

Written evidence submitted by Mr William Barter (IRP0072)

Introduction

I have 45 years' experience in rail operations and planning, initially with British Rail but latterly as a consultant working in the UK and overseas. I am a Fellow of the Chartered Institution of Railway Operators, for whom I have written educational texts in railway operational planning and economics.

Between 2012 and 2019 I was the principal practitioner in operations planning for HS2 Ltd., engaged through the Professional Services contracts, and as such reviewed the journey time modelling, and compiled 'proof of concept' timetables for HS2 services under Phases 1. 2a and 2b, as well as for classic services on the West Coast Main Line (WCML) post-HS2.

This submission has been revised to reflect new information published on 24 January 2022 in 'Strategic Alternatives to High Speed 2 Phase 2b - MML, ECML and Eastern Leg Combined Options' from Mott McDonald.

Summary

My contention is:

- The focus of the IRP on Derby and Nottingham at the expense of Leeds is both strategically unsound as it 1) destroys connectivity from the East Midlands to Yorkshire and the North East that would have been offered by the full Eastern leg, and 2) is unlikely to support a formal business case as fares revenue from Leeds is not captured to the high speed lines proposed.
- Criticism of the HS2 station at Toton (East Midlands Hub) is invalid, as the Hub serves different markets to city centre stations, that are not currently well served by rail. That East Midlands Parkway is not expected to be an adequate substitute is evidenced by the proposed service level at East Midlands Parkway being only half that proposed for East Midlands Hub.
- Headline journey times for IRP train services are not credible, except at the expense of stops at intermediate stations, and indeed at key locations such as East Midlands Parkway, leading to poor service levels at those locations.
- The IRP presents no analysis to demonstrate that capacity issues can be resolved on conventional lines proposed to be shared with high speed services, without detriment to those conventional services.
- Although the IRP proposes a study as to how Leeds can be linked to HS2, proposed HS2 services to Derby and Nottingham, combined with reduction

currently slow, or involve multiple changes of trains, or long drives to a railhead that has faster and direct services.

For instance, a journey from Milton Keynes to Leeds could have been accelerated by as much as 58 minutes, with transfer between Birmingham International and Birmingham Interchange to access the Eastern leg. The IRP offers no equivalent benefits.

Criticism of the East Midlands Hub in the IRP is misplaced. Whilst, in general, city centre stations are to be preferred to fringe-of-city 'Parkways', in practice the East Midlands Hub station would have provided significant benefits to both Derby and Nottingham as well as the East Midlands overall:

- Derby and Nottingham do not have a 'central business district' in the way that, say, Leeds and Manchester do. Business travellers to those cities are as likely to be destined for a business park on the outskirts as to the city centre itself, and for such travellers the Hub would be an improvement;
- Travellers originating from residential areas around a city may find the journey to a city centre station inconvenient, especially if driving there, suffering congestion and city centre parking charges as a result. Such travellers will be tempted to drive throughout their journey, especially given the proximity of motorways to their homes. By contrast, a 'Parkway' would not only serve such travellers better, but could be accessed by the motorway from a wide catchment area, as an alternative to driving throughout.

Catering for these flows is a reason for the proposed IRP services to call at locations such as Beeston (on the Nottingham line) and Long Eaton (on the Derby line) as well as East Midlands Parkway, but this of course trades off against journey time. Not only does the IRP not propose such stops, the headline journey times it promises can only be achieved by not stopping at East Midlands Parkway.

In fact, it is a criticism of the Eastern leg as originally proposed that it did not feature a 'West Yorkshire Parkway' to fulfill a comparable role of Birmingham Interchange and Manchester Airport stations for their cities. Such a Parkway could have been located on the HS2 York main line, North of Garforth, easily accessed from the M1 and A1(M).

Capacity will be discussed specifically later in this submission, but note here that accessing city centres on existing lines introduces capacity problems that a completely new route does not. How well these problems can be resolved depends on the extent to which new services from the high speed section replace existing services.

Journey times

The IRP is highly dependent on claimed journey times comparing with those offered by the HS2 Eastern leg as originally proposed. Improvements are attributed to 'upgrades' on conventional lines, and in particular on the East Coast Main Line (ECML) on 140 mph running. However, many of the claimed times seem to be unrealistic, or are based on invalid comparisons.

