

INFORMED SOURCES e-Preview November 2018

Making sense of recent developments has required lengthy detailed analysis reducing the range of topics covered in each column. This month Informed Sources is back to normal with subjects ranging from fares to Mk3 coach ride

Decoding the Williams Review
Fares review – price, cost and politics?
Mk 3 ride investigated
Class 800 emissions face-off

As reports of a new Railway Review multiplied during the summer, I came up with standard response when asked for my three penn'orth. 'Ownership is irrelevant: it's the structure the counts'. As time passed this condensed to 'structure not ownership'.

So I was gratified to hear Transport Secretary Chris Grayling say in an interview when the Review was first announced on 20 September 'We need an integrated railway. It's not about ownership but about ways of working'. Close enough, but sound bites do not terms of reference make.

Of course, no politician launches a review without knowing the answer he wants. And, sure enough, when the details of the Review were revealed on 12 October my inner cynic was not disappointed. The terms of reference presented to Independent Chairman of the Review, Keith Williams belie Mr Grayling's bravado.

Despite being heralded as 'comprehensive in its scope and bold in its thinking, challenging received wisdom and looking to innovate', the terms of Reference are more prosaic. For example, DfT is looking for a rail network that is financially sustainable and able to address long-term cost pressures, while offering good value fares for passengers and keeping costs down for taxpayers. Wasn't that the remit of the McNulty Review in 2011?

We seems to have had a plethora of rail-related reviews of various kinds in recent years. A check of perception against reality came up with 30 reviews since the 2007 White paper 'Delivering a sustainable railway', or 31 if you include the 2006 National Audit Office (NAO) report into the West Coast Route Modernisation.

Curiosity piqued, the next step was to plot the number of reviews per year. This confirmed my suspicion that they were becoming more frequent.

Finally, I calculated the five year Moving Annual Average (MAA) of Reviews per year. From 2.2 in 2014 the MAA has risen to 3.4 this year. This suggests that we have the making of a new Informed Sources Law, namely, the health of the railway industry is inversely proportional to the five year Moving Annual Average of Government-initiated rail-related reviews. Applying this Law suggests that the things have indeed been getting worse.

On the other hand are reviews that influential? McNulty is now almost forgotten, leading to the further thought that, rather like radioactive elements, review recommendations decay. A half life of 7 years seems about right.

What does a seat cost?

I have always steered clear of the minefield that is rail fares. There are people who have dedicated their working lives to the subject and even they admit it is complex. So what chance would I have?

But with the current 'root and branch reform' of fares and regulations under way it occurred to me that if you really are into 'root 'n' branch', and who isn't this month, you might go back to first principles and ask the question facing all businesses –'what am I selling and what does it cost to make'?

'Passenger miles' and 'Passenger journeys' are not that much use when it comes to cost. However, the airline industry uses a measure called 'available seat miles' and I thought it might be interesting to apply this to passenger rail services.

To simplify data collection I chose operators with small fleets running on broadly homogenous services. They are: Intercity East Coast; Trans-Pennine Express; Cross Country; Essex Thameside (s2c); Hull Trains; and Grand Central.

Costs were broken down into 'direct costs' covering staff, fuel and rolling stock and 'total infrastructure costs'. The 'total' is important because in addition to the Train Operators' fixed and variable Track Access Charges there is also each operator's share of DfT's Direct Grant to Network Rail For example, in the case of Trans-Pennine Express, the TAC come to £92 million and the share of the direct grant £124 million.

Excluding the Direct Grant from the calculation, the overall cost per available seat mile for the franchised TOCs is similar to that of the Open Access Operators who only pay their Variable TAC. On the ECML, the LNER cost is 9.5p versus 9.8p and 8.9p for Hull Trains and Grand Central respectively.

However, the Direct Grant allowance must be included because it reflects part of the cost of the 'product'. For the three 'main line' TOCs this increases the overall cost per available seat mile to around 15p.

These costs are in line with cheap advance fares in the real world. But, of course, rail travel is not subject to the practices of the commercial transport world.

According to the financials for 2017-18 just published by ORR, the franchised TOC's paid DfT net premia of £400 million. However, their share of Network Rail's Direct Grant totalled roughly £4 billion. Hence the need for TOCs to squeeze as much revenue out of their passenger traffic and charge what the market will bear.

Is my analysis of cost per available seat mile irrelevant to the fares review? Not entirely, at least, I would hope not.

It does set a floor on Advance and promotional prices, below which the TOC is actually losing money. But other than that the fares review will probably have as its starting point current fares, which are quite arbitrary and based on what the market will bear or, with Regulated fares, by Government-determined annual percentage increases.

Mk 3 ride mystery

For four decades a well maintained British Rail Mk3 coach used in IC125 has been widely acknowledged as providing the best ride on UK track. But recent IC125 journeys on the East Coast Main Line (ECML) have been characterised by a noticeably 'bouncy' ride. Although I haven't had an IC125 journey on the Great Western Main Line recently, there are suggestions that it too is not as good as it was.

