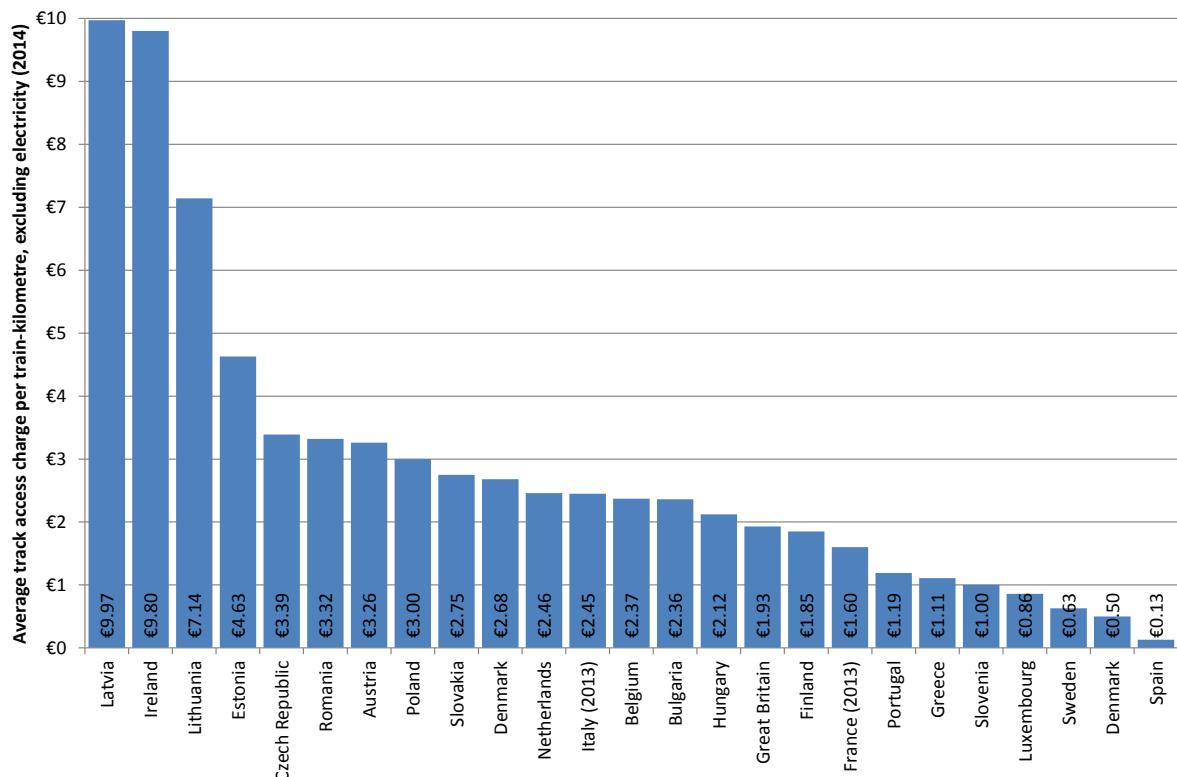




The Transport Economist

The Journal of the Transport Economists' Group



Editor Peter Gordon

Volume 41 Number 3
Autumn 2014

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Developing LUTI models to incorporate the effect of transport on jobs

David Simmonds

Arup

25 June 2014

Introduction

David Simmonds gave an overview of Land Use Transport Interaction (LUTI) models in relation to predicting the effect of transport schemes on jobs and Gross Value Added (GVA).

David opened with an overview of LUTI modelling and a brief history of the last 50 years of model development. LUTI modelling is a spatial tool, one purpose of which is forecasting changes in the locations of jobs and households following the introduction of a transport scheme. Base year land use and future transport networks are inputs; population and jobs are the main outputs. He described the core components of a typical LUTI model which include population growth, migration, economic growth, transport models and land use assumptions. He stressed the importance of the linkages required between transport models and land use models.

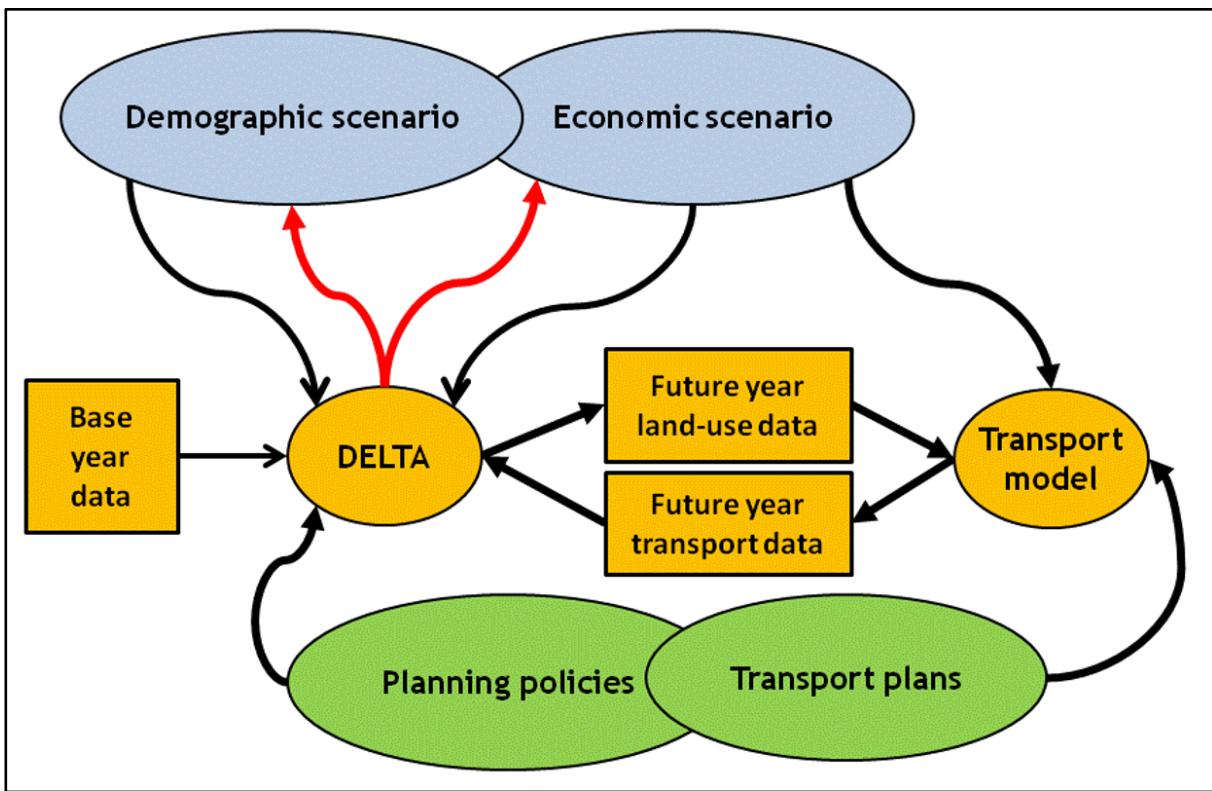
He presented an interesting overview of how various markets interact in land use and transport planning. He went on to describe how transport can affect product markets and labour markets, an example of which was the trend to build office blocks above London Underground stations.

Some LUTI models are static and some are dynamic. The "DELTA" LUTI modelling package developed by David Simmonds Consultancy is dynamic. One year's output becomes the following year's input.

David talked through a flow chart illustrating how land use and transport models interact and how their outputs and inputs are used. Feedback is common, and varies as a result of policies and planning. He then showed a chart of the numerous linkages between the various components of transport models and land use models, which highlighted how strongly transport and land

use interact: everything affects everything else, although to varying degrees and with varying lags.

Figure 1: Illustrative structure of a LUTI modelling suite



He then spoke about different economic scenarios in LUTI and how changes over time are modelled, beginning with simple assumptions such as “everyone gets one year older every year” and then adding complexity.

David spoke about how LUTI modelling is undertaken in practice for clients. Often the client will have both an official scenario, which consists of committed schemes and policies, and an “aspirational” scenario, which includes schemes and policies that are assumed will be committed in the future. Specific policies or transport schemes will then be tested against these scenarios.

The model scope is often greater than the client’s policy area of interest: this requires local calibration of the model and care in drawing conclusions about how far the impacts of the scheme go (local versus national). In practice, clients are often interested in the change in distribution of jobs and population rather than the absolute number, to gain a sense of the general pattern, rather than to be tied to specific numbers.

David spoke about variable employment scenarios and accessibility to market places: more jobs in an area will draw more people. It is often a requirement that the LUTI model be TEMPRO-compliant. It is assumed that TEMPRO has no changing conditions and is therefore a baseline number from which projections can be pivoted. A variable employment sub-model, for example, would show that education employment should increase if the number of children in an area increases.

David talked about charts showing an example of LUTI model outputs. In the example, floor space is added to a particular geographic area and as a result, people are drawn towards the area. However, in the longer term congestion increases and accessibility falls. This is an example of a feedback loop, where physical development can lead to increased congestion which has a negative effect in the longer term.

After employment has been modelled, extracting GVA results is a simple post-processing process.

David described his recent work on the DfT's agglomeration impacts, which up to now have been treated as a post-model appraisal process, but which could be included within a LUTI model. Current work is focused on modelling two effects of improvements in "access to economic mass":

- The concentration of higher-skilled workers in major economic centres (which is probably a sorting effect, increasing value added per worker in those centres at the expense of other areas)
- The general agglomeration effect, whereby value-added per worker increases (slightly) for all the workers in certain sectors

Larger centres often result in the production of more specialised goods and services, typically sold to national and international markets rather than locally, and the model must consider this.

The final part of the talk covered the appraisal process and LUTI, and whether we should move from transport cost benefit analysis to LUTI cost benefit analysis. David highlighted some of the limitations of transport appraisal, including that the attracting trips are fixed. He made a particular note of the time saving benefit that is attributed to "new users". He talked

through an example of the output of the LUTI model for one zone which showed disutility in pounds per household per week.

He concluded by proposing LUTEE as an additional analysis alongside TEE, rather than as a replacement for TEE.

Discussion

David Spurling asked whether LUTI was able to model changes in land value or they are observable market value. **David** responded that the modelling used floor space rents, and that getting to land value would be another step. He noted that changes in land value would help, but that they already include the change in property value, so land value excluding property value would not add anything.

Robin Morphet (UCL) made a number of points and asked questions about competition. DfT assumes that agglomeration benefits exist and arise through imperfect competition. He noted that it is incorrect to assume pure competition as it doesn't exist. **David** responded that DfT begin from a position of assuming pure competition outside the transport market, and then consider why this may not be realistic. Conventional cost benefit analysis is not concerned with the spatial distribution of economic activity. **Robin** also said that logsum analysis needs to apply in pure competition, not just in transport costs. **David** replied that the accessibility term already used a logsum calculation and that the social and spatial distribution of benefits is being examined. **Robin** noted that accessibility, land use and transport cost should all be included in the same logsum. **David** said that the calculation he illustrated in the talk works from the point of view of the consumer: from the point of view of the property owner it is different. An increase in rent would be a benefit to a landowner. **Robin** referred to a "welfare as rent" paper and **David** noted that they were trying to account for distribution issues: spatial and distributional effects need to be accounted for.

Dick Dunmore (Steer Davies Gleave) made the point that it was young professionals at Canary Wharf that benefited from the Jubilee line upgrade. When they moved in, both rent and the price of coffee went up.

John Segal (Consultant) asked about the increase in price being a transfer payment, using an example of a 20% increase in property benefit. **David** agreed, and noted how being in a position to sell was a benefit to the landowner at the point in time when the value of property goes up. He noted how they were trying to consider the distribution in space over time and by group of people.

