Digital Railway Strategy

April 2018

Working together for a better railway:

FOREWORD

This Digital Railway Strategy is a key part of my goal to transform how trains are run by bringing in digital solutions for a digital age, as I have set out in my Strategic Vision for Rail.

We already use digital technology in the skies. Our digital air traffic control systems have created vital extra capacity for UK airports and it will create more space still in the future as it evolves and improves. But our trains are still largely operating in an analogue world. So I want to see digital technology like that, which has transformed our skies, become commonplace on UK rails within the decade. That is why I have asked to see all signalling renewals and upgrades in CP6 and beyond being digital, or at the very least digital enabled.

As the Secretary of State for Transport, I have challenged our rail industry to put passengers at the heart of everything the railway does. Passengers want reliable services and quick recovery when things go wrong. The Digital Railway is about making use of what modern technology can offer so that we can run more trains, faster, more safely and on time. This is one of the ways my Department and Network Rail will work with the rail industry to adapt and change the way we run our railways in Britain, so that we can respond to the unprecedented growth in passenger numbers since privatisation 20 years ago.

I have also made it clear that I consider Britain's railways to be crucial to our economic future. We know investing in transport connects us better, drives economic growth and creates jobs. Investing in a Digital Railway will catalyse the creation of high-skilled tech jobs in the industry and drive innovation in new products and services that we can export around the world, building on the strong reputation our rail engineers already have overseas. This Digital Railway Strategy is an important step towards realising that ambition.

Work has already begun to deliver the Digital Railway. While I have been Secretary of State, the Government has allocated an additional £450 million to accelerate the deployment of digital signalling technology. We announced in the November 2017 Budget a number of Digital Railway schemes, including between Manchester and York, which we are now developing with this funding. A pilot project has already been announced on the Great Western Main Line – a world-first rollout for technology pioneered by British engineers. By the end of 2018 we will have fitted around 200 trains with the latest digital signalling technology and have funded state of the art test facilities, which organisations even from outside the UK come to use. We will also have introduced digital signalling on major projects including Thameslink and Crossrail. This Digital Railway Strategy sets out how we will now build on the strides we have already taken and my Department will continue to offer its full support and leadership to the rail industry as it goes forward on this ambitious journey.

Rt Hon Chris Grayling MP, Secretary of State for Transport

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1. EXECUTIVE SUMMARY

1.1 Drivers for Change: The Need for a Modern Railway

Britain's railways play an essential role in supporting sustainable economic growth, by enabling the safe, fast and efficient movement of large volumes of passengers and goods into and between major economic centres, their catchments and international gateways.

Looking ahead, the rail network faces an enormous challenge. At peak times on the busiest parts of the network, Britain's largely Victorian railway infrastructure is full. Hundreds of thousands of passengers suffer crowded trains every day and the rail freight industry, which is vital to the national economy, suffers from a shortage of suitable train paths, resulting in slower journeys.

These constraints on the rail network, compounded with expected future growth and funding limitations, create a number of industry challenges relating to affordability and asset sustainability, capacity and performance and preserving and enhancing safety, as well as a skills shortage across the rail industry, with changing skills requirements.

In response to these industry challenges and as part of a line of route-wide upgrades and package of interventions, digital signalling and train control solutions are able to offer significant passenger and freight benefits at a lower whole life cost, relative to wholly conventional based solutions. The deployment of digital technologies has the potential to revolutionise the way we implement the replacement of conventional signalling, leading to a transformation in the way trains are operated and controlled around the existing network. In doing so, this will deliver benefits to rail users and the wider economy, including increased capacity, improved performance and enhanced safety for passengers and workers. This means that many passengers will be able to enjoy less crowded, more frequent and more reliable trains than they experience today.

Historical evidence demonstrates that an isolated approach to addressing these industry challenges does not support an efficient whole life cost. However an integrated approach, considering both infrastructure and train operations, targeted to address capacity, performance and asset renewal needs, will optimise the potential of digital train and operational control technologies in resolving industry challenges for the benefit of rail users and the wider GB economy.

1.2 The Digital Railway Programme

The Digital Railway Programme is a benefits-driven, cross-industry change programme enabled by technology, which will facilitate the delivery of systems, technology, business and people change in an integrated way. Being benefits-driven means that the Digital Railway Programme does not see the use of new technologies as an end in itself, but as a means through which the Programme will help to address industry challenges by supporting the deployment of digital solutions in areas that offer the best strategic fit and greatest value for money for the rail industry and wider economy, balancing benefits with affordability.

The Digital Railway Programme will enable the delivery of benefits by embedding a number of new ways of working and technologies. Examples of these technologies include:

- **European Train Control System (ETCS),** which allows trains to run closer together and travel at their optimal speeds and provides enhanced train protection;
- **Traffic Management (TM)** (linking with other systems such as DARWIN and Crew & Stock), which maximises the throughput that infrastructure can support, improves service recovery and enhances performance;

- **Connected Driver Advisory System (C-DAS),** which provides decision support to drivers in the cab to improve timetable adherence and therefore overall performance;
- **Supervised Automatic Train Operation (ATO),** which provides the ability to control trains to a finer resolution in order to run to the maximum capability of the infrastructure in a more consistent way;
- **Smart infrastructure**, with remote condition monitoring technologies, which will improve performance, reduce disruption and improve safety;
- **Rolling stock system performance,** together with decision support tools, providing predictive faulting, performance and reliability improvements and smarter recovery from perturbations;
- **Telecommunications,** providing the backbone to transfer data and information between systems, to operational staff and customers; and
- **Data**, Digital Railway is a data-configurable railway, and therefore a high level of data confidence and integrity is essential, supported with the appropriate cyber security and business continuity processes.

Digital Railway technologies require greater levels of integration across track and train operations and between real time control systems and IT business systems. In contrast to conventional signalling systems, digital signalling systems are deployed on rolling stock, track infrastructure and in operating centres linked to timetable planning systems, triggering the need for new ways of working not currently experienced by UK railways.

The Digital Railway Programme is a pan-industry programme leading the transformation of the GB railway through digital train control and signalling. Sound progress is being made fitting trains with digital capability (ETCS in-cab equipment). However, the transformation from location-specific signalling renewals to an integrated whole-system approach, in partnership with franchises and procurement on an outcome basis to make best use of the supply chain, will not be straightforward.

Within a complex industry, the efficient and effective deployment of these new technologies and ways of working requires a co-ordinated, programmatic approach to optimise benefits and improve cost efficiency. In this context, the core role of the Digital Railway Programme is to provide systems leadership, industry sponsorship, industry change strategies, and business and systems requirements, to enable Network Rail's Route businesses and the wider industry to procure and implement the Digital Railway.

The Digital Railway Programme has a significant role to play in enabling the delivery of benefits to passengers and freight users, broader society and the rail industry itself. Benefits, evidenced in business case analysis, include:
- Increased capacity to meet demand;
- Better performance for passenger and freight customer journeys;
- Enabling faster journey times;
- Less disruption from renewals, maintenance and upgrades;
- Enhanced safety for passengers and workers; and
- Better asset sustainability (lower whole life cost).

Whilst not a direct benefit, the implementation of Digital Railway technologies could enable data connectivity for passengers and freight customers, as well as assets.

The Digital Railway transformation is about delivering a more dynamic, responsive and fit-for-purpose railway for rail users in the digital age. Digital Railway has a significant role to play in contributing to the productivity of the wider economy, creating new high-value jobs, improving productivity, expanding the UK's manufacturing capability, developing a world class industry capable of global exportation and

rebalancing the economy by promoting economic growth in the North, Midlands and South West of England.

1.3   The Digital Railway Delivery Strategy

The Digital Railway Programme will build on previous work and achievements to date, to enable the development and implementation of Digital Railway technologies and ways of working over the short, medium and longer term.

In the **short term, to the end of CP5 (2019),** the Digital Railway delivery strategy involves 'Committed Projects and Learning Lessons'. Building on previous work and achievements to date (notably, the deployment of ETCS Level 2 on the Cambrian Line and the Integrated Electronic Control Centre (IECC) Scalable), implementation of Digital Railway schemes in the short term include Thameslink, Network Rail's systems to support Crossrail 1, and the Traffic Management deployments at Cardiff, Romford and along the Great Western Route. On completion of these projects, knowledge gained, and lessons learned from the deployment of digital technologies, will inform development and delivery of the next stage of deployments. Enabling projects, including development of an ETCS test track and first in class for rolling stock retro-fitment with ETCS, are also being undertaken in the short term.

In the **medium term, from CP6 to mid-CP7 (2019 to c.2027),** the delivery strategy is 'Targeted Deployment', whereby Digital Railway schemes will be identified and prioritised according to the most compelling, stand-alone business cases. This will be based on a set of principles, using an integrated and targeted approach, set out in this strategy. In addition, £450 million from the National Productivity Investment Fund (NPIF) is proposed to accelerate the deployment of a selection of digital schemes to deliver benefits by mid-CP6. Currently there is no allocation in the statement of funds available (SoFA) for CP6 for digital signalling (ETCS) renewals, and additional funding will be sought on a case-by-case basis. The Digital Railway Programme will also provide guidance for the innovation of systems, procedures and processes to enable greater efficiencies and business benefits to be derived from the underlying core technologies.

In the **longer term, mid-CP7 onwards (c.2027 onwards),** the delivery strategy will be based predominantly on asset condition within the notional asset life of Command, Control & Signalling (CCS) assets. It is anticipated that digital solutions will become 'business as usual', as the costs reduce and experience is gained from earlier digital deployments and further innovation. The longer term plan will be regularly revisited to consider and integrate with other factors such as demand, franchising and technology developments.

1.4   Delivering the Strategy

The rail industry has experience of delivering large and complex programmes, but there have been few truly industry-wide change programmes of this scale. Successful delivery of the Digital Railway Strategy will be dependent on overcoming a number of delivery challenges and risks relating to industry collaboration, funding and financing and business change. Examples of key delivery challenges include rolling stock fitment, integration with Train Operating Company (TOC) franchises and freight fitment.

To overcome these industry challenges and successfully deliver the cross-industry benefits of the Digital Railway within the current funding environment, significant changes in industry ways of working, co-operation and, where necessary, contributions from across the industry will be required.

The diagrams below illustrate some of the key changes that will be required to the delivery of CCS programmes. To encourage innovation and drive cost efficiencies, engagement with the supply chain

will be instigated during option development and design (as part of a Joint Design Group). Supply chain relationships will be an important factor in bringing down the unit costs of digital signalling over time, reducing industry-wide costs relative to conventional signalling in the longer term. The opportunity for using private finance in Digital Railway schemes, and for using the franchise competition process will be considered to create opportunities for delivering the Digital Railway.

With new ways of working and technologies deployed on the rolling stock, track infrastructure and in operating centres, industry collaboration and effective business change will be more important than ever. To develop the skills and capabilities required to deliver the Digital Railway, as well as build and sustain confidence from the supply chain, visibility of a long-term pipeline of digital deployments will be required, supported by an industry-wide Signalling and Operational Control Systems Strategy to provide a more detailed implementation plan for digital deployments and give effect to this Strategy.
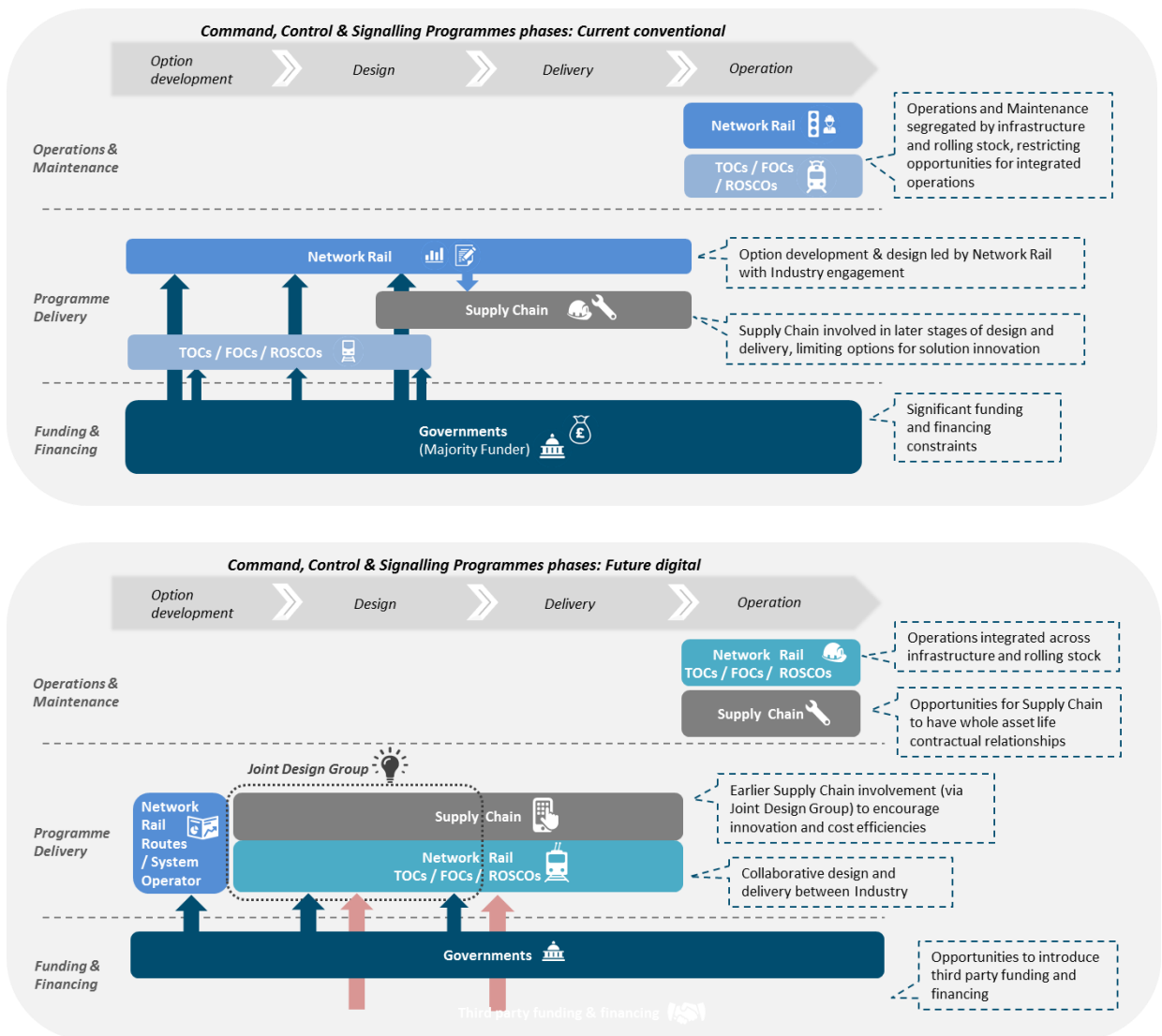

Figure 1: Current and future models for Command, Control & Signalling Programmes

1.5   An Integrated and Whole-network Approach for the Digital Railway

The strategy proposes an integrated, whole-network approach, matching infrastructure renewal needs to train fitment plans and franchise opportunities to safely, affordably and sustainably transition to digital signalling and train control over Control Periods 6 and 7, focusing on the main lines to deliver immediate benefits to passengers and freight users.

