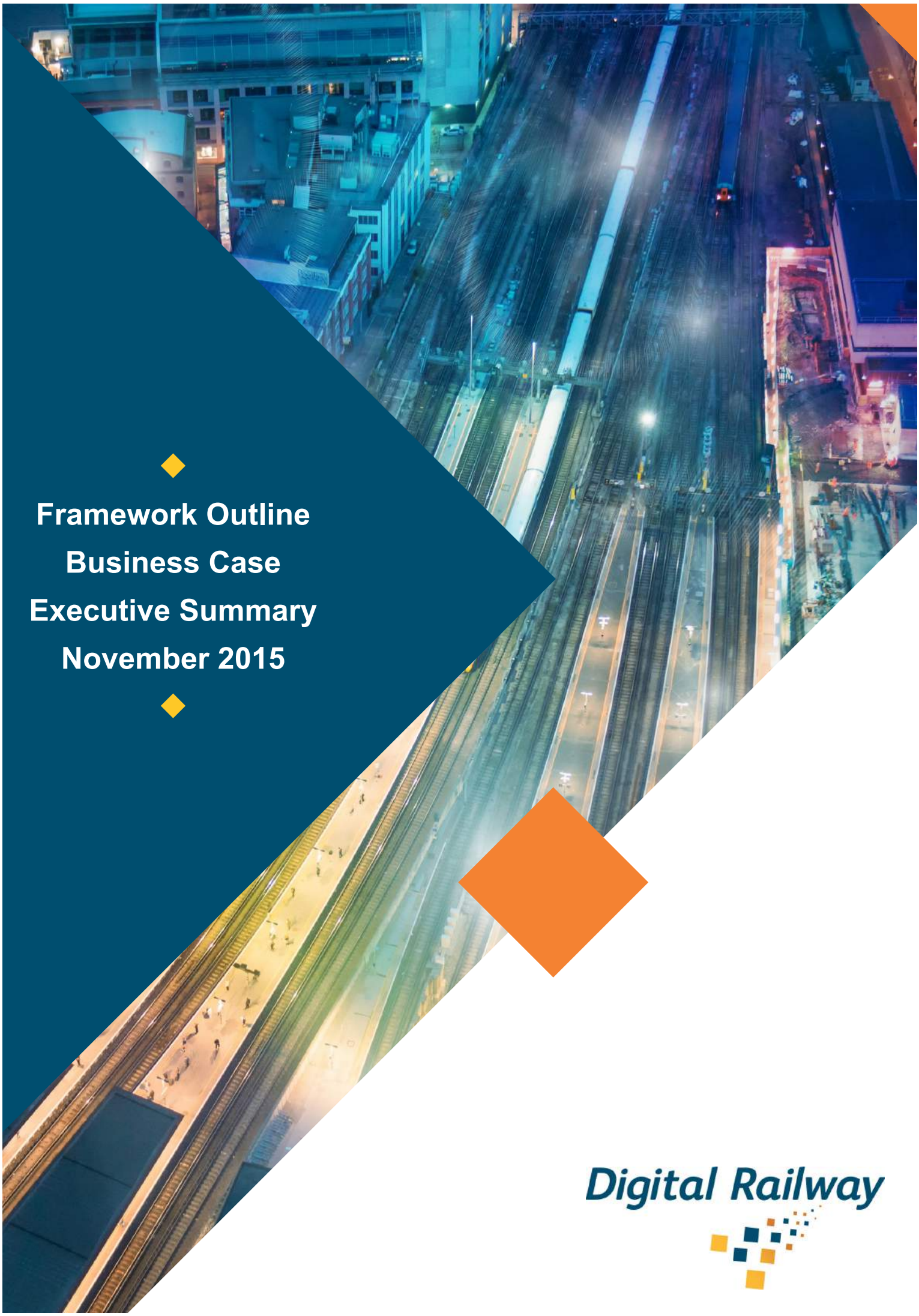

Framework Outline Business Case Executive Summary November 2015

Digital Railway

1. Executive Summary

This document supports a recommendation that the acceleration of digital modernisation on the railway should be the basis of rail's Initial Industry Plan (IIP).