140 mph running in particular offers very limited benefits, in theory saving just 1 minute per 20 miles run compared with 125 mph. That implies an absolute maximum theoretical benefit assuming flat-out running from start to finish of:

- London – Leeds (186 miles) 9 minutes
- London – York (189 miles) 9 minutes
- London – Newcastle (269 miles) 13 minutes

In practice, it is very unlikely that 140 mph operation would allow even half of the theoretical saving. Moreover, increasing the speed of the fastest trains on a mixed-use route is immensely destructive of capacity. This is why the 'spectacular' 156-minute timing today is achieved only by one train per day. By contrast, HS2's time to London would be offered twice an hour, every hour of the day, which is a major but overlooked benefit of the HS2 full Eastern leg.

Although 'digital signalling' is frequently referred to, and cab-signalling systems such as ETCS Level 2 are a condition for 140 mph running, they are not on their own sufficient for 140 mph running, as some station stops will be made, and many locations and route sections on the ECML are already limited to less than 125 mph. Limitations on speed result from factors such as horizontal curvature, vertical curvature, aerodynamic issues in tunnels, and the maximum permitted speed of 125 mph past station platforms.

Examples on the ECML are:

- Kings Cross to north end of Welwyn North Tunnels – various reasons including aerodynamics in tunnels
- Offord - reverse curves and proximity of Great Ouse River

- Stilton Fen - ground conditions
- Peterborough - overbridge vertical curve
- Stoke Tunnel - aerodynamics
- Grantham Station
- Newark station
- Newark flat crossing
- Bawtry Viaduct.
- Doncaster station
- Doncaster to Leeds, especially the viaduct south of Wakefield Westgate

In the year 2000, the Strategic Rail Authority developed a scheme for upgrading the ECML. Items of work remaining uncompleted from that time are inevitably the most expensive, difficult and disruptive.

IRP journey times therefore rely in part on 'upgrades' but mainly on missing station calls compared with now. Of course, if trains are accelerated by missing stops, another train has to run to serve the omitted stations, implying an absolute increase in route usage. The Mott McDonald report implies that 9 trains per hour, of differing stopping patterns, will be needed on the ECML, but there is no demonstration that this level of service could be planned let alone operated reliably despite 'upgrades'.

Note that the potential capacity benefits of digital signalling, whilst real for a metro system (or indeed, HS2) where all trains travel at the same speed, are almost entirely negated on a mixed-traffic railway where the limit on capacity will derive from the difference in speed between the fastest and slowest trains. Benefits offered at termini are also minimal, whereas terminus capacity at Kings Cross is likely to set the capacity of the whole route.

The suggested service pattern appears to attempt to partially harmonise overall train speeds by spreading stops across all the suggested trains instead of running a mix of non-stop and 'all stations' services, but the effect of this is to limit journey opportunities between stations. This is a very similar situation to that applying on the West Coast Main Line (WCML) after the 2010 upgrades, and restoring intermediate connectivity on the WCML is in fact a large part of the case for building HS2.

Ironically, the IRP accuses HS2 of potentially damaging services at intermediate stations (without evidence), whereas its own proposals require that intermediate stops must be omitted to achieve quoted journey times.

All in all, the journey times set out in the IRP seem to me to largely unachievable in regular operation of a viable commercial timetable. In particular, the claim that London to Sheffield can be achieved in the “exact same time” under the IRP as would have been achieved by HS2 is not plausible, other than by missing stops at key locations including East Midlands Parkway itself whereas the HS2 Eastern leg time to Sheffield included a call at East Midlands Hub.

Examples are:

	Now (mins)	IRP (mins)	Comment
London–Leeds	133	113	Current time includes three stops. IRP time is not credible without missing stops.
London–York	112	98	112 minutes now is the non-stop timing, not ‘typical’ as it applies only to about one train in three. Not credible that it can be reduced by 14 minutes through ‘upgrades’.
London – Newcastle, non-stop	156	145	Current time is achieved by one train per day. Pathing issues rule out anything other than a once a day ‘spectacular’ even if the pathing of an accelerated train can be achieved.
London – Newcastle, one stop (presumably York)	169	148	Current trains make between three and seven stops (170 – 192 minutes). IRP times cannot be typical without missing stops or introducing pathing issues.
London– Nottingham	92	57	My estimate for IRP service is 62 minutes – see Appendix 1.
London–Derby	86	58	My estimate for IRP service is 62 minutes – see Appendix 1.