To help illustrate the approach, the map below shows the percentage of passenger train kilometres by 2022 of 'ETCS-fitted' or 'ETCS-ready' (i.e. digitally capable) trains. It includes the following passenger trains:

- Cambrian
- Inter City Express Programme
- Thameslink
- Crossrail
- East Coast Main Line (Virgin Trains East Coast and Open Access)*
- TransPennine Express and Northern
- Anglia ETCS-ready
- Wessex Inner Suburban Trains.
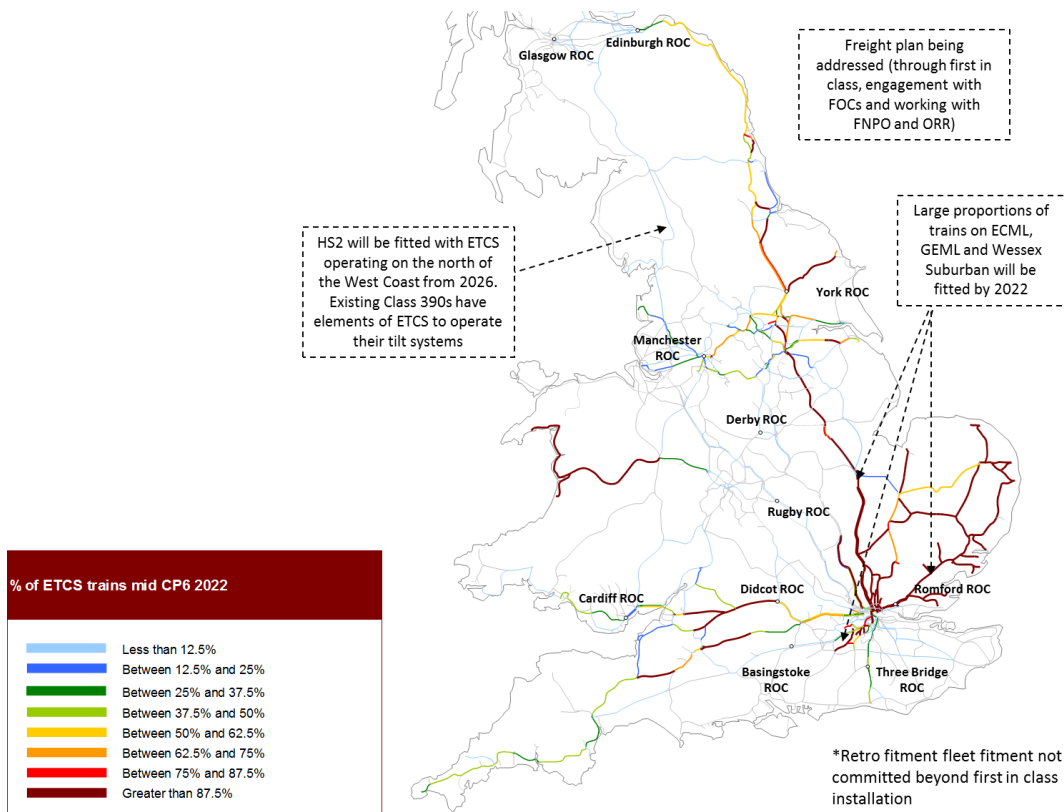
Figure 2: Percentage of ETCS-fitted or ETCS-ready passenger train kilometres assumed by 2022

CP6 (2019-2024) is expected to mark a turning point for Digital Railway, as 'digital-ready' infrastructure and ETCS-fitted trains are increasingly deployed across the network, together with digital train control, Traffic Management and C-DAS technologies. There are clear corridors where trains with digital capability (ETCS-fitted) will be in the vast majority during CP6, such as along the East Coast Main Line from London to Edinburgh.

2. PURPOSE OF STRATEGY

The purpose of this document is to outline the strategic context, drivers for change and overall direction of the Digital Railway Programme, setting out its objectives and benefits, and how the Digital Railway relates to wider economic, social and environmental objectives. The Strategy sets out the strategic direction and delivery approach for the Digital Railway Programme.

Previously, an 'ETCS, Traffic Management and Network Operating Strategy' was proposed for CP5 (2014 - 2019), which was integrated with franchising and rolling stock. This CP5 investment proposal was based on a narrower approach, considering whole life cost savings at the point of signalling asset renewal and operating cost savings. The Digital Railway Programme has assessed whether taking an integrated approach, considering benefits of capacity, performance and safety, changes the priority or timing of investment in digital train and operational control technologies.

In this context, the Digital Railway Strategy provides clarity and an agreed position on:

- Why the Digital Railway Programme is needed;
- How it will contribute to the Government's wider economic, social and environmental objectives; and
- The agreed approach to addressing industry challenges relating to affordability and asset sustainability, safety, capacity and performance.

2.1   Consultation and Stakeholder Engagement

Industry stakeholders including the Rail Delivery Group, freight operators, rolling stock operating companies (ROSCOs), TOCs, the Office of Rail and Road (ORR), the Rail Safety and Standards Board (RSSB), Transport Scotland and the Department for Transport (DfT) are represented on the Digital Railway's governance forums, i.e. the Digital Railway Programme Board (the key decision making body) and the following functional boards: Deployment Board, Strategy & Business Case Board and Systems & Operations Board, reflecting that the Digital Railway Programme is an industry programme.

The Digital Railway Strategy has been developed in consultation with industry stakeholders. Having been agreed and established with industry, this document forms the Strategy for the Digital Railway and is subject to change control.

3. BACKGROUND AND DRIVERS FOR CHANGE

This section outlines the background and strategic context in terms of the railway's contribution to economic growth, and the Government's wider strategic objectives. It also describes the challenges facing the rail industry relating to: affordability and asset sustainability; capacity and performance; preserving and enhancing safety; and a shortage in skills across the GB rail industry.

3.1   Background and Strategic Context

Our railways play an essential role in supporting sustainable economic growth, by enabling the safe, fast and efficient movement of large volumes of passengers and goods into and between major economic centres, their catchments, and international gateways. The rail network is particularly important to the success of our large urban areas, where some of the most productive parts of our economy are based. The huge volumes of commuters carried by the railway drive the economic growth of the nation, with the railway also making a significant contribution to its social fabric, providing essential connections for individuals, families, and communities in all areas of the country.

Over the next Control Period, CP6 (2019 – 2024), the principal funder of the railways in England and Wales, the Department for Transport (DfT), has set out a vision for the railways for "a more reliable, efficient and modern railway delivered by joined up local teams", including:

- A step-change in renewals to maintain safety and improve reliability: efficient asset stewardship on an increasingly busy network;
- The next generation of passenger service contracts: sustainable commercial contracts, securing joint working and quality for passengers;
- A new generation of long-term integrated regional rail partnerships, working to aligned objectives, focussed on passenger needs;
- New connections and new capacity, delivering today's projects and advancing the next generation of rail schemes;
- New partners for infrastructure development, design and delivery and encouraging and facilitating market-led proposals for rail enhancements; and.
- New sources of funding and financing unlocking improvements.[1]

Of relevance to Digital Railway, the DfT also set out the need for a more reliable railway, and the role of digital technologies in achieving the strategic vision:

"The use of digital technology is a huge opportunity for rail. These technologies will help the railway of the future make better use of the existing infrastructure and capacity to reduce the need for costly and disruptive civil engineering schemes, and find much more sustainable solutions which are lower cost for rail users and taxpayers. Investing in Digital Railway could also create high-value jobs, help rebalance the economy and promote the establishment of a world class industry capable of exporting globally."[2]

The Secretary of State has set out the following as strategic priority areas for investment in the next five year funding period (2019-2024)[3], CP6:

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[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/663124/rail-vision-web.pdf
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/663124/rail-vision-web.pdf
[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/630674/high-level-output-specification-web.pdf

- The rolling cost of running the railway, comprising operations, maintenance and renewals, recognising the need for increased volumes of renewals compared to CP5, to improve on the outcomes, delivered in the context of rising demand and to better meet user priorities;
- Continued safe operation of the railway and the good standard of safety achieved by the control of risk across the rail industry;
- Maintaining focus on the delivery of performance, as it is of paramount importance to users, with an emphasis on network resilience during times of disruption; and
- Consideration of forecast passenger demand and opportunities for growth of the rail freight sector, in particular new markets, as set out in the Government's Rail Freight Strategy.

More broadly, the Secretary of State has made clear his priority that the rail industry must seek to put passengers and freight companies at the heart of all decisions taken for rail. The DfT has indicated that it will look to use its funding and railway powers to deliver maximum benefits for transport users, as efficiently, effectively and economically as possible.

The Transport Investment Strategy, published by the DfT in July 2017, sets out the investment objectives for building on progress to date and responding to today's challenges, driving progress towards fulfilling the aims of the Industrial Strategy and putting the travelling public at the centre of investment decisions. Specifically, it states the need for investment "to create a more reliable, less congested, and better-connected transport network that works for the users who rely on it."

The Scottish Ministers' High Level Output Specification for CP6[4] states that the management, operation and governance of all railway activities in Scotland which are funded by the Scottish Government, and the regulatory framework for CP6, must be fully aligned with, and demonstrably support, the Strategic Priorities for rail, which are:

- Improved services – faster journey times, strengthened commuter services and effective connections between cities and regions;
- Improved capacity – optimum utilisation of the network and on-train capacity through high levels of performance;
- Improved value – efficiency and value for money for the taxpayer and the fare-payer and rail freight customer;
- More effective integration – between rail operators and rail infrastructure management, and between rail and other transport modes; and
- Increasing inclusive economic growth.

In 2016 the Autumn Statement[5] announced a new National Productivity Investment Fund (NPIF), targeted at investment from 2017/18 to 2021/22 in areas that are critical for productivity: housing; research and development; and economic infrastructure. Included in the fund is £450 million allocated to trial digital signalling technology, to expand capacity and improve reliability.

Looking forward, our railways are critical to achieving sustainable economic growth, and as outlined above, the Government has set out clear strategic objectives for the railways in terms of safety, asset-sustainability and cost-efficiency for users, capacity and performance, as well as their contribution to wider economic, societal and environmental outcomes.

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[4] https://www.transport.gov.scot/media/39496/high-level-output-specification-hlos-for-control-period-6-final.pdf
[5] www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016.

3.2 Drivers for Change

By quickly, safely and efficiently transporting large volumes of passenger and freight traffic, Britain's rail industry plays a vital role in supporting the nation's economic growth. However in the context of rapidly increasing demand and significant funding constraints, the industry is now facing a number of major challenges:

1. **Affordability and Asset Sustainability**
   - About two-thirds of the rail network's signalling system needs to be replaced in the next 15 years, and the costs of renewing conventionally are expected to rise dramatically over CP7. This is a significant affordability and deliverability challenge for the industry.
   - Now is the right moment for the industry to adopt a different approach, moving to longer term technologies and new ways of working at a lower whole life cost.

2. **Capacity and Performance**
   - Britain's rail network is facing a capacity crunch. At peak times on the busiest parts of the network, the railway is full. Hundreds of thousands of passengers suffer overcrowding every day and the rail freight industry, vital to the national economy, suffers from a shortage of pathways which causes slow journeys and pushes freight onto the road network.
   - Where capacity constraints are caused by the limitations of conventional signalling systems, digital technologies can help to address these critical 'pinch-points'.
   - The industry has worked hard to reduce the number of incidents which cause delays, but the impact of each incident on passengers and freight customers continues to increase.

3. **Safety**
   - Our railway is already one of the safest in Europe, with the opportunity for digital technologies to provide enhanced levels of train protection and further reduce the risk of harm to passengers and rail workers, for example:
     - Passenger safety - reducing the risk of Signals Passed at Danger (SPADs).
     - Track-side worker safety - reducing the amount of work that needs to be carried out track-side.

In addition, there is a shortage in skills across the GB rail industry, with changing skills requirements. These challenges form the compelling drivers for change and are discussed in more detail in the sections below.

