

## **A submission by the Institution of Mechanical Engineers to the UK Government's consultation on a Whole Industry Strategic Plan for the Rail Industry**

**February 2022**

### **About the Institution of Mechanical Engineers**

The Institution of Mechanical Engineers (IMechE) represents 115,000 engineering professionals and students in the UK and across the world.

This submission has been prepared by the IMechE Railway Division.

The Engineering Policy Unit of the IMechE informs and responds to UK policy developments by drawing on the expertise of our members and partners.

### **Reason for Submitting Evidence**

The IMechE's Industry and Special Interest Groups include those covering power, energy, buildings, process industries, alternative fuels, and road and rail transport. Our Railway Division members believe they can make an important contribution to help the Great British Railways Transition Team formulate their long-term strategic plan.

### **Collaboration with other Professional Institutions**

This reply has also been signed up to by some members of the REF (formerly Railway Engineers Forum), a multi-disciplinary body drawn from those Professional Institutions with strong railway interests.

The aim of the REF is, where realistic and appropriate, to provide a common voice on railway topics and co-ordinated responses to requests for professional comment in the railway field.

The constituent partners of the REF are:

- The Institution of Civil Engineers (ICE)
- The Institution of Engineering and Technology (IET)
- The Institution of Mechanical Engineers (IMechE)
- The Chartered Institution of Railway Operators (CIRO)
- The Institution of Railway Signal Engineers (IRSE)
- The Permanent Way Institution (PWI)
- The Railway Civil Engineers Association (RCEA)
- The Chartered Institute of Logistics and Transport (CILT)

## **Preamble**

### **Engineering issues**

The IMechE welcomes the creation of Great British Railways (GBR) as this enables a truly whole system perspective to be taken which allows engineers to make a contribution that will lead to more economic, efficient and even safer solutions. In responding to the GBR transition team's call for evidence, the Institution considers that the following engineering issues underpin its answers to the questions in this call for evidence document.

It is important that GBR is set up as a customer-focussed organisation that can help its partners deliver their objectives and, in turn, help the country to prosper. Railways are dispersed, complex close-coupled engineering systems <sup>1</sup>.

Engineers are there to ensure that whole-systems engineering provides the railway with sufficient capacity, performance and facilities in a sustainable, safe and cost-effective manner to deliver customer requirements. In addition, they should support strategic Government objectives such as decarbonisation and economic growth. GBR should, therefore, employ sufficient people to lead, manage, and maintain this complex engineering machine ranging from earthworks to the trains themselves. Engineers can provide options to improve the rail network and can advise on the implications of decisions. Arguably, the absence of an effective voice for engineering on the board of Railtrack led to the Hatfield accident that brought Railtrack down.

### **Skills**

The Williams-Shapps report rightly points out that the current railway structure makes it difficult for staff to understand how their roles relate to others in different parts of the industry. This limits the opportunity for whole-system high-performance efficient solutions to emerge.

GBR therefore needs to develop a system-wide workforce strategy and plan to enable the organisation to be resourced to meet current and future needs. All disciplines within the railway have a contribution to the effective performance of the railway; operators, timetable planners, station staff, train drivers, signallers, rules makers and all the engineering disciplines – civil, electrical, mechanical, telecommunications, signalling systems, safety etc. They need to have the skills to perform in their own discipline AND have the skills work closely together with other disciplines to deliver the best possible capacity and performance of the railway. Merely delivering a solution compliant with standards within one's own discipline does not necessarily deliver an optimised whole. We urge the GBR team to put skills and training at the heart of its people plans; technical and non-technical skills including leadership. For example:

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<sup>1</sup> : 'Professor Felix Schmid, in his Chairman's Address to the Railway Division in Autumn 2020'

- The Connected Leaders Scheme<sup>2</sup>, which is beginning to equip future leaders with a deeper understanding of customer needs and a better cross-sector perspective.
- The Chartered Institution of Railway Operators' (CIRO) rail system course offerings<sup>3</sup>, which have many years of successfully evaluated learner cohorts with data to evidence how whole system thinking improves rail management across all disciplines.

### **Economics of the Railway**

We urge GBR to focus on the following to ensure that the railway is on a sound economic footing:

- To agree the railway objectives with the government; the "what is the railway for?" question. These objectives might include agreed levels of subsidy to promote economic growth, the levelling up agenda and the provision of public transport facilities to support modal shift.
- There will be targets for growth in passenger and freight traffic.
- Agreement that there will be an aggressive programme to provide better value for money, for elimination of waste.
- An agreed funding stream to implement the Government's decarbonisation agenda.

### **Integrated rolling stock, infrastructure and timetable strategy**

In the current railway structure, Network Rail is responsible for infrastructure maintenance and upgrades, with train operators responsible for rolling stock. There have sometimes been significant disconnects between programmes and, with the exception of the Thameslink programme, little effort to do anything other than the minimum infrastructure change to accommodate new trains. In contrast, the Thameslink programme made a number of strategic civil and system infrastructure changes to accommodate a significant upgrade in the capacity of the Thameslink core. The introduction of programmes such as electrification and digital signalling require rolling stock to be modified or new trains procured in alignment with infrastructure delivery; but little has been seen about the opportunity to improve capacity other than the obvious opportunity to shorten head ways on plain lines with European Train Control System (ETCS) /no signals.

As well as aligning procurement and programmes, it is also an opportunity to integrate improvements in performance or other important capacity or connectivity work. This was not done during the Great Western Electrification programme, hence, for example, rail freight to Wales remains restricted by gauge limitations west of Didcot<sup>4</sup>.

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<sup>2</sup> launched in 2020 - [www.connected-leaders.co.uk](http://www.connected-leaders.co.uk)

<sup>3</sup> <https://www.ciro.org/courses/>

<sup>4</sup> 'Union Connectivity Review March 2021'

## **Maximising capacity**

Whatever the future timetable requirements, high capacity will always be required on core-routes to provide the required connectivity and accommodate freight and modal shift. Although digital signalling can provide some benefit, capacity on a mixed traffic railway is primarily constrained by train performance and infrastructure limitations<sup>5</sup>. Improving capacity thus requires a whole system approach. As an example, moving block signalling provided by ETCS level 3 might offer capacity benefits on mixed traffic and high-speed railways as it allows optimum separation between consecutive trains of whatever type. However, this should only be considered to be a long-term possibility as ETCS level 3 has been under development for 30 years and yet to find any significant use.

