



# A RAILWAY INNOVATION STRATEGY

Getting ready for Great British Railways

April 2022




**Railway Industry  
Association**

*The voice of the UK rail supply community*

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#UnlockRail

**About RIA:** The Railway Industry Association (RIA) is the voice of the UK rail supply community. We help to grow a sustainable, high-performing, railway supply industry, and to export UK rail expertise and products. RIA has 300+ companies in membership in a sector that contributes £43 billion in economic growth and £14 billion in tax revenue each year, as well as employing 710,000 people. It is also a vital industry for the UK's economic recovery, supporting green investment and jobs in towns and communities across the UK; for every £1 spent in rail, £2.50 is generated in the wider economy. RIA's membership is active across the whole of railway supply, covering a diverse range of products and services and including both multi-national companies and SMEs (60% by number). [www.riagb.org.uk](http://www.riagb.org.uk)

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## FOREWORD

Darren Caplan, Chief Executive Railway Industry Association



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*"Innovation: the introduction of new things, ideas or ways of doing something".*  
**Oxford English Dictionary**  
.....

Innovation is a modern buzzword for something that the railways have been doing, and doing very well, since their conception. It is easy to forget how far we have come. Just consider, before railways there were horses, carts, and canal barges. Journeys, fraught with death or injury, could take weeks and were beyond the financial reach of most. Within a few decades of the advent of the 'iron horse', the British people achieved true mobility.

Thousands of tonnes of fuel, food and building materials could be brought to cities from remote areas quickly and cheaply. Fires were lit in the workshop of the world and exports soared, bringing great wealth. Developments in speed and capacity opened ever wider commuter belts and improved connectivity, enabling the country's capital, London to become one of the world's leading economic hubs. Its pioneering electric underground system, akin to arteries, delivering millions of workers daily from the relative sanctuary of the newly built suburbia.

It is fair to say that from the industrial revolution to the present day, the prosperity of the UK, and its citizens, has had a direct correlation with innovation in railways. The message is clear, with innovation cited a key national strategy by the most senior politicians in the country. Furthermore, the Williams-Shapps Plan (2021), and Shaw and McNulty reports (2016 and 2011, respectively) all identified innovation as the foundation for creating a railway fit for the future.

Why, then, has the Railway Industry Association (RIA) produced a document highlighting that we could, and should, be innovating bigger, faster, better, and sooner? Especially given rail's proud history of innovation and its 21<sup>st</sup> Century renaissance as a safe, clean, and inclusive mode of choice, with such high-profile backing from the nation's decision makers, influencers and thought leaders? And why now?

Unfortunately, despite the well-proven benefits of continuous improvement, the reality is that railway innovation is complex, difficult, fraught with challenges, and is often under-funded and under-supported. A supply chain keen to build an even better railway can find itself stifled, and often prevented, from innovating.

Private investors, willing to support innovative businesses, can often only do so with firm commitments from public bodies to pursue change. RIA members, who have so many novel technologies and services that could make a real difference to everyone who uses, builds, operates, and maintains the railway, have no route to make those differences real. We need a new approach.

UK railways are in a period of significant change. COP26 and the race to Net Zero, the transition to Great British Railways, the Integrated Rail Plan, HS2 construction, and ever-changing passenger expectations and travel patterns resulting from Covid recovery, all present a unique set of circumstances. That is why this Rail Innovation Strategy report is timely. We must grasp this opportunity with both hands to ensure positive outcomes not just for the railway industry but for society at large, providing an inclusive, low-carbon transport service to communities nationwide. As well as this, we should remember that rail contributes £43bn annually in investment, supports some 710,000 jobs, and, for every pound spent on rail, £2.50 is generated in the wider economy.

The leaders of both the country and the railway industry can choose whether we retain and develop the technologies, skills, and capabilities required to help UK rail succeed, leading to economic growth, prosperity, exports and 'levelling-up'. And if we do not make the right choices then that technology and those skills will need to be imported and will ultimately be more expensive.



So there needs to be long-term support and commitment to unblocking the pathways to innovation in rail. This will require investment now but will deliver financial and societal benefits to UK plc long into the future. In other industries, we are a world leader in exporting radical innovation. There is no reason this cannot be the case with rail – we have the skills, capabilities, and facilities. The financial reward for the successful creation and export of radical technology should not be underestimated, being worth billions of pounds.

The role of the Government is clear – it should seek to create an innovation-friendly environment. This is not just about funding – the supply chain is poised and ready to invest too, should the right environment be created. The rest of the story can be found in this report, where we set out six simple and straightforward key asks of Government and decision makers. If these

asks are delivered on, the supply chain, for its part, will be able to step up and help create a railway fit for the future. RIA firmly believes that the UK supply chain can remain at the forefront of global rail for generations to come.

This strategy has been prepared with the extensive assistance of the RIA membership and the counsel of experts from across the industry, to give a balanced overview – we would like to thank all those who have helped develop it. We hope those who read it support its content and agree that – to borrow a slogan from the Department of Business, Energy & Industrial Strategy – ‘together, we can lead the future of rail by creating it’<sup>1</sup>.



Students get hands on with HS2's construction - Credit HS2

## EXECUTIVE SUMMARY

This report looks to accelerate the creation of the low-carbon, cost efficient, reliable, and passenger-centric railway by examining the state of the rail research, development and innovation ecosystem and providing six key asks of government, and five recommendations to ensure GBR is an innovation-friendly environment.

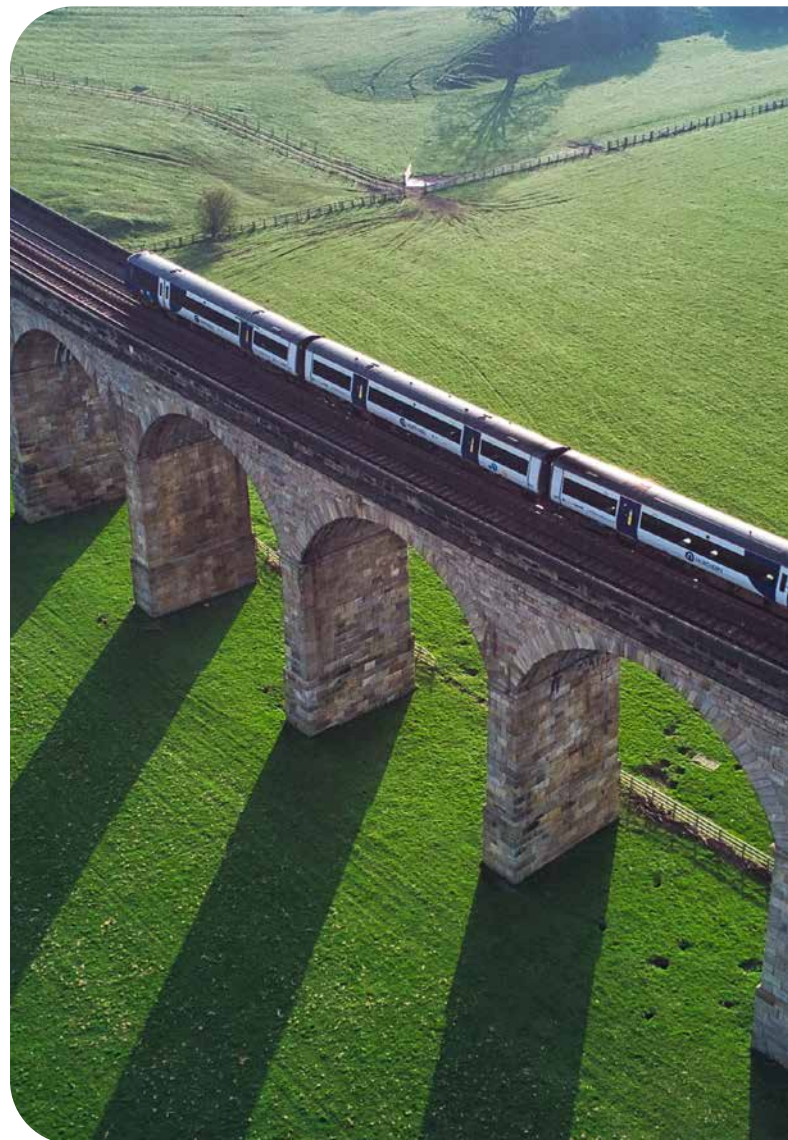
Research, development, and innovation are all crucial to the railway. However, this report identifies that it is through innovation, rather than research and development alone, that true positive change is achieved, and business benefits accrue. Innovation is research and development 'in action'. Value for money, customer satisfaction and exports can be directly influenced by an innovation-friendly environment.

Innovation is highlighted as a flagship Government priority, both within and outside the railway industry. However, despite small bubbles of best practice, we evidence railway innovation to be under-funded when compared to formal targets published by the Government in its recent Innovation Strategy, and under-supported, when compared to best practice. Worse, the path to adoption into business-as-usual for even trivial change is fraught with roadblocks. Radical innovation - which we define later - is almost entirely prevented, yet this is where some of the greatest benefits lie. Our inability to create an innovation-friendly environment has the knock-on effect of stifling private investment and initiative, preventing us recruiting the best talent. Without change, this will negatively impact our industry's ability to create a railway service fit for future generations.

RIA has studied best-practice from other sectors, and gathered evidence from individuals and organisations from across, and outside, our industry. We have examined, and present here, a series of case studies which highlight both the benefits of successful innovation, and the ways in which current practice has prevented adoption of technologies which could have made a real difference to operators, maintainers, and passengers. We have undertaken surveys to identify the blockers to innovation and we investigate how certain blockers could be removed to realise benefits sooner, to decarbonise faster, to leverage the power and investment of the private sector, and to build exports, skills, and capabilities - including through enabling radical change.

As a result, we are confident in making six simple, practical, and evidenced key asks to ensure the future success of railway innovation and, by extension, secure a transport system fit for those who rely upon it. We then build on this to propose some recommendations for creating an innovation-friendly environment within the new Great British Railways structure, unleashing the true power of collaboration with the private sector. These recommendations go some way to fulfilling those key asks.

We are positive about the Great British Railways era, and rail's place in our society and economy but we observe that successfully creating an innovation-friendly environment will require significant commitment from everyone in our industry.





## RIA's Six Key Asks:

- 1.** Increase Government investment in rail research, development, and innovation. Recognise that rail plays an active role in technology families where the UK Innovation Strategy recognises UK global competitiveness and build on this. Build rail into national innovation strategies and use it to deploy cutting edge technologies including zero carbon and digital twins. Seek opportunities to leverage private match funding. Efficiencies gained through the successful uptake of innovation will ultimately save the taxpayer money, whilst also improving customer experience.
- 2.** Strengthen support during the innovation rollout phase. Government and private sector initiatives have been successful in encouraging research and development, but often fail at the market adoption phase. Moving from innovation to business-as-usual requires resources, long-term commitment to change and buy-in from all levels of industry and Government.
- 3.** Lead a concerted cross-industry effort to identify and overcome barriers to successful adoption. Innovations need a clear path to market, and rollout is often prevented by policy, procurement, cultural or industry issues which are beyond the control of private sector innovators and investors. Enabling stronger collaboration with a shared goal will give confidence to private sector to invest in skills, facilities, supply chain, and product/service development.
- 4.** Provide a pathway and funding for radical innovation. To maximise the chance of positive change and securing the greatest benefits we should be prepared to focus a portion of any innovation portfolio on radical and challenging innovations - accepting some may fail, but those which succeed will provide ample reward.
- 5.** The railway must adopt a whole-system and long-term view to enable the right innovation. Innovation is core to the future resilience, cost-effectiveness, and sustainability of the railway, and needs to be treated as a business function like all others. Great British Railways should become the guiding mind on innovation for the national network, owning the implementation of the Rail Technical Strategy, and the Whole Industry Strategic Plan should place whole-system innovation at the heart of its thinking.
- 6.** Support skills development and the creation of an innovation culture. There is a need to encourage and support innovators on the individual level through training and development, promoting a culture of continuous improvement, innovation, efficiency, and customer focus. Innovation should be included in day-to-day objectives at all levels of seniority, bringing high-skilled, flexible, and modern career opportunities for a diverse group of individuals.

## Recommendations to Great British Railways

- 1.** Lead the creation of an industry eco-system to nurture innovation, and innovators, through the whole journey to benefits realisation and business as usual.
- 2.** Support the creation of the Global Centre of Rail Excellence as a comprehensive test centre with open and flexible access for the UK rail industry.
- 3.** Examine the case for test trains to complement UK test centre capability.
- 4.** Great British Railways and its regions organise to be 'the innovation guiding mind' and support the whole journey to innovation deployment and benefits realisation and act as an enabler to exporting opportunities.
- 5.** Take responsibility for allocating funds and teams for the first deployment of promising innovation in the regions.

## INTRODUCTION

This report looks to accelerate the creation of the low-carbon, cost efficient, reliable, and user-centric railway by examining the state of rail research, development, and innovation currently, and providing recommendations for improvement.

There are six key asks which, if implemented together, will enable the UK to remain a world leader and exporter of innovative rail technologies and services in an ever more competitive field. At the end of the document a series of case studies highlight innovations. We have deliberately selected some projects which have failed to make it through the 'innovation' phase, through no fault of the technology involved, to demonstrate the damage that a failing innovation pipeline is doing to our industry.

Research, development, and innovation are all important to the continued success of the railway. The question is whether we have the optimum environment to encourage them. Research and development represent an essential investment in any industry, and rail is no exception. Their importance to creating new understanding and capabilities should not be underestimated. Innovation is just as important, but crucially, from a business perspective, this is where measurable benefits begin to accrue – reducing costs and improving customer experience. All three represent an

investment, but, investing in research and development without proper support for innovation means that the benefits offered by novel technologies and ways of working cannot transpire. In short, we need to concentrate on turning our world leading research and development base into real, tangible changes to our operational railway. We are doing well in R&D and we need to concentrate on innovation.

Effective innovation translates new solutions into established new practice and delivers them with urgency and pace. The solutions must be practical, reliable, and affordable, satisfy customers' and society's needs and minimise demands on funding and resources.



HS2 encourages more women to consider a career in construction - Credit HS2

### Research, development, and innovation: how do we define these terms?

Research and development refer to the processes of paper or laboratory study, and physical creation and advancement, respectively. Research and development are vitally important, but until their application, would not typically bring benefits to a business. They are concerned with knowledge creation, and capability/technique demonstration.

The Oxford English Dictionary defines innovation as 'the introduction of new things, ideas, or ways of doing something'. The key word is 'introduction' – innovation is the beginning of the process to turn something novel into business as usual. At some point on this journey, the expenditure of resources will be offset by the business benefits, meaning the innovation represents a 'net-gain'.

Research, development, and innovation all require funding, but, with a few exceptions, innovation is where that funding pays back.

RSSB are leading on a collaborative piece of work to create a common language around these definitions to ensure the correct understanding during discussions within, and outside, our industry. This work will feed into the Whole Industry Strategic Plan and will be published separately.



### Railway innovation in a historical context

An early Victorian railway pioneer would be simultaneously familiar and astonished if presented with a modern railway system. Elements such as tunnels, viaducts, traction, rolling stock, signalling and telecommunications all still play a role, yet most have changed over time to be almost unrecognisable from those early days.

The constant evolution of railway systems has been driven by societal, business, and operational needs to have more frequent, faster, and higher-capacity services, whilst controlling costs, performance, and safety to acceptable levels. This evolution is the result of a constant pursuit of improvement through research, development, and innovation.

