

Rail Technical Strategy

Innovating across Britain's railway

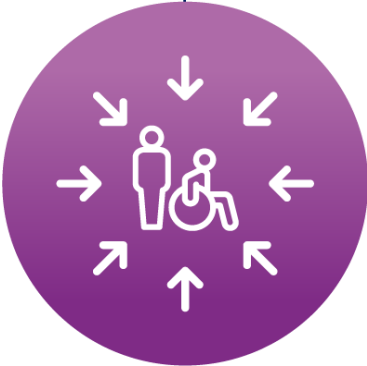


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FUNCTIONAL PRIORITIES

The five functional priorities are industry agreed focus areas where rapid progress is needed and new technical solutions are critical. For each priority, explore the key goals and the 'routemap' that highlights the steps needed in the next five years to get to a sound position in 2025 and set the essential groundwork for progression towards the 2040 vision.



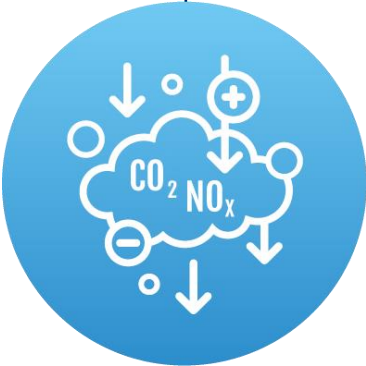
EASY TO USE FOR ALL

Rail will deliver an excellent travel experience to regular and occasional passengers thanks to dependable real-time information, innovative payment methods, and improved solutions for accessibility.



FREIGHT FRIENDLY

Freight growth on the rail network will be enabled through better use of existing and new capabilities of freight assets, and improved whole system thinking with freight at its heart.



LOW EMISSIONS

Carbon and air emissions will be minimised by cheaper and less disruptive electrification, zero-carbon diesel replacement, greater efficiency and removing emissions at source.



OPTIMISED TRAIN OPERATIONS

Train services will be reliable and the capacity of the network improved by real-time management, better train planning and simulation, and shorter headways together with new solutions at nodes.



RELIABLE AND EASY TO MAINTAIN

Reliability and availability will be maximised by design, remote and automatic inspection, and targeted interventions, while whole-life cost is reduced.



Easy to use for all

GOALS	WHY?	RECENT POSITION (2020)	STEPPING STONES IN THE NEXT FIVE YEARS			VISION FOR 2025	VISION FOR 2040
Accurate, accessible and understandable real-time information	Making it easier for passengers to plan and manage their journey reduces stress, exclusion and time lost, and increases confidence.	Real-time information is available but not always reliable and useful. Also staff on the ground often don't have the same information. New need for information relating to biosecurity in rail environments.	Improvements in the timeliness, reliability and accuracy of the information needed for door-to-door travelling, including information on layout and current status of facilities of stations and trains.	Personalised information sent to customers based on their journey and travelling patterns. Development of biosafety indicators that support customers and industry decisions.	The availability of data enables new services from the wider market that cover door-to-door needs. These include information interface for mobile devices, hearing aids and station navigation tools.	Customers receive inclusive real-time information on journeys (including alternatives when disruptions occur) minimising stress and lost time, and boosting confidence.	Timely, easy to use and reliable door-to-door information with rail at its heart.
Smart fare collection	For rail to be attractive it is key that passengers can easily buy rail as part of their travelling options and door-to-door journey.	Ticketing is complex and offers limited flexibility. Lack of clarity on best price available. Limited cross-modal payment options, mainly in urban areas and for train-bus combinations.	Rail pay as you go to cover frequent, shorter and cheaper journeys (including city, regional and intra-regional). Account-based ticketing underpins the Digital Fares and Ticketing Platform to allow simplification and personalisation.	Smart ticketing on mobile devices to improve reservation and personalisation for less frequent, longer, more expensive journeys. Digital Fares and Ticketing Platform enables richer services to passengers and third parties.	Open data and suitable commercial agreements deliver multi-modal ticketing provision.	Payment and reservation experience for rail is easier and more inclusive for all journeys. Increased passenger confidence that they've got a valid ticket at the best value.	Buying door-to-door journeys, either in advance bookings mode or 'get up and go' is the norm, and rail always appears as an option when appropriate.
Personalised services	Personalised services and assistance, where requested, make travelling by rail an easy and more enjoyable experience.	Minimal customisation and personalisation of train services. Limited availability and use of individual customer's data and their journeys to improve experience.	The underpinning customer data to provide personalised services is developed and customers are keen to share their data because its use is fair and clear and there are benefits to them. (Specific) real-time passenger feedback is proactively sought and made easy to provide.	Passenger centric measures of rail performance are identified and used.	Open data and AI enhance the level of customisation of support and services. New design solutions on trains make on-board tasks and activities easier and more pleasant.	Information on passenger movements, preferences and needs allows customised support and services that improve the experience of travelling by rail.	The level of customised support, convenience and inclusivity delivered by rail improves the travel experience for all and rivals other modes.
Accessible to all	Reducing exclusionary barriers throughout the railway enable more people to travel, and to travel independently.	Focus is mainly on step-free access to stations and platforms with limited initiatives for other capability impairments.	Deployment plan and guidance to speed up the adoption of existing step-free solutions (e.g. humps and low-floor trains). Roll out tools for people with less visible disabilities to use the railway. Inclusive design tools and measures to assess and cater for all capability losses are developed and used to inform stretching inclusion targets.	Assess new solutions to remove hazards and barriers for people with reduced mobility (e.g. gateless access and crowding control). Account-based digital services make booking and providing assistance easier.	Passengers with capability impairments are better catered for. Inclusive design tools and measures drive action to maximise the proportion of the population who find the railway easy to use.		
Door to door solutions	In a fast changing transport landscape it is key to make it more convenient and less stressful for customers to use rail as part of their multi-modal journey.	Websites to plan and provide real-time support for door-to-door journeys exist but have significant limitations. Rail focuses on the delivery of train services, and customers are expected to sort out their first and last mile, with very limited services provided by rail to support their full journey.	Improve parking and connection facilities for existing modes (including electric vehicles) at stations. Data exchange in place to allow better connection decisions by transport operators and the travelling public.	Develop operational concepts and facilities for connections with emerging modes (including micro-mobility). Feasibility studies on tools to optimise passenger flow within and across modes.	Passengers' first and last mile are better understood and catered for.	Railway plays a key role in the provision of door-to-door, not just point-to-point, transportation. Information to and from passengers used to manage capacity and optimise its use.	
Reliable and fast on-board connectivity	Customers expect to be always connected if they so choose.	Phone and mobile data coverage on trains is patchy and unreliable.	Lessons learnt from 5G trials inform technical and commercial plans.	Agreed overall plan to improve rail connectivity starts to be delivered.	Regular reports on the extent and quality of mobile coverage on the railways are in place.	Good on-board voice and data connectivity is a given when travelling by rail.	