Following some remark on Mk 3 ride I made on social media (@Captain_Deltic on Twitter), following a visit to York earlier this year, LNER Engineering Director John Doughty got in touch with me. Since he took over a couple of years or so ago he has been intrigued by the better ride achieved by the GWR IC125s.

One factor could be a change in primary vertical suspension damper from the original Woodhead units which, not surprisingly after 40 years, are obsolete. A damper, called shock absorbers in road vehicles, is essentially a piston in an oil-filled cylinder. One end is fitted to the bogie, the other to the wheelset suspension.

When the wheelset moves up and down the piston forces the oil through a system of orifices and valves. This creates a resistance which 'damps' the movement of the piston. By adjusting the flow of oil through the orifices the resistance to the piston's movement can be varied..

Woodhead dampers acquired a reputation for seals eventually failing, allowing the oil to leak out, reducing the performance of the damper and thus ride quality. This propensity also added to maintenance costs and around 10 years ago most Mk 3 coach operators replaced their Woodhead dampers with more modern designs.

Intercity East Coast adopted the Pegasus damper which has proved to be very reliable. East Midlands Trains' Mk 3 coaches were also fitted with Pegasus dampers.

However, on this dynamically more-demanding route the ride deteriorated to the extent that from April last year they were replaced in turn by dampers made by Suomen Vaimennin (SV) of Finland.. According to my colleague Mr Walmsley, a regular MML user, IC125 ride has since improved from 'terrible' to OK which he attributes to the damper change.

On the ECML, last year Mr Doughty decided to take a scientific look at Mk 3 ride. One IC125 set fitted with SV primary vertical dampers and in October last year consultants took comparative ride measurements during normal service running. A standard Pegasus-equipped set was recorded on a Kings Cross-York run and the SV fitted set on a Stirling-King's Cross run the following day.

When the results were analysed and compared, the conclusion was that the vertical ride quality was indeed 'relatively poor'. However, the variation in ride accelerations suggested that the track quality over the route is 'very variable - especially in the vertical direction'.

As for the two types of damper, the difference in vertical and lateral passenger comfort was 'small' and would not be expected to be very significant in terms of passenger perception. The SV units produced 'marginally lower' accelerations in the vehicle body.

While variable track quality was highlighted in the consultant's report, one of the BT10 bogies' strong qualities was the way it coped with poor track. So perhaps the difference lies in the dampers.

Meanwhile, if any reader has a set of Woodhead dampers for a Mk 3 in their garage, or depot store, please let me know as John will get them fitted and run a further comparison. He really does want to improve the ride quality of his IC125s. And the way things are heading they may be in service for a few years yet.

Class 800 emissions background

Engineering is above all the art of compromise, of balancing cost, against performance, reliability, weight and a host of other parameters. The high level of Electro-Magnetic Emissions generated by the Hitachi Class 800 Intercity Electric Trains (IET), reported last month, illustrate some of the trade-offs and compromises facing electric traction engineers.

While Hitachi policy is not to comment, either on or off the record, on developing contentious issues, the company has pointed out an omission from last month's item on the Class 800 Electro Magnetic Compatibility (EMC) problems on both the Great Western and East Coast Main lines. I failed to report that although Class 800 emissions are higher than those of a Class 387, they are within the relevant Technical Specification for Interoperability (TSI) and also lower than the standard requested by Network Rail and published in draft. Hitachi assure me that when running under electric traction the Class 800 series is compliant with the relevant sections of the TSI (EN50121) and also Network Rail's own standards.

As explained last month, in the case of the SSI interference on the ECML north of Colton Junction, there are mitigating circumstances. In an action replay of the introduction of the Class 390 Pendolino fleet on the WCML, the Class 800 emissions exposed a weak point in the Data Link Modules that connect the interlocking to lineside signalling equipment.

This experience was apparently forgotten, and signalling immunisation did not feature in the infrastructure upgrades supporting the Intercity Express Programme on the ECML. But should problems have been expected with the ECML SSI anyway?

Some years back, as part of Alstom's support for a proposal to operate Pendolino tilting trains on the ECML, a series of trial runs was organised. With the Class 390 benefiting from extensive interference testing and amelioration following the Proof House junction problems, EMC was not considered an issue, nor was it.

So why is the Class 800 the noisiest train on the network? Engineering chums suggest a number of reasons.

In direct current circuits you have resistance in the wiring. The equivalent for alternating current circuits is impedance which increases with frequency. There is also reactance, defined as the resistance of an alternating current circuit to changes in current and voltage.

Low impedance and reactance is a good thing when it comes to efficiency in equipment like transformers. But once you have to take EMC into account they have their uses.