Moving block signalling removes the constraint of signalling infrastructure needing to be designed for the worst-case braking performance/speed combination on the line and allows optimal separation between consecutive trains of whatever type. Significant cooperation is necessary between signalling and rolling stock engineers.

A further improvement could be made on high-speed lines if trains were permitted to be closer to each other by implementing relative braking (i.e. where one train is following another, less than a full braking distance is allowed between them based on each train knowing the location and braking status of the other – known as 'relative braking'<sup>6</sup>).

Issues that need to be considered include ensuring that, as far as possible, all trains have the same performance. In practice this requires electrification, especially for freight trains. Although the resultant capacity benefit from electrification is an important part of its business case, this benefit was not quantified in Network Rail's TDNS (Traction Decarbonisation Network Strategy)<sup>7</sup> as it can only be quantified on a case-by-case basis. Neither did the TDNS take account of the rolling stock implications of their study; something that is a feature of Scotland's decarbonisation plan.

Freight trains require loops to accommodate full length 770 metre trains with reasonable turn out speeds that minimise impact on capacity. A mixed traffic railway would also benefit from freight trains with better acceleration and higher top speed. It is notable that the 75 mph speed limit for container trains has been unchanged since their introduction in 1968.

## **Engineering access**

When and for how long to close the railway for infrastructure work is a complex trade-off between train revenue and customer needs against the engineering cost of different access windows. GBR provides the opportunity to optimise such access by considering all relevant factors in a manner that cannot be achieved under the current relatively crude Schedule 4 penalty payment regime. In taking

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<sup>5</sup> 'Rail Engineer September 2018, Digital delusion'

<sup>6</sup> Shift2Rail MOVINGRAIL project <https://cordis.europa.eu/project/id/826347>

<sup>7</sup> <https://www.networkrail.co.uk/sustainability/a-low-emission-railway/>

this opportunity GBR should also consider the access requirements for integrating new, or new-to-route rolling stock, as the interaction between trains and track is ever more complex (Including Automatic Selective Door Open, Correct Side Door Open, Sliding steps, traction power auto changeover, ETCS etc.):

GBR could also accelerate NR's longer-term strategy to switch to mobile infrastructure monitoring systems (MIMS) that deploy increasingly cost-effective sensor technologies – potentially fitted at scale to both passenger and freight trains operating in normal revenue-earning service. Many UK SMEs are capable of capturing and collecting big data from “fit and forget” installations on trains in service. These “there for the ride” systems are ripe for machine learning and artificial intelligence processing to provide infrastructure engineering asset compliance assurance and engineering insights, flagging any relevant asset changes for maintenance attention.

Amongst many benefits, MIMS technologies would reduce the number of specialist measurement train runs (providing a small improvement in network capacity). Overall, more frequently captured and more intelligently processed data would enable more sharply focused maintenance interventions, thus further reducing engineering access requirements<sup>8</sup>.

## **Innovation**

Under the franchise regime the adoption of innovations on trains was limited by the relatively short payback period. As an example, because of the length of the TOC franchise, there was no demand for an innovative fuel saving transmission with a four-year payback<sup>9</sup>. An even bigger impact would be realised if the Double Variable Rate Sander (DVRS) system was installed on the UK's multiple unit fleet. This would transform performance in autumn conditions; something that costs the railway circa £100m per year<sup>10</sup>. It was first demonstrated in 2017 yet the contract for the first fleet fitment was only placed in early 2022. This is an example where, currently, incentives are unaligned. Network Rail is responsible for adhesion issues yet the cost of equipping trains with DVRS currently falls to TOCs or ROSCOs; although applications can be made to the NR Performance Improvement Fund. GBR should explore incentivising such innovations and in particular transitional decarbonisation initiatives that also offer fuel savings. However, although profitable, such investments will require funding which may not be available from the public purse. GBR should pursue opportunities for private financing of such initiatives.

ETCS is a part of the opportunity for GBR to enable increased capacity and there have been separate programmes developed for infrastructure and train fitment. GBR provides the opportunity to integrate the train/infrastructure programmes so that the benefits can be delivered as soon as the infrastructure is equipped. For example, GBR might enable all trains to be fitted early so that ETCS

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<sup>8</sup> 'Using LiDAR and Artificial Intelligence (AI) for Automating Clearances and Beyond, AREMA (American Railway Engineering and Maintenance-of-Way Association) Annual Conference, Sept 2021'

<sup>9</sup> 'Rail Engineer, May 2018, Technology alone is not enough'

<sup>10</sup> 'Rail Engineer, May/June 2021, Get a Grip'

infrastructure installation can always be “without signals”. GBR also has the opportunity to establish a performance regime that recognises that there might be deterioration in rolling stock performance due to the additional train-borne ETCS equipment.

GBR should also continue to support the RSSB data sharing sandbox initiative which encourages innovators to use data to enable better train performance<sup>11</sup>.

Fundamentally, GBR provides a system-wide optimisation opportunity to unlock innovations across the currently contractual train/infrastructure divide – including those in measuring and maintenance which could radically improve efficiency – and reduce engineering access requirements as discussed above.

## **Safety**

Finally in this section, we have assumed that it is GBR’s intention to maintain the safety record of rail which has been improving year on year. There is an opportunity to draw comparisons between modes, for example in freight transport safety, where the high HGV driver death rate (consistently 60+ per annum) might be most effectively reduced by increasing the modal share of railfreight, not by extra measures within highways<sup>12</sup>.