Analysis identifies that the existing plan is too slow and piecemeal to maximise return on investment. A c.25 year digital strategy that spans technology, business change and commercial innovation offers a more cost-effective and higher-performing railway that delivers a bigger economic benefit for Britain. The proposal:

- **Supports Government policies for facilitating economic growth and reducing the costs of running the railway;**
- **Maximises delivery confidence by relying on proven technology and learning from major infrastructure initiatives across Europe;**
- **Releases the capacity and connectivity Britain's economy needs from the railway infrastructure the nation already has – providing strong support to the priorities set for the National Infrastructure Commission;**
- **Delivers benefits on every type of route that are tailored to local priorities – be they for more trains, better connections or greater reliability – each delivered at lower cost than purely conventional alternatives;**
- **Will be strengthened with an additional option to upgrade to the next generation of technology and allow further acceleration that delivers greater benefits over c.15-20 years;**
- **Facilitates commercial innovation that enables access to 3rd party sources of finance, to increase affordability and sustainable risk-transfer;**
- **Is a catalyst to grow engineering talent with the digital skills and knowledge that British suppliers need to succeed in the strategic growth market for digital infrastructure at home and abroad.**

Digital Railway will now develop this analysis and the plan for implementation with IIP partners, enabling an Outline Business Case to be finalised in 2016 that confirms a national deployment sequence and the plan to support rapid progress. This will form a critical part of the IIP in September 2016.

1.1 The strategic case for change

Making the right choices about infrastructure is one of the most powerful ways any country can secure its long-term economic success.

For Britain today, a vital task for the railway is to help our great cities in the regions become engines of national growth, and to sustain London's global economic leadership. This needs a railway that connects more people, skills and goods to more places, with reduced overall end-to-end journey times at lower cost.

With the railway already full in important growth markets, and with passenger numbers set to increase substantially in the decades ahead, Britain's response needs to unlock capacity from the infrastructure it already has in a more cost-effective way.

By facilitating this, faster digital modernisation addresses priorities of the National Infrastructure Commission, helping Britain meet the transport challenge to support growth in jobs, housing and the economy.

The government is funding and supporting a package of major upgrades to the railway to boost productivity and growth (including through its backing of initiatives such as Crossrail and HS2) as part of a National Infrastructure Plan.

But beyond these critical upgrades, a national capacity strategy that is rooted in conventional construction-based enhancements (such as building new tracks) alone will not maximise the benefits of this investment or deliver the capacity that Britain needs over the longer term. Ultimately, we can only deliver and fund the capacity we need by complementing targeted upgrades with digital innovation that makes the infrastructure we already have significantly more effective.

If we do not act now, passengers and freight customers will face longer waits for trains that are less reliable and even more crowded, with fewer choices about where and when they stop. Important contributions to wider government objectives – from a lower carbon economy to 'digital first' public services will also be missed.

But by taking concerted action to tackle constraints to railway capacity, the rail industry can make a powerful contribution to the priorities of the National Infrastructure Commission, recently established to sustain London's global economic success by keeping the city moving and to transform connectivity in the North.

Digital Railway is a vital enabler for long-term growth because it releases latent capacity in the GB rail infrastructure to support the economy. On every type of route, new options can be created to meet the local priorities that matter most – be they for:

- More trains where they are needed most, for example, to rapidly growing metropolitan regions such as London and Manchester;

- Better connections, enabled through more choice about train paths - for example, between our system of cities in the North or for prime freight routes;

- Greater reliability and a reduction in the impact of delays when problems do occur.

As these priorities are met, a future plan based on Digital Railway provides Britain with:

- **A powerful driver for productivity and growth**, clearly aligned to priorities of the National Infrastructure Commission, including to foster a dynamic Northern economy and to support London's global success for the long term;

- **A railway built, maintained and run at lower cost**. A digitally-enabled network has fewer centralised operations centres and has the potential to deliver maintenance cost advantages achieved by the removal of heavy assets and a reduced cost of disruption. With more space in the network, new options are created to undertake maintenance and normal service side by side resulting in a lower cost railway;

- **Better customer experience** from more reliable services supported by better, up-to-date information.

In achieving these benefits, Digital Railway facilitates the wider transformation of the railway industry, for example, through new investment models that harness private investment, new customer services, and new options for freight services.