Easy to use for all Progress against short-term vision

GOALS	RECENT POSITION (2020)	RECENT PROGRESS AGAINST STEPPING STONES		VISION FOR 2025	
<p>Accurate, accessible and understandable real-time information</p>	<p>Real-time information is available but not always reliable and useful. Also staff on the ground often don't have the same information. New need for information relating to biosecurity in rail environments.</p>	<p>Improvements in the timeliness, reliability and accuracy of the information needed for door-to-door travelling, including information on layout and current status of facilities of stations and trains. <u>RDG</u> The second iteration of the Smarter Information Smarter Journeys programme (SISJv2) launched in April 2023 includes work packages due to deliver in 2024-2025.</p>	<p>Personalised information sent to customers based on their journey and travelling patterns. <u>RDG</u> SISJv2 sets out plans for the Customer Information journey experience of the future. Northern is offering live train info via a WhatsApp chatbot.</p> <p>Development of biosafety indicators that support customers and industry decisions. <u>RSSB</u> The LHBR programme published a Pandemic Playbook and Lesson's Learned report capturing insights from the Covid-19 pandemic to inform future planning.</p>	<p>The availability of data enables new services from the wider market that cover door-to-door needs. These include information interface for mobile devices, hearing aids and station navigation tools. <u>RDG</u> EMR launched a free multi-modal planner in June 2023, with personalised journey assistance provided through EMR Messenger.</p>	<p>Customers receive inclusive real-time information on journeys (including alternatives when disruptions occur) minimising stress and lost time, and boosting confidence.</p>
<p>Smart fare collection</p>	<p>Ticketing is complex and offers limited flexibility. Lack of clarity on best price available. Limited cross-modal payment options, mainly in urban areas and for train-bus combinations.</p>	<p>Rail pay as you go to cover frequent, shorter and cheaper journeys (including city, regional and intra-regional). <u>RDG</u> Contactless 'tap-in' payments being rolled out across 53 stations in the South East by the end of 2023.</p> <p>Account-based ticketing underpins the Digital Fares and Ticketing Platform to allow simplification and personalisation. <u>GBR</u> <u>DfT</u> & <u>RDG</u> TfL's Project Proteus plans to evolve Oyster closed-loop contactless ticketing to an account-based system, with a contract award in August 2024</p>	<p>Smart ticketing on mobile devices to improve reservation and personalisation for less frequent, longer, more expensive journeys. <u>DfT</u> & <u>RDG</u> Launch of Rail Online in the UK in May 2023 which is offering operator fare price matching, instant refunds on e-tickets, and no booking fees.</p> <p>Digital Fares and Ticketing Platform enables richer services to passengers and third parties. <u>GBRTT</u> Fares, Ticketing and Retail Review launched.</p> <p>Open data and suitable commercial agreements deliver multi-modal ticketing provision. <u>RDG</u> An Urban Transport Group paper and set of recommendations was published November 2022.</p>	<p>Payment and reservation experience for rail is easier and more inclusive for all journeys. Increased passenger confidence that they've got a valid ticket at the best value.</p>	
<p>Personalised services</p>	<p>Minimal customisation and personalisation of train services. Limited availability and use of individual customer's data and their journeys to improve experience.</p>	<p>The underpinning customer data to provide personalised services is developed and customers are keen to share their data because its use is fair and clear and there are benefits to them. <u>GBRTT</u> Fares, Ticketing and Retail Review aims to develop a more modern retail experience, a rollout of digital ticketing across the network, contactless and pay as you go systems in urban areas, and "simplified, best-available value-for-money options on journeys outside urban areas".</p> <p>(Specific) real-time passenger feedback is proactively sought and made easy to provide. <u>DfT</u> GWR trial of Whoosh digital platform that includes patented 'Tell Us' functionality to enable contextualised fault reporting by passengers and staff onboard.</p> <p>Passenger centric measures of rail performance are identified and used. <u>Transport Focus</u> HS2 concepts to be trialled on AWC to set new customer experience standards, including comfort and personalisation.</p>	<p>Open data and AI enhance the level of customisation of support and services. <u>Suppliers</u> Transport Research & Innovation Grant funding awarded to six 'technologies of the future' projects to improve rail passenger experience in June 2023.</p> <p>New design solutions on trains make on-board tasks and activities easier and more pleasant. <u>UKRRIN</u> PriestmanGoode launched Green Carriage in November 2022 which allows for modular interiors that adapt to passenger requirements.</p>	<p>Information on passenger movements, preferences and needs allows customised support and services that improve the experience of travelling by rail.</p>	
<p>Accessible to all</p>	<p>Focus is mainly on step-free access to stations and platforms with limited initiatives for other capability impairments.</p>	<p>Deployment plan and guidance to speed up the adoption of existing step-free solutions (e.g. humps and low-floor trains). TfL has published results of its consultation on the future of step-free access on the Tube network, announced ten stations to be reviewed for priority step-free access, and trialled a new bridging device.</p> <p>Roll out tools for people with less visible disabilities to use the railway. <u>NR</u> <u>CE</u> NaviLens, an app designed to help blind or partially-sighted customers navigate stations, trialled on DLR. <u>SWR</u> trial using AI to translate passenger info into British Sign Language displayed on totem screens at Waterloo.</p> <p>Inclusive design tools and measures to assess and cater for all capability losses are developed and used to inform stretching inclusion targets. <u>Various</u></p>	<p>Account-based digital services make booking and providing assistance easier. <u>RDG</u> <u>ORR</u> survey found 75% of users highly likely to recommend Passenger Assist. Operators delivering training to accompany the roll-out of the Passenger Assist staff app.</p> <p>Assess new solutions to remove hazards and barriers for people with reduced mobility (e.g. gateless access and crowding control). <u>GBRTT</u> Station accessibility audit completed and National Rail Accessibility Strategy due to be launched.</p>	<p>Passengers with capability impairments are better catered for. Inclusive design tools and measures drive action to maximise the proportion of the population who find the railway easy to use.</p>	
<p>Door to door solutions</p>	<p>Websites to plan and provide real-time support for door-to-door journeys exist but have significant limitations. Rail focuses on the delivery of train services, and customers are expected to sort out their first and last mile, with very limited services provided by rail to support their full journey.</p>	<p>Improve parking and connection facilities for existing modes (including electric vehicles) at stations. <u>CPC</u>, <u>RDG</u> and <u>NR</u> Reading Green Park Station, a new multi-modal interchange designed to improve accessibility and connectivity, opened in May 2023. A regional transport integration hub at Motherwell Station was opened in June 2023.</p> <p>Data exchange in place to allow better connection decisions by transport operators and the travelling public. <u>RDG</u> & <u>NR</u> Transport for West Midlands is developing a single app and single account solution to support planning and decision making across all transport modes.</p>	<p>Develop operational concepts and facilities for connections with emerging modes (including micro-mobility). <u>IBD</u> Tier e-bikes and scooters have been integrated with the Whoosh app to enable onward journeys for rail passengers in London.</p> <p>Feasibility studies on tools to optimise passenger flow within and across modes. <u>IBD</u> The TRIB Transport Digital Twin Vision and Roadmap to 2035 was published, announcing an intention to facilitate connected digital twins across different transport modes by 2035.</p>	<p>Passengers' first and last mile are better understood and catered for.</p>	
<p>Reliable and fast on-board connectivity</p>	<p>Phone and mobile data coverage on trains is patchy and unreliable.</p>	<p>Lessons learnt from 5G trials inform technical and commercial plans. <u>NR</u> <u>SWR</u> and <u>NR</u> continue roll out of Evo-rail's multi-gigabit solution, using self-powered trackside infrastructure. Neos selected as preferred supplier for NR's Project Reach.</p>	<p>Agreed overall plan to improve rail connectivity starts to be delivered. <u>DfT</u> & <u>NR</u> UK Government's Wireless Infrastructure Strategy, which includes delivering digital infrastructure to improve mobile coverage for rail, published in April 2023.</p>	<p>Regular reports on the extent and quality of mobile coverage on the railways are in place. <u>Ofcom</u> Wireless Infrastructure Strategy included a commitment to work with Ofcom to improve reporting of rail network coverage.</p>	<p>Good on-board voice and data connectivity is a given when travelling by rail.</p>