Because impedance increases with frequency, and it is high frequencies that generate most interference problems, high impedance means that potentially troublesome high frequencies are resisted or 'choked'. And slung under many three phase drive traction units you will find chokes.

These are copper coils wound on iron cores which provide lots of impedance. But while they choke interference, this comes at a price. With all that copper and iron, chokes are very heavy, typically 1.5- 2 tonnes. But as my colleague Ian Walmsley notes, would you rather carry round 2 tonnes of copper and iron or have a £5 million train stuck in the sidings because it can't obtain a safety case?.

Transformers, which convert the 25kV current from the pantograph to a more usable voltage, are full of copper windings and can be designed to provide more reactance and thus reduce the critical harmonic frequencies. For example the Class 390 has a high reactance transformer, at the cost of an additional 1.5 tonnes of copper over that needed for the basic function.

This is the first compromise. A low reactance transformer is lightweight and efficient: and remember that weight was a critical factor in the Department for Transport's specification for the Intercity Express Programme train which became the Class 800. According to informed sources the Class 800 has a low reactance transformer.

Interference is generated by traction return AC currents in the running rails inducing AC currents in lineside cables. These wires, carry various signals from axle counter data to speech to CCTV using specific frequencies.

Three phase drive traction packages switch the current on and off at high frequency to create the variable voltage and variable frequency supply needed by the traction motors. With the advent of the Insulated Gate Bipolar Transistor (IGBT) higher switching frequencies became possible. In addition to the basic frequency, harmonics (multiples of the frequency) have to be taken into account. Typical IGBT traction switching frequency is around 900 Hz (cycles/sec). The Hitachi Class 395 and 385 EMU traction packages switch at 950Hz.

Now we come to a second compromise. Each time an IGBT is turned on and off power is dissipated. This is known as switching losses and this power, which appears as heat, has to be dissipated. Power loss is proportional to switching frequency. A 10% reduction in switching frequency reduces switching loss by 10%.

For the Class 800 traction package Hitachi is reported to have reduced the switching frequency to 750Hz giving a 20% reduction in switching losses. However, it also moves harmonics into frequencies used by lineside equipment.

Finally, trains will have more than one inverter. If you arrange a pair of inverters to coordinate their switching you can effectively double the frequency, which is a good thing. This is known as 'interlacing'. The only downside is if one inverter of the pair drops out, but inverters are very reliable.

However, the 800 series trains have either three or five powered vehicles, each with a single inverter feeding the four traction motors which rules out interlacing.

These are the likely factors behind the Class 800s EM emissions characteristics.

Getting LNER's Class 800 bi-modes and Class 801 electrics into revenue earning service is not proving quick or easy. However, the latest aspiration for Type Acceptance is now late November.

LNER policy is that not until Type Acceptance is achieved will an eight week programme of driver training start, leading to initial service entry. The service provided will depend on the scope of the Acceptance and train deliveries. So you can see why John Doughty's IC125s may be in service for a while yet.

New Train TIN-Watch

Still little progress to report. But Wimbledon Depot is working hard on the Siemens Class 707 Desiro Cities and reliability has not only passed the TIN-Watch Pacer test (Northern Class 142 9,051 MTIN MAA) but is better than the worst Class 465 Networker and has broken through the 10,000 MTIN MAA barrier.

Meanwhile the 'countdown to compliance' continues with 433 days to go before any passenger vehicles which do not meet accessibility regulations must be withdrawn, or, as seems increasingly likely, will require a derogation.

Roger's blog

There was a great turn out for Ken Cordner's funeral with the Modern Railways editorial team and writers past and present joined by friends from the railway industry. There were some moving tributes at the service, not least from his son John. It was a beautiful day and afterwards we sat in the garden of his home sharing memories of our colleague.

October began with the Modern Railways Rail Vehicle Enhancements (RVE) show at Derby. I hadn't been to this event before, which was a mistake, because it showcases many of the SMEs which are at the heart of the rolling stock supply chain.

One thing stood out, the number of companies exhibiting equipment for on train Ethernet communications. I have added a technical item on the software enabled train to my Informed Sources 'to do' list.

This week starts with the Railway Industry Association's Annual Conference and October ends with a working lunch with other Rail Future Honorary Vice-Presidents as we judge the annual awards.

November is looking busy, starting with the latest Virgin Trains trade press dinner. Then on 23 November it's the Golden Spanners Awards for train reliability, with a record 22 trophies to be handed out. Further information from chris@shillingmedia.co.uk

Finally, the last week of the month has the Waterfront Rolling Stock Forum, which goes from strength to strength and the Railway Industry Association's Parliamentary reception.

Meanwhile it is time to write my contributions for our annual publication 'The Modern Railway'. Last year the optimistic headline for my scene-setting introduction was '2018 – Year of delivery'. Not surprisingly, 2019 will be 'the year of reckoning'.

Roger