THE ECONOMICS AND PRACTICALITIES OF A RAIL RESURGENCE

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Introduction: the Challenge

Successive British Governments have been supportive in theory of a transfer of freight traffic from road to rail. This has been accompanied by practical measures such as providing around £15m p.a. of funding for new sidings (through Freight Facilities Grants) and then the environmental benefits of some flows (through the MSRS (Mode Shift Revenue Support) scheme) and (rather more significantly) by funding Network Rail's gauge enhancement programme. The latter allows for the raising of bridges etc., thereby enabling the larger 9'6" containers to be accommodated within Britain's small loading gauge (permissible height and width of trains).

The British railfreight industry should be applauded for being successful in replacing the quantity of traffic lost from the demise of the coal sector. However, closer scrutiny of the figures suggest that the picture is less rosy. The various Freight Operating Companies (FOCs) have managed to increase traffic in traditionally rail-friendly sectors, such as building materials and containers to/from major ports, thereby maintaining rail's market share at around 9% of tonne-kms. However, for many sectors, rail is simply not 'in the game' at all. This includes traffics for which rail should be suitable, including the domestic intermodal market. Here, aside from traffics contributed by supermarket giant Tesco, rail carries almost nothing.

Truck Train Industries (TTI) Ltd led a consortium in the "F3" project for Innovate UK during the period 2017-19. That project was targeted at understanding the reasons for low market penetration in the important domestic intermodal sector and, more importantly, for finding ways of overcoming the difficulties found. The F3 project assembled a dataset of some relevant flows, analysed the optimum layout for efficient terminals, undertook trial loading/unloading tests at Long Marston and compiled a financial model which demonstrated where rail might be competitive. The results of all that work are now being commercialised by FreightArranger. This paper shares some of the ongoing findings, which do not necessarily reflect rail freight orthodoxy.

Learnings

Data: If there is no single shipper with sufficient traffic to fill a train, aggregating traffics to train level obviously necessitates (say) 2-4 shippers with 6 containers each. However, there are relatively few of these, making it harder to aggregate than for (say) two different sets of pallets to put in the same truck. Given commercial sensitivities, it is quite understandable why there is no national database of rail-friendly flows, but that means that any new player has to spend several years developing their contacts to create one.

Train length: the traditional view is that freight trains have to be long, if they are to be profitable. The reasoning behind this is that some costs (e.g. driver hours and, to an extent, locomotive provision) are fixed per train, so spreading them more thinly will improve commercial performance. Whilst that may be the case, it also has several confounding factors. First, it eliminates most of the market: very few customers (except Tesco) have (say) 24 containers needing to be taken from the same origin to the same destination on the same day; immediately, we have therefore excluded the majority of the potential shippers. Secondly, long trains require large (hence capital-intensive) terminals able to take them (a 24-wagon train would typically be 500m long, potentially then also needing multiple cranes or reachstackers) and thus a long time to deal with them (some operators using terminals which are ill-designed for such train lengths need 7 hours to unload and reload).

Our analysis demonstrated that a shorter train (of 12-16 wagons) could run more trips per day, thereby achieving similar asset productivity spread across a greater number of train miles, but *in a larger market*. This concept has been taken up by PD Ports at Teesside, with a 20-wagon train which makes two return trips in 24 hours to iPort Doncaster with the same wagon set.

Trip length: Railway economics texts have often presented a diagram similar to that shown in Figure 1. Per mile driven, a freight train is cheaper than an equivalent number of hgvs. Within a single train journey there are some fixed journey costs which need to be overcome, principally lifting costs and the cost of trucks serving the first/last mile from terminals. This constrains shorter journeys from being financially viable – a certain distance is needed to pay back these costs. For road-only flows, such costs are very much smaller; conversely, for ships such costs are much bigger (berthing fees, pilotage fees, lifting costs etc.), but their voyages are either longer or use of a ship is necessitated due to the origin or destination being an island. So, ideally, a freight train transit should be longer rather than shorter.