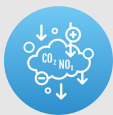
Freight friendly

GOALS	WHY?	2024 STATUS	STEPPING STONES OVER THE NEXT 5 TO 8 YEARS			FURTHER STEPS TOWARDS 2040	VISION FOR 2040		
Increased network access for freight	The GB network is one of the most restrictive in the world due to its historic nature and legacy infrastructure. Easy and predictable access for heavier, longer, and larger freight trains is key to maintain and grow freight traffic. It also improves the efficiency of freight operations.	Current limits to freight train length, weight and size are based on empirical data. RSSB-led research recently developed a methodology to revise the limits that unlock longer train formations. These new limits are now being applied on the network on a case-by-case basis, in advance of systematic embedding in the NR Loads Book.	Develop a digitised platform to provide optimised route options for freight services based on train characteristics including length, weight and size, and infrastructure asset information.	Assess the case for targeted deployment of track design solutions to minimise the impact of freight traffic.		Systems are updated 'right-time' to maximise freight train length, size and weight for given route infrastructure and rolling stock capabilities, as well as timetable demands.	Compliant routes and pathing options for freight journeys are automatically determined and are responsive to freight needs. All key routes for Heavy Axle Weight traffic are maintained and do not require special dispensation access rights. The introduction of new locomotives, wagons, and wagon/box combinations is efficient and streamlined.		
Safer freight operations and better asset management	Better monitoring of freight assets allows failure prediction and timely proactive timely intervention. This can significantly reduce unplanned maintenance and incidents on the network, including derailment risk.	Nearly all safety inspections and train preparation for freight are manual tasks. This introduces human error and, over the last 5 years, has led to a significant number of safety events, including some with significant consequences. Recent trials have demonstrated options for improving loco and wagon connectivity enabling greater automation of asset monitoring.	Improve industry visibility of current and future route availability for Heavy Axle Weight freight services to allow for better and more informed asset management.	Develop robust engineering models that characterise the impact of maintenance costs associated with Heavy Axle Weight traffic.	Assess the business case for targeted interventions for gauge improvement to unlock route compatibility with maximum impact. Consider the holistic benefits to other service types (e.g. higher speeds for passenger trains).			Full adoption and on-going improvements of RCM insight allows for more effective and efficient responses to asset degradation. Technologies that support the automation of freight train movements within terminals starts to be rolled out.	Sudden asset failures and associated incidents on the network are regularly and successful prevented. Yards are significantly safer with workforce exposure to risk minimised.
Enable greater intermodality and access for freight customers	Rail freight is perceived as a difficult mode to start using by new customers. Growth opportunities can also be challenging for existing customers.	Connections to the network are very costly, and currently take over a year to be approved and built. This deters prospective and existing customers to develop new flows.	Embed and exploit changes to W10 and W12 definitions that accommodate more wagon/box combinations over greater parts of the network.	Reduce effort required to complete vehicle compatibility process through improved data availability, systems and simulation tools.					
Greater asset utilisation and reduced freight journey times	Freight travels at lower average and maximum speeds than passenger services. This difference causes freight trains to be signalled into lineside loops or regulated at a junctions. Understanding the value of higher freight speeds and ways to increase these, is key to improving the attractiveness of rail and the utilisation of freight assets.	Due to the prioritisation of passenger services and allowed maximum speeds, the low average speed has negative time and cost consequences for freight journeys. It also significantly limits assets utilisation, ultimately reducing the commercial viability of rail freight and making it less competitive against road.	Assess options for power provision to wagons, accounting for network and off-network requirements. Such wagons to be electrically inert in sidings and yards.	Explore the feasibility of cameras, sensors and other technology in undertaking train safety checks within terminals, thus removing exposure to dangerous tasks.	Explore freight specific options and requirements for remote condition monitoring (RCM) solutions alongside wider industry RCM requirements. Assess the business case for tactical deployment.	Integration of timetable planning, traffic management and connected driver advisory systems with right-time changes in freight train and network capabilities.	Full use of technical capabilities of freight trains combined with mechanisms to recognise the value of freight journeys results in significantly reduced journey times, and easier and better freight pathing.		
Low carbon freight and On Track Machines	There is currently no viable alternative to electrification or diesel to deliver the power necessary to the full range of freight journeys. Without action, rail freight risks being penalised even if alternative modes may be more carbon intensive and increase congestion.	There is no clear path to freight decarbonisation beyond the introduction of multimodal vehicle and limited use of alternative fuels. Spikes in electricity prices following the Russian invasion of Ukraine led to greater use of diesel traction. Industry is looking into maximising the benefits of future electrification for freight, as well as introducing and benefitting from hybrid and bi-/tri-mode locomotives.	Develop options for dynamic aggregation of goods to facilitate the movement of smaller individual quantities which respond to customer supply chain needs.	Explore growth opportunities using parts of the existing network by providing flexible and temporary loading sites, in addition to fixed terminal/yard infrastructure	Assess modular and low-cost signalling systems to support quicker and cheaper connections to off-network locations.			Agree and pursue pathways to freight decarbonisation.	Clear role and relevance for rail as part of overall net zero logistics chain.
			Identify opportunities for enhanced speed differentials on the network that fully accommodate the capability of the infrastructure.	Explore options for the safe application of higher maximum permissible speeds to increase capacity and unlock new paths through reduced block occupation times.	Increase capabilities of industry planning services systems (R2, TOPS) to provide the outputs required to realise the full capacity and pathing benefits offered by future ETCS roll-out.				
			Evaluate options for self-powered wagons, including utilising regenerative braking technology, to improve acceleration capabilities that unlock new pathing options.	Develop path modelling capabilities that consider whole system impact and benefit to UK PLC, including economic and carbon impacts of rail freight.	Improve traffic management utilising C-DAS to enable better on-the-day regulation decisions that is underpinned by improved freight pathing algorithms.				
			Assess freight power options by understanding capabilities of the electrified network, current and future traction options, and what future electrification could look like for freight.	Explore optimised electrification designs and solutions for secondary freight-only routes.	Assess low-cost electrification options at terminals.				
			Explore the feasibility of intelligent/dynamic freight consist arrangements to reduce aerodynamic drag.	Assess the feasibility of novel low carbon alternative fuels and associated changes to engines that would be needed.	Explore options for integrated charging facilities for both road and rail at terminals.				