Peter Gordon (Editor, the Transport Economist) asked if the agglomeration benefits of a "City of North East", recently mentioned in the press could be modelled. **David** said yes, and that investment had to be made in setting up the model, but that this was modest when compared with conventional transport modelling. In transport modelling you may have a £2 million budget, but 75% of this might be spent on roadside interviews. In contrast, land-use modelling relies much more on data which is already collected for other purposes. **Peter** asked a follow-up question on the source of the data. **David** said that the base data should be for a census year and that data or other results for use in calibration come from a variety of sources, including the latest economic research. He gave an example using migration research within the LUTI model.

David Spurling asked a topical question around how LUTI can account for changes in work practices, such as people working from home some days each week. **David** said that this had not been investigated so far, but that research was starting. This was often accounted for by adjusting trip rates, but it is not just trip rates that change, as people may be prepared to travel further if they are travelling less frequently, which will in turn affect locations and rent. He thought that this could best be modelled by defining two or more scenarios and testing these within LUTI. Some work along these lines has since been done for Transport Scotland.

Dick Dunmore noted DfT's interest in a season ticket product for part-time commuters.

Rob Burrows asked about environmental impacts, which included a number of areas including exogenous factors, development consent and biodiversity, implicit output of greenhouse gas emissions, feedback and congestion. He asked how these could all be incorporated within the modelling.

David said that the environment is considered in the transport modelling, and the local environmental impact of traffic is often modelled as an impact on residential location in the LUTI model. David made a general point about the size of models and what they can do, and referred to a billion-zone model that examined the environmental effects of development.

David Metz (UCL) noted the deficiencies of TEE and asked when the speaker would publish his views in a way that makes an impact? He then asked if he would write up the principles for a peer-reviewed journal and disseminate his research. **David** noted he had presented a paper on LUTEE to the European Transport Conference in 2012 (see references at end of this report); other papers related to tonight's talk are readily accessible, with another one on work in Sheffield to be presented in October 2014. He agreed that this area of work has not yet appeared in the peer-reviewed literature.

Dick Dunmore asked whether we are constrained by what government wants to hear. **David** responded that there is a potential issue, but also a matter of self-selection among clients for LUTI work: they are likely to be more open to an impartial analysis. He also noted that, while clients may expect positive numbers, they still want analysis within a rigorous framework.

John Segal asked two questions: had David examples of when LUTI has predicted anything accurately? Are there any overseas examples to learn from, or is the UK leading the field?

David noted that there was not as much assessment "after the event" as might be wished, but land-use effects take time to develop, making it difficult to disentangle what is attributable to the "event" in question, and it is also often challenging to make a comparison, as external factors can change from when the modelling was done. He noted a recent study of the M74 completion, where an independent assessment of the scheme's impacts may shed some light on the success or failure of the forecasting of those impacts.

For overseas experience, **David** said that the UK was one of the leaders; he noted a number of countries that were doing good work in this field including, in Germany, Professor Michael Wegener and colleagues, formerly at the University of Dortmund, who have influenced what is done in Europe and

North America, in particular with regard to the dynamics of change and to environmental feedback. He also mentioned the Netherlands, and their focus on economic effect, some work in France, and various models in Italy, Sweden and Belgium.

Report by Margot Finlay

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Getting the most out of the existing rail network

Chris Stokes, First Class Partnerships

Arup

24 September 2014

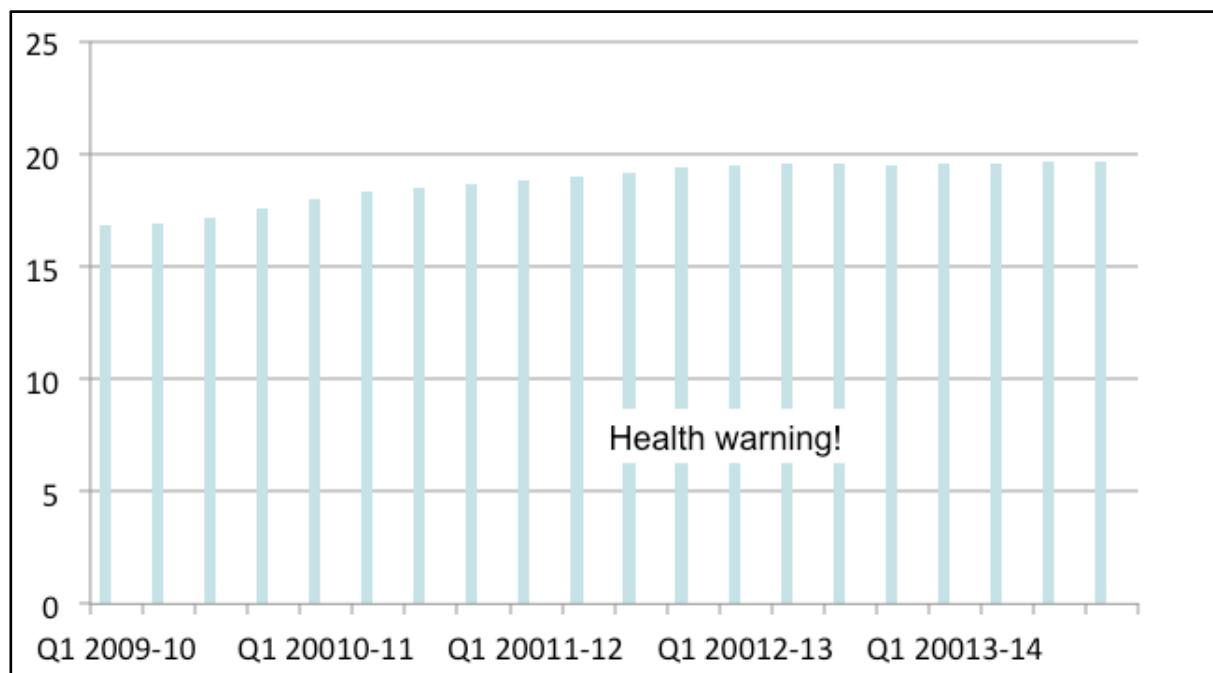
Introduction

Chris began by summarising rail's role in interurban travel:

- It is still a minor mode in a market dominated by road
- It is not competitive for many journeys, such as his own regular travel between Leighton Buzzard and Belper
- It is, however, important in some passenger and freight market segments, and could do more
- It remains politically important, with significant rail closures now unthinkable

Interurban travel

Figure 1: Long distance operator passenger-kilometres



Source: ORR "passenger-kilometres by sector", moving annual average

Passenger-kilometres on long distance operators continued to grow through and after the 2008 recession, but now appear to

have reached a plateau. It is not clear either why this is or how it fits with reports of 4.5% growth in passenger-miles on Virgin West Coast and of 4.5% growth in passenger-journeys on East Coast.

Chris was concerned that the standard forecasting tool, the Passenger Demand Forecasting Handbook (PDFH), was not well-calibrated to situations where rail has a high mode share. Rail is now the dominant mode for middle- and long-distance travel to central London: any growth must come from market growth, rather than from further gains in mode share.

Equally, the case for investment in additional long-distance capacity cannot be driven by mode shift, where average speeds, such as 102 mph between London and York, or 105 mph between London and Warrington, already beat road. The case for HS2 is not proven:

- West Coast Main Line services have low load factors, despite growth after completing the upgrade in 2008 with the introduction of 200 kilometre/hour operation and the VHF timetable of 3 trains per hour to Birmingham and Manchester
- Peak load factors are only 55%, partly because of the fares structure
- Volume growth has plateaued, at least in Figure 1
- Additional capacity can in any case be provided by converting some First Class to Standard and/or train lengthening

Rail is also important, but not dominant, for other city-to-city flows. An average rail speed of 84 mph from Newcastle to Edinburgh is faster than road, and even 53 mph from Manchester to Sheffield is attractive compared with trans-Pennine roads. In contrast to unattractive driving conditions, rail typically offers two trains per hour between well-sited city centre stations.

On flows such as Liverpool to Manchester and Leeds to Sheffield, however, rail is not “punching its weight”, partly because good motorway alternatives make it uncompetitive on journey time.

Figure 2: Current proposals for HS2



On Birmingham to Manchester, rail appears to carry relatively few passengers, although it is not clear why:

- The M6 is congested, stressful and unreliable

- Rail averages a reasonable 50-56 mph centre-to-centre

There may be little affinity between the two cities, and hence only a small market for travel between them. HS2's proposed two trains per hour between Birmingham and Manchester once Phase 2 is complete had a forecast load factor of 20%, whereas Manchester to Sheffield trains are full now.

Chris contrasted rail's services on Edinburgh-Glasgow and Liverpool-Manchester routes:

- Edinburgh-Glasgow has four routes, and with four trains per hour, averaging 57 mph, on the principal Queen Street route, rail is the mode of choice between the city centres
- Liverpool-Manchester has four trains per hour, averaging 35-57 mph, split between two routes, not at "clock face" times, and barely faster and more frequent than in 1910

With Liverpool-Manchester electrification there was, Chris felt, potential to duplicate the effectiveness of the Edinburgh-Glasgow service and to increase rail's mode share dramatically.

Chris concluded that HS2 is a London-centric project which incorrectly targets markets where rail already has a high mode share, and no longer serves either Heathrow or the Channel Tunnel.

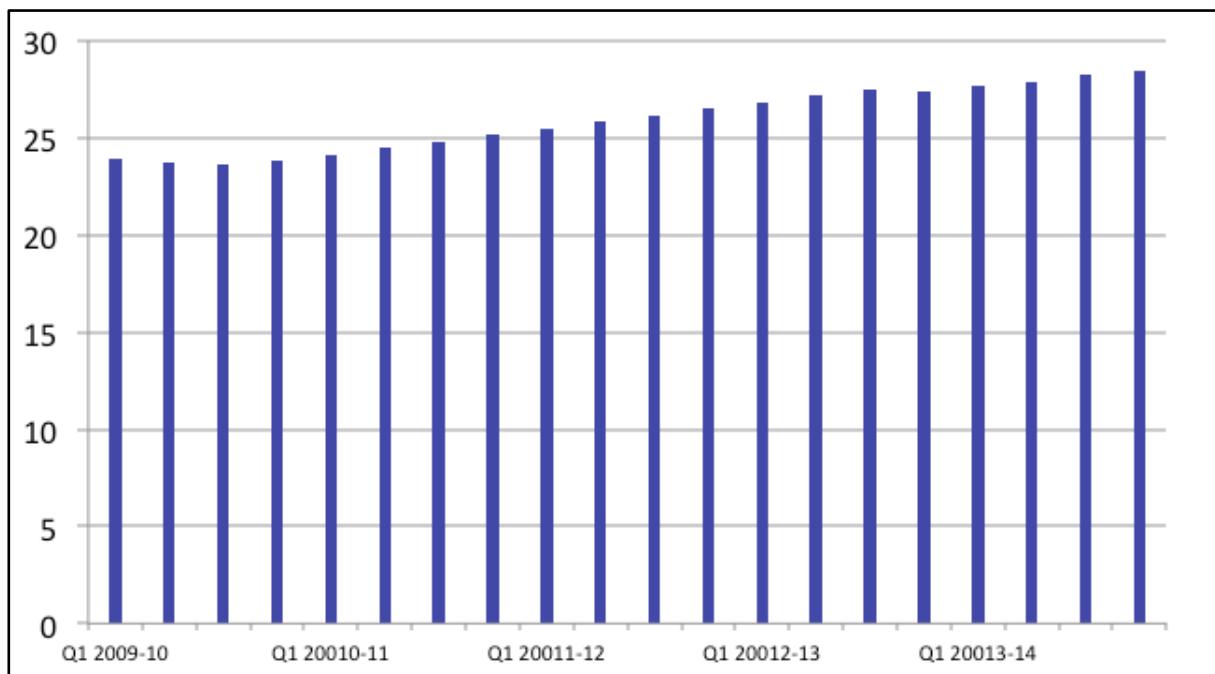
This suggested a possible approach to the interurban market, at lower cost and with less borrowing:

- Focus a higher proportion of investment on non-London flows
- Provide faster journey times, if needed through targeted infrastructure investment
- Improve frequencies, ideally up to 4 trains per hour
- Increase train capacity
- Improve rolling stock quality

London and the southeast

Chris noted that recent changes to Travelcard allocations had apparently inflated the growth reported by ORR in Figure 3.