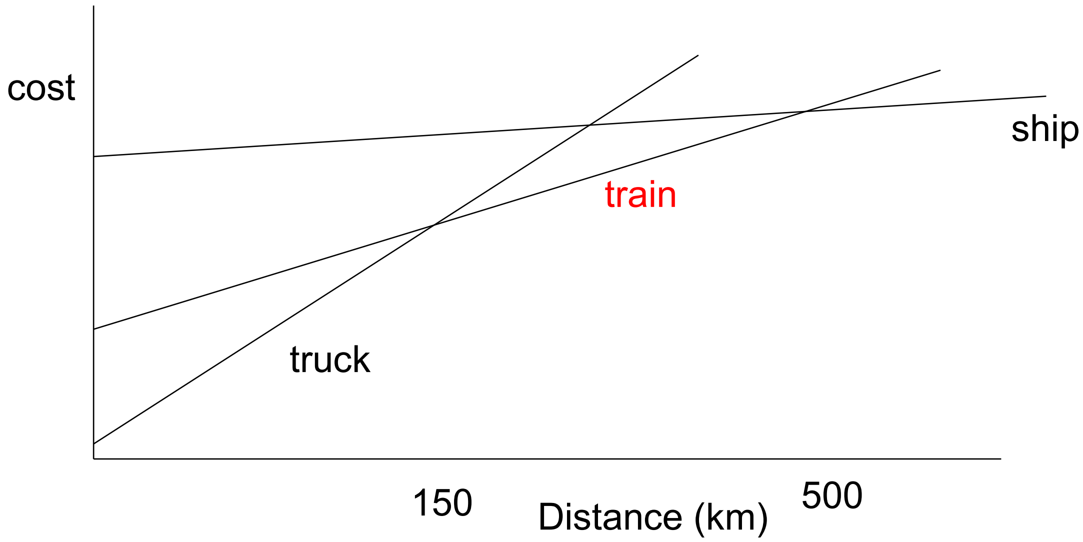

Figure 1. Relationship of Railfreight Competitiveness, as Traditionally-Conceived

Improved asset utilisation enables the railway to compete more effectively at lower distances (e.g. the 100km from Thames-side to Daventry), especially as road congestion and driver shortages both increase, and make ‘Just In Time’ delivery by truck less possible. Nevertheless, one must acknowledge that rail is increasingly strong in the 300km range (e.g. Thames-side to Manchester), because it is often no longer possible for one truck driver to complete a return trip within one shift. Although rail can compete over short distances for very heavy/bulky materials (e.g. coal, building materials), the higher-value commodities for which containerised traffic is used are often of longer distances only available in Britain on a North – South axis; shorter-distance East – West movements have long been recognised as difficult for rail (Mackie, 1995).

However, perusal of DfT Road Freight Statistics reveals evidence that would be expected from an understanding of the gravity model (Profillidis, 2014): the number of hauls and their length are inversely correlated, which provides another constraint to the development of rail services. Most traffic is inherently between larger places which are relatively-close together, although logistics chains can also engineer this through the optimal siting of delivery centres to enable good out-and-back hgv driver utilisation within the constraints of normal working days. But, in terms of widening the addressable market for rail, it is therefore desirable for the minimum economic length of a train journey to be shortened, which in turn means that fixed train journey costs have to be reduced.

Network gaps: Whilst the road network, at around 400,000 route kms is almost infinite (especially in England), the rail network is not. After the cuts of the 1960s, Britain was left with only around 15,000 route kms, which carry almost 10% of the transport demand of the country. However, there are significant gaps in the network, even in populated areas: for instance, the network in the South East is strongly radial to/from London, making orbital journeys relatively difficult, and forcing into London some trains (including freight) which do not want to be there (e.g. Felixstowe – South Wales). Whilst this is widely-recognised, a similar problem arises at a more detailed level where there are no points allowing trains to cross from one track to another, or where junctions have been simplified so that only one train can use them at once.

Network usage: Britain is currently faced with a dilemma, when it comes to intermodal freight by rail. Whilst the principle of gauge enhancement is understood and has been the subject of investment, pre-Covid increases in train service levels (up by 25% in the period 1995-2019) are negating these benefits. Many main lines have been gauge-cleared, but are sufficiently busy with passenger services that good paths for freight trains may not remain (poorer paths, with a requirement to wait in a loop to be overtaken by passenger services, take longer so both cost more and are less attractive to shippers).

From	*To*	*Distance (miles)*	*Time (hours)*	*Ave. speed (mph)*
London Gateway	Liverpool Garston	200	8	25
Southampton	Doncaster iPort	225	9.5	24
Felixstowe	Crewe	227	7	32
Southampton	Manchester T Pk	300	7 overnight	43

Table 1. Example Journey Times

In some cases, the sheer quantity of trains on the network means that slots are not available at all. Table 2 gives some examples of current network congestion constraints on Britain's railway network.