3.2.1 Affordability and Asset Sustainability

As noted above, the costs of renewing conventional signalling assets are expected to rise significantly over CP7, and renewals work-banks have been pushed out to later Control Periods, creating a 'bow-wave' of signalling renewals, illustrated in the diagram below.
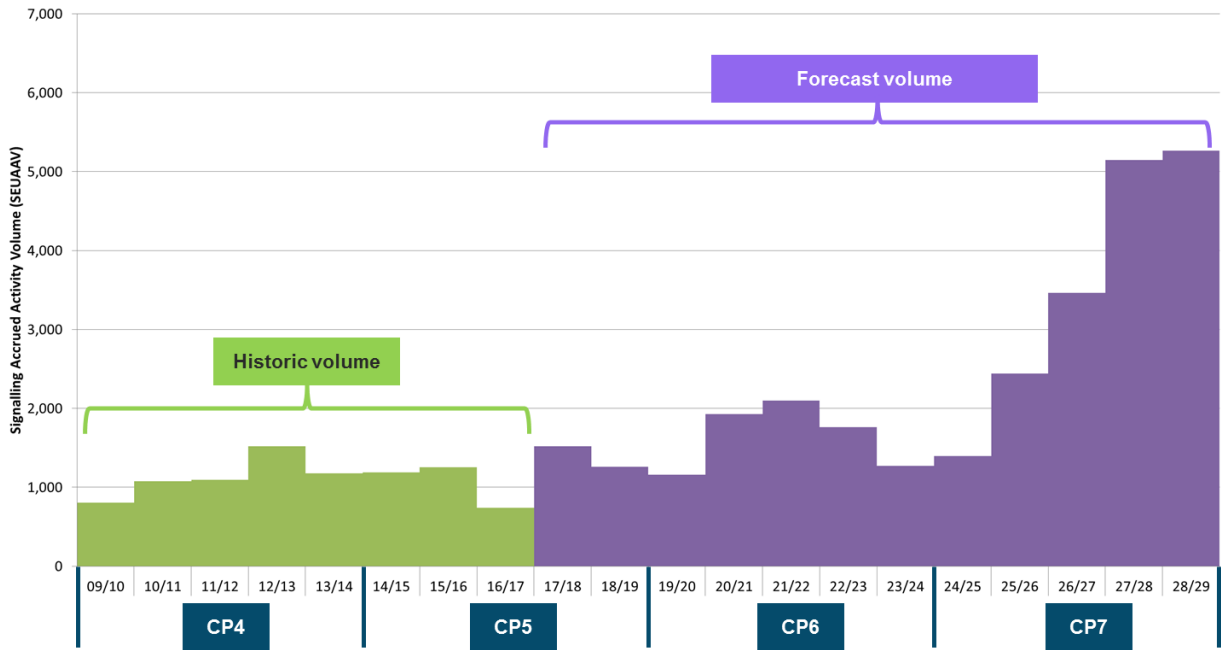
Figure 3: Historic and forecast signalling volumes

As a result of this 'bow-wave' of renewals, expenditure would need to more than double in CP7 and CP8 to catch up. This is an affordability and delivery challenge, and unless a more efficient method of addressing the renewal requirement is found (or higher funding levels are made available in later Control Periods) there will be deterioration in asset condition, poorer performance and potential safety restrictions. Furthermore, this profile of expenditure on conventional signalling systems is not sustainable, either from a supply chain pipeline or a skills development perspective.

The challenge for the Government, Network Rail and the wider rail industry is to provide the additional capacity needed as efficiently and cost-effectively as possible over the whole life of the assets.

3.2.2   Capacity and Performance

Following decades of decline, passenger numbers have more than doubled in the last 20 years, illustrated in the diagram below. Growth in passenger journeys continued through the recent recession and is accelerating at a rate not seen for over 100 years. In the 2016/17 financial year, there were 1.73 billion passenger journeys[6]. While rail passenger journeys declined in the first three quarters of 2017/18, continued growth is expected in the medium term.

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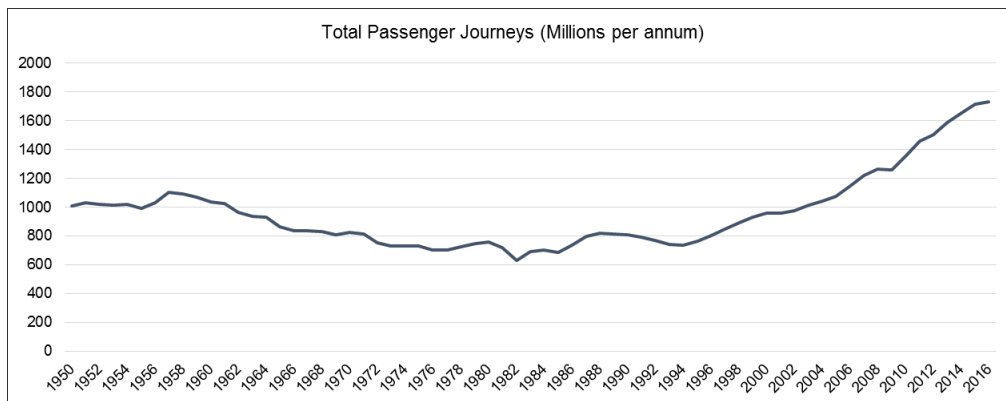
[6] http://orr.gov.uk/__data/assets/pdf_file/0019/24832/passenger-rail-usage-2016-17-q4.pdf

Figure 4: Total passenger journeys (millions per annum)

After a period of sustained growth in the last 20 years, the rail freight market is undergoing change, with a decline in some of its traditional markets, such as coal. However, as shown in the diagrams below, there has been growth in other areas, such as intermodal containers from deep-sea ports to inland terminals, and construction materials. These commodities are transported to and from major cities and operate on the same corridors as passenger trains. So while the market is changing and declining in some cases, there are major capacity constraints to growth of freight on the cross-London routes, the Southampton to West Midland corridor and the north of the West Coast Main Line.

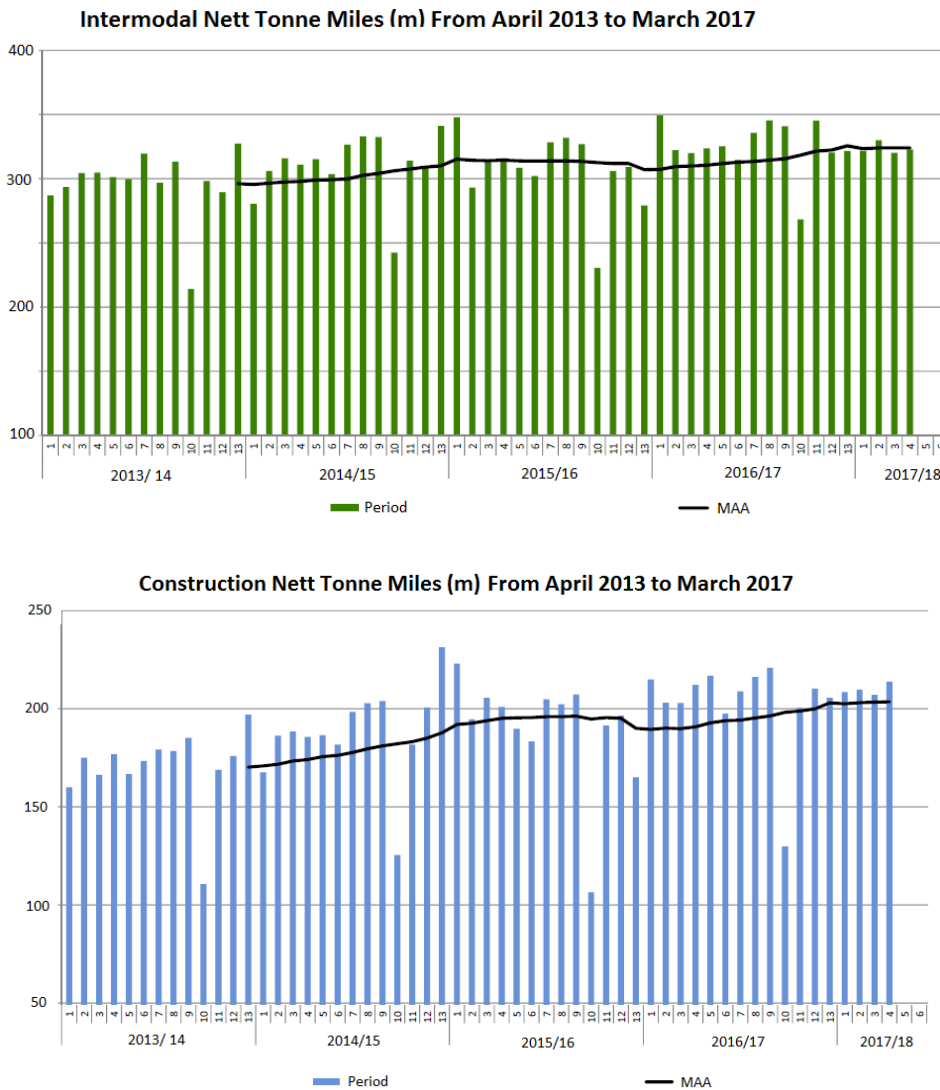Figure 5: Graphs illustrating growth in intermodal and construction Nett Tonne Miles from 2013-2017[7]

The consequence of this growth is that Britain's rail network faces a capacity crunch. At peak times on the busiest parts of the network there is no space to run more services, and trains are so crowded that

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[7] Network Rail (2017) Commodity and Volume Report, Nett Tonne Miles – Period 4 2017-18

many passengers travelling into major towns and cities usually do not get a seat; a smaller but significant number of passengers cannot even board the trains they intended to catch.

Crowding is most severe in London and the incremental options, such as train lengthening, are being exhausted. The morning peak has passengers in excess of capacity (an industry measure of crowding) with 155,000 passengers reported as standing on their arrival into London – this is equal to 27% of all passengers[8].

The National Infrastructure Commission's recent report highlighted a "lack of capacity and major overcrowding on key radial routes into central London…" and forecasted that by 2031, "the number of passenger kilometres travelled in crowded conditions is set to increase by 50%"[9].

Britain's other major cities are similarly affected. Birmingham, Leeds, Manchester and Nottingham have all experienced increases in the number of passengers travelling in excess of capacity during the morning peak, and some of the services between Glasgow-Manchester and Manchester-Edinburgh are the most crowded in the country[10]. While options such as train lengthening, may still be available to address this, often larger scale interventions are required to provide the step change in connectivity to drive economic growth.

The rail freight industry also suffers from a shortage of capacity. Rail freight is of huge importance to the GB economy, transporting one in four of the shipping containers that enter the country, and half of the fuel used for electricity generation. Freight train paths are often slow, which necessitates multiple crew changes and hampers the rail industry's ability to compete more effectively with road freight. This has a direct impact on many industries that rely on freight both through inefficiencies in the supply of goods and an increased reliance on potentially more environmentally damaging alternatives, such as road.

The volume of traffic on the rail network also significantly affects the resilience of the timetable. The level of congestion means that even a minor operational incident that is resolved quickly can have a significant secondary or 'knock-on' effect, where disruption spreads quickly and is still felt many hours later, sometimes hundreds of miles from the original incident. Even though the GB rail industry has successfully reduced the number of disruptive incidents caused by the failure of infrastructure to its lowest ever level, congestion on the rail network means that the impact of each incident continues to increase. Up to 70% of delay on the network is secondary delay[11]. This is illustrated in the diagram below, with the comparison of number of incidents to delay over the last 10 years.

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[8] National Infrastructure Commission (2016), *Transport for a World City.*

[9] National Infrastructure Commission (2016), *Transport for a World City.*

[10] Digital Railway (2016), *The Case for the Digital Railway Programme.*

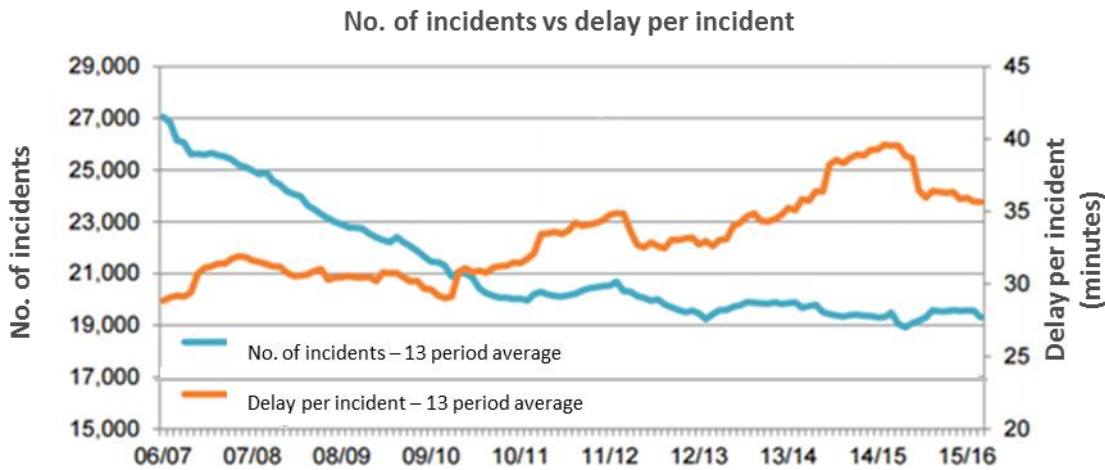[11] Digital Railway (2016), *The Case for the Digital Railway Programme.*

Figure 6: No. of incidents vs. delay per incident

Network Rail is currently delivering the biggest programme of rail modernisation since the Victorian era. Under the Rail Upgrade Plan, over £45 billion is being invested from 2014 – 2019[12] to deliver improvements that will bring significant benefits to passengers and freight across the economy. The Plan includes transformational programmes such as Thameslink, Crossrail and HS2. Further investment in rail infrastructure is currently under consideration, such as the 'Northern Powerhouse Rail' – a proposed new east-west line in the north of England connecting Liverpool, Manchester, Sheffield and Hull.

This investment in the rail network is vital. However, based on current forecasts, this alone will be insufficient to keep pace with rising customer demand on many parts of the network. Without additional investment to accommodate increasing demand, the capacity shortage, crowding and performance impact will become chronic and delay per incident will increase further. As a result, the railway will potentially become an irrelevance in GB as users lose confidence and turn permanently to alternatives, such as roads.

3.2.3 Preserving and Enhancing Safety for Passengers and Workers

Passenger Safety
Following a number of serious incidents relating to a Signal Passed at Danger (SPAD), for example Southall (1997) and Ladbroke Grove (1999), the Railway Safety Regulations 1999 introduced a requirement for all trains to operate with a train protection system. The regulations specify that the preferred train protection system has continuous monitoring of train speed so that over-speed or SPAD incidents would be eliminated or reduced to within safe limits.

The current system, Train Protection & Warning System (TPWS), has been introduced across the majority of the network. TPWS is a very effective means of controlling train collision risk, but as a system has limitations:

- The system is not fail safe in design, (although the design simplicity, internal system monitoring and application design provide a high level of capability);
- The system is fitted only to high risk signals, significant speed restrictions and approaches to terminal station buffer stops;

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[12] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/663124/rail-vision-web.pdf

- The system has poor capabilities on speed supervision;
- It cannot be optimised for every type of rolling stock and therefore does not provide 100% SPAD protection – even for passenger trains, there can be 'gaps' in provided protection; and
- In order not to impact driving styles aligned with the capability of passenger trains, the system is not optimised for freight.

On parts of the Western and Chiltern Routes, Automatic Train Protection (ATP) is used instead of TPWS. These systems will reach the end of their life within the next five years, and the Routes are looking at medium term life extension.