London– Sheffield	118	87	My estimate for IRP service is 94 minutes – see Appendix 1.
Birmingham– Nottingham	74	26	My estimate for IRP service is 31 minutes – see Appendix 1. Would increase to 33 minutes with commercially-desirable stop at Beeston.

The Mott McDonald report presents a train service specification for the Nottingham and Derby services featuring:

- Euston – Sheffield: 2 trains per hour
- Euston – Nottingham: 2 trains per hour
- Birmingham – Nottingham: 2 trains per hour

However, in order to achieve the claimed headline times in each case, only one train out of two on each route is shown to call at East Midlands Parkway. Apart from complicating the timetable and making resolution of capacity issues more difficult because of uneven running times, this leaves key flows such as Birmingham to East Midlands Parkway served only hourly, which is of almost no value over the distances involved. Overall, whereas East Midlands Hub would have had 4 trains per hour to and from London, and 2 trains per hour to and from Birmingham, the service at East Midlands Parkway will be just half that level in each case, implicitly demonstrating that East Midlands Parkway does not serve a comparable role to East Midlands Hub.

Capacity issues

The rationale for building HS2 has always been capacity, with speed as the opportunity that follows from building new infrastructure rather than the reason for building new infrastructure. It is therefore perverse that the IRP focuses on journey times and is devoid of detail as to how its capacity claims will be delivered – other than where adopting HS2’s pre-existing proposals such as between Newcastle and York.

Phase 1/2a of HS2 and the Western leg demonstrably increases capacity on the West Coast corridor, with the benefit of released capacity primarily felt not just in terms just of seats, but most dramatically in improved links between intermediate stations. For a worked example, see my article in *Modern Railways*, October 2019, key findings from which are summarized in Appendix 2.

The benefits of released capacity arise on the WCML because the HS2 infrastructure bypasses complete sections of the route between major centres, e.g. London – Birmingham, London – Crewe. That allows the conventional service to be completely redesigned around the needs of intermediate stations. This would have been true of the East Coast corridor with the HS2 Eastern leg in place, as Leeds – London would have been completely bypassed, as would York – London barring the short distance into York station. In addition the Edinburgh – London flow would also transfer to HS2 given the HS2 Western leg and Golborne link.

The suggestion in the IRP that intermediate stations on the ECML stood to lose services is therefore bizarre and devoid of logic – rather, the effect would be that services at and between the intermediate stations could improve once the need to cater for end to end business between London and Leeds/York on the conventional line is removed.

It is where the new infrastructure does not extend completely between the origins and destinations of the new trains that pathing issues have been identified, e.g. Colwich – Stoke, Preston – Carlisle.

On the Midland Main Line (MML) to Nottingham and Sheffield, the IRP simply introduces this problem of feeding HS2 trains onto conventional lines between major centres. This makes it less likely that the existing conventional service can be reduced to free paths on the shared section, as it will still be necessary to maintain services between intermediate locations South of the junction to Nottingham and Sheffield, so that overall usage of the shared section would increase. So whilst it might be possible to increase services South of the HS2 junction – say between London and Leicester – these additional services could not extend to locations North of the junction.

The IRP presents no analysis or evidence that these capacity issues can be resolved, especially with the complication of uneven intervals implied by differing stopping patterns. Although the Mott McDonald report suggests various ‘interventions’, there is no clear demonstration that these would support both the new services from HS2 as well as an adequate service of conventional trains.

In respect of York – Newcastle, HS2 Ltd developed a package of works to resolve the pathing issues. This package of work is cited in the IRP, but as an IRP proposal allegedly allowing additional conventional trains to operate. In suggesting that HS2 has negative implications for the ECML services on this

section, the IRP is effectively contradicting itself – the problem and the solution are common to both the HS2 and IRP scenarios.

For stations South of York, exactly the same logic as demonstrated for the WCML would apply, in that intermediate services could be expected to improve up to a point that is commercially/economically justifiable.

Moreover, it is the IRP proposals that threaten these intermediate services, as:

- Achieving the quoted IRP journey times regularly as opposed to as occasional “spectaculars” can only be achieved by omitting stops at intermediate stations;
- Increasing the speed of the fastest trains to 140 mph makes it all the harder to find paths for slower services.