Route	Section		Time	
	from	*to*	*from*	*to*
West Coast Main Line	Brinklow (Rugby)	Attleborough (Nuneaton)	15:05	16:00
North London Line	Gospel Oak	Willesden Junction	06:20	09:19
			09:19	11:58
			11:58	14:13
			14:43	18:18
Castlefield Corridor	Manchester Piccadilly	Trafford Park	06:45	13:18
			13:18	20:17

Table 2. Examples of Network Unavailability due to Congestion
Note: assumes full passenger timetable, not those temporarily reduced during Covid
Correct at the time of preparation of this paper

Worse, not all the paths remaining after the table above will be usable if there are junction or other timetabling constraints elsewhere along the intended route. Remaining paths may also either be unattractive to customers (wrong time of day, excessive journey time) or to operators (asset-inefficient).

The alternative is to try to use secondary routes, but most of these have not been gauge-cleared. The result is a dilemma that either train paths are available (but cannot carry all the desired traffics) or necessitate significant deviations (e.g. Immingham – Manchester via the West Midlands) which are not cost-effective against road competition.

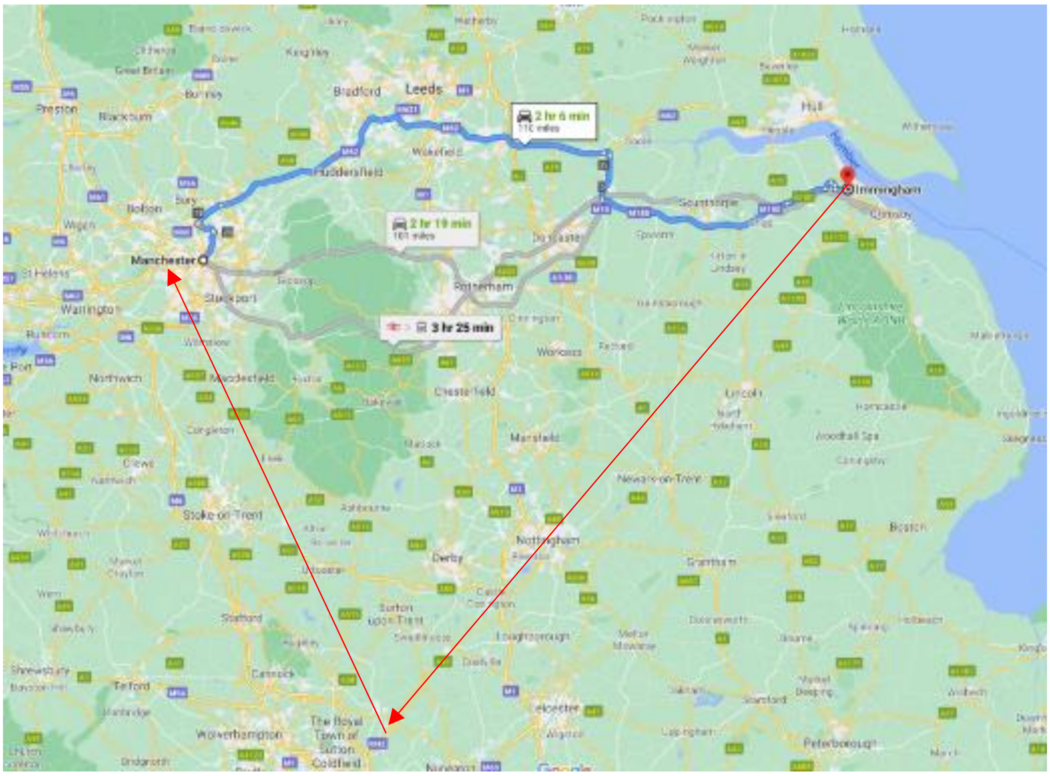

Figure 2. Immingham - Manchester Route for Largest Containers
(Source: Harris, N G (2021))

It can be argued that increases in longer-distance (and hence higher-speed) passenger services during the privatisation period (e.g. on the West Coast main line, in 2007) were a significant cause in the deterioration of freight paths. The capacity of a railway line falls with the increasing divergence in speeds between fast and slow trains, and increases in service frequency (see Figure 3).