The realisation of these benefits is enabled through configuration phases that facilitate a build-up of skills and knowledge alongside the development, testing and deployment of digital technology:

- **Phase 1 configuration -** Strategic Pilots;

- **Phase 2 configuration -** Technology integration and core business change;

- **Phase 3 configuration -** Optional enhancement.

Please refer to Figure 5 on page 14 for a description of the phase configurations.

1.2 The economic case for change

Analysis of demands and constraints on the South West Main Line shows a value for money case for accelerating digital modernisation alongside a package of conventional measures.

Additional route assessment reinforces this finding and demonstrates the potential for digital modernisation to deliver benefits on every type of route that can be tailored to local priorities.

1.2.1 Faster digital modernisation is a value for money response to the challenges of GB's busiest route

Analysis has examined the case for faster digital modernisation on a key commuter route – the South West Main Line. This indicates that:

- **Digital technology available now would deliver significant reliability and capacity benefits** from the Phase 2 configuration, which comprises Traffic Management (TM) and ETCS Level 2 (L2)[1];
- As part of a package of measures, accelerating the deployment of this digital technology would reduce the cost of meeting demand for capacity;
- Accelerating digital modernisation avoids the need for a major and costly intervention to build a 5th track between Surbiton and London Waterloo;
- Up to **11 more trains** in the morning high peak hour - **30,000 new seats** a day, delivered **four years earlier with Digital Railway**;
- A **£60 million lower initial capital cost** in present value terms than the conventional upgrade plan;
- **5 per cent fewer passenger train delay minutes** as a result of TM, even with an increase in trains on the network.

A further upgrade to the Phase 3 configuration, which includes the next generation of technology (ETCS Level 3 or L3)[2], when available, will extend these benefits for more reliability and capacity with less infrastructure:

- Resulting in a **further capital cost saving of £70 million** in present value terms compared to the Phase 2 configuration.

[1] Please refer to section 3.5.2 for a description of these technologies.
[2] Please refer to section 3.5.2 for a description of these technologies.

- **9 per cent fewer passenger train delay minutes**, even with an increase in trains on the network[3].

Overall, the benefit to cost ratios (BCR) are comparable to other major programmes and justify further investigation of the benefits on offer. This analysis includes transport benefits (webTAG[4] compliant); wider economic benefits will be captured in the next stage of analysis.

More detailed timetable analysis will be carried out at the next stage to test the feasibility of running 11 additional trains at a reasonable level of performance. To test the sensitivity of the BCR to the number of trains, a scenario where 6 additional trains are run has been included under each of the different economic options:

- **Option 1 -** Legacy plan and full conventional upgrades by 2032;
- **Option 2 -** Digital Railway Phase 2 configuration plus some conventional upgrades by 2028;
- **Option 3 -** Digital Railway Phase 3 configuration plus some conventional upgrades by 2028.

Figure i: Benefit to cost ratios for the South West Main Line Case study

Additional trains into London Waterloo in AM high-peak hour from current service	Option 1	Option 2	Option 3
11 (Central Case)	0.9*	1.3	1.5
6 (Sensitivity)	0.4	0.5	0.6

*only 10 more trains are possible

1.2.2 A network wide acceleration of digital modernisation delivers benefits on every kind of route

In addition to the South West Main Line, a further 8 routes have been assessed that are representative of the constraints and characteristics of the network as a whole. The high level conclusions of that analysis are that:

- **Digital benefits are across the network** but they differ depending on the characteristics of the route;
- **A system-based deployment of Digital Railway, with a Phase 2 configuration delivers compelling benefits** which could be built upon further by a future upgrade to the Phase 3 configuration once developed;

[3] Core infrastructure reliability improved by 35 per cent - more detail provided in the Economic Case.
[4] WebTAG – web based Transport Analysis Guidance, which is the Department for Transport's interpretation of the Green Book

- **Faster** digital deployment **maximises the benefits** from investment to passengers, freight users and the rail industry, as well as the wider economy;

- Network wide reliability can be improved by up to **7 per cent for the Phase 2 configuration** and **11 per cent for the Phase 3 configuration**.