With growing awareness of environmental impacts, shifting public transport usage patterns, increased customer experience expectations and social mobility, our future railways must continue to evolve to meet new requirements. The railway of 200 years' time will look very different to today, just as ours looks different to those Victorian pioneers. This will be achieved through a mix of incremental and radical innovation.

### Rail in the context of the UK Innovation Strategy

The UK's 'Innovation Strategy: leading the future by creating it'<sup>2</sup>, published by the Department for Business, Energy & Industrial Strategy in July 2021, sets out the Government's vision to make the UK a global hub for innovation by 2035. It earmarks an increase in annual public investment in R&D to £22bn and sets a target of increasing public and private sector R&D expenditure to 2.4% of GDP.

The UK Innovation Strategy identifies seven technology families where the UK has globally competitive R&D and industrial strength:

- Advanced Materials and Manufacturing
- AI, Digital and Advanced Computing
- Bioinformatics and Genomics
- Engineering Biology
- Electronics, Photonics and Quantum
- Energy and Environment Technologies
- Robotics and Smart Machines

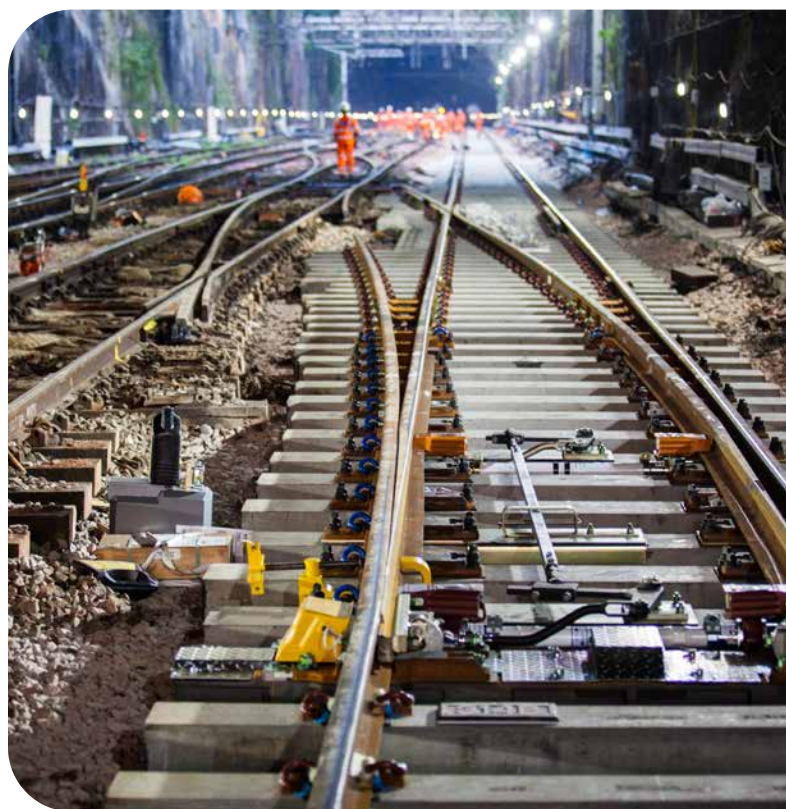
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*"I believe the formula for our success can be seen in the collaboration between industry, science and Government that led to the production of the vaccines. Strong and active Government investing massively in science and technology, coupled with a dynamic enterprise economy that embraces the instincts and know-how of the private sector."*  
**Boris Johnson, Prime Minister, March 2021<sup>3</sup>**  
.....

Railway innovation is already active in most of these families, such as through introducing lightweight materials to rolling stock manufacturing, using digital twin technologies and robotics to improve construction, operations, and maintenance, as well as working towards the target of Net Zero through energy and environment saving practices and technologies. AI is already in use to optimise traffic flows and monitor asset conditions. Many RIA members are pushing the boundaries of technology and know-how with innovations in these areas. Rail would provide one of the best places to develop and demonstrate UK capability in digital twins, automation, robotics and smart machines – with ready-made export customers, worldwide<sup>4</sup>. For these reasons, rail should be at the heart of Government innovation planning and investment.

When innovating in a state-regulated sector, it is natural to look to the state to take the lead. Through funding Network Rail's CP6 research and development programme, Innovate UK's First of a Kind competitions and RSSB's research portfolio, the Department for Transport has signalled its support for research and development, and the acceleration of innovation, in rail. Similarly, by supporting the creation of the UK

Rail Research & Innovation Network (UKRRIN) with two thirds of the funding, suppliers have shown a willingness to co-fund innovation and realise the value it can bring. RIA welcomes and supports these steps on the road to achieving the sort of aspirational changes discussed in the UK Innovation Strategy. However, railway innovation funding needs to be increased to meet targets listed in that Strategy and more strategically aligned around innovation rollout to leverage the additional co-funding available from the private sector. It may be that this increase needs to be gradual to ensure that the industry is capable of delivering the extra work.

It is important that R&D and innovation are responding to key business challenges. Sometimes, and especially in the short to medium term, these challenges are set out by clients and RIA welcomes the use of challenge statements and similar approaches, provided their owners are adequately supported to take forward good responses. Specifying outcomes during procurement or in early supplier engagement is proving very effective in delivering innovation. It is also important to consider the medium to long term and set out a future vision – this is the role of the Rail Technical Strategy.



### Autumn Budget and Spending Review 2021: aspirations vs reality

In the Autumn Budget and Spending Review 2021<sup>25</sup>, the Government confirmed spending £20bn per year on R&D. Total spending on R&D will increase by 1.1% by the end of this Parliament. The Government will meet the full cost of joining Horizon Europe, and increase Innovate UK's annual core budget to £1bn. The scope of R&D tax relief will expand to include data costs and, from April 2023, R&D investment will be encouraged to focus on the UK.

According to the Budget, the Government will support the UK's world-leading research base, while also ensuring that businesses across the UK have access to the ideas, skills, and finance they need to grow, driving increased productivity and leveraging further private investment. This settlement will make significant progress towards the Government's ambition to increase R&D spending to £22 billion by 2026-27, and drive economy-wide R&D investment in both the public and private sector to 2.4% of GDP 2027.

In 2019 the railway sector contributed £42.9bn to the UK economy in terms of GVA, and the rail transport system itself, which includes Network Rail and the train and metro system operators, accounted for £12.2bn of that total. This means that given the Government's own aspirations, RD&I funding for the rail sector as a whole should be circa £515m per annum.

Recent announcements have earmarked £3.8 billion in 2024-25 of 'other' R&D investment, which includes funding from the Department for Transport, among others, however it is unclear what fraction of this will be committed to rail.

### Technology Readiness Levels

Technology Readiness Levels (TRL) were originally developed by NASA as a means of assessing whether emerging technology was suitable for space exploration. The qualitative assessment of maturity uses a nine-point scale:

#### Research

- TRL 1: Basic Principles
- TRL 2: Invention and Research
- TRL 3: Proof of Concept

#### Development

- TRL 4: Bench Scale
- TRL 5: Pilot Scale
- TRL 6: Large Scale

#### Deployment

- TRL 7: Inactive Commissioning
- TRL 8: Active Commissioning

#### Operations

- TRL 9: Operations

### Rail Industry Readiness Levels

TRLs were adapted for the British railway system, putting them into a railway context, creating Rail Industry Readiness Levels:

#### Research and Development

- RIRL 1: Conception
- RIRL 2: Opportunity Development
- RIRL 3: Proof of Concept

#### Demonstration

- RIRL 4: Industry Specification
- RIRL 5: Prototype
- RIRL 6: Operational transition

#### Delivery

- RIRL 7: Initial deployment
- RIRL 8: Roll out
- RIRL 9: Whole Life Management

### Rail Technical Strategy

The Rail Technical Strategy<sup>26</sup> is a cross-industry initiative setting out a vision for how technology can be used to create a better railway and giving guidance on how to prioritise existing dedicated railway research and innovation funds. It focuses on five functional priorities:

- Easy to use for all
- Low emissions
- Optimised train operations
- Reliable and easy to maintain
- Data Driven.

## FUNDING INNOVATION

**Key Ask 1:** Increase Government investment in rail research, development, and innovation. Recognise that rail plays an active role in technology families where the UK Innovation Strategy recognises UK global competitiveness and build on this. Build rail into national innovation strategies and use it to deploy cutting edge technologies including zero carbon and digital twins. Seek opportunities to leverage private match funding. Efficiencies gained through the successful uptake of innovation will ultimately save the taxpayer money, whilst also improving customer experience.

**Commitments through CP6 represent the** greatest uptick of rail research, development and innovation spending in a generation and are now demonstrating the value of investment.

**Most near market-ready innovative products and services** lie with the supply chain.

**The supply chain is ready** to match-fund innovation, and an early engagement within suppliers will create more opportunities to co-invest and reduce risk.

**The supply chain would benefit** from a pipeline of research, development, and innovation activities, including visibility of funding streams and timelines.

**The Government's Innovation Strategy aspires** to 2.4% of GDP being assigned to research, development and innovation spending; rail currently falls far short of this.

**A review of the innovation** funding eco-system and its controls might be beneficial.

The railway is critical to our economy and to millions of commuters every day. However, its commercial structure is unique to the transport industry: public sector policy, regulation, and ownership of most infrastructure, alongside a reliance upon the private sector for its supply chain, operations, and much of its rolling stock asset base.

As part of the CP6 determination, Network Rail were awarded £245m funding<sup>5</sup> for a research and development portfolio<sup>6</sup>, which represents the greatest uptick of rail research, development and innovation spending in a generation, and offers an expected value and saving to the taxpayer of £1.6bn over 20 years<sup>7</sup>. This is a return of 650%, improving the safety, customer experience, sustainability, and resilience of the network.

There is a strong appetite in the private sector to invest in developing innovative products and services, as was demonstrated by £29m of co-funding in the CP5 programme and a £64m contribution to the UK Rail Research and Innovation Network (UKRRIN). Although not all concerned with RD&I, the appetite to invest in rail is further demonstrated by the £5bn invested in the last 5 years<sup>8</sup>. There is clearly a potential to attract more private investment if an innovation friendly environment is created.

It is worth noting that a lot of the private sector investment in railway research, development and innovation is not officially measured or logged as 'match funding'. There are several case studies at the end of this document demonstrating the commitment of RIA members to the continuous improvement of the UK's railway. However, for each innovation success story, there are many which have fallen by the wayside<sup>9</sup> through no fault of their own, and each one of them could have brought positive change to our industry.

The supply chain would benefit from a clear pipeline of research, development, and innovation activities, including visibility of funding streams and timelines. This will help suppliers gear up to deliver what is required, securing, and correctly targeting private co-funding.



RIA strongly supports the continued award of research, development, and innovation funding to Network Rail, and its successor organisation, Great British Railways. However, as forward-thinking as the CP6 R&D settlement was, and as much as it has been a success to date, we believe there were some missing elements to this funding which, had they been properly leveraged, could greatly have amplified its impact.

The CP6 settlement represented a direct funding award to Network Rail. This means that the significant co-funding available in private sector remained only partially tapped and that the supply chain was not fully engaged to examine what was already available – despite most near market-ready innovative products and services lying with the supply chain.

There is also a lack of clarity if and how the private sector can get involved, and around desired outcomes. The supply chain can only commit by understanding future funding pathways and technologies. With the transition to Great British Railways, a lack of clarity around EU funding and Government substitutes, it is unclear what funding mechanisms will be available next year, never mind longer term. Bringing all research, development and innovation funding under a single guiding mind should help bringing clarity and unlock supply chain capabilities.

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*“When Siemens Mobility wants to work on an innovative product it has to compete for the global R&D budget. If we do not have good foresight of the needs and pipeline for innovation, we cannot guarantee that we will develop a product that Network Rail or the Department for Transport needs, or that we will receive funding in the first place!”* **Will Wilson, CEO of Siemens Mobility**  
.....

For every £1 invested in rail projects, £2.50 is generated elsewhere in the economy. Rail contributes £43bn annually and supports some 710,000 jobs<sup>27</sup>. Investing in rail innovation will stimulate jobs, skills development, and diversification of the supply chain alongside any direct benefits from the innovations themselves.

ORR’s annual efficiency and finance assessment found that infrastructure owner Network Rail has made good progress developing its CP6 R&D programme in 2020-21. Network Rail’s R&D programme has 180 projects in its pipeline with 95 projects having commenced. There is a currently committed spend of £236 million across CP6.<sup>28</sup>

A review of the innovation funding eco-system would be beneficial. Any future Government-sponsored innovation competitions for high RIRL innovations could include a requirement to use a standardised toolset to demonstrate a commercial case, co-authored with a client organisation, before funding award. Benefit-cost ratio could be used as one of the key metrics in ranking applicants. This way the commercial feasibility will be considered alongside the technical feasibility and client organisations are brought on board early, helping to prevent ‘dead-ends’. It will make it clear which innovations offer the best possible return on investment, rather than just the smallest expenditure.

The supply chain would benefit from a single point of contact which holds the knowledge of all available funding streams, their suitability, and limitations, in an ever-changing landscape. This may or may not need to be a Great British Railways function, should it come to be the gatekeeper of such funding.



## BRINGING INNOVATION TO MARKET

**Key Ask 2:** Strengthen support during the innovation rollout phase. Government and private sector initiatives have been successful in encouraging Research and Development, but often fail at the market adoption phase. Moving from innovation to business-as-usual requires resources, long-term commitment to change and buy-in from all levels of industry and Government.

**The UK has world-leading and** internationally recognised rail research and development expertise as well as technology development roadmaps and strategy documents.

**Whilst the funding for research** and development is relatively healthy, there is a significant mismatch in the available funding for innovation rollout through to business as usual.

**The investment required at this** stage is typically much larger, and rail rarely benefits from private funding available through Venture Capital, equity, and scale-up investment.

**Innovations moving through the Rail** Industry Readiness Levels often experience not one, but two ‘valleys of death’.

**Suppliers who have developed a** product to market readiness often find clients have limited innovation funding and are prevented from utilising alternative funding sources. This can limit rollout even where there is clear business benefit in the longer term.

**The political, regulatory, and funding** structure of the industry may require bespoke solutions to fully unlock the expertise and co-funding available from the supply chain and investors.

**There are strong foundations to** build on: healthy R&D funding, challenge statements, the Rail Technical Strategy and existing collaborations such as UKRRIN, to name but a few.

RIA recognises the importance of funding innovative ideas to develop the proof of concept and every year we see many good examples of such ideas moving through RIRL's in established research and development pathways. These include academic partnerships, such as UKRRIN, and ideas encouraged from private sector

### Valleys of death

‘The valley of death describes the point where a business, often a technology-based business, has a working prototype for a product or service that has not yet been developed enough to earn money through commercial sales. The company needs to find sufficient money to develop the prototype until it can generate sufficient cash, through sales to customers, that would allow it to be self-sufficient and grow.’ From the Science and Technology Committee report ‘Bridging the valley of death: improving the commercialisation of research.’<sup>29</sup>

Railway innovations experience their first ‘valley of death’ when transitioning from research and development to demonstration, and the second when moving from demonstration to deployment.

innovators who may receive support through initiatives such as first-of-a-kind competitions or RSSB's research and development funding. Independently of state funding, our private sector is busy investing its own time and funds into future product development. For the first time in years, the foundations of good innovation – research and development – has funding consistency.