Low emissions

GOALS	WHY?	RECENT POSITION (2020)	STEPPING STONES IN THE NEXT FIVE YEARS				VISION FOR 2025	VISION FOR 2040
Cheaper and less disruptive electrification	More electrification is fundamental to zero emissions, as well as giving great acceleration, reliability and operating cost benefits.	Concerns over cost and disruption following recent electrification schemes have undermined political support.	Introduction of discontinuous electrification.	Rail has a clear power-supply strategy, including lineside storage, distributed generation, onboard and hydrogen. This takes account of smart grid, storage and load balancing opportunities.	Standards/incentives adopted to reduce the need for civil engineering while maintaining safety.	Faster, more detailed and more effective planning and route clearance is enabled.	New electrification schemes, including discontinuous electrification, are being developed to address cost and disruption challenges.	All high-speed and high-intensity lines are electrified.
Zero-carbon self-powered vehicles	Where maximum journey speeds are under 100mph, there is increasing optimism that hydrogen and batteries will deliver a cost-effective low-carbon alternative that still delivers against operational and timetable requirements.	There are around 2,500 <100mph diesel vehicles currently active, many of which run on lines unlikely to be electrified.	Standards for hydrogen and battery trains and associated infrastructure are adopted.		In-service fleet deployments for hydrogen- and battery-powered trains.		Clear transitional and replacement plans for Sprinters (Classes 150-159) delivering zero-carbon.	All self-powered passenger vehicles are zero carbon.
Low carbon freight	There is currently no viable alternative to electrification or diesel power for rail freight that delivers the necessary power. There is a need to maximise benefits from electrification, as well as from hybrid and bi-/tri-mode locomotives.	Rail freight, with its significant reliance on diesel, runs the risk of being penalised while alternative modes may be more carbon intensive and increase congestion.	Options, criteria and business case to retrofit traction options and alternative drop in fuels are developed.	Clear understanding of where electrification could provide tipping point for freight traction.	Energy-optimised timetable and real-time train speed profiles are enabled for off-peak operation.	Clear understanding of delivery roadmap and transition arrangements for low carbon freight.	Clear role for rail as part of overall net zero logistics chain.	
Increased energy efficiency	Reducing energy consumption (losses and useful consumption) is often a cost-effective way to reduce carbon and can have immediate benefits for existing rolling stock.	The industry is neither incentivised nor aligned to improve the efficiency of rolling stock or infrastructure.	There is a strategy for reducing losses, especially on DC network as well as handling increased freight demand on the DC rail network.			Clear programme to reduce energy use is being delivered across the network.	Energy required per passenger vehicle km is minimised. Smart 'rail power network' that minimises traction carbon at source.	
Reducing polluting emissions	Air quality is the most pressing environmental health risk in the UK. There is a need to balance the best route to long-term decarbonisation against the more pressing need to mitigate harmful air pollutants.	While overall emissions from rail are low, they can be significant locally. The industry currently has limited understanding of the scale, location and risk of emissions.	Low-cost intelligent emissions monitoring and risk mapping is in place.	Clear and agreed technical requirements for rolling stock efficiency and emissions reduction, including retrofit, are adopted.	A programme of trials to test and compare mitigation options is delivered.	Air Quality Improvement Plans are in place and in action at locations where one is required.	Rail has a negligible impact on local air quality.	



Low emissions Progress against short-term vision

GOALS	RECENT POSITION (2020)	RECENT PROGRESS AGAINST STEPPING STONES			VISION FOR 2025	
<p>Cheaper and less disruptive electrification</p>	<p>Concerns over cost and disruption following recent electrification schemes have undermined political support.</p>	<p>Introduction of discontinuous electrification. <u>Various</u> TfW announced Class 230 battery-hybrid trains have been introduced into regular passenger service on the Borderlands Line between Wrexham and Bidston in April 2023. Class 756 electric-battery-diesel hybrid trains tested before entering service on the Rhymney line.</p>	<p>Rail has a clear power-supply strategy, including lineside storage, distributed generation, onboard and hydrogen. This takes account of smart grid, storage and load balancing opportunities. <u>NR & RSSB</u>. T1272 is exploring charging battery/multi-mode trains while running on the existing electrified network. T1229 will publish findings on non-electrified zones of high energy demand for freight trains in autumn 2023. T1270 will examine potential for intelligent energy management using the Western Route as a case study.</p>	<p>Standards/incentives adopted to reduce the need for civil engineering while maintaining safety. <u>NR</u></p>	<p>Faster, more detailed and more effective planning and route clearance is enabled. <u>NR TDNS</u></p>	<p>New electrification schemes, including discontinuous electrification, are being developed to address cost and disruption challenges.</p>
<p>Zero-carbon self-powered vehicles</p>	<p>There are around 2,500 <100mph diesel vehicles currently active, many of which run on lines unlikely to be electrified.</p>	<p>Standards for hydrogen and battery trains and associated infrastructure are adopted. <u>RSSB</u> T1185, an enabler to the operation of battery/multi bi-mode trains re. on-network charging has been published. T1272 will develop 'rules of engagement' between battery trains and traction power networks and examine the wider requirements.</p>	<p>In-service fleet deployments for hydrogen- and battery-powered trains. <u>ROSCOs and academia</u> HyTunnel project (COF=HYT-01) completed in 2023, results will inform decisions about safety equipment, systems and procedures to address hydrogen risks in tunnels. MultiHyFuel project (COF-MHY), risk assessment review of critical scenarios and hazardous areas underway, with best practice guidance due to be published in July 2024. Great Western Railway trial of battery train and fast-charging technology on the Greenford branch line.</p>			<p>Clear transitional and replacement arrangements for Sprinters (Classes 150-159) delivering zero carbon.</p>
<p>Low carbon freight</p>	<p>Rail freight, with its significant reliance on diesel, runs the risk of being penalised while alternative modes may be more carbon intensive and increase congestion.</p>	<p>Options, criteria and business case to retrofit traction options and alternative drop in fuels are developed. <u>ROSCOs and manufacturers</u> T1229 developed a model of traction power and energy requirements for freight corridors to improve understanding of the performance demands that low carbon freight locomotives will need to deliver.</p>	<p>Clear understanding of where electrification could provide tipping point for freight traction. <u>NR TDNS</u>. An aspect of T1263, which has completed with the technical report published in March 2023, explored opportunities to increase freight services where passenger services have been thinned out.</p>		<p>Energy-optimised timetable and real-time train speed profiles are enabled for off-peak operation. <u>NR and RSSB</u> T1263 has developed a framework for freight-prioritised, low emissions pathing and regulation decisions. It considered the holistic impacts of whole network traffic and wide economic benefits of modal shift from road to rail to identify the optimised options. T1270 will assess options to regulate the traction power demand on the Western Route.</p>	<p>Clear understanding of delivery roadmap and transition arrangements for low carbon freight.</p>
<p>Increased energy efficiency</p>	<p>The industry is neither incentivised nor aligned to improve the efficiency of rolling stock or infrastructure.</p>	<p>There is a strategy for reducing losses, especially on DC network as well as handling increased freight demand on the DC rail network. <u>NR</u> HS1 shared findings from a project that involved the introduction of regenerative braking technology introduced on Southeastern trains.</p>	<p>Clear and agreed technical requirements for rolling stock efficiency and emissions reduction, including retrofit, are adopted. <u>RSSB</u> is finalizing the recommendation for Rail Air Quality Targets for the DfT. Guidance on the initial steps TOCs should take to produce Air Quality Improvement Plans will be produced by <u>RSSB</u> by September 2023.</p>			<p>Clear programme to reduce energy use is being delivered across the network.</p>
<p>Reducing polluting emissions</p>	<p>While overall emissions from rail are low, they can be significant locally. The industry's understanding of the scale, location and risk of emissions is improving through the research and implementation carried out.</p>	<p>Low-cost intelligent emissions monitoring and risk mapping is in place. <u>RSSB</u> A Stations Air Quality Monitoring Network (AOMN), developed and operated by <u>RSSB</u> is in place covering over 100 stations. Diffusion tubes are installed at all stations covered, and three reference monitors have been installed so far, with two more to be installed by end of 2023.</p>	<p>SUS-2022-012 'Industry Idling Reduction Initiative' is underway and aims to deliver tangible reductions in engine idling with best practice guidance on how this can be maintained and repeated across industry. The project will understand barriers to idling reduction, assess technical solutions and perform a cost / benefit analysis on various mitigation options.</p> <p>SUS-2022-030 'Onboard trains particulate matter speciation' is also underway and aim to further understand the sources, composition and potential health impact of particulate matters found onboard train. Tests and sampling will be completed by summer 2023. Report including mitigation measures will be finalised by end of 2023.</p>		<p>A programme of trials to test and compare mitigation options is delivered. <u>Various</u> T1235 developed a testing protocol for retrofit emissions mitigation options for diesel rolling stock. TOCs and ROSCOs are working on various mitigation options to reduce diesel emissions from their fleets as part of their National Rail Contracts and Business Plan Commitments. <u>NR</u> announced a trial of new purification devices at platforms 10 and 11 at Birmingham New Street.</p>	<p>Air Quality Improvement Plans are in place and in action at locations where one is required.</p>