Figure 3: London and southeast operator passenger-kilometres



Source: ORR "passenger-kilometres by sector", moving annual average

Nonetheless, the rail network had been a great success:

- It is part of a high quality, well-integrated transport network (and had helped deliver the best Olympic transport system ever)
- It is crucial to the economy of the capital and the region, and major centres of employment growth such as Docklands and Kings Cross
- It has seen fast development of orbital routes (the Overground) and interchanges such as Clapham Junction (half of the users of which are changing trains) and Stratford
- It has supported fast growth in commuting against the peak to East Croydon, Reading and Milton Keynes
- It enables an increasing proportion of young adults to live without a car or, increasingly, without a driving licence

Focusing on the relationship between rail and development, Chris noted that Canary Wharf had begun with the DLR but had since required the Jubilee Line Extension (JLE) and now Crossrail to support its continued development. HS1 has catalysed development at Stratford and Kings Cross, even though it can now be seen that the line only carries a small

proportion of passengers into each area: only domestic trains call at "Stratford International", with an average of only 16 boarding or alighting at each stop. Crossrail could perform a similar role at Old Oak Common and Park Royal.

It was not yet clear, however, whether we can effectively forecast and appraise the effects of such schemes.

The JLE had an original BCR of around 1.1, so it was "not a good scheme", but it would be perverse to argue that it should not have been built, as it was clearly vital to the development of Docklands. Its capacity has already been significantly increased, and peak hours trains are crush loaded. HS1, in contrast, completed in 2007, has not (yet) driven major development at Ebbsfleet, Ashford or in East Kent.

How do we pick winners and evaluate projects, and how do we model the impact of transport projects on development?

Nonetheless, there is already a serious capacity challenge on many key commuter routes. Major schemes under way – Thameslink, Great Western electrification and Crossrail, and lengthening Waterloo inner suburban services – would help, but projected demand growth would require further schemes.

Chris suggested that solutions need to be "smarter" than merely adding capacity where the problem is.

One example would make use of spare capacity on Crossrail west of Paddington, diverting most Euston commuter services into Crossrail, which would:

- Provide faster direct access to the West End, City and Canary Wharf
- Relieve the Victoria and Northern Lines

It could also reduce the massive disruption to the West Coast Main Line over 7-8 years while Euston is rebuilt for HS2: it appears that HS2 Ltd are now proposing to sequence the project to provide such relief.

Another example would be to construct a fast link between Woking and Heathrow Terminal 5, rather than the "tortuous" Airtrack proposal which would cause major traffic delays at three level crossings in Egham. Heathrow Hub has developed a route following the M25 from Chertsey to Heathrow, with a 16-

minute journey time to Woking, where Woking Junction would be grade-separated. This would provide a south western access to Heathrow from Guildford and/or Basingstoke routes and, with through running at Terminal 5, another route to central London relieving both main line and Underground at Waterloo.

Regional services

Figure 4: Regional operator passenger-kilometres



Source: ORR "passenger-kilometres by sector", moving annual average

The city regions present a mixed picture:

- Strong commuting growth related to, and supporting, the growth of city centre service industry employment, although rail share is still low
- Patchy service quality
- Poor financial performance, exacerbated by low yields, meaning that providing extra rolling stock is not commercially viable

The opportunity, and challenge, is for other cities to follow London's example.

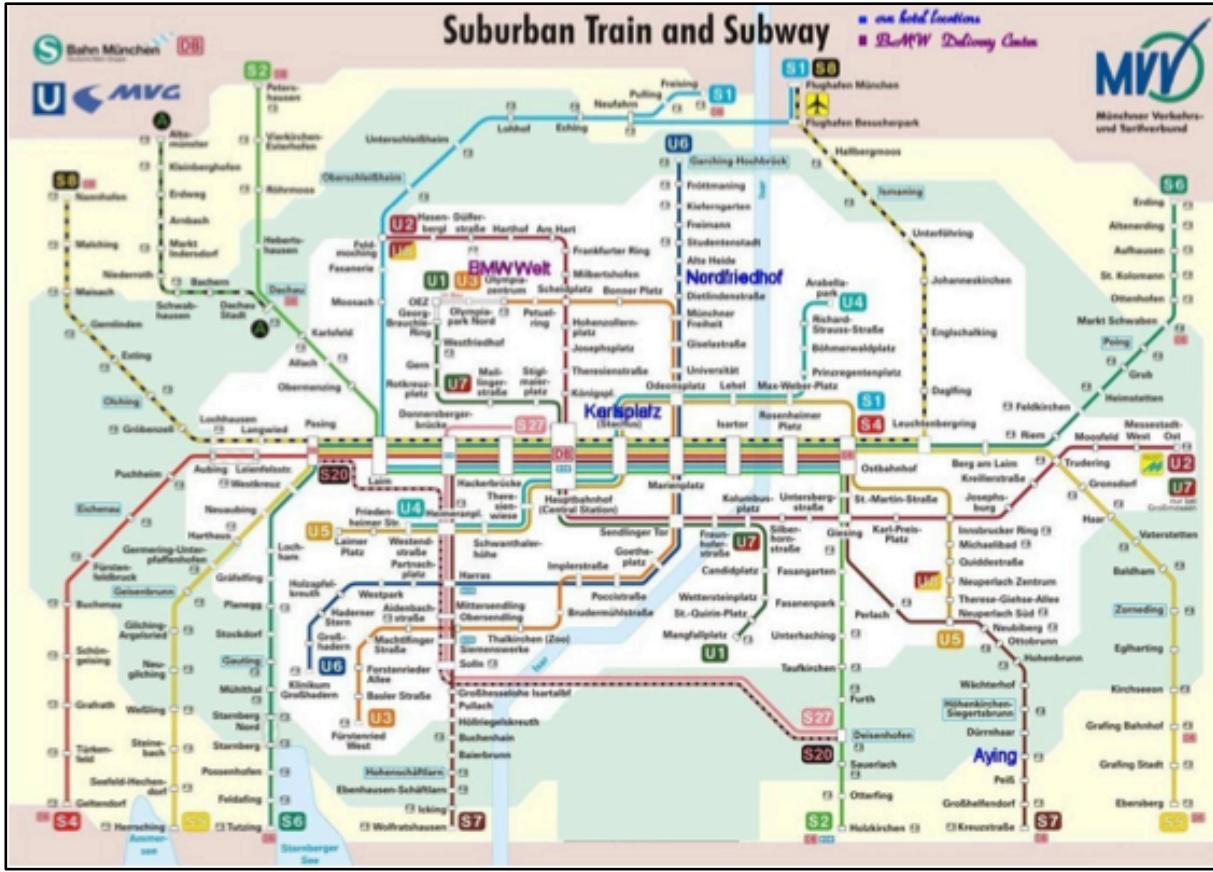
Merseyrail, for example, has frequent electric services and a clean, secure environment with "cared-for" stations, despite old trains operating through difficult areas.

Great Manchester, in contrast, has many unattractive stations and older diesel “Pacer” trains providing slow services on most routes. Rail is not the mode of choice, and is little-used off peak, but this could change.

West Yorkshire has fast, frequent services on the Skipton and Ilkley routes, but a poor quality of service on many others.

Chris suggested a possible way forward, prioritised the creation of high quality networks like those of the German conurbations.

Figure 5: S- and U-bahn network in München



This would mean:

- Devolution of specification and funding to the city regions, which will find it hard to invest with current funding levels.
 - Electrification and re-equipment to develop consistent, high-quality networks.
 - Targeted infrastructure investment to improve journey times and increase capacity. A candidate would be electrification and upgrade of Manchester to Leeds and Bradford, where the fastest trains average only 36 mph.

The need is to develop robust methodologies to make the case.

The rural railway

The rural railway has low mode share and very poor financial performance, but net costs are low in relation to the total cost of the network, and the experience of the Settle-Carlisle line suggests that closure is likely to be politically unthinkable. Closure was refused in 1989, eight stations have been reopened, and the service has now risen from two to seven trains per day each way. While the net cost has almost certainly risen, cost per passenger mile is almost certainly lower. In contrast, the Middlesbrough-Whitby line is operated by a single train, so the first arrival in Middlesbrough is at 10:17 and the last departure is at 17:40, too short for a full working day. Operation with two trains, one of them in Whitby overnight, could improve both financial and economic performance.

The rural railway is also perceived as important for economic and social inclusion. Services and financial performance could be improved by micro-franchising, but transaction issues have prevented this. Chris considered that these lines should be devolved to regional and local authorities.

Freight

Chris noted the changing patterns of freight demand:

- Coal for electricity generation moves longer distances, from ports rather than pits, but the sector is set to decline
- Intermodal traffic is growing rapidly, with not only import/export but also domestic flows
- Traditional markets such as aggregates, metals and petroleum are likely to be broadly flat

Chris suggested a policy of “benign support” (as distinct from “benign neglect”), with policy support for additional intermodal terminals such as Radlett, safeguarding sufficient train paths to allow for flexibility and growth, limited and targeted infrastructure investment, and holding access charges at the level of freight incremental costs.

Fares

Chris argued that the long distance fares structure is “broken”. Regulated off-peak fares create artificial peaks (such as at 19:00 from Euston) and inhibit rational yield management. While the business offer is increasingly unattractive, Advance fares are sometimes “ludicrously” cheap: train-specific fares increase generalised journey time, although by buying multiple tickets it is possible both to undercut the flexible product and to guarantee a seat. The root of the problem had been regulating the market-priced off-peak return (“Saver”) rather than the price-inelastic peak single fare.

The future

Chris was wary that the future might surprise us.

Eurostar volumes had been way below those forecast for HS1. As with intercity travel, Eurostar dominates the “intercapitals” markets, with 80% share, and is reliant on market growth for more demand, but is weak in others. Eurostar had been a completely new service and, in the 20 years from the 1987 commitment to build the Channel Tunnel to completion of HS1 in 2007, European air travel had gone from a luxury to a commodity.

Equally, and looking forward:

- The impact of IT on business travel remains unclear, but DfT’s evidence is that overall business travel has been declining in recent years, although rail’s share has grown
- Car-sharing apps may reduce the effective cost of car travel for price-sensitive travellers
- Driverless car technology may mean that in-car time becomes no less productive, or relaxing, than in-train time, but may equally provide a “final mile” service to complete rail’s end-to-end offer

As with Eurostar, any or all of these effects may play out before HS2 opens in 2026 and 2033.

Conclusions

Chris ended with some tentative conclusions for discussion:

- Concentrate on delivering faster journey times and better quality on key non-London interurban flows, where there is greatest opportunity for mode shift and greatest economic benefit for the regions
- Provide “smart” extra capacity in London and the southeast
- Develop better methodologies to establish robust, realistic links between rail investment and major developments
- Invest to deliver modern, high quality devolved networks in the City regions

Discussion

David Spurling wondered whether it would be possible to introduce the originally planned Eurostar service to Birmingham and Manchester. **Chris** replied that the problems included the strict approach taken by the Transport Security & Contingencies Directorate (TRANSEC). Trains from Aix-en-Provence to London spend 70 minutes at Lille Europe while passengers and baggage are subject to security and immigration checks and the train is searched. Similarly uncompetitive arrangements are anticipated for the proposed Amsterdam to London service and for any beyond-London services within Great Britain. Even Birmingham to Paris is a small market served by frequent but small Flybe services. Large Eurostars would be infrequent and attract only low volumes, with a forecast load factor of around 10%.