The UK also has an excellent suite of guidance around what short and mid-term innovation is required, through publications from Network Rail, Transport for London, HS2 and various operators. The Railway Technical Strategy gives roadmaps through to 2040 with key steps in-between. The client organisations have each published a set of challenge statements listing key technical and performance challenges which need to be overcome. Train operators, rolling stock companies and freight operators regularly publish similar challenges, and are often involved in their own privately funded competitions based upon them. Increasingly we are seeing innovation being driven by intelligent clients procuring by specifying outcomes. Those challenge statements should be owned by teams with the authority and expectation that they will procure and deploy successful innovations.

There is, however, a catch. Whilst funding for research and development is relatively healthy, there is a significant mismatch in the available funding for innovation rollout through to business as usual. This failure to adopt good R&D outputs has been referred to as a 'valley of death'. This is not an issue unique to the railway industry, in 2013 the UK Government published a report on 'Bridging the valley of death: improving the commercialisation of innovation'<sup>10</sup>. Railway innovations moving through the Rail Industry Readiness Levels often experience not one, but two 'valleys of death'. The initiatives listed below help to overcome the first valley, but not the second. Overcoming the second is just as important, as this is when any investment made up to that point pays back.

Since 2004, Innovate UK has awarded nearly £50m in funding to 205 rail specific projects<sup>11</sup>. 151 of those projects have been completed, and by a simple measure, around half have reached 'first deployment'<sup>12</sup>, though market penetration beyond this remains unclear. Lab by Transport for Wales has been created in partnership with Transport for Wales Rail (TfWR) to make rail an attractive industry for tech start-ups. It is a 12-week accelerator programme to help start-ups develop a fit for purpose minimum viable product and an opportunity to be awarded a contract of work with TfWR, allowing them to develop and launch their solution to market. Similarly, HS2's Accelerator Programme is a partnership with Connected Places Catapult and Burntwood SciTech offering a 4-month cohort to commercialise innovative digital products and services for HS2.

Infrastructure client organisations are constantly under time or cost pressure, leaving little room for innovation rollout, which often requires upfront investment for payback over many years, or even decades. Front line staff in these organisations face a constant barrage of approaches to try new techniques or products, but often do not have the capacity, funding, contractual flexibility, or management acceptance of failure to allow them to innovate. The situation is different within the rolling stock world, with private owners often seeing the financial benefits of innovation and being able to make the internal case for investment on an ad-hoc basis. However, the complex nature of rolling stock operation and ownership, relatively short-term operational contracts coupled with very long-term design, development, and implementation cycles for new rolling stock, often leads to similar outcomes.

### Universities and research organisations

The UK has a priceless asset in the strength of its research base, which is consistently ranked as world-leading in a wide range of areas. We have four of the top 10 global universities and 18 in the top 100. With less than 1% of the world's population, the UK accounts for 4% of researchers, 7% of the world's academic publications, and 14% of the world's most highly-cited academic publications. We also have strength in our research organisations which include independent and non-profits, as well as Research Institutes.<sup>30</sup>

There are isolated bubbles of good practice: Network Rail's Accelerated Innovation Programme is part of the R&D portfolio and offers an agile approach to delivery. Working in short 'sprints' and learning as they go, cross-functional teams solve problems and rapidly build concepts to test. By testing technologies earlier in the development process, the teams find out if they have potential and where there could be barriers. This approach allows projects to move from idea to trial 75% faster than with traditional methods. Equivalent initiatives are in place within HS2, TfL and many of the Train Operating Companies, but central innovation functions represent relatively small elements of each organisation rather than innovation being embedded throughout.

Network Rail's performance innovation fund enables innovation rollout where the benefits and costs are misaligned and is already seeing success through enabling, for example, the rollout of Double Variable Rate Sanders<sup>13</sup> for enhanced braking performance.

Whilst the supply chain welcomes these initiatives, it should be noted that they only offer a 'foot in the door' upon successful completion/demonstration, and in each case, there is minimal or no funding assigned directly to further rollout through to business as usual, should one of the many demonstrator projects prove feasibility. Some of the more aspirational or radical elements of these challenges may not be achievable using existing innovation pathways, and for this, perhaps a different approach would be more suitable.



Of course, innovation rollout funding should not always be the responsibility of the client and/or Government, especially where the private sector stands to benefit from the provision of a new product or service. The rail industry does not take full advantage of the range of private finance options available to companies who are scaling up or rolling out. Venture Capital, for example, is rarely seen, yet in other industries, it would be the norm for disruptive market entrants. Surety of market and strong and willing customer pull, and faster routes to market to enable quicker return on investment may help overcome this, unleashing the full power of private finance. Other options such as equity purchase and scale-up investments see similar challenges due to the complex market and long projected payback periods - sometimes decades.

Charting the progress of R&D through rail industry readiness levels; introducing new procurement models to facilitate collaboration from conception through to deployment; and establishing early sponsorship from Network Rail's devolved regions and routes to steer and pull through new products and services, will all be vital.

.....  
*"Innovation drives economic growth and creates jobs. The UK has a world-leading research base, which will be boosted by the Government's significant uplift in R&D investment and the creation of the Advanced Research & Invention Agency to fund high-risk, high-reward research."*  
**Rt Hon Rishi Sunak MP, Chancellor of the Exchequer, March 2021<sup>14</sup>**  
.....





## OVERCOMING BARRIERS TO ENABLE INNOVATION

**Key Ask 3:** Lead a concerted cross-industry effort to identify and overcome barriers to successful adoption. Innovations need a clear path to market, and rollout is often prevented by policy, procurement, cultural or industry issues which are beyond the control of private sector innovators and investors. Enabling a stronger collaboration with a shared goal will give confidence to private sector to invest in skills, facilities, supply chain, and product/service development.

**The complex railway ecosystem** is prohibitive to new entrants from outside the sector, with barriers present in policy, procurement, culture, and process, where misaligned costs and benefits prevent the justification of investment.

**A clear path to market** with a simple benefit and reward structure will stimulate private sector investment in skills and facilities.

**There are already some initiatives** underway to enable innovation by addressing barriers, and some more have been suggested by RIA members to further help overcome them.

**There is no one-size-fits-all approach**, but personnel at all levels should be coached to understand the value of, and how to enable, innovation.

To help the railway industry understand and overcome barriers to innovation, RIA works with partners, including Network Rail and UKRRIN, to deliver our award-winning Unlocking Innovation<sup>15</sup> programme. As part of this programme RIA has conducted two Innovation Perception Surveys<sup>16</sup> in July 2019 and July 2021, to determine how the railway sector perceives itself in innovation terms.

When asked which policies and processes had the greatest impact on innovation in rail, respondents said procurement was the main issue in both 2019 and 2021. However, industry sponsorship and champions had risen by 7% over the two surveys.

When it came to facilities and resources, respondents said the availability of innovation funding was the key factor, yet those responding this way had dropped 5% points from 2019 to 2021. The availability of testing and trialling facilities, however, had increased as a factor, rising 7% points from 2019 to 2021.

It is important to remember that this is a survey result and therefore only indicative. As respondents were asked to pick the 'main barrier' they may have experienced in each case, there may have been other barriers they had not yet faced. Additionally, their perceived barrier may not have been the reason each innovator was unable to achieve a path to market – it is only a perception. An example, it may be a product that 'couldn't get access to test facilities', but this may have been for a legitimate reason such as that product being unsuitable for the test, or having an incomplete safety case, so 'availability of innovation advice' would have overcome this. Each barrier, therefore, should not be taken in isolation. Nevertheless, as the results show relatively good consensus, it is perhaps sensible to target resources at the largest perceived blockers.

Throughout 2021, representatives of the cross-industry Technical Leadership Group, Innovation Leadership Group, supply chain, and clients joined a series of RIA-led workshops to share the results of the survey and identify barriers to innovation, as well as opportunities and initiatives to overcome them.

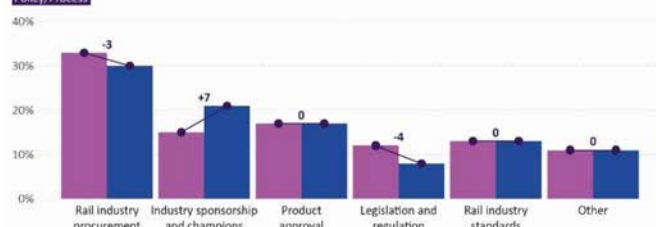
The workshops considered barriers and initiatives under two separate categories: those already completed, underway, committed to, or funded, and those which require further work, or even initiating, before becoming 'business as usual'.

### Results: Factors for innovation

Q8: Which one of these policies and processes, if any, has the greatest impact on innovation in the rail industry sector?

■ November 2019 ■ July 2021 ● +/- Change

#### Policy/Process

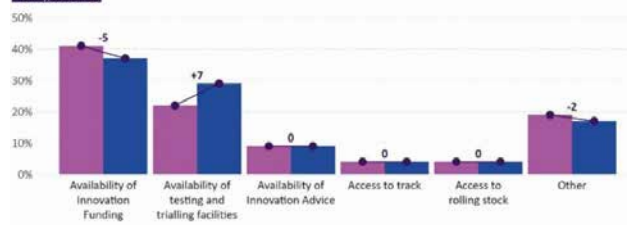


### Results: Factors for innovation

Q9: Which one of these facilities and resources, if any, has the greatest impact on innovation in the rail industry sector?

■ November 2019 ■ July 2021 ● +/- Change

#### Facility/Resource



### EXISTING ENABLERS

#### Increased support for SMEs

Network Rail has appointed a dedicated champion to help achieve the Government's target of awarding 33% of work to SME's. Part of the support has included a 'Dragons Den' type event<sup>31</sup> and support through the Product Acceptance process.

#### Increased use of SBRI

Innovate UK's annual First of a Kind competition uses the Small Business Research Initiative<sup>32</sup> model and has been running successfully for several years, with themes aligned with the Rail Technical Strategy.

#### Commitment to improve Product Acceptance process

Network Rail, the current custodian of the mainline Product Approvals<sup>33</sup>, has committed to clarify the process through updated information and training.

#### Network Rail CP6 Funding

The CP6 funding settlement included £245m, or circa £50m per annum, research and development fund, the largest such funding allocation for rail R&D since British Rail Research.

#### Refreshed Railway Technical Strategy

The Rail Technical Strategy was refreshed in October 2020 with a renewed focus on the tangible, short-term opportunities for technology to help deliver benefits to rail. This new iteration is a live strategy, with regular review and reporting of progress against the steps towards the vision, keeping all in industry honest; identifying issues, and recognising and sharing successes.



#### Refresh of Network Rail challenge statements

Network Rail has published a series of challenge statements<sup>34</sup> giving up-to-date information on problems on the operational railway.

#### Establishment of UKRRIN

The £92m UK Rail Research and Innovation Network<sup>38</sup> is a partnership between academia and the rail industry. It brings together key academic capability and knowledge, providing access to industry partners and enabling better innovations, sooner. It's model of industry-academia collaboration is envied overseas and is forming the blueprint for similar organisations in Australia, Portugal and Malaysia.



#### Enhanced access to standards for supply chain

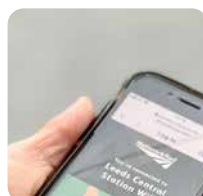
RIA led a campaign to make access to railway industry standards free for suppliers. This has now been granted, and standards are available online to registered organisations<sup>35</sup>.

#### Network Rail Performance Innovation Fund

The £40m CP6 Network Rail Performance Innovation Fund targets short term improvements for customers and supports innovative projects aimed at driving improvements in train service performance and punctuality.

#### Innovate UK Knowledge Transfer Network<sup>36</sup>

Innovate UK KTN connects ideas, people, and communities to respond to challenges and drive positive change through innovation. They offer support in networking, events, industry awareness and knowledge, finding funding, partnership building and more.



#### Network Rail Standards Challenge<sup>37</sup> process

With the assistance of RIA, Network Rail has developed a process by which existing published standards may be challenged with the goal of enabling products or solutions, which would otherwise have been unable to meet a given standard, to be certified.



#### RIA's Innovation Navigator

RIA has developed a website which will guide and inform new market entrants about specific pathways and pitfalls of innovating in railway. The Innovation Navigator<sup>39</sup> includes an interactive section to self-assess how 'railway-ready' an innovative business is.

## EXISTING ENABLERS

### RIA's Unlocking Innovation Programme

RIA's innovation communication and networking programme, Unlocking Innovation<sup>40</sup> aims to bring people together with ideas and ambition to drive change within the rail industry, supporting the industry to transform.

### Increased use of Digital Twins and Synthetic Environments

The rollout of digital signalling is benefitting from the use of these approaches to prove technical function and de-risk innovations before they move through to the operational deployment phase<sup>47</sup>.

### Re-establishment of Innovation Leadership Group

RIA has led the reformation of the Innovation Leadership Group, a sub-group reporting to the cross-industry Technical Leadership Group<sup>41</sup>, with a specific remit both to publicise the benefits and successful case studies involving innovation, and to help unlock promising innovations.

### Global Centre for Rail Excellence (GCRE), Wales

£150m has been committed to open a world class rail testing, maintenance, research, development, and storage centre in South Wales<sup>44</sup>. The centre will feature inner and outer loop electrified testing tracks and associated infrastructure, significantly boosting the UK railway testing capacity.

### UKRRIN/Unipart Innovation Hub, Doncaster

Led by Unipart Rail, the Innovation Hub<sup>45</sup> will support the sector in translating academic research and innovation to solve strategic industry challenges and to enable and develop the next generation of products and services. The Hub will have a particular focus in supporting SMEs, both those established and new to the industry.

### Understanding of innovation funding post EU Exit

UK-based researchers and innovators can still apply to most Horizon Europe<sup>42</sup> funding opportunities on the same terms as EU-based applicants. A new financial safety net has been established to existing applicants and RIA works closely with relevant organisations to keep the supply chain informed about any changes.

### Rail Innovation and Development Centres

Network Rail owns and operates two Rail Innovation and Development Centres. RIDC Melton is a purpose-built test track for the testing of rolling stock, plant, on-track machines, infrastructure, and equipment. RIDC Tuxford is 10 miles of single line test track with a 3-mile double section, allowing testing speeds of up to 75mph.

### Black Country Innovative Manufacturing Organisation

BCIMO<sup>43</sup> has been founded with the intention of creating a new industry centred around Very Light Rail. The facility in Dudley will allow whole-system development of track, vehicle and associated control and automation technologies.

### Rail Industry Balanced Scorecard<sup>46</sup>

As part of the Rail Sector Deal, a new procurement approach was built focusing on value for money, rather than price and looking at whole life value rather than the initial cost. It aims to build on the existing Balanced Scorecard and develop a common set of strategic themes. The focus on reducing impact and continuous improvement encourages suppliers to demonstrate new and innovative ways to deliver projects.

### Innovate UK EDGE

Innovate UK have launched the EDGE<sup>48</sup> scheme is a publicly funded service available to all high potential innovation-driven SMEs, including Innovate UK grant winners. It aims to bridge the gap between demonstrators and market adoption.

## SUGGESTED FUTURE ENABLERS

### Ensure continuity of funding through CP7

Ensure the continued funding for research, development, and innovation through CP7 and beyond. Promote the benefits, return on investment creating better value for money for the taxpayer, with ringfenced funds for the rollout phase. Allow for whole system thinking and supply chain co-funding and engagement.

### High Level Innovation Specifications

Change the procurement models to focus on High Level Innovation Specifications that are outcome based with general parameters around the aspired level of performance.

### Innovation Partnerships<sup>49</sup>

Educate and empower procurement teams to be able to use the Innovation Partnership model, where appropriate, as part of a portfolio of procurement techniques.

### Radical innovation

Create a mechanism which enables radical innovation.