Relationship between IRP and Euston

From the Mott McDonald report, and pages 90/91 of the IRP, the given seating capacities that the following train service frequencies and formations are proposed:

- London to Nottingham: 2tph x 200m trainsets;
- London to Sheffield: 2tph x 200m trainsets.

Assuming that the full total of 11 tph, as set out on page 133 of the April 2020 HS2 Full Business Case, is operated on the Euston to Birmingham, Macclesfield, Liverpool, Lancaster, Glasgow/Edinburgh and Manchester services, the total number of trains using London Euston will be 15 tph. This itself presents no difficulty, as the practical capacity of the 10-platform Euston HS2 station is 16 tph¹.

However, the implication is that if the Eastern leg or anything like it is ever completed in full, only 1 tph could operate on it to London due to lack of capacity at Euston, which is hardly likely to support a business case. This is the combined effect of adding Nottingham as a new destination to the HS2 service specification, and reducing Euston station from 11 platforms to 10.

A mitigation would be to run the Sheffield and Nottingham trains combined as one 400m train from Euston, splitting them at Birmingham Interchange where adequate platform length is available. However:

- the extra stop (albeit commercially desirable in itself) and the split/join activities would take journey times to Sheffield and Nottingham even further from those claimed in the IRP;
- even three paths per hour, presumably to Leeds, on an extended Eastern leg is unlikely to support a business case.

Of course, if Euston station had 11 platforms, a total of 18 trains per hour could be operated, and so 2 tph to Newcastle be added. This is equivalent to the April 2020 specification, and so could be expected to support a business case.

Future options for Leeds

The IRP leaves open the issue of how Leeds might be linked to HS2 in due course. I suggest there are three potential approaches:

1. Complete the Eastern leg broadly as previously planned;
2. Complete only a further section of the Eastern leg, sufficient to allow trains to Leeds to complete their journeys on existing lines;
3. Serve Leeds as an extension of London – Manchester trains.

Complete Eastern leg as planned

The time savings offered by the Eastern leg are so dramatic that some saving could be sacrificed to reduce costs in critical locations, e.g. by minimising alterations to parallel motorways. HS2 Ltd have explored some such economies with the aim of optimizing the balance of costs and benefits, whereas if the objective is simply to reduce capital cost further economies might be made.

Arrangements in Leeds itself do need to be considered. A terminus station here is less satisfactory than at Manchester, as the Manchester station is designed for a quick 'run in, run out' between different routes whereas the erstwhile plan for Leeds was not, with access to the North East being provided by a separate branch (in fact by the main line to South of York, with Leeds as the branch). Unless the main line to York is provided, it is essential that trains from London and Birmingham should be able to run through to York.

The erstwhile proposal for Leeds was notable in failing to provide an 'out of town' station on the high speed line, so that passengers from the Leeds hinterland unable to use public transport to the Leeds station would have

to drive there, incurring parking charges and adding to congestion. A suitable location for such a station would be North of Garforth on the York main line, accessed by the M1 and A1(M).

Complete a further section of the Eastern leg

Where the Eastern leg was to pass to the East of Rotherham, following the M18 a few miles further instead of turning North to approach Leeds/York would allow HS2 to join the Sheffield – Doncaster line, and run into Doncaster station. From there trains could use existing lines to Leeds and Newcastle.

A faster approach to Doncaster would be possible if some tunnelling were undertaken, but obviously this would cost more for what might be a stop-gap solution.

This approach puts Doncaster into the high speed network, with potentially very significant benefits for a regeneration area.

The Sheffield spur from Pinxton to Stonebroom could also be included if desired, and Sheffield trains use that route as originally planned to achieve some further journey time savings, but this would withdraw the high speed service from Derby.

Serve Leeds as an extension of London – Manchester trains

This may be technically possible but would leave Leeds with a London service that is permanently half an hour or so slower than Manchester's.

The main problem is capacity. If seating capacity on trains is partly taken up by Leeds passengers, then fewer seats remain for Manchester passengers. In the absence of capacity for Leeds trains at Euston, one can conceive of a service whereby a train starts from Euston for Manchester with two trainsets coupled, and on arrival at Manchester Piccadilly one set is detached and continues to Leeds. However the HS2 specification is for peak-time Manchester trains to be formed of two sets anyway, so this modus operandi would see a reduction in Manchester's peak time capacity.