John Segal agreed with Chris’s observations on Eurostar. He wondered whether the apparent buoyancy of demand during the recession had been won by reducing yields, and whether the lack of subsequent growth reflected them being raised again. **Chris** agreed that this was a logical possibility, and noted that in the similar 1980 recession, before yield management, InterCity travel had fallen 20% within months.

John Cartledge pointed out that border checks had been carried out on Eurostar in the early days. He wondered what lessons Chris drew from the failure of the proposed Watford to St Albans tram-train project. **Chris** suggested that high Network Rail costs might have made the project unaffordable.

John suggested that a further issue was failure to reach agreement on sharing through ticket revenue.

David Metz (UCL) noted that the government intended to invest heavily in interurban road, and wondered which mode would be the better investment at the margin. Perhaps more should be spent on rail? **Chris** noted that rail would lose Manchester-Sheffield share if there was a good road, but that major road schemes are now "problematic". Nonetheless, it was possible that rail was receiving a disproportionate share of capital expenditure.

David Starkie (Case Associates) raised the issue of "smart" capacity and the suggestion of double-decker stock on South Western: two double-decker sets had operated on the route to Gravesend between 1949 and 1971 but proved unsuccessful. He had in the past suggested a 20% discounted "economy" class, with standing room only – only a small proportion of passengers would have to accept this to reduce crowding elsewhere – but Chris had not been keen, although there were some reports that the idea was liked in the regions. **Chris** was still pessimistic: it was not a bad idea, but the government dared not try it, having repeatedly withdrawn from a real 1% increase in regulated rail fares.

Dick Dunmore (Steer Davies Gleave) pointed out that "mainly standing" had been introduced on the London Overground, with no fares reduction, but this had been part of a package of new trains, higher frequency, refurbished and manned stations and Underground ticketing and fares. **Chris** also noted that most journeys on the Overground are short: **John Segal** thought that 10-15 minutes was typical.

Stephen Bennett noted that his town, Haslemere, was "choked" with cars dropping passengers at the station, but that there was never enough time in the franchise cycle to justify capital expenditure on car parking. Parking costs £1,000 a year, with a 7-year wait, and this was now seen as the biggest single issue in consultation on the local plan. How much worse would things be in 20 years? **Chris** noted that Toronto built free weather-proof multi-storey commuter car parks. He was not sure what demand the next 20 years would bring, but it was equally unclear what could be done to increase capacity.

Nonetheless, rising Central London Employment (CLE) and limited new housing in London implied more commuting.

Alan Peakall noted that there were triple-decker car parks at Warwick Parkway and wondered whether Haslemere was "too pretty for planning permission". He agreed that there was no "relationship" between Birmingham and Manchester, but wondered if the Ordsall Chord might change things.

David Starkie was concerned about the cost of Stratford International, never used for international services. **Dick Dunmore** stated that demand modelling in 1991 had concluded that a Stratford stop would reduce revenue, but politicians believed that an international line through east London would lead to regeneration. Stratford International now attracts only 4% of the passengers using Stratford Regional. **John Segal** agreed that, in contrast to Stratford International, Stratford Regional was "buzzing". **Chris** noted that disproportionate money had also been spent on provision for freight on HS1.

Dick Dunmore wondered what lessons could be drawn for Willesden Junction, an existing interchange which had the potential to become a major local hub but seemed to be ignored in favour of a new station 800 metres away on a proposed high speed line. **Chris** admitted that, as a commuter from Leighton Buzzard, he did not want to stop at Willesden Junction, but conceded that it might be better to do so.

Tom Worsley (ITS, Leeds) noted that Chris had made no mention of Network Rail's Regulatory Asset Base ("the RAB"). What was to be done about Network Rail's debt? **Chris** said that his investment proposals would not be commercial, but would cost a lot less than HS2, and **Tom** noted that the Jubilee Line Extension (JLE) had had a low BCR but generated many other benefits. **Chris** felt that Liverpool, Manchester and Leeds could all do better things with the money required for HS2, but that it would be better if capital expenditure was clearly identified as such, in the year of spend, rather than converted into a long stream of payment on credit.

Report by Dick Dunmore

Creating rail open access across continents

Dick Dunmore, Steer Davies Gleave

Arup

26 November 2014

Introduction

Dick's presentation drew on recent work by Steer Davies Gleave and Network Rail in Brazil, where "vertical concessions" had once seemed to be the way forward. However, while there was much debate on "integrated" and "separated" national models across Europe, this did not address the issue of how to connect different networks.

Europe had effectively begun with one railway per state and Australia had started in the colonial era as one railway per state or port. Brazil also approximated to one railway per port.

Horizontal separation in Europe

The earliest railways in the largest European states were between Stockton and Darlington in 1825, Saint-Étienne and Andrézieux in 1832, Nürnberg and Furth in 1835, Napoli and Portici in 1839 and Barcelona and Mataró in 1848. These were all domestic lines, serving existing settlements including ports but sometimes extending inland. There were various gauges, the most common being standard gauge but with railways, particularly on the periphery of Europe, going their own way.

In 1991, the European Union (EU) intervened to set a high level framework, arguably a unique precedent which included the oldest and most established railways in the world. The EU is attempting to create a single market across difference cultures, languages and operating and technical standards and is proceeding more by imposing a market than relying on mutual agreement.

A fundamental proposition of the single market was that any operator could enter any European market. There was also a perception that infrastructure capacity was not used well,

resulting in policies including open access to use spare capacity, competition in the market where possible, and competition for the market where competition in the market is not possible.

This was supported by increasing regulation and separation to prevent abuse of incumbency, together with a wide range of institutional, procedural and technical harmonisation.

- In 1991 Directive 91/440 mandated accounting separation
- In 2001 the First Package added licensing, capacity allocation and charging
- In 2004 the Second Package opened all freight markets from 1 January 2007
- In 2007 the Third Package opened international passenger markets from 1 January 2010
- In 2012 the Fourth Package proposed opening of domestic passenger markets from 2019, but this is delayed and may not happen until 2122, if at all

An important part of this was track access charges, the basis of which each infrastructure manager must now set out in an annual Network Statement. First Package Directive 2001/14 requires cost-based tariffs based on marginal costs ("directly incurred", including dispatching and inspection), but allows mark-ups to recover at least some fixed costs, provided that there is no discrimination between operators competing for the same traffic and no exclusion of "market segments" that could afford marginal cost.

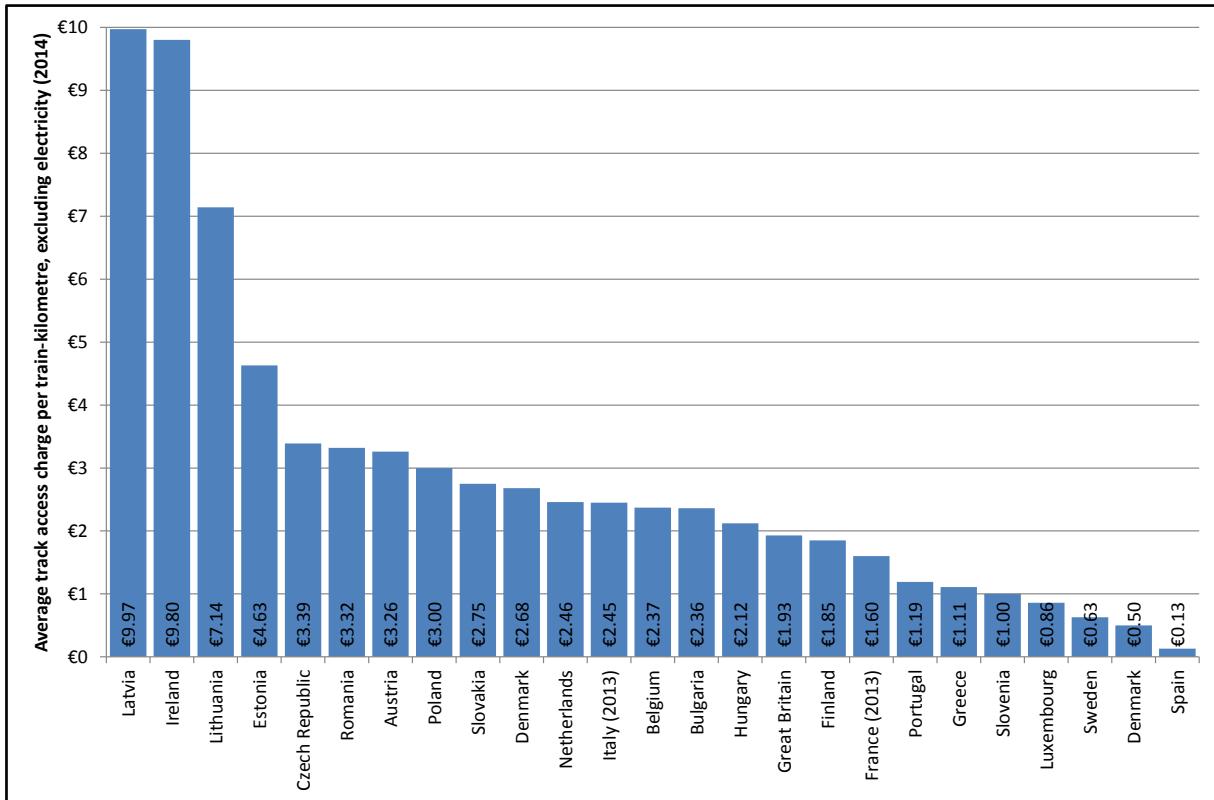
In practice a wide range of structures and levels of tariffs has emerged, as shown in Figure 1 below based on the European Commission's Rail Market Monitoring Scheme (RMMS). Among the highest track access charges are those in small transit states, where infrastructure managers controlling access to ports have market power over transit traffic.

Marginal costs have proved difficult to estimate in many networks and, however estimated, they rarely cover more than a third of total costs.

The wording of the restrictions on mark-ups is also potentially problematic: "market segments" such as open access and freight have at least some price-elasticity, so any mark-up may

exclude traffic which could afford marginal costs. Mark-ups have also proved difficult to devise, as infrastructure managers have little information on customer markets or price-elasticity to tariffs, although there have been a few studies in Sweden and in the UK, where ORR researched the impacts of coal spillage and freight specific charges.

Figure 1: European track access charges per train-kilometre



Most charges are expressed as a levy per train-kilometre and/or gross tonne-kilometre. In addition to mark-ups, First Package Directive 2001/14 also allows charges to be above marginal cost if there is a shortage of capacity, or "scarcity charging". Some infrastructure managers have introduced reservation charges which are paid even if a train is not run, charges varying by line and time of day and scarcity charges at "bottlenecks". However, these are acknowledged to be too low to manage demand effectively.

Tariffs also cover services such as electric power and diesel fuel, freight terminals, marshalling yards, train formation facilities, storage sidings, maintenance, and the heating of trains in winter.

For example, until 2007, a London-Brussels Eurostar train used five sets of infrastructure.

Table 1: Infrastructure charges faced by Eurostar until 2007

	Tariff approval by	Charging basis (highly simplified)	
Network Rail (GB)	ORR (GB)	Per vehicle, based on engineering models of long run marginal cost	
HS1 (Concession)	ORR (GB)	Per path, based on non-stop speed ... even if stops are included	
Eurotunnel (Concession)	IGC To be ORR+ARAF	Per passenger (over 50 km)	Per train (over 50 km)
RFF (France)	ARAF (France)	Per train-km (Circulation fee)	Per km (Reservation fee)
Infrabel (Belgium)	Infrabel (Belgium)	Per tonne-km, modified by priority, time, route section and deviation from standard path	

A passenger operator can plan ahead, but a freight operator may have a customer on the phone asking for a price, and needs to be in a position to reply rapidly. Over half of European rail freight crosses international boundaries, where inconsistent regimes send inconsistent incentives on (for example) train length and frequency.