### Source locally

Including social and environmental value in tender evaluations will support Government's levelling-up aspiration. Supporting local businesses to develop innovative products and services will build indigenous capability and understanding.

### Whole system innovation

The existence of Great British Railways and its regions as the 'guiding mind' for innovation creates the opportunity to identify whole system challenges and opportunities, and bring together the parties to collaboratively develop solutions.

### Challenge interoperability

Where appropriate, support selected deviations from standards (including interoperability) to enable innovative solutions provided there is a business case to do so including consideration of the gains or losses for export potential of novel solutions.

### Product Acceptance

Provide clarity of product acceptance, certification, and approvals processes under Great British Railways. Engage with the supply chain in any future revision of these processes.



### Solution-agnostic standards

New standards should be created in a solution-agnostic manner which should, wherever possible, not prevent competing technologies entering the market. Standards should focus on principles and outputs.

### Overhaul of the product-sponsor architecture

There should be a route to market for promising innovations independent of sponsors. The creation of a national database of named 'problem owners' could help market entrants who have not yet developed relationships with client organisations or have innovations which aren't geared towards solving one particular problem.

### Contractual incentives to innovate

Include incentives to innovate in any future contracts, such as the Passenger Service Contracts between the Great British Railways and train operating companies, or when procuring large civils works, for example. Include innovation KPIs in staff job descriptions, performance reviews and contracts.

### Enhance change management

Embed a cultural acceptance of change to create organisations open to innovation, adaptation and progress.

### Balance innovation benefits versus risk

Have stage-gate reviews which include business cases and examine the likelihood of adoption. Share cost, risk and benefits fairly between all partners in a project, whether client or supply side.

### Explore collaborative funding models

Ensure the incentives and objectives of the private bodies and contracts are closely aligned to the long-term business aims of the railway. This may include clarity on markets and procurement, partnerships, and private finance initiatives for infrastructure development.





## RADICAL INNOVATION

**Key Ask 4:** Provide a pathway and funding for radical innovation. To maximise the chance of positive change and securing the greatest benefits we should be prepared to focus a portion of any innovation portfolio on radical and challenging innovations - accepting some may fail, but those which succeed will provide ample reward.

**Incremental innovation is important to** continuous improvement, ensuring the customer offering continues to meet expectations. Radical innovation creates whole new customer offerings - growing industries and bringing about step-change reductions in costs.

**Radical innovation is key to** upskilling, levelling-up and economic growth.

**The more radical an innovation,** the greater the potential risk of failure, but the greater the potential reward. And as an industry we must be more accepting of failure as a step in the process of change.

Approaches to enable cross-disciplinary radical innovation are discussed in the section on creating an innovation friendly environment. Radical innovation, sometimes referred to as disruptive innovation, is a technology, technique or business model which has the capability to completely transform or replace the existing ways of doing things. It takes an existing system, design or invention and adapts it into something new. It may change the parts of the system, processes, or both. Radical innovation can be a well-developed technology from another industry applied to the railway for the first time. It brings about a step-change reduction in cost or improvement in customer offering, compared to the current best way of solving the challenge. The boundary between radical and incremental innovation is difficult to define, and often a matter of opinion. The reality is, of course, that it is a scale, and the definitions overlap, therefore we have provided some illustrative examples.

### **Innovation in traction: incremental, radical and whole system**

A good example of the difference between incremental and radical innovation, and the importance of whole-system thinking, can be seen in the evolution of traction.

For many years, the railway was dependent upon steam locomotives. Incremental innovation in steam technology allowed faster and heavier trains, but the underpinning technology – burning coal and the expansion of steam in a cylinder – remained the same. Maintenance was intensive, efficiency was low, and by modern standards, it was very dirty. Electric traction can be seen as a radical innovation which completely transformed this. Electric traction was clean and allowed more intensive services. Modern electric trains are, of course very different to the first endeavours, and this is again the result of incremental innovation in electric traction technology.

Though the benefits were clear, the radical shift to electric traction would not have been possible without a whole-system view. The most obvious physical change was the requirement for a power supply to be placed alongside the track. However, less obvious was the creation of whole new engineering disciplines to install and maintain this. New infrastructure technology, depots, maintenance and overhaul procedures, operational and safety practices were required, along with staff training.

British railway expertise and technology is still held in high regard overseas and it is a strong export sector as demonstrated by its prominence in recent free trade agreements. Technology developed, demonstrated, and adopted here has a high chance of becoming exportable. Historically, our rolling stock and signalling technologies have found significant markets overseas.

However, the pressure to find quick wins and to minimise risk has led to innovation funding being assigned almost exclusively to incremental innovation. Small changes to the passenger offering are noticed and appreciated by those using the railway, and RIA is supportive of this ongoing evolution. However, space needs to be created for breakthrough technologies and practices.

There is a risk that in focussing all effort on incremental innovations, we miss out on the value created by radical innovation. Radical innovation can involve a whole system or on subsystems, and there are several examples in the case studies section at the end of this document.

Any innovation, by bringing about technological or organisational change, carries with it the risk of failure. Often the more radical an innovation, the more safety critical it's nature, or the more interfaces or traditional railway engineering disciplines the innovation crosses, the greater the risk and impact of any potential failure.

Breakthrough innovations have a higher failure rate and they should be allowed to fail fast. Failing fast also means innovators being awarded a project quickly and without onerous paperwork, to remove the overheads associated with traditional R&D. Failing fast after a 3-year application, filtering and vetting process is not failing fast! We must allocate a portion of budget to 'just try it then', with appropriate rapid-iteration technology and commercial filters.

.....

*"To truly secure rail's future, there must be radical change. The railways lack a guiding focus on customers, coherent leadership and strategic direction. They are too fragmented, too complicated, and too expensive to run. Innovation is difficult. Incentives are often perverse. Some working practices have not changed in decades. There must be single-minded efforts to get passengers back. In short, we need somebody in charge (...) Private sector innovation has helped deliver the spectacular growth the railways have seen in the last quarter-century; it is essential that we keep the best of this and encourage more."* **Rt Hon Grant Shapps MP, Secretary of State for Transport and Keith Williams, Chair, Williams-Shapps Rail Review, May 2021**<sup>17</sup>

.....

RIA asks that a portion of any future funding should be secured for radical research and development. Typical best practice indicates a portfolio split which includes an element committed to radical solutions; the exact value of this split varies from industry to industry. In private sector, companies which apportion greater funding to radical R&D have been shown to achieve technical progress faster than lower-spending competitors. Financially, it must be accepted that not all funded 'radical' projects will provide a return, but those that do will amply make up any losses.

The route to market for radical innovation requires a different approach to any initiative currently underway in our industry. Some strategies, such as different approaches to procurement and specification, can help, and are covered in our key ask under removing barriers. Fundamentally though, radical innovation needs a place to be de-risked, in a technological, organisational, and systems integration sense. Part of the challenge is that it is difficult to implement any new concept on an operational railway, never mind a radical one. Once it is tested and proved to be commercially viable or offer a step change in performance, there is much more openness to introduce the innovation into business as usual.

### ETCS and ATO on Thameslink: Outcome specifications driving radical innovation

The Thameslink project is an example of an outcome specification. The objective was to get the maximum possible passenger numbers through the central London tunnel. The trains were specified to be as long as possible, but this alone was not sufficient, 24 trains per hour (tph) were required for the business case to work. Conventional wisdom was that 16 tph was the maximum possible on a conventional heavy rail network. Nevertheless the project was tendered on an outcome specification of 24tph. This led to the world first introduction of 'ATO over ETCS' - Automatic Train Operation supplementing the in-cab Signalling System to provide the precision needed to operate at this frequency reliably and consistently. The UK now has an exports reference site which international railways are keen to visit.

### Contactless ticketing on Transport for London (TfL)

A good example of a recent radical innovation is the implementation of contactless ticketing across the TfL Network - originally achieved with the Oyster payment card, and later improved to accept retail credit and debit cards. Contactless technology was not new, nor was it a rail-specific development, but the change to the passenger experience was radically different. The underlying RFID technology has been in use for many years in applications outside rail.



To enable the rollout of radical innovation, a test track built and operated in a manner to represent a fully operational railway system, such as the Global Centre of Rail Excellence in Wales, combined with support for SMEs and first deployment, are key enablers. This is discussed in the 'Getting Ready for Great British Railways' section of this report.



Pendolino tilting trains - Credit  
Avanti West Coast

### Tilting Trains

The West Coast Mainline has some tight curves and a mixed range of traffic speeds. The introduction of tilting trains enabled train operators to keep passenger comfort to acceptable levels, increasing express passenger traffic to 125mph whilst still allowing freight to share the line. This technology was first prototyped in the 70s by a number of countries, and in the UK by British Rail's Advanced Passenger Train. However, due to lack of commitment for the project, the prototype failed to enter mass production and the patent was sold to Fiat in 1982. After many more years of continued improvements the now familiar Pendolino trains, built on that technology, operate in 11 countries across Europe.<sup>50</sup>



## WHOLE SYSTEM INNOVATION

**Key Ask 5:** The railway must adopt a whole-system and long-term view to enable the right innovation. Innovation is core to the future resilience, cost-effectiveness, and sustainability of the railway, and needs to be treated as a business function like all others. Great British Railways should become the guiding mind on innovation for the national network, owning the implementation of the Rail Technical Strategy, and the Whole Industry Strategic Plan should place whole-system innovation at the heart of its thinking.

**The railway is a system** consisting of many engineering and operational disciplines.

**It needs whole-system and long-term** innovation thought leadership. We believe the formation of Great British Railways offers a once-in-a-lifetime chance to put this in place.

**Innovation should be built into** job descriptions and contracts throughout the industry to ensure an environment of constant improvement and adaptation is created.

The railway is a system made of many interacting subsystems. Rolling stock, track and civil infrastructure, energy management, control command signalling and operations, stations, ticketing, back-office data and planning functions, and many others, all interact to provide customers a service. Customers often do not see or understand the boundaries between these systems – whether in engineering or business terms – they merely want the system to be punctual, affordable, reliable, and safe.

Central to that system – and indeed the core reason for the existence of the railway – are its customers, freight or passenger. The make-up of users, and their requirements are ever evolving. The demand for freight capacity is increasing and its split between bulk, high-speed and/or high value is changing. The demand for passenger capacity is seeing a change from commuters to leisure travel in the wake of COVID-19. All existing and potential customers must be continually consulted as to what they wish the railway to do, and

how they would like it to perform. This step may seem simple, but it should offer the single biggest insight to ensure the railway delivers for all.

Recent rail reviews have highlighted the lack of whole-system view and leadership. The Williams-Shapps Plan for Rail recognised that there is no joined up thinking across the industry, saying: ‘Almost a decade ago the McNulty Review highlighted the lack of whole system thinking and adversarial relationships as key reasons for high costs, poor value and inefficiency in the rail sector.’ The new public body, Great British Railways, will bring the whole railway system under single, national leadership. It will develop the 30-year Whole Industry Strategic Plan, which aims to create a stable foundation for innovation and problem-solving, saying that priorities will only be achievable and affordable if the whole system of suppliers, operations and funders work together to plan, innovate, and achieve long-term ambitions.

The whole-system view should not become ‘one way of doing things’: delivery still needs to be adapted to individual requirements which may vary from region to region or operator to operator. Nor should it prevent agile development of ideas from the ground up. The guiding mind should co-ordinate and guide, but not necessarily lead on delivery, and must not become an innovation blocker. Systems integration – often overlooked – must be a key consideration.

Innovation should be at the forefront of every mind during the development of the future railway structure, including planning, design, implementation, testing, operation, and maintenance stages. The Whole Industry Strategic Plan should place whole-system innovation at the heart of its ideas, taking inspiration from cross industry initiatives such as the Rail Technical Strategy. Innovation should not be a separate, centralised business function. Organisations which are

### The International Union of Railways

UIC highlights the need to create innovative and sustainable technical solutions, aimed at increasing its competitiveness while taking into account not only single domains, but the railway system as a whole.<sup>51</sup>



viewed as progressive leaders have innovation woven throughout every function of their business, in every contract and in every job description<sup>18</sup>.

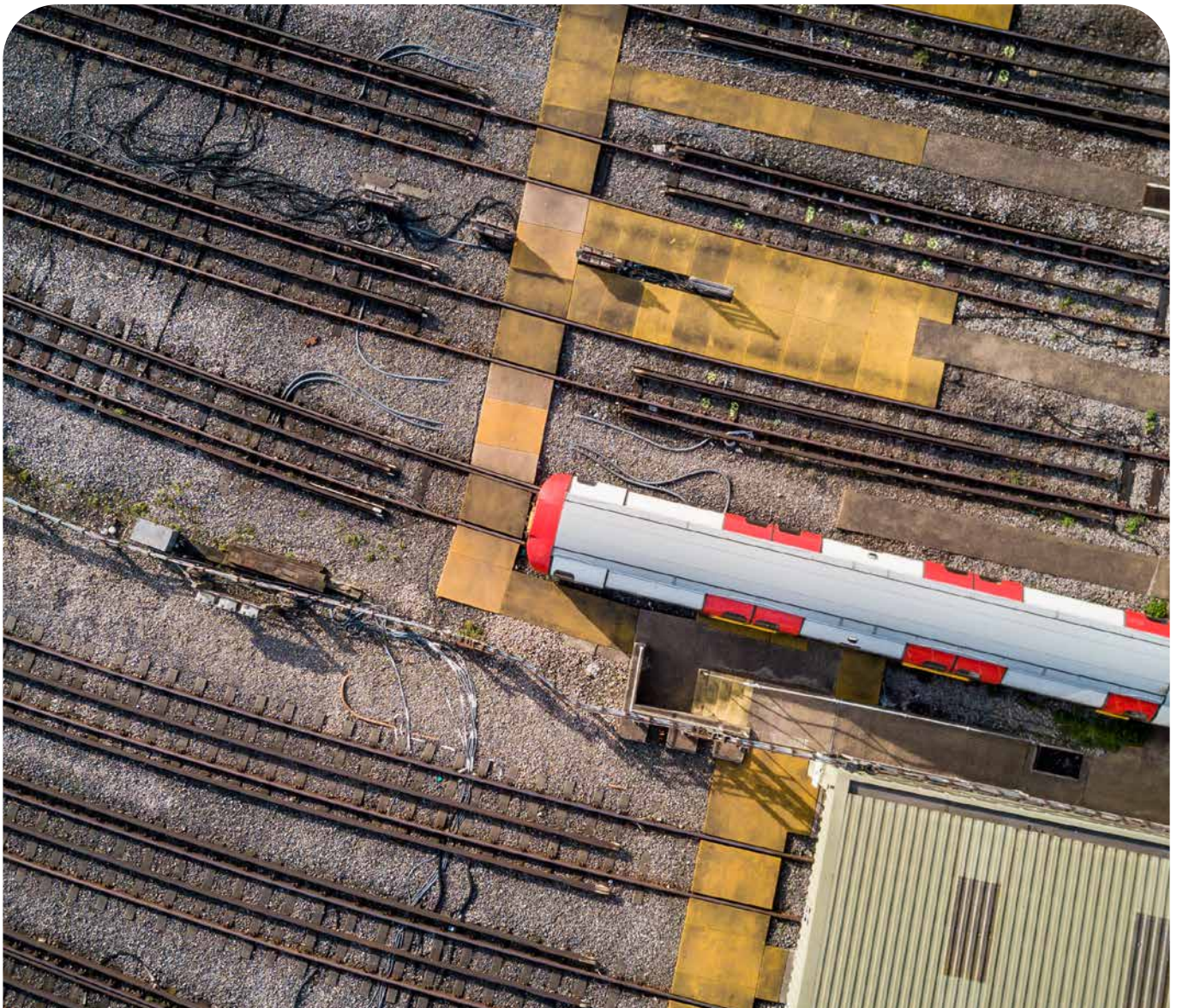
The split of asset ownership on the national network has led to significantly different innovation pathways. The Network Rail CP6 R&D settlement focused on improving infrastructure, and there is a noticeable difference in research and innovation funding between rolling stock and infrastructure functions. Unlike infrastructure, most of the rolling stock in the UK is privately owned, maintained, and operated. With private ownership of the assets, it makes commercial sense to balance risk of failure with commercial reward through innovation.

