8ft6 high or more increasingly high cube 9ft6. Short sea boxes from Europe will be 45ft pallet-wide, as are domestic retail loads. The SSS 45ft pallet-wide boxes tend to go to the English DCs rather than Scotland anyway, so there is less of an issue in terms of trying to match them with Scottish exports in deepsea boxes. The issue for Scotland is related more to the 40ft deepsea boxes that come through English ports to English DCs, then return empty to the port to go back to the Far East, or indeed are moved up the coast to Scotland, when they could have gone directly from the midlands DC to Scotland.

VIII. COLLABORATION

A. Vertical

Both vertical and horizontal collaboration can be observed in the industry (see table 5), however it is the former that is having the greatest impact.

Table 5. Vertical and horizontal collaboration

Company	**Sector**	**Vertical collaboration**	**Horizontal collaboration**
Tesco	Retailer	High	Low
Sainsbury	Retailer	Low	Low
The Co-operative	Retailer	Low	Low
Costco	Wholesaler	Medium	Low
JG Russell	3PL	Medium	Medium
WH Malcolm	3PL	Medium	Medium
Eddie Stobart	3PL	High	Medium
DRS	Traction provider	High	Low
Freightliner	Traction provider	Low	Medium

Most noticeable is the relationship between retailer Tesco, logistics provider Stobarts and traction provider DRS. Working closely together has allowed all parties to develop knowledge of requirements and adjust operations to suit. They work together to develop new services and solve requirements, operational issues, etc.

Vertical collaboration or integration between all levels of rail operations (from terminal operation, traction provision, train management and road haulage) presents an interesting dynamic. Terminals can be run by rail operators (e.g. Freightliner or DB Schenker), 3PLs (e.g. WH Malcolm) or other companies (e.g. ABP at Hams Hall), or even be private sidings for which the operation is sub-contracted (e.g. Stobart operating the Tesco siding at DIRFT). Likewise, the customer side of trains is normally managed by a 3PL rather than the traction provider (e.g. JG Russell, WH Malcolm and Stobart operating trains with traction provided by DRS or DB Schenker), but for other trains the management is also done by the traction provider (e.g. Freightliner or DB Schenker). Therefore various levels of vertical collaboration exist depending on the particular service which may or may not be running into the terminal of the traction provider. However when a service is vertically integrated, such as the Anglo-Scottish service of WH Malcolm which runs between their two terminals at Daventry and Grangemouth, the last mile is removed and the economic feasibility of the service is improved.

B. Horizontal

Turning to horizontal collaboration, this can relate to retailers sharing space, either within containers (or using each other's containers), or sharing space on trains. The former does not currently happen, but the latter is already in evidence, with most retailers using multi-user 3PL trains as noted earlier. It can also refer to 3PLs sharing space on their services, which does already happen. It is sometimes on an ad hoc basis, but also on a regular basis, especially boxes coming from ports, as these services are mostly run by Freightliner who specialises in these flows. 3PLs have

not entered this market so they will buy space on those trains (e.g. Stobarts bringing boxes from Tilbury to their hub at Widnes). 3PLs can collaborate in other ways, for example, Stobarts run the Tesco train from Mossend to Inverness, where it terminates at the JG Russell terminal, from which point JG Russell distributes the containers to stores by road. Likewise, the Stobart Valencia fruit train utilises the JG Russell terminal at Barking. Other interesting collaborations occur as responses to unusual circumstances. In the winter of 2010/11 there was a big problem with snow and they needed to move cargo so they put together a train with DRS traction, Freightliner wagons and WH Malcolm traffic. However, while 3PLs will share spare on each other's services when needed, they do not actually run any trains together. It could be that in the future this kind of collaboration will be required to improve the economics of rail operation.

At the present time, Tesco is the only retailer large enough to fill a complete train. However the decision is whether to operate a dedicated service, in which case the retailer pays for the whole train and therefore must take responsibility for filling any empty wagons or suffer a financial penalty. Scheduled services may be used by any shippers, but having a dedicated train grants more control over the timings and operation of the service. Establishing a dedicated Tesco train rather than just buying space on a third party train gives them more control and enables them to plan the primary and secondary distribution as part of a unified system.