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<sup>11</sup> ‘Rail Engineer, June 2019, Enabling better performance’

<sup>12</sup> ‘Health, safety and sustainability opportunities and challenges’ – the PACTS Perspective, October 2021’

## **Question 1:**

### **Strategic Objectives for the Whole Rail Industry**

**The UK Government has developed five strategic objectives for the Strategic Plan over the next 30 years: meeting customers' needs, delivering financial sustainability, contributing to long-term economic growth, levelling up & connectivity, and delivering environmental sustainability. We intend to put these objectives at the heart of the Strategic Plan, and we are using them to guide all of the questions in this call for evidence.**

- a. How would you apply these objectives to rail in your region or to your area of expertise within the transport sector? Do you have evidence you can share with us of how you have applied similar objectives in relation to rail, and do you consider the objectives to have missed any key areas?**

What follows is a summary of engineers' involvement with each of the 5 points in Question 1. There will be more detail in our responses to Questions 2 to 6:

- Relationships within GBR and with the wider industry should be rebuilt. Currently, especially for rolling stock, the current industry set-up stifles innovation. Specifications tend only to ask for what is available, and suppliers tend to only develop what is asked for. GBR could change this approach.
- There needs to be a commercial will to realise real economies of scale with sufficient central vision and budget to support regional/local autonomy. For example, national contracts could be put in place to automate infrastructure data gathering, process data into insights and thirdly provide insights to regional and local asset management engineers for them to deliver. This mitigates the risk of "not invented here" and diseconomies of scale from devolution.
- GBR should emphasise "Working Together". This applies to teams within GBR and its suppliers, customers and stakeholders. One example to maximise value & improve safety and minimise cost & risk would be simplifying and/or removing interfaces between teams.
- Working together also applies between different work-streams. For example, if switches and crossings are being replaced and there's a capacity upgrade on the horizon, then perhaps the renewal might be undertaken including the design needed for the capacity uplift.
- Delivering Financial Sustainability – Aventra EMU case study:

In recent years, UK railways have ordered an unprecedented number of (>7,000) new vehicles including 2,600 Bombardier (now Alstom) Aventra electric multiple units for five different customers. This latter might appear to be an excellent case of standardisation on a rolling stock platform, but each fleet has ended up being unique. There are:

- three different cab designs,
- three different vehicle lengths,
- two different door layouts,
- 3, 4, 5, 9 and 10 car configurations,
- AC only, AC/DC, and DC only variants,
- a variety of interior layouts,
- some are equipped for ETCS and two class B systems (TPWS/AWS and CBTC) and some with just TPWS/AWS. One fleet has a form of partial automatic control, known as Automatic Braking and Door Operation, based on ETCS components.

Managing these variations puts significant pressure on design, configuration and certification resource as well as on software management which is increasingly important on modern rolling stock. All these resources were, and still are, in short supply which has put pressure on both customers and suppliers alike.

Given the constraints of the UK rail infrastructure, some of these variants were inevitable, but a structured long term GBR rolling stock strategy should be developed which should have at its heart steady procurement of new trains to avoid so-called "boom and bust". This benefits component suppliers, many of whom rely on a steady flow of work.

**b. How is it possible to make progress against a number of the objectives simultaneously? Do any of the objectives have larger barriers associated with them than others, or do any objectives pose possible barriers to others? Where would you make the trade-offs?**

It is absolutely necessary to make progress against these objectives simultaneously. Some are naturally linked, for example:

- By 'Meeting Customer's Needs' you increase ridership and help contribute towards 'Delivering Financial Sustainability'.
- By 'Levelling Up and Connecting' you contribute towards 'Long-Term Economic Growth'.
- By innovating to deliver 'Environmental Sustainability' you are 'contributing towards long-term economic growth'.

But it is important to have a prioritised plan containing 'shovel ready' projects agreed with stakeholders that can be quickly started as and when money is available. Comprehensive programmes of the nature of "I want it all and I want it now" will not attract attention when money is tight.

- The objective with the largest barrier is 'Delivering Financial Sustainability'. According to the latest ORR Passenger rail usage report<sup>13</sup>, 50% of the cost of running the railway comes from the fare /freight

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<sup>13</sup> Office of Rail and Road (ORR) – Passenger Rail Usage reports (2021-22')

revenue, with the other 50% being funded by the taxpayer. The ways to close this gap include:

- 'Cut Cost' - Remove costs quickly by simply reducing spending based on the advice of experienced engineers who can advise on what work could be deferred and with what risk. Projects could also be delayed. However, cost cutting is likely to have the impact of delaying the customer, capacity, sustainability or levelling up objectives.
  - 'Reduce Costs' – This involves everyone, including engineers, working through how to deliver more for less; i.e. maintain or increase quality/safety at lower cost. Commitments to long term programmes, such as electrification, provide suppliers with the incentive to invest to cut costs. Introduction of automated infrastructure inspection and adapting standards to enable new first-principles thinking would enable condition-based infrastructure maintenance that parallels the approach already taken with railway vehicles.
  - 'Increased Revenues' - Generally being able to get more or longer trains through the same bit of track (increased revenue vs. existing fixed costs) or else more passengers onto the same number of services. The biggest opportunity is modal shift aided by 'Meeting Customer's Needs'.
- None of these are easy or short-term challenges.
  - But the railway is not just about delivering an excellent sustainable transport service. The non-transport benefits to the economy of investment in railways are huge; with a significant multiplier on return-on-investment in the medium and long term. There is work for GBR to do to capture the non-transport benefits of the railway industry when making the case for funding. For example, the Economic Contribution of Rail report<sup>14</sup> found that, aside from transport deliverables, in 2019 (the latest year for which data is available), the rail industry itself has increased key metrics by typically 20% since 2016, supporting £43 billion GVA in economic growth, 710,000 jobs, £14 billion in tax revenue each year. And, for every £1 spent in rail, £2.50 of income was generated in the wider economy. Further, using National Infrastructure Commission future scenarios, the report shows that if rail investment is increased by 50% the rail sector would contribute to the economy an additional £5.6 billion per year between 2025 and 2029; with an extra 104,000 individuals employed in the industry as a result.
  - The objective with the smallest barrier is 'Meeting Customer's Needs'. In practice the railway does this every day – be it the supply chain meeting the operational needs, or the operator meeting the passengers' needs. The ability for both suppliers and operators to fully embrace a modern