The private sector is already investing in rolling stock R&D. RIA member Porterbrook was challenged by their own supply chain to find a way to fast-track their innovations into a real railway environment. The Innovation Hub was born, a Class 319 off-lease

train which has been re-purposed into a show-train to demonstrate as many innovations as possible. In June 2021

Porterbrook took over the Long Marston railway test facility with plans to transform it into a leading centre for railway innovation. The company also invested £7 million in UK's first hydrogen-powered train HydroFLEX, tested at Long Marston. There are many more examples of supply chain investing in research, development and innovation affecting, but benefitting, the whole system, such as the Actiwheel case study.

.....  
*"We have to change the way we think about the application of new technologies and techniques, placing a real focus on the outcome to drive technology choice, as opposed to getting excited about a technology and then thinking about how we could use it."* **Dyan Crowther, Chief Executive, HS1**  
.....





## SKILLS AND CULTURE OF CONTINUOUS LEARNING

**Key Ask 6:** Support skills development and the creation of an innovation culture. There is a need to encourage and support innovators on the individual level through training and development, promoting a culture of continuous improvement, innovation, efficiency, and customer focus. Innovation should be included in day-to-day objectives at all levels of seniority, bringing high-skilled, flexible, and modern career opportunities for a diverse group of individuals.

**The biggest innovation enabler** is empowered, supported and motivated people.

**There is a need to** support individuals at all levels in a business to be able to improve personally, to adapt their roles and responsibilities and empower them to make positive change.

**This encouragement and support needs** to start through the promotion of diversity and inclusion such that our workforce reflects our customer base.

**There are opportunities to learn** from companies like Toyota who set an expectation that all employees are responsible for customer focus and quality – encouraging individuals to take responsibility for identifying incremental improvements and efficiencies.

For the railway industry to thrive, grow, and innovate, we need talented and highly skilled individuals across the full diversity of roles with strengths in collaboration, leadership, and systems thinking. The high demand for rail skills and the secure opportunities presented by the sector are internationally recognised. Railway suppliers are addressing the diversity and inclusion challenge by changing recruitment practices, celebrating the wide diversity of roles and opportunities the industry can offer and promoting equality, diversity, and inclusion throughout their teams. The industry should look to upskill its own workforce wherever possible, and only look to bring in external skills where they add value, not to replace the people we have.

Staff empowerment is key to accelerating innovation, and this has been demonstrated in the private sector. An excellent example is Toyota's principle of enabling

everyone in the organisation to bring about positive change through innovation, and the corporation's rise from humble beginnings to be the world's largest automotive manufacturer<sup>19</sup>. This culture may be beginning to occur in rail, through examples such as Network Rail's project SPEED<sup>20</sup>.

Innovation can cause a shift in the skills required of a workforce, and this should not be overlooked as part of the change management process. Constant training and development is necessary to ensure staff are best equipped to deal with new techniques and technologies. A recent stakeholder survey by the University of Huddersfield and RSSB<sup>21</sup> identified that reaping the full benefits from digital maintenance – for instance remote condition monitoring and data-based interventions – is being significantly delayed as the workforce, highly skilled in traditional maintenance practice, are needing to re-train and adapt to the new techniques.

In RIA's Innovation Perception Survey, 21% of respondents said that industry sponsorship and champions have the greatest impact on innovation in the rail sector. Supporting innovation from the earliest possible stage of a project and embedding an innovation culture in the project team, unlocks the expertise of the UK rail supply chain and ensures that the innovation is part of the project lifecycle.

In September 2019, Network Rail announced eight framework contracts with the universities of Southampton, Birmingham, Sheffield, Huddersfield, Newcastle, Nottingham, Heriot-Watt, and Loughborough to help the company deliver its R&D portfolio through CP6. The framework contracts envisage a minimum £10 million investment for universities to help deliver Network Rail's R&D portfolio and, crucially, allow universities to maintain core teams and nurture talent. The initiative delivers against the Government's Rail Sector Deal as an example of continued investment to help the UK become a world leader in rail technology, boosting exports and skills.

In 2020, the Railway Industry Association and Women in Rail launched a joint 'Equality, Diversity & Inclusion Charter', which is a commitment to work together to build a more balanced, fair and high performing sector. RIA launched this as a voluntary initiative, open to all companies, clients and organisations working in the UK rail sector who wish to play a role in promoting positive change in our industry. The ambition is to recognise and build upon the progress which has already taken place,

providing the basis to encourage further collaboration and action across the sector. It has already secured signatures from almost 200 organisations.

Again, private sector is an active participant in harnessing innovative skills and future talent. British Steel, a major supplier and exporter, has signed an R&D partnership with the University of Sheffield to test steel that can be used to build new and improved railway infrastructure. British Steel is contributing £1.6 million including significant staff time and materials, matched on a 2:1 basis with Research England funds.

*"Innovation is central to the largest challenges the world faces, from climate change and the ageing society to global pandemics. The UK must be in the vanguard of the response to these challenges. (...) By supporting innovation in places, sectors, and businesses across the UK, we can level up the economy and create high-value new jobs and trading opportunities as we build back better."*

**Rt Hon Kwasi Kwarteng MP, Secretary of State at the Department of Business, Energy and Industrial Strategy (BEIS), July 2021<sup>22</sup>**



BBV Kickstarters and apprentices with a model of TBM Dorothy - Credit HS2

# GETTING READY FOR GREAT BRITISH RAILWAYS

## Creating a future innovation-friendly environment

RIA's work in helping to overcome innovation blockers through our award-winning Unlocking Innovation programme has led us to speak to many stakeholders from across the industry. Time and time again we hear the same three major issues from opposite sides of the client/supplier interface. These issues relate to getting 'first deployment' innovation out on the railway and are, by their very nature, intertwined.

**The innovators struggle to get** access to an operational railway. People with innovative products, techniques and services have no way to prove the business benefits of their innovations, as the only way to truly do that is by fitting a first deployment on the operational railway.

**The operational railway can't accept** the risk of failure, whether that failure risk is of detriment to safety, reputation, cost, or delays. Neither staff, nor organisations, are incentivised to 'fail' - and with good reason so far as the customers are concerned! Hard evidence is needed, backed up by operational experience. The tendency, therefore, is to adopt a proven solution to avoid risk.

**The operational railway is unable** to support first deployment. Many valuable innovations find that there is no 'take-up' for first deployment due to issues such as the scale of funding, change management or there simply being no business drive for implementation – it is nobody's job to realise the benefits that the innovation offers.

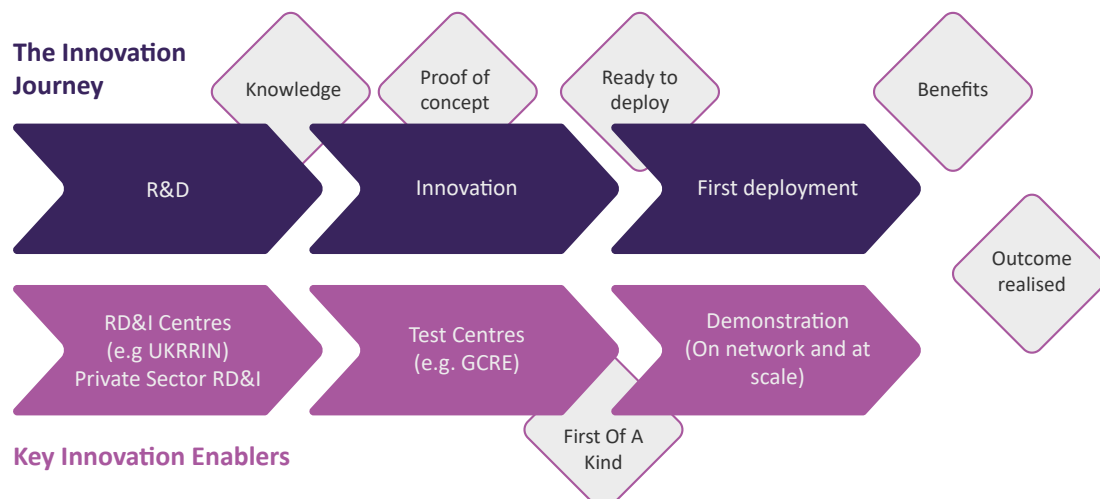
Simply solving one of these issues will not bring about an improved route to market, all need to be addressed. Furthermore, the more radical an innovation is, the harder it is to solve these issues, because the risk of failure is higher. There needs to be an approach which targets all three and we believe this solution is to consider and support the whole innovation journey.

The first two issues can be largely addressed by a comprehensive test and demonstration facility, able to prove an innovation technically and in integration with the wider system, as well as gather much needed evidence to support business case development. This can be further enhanced by making a fleet of test trains available. However, the third issue - deployment and commercialisation - requires further measures; solving this requires the creation of an innovation friendly environment throughout our industry, and Great British Railways will be core to this.

## How Great British Railways can support an innovation-friendly environment

A successful innovation journey is likely to be characterised by an environment in which there is:

- A pull from a client for an ambitious radical change expressed in outcome terms.
- Client funding to kick-start this innovation.
- A collaborative risk sharing approach as well as an understood and documented pathway through to commercialisation.
- The potential of a win-win for all parties balanced by a recognition and acceptance of an element of risk of failure.





Many of the building blocks for this journey are in place. Industry R&D programmes and UKRRIN are good examples. Two new initiatives have the potential to address the current gaps in this model - the proposal to increase UK test track capacity and capability (Global Centre of Rail Excellence) and an innovation guiding mind (Great British Railways). The journey and the innovation friendly environment that would support it are conceptually illustrated below.

**Recommendation:** Great British Railways to lead the creation of an industry eco-system to nurture innovation, and innovators, through the whole journey to benefits realisation and business as usual.

### Support the creation of test and demonstration facilities

In the UK railway, test centres are in such high demand that access has been very restricted, and they have tended to largely focus on train endurance testing.

This capacity challenge was the genesis of the initiative to create a new world class test centre – the Global Centre of Rail Excellence in Wales. The new centre will provide a multi-disciplinary facility capable of testing both infrastructure and rolling stock innovations in a representative environment and with representative traffic loadings, all complemented by research and development capabilities and support for SME access.

**Recommendation:** Great British Railways to support the creation of the Global Centre of Rail Excellence as a comprehensive test centre with open and flexible access for the UK rail industry.

### Provide test trains

Once a world class test centre is in place, one remaining challenge is the absence of readily accessible test trains to trial and demonstrate new rolling stock technology. In recent years there has been some success with train operators and rolling stock companies supporting trials of some of the most promising technologies, for example, battery and hydrogen propulsion, hybridisation, multiple variable rate sanders. However, it remains difficult for many, especially smaller companies, to access vehicles, provide engineering support, and manage the re-certification liabilities.

### High Level Innovation Specification (HLIS)

High Level Innovation Specifications are outcome based and set some general parameters around an aspired level of performance, for example, in CapEx or whole-life cost, service quality, or carbon. These goals could be based upon stretches of existing best-in-class, for example, 40% cheaper than best existing.

They should not specify what technologies should be fitted, but it is important for them to define what is out of scope, and to specify the system boundaries.

The HLIS will usually be informed by long term strategies and R&D outcomes and should be seen as a means of stimulating the move from R&D to innovation and ultimately deployment.

The supply chain is then informed of the HLIS (and any R&D outcomes) and invited to submit its best and most relevant proposals for technologies which will help achieve those goals, including cost and benefit suggestions. The Innovation Partnership procedure could be one way of doing this.

Whilst there will be some integration risk, the assumption is that suppliers will be asked to bring TRL 6/7 or above products, unless there is a compelling case.

A range of collaborative commercial and funding will be made available to the partners (client and supply chain) which will depend on the projected benefits with the objective of creating a win-win-win outcome.

Where the market size is sufficient for downstream competition to be important and/or where alternative solutions are desirable possible, then the stage gates of an innovation partnership and the longer-term commercial arrangements can be designed to secure diversity of supply.

A fleet of test trains could allow pre-production versions of components to be tested under closer monitoring than would be possible in operation on service vehicles. The ability to test away from the operational railway significantly reduces the risks to normal train services and availability of a dedicated test fleet eliminates access to vehicles as an obstacle to technology development and innovation.

Test trains offer a potential solution to the radical innovation challenge and may also provide more affordable access to SMEs pursuing incremental innovations.

**Recommendation:** Great British Railways to examine the case for test trains to complement UK test centre capability.

### Become the ‘innovation guiding mind’

To seize the opportunity to improve the railway offer to its customers and reduce its long-term operating costs the industry needs to innovate. Recognising this, the Williams-Shapps Plan for Rail includes a long-term strategy and an emphasis on outcome focussed innovation. It further proposes that the Great British Railways will be the major public funder of rail RD&I with innovation projects being delivered by its regions.

The essential role of the private sector is recognised – ‘Stronger links with centres of industry and private sector innovators will be a core part of the new RD&I system’.

.....  
*“Priorities will only be achievable and affordable if the whole system of suppliers, operators and funders work together to plan, innovate and achieve long-term ambitions. Combined with rolling programmes of transformation, the plans set out by the strategy will save time, reduce costs and enable innovators to develop new ideas and solutions.”*  
**Williams-Shapps Plan for Rail**  
.....

This approach is very welcome and will need a reinvigorated collaborative ‘can-do’ culture amongst all parties. Within Great British Railways and the regions this will require a balance of people well versed in research, development, and innovation activities, and those with excellent railway engineering skills. There should be a good portion of staff that are ‘yes let’s try, maybe we’ll fail but we can learn from that’ people rather than ‘No!’ people – and job descriptions and incentives need to emphasise and reward this.



### Lockheed Martin’s Skunkworks

Lockheed Martin’s ‘Skunkworks’ is an example of a High Level Innovation Specification in action. The plant has been responsible for engineering marvels such as the SR-71 Blackbird and U2 spy planes. The Skunkworks receives a block budget with an output specification rather than a technology-centric specification, for example: ‘be able to spy over a hostile state for 10 hours without getting shot down by any known anti-aircraft system’. Development and production then proceed in a technology-agnostic fashion. This approach, particularly the block funding, requires trust and acceptance of failure on the part of the funder, and transparency on the part of the supply chain.<sup>52</sup>

### Solid State Interlocking (SSI)

In the 1980's British Rail identified the challenge to move from relay based to solid state (computer) signalling interlocking to deal with obsolescence, improve performance and reduce long term costs. British Rail Research developed a laboratory proof of concept and through a collaboration with two signalling manufacturers developed a common platform, which became a great success both in the UK and internationally, earning British Rail royalties.

This approach to procurement created a win for all parties. British Rail were able to realise the benefits of SSI and secure a royalties revenue stream. The private sector got a committed development partner, the first reference sites and a new product line. For the UK this created new intellectual property, securing and creating capability and jobs that remain the backbone of our signalling industry today.