Optimised train operations

GOALS	WHY?	RECENT POSITION (2020)	STEPPING STONES IN THE NEXT FIVE YEARS				VISION FOR 2025	VISION FOR 2040	
Flexible and reliable train planning	There is a need to reduce the lead time and improve quality of future timetables. Easier and more robust ways to add / change paths at short notice allows services to be adjusted to meet passenger and freights needs.	The timetabling process has a long lead time and the working timetable generated doesn't learn from actual running times. The 'short-term' and 'very short-term' planning processes are very manual and not robust.	Single common model of GB rail infrastructure used for all planning.	Prioritised improvements of train planning data.	Greater integration of crew and stock planning for long and short term planning.	Solutions to allow the working timetable to learn from actual train performance.	Improved working timetable allocates allowances optimally, decreasing the risk of significant disruption if perturbations occur. Train paths are added easily and reliably at short notice. Increased (predictable) quality of service during disturbances and faster recovery.	Demand-based operations: planning and re-planning of trains to meet customer needs can be achieved and communicated in near real-time. Timetable development is informed by real-world operational performance.	
			Development and validation of new simulation tools to reflect the complexity of the railway and allow the outcomes of different optimisations to be compared and understood.		Solutions available to increase flexibility and robustness of very short-term planning.				
Improved real-time operations and decisions	Real-time train performance can be significantly improved by reducing the variability of train operations, and by improving traffic regulation and management during normal working and disruption.	Manual train handling leads to acceleration, braking and coasting lacking consistency. Initial deployments of Traffic Management (TM) and Connected Driver Advisory Systems (C-DAS) are used in a few locations. Shared understanding of where to deploy optimisation solutions and how to get best value out of them is limited. Richer data to better understand disruptions is starting to be explored. Incidences of Signals Passed at Danger remain a problem.	Open-source software infrastructure description	Crew and rolling stock resources linked to traffic management (TM).	TM integration with signalling systems.	Wider roll-out of TM to support, and where appropriate, automate decisions in perturbation.	Strong business case in place for widespread roll-out of TM based on positive results from early implementations. Reduction of variability in acceleration, braking and coasting on key route. Data insight used to inform real-time decisions and to prevent disruption. SPAD risk is virtually eliminated, with positive impact on service reliability.	Real-time optimisation of trains across the network together with effective prevention and recovery from disruptions. All lines have or are migrating to a digital signalling solution.	
				Widespread roll-out of C-DAS in conjunction with TM to improve passenger and freight performance.	Elements of ATO-ETCS piloted to remove variability in driving profiles.	Agreed strategic deployment plan for driving task support systems to maximise value for money.			
				New data driven tools to prevent and help mitigate disruptions.		Define the capability gaps remaining to improved real-time operations and decisions during disruption.			
				Trial and initial fitment of ETCS Limited Supervision on non-ETCS infrastructure.					
Improved degraded operations	Current degraded working takes time to set up and significantly reduces throughput of trains.	Degraded Mode Working System (DMWS) has been developed in the lab but not yet piloted.	Mainline trials of DMWS.	Agreed deployment plan for DMWS which exploits quick wins enabled by some of its elements.	Exploration of alternative approaches including hybrid solutions that interface with the signalling system.		Reduced disruption during signalling failures.		
Signalling and train capabilities support higher route capacity	There is the need to fit more trains on those parts of the network that are full either because of headway lengths or because of bottlenecks at nodes.	Thameslink is successfully ramping up its capacity but traditional signalling and management of nodes continue to limit capacity on most of the network. The migration strategy to digital signalling is unclear. Conventional signalling is based on the worst performing train, which means that the improved performance of modern rolling stock in terms of braking and acceleration are not utilised. Reliable braking in low adhesion remains a challenge.	Open-source software infrastructure description	Agreed migration strategy and roll-out plan for radio based ETCS with no lineside signalling.	Lessons identified and implemented from Thameslink mainline ATO deployment over ETCS Level 2.	Optimised ETCS braking curves for freight.	Schemes deploying radio based ETCS with no lineside signals are in delivery. The overlaying of ATO can be planned and delivered in a more informed way. Capacity in the process of being increased at key bottlenecks thanks to better design and solutions. Use of existing capacity is maximised Predictable and reliable braking unaffected by railhead conditions.	Trains can run closer together safety.	
				Validated freight train integrity devices.	Enhanced train position systems.	Block lengths shortened and optimised by automated design for new schemes.			Faster operating, inherently safe, point mechanisms piloted.
				Rationalisation of train classes and applicable speeds to create homogeneous operations..		Fundamental review of operational principles for mixed-traffic.			
				Double variable rate sanders specified for new trains; prioritised retrofitting for existing trains.	Magnetic track brakes for all new, frequent stop trains.	Train doors and interior layouts optimised during overhaul and for new build to minimise dwell time.			