Different European networks comply in different ways. Sweden's Government was committed to commercialisation and open markets, and separated infrastructure and operations in 1988, with charges based on marginal cost and a (small) annual fee per vehicle. There is now also a small congestion charges in three major cities. It was twenty years before material passenger open access emerged.

Germany has many small local lines. States (Länder) control passenger transport, but the vertically-integrated Deutsche Bahn dominates freight. The Government is unwilling to break up DB to make competition effective. Tariffs are set by its subsidiary DB Netz, with mark-up by traffic type and route. Regulation is weak and sometimes through challenge in the courts, which takes time. Independent operations on the main network are limited, as DB still dominates freight and passenger services.

Figure 2: Freight tonnage lifted in Europe (source Eurostat)

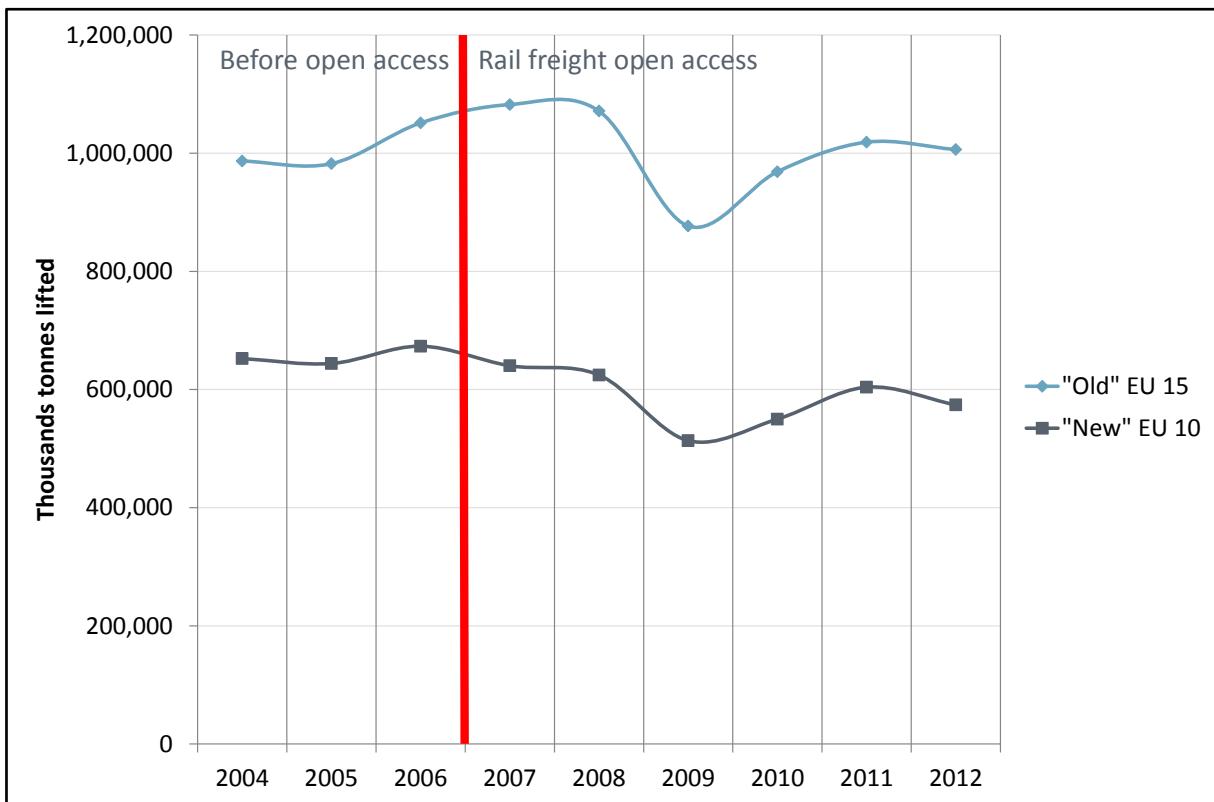
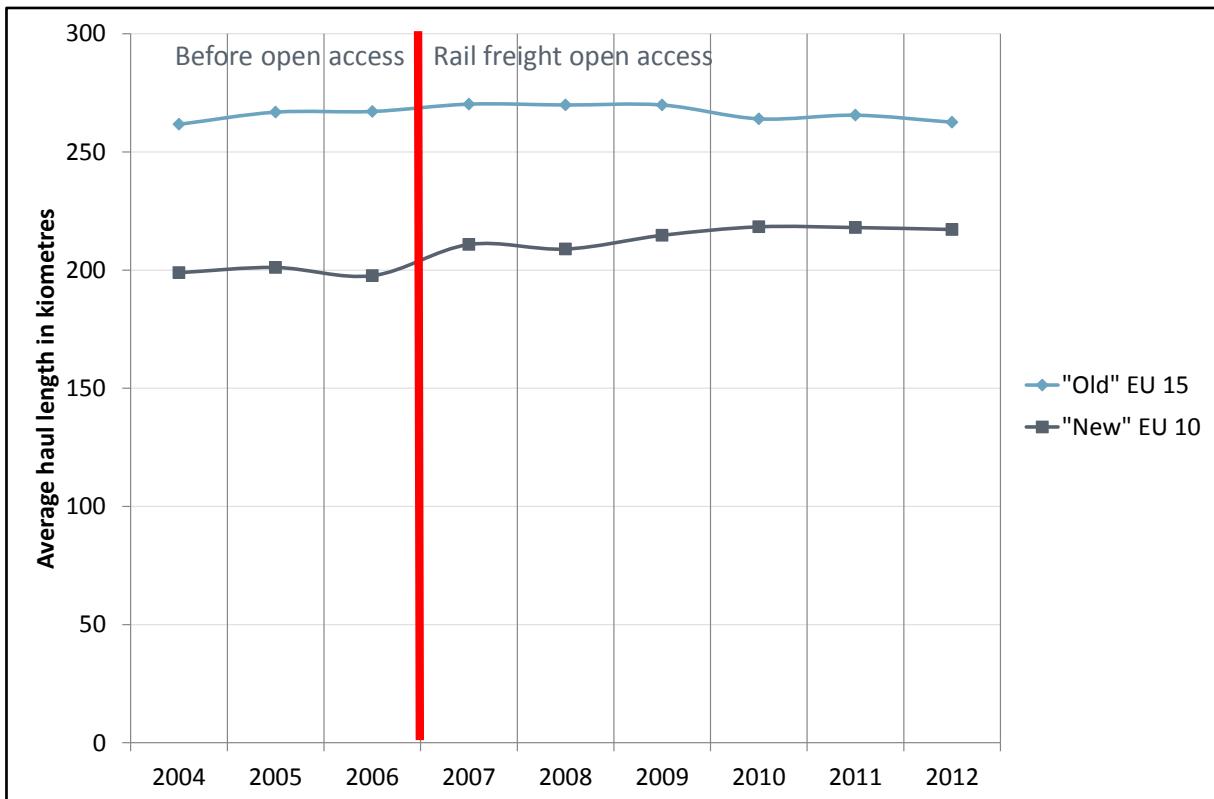


Figure 3: Freight haul length in Europe (source Eurostat)



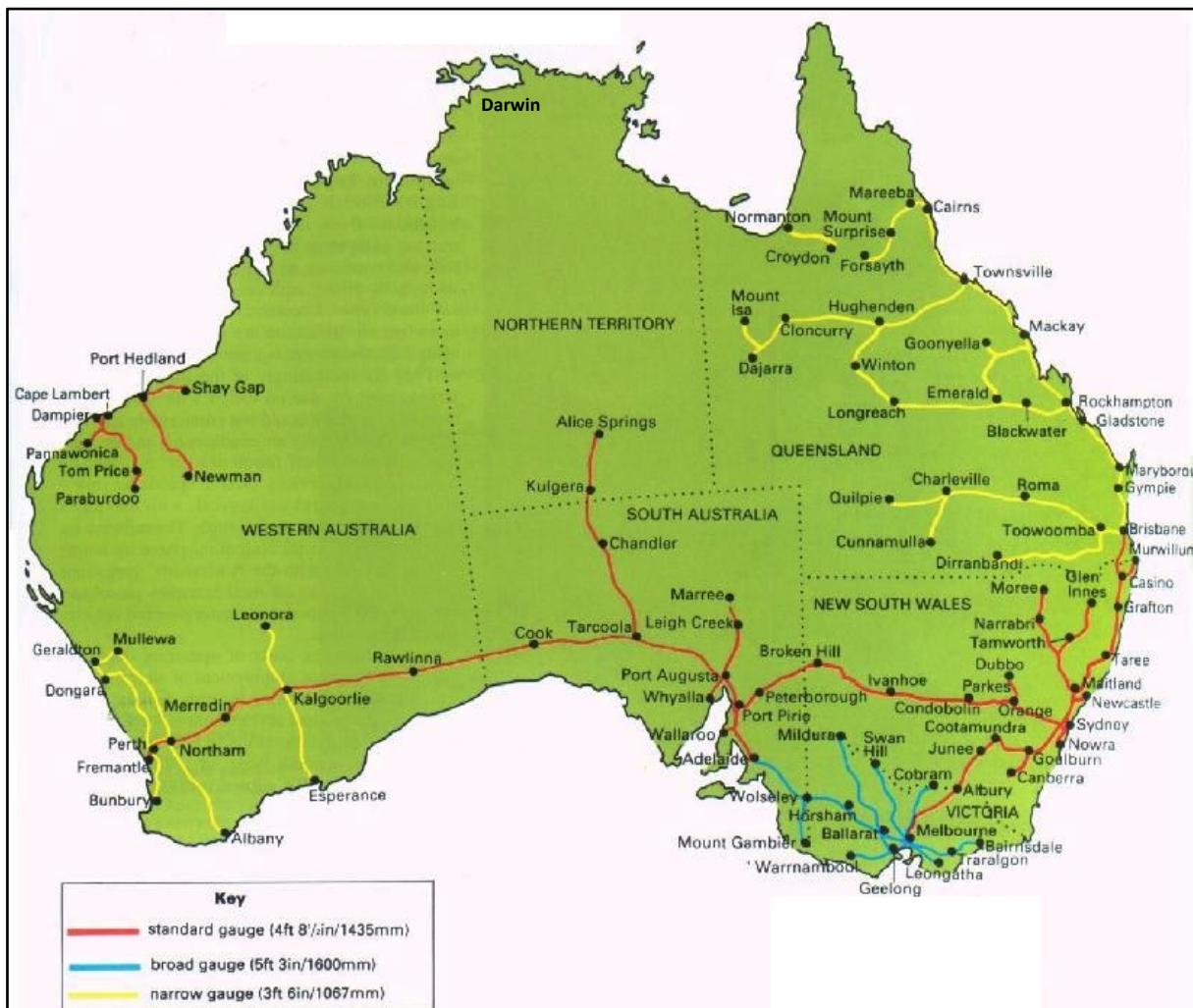
Freight tonnage lifted has not noticeably increased since market opening in 2007, although the recession since 2008 will have depressed traffic somewhat.

The average haul length has also remained broadly the same, suggesting no increase in longer distance international traffic, although there may be a loss of short distance traffic to trucks.

Horizontal separation in Australia

Independent railways developed in each Australian State to serve mining and agriculture and for access to the interior. This resulted in the challenge of integrating the original State railways with different gauges: some lines became dual gauge.

Figure 4: Continental Australia's rail networks



There was subsequently a limited Federally-owned standard gauge network, with regulation of infrastructure by the State or the Federation as appropriate.

Infrastructure managers must generally charge the same for the same service, and negotiate tariffs between the floor of marginal cost and ceiling of total cost, including a return on capital. Where negotiation fails, tariffs are set by arbitration.

However, uncertainty has been created by the absence of specific pricing principles and the wide range between tariff floor and ceiling. As in Europe, inconsistent access regimes send inconsistent signals and “Interstate” rail has to compete with trucks and foreign-owned deep sea ships.