This type of relationship is possible again with Innovation Partnership where a public sector client is seeking to solve a challenge where there is not yet a commercially available solution. Innovation Partnerships and similar models place the competition at the beginning of the process to select the partner(s) to iteratively develop the solution. The project is managed through stage gates which allows for 'fail fast, fail cheap' and, if the market potential justifies it, multiple suppliers can be taken through to implementation.

To support this culture change and maximise its impact there will need to be a new collaborative approach to engagement with the private sector, which could include:

- The Whole Industry Strategic Plan embodying the Rail Technical Strategy, which will give confidence in a long-term strategy.
- Clear articulation of challenges in outcome terms – the High Level Innovation Specification, demonstrating client 'pull' for a solution, backed by sufficient commitment to give suppliers confidence in return on investment.
- An understanding of the market size and route to market, which will support investment decisions.
- A collaborative approach to procurement and risk sharing, such as Design Competitions and Innovation Partnerships.
- Support the private sector to make the case for the investment in scale-up and commercialisation, as well as innovation co-funding, for example via venture capital.
- Increasing the public sector's understanding of the operational and change requirements to build the business case for roll out.

**Recommendation:** Great British Railways and its regions organise to be 'the innovation guiding mind' and support the whole journey to benefits realisation, and act as an enabler to exporting opportunities.

### Provide support for the first deployment and commercialisation phase

The first deployment is the last and most important stage of the RD&I journey because it is only at this point that benefits start to be realised. The first demonstration deployment is an opportunity to gain operational experience and gather evidence on the real-life performance as well as the benefits of the innovation to inform wider deployment. For the supplier it creates the first customer reference, which could support further sales and potentially exports. At this stage the client must be ready with the change management including staff training necessary to maximise the benefits.

This first deployment is also a demonstration period during which the innovation is being used and data is being collected about the operational, technical and commercial performance of each innovative element of the project to ensure it is meeting the High Level Innovation Specification. The demonstration should be to industry visitors to support wider deployment and allows performance to be fully understood and documented for direct comparison to existing. Although schemes such as the 'First-of-a-Kind' will continue to be welcome, what we are proposing here is not a single demonstration but a wider deployment to gain experience at scale.

In an industry with misaligned incentives and timeframes this stage has been the most difficult because the level of commitment and expense increases significantly for all parties. As a result, there are many promising innovations, both incremental and radical, which have not progressed to first deployment and commercialisation.

We understand that one of the learnings from the Network Rail CP6 R&D programme is the need for first deployment to be supported at regional level. Therefore, we welcome the proposal in the Williams-Shapps Plan for Rail that the Great British Railways regions will have integrated local teams which 'through engaging innovators, third-party funders and investors, regional divisions will be able to use their new procurement and research, development and innovation (RD&I) capabilities to unlock additional private investment and support promising new start-ups. This will open up opportunities for innovative suppliers to secure funding, improve competition and speed up delivery'.

It's important that these teams have a culture focussed on collaboration and benefits realisation with an element of national coordination to avoid duplication of effort.

**Recommendation:** Great British Railways to take responsibility for allocating funds and teams for the first deployment of promising innovation in the regions.

With Great British Railways leading the allocation of first deployment, it is expected most will take place on the national network. However particularly for the more radical and system level first deployment there may be a case for imaginative approaches on and off the national network. We are already seeing encouraging examples of this for both the national network and light rail:

- The East Coast Digital Programme is a first deployment of a complex new technology and is being done at scale on the operational railway. It is also a hugely challenging change project and is using a new delivery model with an industry and commercial partnership, a greater role for train operators and the supply chain. The Railway Industry Association's Signalling Change Report<sup>23</sup> provided an independent analysis of the progress on the programme, showing it is delivering successfully, to time and budget, and is steering the way for a new way of working on major projects, which could be a model for the future.
- Eversholt Rail have led development of the Revolution VLR – a Very Light Rail demonstration vehicle, and restored a section of track in Ironbridge, Staffordshire, to demonstrate the associated low-cost station and



Picture Credit:  
Network Rail



maintenance infrastructure, which could be used to reopen closed lines with minimal funding<sup>24</sup>.

- BCIMO's Very Light Rail National Innovation Centre in Dudley will create a demonstration of whole-system solutions for very light rail. The centre is a test and integration facility, which will not be handed over to passenger service. A first deployment, which is already agreed to be in Coventry, will later demonstrate the commercial case.

### Conclusion

Adopting this approach should enable the ambition identified in the Williams-Shapps Plan for Rail and delivering benefits for all parties:

Great British Railways gets the benefits of a pipeline of collaboratively developed innovations to deliver the challenging outcomes expected by customers and funders and support the ambitious approach to decarbonisation, climate change adaptation and data-driven transformation.

The supply chain gets the opportunity to collaboratively develop and demonstrate their latest innovations against a clear client 'pull'. The expectation of co-funding and risk sharing is more than offset by the accelerated route to market and approvals, robust demonstration of business benefits for future sales, and reputational opportunity, including for exports - from a Great British Railways supported reference case.

The wider railway gets access to hard evidence on the technological, operational, and financial performance of each key innovation, at lower risk and cost. Even if the whole-system is not adopted elsewhere, key technologies and techniques can cascade to national and regional networks with the safe knowledge that they have been de-risked. It will be much easier to make the case for innovation adoption, leading to wide benefits to our networks. Innovations which don't live up to expectations can be identified early preventing expensive and wasteful false starts and ensuring funds are deployed to the most promising innovations.

The Government gets the customer and funder benefits as innovations are cascaded, and significant export opportunities. It gets lasting, measurable, and demonstrable impact from innovation funding. It gets the opportunity to demonstrate the key principles laid out in the Innovation Strategy – the most important of which being a private sector drive and funding in an innovation-friendly environment.



Artists impression of an HS2 train  
from the side - Credit HS2

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## CASE STUDIES

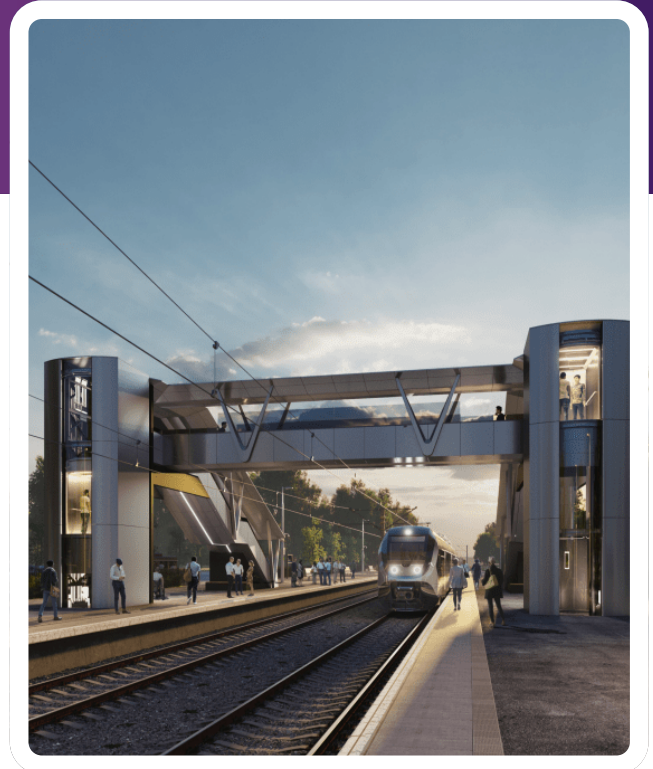
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# AVA BRIDGE

AVA is a 'flat-pack' bridge developed with a diverse consortium applying leading edge principles and techniques for modern methods of construction. At the heart of AVA's development is a 'design for manufacturing and assembly' approach and a configurable design that means AVA can fit any station. AVA is forecast to achieve 25% reduction in cost, 50% reduction in time on site and 50% reduction in whole life carbon compared to a standard footbridge with lifts over a two-track railway.

Crucially it enables all passengers to use the same route through a station underpinning Network Rail's vision to apply inclusive design to put all passengers at the heart of services. AVA forms part of the DfT Transport Infrastructure Efficiency Strategy Living Labs initiative which aims to share solutions and learning across the transport sector, driving cost-efficiencies and better outcomes.




A partnership between

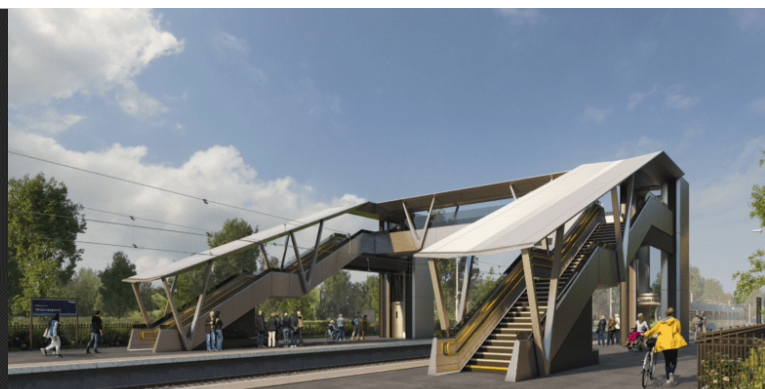
    

In collaboration with: Quantum Infrastructure, SCX, Hawkins\Brown, Norman Foster Foundation, Atelier Ten

Funded by

 UK Research and Innovation

The AVA footbridge project is part of the TIES Living Lab programme



# PANTOGRAPH-CATENARY DYNAMICS TEST RIG

With £3.5M of capital funding provided through the UK Rail Research and Innovation Network (UKRRIN), the University of Huddersfield has recently commissioned a pantograph-catenary full-scale test rig that will create conditions to support the railway industry in their research and technology developments associated to these critical assets.

The test bench, named PANTHER (Pantograph Huddersfield Experimental Rig), has several innovative characteristics and high-performance capabilities that make it, probably, the most advanced pantograph-catenary test bench in the world. It meets industry demands by allowing to perform dynamic tests with speeds up to 400 km/h, on different types of pantographs for conventional and high-speed, enabling the analysis of existing pantographs or support the design and development of new concepts. Furthermore, it allows to study/optimize legacy designs of catenaries and de-risk the development of innovative electrification solutions for new/renewal infrastructure systems.

Advanced electronic systems are used to control the movement of the bench actuators in order to apply the loads on the pantograph contact strips. These loads represent, in real time, the dynamic interaction that is developed between the pantograph and the catenary while in service. The pantographs under testing are pneumatically fed by the bench control system. An adjustable DC power supply is also available to test active/smart pantograph solutions.

In order to represent the whole range of scenarios that the pantographs experience in service, they are mounted on a 6 degree-of-freedom motion platform that can replicate any train movement or vibration. The bench is also equipped with a set of state-of-the-art sensors to monitor forces, displacements and accelerations. These quantities are necessary for the bench control system and for the measurement of the quantities required by the industry and/or defined in the rail standards.



The main tests that can be carried out in the test rig include:

- Conventional and high-speed dynamic tests;
- Pantograph-catenary interaction dynamics in open and/or closed-loop;
- Consider realistic operation conditions, including curves, gradients and catenary irregularities;
- Assessment of compatibility performance between the pantograph and the catenary;
- De-risk and simplify the authorization process of new designs;
- Measurement of contact forces, displacements and accelerations;
- Test and calibration of innovative sensing/data acquisition systems;
- Support the development of predictive/condition-based maintenance methodologies.

# UKRRIN

The UK Rail Research & Innovation Network (UKRRIN) is a £92 million partnership between industry and academia. It is designed to create powerful collaboration between academic experts and industrial practitioners, aiming to provide a step-change in innovation in the sector and accelerate new technologies and products from research into market applications globally.

The initiative was built on the development of three Centres of Excellence formed by a consortium of universities, in collaboration with existing industry testing and trialling facilities such as Network Rail's Rail Innovation and Development Centres.

## Centres were created in:

Digital Systems (led by University of Birmingham, in partnership with Lancaster University, Imperial College London, Swansea University and University of Hull),

Rolling Stock (led by University of Huddersfield, in partnership with Newcastle University, Loughborough University, University of Cambridge, University of Bristol, Brunel University and University of Nottingham) and

Infrastructure (led by University of Southampton, in partnership with the University of Nottingham, the University of Sheffield, Loughborough University and Heriot-Watt University).

Some £92m of total funding was committed to the centres by the UK Government and leading industrial partners.



UKRRIN offers industry access to purpose built world-leading facilities and skills in a range of areas to support research, development and innovation for new technologies and products. The centres are supported by industrial partners to deliver world-leading research from inception to market application for both the UK and global markets. The Centres of Excellence provide the ability to deliver new products and technology to market faster, using advanced purpose-built simulation and testing facilities. The centres also help the UK maintain its position as a technology leader in rail on the world stage.

Founding industry members include Siemens, Bombardier, SMRT, RSSB, Unipart Rail, British Steel, Railway Industry Association, Progress Rail, Thales, Hitachi, Atkins, and Pandrol.

# TECHNOLOGY & INNOVATION HUB

UK railways have complex safety-critical systems that ensure that trains are one of the safest forms of transport, however changing one minor element of these integrated systems may adversely affect others, hence the industry historically has perhaps attracted an unfair reputation as a 'laggard' with regards to adoption of digital technology.

United Kingdom Rail Research and Innovation Network (UKRRIN) was created to connect Government, Academia, Industry and SMEs in a shared endeavour to focus on driving innovation to the sector.

## UKRRIN Technology & Innovation Hub

Unipart Rail is now creating 600 sqm Technology & Innovation Hub in Doncaster designed to showcase the UKRRIN Centres of Excellence, co-locate experts to facilitate cross-expertise learning and innovation, mentor and develop SMEs to help bring their innovations to market, and showcase Unipart Rail's role in driving innovation across the sector. The hub will be launched on 22nd September 2021.

.....  
*"We see the Hub as a key factor in realising the aspirations of the UK rail industry. The purpose of our Hub is to ensure a route to market for the next generation of rail technologies and we are delighted to not only have the support of Network Rail's Centre of Excellence for Testing, but also an opportunity to showcase their research and development programme. This will undoubtedly be an inspiration for those of us in the supply chain to ensure we don't unnecessarily waste resources reinventing what already exists or learning lessons regarding unsuccessful endeavours elsewhere."* **Jake Rudham, Marketing Director, Unipart Rail**  
.....



Unipart Rail is the leading specialist provider of technology and supply chain solutions to the rail industry. With a growing international presence and extensive expertise in infrastructure, signalling and traction & rolling stock products, Unipart Rail is a major partner to the rail industry. Unipart Group is headquartered in Oxford, has a £786m annual turnover, and provides services to a growing range of blue-chip clients including Jaguar Land Rover, Vodafone, Sky, and many other household names.



# HAROLD 2.0

With £1M of capital funding provided through the UK Rail Research and Innovation Network (UKRRIN), the soon to be launched HAROLD 2.0 full-scale bogie test rig builds upon the existing HAROLD facility opened at the University of Huddersfield in 2016.

Significant enhancements to functionality include the integration of a real-time train braking performance model and a fully functional power bogie, comprising both friction and regenerative brake systems and complete traction package. Utilising the capability of hardware-in-the-loop (HiL) test methods, on-train systems including state-of-the-art wheel-slide protection (WSP), dynamic brake blending control, and traction components can be analysed. The test environment can re-create whole-route traction and braking duty-cycles at speeds of up to 200kph, under a range of wheel-rail adhesion conditions, thereby providing an invaluable proving stage prior to on-track trials.