Optimised train operations

Progress against short-term vision

GOALS	RECENT POSITION (2020)	RECENT PROGRESS AGAINST STEPPING STONES			VISION FOR 2025	
<p>Flexible and reliable train planning</p>	<p>The timetabling process has a long lead time and the working timetable generated doesn't learn from actual running times.</p> <p>The 'short-term' and 'very short-term' planning processes are very manual and not robust.</p>	<p>Single common model of GB rail infrastructure used for all planning. <u>NR SO</u></p>	<p>Prioritised improvements of train planning data. <u>NR SO</u></p>	<p>Greater integration of crew and stock planning for long and short term planning. <u>RSSB</u> COF-G26 case study of Advanced Model Interface L3 of TM and Stock and Crew integration on ECML underway, due to complete 2024.</p>	<p>Solutions to allow the working timetable to learn from actual train performance. <u>NR SO</u></p>	<p>Improved working timetable allocates allowances optimally, decreasing the risk of significant disruption if perturbations occur.</p>
<p>Improved real-time operations and decisions</p>	<p>Manual train handling leads to acceleration, braking and coasting lacking consistency.</p> <p>Initial deployments of Traffic management (TM) and Connected Driver Advisory Systems (C-DAS) are used in a few locations. Shared understanding of where to deploy optimisation solutions and how to get best value out of them is limited.</p> <p>Richer data to better understand disruptions is starting to be explored.</p> <p>Incidents of Signals Passed at Danger remain a problem.</p>	<p>Development and validation of new simulation tools to reflect the complexity of the railway and allow the outcomes of different optimisations to be compared and understood. <u>NR SO, NR Target 190plus & UKRRIN</u> NR Prior Information Notice for Target 190plus Synthetic Environment for the design and testing of signalling solutions published in July 2023.</p>	<p>Solutions available to increase flexibility and robustness of very short term planning. <u>RSSB</u> and <u>V/TC&C SIC</u> 3Squard completed Solent Stevedores pilot to locate and load containers onto trains, and is refining an algorithm that shows probabilities of freight paths being used. Tracsis /Bellvedi path searching and automatic initiation of contingency plans now available.</p>	<p>Train paths are added easily and reliably at short notice. Increased (predictable) quality of service during disturbances and faster recovery.</p>	<p>Strong business case in place for widespread roll-out of TM based on positive results from early implementations.</p>	
<p>Improved degraded operations</p>	<p>Degraded Mode Working System (DMWS) has been developed in the lab but not yet piloted.</p>	<p>Widespread roll-out of C-DAS in conjunction with TM to improve passenger and freight performance. <u>RSSB, V/TC&C SIC/DAS PCB</u> Class 387s running with C-DAS operational, Class 802 operations not yet commenced. C-DAS benefits paper from operational trial expected Autumn 23.</p>	<p>Elements of ATO-ETCS piloted to remove variability in driving profiles. <u>V/TC&C SIC</u> In use on Thameslink Core, with uptake of ATO increasing as new cohorts of drivers are trained.</p>	<p>Agreed strategic deployment plan for driving task support systems to maximise value for money. <u>NR Projects</u></p>	<p>Reduction of variability in acceleration, braking and coasting on key routes.</p>	
<p>Signalling and train capabilities support higher route capacity</p>	<p>Thameslink is successfully ramping up its capacity but traditional signalling and management of nodes continue to limit capacity on most of the network.</p> <p>The migration strategy to digital signalling is unclear.</p> <p>Conventional signalling is based on the worst performing train, which means that the improved performance of modern rolling stock in terms of braking and acceleration are not utilised.</p> <p>Reliable braking in low adhesion remains a challenge.</p>	<p>Open-source software infrastructure description. <u>NR</u> Project Axiom East Coast pilot underway (includes track, platform, S&C, signals and track circuit data). Proofs of concept include geospatial viewer, gradient data, data interoperability and automated schematics.</p> <p>Crew and rolling stock resources linked to traffic management (TM). <u>NR Projects</u> Western Route deployment of Integrale and Luminare, extended across Western Region and Anglia Route.</p> <p>TM integration with signalling systems. <u>V/TC&C SIC</u> Thameslink Class 700s to be upgraded following Class 387 testing, as part of the ECDP.</p> <p>Wider roll-out of TM to support, and where appropriate, automate decisions in perturbation. <u>NR Regions</u> National TM Strategy exploring the range of options for deployment.</p> <p>New data driven tools to prevent and help mitigate disruptions. <u>RSSB, RDG, NR and TOCs</u> NR Seasons Team is looking at the Seasonal Agnostic Railway Model and assessing the impact of asset failures.</p> <p>Define the capability gaps remaining to improved real-time operations and decisions during disruption. <u>TBD</u> Following IMP-T1154, NR is continuing roll out of the toolkit and associated processes, with 4 of 6 tranches completed, and the NOCs (to include CrossCountry and freight), due for completion by CP6 end.</p> <p>Trial and initial fitment of ETCS Limited Supervision on non-ETCS infrastructure. <u>V/TC&C SIC/TPSG</u> Proof of concept largely demonstrated on Class 150/2. Development has migrated to a speed management system with trials being planned on the West of England line with a Class 159, but funding is not yet secured.</p> <p>Mainline trials of DMWS. <u>V/TC&C SIC/DMWS</u> Plans for 'track-only' trial cancelled due to funding constraints.</p> <p>Agreed deployment plan for DMWS which exploits quick wins enabled by some of its elements. <u>V/TC&C SIC/DMWS</u></p> <p>Exploration of alternative approaches including hybrid solutions that interface with the signalling system. <u>V/TC&C SIC/DMWS</u></p> <p>Agreed migration strategy and roll-out plan for radio based ETCS with no lineside signalling. <u>V/TC&C SIC/TPSG</u> ETCS pilot on Northern City Line (Moorgate-Finsbury Park complete and deployed. East Coast delivery programme continuing train and infrastructure fitment through 2024.</p> <p>Lessons identified and implemented from Thameslink mainline ATO deployment over ETCS Level 2. <u>V/TC&C SIC/TPSG</u> Included in the European ATO over ETCS (AoE) specifications, recently published in the updated CCS TSI. Learnings from DRACAS also available for AoE projects.</p> <p>Optimised ETCS braking curves for freight. <u>V/TC&C SIC/TPSG</u></p> <p>Validated freight train integrity devices. <u>RSSB, RFG</u> Findings from T1264 provided GB freight industry with an evaluation framework and shared evidence base for introduction of Digital Automatic Coupling.</p> <p>Enhanced train position systems. <u>Various</u></p> <p>Block lengths shortened and optimised by automated design for new schemes. <u>V/TC&C SIC</u></p> <p>Faster operating, inherently safe, point mechanisms piloted. <u>NR R&D & UKRRIN</u> IN2TRACK3 project on redesigning actuators and simulating interlocking & actuators (based on REPOINT) due to complete end of 2023.</p> <p>Rationalisation of train classes and applicable speeds to create homogeneous operations. <u>OPG and TOM SC</u> T1266 is assessing the benefits of applying a speed differential based on the actual braking capabilities of freight trains using the same methodology that is required for ETCS and ERTMS. The final report is due to be published by the end of 2023.</p> <p>Fundamental review of operational principles for mixed-traffic. <u>TBD</u> Rail Partners' 'Freight Expectations' report published in March 2023 outlined the potential economic contribution of rail freight and calling for a set of commitments to support the shift from road to freight.</p> <p>Double variable rate sanders specified for new trains; prioritised retrofitting for existing trains <u>RDG</u> Fitments are underway with SWR n Class 158/9s, Northern Class 323s and Scotrail Class 170s.</p> <p>Magnetic track brakes for all new, frequent stop trains. <u>ARG</u> Testing of new Stadler-built Nexus metro fleet has now started ahead of entering passenger service in phases from 2023 -2025 .</p> <p>Train doors and interior layouts optimised during overhaul and for new build to minimise dwell time. <u>RSSB</u> T1257 best practice on guard controlled door operation has been published and T1262 on Safe and Efficient Driver Controlled Door Operation underway.</p>	<p>SPAD risk is virtually eliminated, with positive impact on service reliability.</p> <p>Reduced disruption during signalling failures.</p> <p>Schemes deploying radio based ETCS with no lineside signals are in delivery.</p> <p>The overlaying of ATO can be planned and delivered in a more informed way.</p> <p>Capacity in the process of being increased at key bottlenecks thanks to better design and solutions.</p> <p>Use of existing capacity is maximised.</p> <p>Predictable and reliable braking unaffected by railhead conditions.</p>	<p>Data insight used to inform real-time decisions and to prevent disruption.</p> <p>SPAD risk is virtually eliminated, with positive impact on service reliability.</p>	<p>SPAD risk is virtually eliminated, with positive impact on service reliability.</p> <p>Reduced disruption during signalling failures.</p> <p>Schemes deploying radio based ETCS with no lineside signals are in delivery.</p> <p>The overlaying of ATO can be planned and delivered in a more informed way.</p> <p>Capacity in the process of being increased at key bottlenecks thanks to better design and solutions.</p> <p>Use of existing capacity is maximised.</p> <p>Predictable and reliable braking unaffected by railhead conditions.</p>	