Figure 2 provides more detail and demonstrates the potential for Digital Railway to have a highly beneficial impact on a wide range of routes.

This demonstrates that a digital railway can create options for each line of route to meet local priorities for more trains, better connections and greater reliability. It also highlights the additional capacity benefits that an upgrade to the Phase 3 configuration can offer, at a lower cost.

Digital Railway can also offer synergies with other programmes to generate more return from future investment in infrastructure, for example potentially reducing the cost of electrification as a result of there being no need for immunisation and signal sighting works.

Figure ii: Assessment of Digital Railway on sample lines of route

Line of route characteristics	Capacity	Reliability	Better connections	Lower Cost
South West Main Line – London Commuter, freight and interregional	★★★	★★	★	★★★
Northern Powerhouse Rail – transformational programme linking the Northern cities	★★★	★★★	★★★	★★★
Midland Main Line – long distance high-speed, interregional freight and London commuter[5]	★	★★	★★★	★★
Brighton Main Line – London commuter	★	★★★	★	★
Leicester – Ely – Freight Felixstowe to north and midlands and interregional	★★★	★	★★	★★★
Cardiff Valleys – non-London commuter	★★★	★	★	★
Aberdeen to Central Belt – interregional and freight	★	★	★★★	★
Grantham – Skegness – rural	-	★	★	★
Essex Thameside – London commuter and freight[6]	-	★	★★	★

★★★ – Opportunity to achieve greater capacity benefits and cost savings with future implementation of ETCS L3 as part of Phase 3 configuration

[5] Northern Powerhouse and Midland Main Line – Digital Railway has the potential to reduce the cost of electrification

[6] Essex Thameside – Route Study analysis based on the growth forecasts from the Market Studies shows that lengthening of services on the route will support capacity on the route to 2043

1.3 A case for supply-chain stewardship and commercial innovation

1.3.1 An effective supply-chain partnership

The Programme has conducted an initial review of the skills and services required from the supply chain to deliver an accelerated digital modernisation.

A gap analysis confirms that the industry capabilities required broadly exist and a procurement strategy will be created to bridge outstanding gaps which heavily emphasises engagement, information sharing and collaboration with the industry.

The achievability of this strategy is increased by the opportunities for the industry to benefit from the long-term drivers for change brought about by Digital Railway, which include:

- **Market growth,** not just for operators who can serve more passenger and freight customers on the existing network, but throughout the rail supply-chain;
- **Skills development,** catalysed by Digital Railway creating a 'pull' for the rail industry and related industries, such as power and process, to future-proof its skills base, grow the talent and develop the skills needed to succeed in the growing global market for digital infrastructure;
- Presenting an opportunity for the rail industry to **innovate** through the pursuit of new kinds of **commercial partnerships** and application of skills to new areas of business;
- Creating **new markets,** made possible by the process changes necessitated by Digital Railway, such as new timetabling planning tools that creates new opportunities for operators and freight;
- Providing a catalyst to develop the skills and knowledge to position the supply chain as global leaders in digital infrastructure and give it a **competitive edge**.

1.3.2 Increased performance through commercial innovation

Digital Railway has identified how and where the current funding and commercial landscape might be affected by faster digital modernisation. This confirms that commercial innovation will be required, but will also be enabled, by the Programme – making it an important driver for increased affordability, efficiency, performance and sustainable risk-transfer.

Contracting options have been identified to achieve this and will now be tested through consultation against clear tests of success:

- Value for money;

- Access to finance, including private finance;
- Effective transfer and management of risk;
- Strong accountability for delivery and performance;
- Incentives that promote high performance and partnership;
- Increased focus and clarity of purpose.

Case study: how Digital technology and industry funding structures affect each other

Changing the signalling system requires close integration between track-based equipment, telecoms, train-borne equipment and driver skills. As a result, change in this area must be implemented in a joined-up way that allows risks and dependencies to be managed effectively – for example, using a single programme of work under one supplier or a collaborative partnership that allows several stakeholders to integrate their activities closely.

In either case, delivery and funding vehicles must help to allocate commercial risks appropriately between those involved. This may require new kinds of commercial models that promote behaviours and incentives that increase value for money.