As this approach would place the nation's two biggest revenue earning flows onto one train service, failing to provide adequately for the volume would put a large amount of fares income at risk.

Conclusions

May I suggest that the Committee asks Ministers and the DfT:

- How they expect to make a Business Case for the truncated Eastern leg in the absence of fares revenue generated at Leeds?
- How accelerated services on the ECML are compatible with connectivity at intermediate stations, let alone allow for any improvement?
- How they intend to provide connectivity from the South and East Midlands to Yorkshire and the North East equivalent to that which would have been provided by the full HS2 Eastern leg?
- How HS2 services to Sheffield and Nottingham are expected to be accommodated on the Midland Main Line, and at Nottingham and Sheffield stations, along with all other required services?
- How, if Leeds is ever connected to HS2, they expect trains from Leeds to be accommodated at Euston station in addition to the services proposed in the IRP?

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Appendix 1:

Validation of IRP journey times

Curzon Street – Nottingham

Route Section	Minutes
HS2 Curzon Street to East Midlands Hub (Toton) – Start to Stop	20
Adjustment for reduced distance to East Midlands Parkway - Stop	-1
Dwell at East Midlands Parkway	2
East Midlands Parkway to Nottingham – Start to Stop	9.5
TOTAL PUBLIC TIME	31
IRP TIME	26

Euston – Nottingham

Route Section	Minutes
HS2 Euston to East Midlands Hub (Toton) – Start to Stop	51.25
Adjustment for reduced distance to East Midlands Parkway	-1
Dwell at East Midlands Parkway	2
East Midlands Parkway to Nottingham – Start to Stop	9.5
TOTAL PUBLIC TIME	62
IRP TIME	57

Euston - Sheffield

Route Section	Minutes	
	Section	Total
HS2 Euston to East Midlands Hub (Toton) – Start to	51.25	

Stop		
Adjustment for reduced distance to East Midlands Parkway	-1	50
Dwell at East Midlands Parkway	2	
East Midlands Parkway to Derby – Start to Stop	9.5	62
Dwell at Derby	2	
Derby to Chesterfield – Start to Stop	16.5	80
Dwell at Chesterfield	2	
Chesterfield to Sheffield – Start to Stop	11.5	
TOTAL PUBLIC TIME	94	94
IRP TIME	87	

These estimates are made by combining known HS2 timings with best times from the current Working Timetables on conventional lines. They include all factors relevant to creating a timetabled schedule – specifically, station dwell times, performance time <x> as per current Planning Rules, engineering time [x] as per current Planning Rules for conventional network or equivalent buffer within sectional running times on HS2. Pathing time (x) in current Working Timetables has been excluded, but there is no guarantee that some pathing time will not be required in future timetables, in fact this is extremely likely.

Dwell times are assumed to be the HS2 standard of 2 minutes, reflecting rolling stock features as well as likely passenger demand. These might be improved on, but any improvement is common to both IRP and HS2 scenarios so will not change the difference between them.

To achieve overall public timings, half-minutes or three-quarter minutes have been rounded up to the next full minute. Quarter minutes have been rounded down to the previous full minute.

Appendix 2

Exploitation of released capacity on the West Coast Main Line post-HS2

Fast services between key locations on WCML South, 2019 service, evening peak hour

	Euston	Watford	Milton Keynes	Rugby	West Midlands
Euston	x	0 ¹	4 ²	3	3
Watford		x	0	0	1
Milton Keynes			x	1	1
Rugby				x	1
West Midlands					x

Fast services between key locations on WCML South, post-HS2, suggested peak hour

	Euston	Watford	Milton Keynes	Rugby	West Midlands
Euston	x	2	8	4	2
Watford		x	2	2	2
Milton Keynes			x	4	2
Rugby				x	2
West Midlands					x

¹ One train calls to pick up only.

² Of which, two are Slow line from Ledburn.

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Endnotes

¹ I am well aware that Mr Stephenson's October 2021 Update to Parliament claims that 17 tph could be operated, but this claim is neither logical nor supported by analysis. For my analysis of the practical capacity of the 10-platform station, please see <https://www.newcivilengineer.com/latest/explained-why-11-platforms-are-needed-at-hs2s-euston-terminus-07-09-2021/>. 17 tph could only operate at the expense of service reliability, or of HS2 journey times, or by truncating one Anglo-Scottish service per hour at a location such as Preston, all of which are detrimental to the business case.