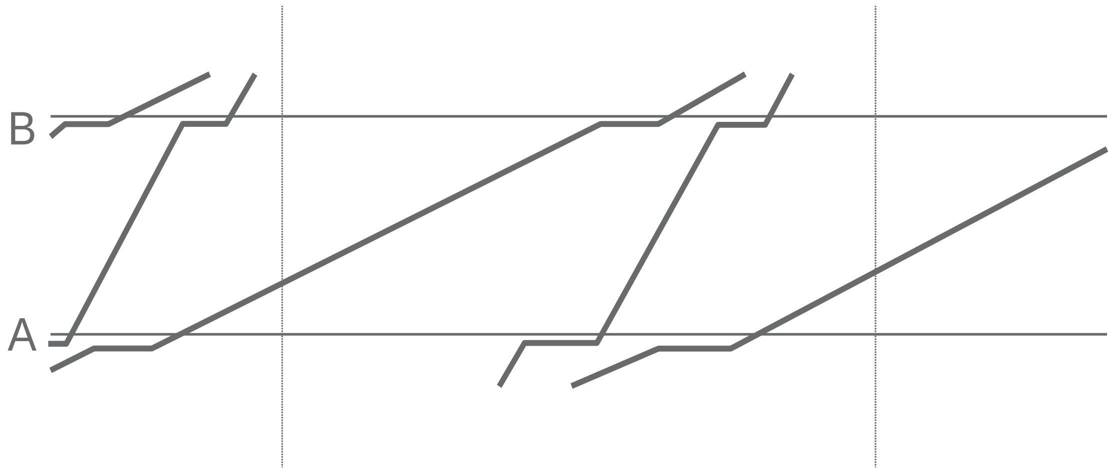

Figure 3. Impact of Differential Speeds on Railway Line Capacity
(source: Harris et al, 2016, Figure 3.25)

Various industry stakeholders are attempting to resolve this dilemma. Network Rail's long-term route planning has generally striven to provide 'paths for freight growth', but it is not always possible to double-guess the appropriate origins, destinations and times of day when such slots might be of greatest value. The Great British Railways transition team have hinted that they will try better to balance the needs of future freight and passenger services. ROG is developing container wagons capable of running at 95mph, trains of which would therefore not need to be overtaken by passenger services.

No appropriate terminals: Network Rail quotes only around 65 inter-modal terminals on the British network, although there are about 10 times as many sets of sidings, some of which could surely already be used as/could be developed for intermodal traffic. Some of the 65 are clustered (e.g. on Thames-side), leaving much of the network not near an established intermodal terminal. However, setting up a new terminal is only likely to add value to the overall rail offer if it is somewhere new, but that typically involves being on a secondary route, which is unlikely to have been gauge-cleared, thereby making the investment in that terminal difficult. The overhead costs of a new intermodal terminal also indicate that it is not commercially-viable at fewer than 4 trains per day, traffic volumes which may not be available at more-distant locations.

More subtly, some terminals are not long enough to handle the desired trains (without expensive and time-consuming shunting), whilst others may have restrictive covenants limiting the number of daily trains, or the inability to operate at night. Moreover, observation shows that (compared to the best) many existing terminals are inefficiently-operated, taking many hours to service a train: greater urgency is needed, to reflect the cost impact of poor utilisation of the expensive asset: the train. Using more reach-stackers or developing automated despatch procedures could help here.

Safety processes: Railways can rightly celebrate their excellent safety record. However, it does bring its disadvantages. For instance, train drivers are required to know the details of the routes on which they drive, limiting the potential for diversion during disruption. Similarly, loading gauge constraints can limit the transit of larger containers to key routes, whilst paperwork (e.g. the GT3257 form) requires formal agreement from Network Rail that wagons which should theoretically be able to run on a route have actually been given permission to do so. A lack of standardisation (e.g. in container sizes) means that these processes need to be duplicated, increasing cost. Without that standardisation, a lack of flexibility can limit the ability of the railway to achieve the delivery performance levels desired by shippers.

No wagons: Because of recent growth in the market by FOCs making low profit margins, all existing container flat wagons are in use, and no-one has had the confidence and capital to invest in new ones. In particular, there is a shortage of wagon types able to carry the largest containers: this can either be in well wagons (where the bigger boxes are suspended between the bogies, but with a loss of useful train length) or in wagons with smaller wheels (where the floor can be lower). Even here, few railway wagons can accommodate the pallet-wide containers common in domestic and European traffic, so the FA team have created a design which will do this (see Figure 4).