1.4 Meeting the requirements for successful digital modernisation

1.4.1 Delivery requirements

Historically, the rail industry endorsed a strategy to replace traditional signals with ETCS nationally as existing signaling systems reach life-expiry. This proposed transition is scheduled to take over 50 years, even though the required technologies are being delivered on networks world-wide now and are advancing rapidly.

This legacy plan lacks the pace and prioritisation needed to maximise the benefits of digital capacity (to the national economy and to rail passengers and freight customers) or the strategy needed to address risks in respect to technology integration, business change, supply chain capability and programme delivery.

Having reviewed lessons from other major infrastructure initiatives, Digital Railway has been designed to meet the success factors which are not addressed effectively under current plans.

- **The core proposal is for a deployment strategy rooted in proven technology** and a phased build-up of skills and knowledge. **This will deliver faster access to benefits from technology that is:**
    - Compliant with international technical standards to ensure interoperability;
    - Compliant with UK Governments and EU policy;
    - Available now and in use around the world;
    - Known and tested on the ground through a number of accelerator projects already delivered or in progress, including TM (in Romford and Wales Rail Operating Centres), ETCS L2 on the Cambrian Line, the Paddington approach to Heathrow and on the East Coast main Line.
- The deployment strategy includes the creation of options to **upgrade to the Phase 3 configuration**, including ETCS L3 – subject to the pace of development in technology and (international) standards. Development activity will be critical to enabling this, supported by the **key criteria for an area by area roll-out**.

Key criteria for area by area roll-out

- Southern capacity improvement (passenger);
- Support 'Northern Powerhouse' objectives;
- Improve freight journey times & paths;
- Improved timetable adherence (Performance);
- Key Line of Route completion;
- Level of existing investment.

Digital Railway will now develop its deployment plan as part of further discussion and research with stakeholders. An indicative sequence is shown at Figure iv. For the avoidance of doubt, the sequence presented will be subject to change as the Digital Railway Programme engages with the industry to refine and finalise the sequence. This includes the routes who will be considering how to manage other assets alongside digital signalling and train control to give full access to the Digital Railway benefits. Delivery of Digital Railway is based on the following:

- An implementation plan for Digital Railway that is **technology-enabled** but **led by business-change** - prioritising delivery in areas where benefits and readiness are greatest;
- A **geographically focused deployment plan that allows resources to be concentrated** on specific areas of the network to provide the required delivery capability, whilst implementation over a shorter time frame is more likely to maintain impetus for change;
- A business case that has tested options against criteria to identify an **initial sequence for deploying Digital Railway on an area by area basis;**
- **A procurement strategy** that keeps the supply chain capability closely aligned to the needs of the Programme;
- A **systems architecture approach** that gives everyone building the future railway a common and comprehensive understanding of the total framework of change – spanning services, people, processes, and technology;
- An established **programme governance and assurance plan**, which incorporates **independent testing** by government bodies.

Figure iii: Strategy summary

Govts. Strategy[7]	Challenge	Impact of not changing
Use digital technology to achieve efficiency;	▶ Update railways to the current generation of proven technology; ▶ Meet the needs of increasingly demanding digitally enabled users; ▶ Enable rail users to access accurate appropriate and timely information.	▶ Missed opportunity for increasing capacity of the railway; making GB less competitive; ▶ Users choose alternative modes of increasingly congested travel; ▶ Rail falls behind in the provision of customer services compared to other forms of transport.
Use assets in a more effective manner;	▶ Reduce the costs of operating, maintaining, renewing and enhancing the railway.	▶ Increased costs to Governments, taxpayers and passengers, as more expensive conventional interventions are required.
Environment;	▶ Conform to international treaty obligations to reduce carbon emissions.	▶ Environmental consequences of more road travel – increased $C0^2$; global warming; noise; visual intrusion; air quality and health issues.
Improve transport in Scotland and Wales.	▶ Improve journey times, connections, quality, accessibility and affordability of transport, whilst reducing emissions; ▶ Connect regions internally, with the rest of the UK, and globally.	▶ Missed opportunity for shorter journey times and improved connections leads to users choosing alternative modes of transport; ▶ Missed opportunity to make better connections with global markets and boost the economy; ▶ Environmental consequence of more road travel.
Infra. Strategy[8]	**Challenge**	**Impact of not changing**
Keep London Moving;	▶ Maintaining and expanding the number of people who are able to connect with the markets and places of work within London.	▶ London loses its position as a global centre for trade and industry; ▶ UK productive potential and economic growth is limited.
Transform the connectivity of the North of England, and across the UK;	▶ Operate more trains – bringing together the different regions of the UK and facilitating economic development through: freight, business travel, tourism, and agglomeration; ▶ Better connections through flexible services to meet needs of freight and passengers.	▶ Northern cities fail to capitalise on their economies of scale; ▶ Scottish regions remain poorly connected, and services fail to unlock economic growth and tackle inequality; ▶ Wales remains poorly connected with the rest of the UK.
Help the UK to tackle its energy needs and obligations.	▶ Better product offer from rail, attracting increasing numbers of road users to rail; ▶ Increase capacity on the rail network whilst limiting the $C0^2$ impact from conventional interventions and materials such as concrete and steel.	▶ Environmental consequences of more road travel; ▶ Maximum conventional interventions are needed, increasing the CO^2 footprint.