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<sup>14</sup> [https://www.riagb.org.uk/RIA/RIA\\_new/Press/Oxford\\_Economics.aspx](https://www.riagb.org.uk/RIA/RIA_new/Press/Oxford_Economics.aspx)

'product management' approach is sub-optimal in the current industry structure and improvements in some key areas would turbocharge this:

- Greater innovation, flexibility and simplification in fare design.
- Fewer technical specifications and tenders for purchase products.
- Better marketing to the public, as currently, there are too many misconceptions about rail.
- Providing the passenger with a consistent face, for example, eliminate the problem where the customer is faced with a cancelled train from TOC A and is told they cannot travel on the next train which is from TOC B.
- Reintroduce holding connections to allow customers to complete their journey despite delays. This disappeared with TOC privatisation but is welcomed in Europe!

**c. What long-term trends in wider society, the economy, and the environment will affect these five objectives over the next 5, 10, and 30 years? Please give evidence to support your response.**

With the country still subject to pandemic related restrictions and public perceptions modifying behaviour, it is hard to see how the country will recover, and to what extent travel will return to its former patterns or even if that pattern might be changed forever. Whilst there may be long-term changes in demand patterns, decisions on railway capacity should not be taken based on the short-term impact of the pandemic as railway investment is a long-term business. Furthermore, there are indications that the pandemic and public expectations of low-carbon freight haulage will significantly increase rail freight traffic.

This is affecting all service industries and even the IMechE is uncertain how much business it will do face-to-face and how much will be hybrid or online. With so much uncertainty GBR will have to develop scenarios based on a variety of separate, but inevitably linked, issues. We have listed some of them:

- UK decarbonisation strategy; UK rail is still heavily reliant on diesel trains.
- Particulate emissions reduction, noting that electrification of road vehicles does not eliminate particulate emissions.
- Work-life balance and commuting habits.
- Domestic vs. international holidays.
- Electrification of road vehicles and introduction of autonomous vehicles.
- UK manufacturing; import vs export strategy.
- Demand for more integrated end-to-end journeys, i.e. links with bus and other providers for travel to/from railway stations.

- Increased demand for freight traffic, particularly container traffic and logistics traffic carried in converted passenger trains.
- A single focus for improved/simple customer ticketing and information apps from better wireless connectivity, data management and engagement with relevant stakeholders. Where necessary, such apps should be multi-modal to facilitate end-to-end journeys.
- Obesity and poor mental health – countermeasures related to active travel, supported by public transport use.

**d. What are the key uncertainties you consider that the Strategic Plan must be resilient to in order to be effective over the next 5, 10 and 30 years?**

This reply echoes our answer to question 1c

- Work-life balance and commuting: Passenger traffic rebuilt steadily during 2021 (until Omicron), with up to 70% of pre-Covid passenger journeys, increasingly shifted to leisure with less daily commuting (e.g. twice-a-week commuting has doubled; whilst daily commuting is at less than half pre-Covid rates)<sup>15</sup>. Less commuting reduces peak pressure by lowering the height of the peaks; but, in turn, more leisure travel demands more capacity off-peak, creating pressure to reduce weekend 'engineering work' and track possession downtime – to better enable modal shift from cars to trains. This uncertainty will continue.
- Domestic vs. international holidays.
- Driverless road vehicles.
- Domestic air subsidy – recent environmentally perverse incentives have been applied to journeys more readily carried out by rail, such as London-Edinburgh. The UK public's appetite for a robust approach to carbon-taxing of transport was established in the government's Climate Change Assembly<sup>16</sup>. For a counter-example, a diametrically different approach is being taken within the EU, where the high speed rail network is being more fully exploited, with increased specification sleeper trains being reintroduced, competitively priced and environmentally marketed.
- Online shopping growth. This is a **risk** as journeys for shopping might reduce but is also an **opportunity** for express freight ('parcels as passengers'); inter-urban express freight station-to-station, for fastest delivery to city centres (dedicated freight trains); and depot-to-depot logistics, with road-hauled 'final mile' (from dedicated trains serving distribution centres).

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<sup>15</sup> Office of Rail and Road (ORR) – Passenger Rail Usage reports (2021-22'

<sup>16</sup> "The Path to Net Zero" Climate Assembly UK report, Sept 2020

**e. Over the next 5, 10 and 30 years, which steps should the sector take to improve integration of rail with the wider transport system (including walking and cycling) in pursuit of these objectives?**

There should be enhanced transport integration to promote seamless transport journeys with promotion of active (walking/cycling etc) last mile journeys. Rail should embrace "Mobility as a Service"<sup>17</sup> to work in partnership with other providers to offer passengers with seamless journeys/tickets and choice of transport options e.g. quickest, cheapest, most environmental etc.

A good example of this occurs in Northern Ireland where bus stations are part of rail stations.

Rail freight needs to become better integrated too, including:

- Heavy haul for industrial customers.

Container freight for wholesalers on trunk electrified rail corridors relieving road congestion (with modal shift for the bulk transit facilitated by investment in trans-modal transfer hubs and distribution centres for regional and local deliveries).

- Express freight.

'Parcels as passengers' services supported by at-station collection hubs; with inter-urban express freight station-to-station providing dedicated freight trains for fastest delivery between city centres.

These services, the roll out of ETCS and the need to increase capacity to respond to the demand of modal shift, are likely to require more powerful locomotives such as the forthcoming Class 93 and electrification.