There were 277 SPADs in 2015/16, compared with 298 during the previous year; however the underlying risk profile trend has not shown significant change for a number of years (as shown in the red area in the Precursor Indicator Model (PIM) below). The PIM measures the underlying risk from categories of train accidents by tracking changes in the occurrence of their accident precursors.
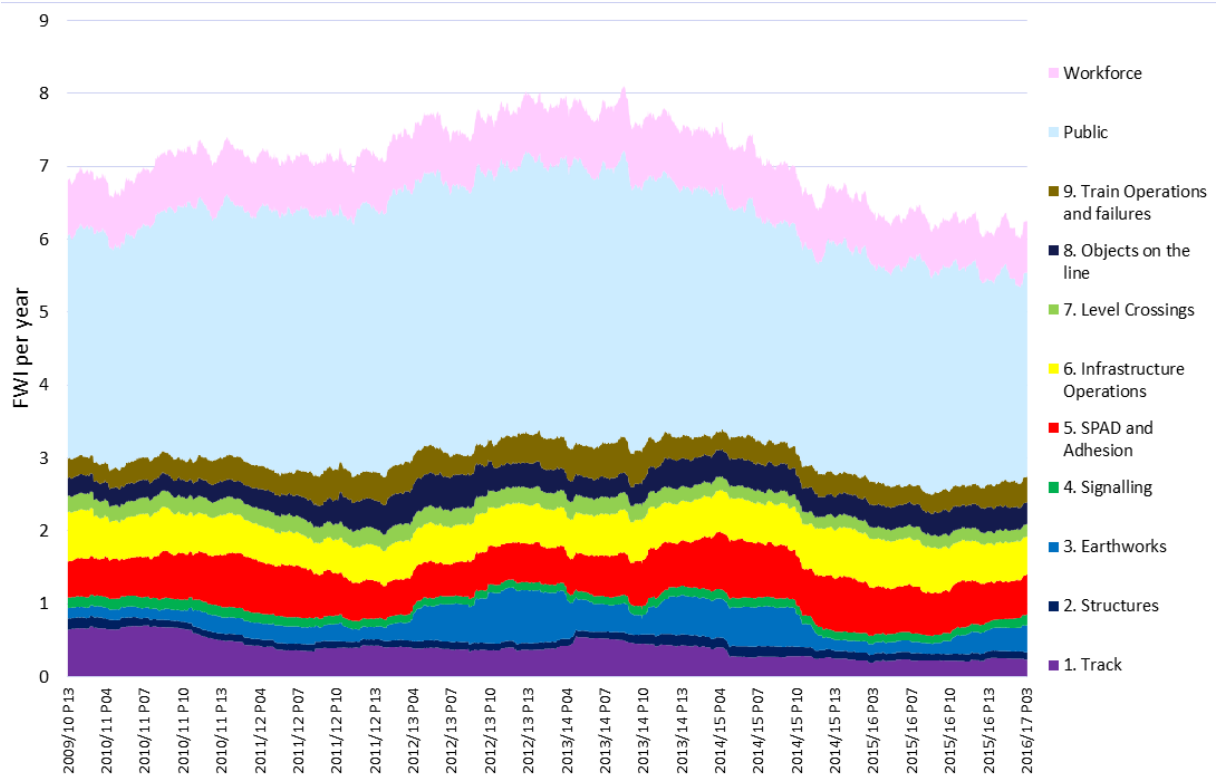
Figure 7: Trend in the overall Precursor Indicator Model

In determining the rollout of digital technologies with potential safety benefits, timing is a key consideration to make best use of opportunities to enhance passenger safety as part of industry processes.

Trackside Worker Safety

Network Rail's third biggest track worker safety risk is posed by the potential for staff to be struck by a train whilst working track side[13]. There were three fatalities as a result of track workers being struck by a train on Network Rail controlled infrastructure during CP4. Network Rail has a commitment of zero fatalities or major injuries to their workforce by the end of CP5.

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[13] https://www.rssb.co.uk/Library/risk-analysis-and-safety-reporting/2016-07-annual-safety-performance-report-2015-2016.pdf

Although there are ways to reduce the need to access trackside and reduce the associated risks to staff, there will always be a need to deploy workers onto the track to inspect, maintain and take remedial action.

Current processes allow for human error, and workers are required to follow complex procedures and rely on communication between lookouts, workgroups, signallers and controllers of site safety.

The illustrative diagram below shows four key factors of trackside safety for workers, which if reduced, can reduce the overall enterprise risk level.
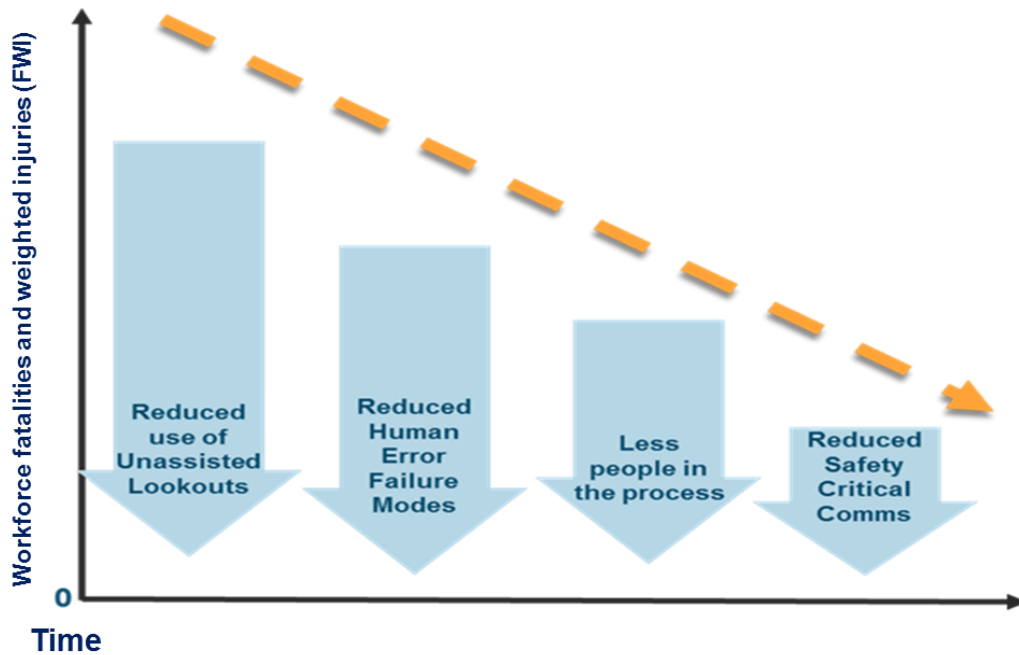
Figure 8: Risk of track worker being struck by a train, showing factors that if reduced, could reduce the enterprise risk level

There are opportunities to use new reliable Digital Railway systems and technologies to reduce the reliance on old systems with human error failure modes, as well as reducing the need for workers to be trackside. The opportunities and safety benefits of new systems and technologies are discussed in Section 5.4.

3.2.4 Shortage in Skills and Changing Skills Requirements

In addition to the drivers for change outlined above, the rail industry is facing both a challenge and an opportunity in terms of a shortage in skills and changing skills requirements. While there will be a significant depletion of the available GB workforce over the next ten years due to retirement, which will require a significant focus to attract and retain the very best talent, there is also the opportunity for skills development and a broadening of capabilities across the rail industry.

Engineers and technicians are no longer being trained with the skills required to maintain mechanical and relay-based signalling systems, and therefore within both Network Rail and the supply chain, it is becoming increasingly difficult to maintain these systems.

Skills forecasting work, carried out by the National Skills Academy for Rail in 2012, highlighted the 'skills gap', with over 10,000 new rail engineers, system engineers and advanced technicians required across the sector over the next five years. Key findings from this work are highlighted in the blue box on the right.

There is also a growing need and opportunity to upskill the current workforce to address new and advancing technologies and processes. Increasingly, engineers need capability in multi-disciplinary areas of engineering, as well as cross-functional skills, such as innovation, leadership, project management and commercial acumen.

Skills gap in traction and rolling stock:

- 40% of workers are over the age of 50; 22% are over the age of 55.

- Over 3,000 new rail engineers are required to maintain current skills levels.

- At least 7,000 more advanced technicians are required over the next five years.

Ref: National Skills Academy for Rail (NSAR), 2012

Whether digital solutions are implemented or not, addressing the skills gap will be an ongoing challenge for the industry. Opportunities for the Digital Railway in helping to address the skills gap and support capability development are explored more in Section 7.3 (People Strategy).

4. ADDRESSING THE CHALLENGES: THE DIGITAL RAILWAY

The previous section looked at the strategic context and drivers for change in terms of challenges facing the rail network. This section looks at why we need the Digital Railway to address these challenges, and why an integrated and targeted approach is beneficial.

4.1 The Need for a Modern Railway

Critical railway assets, such as trains and signalling assets, typically last for 35 years or more. This means that decisions taken today can lock in the industry's future direction. Hence, if we don't change to modern capabilities today, we are locking in yesterday's asset performance for the next 40 years, or we are at risk of renewing assets before they reach life-expiry, significantly increasing costs in the medium to long term.

The case for action is compelling, with the Government and the rail industry having reviewed several ways to modernise the railway through the introduction of electric trains, increasing passenger accessibility by rebuilding stations and concourses, as well as conventional track infrastructure upgrades.

Key limitations of conventional signalling systems are:

- Trains that could run closer together are not capable of doing so. The result is a network where in some areas demand cannot be met, as signalling restricts the ability to make use of infrastructure capacity; and
- The lack of real-time communication of train location and speed between rolling stock and signalling infrastructure creates an inflexible network.

Using progressive levels of digital signalling (ETCS), the constraints of conventional signalling systems are progressively reduced, illustrated below.
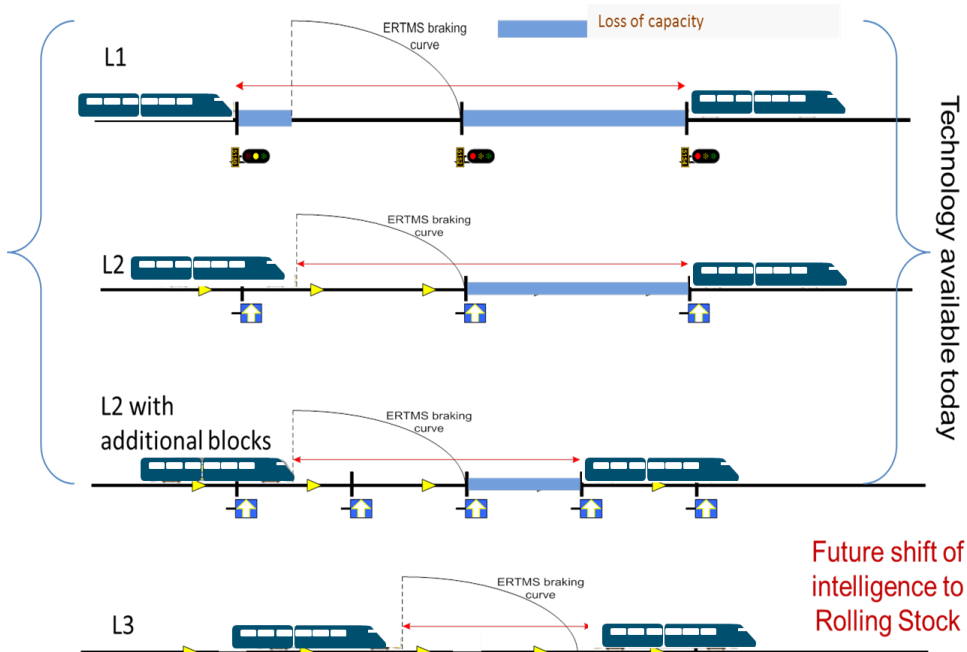

Figure 9: Illustration of digital signalling - ETCS Level 1, 2 and 3

With digital signalling systems, the relationship between braking distance, block length and the signal sighting is no longer a relevant factor, as the train is able to calculate its own braking distance in real time. As a result, 'fixed' block lengths are able to be reduced, or ultimately removed, if technology is developed far enough, as illustrated on the previous page. This allows the separation between trains to be safely reduced, which results in a more efficient use of the rail infrastructure, increasing plain line headway capacity by allowing more trains to run on the existing network.

Train control operations are currently based around significant manual operation within a complex infrastructure configuration. Signallers have a limited view of the network, which can lead to train regulation decisions that are not always optimised, and which at times of perturbation can become a real issue for service management and recovery. Replacement of existing train control systems with digital alternatives could provide better and more timely information, improving the decisions made in both normal operation and at times of perturbation, reducing reactionary delay.

To achieve capacity improvements at key locations (such as terminal stations), it is of paramount importance to ensure that trains arrive at critical bottlenecks at the right time and at the optimum speed. This not only requires an understanding of the current traffic situation, but also the capability to advise the train on the most appropriate speed when approaching the critical bottlenecks – this initially involves advising the driver of the optimum approach speed, and ultimately directly instructing the train through automatic systems.

Digital train control can unlock constraints to meet passenger and freight demand. Recognising that digital train control is not a solution to all capacity constraints, a targeted approach is recommended, to areas where digital train control can help to address barriers to demand. This 'targeting' is done via the Route Studies (developed by Network Rail on behalf of the industry), which identify long term needs and any barriers to addressing those needs.

In summary, digital signalling and train control solutions present a lower whole life cost relative to conventional solutions over the medium to long term, which is critical in addressing industry challenges relating to affordability and asset sustainability. Furthermore, the targeted deployment of digital train and operational control technologies has the potential to revolutionise the way trains are operated and controlled around the network, and to significantly increase available capacity, improve performance and enhance safety for passengers and workers.

4.2   An Integrated and Targeted Approach for the Digital Railway

An **integrated and targeted approach** for the Digital Railway, considering all elements holistically, can address the industry challenges and maximise the potential benefits in the most cost-efficient manner.

Case study evidence of the benefits of such an approach are detailed in Section 6.2, and some examples of the limitations of an isolated approach are provided below.

Limitations with a **'Capacity and Performance only'** approach:

- May renew signalling assets that have not reached the end of their life, increasing the cost, but meeting future renewal needs; and
- Digital signalling may be deployed in small sections of the network, triggering the requirement to fit a high number of trains (at a high cost) for a relatively small section of the network.