In Queensland, Aurizon manages the 1067 mm gauge network of the former Queensland Rail (QR) and provides services for coal, iron ore, containers and other bulks. Infrastructure access is regulated by the Queensland Competition Authority (QCA) through the 2010 Access Undertaking, the requirements of which include the production of a costing manual and updating of network diagrams. Aurizon produces new Draft Access Undertakings (DAUs) but these are subject to approval by QCA.

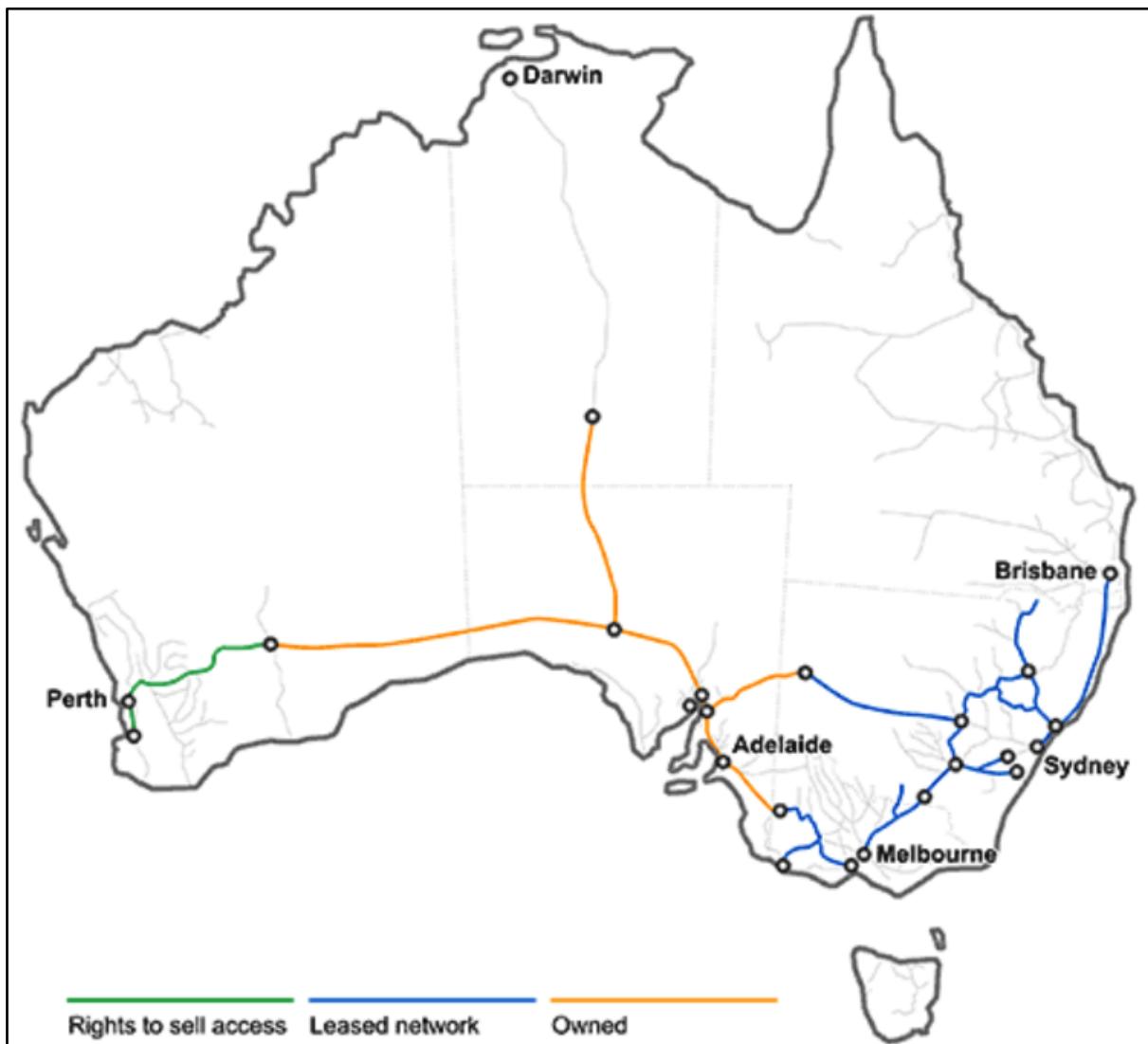
Aurizon went on to acquire the operations on the 1067 mm gauge network in Western Australia, and now provides services there and across the national network.

Railways in Western Australia are also mostly 1067 mm narrow gauge. In 2000, the Western Australian network was privatised as a vertical business to a joint venture between Genesee and Wyoming and Wesfarmers. In 2006, this was split, with freight operator Australian Railroad Group sold to QR National, which subsequently became Aurizon. In 2009, the infrastructure operator was renamed Brookfield Rail, which provides open access on 5,500 kilometres of network including the narrow gauge lines in the “wheat belt” and the standard gauge line from Kalgoorlie to Perth and the port of Kwinana.

The access regime is defined by the Economic Regulation Authority of Western Australia (ERAWA) Rail Access Regime including an optional (50-page) Railways (Access) code.

Since 2001, capacity on Brookfield’s standard gauge network between Perth/Kwinana and Kalgoorlie has been sold “wholesale” to the Australian Rail Track Corporation (ATRC), which effectively controls the 8,500 kilometres of the key interstate network shown in Figure 5.

Figure 5: Australian Rail Track Corporation (ARTC) network



ARTC, created in 1997, also owns the network between Kalgoorlie (WA), Alice Springs (NT), Broken Hill (NSW) and Wolseley (SA) and has a 60 year lease on the network from Broken Hill and Wolseley to Melbourne, Sydney (exclusive) and Brisbane. The Sydney Metropolitan Region in NSW has dense passenger flows, and providing sufficient capacity for freight through Sydney remains problematic.

Where ARTC leases infrastructure from other railways, it is responsible for managing infrastructure maintenance until the assets are returned to the owner, managing the network, developing new business, selling access rights to train operators and capital investment in the corridors.

Most access is regulated by a 2008 voluntary access undertaking accepted by the Australian Competition and Consumer Commission (ACCC). Tariffs are regulated by corridor and commodity and per train-kilometre "flag fall price" plus per thousand gross-tonne-kilometre "variable price", as in Figure 6.

Figure 6: Australian Rail Track Corporation (ARTC) tariffs

TRACK ACCESS PRICES	EAST - WEST										NORTH - SOUTH					HUNTER VALLEY & INLAND				
	PARKES ACT - BROKEN HILL	BROKEN HILL - CRYSTAL BROOK	ADELAIDE - PORT AUGUSTA	PORT AUGUSTA - PARKESTON	TABERLAKE - ALICE SPRINGS #	PT AUGUSTA - WYALIA	ADELAIDE - PELION PT	ADELAIDE - MELBOURNE	APPERTON DOCK/CF - PORTSMOUTH RD	APPERTON DOCK/CF - SWANSTON DOCK	ACADEME - SINGAPORE	TOTTENHAM - MACARTHUR	MACKPATERSON EAST - SEFTON PARK ACT (SPL)	CODAMMORA - PARKES ACT	MISSIVALE - WANDERA	MAITLAND - MUSWELL BROOK	MUSWELL BROOK - MERVILLE	MUSWELL BROOK - WERNIS GREEK	GEOBANG ACT - WERNIS GREEK	Type 54 - 80G/20L4
All Freight	\$ 4.015	\$ 4.015	\$ 3.079	\$ 3.079	\$ 5.769	\$ 5.193	\$ 4.534	\$ 3.445			\$ 3.589 *	\$ 2.822 *	\$ 5.422 *	\$ 3.952	\$ 4.538	\$ 3.824	\$ 3.373	\$ 3.824	\$ 2.514	\$ 2.599
VARIABLE PRICE per TRAIN KM	4.015	4.015	3.079	3.079	5.769	5.193	4.534	3.445			3.589 *	2.822 *	5.422 *	3.952	4.538	3.824	3.373	3.824	2.514	2.599
Passenger	1.725	1.725	4.221	4.221	5.181			2.599												
Express Freight	1.129	1.129	3.997	3.997				2.089				1.188	3.819	1.188						
Regular Freight	1.201	1.201	3.980	3.980	4.810	2.677	2.851	2.424	48.798	20.901	1.954	1.893	8.396	1.565	1.153	5.352	5.474	4.664	0.807	0.553
Super Freight	1.108	1.108	3.969	3.969	4.810	2.677	2.851	2.137	48.798	20.901	1.039	1.123	3.618	1.070	1.123	0.485	0.525	0.485	0.109	0.553
Standard Freight	0.565	0.565	2.831	2.831	3.526	1.935	2.372	2.032	48.798	20.901	0.920	0.694	3.196	0.472	0.581	0.485	0.473	0.485	0.092	0.553
Heavy Freight																				
VARIABLE PRICE per TRAIN KM	4.879 *	4.879 *	3.741	3.741	7.011	6.312	5.510	4.187			3.589	5.474		7.567 *	7.300					
FLAGFALL PRICE per TRAIN KM	1.460 *	1.460 *	4.837	4.837	5.845	3.254	3.465	2.947			1.954	1.893		1.965 *	1.153					
Express Passenger																				
VARIABLE PRICE per TRAIN KM	3.961										3.542	2.796		4.475	3.771		3.771	2.479	2.389	
FLAGFALL PRICE per TRAIN KM	2.002										2.115	2.269		2.038	1.997		2.014	2.017	1.807	
Adhoc Grain																				
VARIABLE PRICE per TRAIN KM	4.015	4.015	3.079	3.079	5.769	5.193	4.534	3.445			3.589	2.987	5.422	3.952	4.538	3.824	3.373	3.824	2.514	2.599
FLAGFALL PRICE per TRAIN KM	0.565	0.565	2.831	2.831	3.526	1.935	2.372	2.032	48.798	20.901	0.920	0.736	3.196	0.472	0.581	0.485	0.473	0.485	0.092	0.553
FLAGFALL APPLICATION																TRAINS				
FLAGFALL																TRAINS				
Express Passenger	Max train speed above 115kph / Max Axle Loading up to 19T										XPT, Intra Urban Passenger, Intra State Passenger									
Passenger	Max train speed 115kph / Max Axle Loading up to 19T										Long Distance Passenger									
Express Freight	Max train speed 115kph / Max Axle Loading up to 20T										Bi Modal									
Regular Freight	Max train speed 80kph / Max Axle Loading up to 23T / Length to corridor standard max										Scheduled Services including Steel, Cement, Concentrates									
Heavy Freight	Max train speed 80kph / Max Axle Loading up to 25T / Length to corridor standard max										Limestone, Minerals									
Super Freight	Max train speed 110kph / Max Axle Loading up to 21T / Length up to corridor standard max										Intermodal, Land Bridging									
Standard Freight	Max train speed 80kph / Max Axle Loading up to 23T / Length to corridor standard max										Non Scheduled services excluding Grain									
Adhoc Grain	Max train speed 80kph / Max Axle Loading up to 23T / Length to corridor standard max										Non Scheduled Grain services									

* The applicable rate may be reduced by up to 25% for eligible freight that commenced transfer from Road to Rail during the period 1/1/2013 - 31/12/2013