Reliable and easy to maintain

GOALS	WHY?	RECENT POSITION (2020)	STEPPING STONES IN THE NEXT FIVE YEARS			VISION FOR 2025	VISION FOR 2040
<p>Improved reliability and availability of existing systems</p>	<p>Reliability that is appropriate to the role of rolling stock and fixed assets in the system reduces disruption to services and drives cost efficiency through less maintenance.</p> <p>Services should only be disrupted as a last resort when assets fail.</p> <p>Increasingly complex railway systems raise the likelihood of service disruption through faulty interactions of assets or sub-systems.</p> <p>Greater resilience needed to cope with system stresses including climate change.</p>	<p>The timing of failures is unpredictable resulting in over-cautious inspection and maintenance or emergency intervention and delay.</p> <p>Response to faults can overlook, or take insufficient account of, wider operational implications.</p> <p>Individually reliable components and systems can interact to delay trains.</p>	<p>Identify rolling stock and fixed assets to be prioritised for improved reliability and availability, based on their performance impact.</p>	<p>For high-priority assets and their operations: identify and assess improvement options, and review fault response to ensure services can keep running with minimal disruptions.</p>	<p>For high-priority assets, pilot and roll-out improvements to the assets, their management, fault response and operating approaches that keep services running.</p>	<p>System resilient to many localised failures.</p> <p>Improved reliability by designing refinements that have high performance impact.</p> <p>Improved availability by accommodating failures to in-service assets with 'smarter' operations.</p> <p>Knowledge is routinely applied to improve system reliability, with the workforce guided by data and maintainers engaged in design.</p>	<p>System resilient to most localised failures.</p> <p>All assets performing with a known and appropriate level of reliability at component, sub-system and system levels and causing minimum disruptions.</p>
<p>Safe and rapid inspection and repair</p>	<p>Targeted interventions based on the condition of rolling stock and fixed assets. Minimised downtime for maintenance and repairs can have significant positive impact on both costs and customer satisfaction.</p> <p>Lower risk to workforce and less disruption can be achieved by more automated inspection and repair methods, and decision support.</p>	<p>Progress towards optimal inspection and monitoring, but remote inspection and monitoring (RCM) and non-destructive testing is only used for a limited set of assets.</p> <p>Where deployed, RCM is starting to move workforce away from live operational environments.</p> <p>Most maintenance and repairs require rolling stock being temporarily removed from service or track possessions.</p> <p>Safety-driven initiatives to reduce workforce risk are focused on improving current procedures.</p>	<p>Identify which high-priority (cost and impact) rolling stock and fixed assets could best use RCM, aligned with available sensor and comms technology.</p>	<p>Deploy RCM systems to high-priority assets and use the data to optimise inspection, servicing and replacement schedules based on asset conditions and performance.</p>	<p>Develop and deploy RCM systems to more rolling stock and fixed assets.</p> <p>Evolve RCM algorithms to improve their prediction accuracy.</p>	<p>Condition-based inspection and maintenance (optimised for practicability) is widely used, replacing periodic inspection and maintenance.</p> <p>Widespread use of robotics and AI to identify – and in some cases rectify – asset faults.</p> <p>Workforce has been trained on remote supervision, leading to fewer and shorter withdrawals from service or track possessions and greater safety.</p>	<p>All assets inform owners about health, degradation of performance and remaining service life.</p> <p>Railway maintenance is highly automated.</p> <p>Workforce typically co-ordinate automated repairs in live operational environments, often remotely.</p>
<p>Step-change in reliability, availability and whole-life cost for new assets</p>	<p>Future railway systems are designed to minimise single points of failure and deliver reliable service including under future climatic conditions.</p> <p>Upgrades of rolling stock and fixed assets are affordable and can deliver lower operating costs and a higher performing railway.</p> <p>Opportunity to create high-value, safe roles for our workforce, designed to exploit new asset capability.</p>	<p>The case for, and path to, next generation assets is not always clear and whole-life cost is considered too narrowly.</p> <p>New generation asset design is not always driven by reliability and availability, especially at a system level.</p> <p>Design thinking and enhancements to the current generation of assets provide insights to inform new specifications.</p> <p>Renewals and mid-life refurbishment present opportunities but are often used to replace like-for-similar.</p>	<p>Incorporate targets for Mean Time To Repair and Between Failures and ease of repair in asset specifications and sub-systems.</p>	<p>Develop revised design specifications incorporating design for reliability and avoiding single point of failure.</p>	<p>Use revised specifications when replacing assets.</p>	<p>Maintenance strategy and requirements are always specified at design stage as part of optimising whole-life cost.</p> <p>Key train and infrastructure requirements, or equivalents, set at an appropriate level of detail, system-level outputs and long-term asset strategy.</p>	<p>New assets designed for availability through non-disruptive repair; easy renewal; and reduced whole-life cost and environmental impact.</p> <p>New assets designed for reliability at system level and for future climatic conditions. They do not have single points of failure and include in-built health monitoring.</p> <p>Future transitioning and re-purposing of assets considered as part of design.</p>