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<sup>17</sup> 'Mobility as a Service in the UK, UK Government Office for Science'

## **Question 2:**

### **Meeting customers' needs**

**Rail industry customers broadly fall into two types: passengers and freight. The rail network provides important benefits to the customers who rely on it. The Plan for Rail says that passengers must receive high-quality, consistent services day in, day out. This means accessible, reliable journeys that are well connected with other transport services and include new customer offers at stations and on trains.**

**Since the COVID-19 pandemic began, the rail freight industry has shown its resilience and agility, working to transport food and medical supplies around the country. This example, and others given in the Plan for Rail, highlight how important rail freight is to our economy now and in the future, and how we will develop growth targets for freight that will be included in the Strategic Plan. The Plan for Rail says of freight: 'national co-ordination, greater opportunities for growth and strong safeguards will put rail freight on the front foot.'**

- a. Passenger: how will rail passenger expectations, including accessibility requirements, evolve over the coming 5, 10 and 30 years, what will be the driving causes of these changing expectations, and how can they be most effectively met by the rail sector?**

Customer service: Providing customers with improved and simplified ticketing and information must be one of GBR's key objectives. Freight customers also require better systems to plan their operations and track shipments. We expect GBR to provide the focus for the development of customer-focused systems which will require improved telecoms connectivity, open data and sensors on trains, stations and infrastructure.

There is opportunity to integrate rail data into passenger-facing apps and connect data across systems. Such services will require GBR to support the government's ambitions for 5G connectivity and the development of the railways' digital infrastructure through the recently announced 'Project Reach' initiative<sup>18</sup> in which telecoms partners will build new communications networks along the railway in return for the right to commercially exploit it under a long-term concession agreement.

To provide seamless transfers between rail and other transport modes GBR needs to work with other stakeholders to develop "Mobility as a Service" systems to encourage modal shift from car to public transport<sup>19</sup>.

Accessibility: GBR has the opportunity to provide joined-up approach to accessibility. This includes getting to, from and around stations and on and off trains, including level boarding. On a mixed traffic railway level boarding is a

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<sup>18</sup> <https://www.networkrail.co.uk/stories/network-rail-invites-1bn-private-sector-investment-in-telecoms/>

<sup>19</sup> Mobility as a Service in the UK, UK Government Office for Science

complex issue which requires consideration of the complex platform train interface (PTI) and is another example of the need for a whole systems approach. Developing the best infrastructure/rolling stock solutions to improve accessibility for people with disabilities benefits everyone. GBR provides an opportunity to have a better balance between whether you invest in platforms/track or train to get the best value solution for PTI.

Environmental sustainability (carbon used, emissions etc.) is a virtue of rail, and rail's green credentials should be available to passengers so they can make informed journey decisions.

Passenger expectations will continue to rise as technologies develop and there will continue to be competition especially from road transport. GBR needs to understand and respond to changing expectations whilst having regard to the long life of rail assets. For example, before UK rail completes fitting USB A sockets to the passenger train fleet, they are likely to be obsolete in favour of USB C. (Historic examples include the provision of at-seat radio on Class 390 just as the iPod was invented. Payphones on High Speed Trains just as the mobile phone became popular. And, in the 2010s, new trains being delivered the with dot-matrix rather than LCD interior PIS displays etc.)

**b. Passenger: in your experience, how can we most effectively monitor and assess customer satisfaction? What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What evidence can you share to support your view?**

The IMechE asks its customers for feedback on the events it runs. Many organisations ask their customers some questions after they have bought something or have had some other interaction; such surveys should be routine. For customers who buy tickets online via websites or apps this is increasingly easy and should be adopted as a matter of course - as the market is moving away from season tickets this method will become more powerful.

There is a rich social media feed to most GB TOCs. This could be used and "mined" to provide some indicators.

**c. Freight: what evidence can you provide regarding the advantage(s) of transporting goods by rail and what evidence can you share for how that could develop in the next 5, 10 and 30 years? What do you consider to be the most effective role for rail freight in the existing supply chains served and those that it doesn't? How could this change over that period? In answering, please explain and take account of likely developments in technology and in the wider economy.**

- The green credentials of rail vs road e.g. promoting better air quality.
- The better safety record of rail vs road comparing not only freight train/HGV drivers but wider road haulage-caused road accidents.

- This will change through express freight (lighter, more time sensitive items) and the potential for “parcels as passengers”.
- The challenge/opportunity for freight is to accord it the priority required to compete. Trains that should travel at an average speed of 60mph often travel at circa 20mph because of priority accorded to passenger trains.
- Electrification to improve freight train performance and thus increase capacity.
- In addition, there is the obvious challenge, for much of potential rail freight, that the first/last mile still needs road transport. This adds additional logistical complexity and handling time which means that the two biggest things in logistics (cost and speed) are potentially compromised. Opportunities for innovation should be explored with freight partners.

**d. What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What are the interventions over that period which will be the maximum value for money, and what evidence can you share to support your claim?**

In the run up to the 2012 Olympics, London’s public transport was seen as a potential risk to the success of the events due to reliability concerns. Everyone worked together to make the railways, particularly the Underground, extremely reliable; and reliability has further improved since. Top retail organisations expect to see customer satisfaction ratings of good or outstanding (around 90%); this is a reasonable goal for reliability, cleanliness and customer service. Safety should be so good as to be taken for granted. Customer satisfaction will inevitably include questions about value for money.

The industry already has metrics for the cost of the railway and we assume that these would continue to be used with adaptations to the new organisation.

Engineers can support policy makers with data and analyses to achieve short- and long-term wider society objectives, such as:

- Carbon per passenger or tonne-mile.
- Congestion-avoided-productivity-benefit (capturing modal shift from roads into passenger mass-transit and HGV-displacing rail freight).
- Active-travel facilitation (capturing positively correlated public transport impacts on obesity and mental health).
- Air quality (perhaps a proxy for impacts on respiratory condition costs to the NHS), etc.

GBR has a unique opportunity to promote a more holistic approach to transport planning that meets wider governmental and societal objectives more effectively – and sets the framework for ongoing development and innovation towards the goals that customers (and taxpayers and citizens) really want.