Limitations with a **'Sustainability only'** approach:

- The asset renewal programme is driven by 'renewal' needs that results in areas of high capacity not being prioritised, and the signalling system is not necessarily optimised for future capacity needs;
- Significantly lengthy programme with a long tail-off for conventional renewals and TPWS; and
- Maximum benefit from the investment in rolling stock fitment is not realised.

Limitations with a **'Safety only'** approach:

- Unlikely to drive deployment of digital signalling alone, as prohibitively expensive compared to the incremental benefit achieved above that provided by the current system, TPWS.

5. THE DIGITAL RAILWAY PROGRAMME

The section above outlined the need for digital train and operational control technologies to address industry challenges, and why an integrated and targeted approach is required to deliver benefits across the rail network. This section looks at the Digital Railway Programme: what it is, its key components, why it is needed and its objectives and benefits.

5.1   What is the Digital Railway Programme?

The Digital Railway Programme is a benefits-driven, cross-industry change programme enabled by technology, which will support the delivery of systems, technology, business and people change in an integrated way. It will support the deployment of digital solutions in areas that offer the best strategic fit for the rail industry and greatest value for money, balancing benefits with affordability. The Programme will co-ordinate activity across industry, providing guidance and expertise to support Digital Railway deployments.

The core role of the Digital Railway Programme within industry is to:

- **Provide system leadership and industry support** through an enterprise architecture and national systems authority for digital train control and signalling, and including cyber security risk management;
- **Provide industry sponsorship** to ensure business cases for deployment of digital train control systems are identified, funded and prioritised, and deliver whole life benefits;
- **Define funding needs**, working with Network Rail's Route businesses, central functions and the System Operator;
- **Develop innovative financing solutions** for Network Rail's Route businesses and wider industry, in conjunction with Network Rail's Finance function;
- **Develop industry change strategies** to ensure that an industry operating model is in place to optimise the use and extract the full benefits of new technology;
- **Develop business and system requirements** for Network Rail's Route businesses and wider industry to procure and implement the Digital Railway, linking in with the European Union Agency for Railways (EUAR) to support ongoing specification development;
- **Provide guidance and coordination for systems innovation,** working closely with academia, industry partners, the supply chain and innovation initiatives such as the UK Rail Research Innovation Network (UKRRIN) and Shift2Rail; and
- With train operators, Network Rail's Route businesses, the supply chain and other industry stakeholders, **develop appropriate procurement and delivery strategies that reflect the key findings of the Early Contractor Involvement (ECI) efficiencies.**

In this context, the role of Network Rail's Route businesses and the System Operator is to:

- Define the industry-wide problems and needs of the network for the long-term;
- Configure the national system for local needs;
- Secure funding;
- Procure schemes;
- Deliver the schemes and realise benefits; and
- Capture and transfer lessons to future schemes.

Wider industry stakeholders will have important roles to play in the development and delivery of the Digital Railway. A high level overview of the industry stakeholders and their roles is described in Section 7.1 (Importance of Industry Collaboration).

5.2 Key Components

The Digital Railway Programme will enable the delivery of benefits to passengers, freight users and the wider economy by embedding a number of key ways of working and technologies, illustrated in the diagram below.
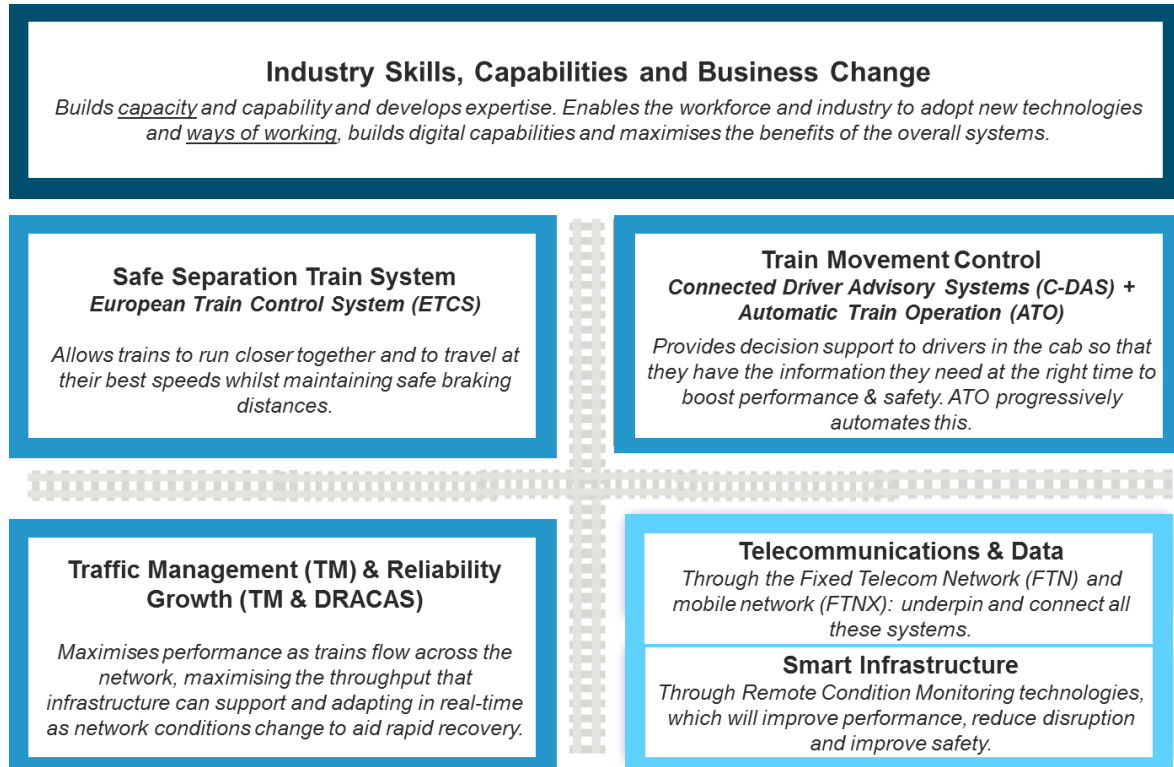
Figure 10: Key components of the Digital Railway Programme

5.3 Benefits of a Programme Approach

Whilst recognising that the majority of benefits will be realised on an actual scheme-by-scheme delivery basis by Network Rail's Route businesses and wider industry, there are compelling reasons for managing the development and subsequent deployment of Digital Railway through a national Programme. These are summarised below.

To improve cost efficiency
- A programme approach provides the opportunity for economies of scale in procurement, and sharing of costs that would otherwise be incurred in every scheme. This includes:
  - o Savings identified by early contractor involvement work streams; and
  - o Fixed costs of, for example, rolling stock fitment.
- Supported by fit-for-purpose funding mechanisms, a national programme will have the scale to enable commercial innovation across the supply chain and to pursue finance that could not be accessed by individual schemes acting in isolation.

- The Early Contractor Involvement Report (December 2016) identified significant potential reduction in costs on digital train control deployment by changing the way the supply chain works. The Digital Railway Programme will monitor the outturn performance of schemes to establish if this saving is borne out in reality in tender returns and actual costs of deployments.

To drive consistency and interoperability

- It is vital to drive compatibility of technologies and solutions that underpin the Digital Railway. Compatibility will be important to ensure operational and technical interoperability of rolling stock and systems across the network, including compatibility of data required to operate, maintain and renew the railway;

- Consistency of systems is also important to minimise (as far as reasonably practicable) risks of human errors caused by additional demands placed on workers of having to use multiple different systems;

- There are a number of national services and capabilities required to enable digital signalling and train control such as Traffic Management and Rail Operating Centres (ROCs). Compatibility of solutions and technologies are vital to enable these national capabilities; and

- This will be delivered by putting in place relevant programme design and integration authorities that will consider all aspects of component, solution and system design to ensure compatible interfaces, considering the balance between definition and freedom to innovate. Developing principles at an industry level is important to spur common understanding, efficiency and completeness of approach.

Selection and delivery of the right schemes at the right time

- Identification of the schemes that deliver the best strategic fit, as well as consideration of greatest value, and prioritising these in a capital-constrained environment, can only be done at a programme level (discussed further in Section 6.2 below).

To manage dependencies across schemes

- There is a need to coordinate local delivery plans at a national level to manage dependencies and delivery conflicts, thereby ensuring continuity of workload across the network; and

- There may be many schemes that deliver value and are desirable to initiate now, but running multiple, parallel deployment programmes across the network may overburden scarce industry resources, and is unlikely to maintain passenger service at acceptable levels.

To realise maximum benefits across schemes

- Realising the full benefits of the Digital Railway requires business change across many of the key participants in the industry. This requires a level of industry sponsorship and cooperation that cannot be provided at an individual scheme level, and also requires a different skill set to that typified by project delivery organisations.

To effectively manage risks and deliver quality

- Many technical, business change and operational risks will be consistent across schemes. The programme will provide a centre of excellence for identifying and mitigating these risks.

To develop Great Britain's skills and capabilities

- The capability and capacity of the supply chain to deliver Digital Railway solutions in Great Britain can only be developed through effective industry-wide strategies targeting long term drivers for change. These include:
  - Ensuring a predictable and manageable pipeline of Digital Railway investment;
  - Investment in a local and national skills base to develop the right capabilities; and
  - Innovation to drive efficiencies in the implementation of Digital Railway systems.

- Creating new markets, for the skills necessitated by Digital Railway, that creates new opportunities for operators, freight and the GB rail supply chain abroad; and
- The Digital Railway Programme will have the longevity to support the development of a competitive market for delivery of the Digital Railway.

5.4 Benefits

The Digital Railway Programme has a significant role to play in enabling the delivery of benefits to passengers and freight users, broader society and to the rail industry itself. These benefits are aligned to the Government's strategic objectives outlined earlier and evidenced in case study findings, described in Section 6.2 below.

Digital signalling and train control solutions present a lower whole life cost relative to conventional solutions over the medium to long term, which is critical in addressing industry challenges relating to affordability and asset sustainability. Additional direct benefits include: addressing specific capacity constraints; improving performance and enhancing safety for passengers and workers. Secondary benefits of the Digital Railway include: improving the passenger experience; accelerating economic growth and improving environmental outcomes.

These benefit areas are summarised in the diagram below, and described in more detail in the following table.

Figure 11: Benefits quantified to date in case studies

Benefit Area	Description
Better asset sustainability	Digital solutions (such as ETCS) offer the lowest whole life cost means to deliver asset sustainability over the medium to long term. The cost of rolling stock fitment in the long term is offset by the substantial reduction in cost of Command, Control & Signalling infrastructure renewals. This is a key benefit area, particularly in the context of the current challenges associated with the affordability and deliverability of the renewals bow-wave of conventional signalling systems. Other benefits include operating efficiencies as a result of reduced maintenance and more efficient means of access, as well as supporting consolidation of areas of control.
Increased capacity	As part of a targeted line of route-wide upgrades, the Digital Railway has the potential to increase capacity by allowing more trains to run on the same underlying infrastructure (in a way that not only avoids compromising performance and safety, but actually improves them, as set out below). In areas identified with specific constraints, this capacity expansion to meet current and forecast demand means: • More frequent, more comfortable, faster and less crowded journeys for passengers; and • More paths, increased flexibility and higher average speeds for freight operations.
Better performance	Through a combination of increasing capacity, and providing signallers, drivers, train controllers and incident managers better tools to manage incidents and knock-on delays, Digital Railway offers a once-in-a-generation opportunity to enable improved performance on the railway, particularly in terms of quicker recovery of service. The opportunities for improvement are greatest in the highly congested parts of the network with the most delays affecting passengers, such as in and around London and on major inter-city routes. ETCS and Traffic Management systems also potentially reduce primary delay, as more resilient and reliable solutions than the conventional systems they replace.
Enhanced safety	ETCS introduces an enhanced level of train protection, reducing the risk of SPADs, and maintains compliance to fulfil the Railway Safety Regulations 1999. Digital Railway technology enables the use of other systems that introduce new ways of working, reducing the safety risks to track workers. The Track Worker Protection System is a new high integrity protection system. Protection for track workers can be enabled via a mobile application integrated with the Traffic Management system; this removes human error failure modes, reliance on signallers and safety critical communications. The reduced time to take possession of the line for disruptive access can reduce the time workers are exposed to the track-side environment to carry out their activities. In addition, ETCS potentially reduces the number of lineside signalling assets that require staff to go trackside for faulting and maintenance activity. The Signal Controlled Warning System uses real time train position information from Digital Railway technologies to issue a warning to trackside workers, when a train passes a predetermined threshold. This reduces the risk to lookouts and staff on track. While the deployment of Digital Railway technologies is not expected to directly impact the safety of level crossings, as part of wider network upgrades, risk modelling using the All Level Crossing Risk Model (ALCRM) and the associated Level Crossing risk assessment process will be carried out as part of these infrastructure upgrades. This may identify opportunities to improve level crossing safety alongside digital deployments, particularly around 'passive' crossings where interaction with the signaller and train positioning information is critical.
Improved passenger experience	The direct impacts of increased capacity, improved performance, reduced crowding and more trains (therefore offering reduced generalised journey times and reduced delay) will improve the experiences of GB railway passengers. Passengers will also benefit from better information via enabling the flow of data, particularly during periods of disruption.
Accelerated economic growth	Digital Railway will unlock opportunities for economic growth and prosperity. By enabling the benefits of increased service frequencies and reducing disruption, the Programme will result in shortened travel times for passengers and freight journeys. This allows people and businesses to produce more, boosting the economy. Equally importantly, by enabling efficiency improvements of the rail network, Digital Railway will support businesses to interact more easily with their customers and suppliers, open up labour markets, and support regional and national economic performance.
Improved environmental outcomes	Rail is already a highly sustainable mode of transport. By enabling increased capacity, improved customer experience, reduced journey times and improved performance, it is expected that more passengers and freight traffic will shift to rail, away from less sustainable transport modes such as road and air. This will help improve the overall environmental performance of the GB transport system. In addition, Digital Railway will support rail travel becoming a more environmentally-friendly choice of travel, by improving the efficiency of timetabling and Traffic Management so as to reduce idling and 'stop-start' traffic flows.

Table 1: Digital Railway benefit areas

5.4.1 Digital Railway's Contribution to the Wider Economy

Investing in Digital Railway will create new high-value jobs, improve productivity, expand the UK manufacturing capability, develop a world class industry in the UK capable of exporting globally, and rebalance the economy by promoting economic growth in the North, Midlands and South West of England. This is critical in the post-Brexit context, where the UK seeks to enter new markets and boost economic growth at home. Digital Railway supports the Government's Industrial Strategy objective to increase UK manufacturing and export capability in high-value sectors.