With provision for battery banks and fully configurable real-time models, the test rig will also provide the capability to explore novel hybrid drivetrains and energy storage systems, enabling hardware and software solutions to be trialled in a controlled but realistic environment.

.....  
*"In helping realise predictable and optimised traction and braking performance, the HAROLD 2.0 test rig will contribute to delivering a more reliable and higher capacity railway. Through testing and development of hybrid vehicle concepts, will support the railway industry in overcoming its wider decarbonisation and electrification challenges"*  
**Prof. Paul Allen, Assistant Director of the Institute of Railway Research.**  
.....



## Train Braking:

- Hardware and software development and proving of next generation WSP systems
- Train brake blending controller optimisation (friction and electro-dynamic brakes)
- Route-specific and brake duty-cycle testing to support vehicle acceptance
- Re-creation of very low adhesion conditions and train brake system response
- Provides a stepping-stone between desktop/bench-tests and on-track trials

## Traction and Energy Systems:

- Wheel-slip and traction management system development, problem solving and proving
- Hybrid drivetrain and energy storage solution development and proving
- Real-time energy storage models (e.g. battery and hydrogen fuel cell model-in-the-loop)
- Whole-route energy cycle evaluation for proving hybrid drive solutions

# VERY LIGHT RAIL

Very Light Rail (VLR) is a new mode of rail-based public transport, designed to:

- Supplement existing heavy and light rail systems.
- Supersede other, less efficient, modes.
- Support modal shift and the transition to end-to-end (Hub-to-Home) journeys using public transport.

VLR discards the heavy rail rule book, and through the transfer of technology from the automotive and other sectors, offers solutions that are:

- Lighter weight and less disruptive to implement, which means they can be manufactured, constructed, and operated at lower cost.
- Environmentally friendly, meaning they support the UK's net zero by 2050 target.

VLR takes a whole systems approach, taking the vehicle, civil and infrastructure, command, control and communication, and passenger experience into consideration, integrated through the application of digital technologies.

VLR systems can be used in a number of areas, including:

- In towns / smaller cities that may not warrant, or be able to afford, a traditional light rail system. The Coventry VLR project (Coventry Very Light Rail – Coventry City Council) is the UK's first VLR system in development and plans to have an operational route in place by 2025. Its demonstrator vehicle will shortly begin testing at the Very Light Rail National Innovation Centre (VLRNIC) in Dudley.
- On disused branch lines, many of which were closed under the 1960's Beeching review. The Revolution VLR project (Revolution VLR - Home | First of a kind



VLR project) has developed a prototype vehicle which is currently being demonstrated at Ironbridge.

- In new land developments, where affordable rail-based public transport schemes can be installed during the development phase, rather than fitted retrospectively.

The Coventry and Revolution projects signify the start of a very exciting journey for the VLR industry, with many local authorities and community groups now expressing significant interest in having a VLR scheme, and ongoing technological developments enabling the design and development of more advanced VLR systems.

This is where the Black Country Innovative Manufacturing Organisation (BCIMO) comes in. BCIMO has been established to oversee the operation of the VLRNIC, a brand new £32m investment, funded through the Black Country LEP, the Getting Building Fund and ERDF, built with the advancement of this journey in mind. The VLRNIC is built on the site of the old Dudley railway station and mothballed South Staffordshire line which closed in the 1980s.

The VLRNIC will officially open in May 2022, but the test track is already open for certain types of business, such as vehicle testing. The BCIMO is currently developing its brand-new website (BCIMO | Making the local connection) which will provide details of all the services and facilities it has on offer.

Through the VLRNIC, BCIMO aims to take a collaborative approach to support the development of:

- The market for integrated VLR transport systems, both in the UK and overseas.
- The specific technologies required to deliver high value manufactured and fully integrated VLR system solutions.
- The supply chain required to deliver the above, here in the UK, and specifically in the West Midlands / Black Country.
- The skills required by our current and future workforces for VLR manufacture and implementation.

For more information please register as a virtual attendee for the UK VLR Conference, taking place on the 16th June (VLR Conference | BCIMO) or email [info@bcimo.co.uk](mailto:info@bcimo.co.uk).





# THE GLOBAL CENTRE OF RAIL EXCELLENCE

A world class dynamic testing facility being developed on a former opencast mining site at the head of the Dulais and Tawe Valleys in South-West Wales to accelerate the throughput of innovation in the rail industry and other connected sectors such as energy. The Welsh Government and the UK Government have pledged significant capital funding for the delivery of the first phase of the project. Detailed design is underway in 4 categories – earthworks; energy; rail systems; site master-planning. Bulk earthworks will commence in August 2022.

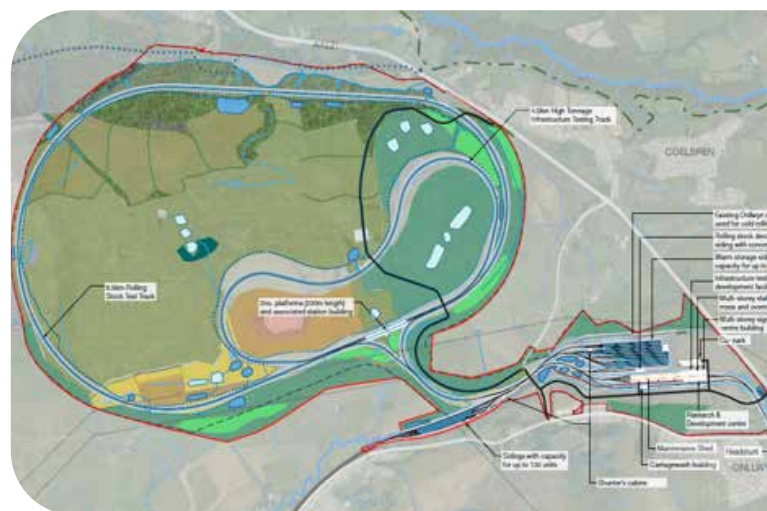
A Special Purpose Vehicle (SPV) – GCRE Ltd, has been established by Welsh Government to expedite project delivery. The project is the result of collaborative working with partners and extensive engagement and consultation with industry, UK, and international stakeholders as well as local authorities and the communities they serve.

The rail testing and innovation facility will include:

- 25KV Electrified high-speed outer rail testing track (6.9 km) for performance testing of electric, battery, diesel/bi-modal and hydrogen-powered trains with a line speed up to 110 mph.
- A unique to Europe Electrified low-speed inner rail testing track (4.5 km) for testing infrastructure - such as the track, sleepers and other formations, platforms and signalling as well as power and telecommunications equipment at a line speed of up to 40mph.
- Dual platform station environment (typical of the UK rail network) for the testing of train platform interfaces.
- Development of the UK's first net-zero railway



The centre will also offer research, development, education, validation and certification, demonstrator, showcasing and training services, including a conference centre, a laboratory space, and a rolling stock maintenance and storage facility. A consortium of Higher Education partners led by the University of Birmingham/Birmingham Centre of Rail Research and Education has plans to establish a Centre of Excellence in Testing and Validation on the GCRE site.





# CAFIBO

The aim of the CaFiBo (Carbon Fibre Bogie) project was to demonstrate that a composite bogie could provide a reliable and cost effective, lightweight alternative to a conventional steel framed bogie. The project was funded by RSSB and led by ELG Carbon Fibre (now Green 2 Carbon) with support from Alstom UK, Magma Structures, The Institute of Railway Research at the University of Huddersfield and the University of Birmingham.

The bogie frame was made of 50% recycled carbon fibre with virgin fibre where needed for additional strength. Steel components were used where required to link to the existing suspension and braking components. A class 180 multiple unit was chosen as the target vehicle as its performance is well understood and components are readily available. The mass of the composite frame was 337kg compared with 936kg for the steel frame (a reduction of 64%) and the complete CaFiBo bogie has a mass of 940kg compared with 1468kg for the conventional bogie (a reduction of 36%).

This mass reduction results in lower operational energy requirements as well as reduced damage to the track. The bogie is also designed to improve reliability and operational availability through an embedded health monitoring system.

The bogie has been statically and dynamically tested on the HAROLD bogie test rig at the University of Huddersfield and has completed 6 million loading cycles as well as 2 million cycles at 120% load in line with BS EN 13749:2005.



.....  
*"Replacing steel with recycled carbon fibre to produce a rail bogie is a world first, so it is a hugely exciting and rewarding project to be part of. We hope to make recycled carbon not only an attractive option for the rail industry in terms of weight reduction, but also to eliminate waste and drive down cost."*  
**Frazer Barnes, Managing Director of ELG Carbon Fibre (now Green 2 Carbon)**  
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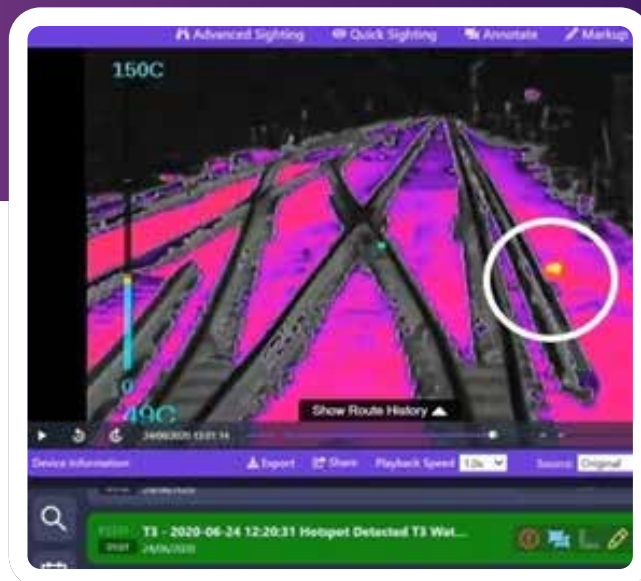


# ONE BIG CIRCLE

Bristol-based SME, One Big Circle was founded in 2017 by a team of video and integration specialists looking to create intelligent solutions to overcome challenging industrial problems and has since focussed on providing this to the rail industry.

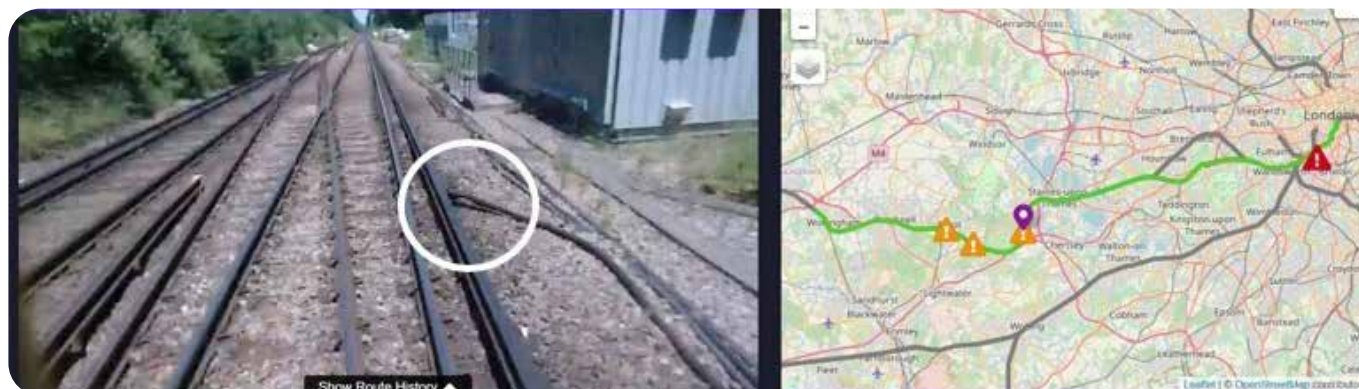
In 2019, in response to published Network Rail Challenges they developed AIVR – Automated Intelligent Video Review – a lightweight train-borne device that can be rapidly installed on any in-service vehicle capturing and transmitting video data whilst on the move. The video is packaged with telemetry and other sensor data, synched to the Corporate Map and transmitted instantly from the train via 4G.

AIVR was built to make video data rapidly accessible securely online, thus enabling remote condition monitoring of assets and environment. The system has had rapid take up throughout Lockdown when access to sites and cab-rides was restricted. Usage continues to grow across a wide range of disciplines and specialisms with over 1,600 licence holders now accessing the AIVR data for assessment and analysis. Network Rail and multiple Train Operating Companies have worked collaboratively using AIVR to collect over 240,000 miles of up-to-date lineside imagery from across the UK. This open approach to data and access enables huge cost-savings and massive safety benefits, removing thousands of hours of ‘Boots on Ballast’ by providing virtual site access instead.



One Big Circle has become a trusted supplier in a short space of time and has secured ongoing contracts with Transport for Wales and Network Rail for continuous collection and transmission of critical video, as well as specialist projects including using Machine Learning to detect critical faults on the conductor rail of the electric sections of routes.

.....  
*“Working with SMEs such as One Big Circle enables us to bring specialist skills and innovative ideas into the industry to help us meet our challenges. The development of the thermal monitoring is just such an example and will help us improve safety and efficiency.”* **David Shipman, Innovations Engineering Manager of Signalling Innovations Group for Network Rail**  
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# DURA PLATFORM

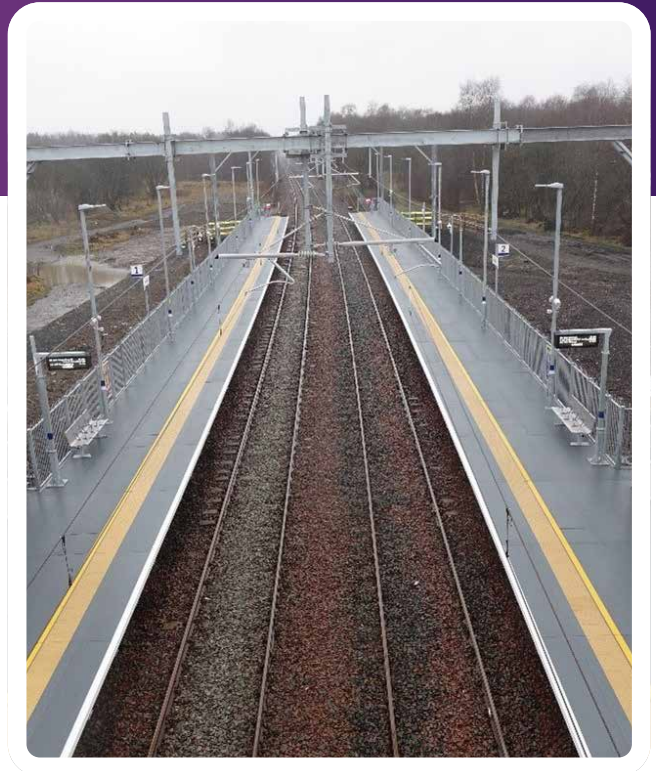
Following the initial installations of its composite railway station platform known as Dura Platform, Dura Composites engaged with the industry body, Rail Industry Association (RIA) and fire experts from Network Rail as part of the Standards Challenge programme.

Standards exist to ensure Britain has a safe, high performing and cost-efficient railway, but they are often seen as overly complex and adding unnecessary cost. The Network Rail Standards challenge initiative allows suppliers to input their expertise to challenge and improve on existing standards relating to the proper use of materials on the rail network.

Dura Platform is made of Glass Reinforced Plastic (GRP) and the existing standards, at the time, were not suited to the properties of GRP, additionally there was a lot of uncertainty around fire standards in areas such as burn time and smoke toxicity.