### **Question 3:**

#### **Delivering financial sustainability**

**Rail is both a public service, supported by the taxpayer, and a business, run by private operators, with paying passenger and freight customers. The railways have received unprecedented levels of public support throughout the pandemic, protecting the essential services that people, including commuting key workers, rely on. As the recovery and rail reform gains pace, as with all areas of public expenditure, there is an onus on the rail sector to ensure value for money for users and taxpayers in how funds are used, and it must harness the incentives of the private sector to deliver the service in the most cost-effective way.**

**The railway, accordingly, must seek to deliver infrastructure and services more efficiently, in order to maximise beneficial outcomes while balancing costs against revenue and taxpayer funding. This is more than just a short-term issue: we are clear that reducing the cost of the railway, increasing efficiency including through innovating with private partners, and achieving a better deal for users and taxpayers is a critical priority over the next 30 years.**

- a. Where are the most significant opportunities and barriers to delivering financial sustainability in the rail sector over 5, 10, and 30 years and how do we achieve/overcome them? How can we most effectively monitor and assess this? What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What are the interventions over that period which will be the maximum value for money?**

Building on our reply to question 1b:

#### **Avoiding boom and bust**

The costs and skills issues of the UK's boom and bust approach to rail electrification has been highlighted by the Railway Industry Association<sup>20</sup>. This has also been a significant issue for rolling stock procurement. Between 2016 and 2021 around £11 billion was invested in 7,000 rail passenger vehicles. In the previous six years less than 1,000 vehicles entered service<sup>21</sup>. This was approximately half the then UK passenger fleet and resulted in 4,000 vehicles becoming surplus to requirement; some of which were quite new. It included surplus electric units for which there was no electrified railway to allow them to be redeployed. Most of the new train fleets were delivered late and suffered, and continue to suffer, from teething problems. An IMechE seminar highlighted the

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<sup>20</sup> RIA Electrification Cost Challenge March 2019'

<sup>21</sup> Rail Engineer editorial, April 2018, Rail Engineer, April 2017, New trains in their thousands'

reasons for this, many of which were related to the industry's capability to deal with so many new trains entering service at the same time<sup>22</sup>.

As the programme has progressed the situation has not improved; the unnecessary cost associated with procuring such a large number of trains is likely to be a significant percentage of their cost; perhaps in the order of £1 billion.

In other parts of the rail industry, giving teams a long-term work scope to deliver largely repetitive schemes is, if properly incentivised, the surest way to reduce costs; sometimes very significantly. The Railway Industry Association's Electrification Cost Challenge report showed this very clearly.

In the short and medium term (over 5-10 years), some of the long-term advantages of more radical application of the engineering science to optimise across interfaces can be realised; such as differential infrastructure pricing to reward trains which are more track-friendly. Engineers work well at defined interfaces e.g., wheel-rail. For example, cross-industry railway engineers got together post-privatisation to create Systems Interface Committees (SICs), hosted by RSSB. The Vehicle-Track SIC has successfully sponsored novel R&D and produced a world-leading whole-life wheel-rail cost model, quantifying and enabling better optimisation of the interface. Implementation has however been more limited, without wholehearted adoption of long term significant stable pricing; this is an opportunity GBR should develop and take further.

Finally in this section, all involved in spending money should be incentivised to reduce cost whilst maintaining or even improving safety/quality. On projects there are many system/process ways of achieving this; for example, not seeking to transfer risks to suppliers that are best managed by the customer. At the specification stage, it is often sensible to use a competitive process that allows dialogue between suppliers and customers to enable suppliers' ideas to be incorporated into the specification and for customers to understand how much innovations might cost. Such an exercise on the Bank Station enlargement on London Underground delivered significant improvement in customer facilities and easier construction.

There is also benefit in aggregating orders to achieve economies; illustrated by the recent combined order for up to 504 trams by six German/Austrian operators, where savings of up to 20% were claimed<sup>23</sup>.

### **Private investment**

Rolling stock leasing has been an effective way of introducing private capital into railway investment in the UK. If rolling stock could be secured against long leases, i.e. separated from operating contract durations (e.g. TfL leases of classes 378 and 345 trains, not their operating concessions), we would expect savings to be made. Moreover, the ready supply of lease finance would assist in

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<sup>22</sup> Rail Engineer December 2019, Improving new train introduction

<sup>23</sup> [www.railwaygazette.com/](http://www.railwaygazette.com/) - Six operators award joint contract for up to 504 tram-trains

making progress against the decarbonisation agenda; see our response to Question 6a.

Could private finance be viable for the fixed infrastructure? Depots are an obvious area where private investment could be attracted at low risk, which might be a path to finding ways to attract private investment into operating infrastructure assets.

If a short, medium and long-term capital programme were to be developed it would encourage the supply industry to invest in ways and means to deliver more efficiently.

**b. How can we most effectively monitor and assess this?**

We have not offered a response.

**c. What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years?**

We have not offered a response.

**d. What are the interventions over that period which will be the maximum value for money?**

Maximum value for money will accrue from investments that maintain our alignment with EU standards – so that GBR benefits from the common market in railway system components and that UK rail industry benefits from aligned innovation (preferably supported by UK government seed-funding) by being able to export to the EU market (and beyond; EU standards are increasingly being adopted internationally).

GBR should also embrace the opportunity for challenging standards where a solution provides acceptable risk and cost effectiveness such as the use of Very Light Rail vehicles and infrastructure.

The other big opportunity is to encourage engineers to use their flair to add value to their projects whilst meeting the requirements of the various standards. Solutions that inspire and delight; not just the culture of compliance that seems to have arisen in the last decade or so. The recent covered way at Bletchley, constructed in place of a former viaduct for the East West Railway is an example of a better, cheaper solution than the original plan to refurbish the viaduct.