Specifically, Digital Railway aims to achieve wider socio-economic benefits for the GB economy through:

- Workforce productivity benefits through better rail connectivity and journeys for people into major cities;
- Improved freight access leading to enhanced growth for small and large businesses;
- A hub for digital railway skills and innovation that will generate 'spill-over' to other industry sectors and increased export potential for GB PLC; and
- Supporting the introduction of a simplified rail industry operating model that reduces the whole industry costs of railway operation.

Many of these will be driven by the procurement choices that are made when delivering Digital Railway schemes. The Programme is currently working with Government and the industry to design suitable procurement strategies, which will be key considerations when making Digital Railway investment decisions.

The Ministerial Group for the Digital Railway (formed in autumn 2016) made the following recommendations[14] to support the introduction of digital signalling technology within the UK railways:

- To promote industry confidence, cross party support and attract private sector participation, the Government should publish a clear statement of policy for the delivery of digital signalling and the benefits expected for passengers and the freight community.
- To position the UK as a global player in the delivery of rail signalling and operational innovation, and to increase export potential, the Government and industry partners should work together to stimulate the development of knowledge, skills and capability within the wider UK rail industry to embed digital signalling and technologies into the railways.
- To stimulate innovation and reduce barriers of entry to the rail market, Network Rail should find ways to open up its supplier base to a wider range of organisations. Government should develop a proposal to accelerate the introduction of innovative technologies and processes for the Digital Railway.
- The industry must challenge existing orthodoxy to drive greater value through a different approach to risk transfer. To secure third party investment, Network Rail should work with Government to encourage alternative models of funding, financing and delivery. The investor community must be involved much earlier in the planning and development of future investments.
- Government should agree a programme of delivery and then incentivise the industry and give it space to deliver. In return, industry will be held to account for delivery. Where necessary, the programme should flex to ensure outcomes are delivered in the most cost effective way.

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[14] https://www.gov.uk/government/publications/digital-railways-programme-recommendations-to-support-development-and-deployment

- To establish an approach to delivery that is sustainable and affordable, Network Rail must work collaboratively with industry partners, including suppliers, operators, financiers, employees and trade unions.
- To secure programme success, Network Rail and industry partners should develop an incremental programme for the delivery of targeted and scalable digital signalling and operational innovations, or early "quick wins", which build upon lessons learnt from previous deployments, demonstrate cost effective delivery and encourage industry and stakeholder confidence.
- Government should work with Network Rail to establish an appropriate governance structure for the digital railway programme. This must ensure that there is clarity of roles, responsibilities and accountabilities, with appropriate delegation and empowerment.

Furthermore, Digital Railway supports the Government's objectives for the railways and wider economy (discussed in Section 3.1 earlier), especially those listed below:

- DfT's strategic vision for a more reliable, efficient and modern railway delivered by joined up local teams, including a step-change in renewals to maintain safety and improve reliability: efficient asset stewardship on an increasingly busy network;
- The Secretary of State's strategic priority areas, including a focus on the rolling cost of running the railway, comprising operations maintenance and renewals, as well as maintaining focus on the delivery of performance;
- The Government's Transport Investment Strategy, to create a more reliable, less congested, and better-connected transport network that works for the users who rely on it; and
- The Scottish Ministers' High Level Output Specification for CP6 strategic priorities to improve services, improve capacity, improve value and deliver more effective integration between rail operators and rail infrastructure management.

5.5   Digital Railway Programme Objectives

To deliver the vision of 'a Digital Railway for a Modern Britain' and the benefits described above, the Digital Railway Programme has structured itself around short, medium and long term objectives, as set out in the table below. The objectives will also be used to prioritise and determine appropriate solutions for any specific capacity improvement programmes using digital technologies. The wider socio-economic benefits of a Digital Railway, such as skills development, productivity and housing benefits will continue to be explored and refined as schemes develop over time.

The Digital Railway Programme will enable the vision of **a Digital Railway for a modern Britain** by providing:
- System leadership and industry support through an enterprise architecture and national systems authority for digital train control and signalling;
- Industry sponsorship to ensure business cases for deployment are identified, funded, prioritised and deliver value for money and whole life benefits;
- Industry change strategies to ensure that an industry operating model is in place to optimise the use and extract the full benefits of new technology; and
- Requirements for Network Rail's Route businesses and wider industry to procure and implement the Digital Railway.

Benefits enabled	Increased capacity	Safer, more secure & environmental railway	Improved train performance (reliability and availability)	Improved whole life cost and sustainable commercial model	Wider socio-economic (e.g. skills, productivity, housing, exports)
Long term objectives' – wider scale deployment	Provide the digital capability for a whole system capacity uplift to meet projected demand on the railway.	One system architecture for signalling and train control system for GB.	Improved performance (availability and reliability) through digital train control and signalling, to enable a better customer experience.	Set of financial and delivery options and their associated whole life costs and benefits to facilitate digital transformation and improve affordability of GB railway.	• Job creation and multiplier benefits • Productivity benefits through reduced delays • Increased use of freight rail with economic benefits for UK Plc • GB hub for train control and signalling expertise and innovation, with export opportunities • Enhanced ability to support housing plans.
Medium term objectives – targeted deployment	Demonstrate targeted digital train control and signalling solutions as part of a whole system upgrade that meets projected demand.	Co-ordinate and integrate partners, their learning and the developed standardised configurable system which is deployed on the railway on a targeted route basis.	Demonstrate the performance, availability and reliability benefits of digital train control and signalling on targeted schemes to enable a better customer experience.	Working with partners investigate, explore and develop commercial models for a targeted route basis while reducing whole life costs.	
Short-term objectives – initiation	Secure funding and undertake initial development of targeted digital train control and signalling schemes for CP6 deployment.	Assured requirements for a standardised configurable system (process, organisation, technology, information) ready to be deployed.	Support the delivery of current CP5 programmes that demonstrate the capability of Digital Railway solutions.	Co-ordinate and integrate partners and their learning to exploit and deliver the commercial models on a route basis.	

Table 2: Digital Railway Programme objectives

6. DIGITAL RAILWAY DELIVERY APPROACH

The previous section outlined the Digital Railway Programme and its objectives, benefits and key components. This section looks at the delivery approach for Digital Railway, over the short, medium and long term.

The Digital Railway Programme will enable the development and implementation of key technologies over a series of Control Periods, illustrated below and described in more detail in Sections 6.1, 6.2 and 6.3.
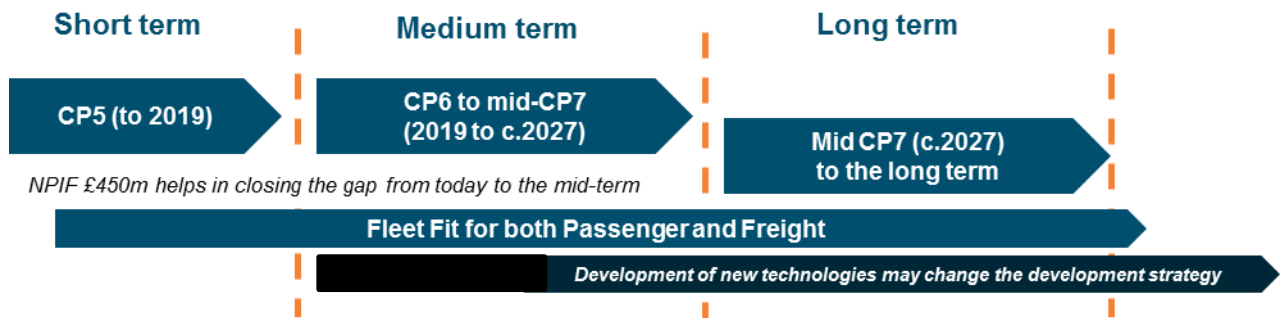
Figure 12: High level overview of Digital Railway Delivery Approach

6.1 Short Term: Committed Projects and Learning Lessons

The Digital Railway Programme will build on previous work and achievements in the UK and also has the benefit of learning from similar projects undertaken internationally, which demonstrate that the technology solutions being proposed, whilst innovative, are proven. A key aspect of the Digital Railway Programme will be to learn from the implementation of similar technology and ensure best practice solutions are incorporated. This will also have positive impacts on the ability of the Programme to accurately cost and implement proven solutions.

6.1.1 Building on Previous Work and Achievements to date on the Cambrian Line and IECC Scalable

The Digital Railway Programme has the benefit of learning lessons from the Cambrian Line project, the first ETCS solution commissioned and in use on a passenger railway in the UK (full service commissioned in March 2011). The scope of this project involved the implementation of ETCS Level 2 (no line-side signals) along 215 kilometres of track, with a new control centre and fitment of 24 passenger trains. A critical success factor for the Cambrian project was to ensure the products, processes, standards and procedures developed can be reused and inform the national implementation of digital signalling and train control.

Another important achievement in the UK that the Digital Railway Programme will build on, is the introduction of the Integrated Electronic Control Centre (IECC) Scalable system, which replicates the functionality of the original IECC on a modern hardware platform and software architecture. IECC Scalable provides comprehensive fault diagnostics and monitoring, with Automatic Route Setting (ARS) to optimise traffic flow, even under disrupted conditions.

6.1.2   Implementation on Crossrail 1, Thameslink, Cardiff, Romford and Western

Thameslink, and Network Rail's elements of Crossrail, which are due for completion in CP5, are part of the early implementation of individual train control systems. These will achieve localised benefits as they both include scheme-specific Digital Railway systems. The Crossrail core section utilises Metro based signalling that is not scalable from either a technology or procurement perspective for widespread mainline applications.

In addition, there will be deployment of Digital Railway solutions at the Romford and Cardiff Rail Operating Centres (ROCs). These two ROCs will use early applications of existing Traffic Management systems to drive early performance benefits and build experience that will benefit future deployments.

Network Rail has signed a contract to trial Luminate, a new Traffic Management product along the stretch of the Great Western Route, from London Paddington to Bristol Parkway. Initial deployment of the trial system began in June 2017, and if after two years the trial is considered successful, negotiations to agree a performance-based contract will begin.

As part of the new system, Route Controllers will have a set of functional tools which provide information about the train services across the whole network. This information will include forecasts of train movements and any conflict information. Luminate will enable re-planning of the timetable for train services when required.

Specifically, the technology being implemented across all committed projects will provide the following benefits:

- Demonstration of an integrated digital control system team which can develop best practice approaches to operations for future front line control system teams;
- Discrete deployment of ETCS and ATO, and TM systems, thereby increasing capacity and improving performance in localised areas, with specifically updated ROCs; and
- Demonstration of GSM-R telecommunications network integration with schemes to provide automatic, real-time information to drivers.

On completion of the above specific schemes, knowledge gained from the deployment of digital technologies will be used to inform the next stage, which will see system implementation for significant parts of the GB rail network using available technologies and operating methods.

6.2   Medium Term: Targeted Deployment

The Programme has completed Strategic Outline Business Cases (SOBCs) for five Routes – Anglia, London North East, South East, Wessex and Western. A set of assessment criteria was used to determine these routes, illustrated in the diagram below. These criteria were based on case study analysis and the industry challenges outlined in Section 3 (capacity and performance drivers, sustaining the signalling assets, safety, and franchise/renewals opportunity alignment).

Challenges

Capacity challenges

Performance challenges

Performance and capacity challenges could justify any digital intervention in the short term

Opportunities

Franchising (Routes that will come up for renewal in CP6)

Signalling renewals & enhancements

CP6/7 franchising and renewals provide the opportunity for intervention
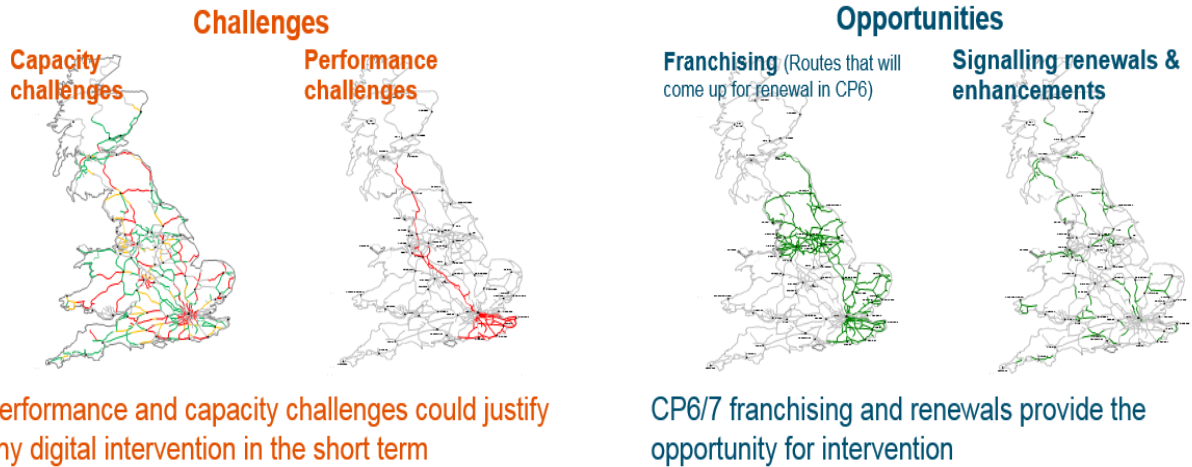
Figure 13: Candidate schemes identified based on alignment of performance / capacity with franchise / renewals

The SOBCs demonstrate strong evidence that Digital Railway technologies can unlock capacity to address specific constraints, improve performance and deliver wider benefits to railway users and the British economy at a lower whole life cost. It is also clear that digital technologies must be used in conjunction with conventional measures in the majority of cases, and finding the right balance of digital and conventional solutions requires a deep understanding of the specific challenges of each route.

A summary of the benefits of the five SOBCs is provided below.