Dura Composites agreed upon and commissioned live fire tests to demonstrate an improved methodology for platform fire tests and invited Network Rail to attend these and see how the GRP Dura Platform performed in a real-life scenario. The demonstration proved that the Dura Platform resist the spread of flame more than any other GRP product on the market and the Network Rail test standards were updated as a result. Classifications have now been published that cover both structural and non-structural applications for GRP and include fire tests covering flame spread, burn time and load bearing testing. All Network Rail projects are obligated to use products that meet these standards, meaning that Dura Platform is a compelling choice for project designers and specifiers.

The Standards Challenge marked an important milestone in helping Dura Composites deliver on its ambition to make the use of composite products mainstream and is the latest in a series of major developments for the company, which won its second Queen's Award for Enterprise (Innovation) in 2020.





# NATUREMETRICS

One of the first five cutting-edge tech firms to join the HS2 Ltd Innovation Accelerator programme was NatureMetrics, whose simple biodiversity monitoring kit could help with the creation of HS2's green corridor either side of the tracks by monitoring the progress of its newly created woodland habitat. The technology sequences DNA into usable ecology information that shows the distribution of species across a landscape and tracks how habitats change throughout the project lifecycle.

.....  
*"For surveying newts our client told us that eDNA technology can work out at a quarter of the price of traditional surveys and for wider ecological data this can be even more due to all species being able to be identified from a single sampling effort. Some species like many of the soil micro biome cannot be identified in other ways so our technology gives a much more complete and robust way to understand ecosystem impacts and values."*

**NatureMetrics CEO Katie Critchlow**  
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# RIDING SUNBEAMS

Riding Sunbeams explores the potential for solar power as an alternative energy source for the rail sector. It was founded by climate charity Possible and Lewes-based Community Energy South. Riding Sunbeams' key partners are Thrive Renewables, Ricardo, Turbo Power Systems and Network Rail. After extensive feasibility work and research, Riding Sunbeams connected the first pilot solar traction array to the railway at Aldershot station in 2019 through its First Light project, which proved that plugging solar directly into the UK railways can be done safely and efficiently without disrupting trains.

The 30kWp solar test unit connects to an ancillary transformer on the traction system of Network Rail's Wessex Route, with the energy captured from the panel array used to power signalling and lights. The project aims to show that lineside solar electricity could prove cheaper than energy from the grid and could provide as much as 10% of the Southern Region's power needs in the UK.

Riding Sunbeams' work has helped to inform Network Rail, Transport for London and HS1's developing tender processes to procure renewable traction energy direct from lineside generators.

In 2020 Riding Sunbeams completed a feasibility study with Transport for Wales, finding that around 40% of the South Wales Metro's projected traction demand could be met with from lineside community solar and wind sites in the Valleys. Riding Sunbeams are currently developing a bespoke, low-cost solar-to-rail power converter to enable direct supply to 25kV AC overhead electrified routes for the first time. Internationally, the company is on a Mission to India discussing Riding Sunbeams with Indian Railways, where the solar-to-rail potential is greatest and could ultimately power a quarter of all trains on the network.

The unfolding energy price crisis has seen the potential financial savings available from direct solar supply increase steeply in 2022, and Riding Sunbeams estimates that the private wire model can now supply traction energy at less than half the cost which UK railways will face at their next price review.



Riding Sunbeams will offer shares in its solar farms to communities and commuters, so local people will own and benefit from the clean energy powering their trains.



# ACTIWHEEL GS FROM SET LTD

Stored Energy Technology Limited is a small, innovative, electronics and mechanical engineering company based in Derby.

In response to a call from the RSSB for ideas on mitigating rolling contact fatigue, SET designed and developed ActiWheel GS. The system utilises an onboard digital control system linked to independently rotating, in-wheel, traction motors, that autonomously guide and steer the train over the track.

Although ActiWheel GS delivers significant benefits to owners, operators, passengers, and the environment, by far the greatest beneficiary is Network Rail. Over a year Network Rail spends in the region of £1.3bn on track renewals and maintenance, with around £250m of that caused by Rolling Contact Fatigue. ActiWheel GS practically eliminates Rolling Contact Fatigue and gauge corner wear.

Introducing the technology to the rail industry has proved difficult because the main beneficiary is unlikely to be the entity that invests in and employs the technology.

ActiWheel GS is a step-change for the rail industry. It positively impacts many areas and is patently a useful technology. It also puts the UK in a leading position and offers export opportunities. At the moment.

If it can't be moved forward, eventually someone else will develop a similar system and the advantage will be lost.

A vertical market would address many of these issues as the purchaser of the technology would also be the beneficiary and integrated groups/personnel and information would be accessible.



## Approvals

To meet the safety requirements of the rail industry any new technology is required to meet various attestations and approvals. This is a costly exercise and is a barrier for a small company. Access to test facilities, both track and train, are required prove safety standards before the technology can be put on a mainline vehicle, at which time it could begin to build a mileage history.

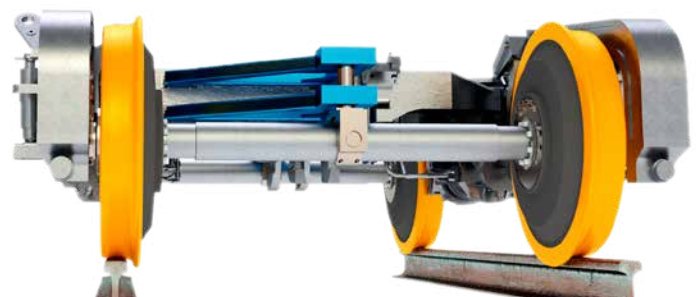
## Access to funding

Funds available through NR, Horizon EIC, Innovate UK. Not really geared up to support a project of this size.

Applications can be complex and require a significant amount of time to complete.

Often require external assistance (at cost) for a company to make a submission.

Finding funding appropriate to project.



### Cross Industry benefits

Government	Network Rail	ROSCO	TOC	Passenger
Carbon reduction Improved environment Technical leadership	Eliminate RCF Reduced track damage Reverse Breeching	Stock life extension Improved reliability Improved competitive offering Reduced maintenance costs	Reduced maintenance costs Improved reliability Energy efficiency Reduced operating costs	Improved ride quality Service reliability Improved

# REPOINT

The REPOINT concept provides fault-tolerant railway track switches which remain functional after the occurrence of faults.

Other switching solutions use a single actuator to move the switch rails. If it fails, there is no back-up. For passengers, this means delays and cancellations whilst a maintenance team is despatched to undertake an inspection and emergency repair. Repoint uses architecture similar to aircraft flight control systems with multiple channels for actuation, locking and detection. If a fault occurs in a single channel, the switch continues to operate – without the need for immediate repair – and services can continue to run as timetabled. Unlike other switching solutions, locking is provided passively by the position of the rails. The actuators lift the rails out of their lock to move them. Any single actuator can provide this motion and, in the event of an actuator failure, locking is not impaired.

Currently, switch maintenance is performed line-side, and the line is closed to traffic whilst the switch is inspected and adjusted. This is getting more difficult in an ever more congested railway, requiring ‘boots on ballast’. The vision for maintenance of Repoint is to exploit LRU’s (line-replaceable units), just like modern industrial equipment. The LRUs are standardised, sealed, and maintenance-free for their operational lifetime of many years. At end of life, they are replaced in a matter of minutes, and returned to base for overhaul in a clean, safer environment.

This combination of features offers a step change in switch performance, with modelling suggesting a reduction in failures of 85%, alongside significantly improved whole life costs, compliance with safety standards, and compatibility with future mechanised maintenance practices.

The business case is compelling, and the project reached TRL7 with the deployment and commissioning of a full-scale actuation demonstrator in 2019. REPOINT development was majority funded by the UK taxpayer via RSSB. The IP for Repoint lies within UKRRIN with the patents maintained and owned by



BCRRE, who are keen for industry to exploit, including Network Rail directly, or any part of supply chain. The technology has the potential to save over £100m per year, but remains unadopted despite a total development investment of over £2m.

<https://www.globalrailwayreview.com/article/93707/repoint-the-future-of-track-switching/>

<https://www.birmingham.ac.uk/staff/profiles/mechanical/dixon-roger.aspx>



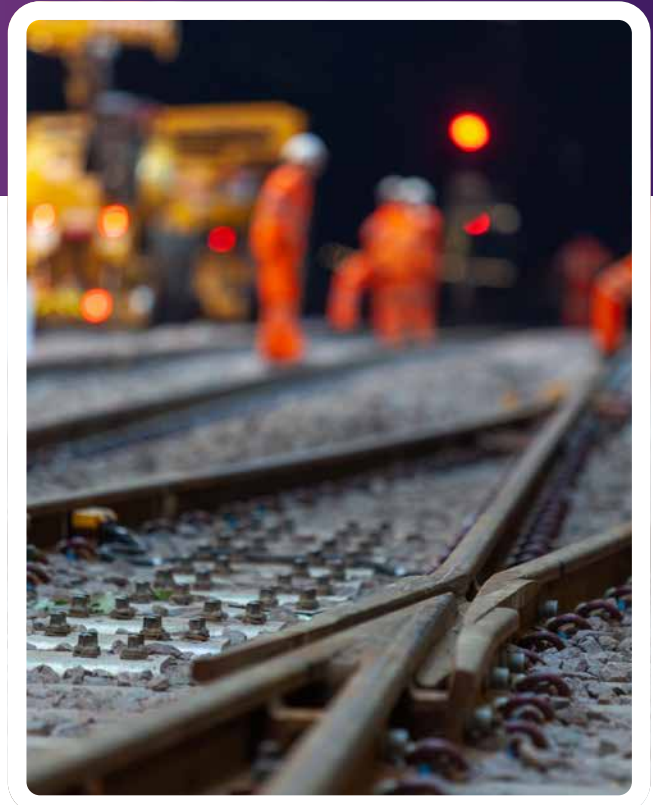
# UNIVERSITY OF SOUTHAMPTON

Research in infrastructure having a direct impact to the UK Economy

Transport infrastructure research at the University of Southampton has achieved significant performance and reliability improvements for railway and other critical infrastructure systems. It has led to substantial cost and carbon savings, supported government decision-making and enabled industry innovation for economic gain. The University of Southampton leads the UKRRIN Infrastructure centre of excellence.

Amongst other outputs, the research has led to specific and measurable innovations such as:

- The restart of the UK's rail electrification programme, delivering savings worth an estimated GBP650m to the UK economy.
- An estimated cost reduction of HS2 noise barriers by GBP65m and HS2 geotechnical works by GBP100m, thereby reducing the risk of further costly delays to the project.
- New industry design guidelines and standards that influence engineering practice globally.
- High-level policymaking, including the provision of research-based advice that contributed to the Government's decision to proceed with Phase 1 of HS2 and modelling that contributed to the UK's first National Infrastructure Assessment.
- Industry innovation that led to commercial advantage and growth; including contributing to a GBP18m rise in annual turnover for one UK-based construction company.





# THE RAIL TECHNICAL STRATEGY

The Rail Technical Strategy (RTS) sets a clear direction for the development and uptake of existing and new solutions that are essential for industry to deliver against the challenges it faces.

It was originally conceived and created in 2012 as a printed document which brought together the aspirations for change within the industry in order to provide a clear direction for technology development and innovation – something that is not always clear in a fragmented industry.

Since the 2012 version, the RTS has been valuable in aligning thinking and action in the UK and more widely, globally promoting the UK's world-class rail expertise and its vibrant innovation community.

The direction set in the RTS is key to informing the investment pipeline within industry organisations. Senior budget holders in infrastructure managers, vehicle owners, train and freight operators and OEMs have better visibility of the direction of travel when it comes to the technical needs and opportunities that the railway has. This in turn is essential to ensure that supply chain is stimulated to invest with confidence in innovative solutions in the most important areas.

The RTS is also important to guide the prioritization of existing dedicated research and innovation funds that the railway has and facilitate their coordination, including the establishment of easy pathways for progression through the Rail Industry Readiness Levels. It also allows the rail industry to influence and make the best of the R&D spending that exists beyond rail and the transport sector, which could have applicability to the challenges rail faces.

The latest edition has been updated through consultation with clients and industry. Many longstanding challenges for rail in the UK remain and new challenges continue to emerge, especially in light of the Covid-19 global pandemic and its aftermath. In order to reinvigorate interest and achieve greater buy-in for rapid and coordinated technical progress, the new edition has been developed with the following principles in mind:

More focused, with clarity on the agreed key problems, opportunities and solutions that need industry attention, rather than attempting to create a fully comprehensive plan

More compelling, in particular, setting out the steps needed in the short term, in the context of the longer-term vision

Less R&D centric, acknowledging that research and development is only part of any successful technical strategy, and therefore putting equal emphasis on the challenges and opportunity around successful deployment and adoption

The latest edition is in digital format – an evolving, living strategy which, thanks to ongoing contributions from across the industry, becomes richer over time, captures progress, and evolves to support industry long term strategy.

The latest edition of the RTS was created collaboratively by a working group comprising representatives from RSSB, Network Rail and both academic and industrial UKRRIN partners. It was developed with wider industry engagement and support including more than 100 organisations and over 30 prominent cross-industry groups including Planning Oversight Group, the Industry Decarbonisation Task Force, each of the seven Systems Interface Committees, Customer Experience Forum, and many more. Steering was provided by the Executive Technology Leadership Group. The Rail Delivery Group and Railway Industry Association provide ongoing support and input.

<https://railtechnicalstrategy.co.uk/>

You can get in touch with the working group at [rts@rssb.co.uk](mailto:rts@rssb.co.uk)

# HYDROFLEX

HydroFLEX is the UK's first hydrogen-powered train, and the world's first existing train to be retrofitted with hydrogen technology. It draws power from overhead wires and where these don't exist, operates in hydrogen self-powered mode using fuel cells and batteries.

HydroFLEX started as a collaboration between Porterbrook and the University of Birmingham. Following successful mainline testing in September 2020, Porterbrook partnered with Network Rail to build a new version of HydroFLEX capable of replicating the duty cycles of the diesel trains it aims to replace. This allows for speeds up to 100mph, with a range of around 300 miles.

Hydrogen trains provide a zero-emissions solution on non-electrified routes without the need for costly and disruptive infrastructure upgrades. They can complement electrification on a transitional basis, or as a permanent solution on routes where overhead wires are not economically viable.

HydroFLEX represents a £10m private sector investment by Porterbrook. The design and build of the train have been supported by 30-UK based suppliers, protecting jobs and kick-starting the creation of a hydrogen rail supply chain.

.....  
*"It is amazing to see Porterbrook's HydroFLEX train showcased on an international stage. Ground-breaking green technology projects like HydroFLEX are central to our plan to decarbonise the rail network by 2050."* **Former Rail Minister Chris Heaton-Harris MP**  
.....

The next step in the adoption of hydrogen traction technology would be clear government commitment to a retrofit or new-build programme. The industry has been awaiting this for some time, whilst now watching other countries – e.g. Germany – taking the lead by placing orders.



## Long Marston Rail Innovation Centre






On the 23 June 2021, Porterbrook added the Long Marston Rail Innovation Centre to its portfolio of managed railway assets. The Long Marston Rail Innovation Centre is a 135-acre rail connected site in Warwickshire, it offers a 2-mile circular test track and 12 miles of secure sidings. Porterbrook's plans for the site will see a significant investment and upgrade in these facilities.

Working with the supply chain, including SMEs and academic bodies, Porterbrook will develop the Long Marston Rail Innovation Centre to become a leader in developing sustainable and digital technology focused on the needs of passengers, rail freight users, train operators and infrastructure owners.



# Railway Industry Association

*The voice of the UK rail supply community*

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