#### **Question 4:**

### **Contributing to long-term economic growth**

**Rail helps to boost productivity and growth through improved connectivity and job creation, enables supply chains, delivers goods to businesses and consumers and directly employs over 240,000 people (source: the rail sector in numbers). Among other factors, such as population growth, long term economic growth is influenced by emerging technology, and innovative, more effective ways of thinking and doing things. Over the next 30 years, wider economic, social, environmental and technological trends will change the role rail plays in our economy. It will be for the whole sector to demonstrate that it cannot only continue to deliver wide economic benefits in the face of a changed economy but that it can find new ways to catalyse growth and prosperity.**

- a. As Britain recovers from the effects of the COVID-19 pandemic, what evidence do you have for how rail can contribute to wider economic growth over the next 5, 10, and 30 years? What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What type of interventions over that period will provide maximum value for money from rail's economic contribution, and what evidence can you share to support your views?**

The report by Oxford Economics commissioned by the Railway Industry Association (as previously referenced in Question 1) shows that UK rail system contributes £36 billion annually, provides £11 billion in tax revenue and supports 600,000 jobs. These figures are larger than UK Government figures of £10 billion economic contribution and 240,000 jobs and these do not take account of the wider rail network. There is no reason why rail should not continue to contribute to the economy on this scale.

As for the value of rail transport of itself, particularly investment in infrastructure and system capacity, this is well-known to deliver significant benefits such as regeneration. These arguments are evidenced in many reports such as the Transport for the North Rail Strategy<sup>24</sup> so we will not repeat them here.

There are also ample impact studies, citing the effectiveness of investment in rail infrastructure as a fixed system demonstrating a long-term commitment upon which others, from private sector investors to individual citizens, can confidently build. This is exemplified by South Yorkshire Supertram which was initially criticised as "taking unemployed people to where they used to work", i.e. from residential areas of Sheffield to the ex-steel manufacturers along the Rother Valley. Now it is recognised as a transformative engine in enabling people to access re-education services to up-skill and be taken on by innovative employers

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<sup>24</sup> <https://transportfornorth.com/rail-franchising-investment/>

re-energising the city. It has also outstripped its own demand forecasts; something it has in common with all of UK's light rail systems.

**b. In the context of enabling development and regeneration opportunities both in the immediate vicinity of stations and within the surrounding area, how can rail best facilitate improvements to places and local growth, through improved connectivity and unlocking commercial activity, housing, and employment over the next 5, 10 and 30 years?**

We have not offered a response.

**c. What innovative and modernising ideas do you have which would benefit the railway while supporting the strategic objectives? Please give evidence and make reference to how they would maintain or enhance the railway's safety record.**

**Customer benefit**

Improving local connectivity – rail/bus etc. – should be easy, but often is not. Making it easy for customers to interchange between trains and modes is a great opportunity for GBR. Generally, such connections are best managed by local people, which should be easier as a devolved organisation, which GBR aspires to be. However, the local initiatives should be measured against a national framework so that customers see consistent provision and quality.

**Operating and maintaining the railway cost effectively**

GBR may be tempted to diverge from standards but this idea is likely to have perverse impacts, impeding strategic objectives and dis-benefiting the railway system. Common international railway standards are crucial to enabling UK-based engineering to compete cost-effectively in overseas markets. As we learned in the development of TSIs, common standards are key to cost-effective procurement for UK-rail, with its limited purchasing power in the global rolling stock market. Furthermore, by continuing to maintain alignment with international standards in the domestic railway we facilitate UK rail industry exports.

However, it is important to evolve and innovate HOW we deliver standards; which should concentrate on interface-definition and deriving compatible performance, safety and reliability outputs. We acknowledge the excellent work done in this respect and there is a good infrastructure innovation framework in place which GBR should build upon cross-system.

One of the areas with most potential for innovation is how we maintain the railway. For example, there is huge scope to move away from periodically measuring the infrastructure, using expensive specialist machines operated expressly for the purpose, to frequent infrastructure monitoring; i.e. identifying any issues using comparatively inexpensive equipment that can capture insights from normal daily operation on trains in service, such as the Perpetuum

vibration sensors fitted to the axleboxes on all of South Eastern's Electrostar fleet<sup>25</sup>.

The GBR must enable the will to roll out new thinking/equipment in order to realise economies of scale; balancing vision and budget between the central organisation and regional/local devolved teams. In addition, there should be national contracts to automate infrastructure data analysis and processing into insights; these would then be provided to regional and local asset management engineers for them to action. The need is to mitigate the risks of "not invented here" over-conservatism of individuals and diseconomies of scale from devolution; barriers upon which great innovations, often from SMEs, have perished. The overriding need is to have absolute confidence in the infrastructure in order to operate safe and reliable services with maintenance interventions only at planned intervals.

Post-Covid passenger trends demanding increased off-peak passenger train capacity further strengthen the case for improving system availability through better infrastructure monitoring and more focused maintenance, with the parallel demand to increase track-worker safety by reducing worker exposure. See also our comments about engineering access in our Engineering Issues pre-amble.

Similar arguments apply to monitoring rolling stock. On-board systems monitor a great deal, but sometimes lineside systems can provide good information more economically. For example, lineside heat and vibration monitoring equipment successfully provides information about the condition of wheels and axle bearings on Chiltern Railways.

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<sup>25</sup> <https://www.railengineer.co.uk/a-tale-of-two-rcms-remote-condition-monitoring-or-reliability-centred-maintenance/>

## **Question 5:**

### **Levelling up and connectivity**

**The Secretary of State for Levelling Up has outlined four key outcomes on which the government will focus:**

- **Empowering local leaders and communities;**
- **Boosting living standards by growing the private sector and improving productivity and connectivity;**
- **Spreading opportunity and improving public services; and**
- **Restoring local pride.**

**Rail has an important part to play in working toward these outcomes, and particularly so in connecting the nations, regions and communities of the UK. Improved rail links can connect people to jobs, education and skills, high-quality housing, social opportunities, services, and green spaces, as well as encouraging the growth of businesses, and attracting leisure visitors into an area. Improving stations and surrounding areas can also act as a catalyst for regeneration and development and a cause for local pride.**

**At present, usage of rail differs widely across the UK; before the pandemic, almost two thirds of all rail journeys made were in London and the south east (Rail Sector in Numbers report from 2019).**

- a. What evidence can you provide for how the rail sector contributes to the four levelling up outcomes and to improving connectivity in across Great Britain, including through cross-border services? How does this change depending on the type of place where the sector operates (including in cities, towns and rural areas), and what are the most cost-effective ways at the sector's disposal to improve that further during the next 5, 10, and 30 years?**

We have not offered a response.