Unfortunately, it is still not possible to carry the highest widest longest box on the smallest loading gauge in use (designated W6), but various new combinations would be enabled if these wagons could be introduced. But that leads to a further problem:

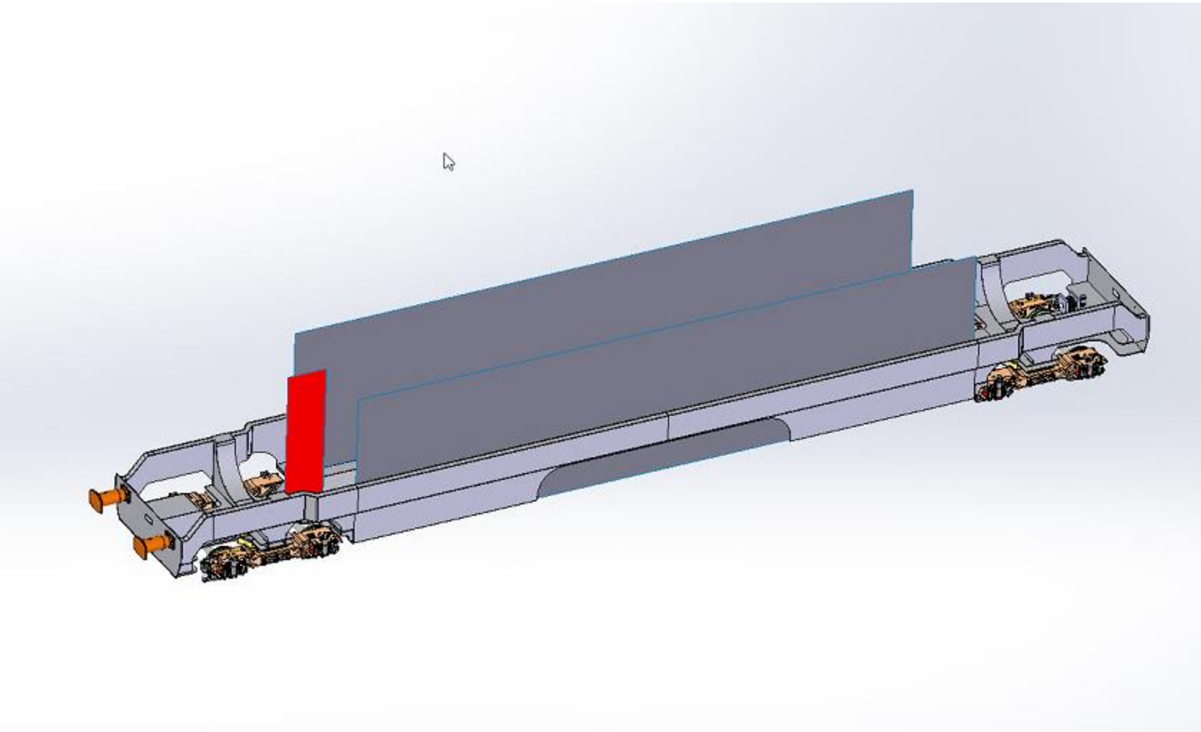

Figure 4. W wagon Concept Design
(source: TruckTrain Industries)

Wagon leasing: Railway wagons have a relatively-long life of at least 30 years, and are typically paid for in about 15 years, in contrast to the fact that many road hauliers would depreciate trucks over a 6-year period. Where 10-year deals can be struck (e.g. for port traffic from Southampton and Felixstowe, with the biggest shippers, or in more conventional market segments such as building materials, and/or where a shipper is prepared to make a significant investment themselves), investment in rail wagons is therefore possible: investors are prepared to take the risk on the low remaining residual value. However, the logistics market is perhaps faster-moving, and simply does not sign up for such periods: 1-3 years would be more normal. Whilst investment in a truck with a life of 6 years may be possible against a 3-year contract, this simply does not work for a railway wagon: a 3-year contract does not offer sufficient surety to conventional investors if the pay-back period is at least 10 years longer.

Synthesis

Most of the issues raised in the preceding section are not necessarily ‘show-stoppers’ in themselves; instead, they merely limit options. Consideration of them, however, gives some guidance as to where railfreight providers need to be in the market, in order to find that ‘sweet spot’ where their offer is unbeatable. It may be understood to be a form of multi-dimensional trade-off, as shown in Figure 5. Distance and train length, two key elements of the traditional orthodoxy, are insufficient unless both trains and terminals can be worked efficiently.