Reliable and easy to maintain Progress against short-term vision

GOALS	WHY?	RECENT PROGRESS AGAINST STEPPING STONES			VISION FOR 2025
<p>Improved reliability and availability of existing systems</p>	<p>Reliability that is appropriate to the role of rolling stock and fixed assets in the system reduces disruption to services and drives cost efficiency through less maintenance.</p> <p>Services should only be disrupted as a last resort when assets fail.</p> <p>Increasingly complex railway systems raise the likelihood of service disruption through faulty interactions of assets or sub-systems.</p> <p>Greater resilience needed to cope with system stresses including climate change.</p>	<p>Identify rolling stock and fixed assets to be prioritised for improved reliability and availability, based on their performance impact. <u>Various</u> Porterbook has opened a modern Asset Management Facility (AMF) at Long Marston Rail Innovation Centre, to support trialling and testing of innovative traction tech.</p> <p>NR and Arcadis pilot performance-based data analytics and technical insights model on 19km of Western Route.</p>	<p>For high-priority assets and their operations: identify and assess improvement options, and review fault response to ensure services can keep running with minimal disruptions. <u>Various</u> First-of-a-Kind Reliable and Maintainable Assets Rail competition for high maturity demonstrations launched in June 2023.</p>	<p>For high-priority assets, pilot and roll-out improvements to the assets, their management, fault response and operating approaches that keep services running. <u>Various</u> Northern equipping up to 40 Class 335 trains with LiDAR cameras, thermal imaging software and HD CCTV to record infrastructure defects, environmental factors and maintenance issues.</p>	<p>System resilient to many localised failures.</p> <p>Improved reliability by designing refinements that have high performance impact.</p> <p>Improved availability by accommodating failures to in-service assets with 'smarter' operations.</p> <p>Knowledge is routinely applied to improve system reliability, with the workforce guided by data and maintainers engaged in design.</p>
<p>Safe and rapid inspection and repair</p>	<p>Targeted interventions based on the condition of rolling stock and fixed assets. Minimised downtime for maintenance and repairs can have significant positive impact on both costs and customer satisfaction.</p> <p>Lower risk to workforce and less disruption can be achieved by more automated inspection and repair methods, and decision support.</p>	<p>Identify which high-priority (cost and impact) rolling stock and fixed assets could best use RCM, aligned with available sensor and comms technology. <u>Various</u> NR's Intelligent Infrastructure (II) plans for CP7 includes a focus on predictive asset management and monitoring data to underpin decision making. Planning to be integrated across industry, aligning access and resources.</p>	<p>Deploy RCM systems to high-priority assets and use the data to optimise inspection, servicing and replacement schedules based on asset conditions and performance. <u>Various</u> NR's Intelligent Infrastructure (II) plans for CP7 includes plans to consolidate and exploit asset condition and usage data to optimise asset repairs and enhancements.</p>	<p>Develop and deploy RCM systems to more rolling stock and fixed assets. Evolve RCM algorithms to improve their prediction accuracy. <u>Various</u> Angel Trains and Cordel used LiDAR and co-located video, on the Didcot to Paddington route, to create a survey-grade digital twin aligned to NR's linear reference system. Data that is captured can be used to enhance the AI algorithms and deliver new insights for NR.</p>	<p>Condition-based inspection and maintenance (optimised for practicability) is widely used, replacing periodic inspection and maintenance.</p> <p>Widespread use of robotics and AI to identify – and in some cases rectify – asset faults. Workforce has been trained on remote supervision, leading to fewer and shorter withdrawals from service or track possessions and greater safety.</p>
<p>Step-change in reliability, availability and whole-life cost for new assets</p>	<p>Future railway systems are designed to minimise single points of failure and deliver reliable service including under future climatic conditions.</p> <p>Upgrades of rolling stock and fixed assets are affordable and can deliver lower operating costs and a higher performing railway.</p> <p>Opportunity to create high-value, safe roles for our workforce, designed to exploit new asset capability.</p>	<p>Incorporate targets for Mean Time To Repair and Between Failures and ease of repair in asset specifications and sub-systems. <u>Various</u> New Greater Anglia/Stadler FLIRT bi-mode fleets achieving punctuality figures between 93% and 99% on routes where the new Stadler trains are running.</p>	<p>Develop revised design specifications incorporating design for reliability and avoiding single point of failure. <u>Various</u> Development of FFA-G wagons by Freightliner/Greenbrier Europe/Wabtec Axiom Rail – the FFA-G wagon is 2 tonnes lighter per platform and uses low track force bogies to help reduce track damage.</p>	<p>Use revised specifications when replacing assets. <u>Various</u> RIS-0703-CCS Issue 2 published by RSSB, to help suppliers and signalling layout designers to develop, design and implement lineside signalling systems that follow good practice.</p>	<p>Maintenance strategy and requirements are always specified at design stage as part of optimising whole-life cost.</p> <p>Key train and infrastructure requirements, or equivalents, set at an appropriate level of detail, system-level outputs and long-term asset strategy.</p>
		<p>Workforce and technologists co-create opportunities and co-design new way to exploit new technology for safety, reliability and value. <u>Various</u> East Midlands Railway project with the University of Sheffield will work with operational staff to build a representational model of the Nottingham Eastcroft depot which will form the basis of a virtual depot simulation tool, to plan and stress test operational scenarios.</p>	<p>Pilot cross-industry reporting system to prove its benefits in managing complex faults. <u>Various</u> The East Coast Deployment Programme is piloting an ETCS DRACAS tool with a small number of operators, starting with Grand Central, before rolling out to other operators in 2024. Lessons learnt will inform implementation and the development of a national system.</p>	<p>Increase the range of assets covered by this reporting system and feed enhanced system-level requirements into design specifications. <u>Various</u> The Asset Integrity Group (AIG) has created a roadmap for the implementation of the National CCS DRACAS.</p>	
		<p>Identify priority retrofit solutions to deliver a step-change through asset upgrades. GTR's first C387/1 Great Northern Electrostar train has been retrofitted with Alstom ETCS in-cab signalling as part of the East Coast Digital programme. Dynamic testing at NR's Rail Innovation Development Centre will complete by the end of 2023.</p>	<p>Develop tools to plan and assess the case for transitions to step-change performance of assets. <u>Various</u> Vehicle/Track Interaction Strategic Model (VTISM) updated by RSSB to provide improved modelling capabilities for vehicle/track interactions and long term asset maintenance/renewal planning</p>	<p>Apply the tools to inform industry planning.</p>	
<p>Agree with industry and ORR the economic and safety case for condition-based inspection and maintenance. <u>IBD</u> There is currently no clear mechanism to support the coordination necessary to understand the case and support transition from periodicities.</p>					

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Explore the full strategy including the live components at:

www.RailTechnicalStrategy.co.uk

Share the technical solutions you are developing and deploying

We invite you all to let us know what you are working on to capture what wider industry is delivering or considering initiating in relationship to the five functional priorities.

We are also looking to expand the range of case studies featured in the RTS to help the railway celebrate and publicise technical successes. The aim is to help potential partners and customers find you and understand what is available whilst protecting your IPR.

Your feedback is welcome

Individuals and organisations can add to the picture, and constructively challenge the direction of travel and its speed.

We are interested to know about new ideas and opportunities to accelerate towards the stated vision for 2040.

Get in touch at:

rts@rssb.co.uk