- b. How could the rail industry, over the next 5, 10, and 30 years, become more responsive to, and more accountable to, local communities and passengers? Please give evidence and examples in your response**

Network Rail has been pursuing a programme of devolution to regions/ routes, working closely in as integrated a way as possible with the train operator on the route. As an example, Scotland's railway is integrated with the Network Rail organisation and the Train Operator working together under a single managing director. GBR provides the opportunity for further integration with the elimination of overlapping or duplicate roles. Devolution risks independently minded approaches with divergent outcomes, and the challenge for GBR is to manage this tension, that exists in all matrix organisations, so as to deliver both innovation and common customer experience.

- c. What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What are the interventions over that period which will be the maximum value for money, and what evidence can you share to support your views?**

An example of a successful outcome of devolved integration is in Scotland where, in partnership with Transport Scotland, an integrated net-zero carbon plan had been formulated<sup>26</sup>.

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<sup>26</sup> <https://www.railengineer.co.uk/decarbonising-scotlands-railway/>

## **Question 6:**

### **Delivering environmental sustainability**

**The Plan for Rail commits to the creation of a comprehensive environment plan that will establish rail as the backbone of a cleaner future transport system, one that aims to protect and enhance biodiversity and the natural environment. That plan, the Sustainable Rail Strategy (SRS), will be one of the inputs to the Strategic Plan, and will build on and develop a strategy for achieving the policy commitments set out in both the UK's Transport Decarbonisation Plan and the Rail Environment Policy Statement that were published in July 2021, as well as the Net Zero Strategy from October 2021.**

**In addition to tackling the causes of climate change, the rail network must also be able to adapt to the changes already being seen. This means preparing for the impact of extreme weather events and increasing the resilience of the rail network to the impacts of these events – for example, flooding.**

- a. What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years?**

### **Carbon Neutral**

Although rail has low carbon emissions, UK rail's carbon emissions are amongst the world's worst. This is because the UK operates what is, probably, the world's most intensive diesel passenger service; with diesel providing respectively 56% and 96% of the energy for UK passenger and freight trains<sup>27</sup>.

As Network Rail's TDNS has shown, UK rail can only be decarbonised with a large scale electrification programme. However, Government has yet to be persuaded that the benefits of electrification justify funding of a large-scale electrification programme. GBR thus has a role to convince Government of the financial whole-system benefits of electrification which includes significant capacity benefits and **is the only way to decarbonise rail freight**.

Network Rail Scotland are currently implementing a programme to deliver a net-zero railway by 2035. Net-zero carbon by 2050 is a realistic objective for the rest of the UK, though this requires the UK Government to follow the example of the Scottish Government by agreeing to a rolling electrification programme. The basis for this programme is well described in the TDNS. The ability of GBR to co-ordinate infrastructure and rolling stock investment will improve the cost-effectiveness of this programme.

As the required electrification programme will take decades to complete there is a requirement to retrofit existing trains to reduce both carbon and other harmful diesel emissions. The formation of GBR both enables this to be done in co-

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<sup>27</sup> RIA report 'Why Rail Electrification', Appendix 4

ordination with the electrification programme and provides a business case to justify such investment.

With the constraints of public funds, sadly we expect that network electrification will be slower than envisaged pre-COVID. However, GBR should take the opportunity to make meaningful progress to improve rail's carbon footprint in the short-term by providing trains suitable for the lines that might never have enough traffic to justify electrification. This can be done in a cost effective and value for money manner by:

- Maximising the effective use of existing assets through:
  - hybridisation of midlife DMUs,
  - deploying alternative zero-carbon fuels.
- Replacing existing life expired DMUs urgently with zero carbon battery or hydrogen powered alternatives.

### **Modal Shift**

Even if the road network is largely populated by electrically propelled vehicles in the future (and, in our view, proposals to electrify trunk hauled road freight are in their infancy), there will still be emissions from rubber tyre and friction brake particles. Modal shift to rail is therefore to be encouraged. A 4% shift of passengers and freight to rail from road (and 20% of passengers from air) would save 3.5 million tonnes of CO<sub>2</sub>. This would mean 36% more rail traffic<sup>28</sup>.

Although HS2 will provide significant extra capacity on the London Birmingham, East Midlands, Manchester axis, further capacity increases will be required in other axes that are already near, or at, capacity. Some capacity might be unlocked by remodelling current constraints but in other areas new build may be necessary.

To encourage modal shift, customers will require a seat, reasonable prices, reliable services and timetables that work for them. An acid test might be: "does your line provide a reliable service home from an evening out in the nearest city?" Regular clock face timetables (where services run at consistent intervals), with long enough trains and traffic management systems that make connections work, are features that will encourage modal shift.

### **b. What are the interventions over that period which will be the maximum value for money, and what evidence can you share to support your views?**

We have not offered a response.

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<sup>28</sup> IMechE Round Table Event Dec 2021: Refocussing the Railway: Engineering into GBR

**c. How can rail best invest in climate resilience, supported by smarter forecasting, planning and technology, over the next 5, 10, and 30 years and what evidence do you have to support your view?**

Climate resilience is a particular case of ensuring that the railway is available.

Going forward, new and existing rail infrastructure must be maintained and constructed with resilience to climate change built in. This will involve assessment and mitigation of the risks posed by the impact of changing weather patterns and increasingly common incidents of significant climatic events; for example, increased rainfall contributing to landslips on to lines, higher temperatures affecting rails and violent storms with high winds causing trees to fall on lines or overhead wires. GBR will need to ensure that environmental specialists coordinate with rail infrastructure professionals to overcome these challenges.

Also, see our response to Question 4c in relation to innovation for maintaining the railway, with particular focus on frequent infrastructure condition monitoring, for example, levels in sumps, flow rates in drains, and with 'big data', linked to rainfall levels.

### **Contributors**

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