[7] Her Majesty's Treasury (2015), "Fixing the Foundations: Creating a More Prosperous Nation"

[8] UK Government (2015) "Chancellor announces major plan to get Britain building" https://www.gov.uk/government/news/chancellor-announces-major-plan-to-get-britain-building

Figure iv: Initial rollout tranches

ROC Location	York	Three Bridges	Romford	Rugby	Manch.	Derby	B.stoke	Glasgow	Cardiff	Didcot	Edinb.
Southern capacity improvement (passenger)	High	High	High	High	Low	High	High	Low	Low	High	Low
Support 'Northern Powerhouse'	High	Low	Low	High	High	High	Low	Low	Low	Low	Low
Improve freight journey times & paths	High	Low	High	High	High	High	High	High	High	High	High
Improved timetable adherence (Performance)	High	High	High	High	High	High	High	Low	Low	Med.	Low
Key Line of Route completion	High	High	High	High	High	Med.	Low	Med.	Low	Low	Med.
Level of Phase 2 investment	High	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Tranche	**T1**	**T1**	**T1 and T2**	**T2**	**T2**	**T3**	**T3**	**T3**	**T4**	**T4**	**T4**

Digital Railway is being developed in phases to reduce the deployment risks whilst providing time to develop technology which can maximise the economic value of a digital railway. Responsibility and risk management of developing the component parts of Digital Railway (ETCS, TM, ATO) will rest with Network Rail, to enable a standard specification for the technology involved.

Figure v: Phase configurations

Phase 1 configuration – Strategic pilots

This phase is intended to maintain current delivery momentum on strategic projects, featuring the component parts of Digital Railway (ETCS, TM, ATO) in various targeted interventions. This is intended to be completed by the end of CP5 – some example projects are:

- **TM** deployment at Romford & Wales Rail Operating Centres (ROCs);
- **ETCS L2** deployment on the Paddington approach to Heathrow**;**
- **ETCS L2** deployment on the East Coast Main Line.

Phase 2 configuration – Technology integration and core business change

This phase is intended to cover the majority of the business change required for Digital Railway. This includes (but is not limited to):

- **Rolling stock fitment** with the train based components of Digital Railway**;**
- **Driver training** to use the new systems**;**
- **Movement of signalling staff** into new ROCs.

Once these are delivered, the baseline plan contained within Phase 2 will be to deliver a rail network featuring ETCS L2 over a time period at roughly twice the rate of the legacy plan (which sets out a 50 year deployment schedule). This plan can be adapted depending on the successful development of ETCS L3 (see below);

Phase 3 configuration – Optional enhancement

This represents an option for further digital acceleration to release additional capacity and improve performance over Phase 2 configuration through a combination of:

- The **development and deployment of ETCS L3.** Through the early part of CP6, ETCS L3 will be developed in partnership with other infrastructure operators across Europe. Once approved, Phase 3 will present the option for the deployment of ETCS L3 instead of L2;
- **Open architecture** to convert the bespoke signalling systems to software based open systems;
- **Automated Design** that standardises the layout design to a small number of pre-approved repeatable “building blocks” which allows much faster design and deployment.