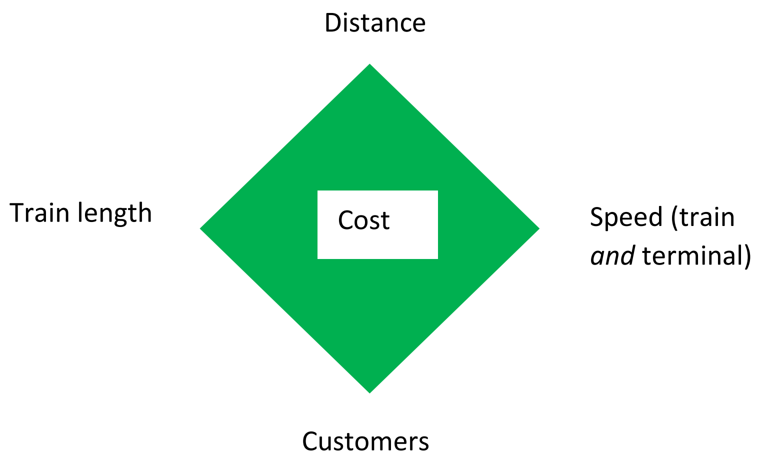

Figure 5. Key Trade-offs for Successful Rail freight

The practicalities of actually assembling a cost-effective trainplan are therefore significant. However, current pressures on the road haulage industry (notably driver shortages, fuel prices, road congestion and environmental concerns) are encouraging many to seek rail freight opportunities. The good news is that there are those around who understand the real underlying issues, and not just the policy direction upon which many agree. This enables the industry to push through some of the constraints routinely accepted by conventional railway thinking, and to find the ‘sweet spots’ that theoretically exist (see Figure 6).

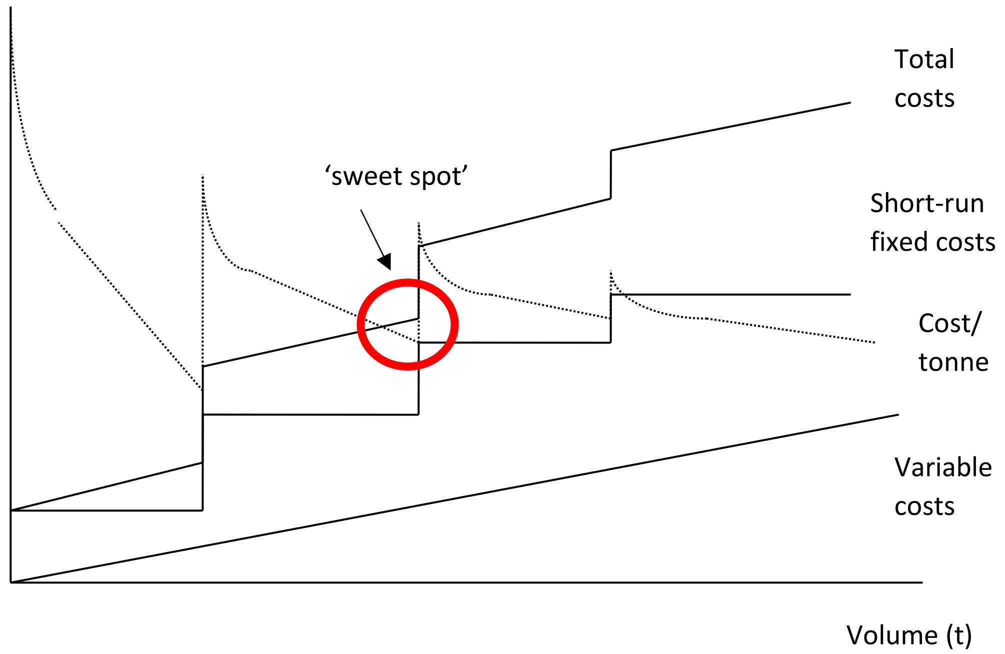

Figure 6. Potential Solutions to Railfreight Problems
(source: Harris & Schmid, 2003, Figure 17.2)

Conclusions

A range of informational, organisational and management issues are at least as important in determining potential future rail freight flows as conventional wisdom (based on volume and distance criteria) would suggest. Rather than just focusing on train paths, a systems engineering approach is needed, to reflect the multiple constraints on the system: better wagons or improving terminal and/or trucking operations can be as important as finding a better train path. Without the existing practices and constraints being overcome through innovation, however, policies to achieve mode transfer to rail will struggle to achieve their objectives.

References

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