The retail interviews found that in an ideal scenario they would all prefer to have their own rail-connected sheds rather than using an open user terminal to load a multi-user train. This means that they would need to run a full train, which would reduce opportunities for collaborating and perhaps suggests that they are not so keen on sharing space. The new DIRFT 3 appears to be planned around more rail-connected sheds. Similarly, the new DC being built by M&S at Castle Donnington is rail-connected, but without the retailer being able to provide enough volume for regular services, this development will make asset utilisation more difficult for rail operators. It can only work if an operator (or someone else) can provide more rail flows to this terminal to get better asset utilisation of the rolling stock.

The primary rail hub in the UK is Daventry, but within the site there is the option of using the shared user terminal operated by WH Malcolm, or private sidings if a company has leased one of those sites. This is still a feasible option as shunting the train through the terminal to the private siding is not such a problem, and using the shared terminal would necessitate a road shunt to the warehouse anyway. But it is representative of the desire for supply chain control evidenced by the large retailers who would prefer not to share third party trains, however as shown above, other than Tesco, all retail use of trains is on third party services.

IX. Conclusion

The examination of the rail industry revealed that the intermodal market is growing but served by a limited supply of traction providers and 3PLs. The key route is Anglo-Scottish though port flows are relevant, for example Tesco seeking to replace carrier haulage with their own primary network. Intermodal terminals for these flows in England and Scotland were identified along with current service provision.

From an operational perspective, it was found that asset utilisation is key for traction providers as expensive assets are forced to remain idle while daytime paths are used by passenger trains. This means that promoting rail usage is not simply about infrastructure upgrades but related significantly to operational issues. It also relates to the fragmentation of the UK freight industry in terms of providing enough flows for each train. Other operational issues such as wagon and container management play a crucial role.

Horizontal collaboration is important to achieve full trains, and while there is a small amount of this happening at the moment, the issue of preferring private sidings rather than shared user terminals splits economies of scale and can be a barrier to greater use of intermodal transport. Planners should consider whether multi-user platforms should be preferred in the planning system rather than more rail-connected sheds.

Vertical collaboration is more common. This involves working closely with traction providers and 3PLs to develop a seamless operation from the DC to the terminal, the handling, the trunk haul and the last mile. The partnership between Tesco, DRS and Stobarts has been shown to be successful in overcoming operational issues.

Analysis of the spatial development of the retail sector identified the centralisation of DCs, growing retailer control of the primary chain which provides new opportunities for intermodal use as does greater use of planning and forecasting through ICT. The need for full containers of product to go into NDCs before sending picked loads to RDCs and stores is something that will remain a barrier to solving the container imbalance. Scotland needs more northbound deepsea containers, but currently they receive many northbound moves in trailers or 45ft boxes.

There are some potential drivers for decentralisation, such as port centric logistics and continental hubs. The analysis in this paper has suggested however that they have only limited potential. One aspect of distribution geography is the importance of consolidation centres. They are very important for consolidating LCL into FCL which can feed intermodal services if they are located at intermodal hubs. They can also be used for retailers de-stuffing containers and consolidating loads for regional stores. This could be a planning target for the public sector.

In the interviews it was unclear to what degree a company's interest in using rail is due to a shift in the sector or a purposeful management policy or whether it is just down to an individual in a company. Therefore it is difficult to drive this through policy when it often comes down to individuals, meetings and discussions between 3PL or rail personnel and the potential client, built on individual relationships.

Future drivers of rail growth include fuel price rises, carbon targets and increasing road congestion, particularly in areas where the road is poor. It will still be 3PLs, retailers and shipping lines who drive this. Fuel price is certainly an issue, as some operators update their costs on their contract weekly due to changing fuel costs. Congestion is less of an issue at the moment but will not go away, and corporate social responsibility has grown in importance, according at least to company reports and promotional literature (Jones et al., 2005). While the green agenda may have fallen slightly in prominence due to the recession, it remains a key driver, according to interviewees.

ACKNOWLEDGEMENTS

Research for this paper was supported by the Interreg IVB programme Dryport and Foodport projects, funded by the European Commission.

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Manuscript received by 30 April 2012.

Published as submitted by the author(s).