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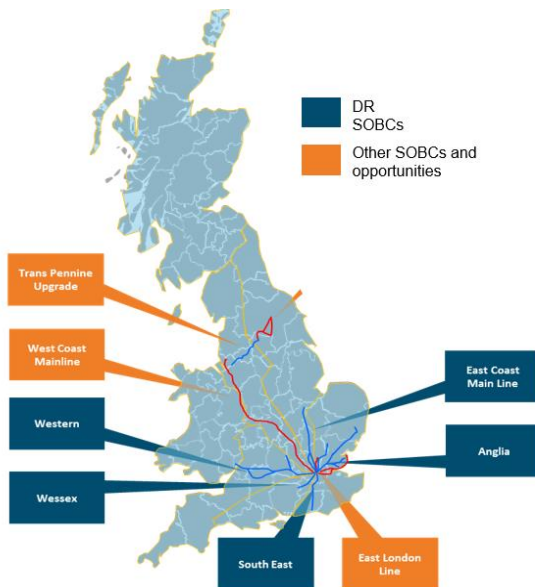
Figure 14: Map illustrating Digital Railway and other SOBCs

Candidate Schemes' Benefits:

- **Net Present Value of £2,300m – £3,450m across all schemes**

- **A reduction in delay minutes up to 7% in areas covered by Traffic Management**

- **Capacity for up to 4 additional peak trains per hour for the Great Eastern Main Line and South West Main Line.**

- **Potential increase of 4,200 – 10,600 jobs by 2035 due to improved rail service**

- **Increased skill levels in the labour force, such as the training of approx. 3,100 drivers to operate the systems**

- **Automatic Train Protection that reduces risk of SPADs**

- **Improved Track Worker Safety**

Conclusions from analysis of the five route schemes provides evidence supporting the need for an integrated and targeted approach for the development and deployment of Digital Railway, considering all elements (such as capacity, performance, sustainability and safety) holistically. The delivery approach therefore, is to identify and prioritise Digital Railway schemes with the most compelling, stand-alone business cases, based on the following principles:

Signalling System

- Targeted deployment of digital signalling, aligned to renewal needs of existing signalling assets and integrated with line of route-wide investments (outlined in the London North East, Anglia and Wessex business cases);
- Prioritise schemes where capacity and performance benefits are high and schemes can justify fixed upfront costs, such as train fitment and programme costs (outlined in the London North East business case); and
- A network-wide programme approach to Digital Railway schemes that shares fixed costs, such as train fitment and programme costs, over a number of deployments as part of a long term plan to maximise the benefits from initial investment (outlined in the Wessex and Anglia business cases).

Train Control System

- Prioritise deployment of Traffic Management in areas of the network with high volumes of passengers and freight traffic and performance challenges, and therefore generating the highest value (outlined in the South East business case);
- The choice of Traffic Management system is influenced by the type of existing signalling control assets, and whether they are due for renewal, as this is likely to be the lowest cost point of intervention (outlined in all five business cases);
- Traffic Management delivers benefits when it controls large areas of the network, giving operators a wide view of the impact of their decisions on the train service (outlined in all five business cases);
- Digital train control needs to be considered at a network level alongside an operating strategy to ensure systems integrate with each other;
- Build upon the Traffic Management systems already planned for deployment to learn the lessons of their deployment, develop evidence of their benefits in GB operation and to consider the case for their extension in coverage and capability; and
- The role of a range of technologies should be considered which, as a suite or individually, may be beneficial when deploying Traffic Management. These include C-DAS, Crew & Stock, incident management and enhanced customer information systems.

With both signalling and train control systems, the approach to deployment needs to consider safety and security issues, including cyber security and business continuity.

In addition to funding enabling investment during CP5 (e.g. First-in-Class fitment), the NPIF allocation is proposed to accelerate the deployment of a selection of digital schemes, based on a set of criteria to reflect the objectives and constraints of the investment fund. The priorities for the fund are to deliver tangible benefits (capacity, performance, safety, journey time and improved customer information) to rail users by mid-CP6, to support the future roll-out of further digital schemes and to contribute to the Government's Industrial Strategy and wider objectives to rebalance the economy.

The fund is not sufficient to fund every candidate scheme or the full scope of the business cases and therefore the Digital Railway Programme is exploring funding options for further development and deployment of targeted schemes, discussed further in Section 7.2.

6.3 Long Term

The longer term strategy will be based largely on asset condition within the notional asset life of Command, Control & Signalling assets. A long term plan is required to give clarity and confidence to

funders, operators and suppliers. However the deployment plan in the longer term, by necessity, will need to be flexible, considering factors such as:

- Allowing for re-prioritisation based on the future needs of users and funders;
- Taking advantage of the development of technology;
- Realising the benefits of research and development where today's technologies do not meet current or future needs; and
- Affordability and availability of funding.

As the development of digital technologies and processes matures and experience is gained from deployments, the costs for digital signalling, smart infrastructure and train control are expected to reduce. Therefore, it is anticipated that renewing Command, Control & Signalling assets with digital technologies will become 'business as usual' across the network in the longer term.

To give effect to this Strategy, an industry-wide Signalling and Operational Control Systems Strategy, with a more detailed implementation plan for the longer term is being developed, covering both signalling and train control systems.

7. DELIVERING THE DIGITAL RAILWAY STRATEGY

The rail industry has experience of delivering large and complex programmes, but there have been few truly industry-wide change programmes on the scale of the Digital Railway. The Digital Railway Programme is therefore preparing for safe, timely and efficient delivery of schemes.

The Digital Railway Programme is responsible for shaping and driving the wider programme of future digital deployments. Once the Programme has completed the requirements definition activity and delivered the enablers for the targeted deployments, responsibility for scheme development and deployment will sit with Network Rail's Route businesses and the wider industry.

Within this context, the Digital Railway Programme's delivery strategy is to:

- Maintain a visible and up-to-date pipeline of opportunities for the supply chain, supported by an appropriate funding pipeline;
- Establish the concept of a Joint Design Group inclusive of supply chain, industry and operators (Route and Train Operating Companies/Freight Operating Companies) to deliver and enable:
  - Early engagement to improve the development of whole line of route outcomes-based requirements, to meet the needs of customers while making appropriate use of the enterprise architecture
  - Focused Research and Development in digital train control activities for the GB network
  - Specific technical outputs to support business strategies and project delivery/ development
  - Skills growth and knowledge transfer across industry;
- Drive consistency in operational procedures, recognising that trains will operate across a number of areas fitted with Digital Railway systems and also conventional systems;
- Drive consistency in procurement and delivery strategy at Route level across the industry to build confidence, improve productivity and reduce costs;
- Drive behavioural change through strong and focused leadership to promote collaboration across procurement and delivery;
- Channel lessons learned from early deployments to maximise realisation of benefits by other Route businesses and the wider industry;
- Establish a national System Authority within industry which will continue to offer guidance, configuration management, and issue resolution to future deployments and operations;
- Develop whole life commercial mechanisms which are outcomes-focused and reward success, and consider alternative funding and finance mechanisms with appropriate risk transfer;
- Set out clear objectives and outcomes through the procurement process. As an intelligent customer, focus on outcomes, performance and interfaces, allowing the supply chain to focus on the technology to deliver and innovate; and
- Develop procurement models which support the building of UK supply chain capability.

Successful delivery of the Digital Railway Strategy will be dependent on overcoming a number of challenges and managing risks relating to:

- Industry collaboration;
- Funding and financing;
- Business change; and
- People and skills.

These are explained in more detail below in Sections 7.1 - 7.5. Success of the Digital Railway will be defined and measured against the drivers for change and outcomes set out in this strategy, including initial capital cost savings.

7.1   Importance of Industry Collaboration

Whilst the Digital Railway is underpinned by technology, at heart it is a benefits-driven business change programme that will impact all parts of Britain's rail industry. Realising the opportunity of the Digital Railway will by no means be straightforward. Whilst people and technology are critical, at the same time, the rail industry is a network of complex stakeholders, boards and approvals, including:

- **Government:** as a policy maker and funding provider via DfT, Transport Scotland, Welsh Government or Passenger Transport Executives; and as the accountable body for regulation;
- **Regulators:** The Office of Rail and Road (ORR) or the Intergovernmental Commission;
- Regulated entities providing services to the industry such as:
    - **Network Rail**, with eight devolved Routes, maintaining 31,000km of track and 64,000 signal equivalent units;
    - Transport for London, HS1, HS2, and the Heritage Railways;
    - The seven **Freight Operating Companies** (FOCs) who operate over 800 locomotives;
    - Twenty five franchised and open access **Train Operating Companies** (TOCs) delivering billions of passenger journeys every year;
- **Safety** bodies such as the Rail Safety & Standards Board (RSSB), European Union Agency for Railways and Health and Safety Executive;
- **Industry organisations** such as the Rail Delivery Group, Rail Freight Group, Crossrail Ltd, HS2 Ltd, Unions and a significant **supply chain** of key providers, including the Rail Supply Group and Rail Industry Association; and
- **Rolling stock operating companies** (ROSCOs) which own and lease trains to the operating companies.

Delivering a line of route-wide upgrades, such as a Digital Railway deployment, impacting on each of the critical industry stakeholders, requires strong strategic management, collaboration and goodwill from all parties who may incur a cost of change without a clear contractual route to bear the cost directly.

The success of the Digital Railway and delivery of benefits is therefore dependent on engagement, active participation and consensus across the industry.

In recognition of this challenge, the Digital Railway Programme brings together industry leaders and governing bodies. It is led by the Digital Railway Programme Board that informs and sets the Programme's direction.

An overview of the key Digital Railway stakeholders is provided in the diagram overleaf.
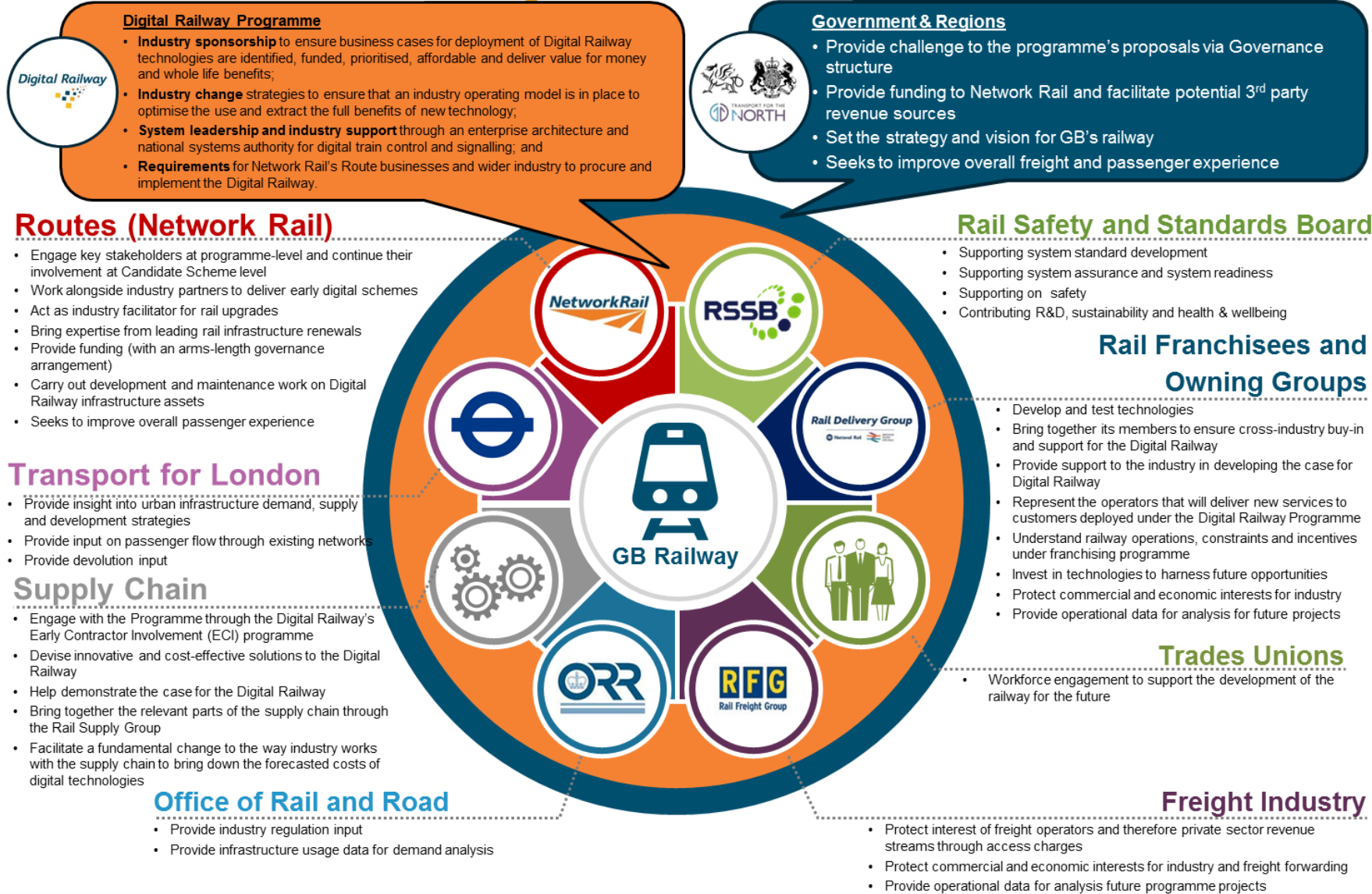
Digital Railway

Digital Railway Programme
- **Industry sponsorship** to ensure business cases for deployment of Digital Railway technologies are identified, funded, prioritised, affordable and deliver value for money and whole life benefits;
- **Industry change** strategies to ensure that an industry operating model is in place to optimise the use and extract the full benefits of new technology;
- **System leadership and industry support** through an enterprise architecture and national systems authority for digital train control and signalling; and
- **Requirements** for Network Rail's Route businesses and wider industry to procure and implement the Digital Railway.