** Rates applicable to new traffic commencing 1 July 2014

APT Interface

** Rates apply to ARTC business customers only

** Adelade - Parkes now separated into Adelaide - Port Augusta and Port Augusta - Parkes

** Some rounding may occur on the final invoice

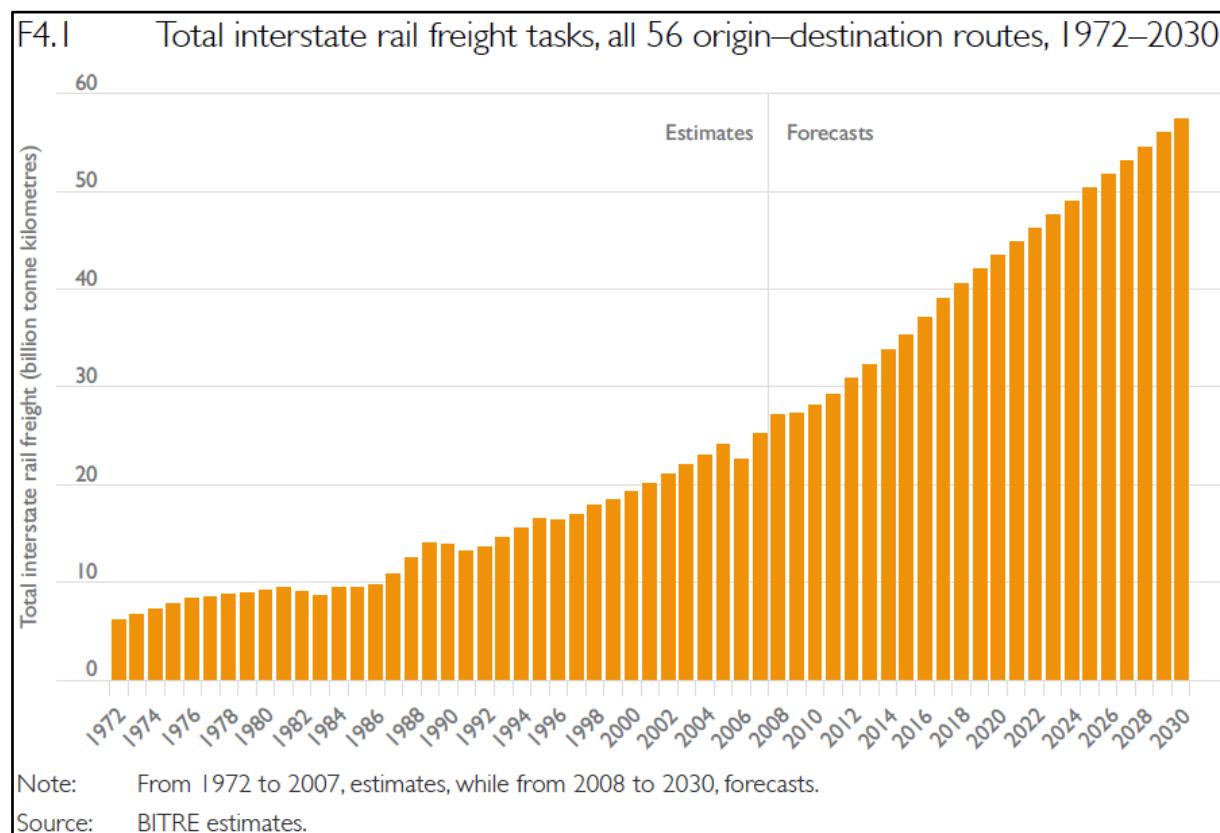
ARTC-controlled infrastructure is now served by a number of operators, listed in Table 2, in which "V" indicates use by adjoining vertically-integrated freight ("F") or passenger ("P") businesses.

BITRE estimates indicate significant growth in interstate rail freight (billion tonne-kilometres), as shown in Figure 7. Note, however, that 1972 to 2007 data are estimates and 2008 to 2030 data are forecasts, and neither may be accurate.

Table 2: Operators on the ARTC network

Operator	V	Characteristics
Aurizon (2010)	F	State (QLD) lines, floated, manages lines, freight services
Sydney Trains NSW TrainLink	P	State (NSW) lines, regional and urban passenger services
V/Line passenger services	P	State (VIC) lines, regional passenger services
Genesee and Wyoming (2006)		State (SA), sold, also operates to Darwin and provides freight services
Great Southern Railway		Federal tourist train operator, sold to Serco
Pacific National (2002)		Federal freight operator, varied services
Freightliner (2008)		UK-owned, containers, long coal contract
Qube Logistics (2011)		Port operator, provides freight services
P&O Transport		Port operator, provides freight services, owned by Qube since 2011
Specialised Container Transport		Australian-owned, provides freight services

Figure 7: Australian interstate freight tonne-kilometres (BITRE)



Vertical integration in North America

Figure 8: Class 1 railroads of North America



Arrangements in North America evolved under market forces as market share was lost to trucking. There are now seven large railroads (including two Canadian) and several hundred small ones, all vertically integrated. There is coordination on technical standards but not planning and control. The speaker wondered if BR's "Organising for Quality" could have looked like this?

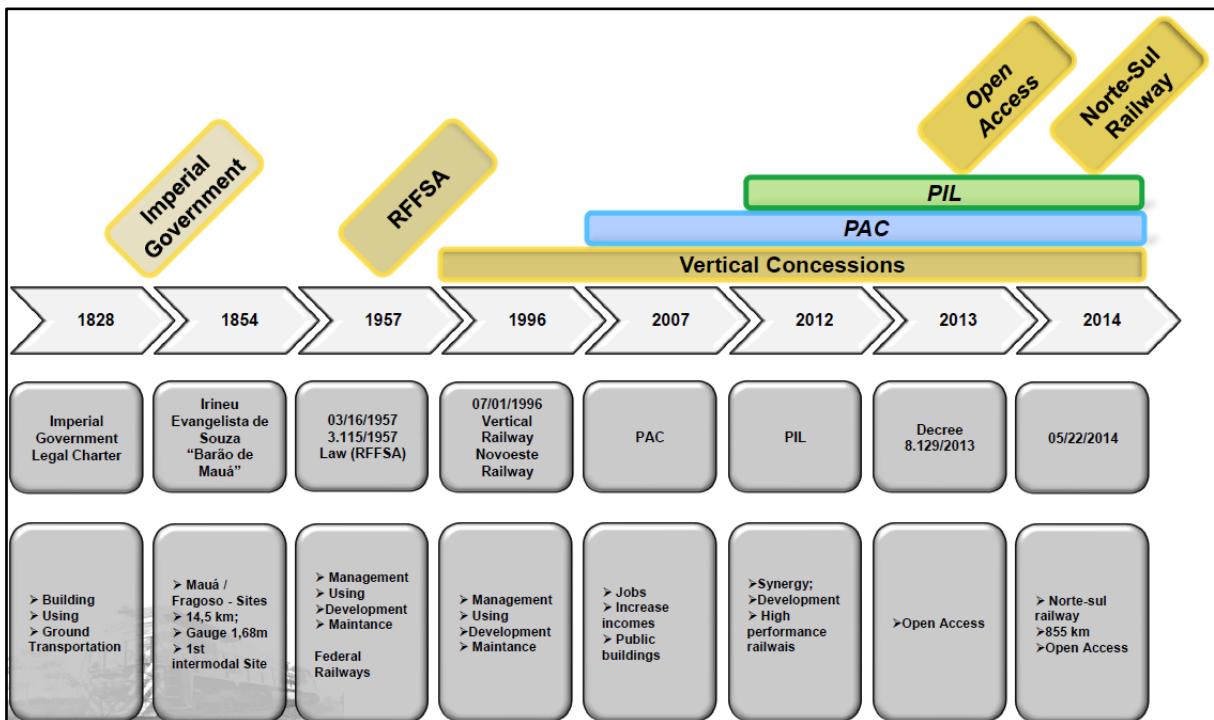
Railroads compete with other modes or where networks serve the same point(s). Most wagons are owned by shippers rather than railroads. Open access is not obligatory but, where allowed it is negotiated and usually confidential, unless the regulator sees abuse of power.

Railroads have detailed cost-accounting systems and a code, approved by the regulator, of working “open book” to agree tariffs. The vertically-integrated railroads understand each other’s cost structures. Tariffs negotiated with general pricing freedom are based on trains, train-miles or tonne-miles.

The next challenge: Brazil

The railways of Brazil date back to the imperial government and have since been through nationalisation and concessioning.

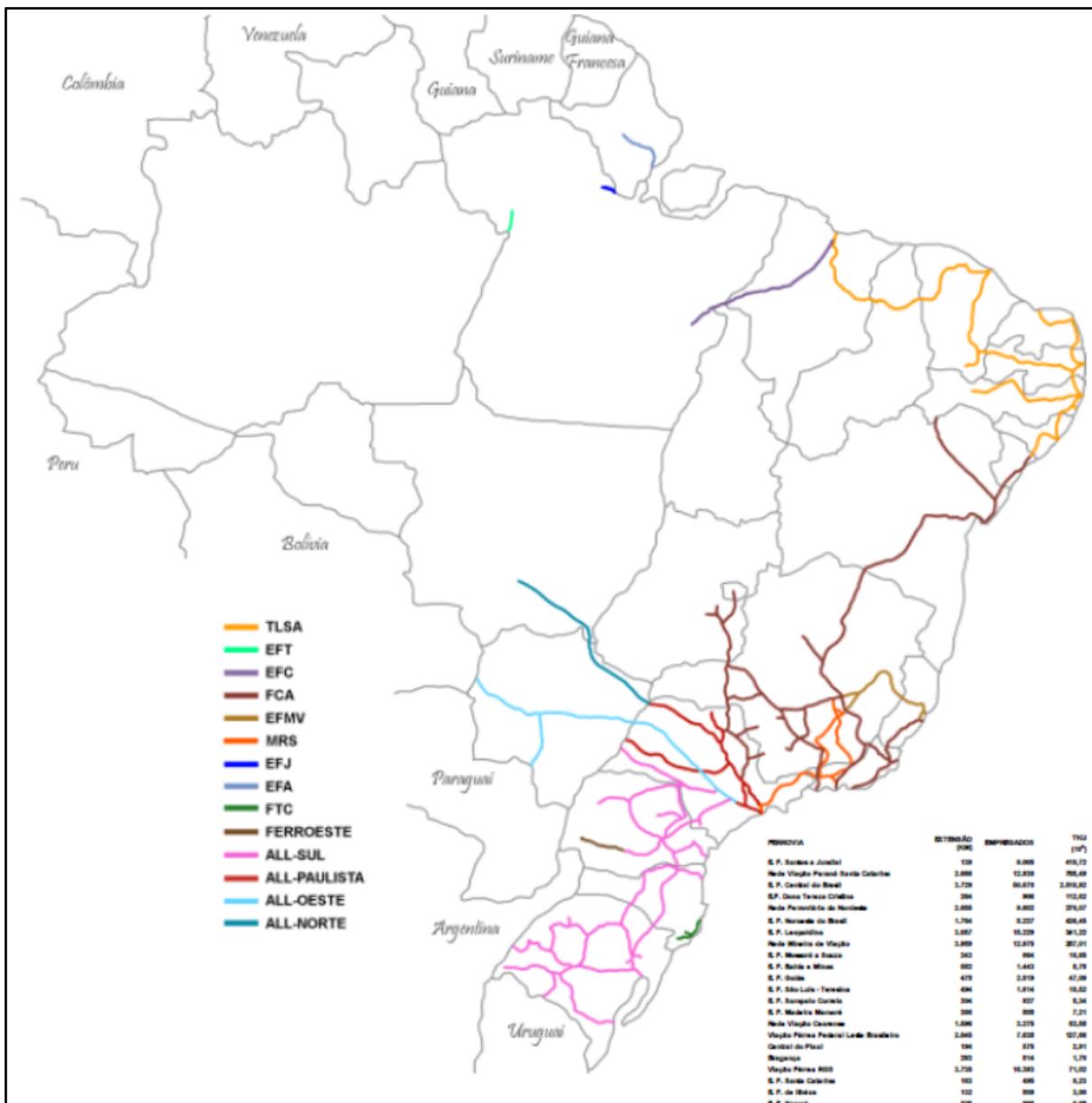
Figure 9: Overview of railway developments in Brazil



From 1996, the former national RFFSA was sold off as vertically-integrated concessions, typically connecting mining or agriculture with a port, shown in Figure 10. While suited to an export-led economy, this resulted in poor connectivity, particularly north-south, and was not suited to increasing integration and internal trade.