Government & Regions
- Provide challenge to the programme's proposals via Governance structure
- Provide funding to Network Rail and facilitate potential 3rd party revenue sources
- Set the strategy and vision for GB's railway
- Seeks to improve overall freight and passenger experience

Routes (Network Rail)
- Engage key stakeholders at programme-level and continue their involvement at Candidate Scheme level
- Work alongside industry partners to deliver early digital schemes
- Act as industry facilitator for rail upgrades
- Bring expertise from leading rail infrastructure renewals
- Provide funding (with an arms-length governance arrangement)
- Carry out development and maintenance work on Digital Railway infrastructure assets
- Seeks to improve overall passenger experience

Rail Safety and Standards Board
- Supporting system standard development
- Supporting system assurance and system readiness
- Supporting on safety
- Contributing R&D, sustainability and health & wellbeing

Rail Franchisees and Owning Groups
- Develop and test technologies
- Bring together its members to ensure cross-industry buy-in and support for the Digital Railway
- Provide support to the industry in developing the case for Digital Railway
- Represent the operators that will deliver new services to customers deployed under the Digital Railway Programme
- Understand railway operations, constraints and incentives under franchising programme
- Invest in technologies to harness future opportunities
- Protect commercial and economic interests for industry
- Provide operational data for analysis for future projects

Transport for London
- Provide insight into urban infrastructure demand, supply and development strategies
- Provide input on passenger flow through existing networks
- Provide devolution input

Supply Chain
- Engage with the Programme through the Digital Railway's Early Contractor Involvement (ECI) programme
- Devise innovative and cost-effective solutions to the Digital Railway
- Help demonstrate the case for the Digital Railway
- Bring together the relevant parts of the supply chain through the Rail Supply Group
- Facilitate a fundamental change to the way industry works with the supply chain to bring down the forecasted costs of digital technologies

Trades Unions
- Workforce engagement to support the development of the railway for the future

Office of Rail and Road
- Provide industry regulation input
- Provide infrastructure usage data for demand analysis

Freight Industry
- Protect interest of freight operators and therefore private sector revenue streams through access charges
- Protect commercial and economic interests for industry and freight forwarding
- Provide operational data for analysis future programme projects

Figure 15: High level overview of Digital Railway stakeholders

7.2 Funding and Financing

The Digital Railway Programme requires two major tranches of funding and financing:

1. **Initial funding** to develop business cases, scope definition and delivery strategies until individual schemes can secure funding and be authorised for delivery, as well as to provide overall programme management, engineering test facilities, development of generic system requirements and architecture, and system authority oversight. As at July 2017, short term funding had been allocated within CP5 only; and
2. **Scheme funding and financing** to deliver individual schemes led by Network Rail's Route businesses where business cases justify such investments. The funding required to support these schemes is not yet in place, other than the NPIF allocation.

The Digital Railway Programme is exploring funding and financing options available to develop and deliver the targeted deployment strategy outlined in Section 6. In addition to delivering enabling projects, the NPIF allocation of £450 million to digital signalling and train control technologies is proposed to target schemes that can be delivered in CP6. This initial funding should help in proving the concept and encouraging the market, as well as delivering tangible passenger benefits. More schemes have been suggested for funding through NPIF than it can support. Options being considered to fund wider schemes within the targeted deployment plan include third party funding, funding through the franchises and through the regulatory settlement. Government will need to ensure that the funding option pursued is affordable and represents best value for money.

Private financing options are being considered for the delivery of Digital Railway schemes, and supply chain engagement thus far has suggested there is a strong appetite for this in the market. Key to ensuring value for money is an effective and appropriate transfer of risk to the private sector on a whole life basis, for example, allocating some of the technical integration complexity to the suppliers best placed to understand and manage it. The Digital Railway Programme is considering a range of commercial structures to deliver Digital Railway schemes, including the possibility of private finance and supply chain involvement.

7.2.1 The Role of the Franchise Competition Process in Delivering the Digital Railway

The franchise competition process will be an important mechanism in delivering the Digital Railway. Consequently, the Digital Railway Programme has instigated direct involvement in DfT-led franchise procurement activity, with a key focus on advocating and facilitating the introduction of Digital Railway solutions into franchises through the procurement process where this represents best value for money.

Where practicable and agreed with the DfT, the franchise invitation to tender (ITT) process can challenge bidders to make meaningful and practical investment in capacity and performance in their bids, including consideration of Digital Railway solutions where they can be proven to provide strategic impact. The Digital Rail Programme will work with DfT whenever a new franchise is put out to tender, to consider whether bidders should include more use of Digital Railway technologies. In order to facilitate this, the Digital Railway Programme will:

- Advise DfT on applicability of Digital Railway solutions to address required franchise outcomes;
- Identify additional opportunities presented by franchises to adopt Digital Railway solutions;
- Advise on how bidders could be incentivised to propose/adopt Digital Railway solutions;

- Assist DfT in evaluation and assessment of bidders' responses to requirements and/or alternative proposals for incorporating Digital Railway solutions in franchises;
- Maintain alignment between franchises and Network Rail with regard to adoption of Digital Railway solutions; and
- Interface with franchisees/partners to support Digital Railway solution development, deployment and operational introduction.

More collaboration across industry is required to ensure the right frameworks are implemented, and that any disincentives are removed or managed.

7.3   People Strategy

The Digital Railway will enable a change in how people in the rail industry work in the future, and help to address some of the challenges in terms of an ageing workforce and changing skills requirements discussed earlier.

This change can only be successfully delivered by involving people at the outset, and there are practical, cultural and behavioural barriers that must be identified and addressed. It is critical that the required skills and capabilities are developed in order to deliver the required outcomes. Early and full engagement with people and their trades unions will be essential for them to work together towards delivering the Digital Railway collaboratively. Plans must be put in place to upskill and retrain the current workforce, as well as to recruit, train and retain future employees.

A 'one size fits all' approach will not work; each part of the industry has its own approach to people and business change, and different organisations will have different ability levels to adapt to, and embrace the change. An ageing rail workforce will increase the risk that vital skills and knowledge are lost, and steps must be taken to continuously develop new skills and transfer knowledge.

7.3.1   Responding to the People Challenge

A senior team from across the rail industry has been established to lead the people planning and delivery aspects of the Digital Railway. A high-level strategy has been produced, led by the Steering Group, proposing how to prepare our people for the changes, opportunities and challenges ahead.

Contained within the high-level strategy are seven core people principles ('design principles'), which will help ensure that a common, joined up approach is taken to meeting the people challenge across the rail industry. These principles are:

- **Skills and capabilities:** to continually analyse and assess the skills and capability levels of the rail workforce. Includes forecasting and anticipating skills gaps and areas of risk to enable recruitment, retention and development of people to deliver the mobility and flexibility that the industry will require;
- **Training and development:** to work together with customers, trade unions, industry and the supply chain, to form a common industry training capability based on business needs and training analysis, design and delivery;
- **Attraction:** to prepare the industry for Digital Railway by defining the skills and attributes for the future workforce, to attract and retain a diverse workforce as is required, that is based on the "right people, right skills, right time";

- **Retention:** to retain and develop the people who are responsible for all aspects of the rail network, and raise awareness of the key factors that can help to retain people;
- **Trades union engagement and industrial relations:** to work together with industrial relations teams, trades unions, and their members, to mitigate the impact that the widespread introduction of digital technologies may have on people;
- **Lessons learned:** to outline key recommendations on how past 'lessons learned' can be used within the Digital Railway People Strategy, and integrated into a continuous improvement cycle; and
- **Communications:** To have a clear approach to communications, feedback and ideas across the industry.

7.4   Business Change

Digital Railway technologies are a key enabler in changing the way the GB railway is operated to deliver benefits to passengers and freight users. These changes represent one of the biggest opportunities and, at the same time, if not properly addressed, give rise to significant risks to delivering the benefits of a Digital Railway.

The scale and breadth of the industry mean that current capabilities vary from organisation to organisation across the country. This breadth also means that different stakeholders face a range of different challenges on their section of the network, and have a number of different aspirations for their businesses or business units. Balancing these current capabilities will require an agile approach – both to technology and to associated business and process change.

In order to effectively embed the changes of any proposed Digital Railway schemes and to fully realise targeted benefits, consideration will need to be given to business change and to close working and collaboration with Network Rail's Route businesses and wider industry. The impacts of Digital Railway initiatives are likely to be wide-ranging covering all aspects of operations. Some of the potential impact areas are shown overleaf in line with the 'POTI' framework, detailed within 'Managing Successful Programmes'.
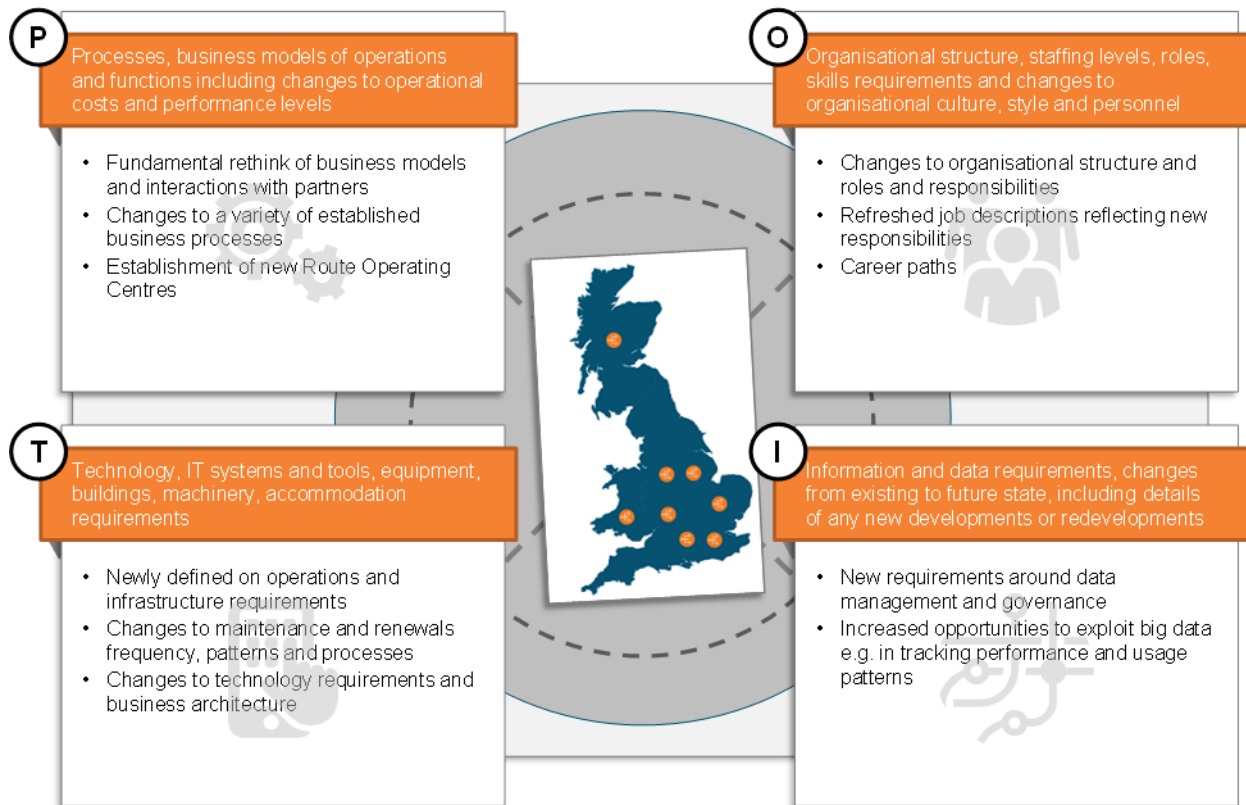
Figure 16: POTI framework

As part of the devolution agenda, Network Rail's Route businesses are increasingly autonomous organisations. In line with this, Routes are accountable for ensuring that change initiatives are effectively defined and delivered across their networks.

In order to support the Routes (and wider industry) in the most effective manner, the Digital Railway Programme will establish a business change capability which will focus on raising awareness of the objectives of Digital Railway, planning for change and effectively realising any change. The business change team should help Routes and wider industry to understand the full implications of delivering Digital Railway initiatives and look to refine the approach to managing change with every subsequent deployment, through learning lessons and maintaining dialogue with planning and delivery teams.

The Digital Railway Programme is assumed to be time-limited to the end of CP6 (2024). In this context, all activities, including visibility of a long-term pipeline of digital deployments, and the required skills and capabilities, will have transitioned to 'business as usual' by the end of CP6. As it transitions, it is anticipated that Digital Railway will become a widely available tool for Network Rail's Routes / System Operator, wider industry stakeholders and funders in their strategic planning processes.

8. SUMMARY AND RECOMMENDATIONS

8.1 Summary

In summary, the Digital Railway Strategy outlines the opportunity for digital train and operational control technologies to address industry challenges relating to affordability and asset sustainability, safety, capacity and performance. The Strategy also outlines how the Digital Railway will contribute to the Government's wider economic, social and environmental objectives.

The plan entering CP5 for deployment of the Digital Railway was based on assessing asset condition and operating costs. The Digital Railway Programme has modified this approach by also considering other factors including performance, capacity and safety needs. The case studies and business case analysis, produced by the Digital Railway Programme, demonstrate that an integrated and targeted approach to deployment of digital train and operational control technologies maximises the benefits of the Digital Railway to the users of the railway in the most cost-efficient manner. The Digital Railway makes the best use of funders' investments to benefit passengers, freight customers and the wider economy.

The Digital Railway Programme is a benefits-driven cross-industry change programme enabled by technology, which will enable the delivery of systems, technology, business and people change in an integrated way. It will support the deployment of digital solutions in areas that offer the best strategic fit for the rail industry and greatest value for money, balancing benefits with affordability.

To give effect to this Strategy and provide long-term visibility to funders, operators and owners of trains, the suppliers and stakeholders, an industry-wide Signalling and Operational Control Systems Strategy and implementation plan is being developed for signalling and train control systems. Visibility of a long-term pipeline of digital deployments will be required to develop the skills and capabilities required to deliver the Digital Railway, as well as build and sustain confidence from the supply chain.

A coordinated programme approach will result in schemes that are cost efficient and integrated, and ensure that risks and dependencies are effectively managed. Successful delivery will require industry collaboration, as well as strategies to manage risks, challenges and opportunities relating to people and business change. The Digital Railway Programme will support the rail industry and Network Rail's Route businesses to deliver the Digital Railway by providing systems leadership, industry sponsorship, industry change strategies and developing requirements.

8.2 Recommendations

Based on the principles set out in this Strategy, the key recommendations are:
- A coordinated programme approach with close industry collaboration is required to unlock the full benefits of Digital Railway technologies;
- As part of a line of route-wide upgrades and package of interventions, the Digital Railway will help to address the drivers for change outlined in this Strategy, and these will form the basis of the measures of success;
- An industry-wide Signalling and Operational Control Systems Strategy is required to implement this Strategy with the Digital Railway Programme acting to create strategic coherence across Routes and franchises. This links the assets, rolling stock and people; and
- The Digital Railway Programme will need to be sufficiently agile to take advantage of future technologies and changing requirements.

Digital Railway

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