The Growth Acceleration Programme (Programa de Aceleração do Crescimento, PAC) began in 2007 followed by the Logistics Investment Programme (Programa de Investimento em Logística, PIL) began in 2012. “Horizontal concessions” will build new lines and then Brazil's federal rail company Valec will buy all their capacity and sell it to operators as “broker”.

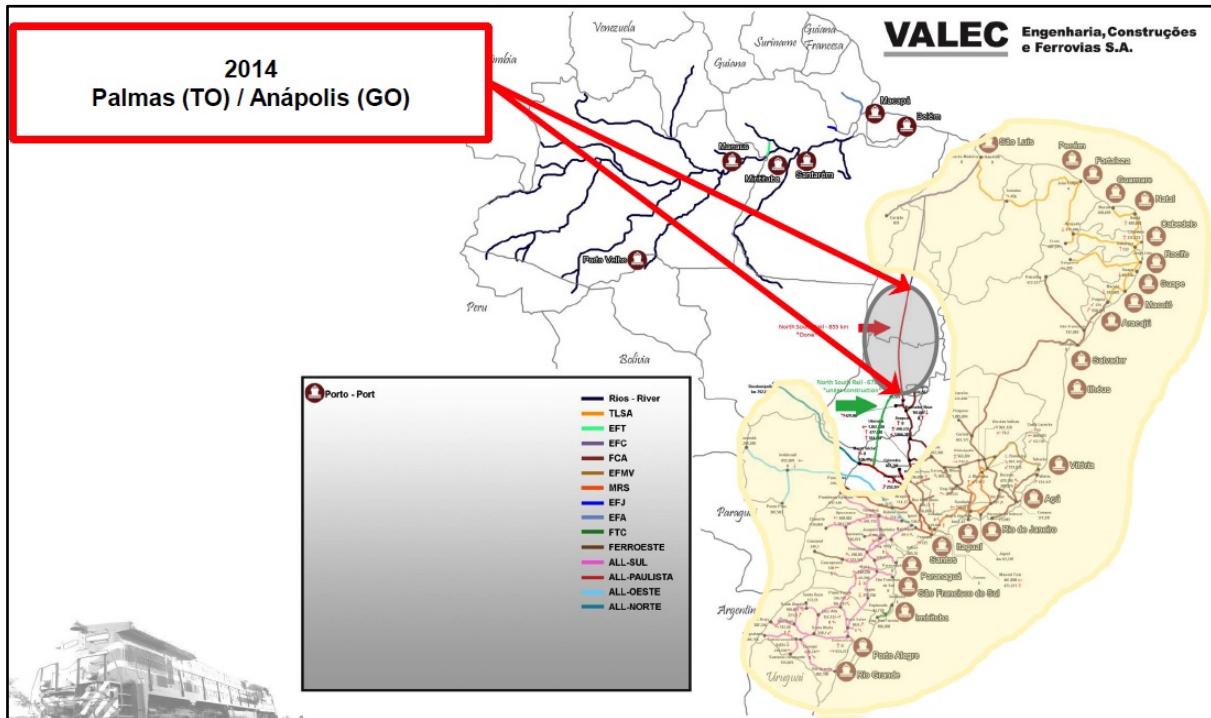
Figure 10: Brazil's vertically integrated concessions after 1996



A key element is the completion of a north-south route linking Belém in Pará with Rio Grande do Sul, 855 kilometres of which has now been completed by VALEC, as shown in Figure 11.

However, effective use of the north-south link raises a number of challenges. There may be little or no demand to travel wholly within the new line, but access to all the ports is via the existing "vertical concessions" which retain a monopoly on carriage on their network. It is also unclear to what extent they have spare capacity: the same issue has arisen with attempts to open up the railways of Australia's Pilbara.

Figure 11: Brazil's new north-south link



Tentative conclusions

A key conclusion is that local networks can't serve integrating economies: "small" and "local" are not good for economic integration. The 19th century national and state railways and 20th century vertical concessions in Brazil "seemed a good idea at the time" but, as local monopolies, do not offer an integrated network. To provide an integrated "railway space" across a continental network, there are three conceptual options:

- **Mergers and acquisitions**, which will work up to a point, but take time and create a need to restrict monopoly. Full integration could be allowed if state-run or well-regulated, both of which raise questions.
- **Mutual trading as equals**, used in industries such as oil. This was planned for British Rail as "OfQ", and works in the USA, Canada and Mexico, where a combination of technical compatibility and lack of barriers has allowed the market to build continental networks.
- **Separation and open access**, as in other network industries. This was imposed in Europe and Australia by agreements between "States" as a result of political geography.

Europe, Australia and Brazil can all replace small regional vertically-integrated networks with an open national system, improving economic integration, without waiting for consolidation. This provides opportunities to:

- Open up new areas to rail
- Attract new agriculture, industries and trading links
- Give rail operators a choice of ports and export corridors
- Give shippers an alternative to truck transport
- Give shippers a choice of rail provider

It also provides opportunities for the supply industry in railway services, increases economies of scale and allows shippers, logistics companies, operators and suppliers to choose business arrangements which work best for them.

The Australian Federal and State governments (and Great Britain) separated publicly-owned networks and operations, creating a national network open to all operators. Freight operators were privatised and bought on the basis that they would have access but face competition.

The European Union effectively confiscated the monopoly rights of national railways in exchange for Europe-wide access: the network became open to all operators, who lost monopoly rights but gained new markets.

Brazil faces a different starting point and has to work with the existing vertical concessions. It wishes to create open and competitive networks which can bring benefits to customers and operators alike, but existing concessions may not wish to trade local monopoly for new access rights. One challenge for Brazil is implementing open access with new and untried "horizontal concessions".

New infrastructure is more expensive than fully-depreciated existing lines, so cost-recovery may be difficult, particularly in the early stages. However, the 855 kilometre line from Palmas to Anápolis is built and a "sunk cost". The optimum outcome is its use by all who can pay the additional costs they impose. While usage is low, managing capacity constraints and performance need not be a priority.

The horizontal concession arrangements must be clear and transparent, with provision for change as the industry improves, and provide sufficient certainty in which to invest in a business.

Even where infrastructure exists, there may be no providers of associated services, and for entrants to offer services there may be a need to create an environment of confidence. The first operators(s) may need help to obtain the support services they need, which could (in extremis) mean intervention in the market to create the capability for new operators. The key will be to demonstrate reliable operations and a satisfied customer, and securing a first operator is the key to doing this.

Discussion

Chris Castles wondered what traffic could use the new railway in Brazil? **Dick** said that target traffics examined included exporting some commodities through the north of the country.

David Spurling asked how the overall vision for open access fitted into reducing global warming. **Dick** was not sure whether and how the need to address climate change had been addressed in Brazil's long term logistics plans. Coal is not central to all railway development, although Australia is a major exporter of coal and has removed its carbon tax.

John Cartledge (London TravelWatch, retired) noted that one pillar of the EU strategy is technical interoperability which was actually devised by the industry directorate. Is there anything similar in other countries? **Dick** replied that most EU states agreed with technical operability and that the process was stripping out costs. It also happens in the U.S. where it is industry-led. Brazil has inherited some common standards, but interoperability may yet become an issue.

Gregory Marchant (SRA, retired) said that while the U.S. industry has sorted itself out, there were still some differences. For example, there were various gauges in different southern states prior to the civil war and the First World War encouraged the standardisation of technical standards. **Dick** note that in Australia the Federal Government could use funding to incentivise convergence among the States.

Robin Whittaker was concerned that automatic couplers are needed to facilitate wagonload traffic but that railways in Europe had been arguing about this for the last fifty years. There was also an issue, with separation, that local station staff no longer had operating skills which could be a problem if, for example, there were a points failure. **Dick** replied that some parts of any railway will always be better-managed than others, but local failures might be seen as an argument for a competitive process to weed out poor management.

Stephen Plowden noted that freight operations dominated in three of the four networks Dick had discussed. Could you have an integrated passenger railway with access rights for freight? **Dick** agreed that this, or the converse, might suit some parts of Europe, and also that a common model might nowhere be optimal. Sydney and Melbourne are still both vertically integrated but have both freight and passenger traffic. It is not clear where we will be in Europe in 20 years' time, especially as technically legal compliance with European Directives may be insufficient to create the liberalised market envisaged by the Commission.

Chris Castles suggested that the downstream effects of offering long vertical concessions had not been thought through.

Report by Peter Gordon

Review

The views expressed are those of the reviewers and should not be attributed to the Transport Economists' Group

The Geographies of Air Transport

Edited by Andrew R. Goetz and Lucy Budd

Ashgate ISBN 978-1-4094-5331-4

The book is a collection of fourteen essays by a total of twenty one academic authors. The first section is titled thematic approaches, and contains eight chapters examining particular areas such as geopolitics and economics.

There are separate chapters on the environmental externalities and sustainability of air transport, which of necessity cover similar ground. Whilst the topics are covered well, sadly the authors do not come up with a silver bullet.

The chapter on Global Cities and Air Transport by Ben Derudder and Frank Witlox is well worth a read, and examines the relationship between air travel and global city formation. There is discussion on the extent to which these are correlated and indeed if this implies causality.

The chapter on Social and Cultural Geographies of Air Transport by Peter Adey and Weiqiang Lin is rather heavy going, certainly for someone with an economics background, but interesting if one is looking for an alternative perspective from a non-economic viewpoint.

The second section has six chapters on air transport in different parts of the world. The one on Africa by Gordon Pirie is particularly interesting, as the continent tends to receive relatively little coverage. Madrid airport alone had more passengers than all of sub-Saharan Africa aviation in 2009. The obvious way ahead is for traffic to be organised around a few large hubs, but would smaller countries African countries finding themselves without a hub be happy about this?

With an average chapter length of under twenty pages, the authors have to be concise rather than expansive about their topics. For those wanting to delve deeper, there is an average of three pages of references per chapter, citing about fifty papers.

Most of the essays give a very good overview their area and contain a lot of useful material. This book is recommended for those wanting a good overview of the subjects covered, and will be a good read for the student of air transport.

Review by Peter Gordon

TEG Committee 2014-2015

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The Transport Economists' Group, formed in 1973, provides a forum for people involved in transport economics to meet regularly and discuss matters of mutual interest. Membership is open to economists working in transport and others whose work is connected with transport economics.

The aim of the Group is to improve the quality of transport management, planning and decision-making by promoting lectures, discussions and publications related to the economics of transport and of the environment within which the industry functions.

Meetings, held at Arup's Central London HQ at 13 Fitzroy Street from September to June (except December), consist of short papers presented by speakers, drawn from both within the Group's membership and elsewhere, followed by discussion.

The Group's Journal, "The Transport Economist", is published three times a year reporting on meetings and other activities of the Group. It reviews recent publications of interest and contains papers or short articles from members. The Editor welcomes contributions for inclusion in the journal, and can be contacted at petersgordon@blueyonder.co.uk.

The current membership of over 150 covers a wide range of transport modes and types of organisation. Members are drawn from transport operators, consultants, universities, local and central government and manufacturing industry. All members are provided with a full membership list, updated annually, which serves as a useful source of contacts within the profession. Applications from people in all sectors are welcome.

Applications for membership should be made on a form which can be downloaded from the Group's website at www.transecongroup.org.

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Reports of meetings		
Developing LUTI models to incorporate the effect of transport on jobs	<i>David Simmonds</i>	1-7
Getting the most out of the existing rail network	<i>Chris Stokes</i>	8-20
Creating rail open access across continents	<i>Dick Dunmore</i>	21-37
Review		38-39
TEG Committee 2014-2015		

Details of meetings are provided on our website at

<http://www.transecongroup.org/meetings.htm>

