CP6 *Intelligent Infrastructure*

Delivering the data-driven railway

14 June, 2019

Britain's railway today

- Britain's railways are a remarkable success story – we are the fastest growing, and one of the safest and most reliable railways in Europe.

- Passenger numbers have doubled in the last twenty five years and are continuing to grow.

- We run more trains than Spain, Switzerland, Holland, Portugal and Norway combined.

- Network Rail employs 40,000 people across the UK, and supports 89,000 full-time jobs in our supply chain. The railway and its supply chain support 216,000 jobs across Britain.

- Network Rail continues to evolve to ensure the needs of our customers – passengers and train companies – are at the heart of what we do.

Reputational Damage - "Network Rail fails again…"

Daily Mirror

Trains on up-country line delayed due to derailment

THE INDEPENDENT

Network Rail hires consultant to sort out late trains, missed targets and spiralling engineering costs

London Evening Standard

Train commuters on packed London lines warned to take holiday during Rugby World Cup

BBC NEWS

Network Rail fined £2m for delays

BBC NEWS

Dawlish's storm-damaged railway line reopens

BIRMINGHAM MAIL — WEBSITE OF THE YEAR

Network Rail pay Virgin Trains £15.3m to compensate for delays

NetworkRail

- Large parts of the network are now full with no contingency for when things go wrong – disrupting our passengers.

- We are spending over £20 million every day just to operate, maintain and renew the railway, which in many places is still 50 to 150 years old, yet much more heavily used than it was originally designed for.

- A single fault at one place at rush hour can have a knock on effect to services hundreds of miles away, many hours later.

- We need to embrace innovation to deliver a better performing railway

NetworkRail

20,000 Miles of track

820 Signal Boxes

7,400 Commercial Properties
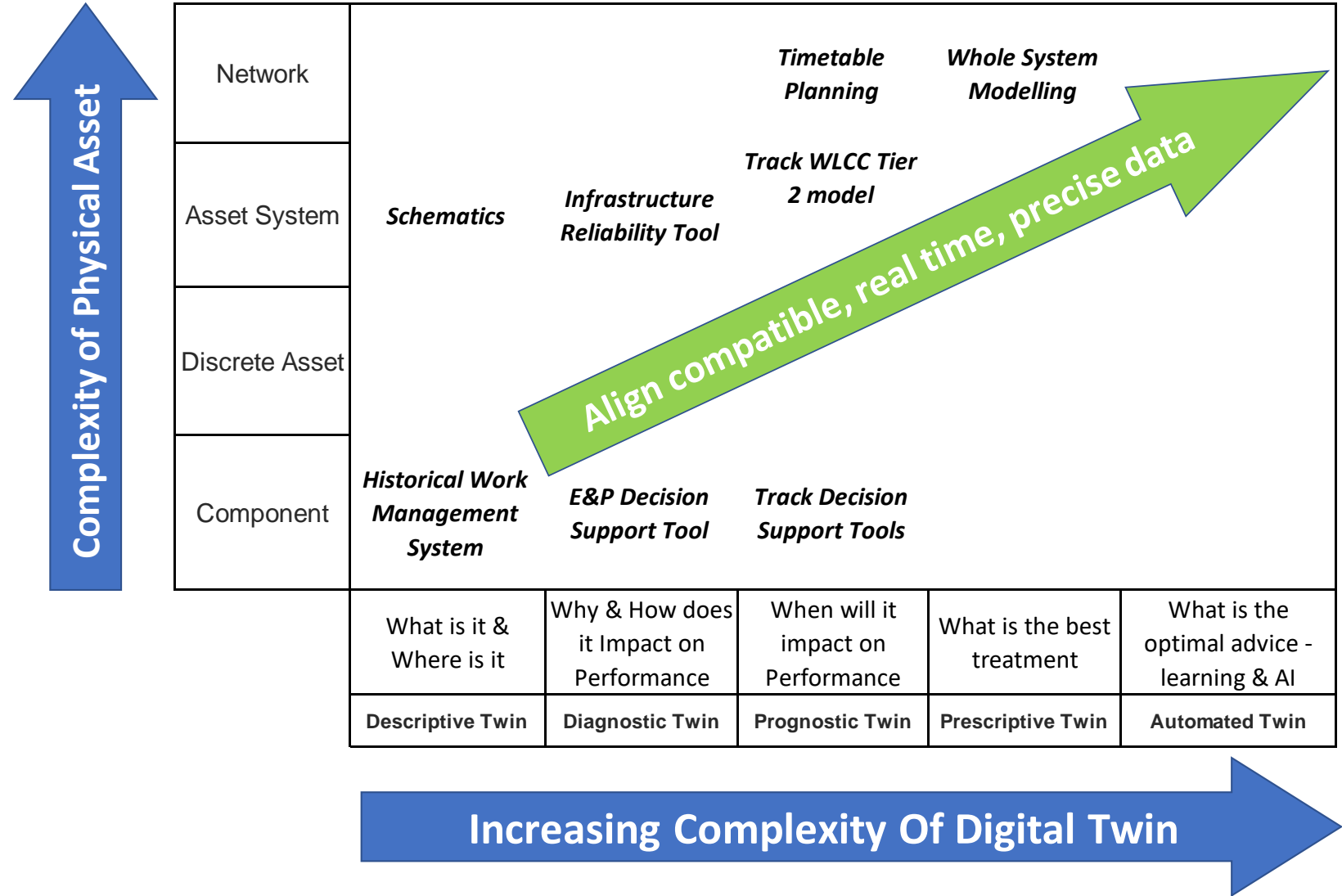
37,000 Bridges and Tunnels

23,000 Switches & Crossings

19 Managed Stations

6,700 Level Crossings

NetworkRail

Developed from work for IAM Patrons, Kersley,T.(Network Rail), Foley,J (EAMS) & Pocock,D (Jacobs)

Safe
- 10% improvement in train accident risk
- 13% improvement in level crossing risk
- 54% improvement in Lost Time Injury Frequency Rate

Reliable
- 12% improvement in delayed trains in 2019/20
- 28% improvement in delayed trains by the end of CP6

Efficient
- 3.5bn incremental efficiency savings between 2019-2024

Putting people first
- 50% improvement in the number of women employed
- 25% improvement in occupation related mental health absence

Environmental Impacts
- 25% improvement in carbon emissions
- 18% improvement in energy consumption

The Journey so Far

ORBIS 7-years - 20+ projects

NetworkRail

ORBIS was a **seven year, £330m digital transformation programme** designed to place quality asset data at the heart of decision-making in Network Rail.

CAPTURE

My Work Application
- > 14,000 devices deployed
- > 15 million work orders closed

Asset Data Capture
- > 155,000 signalling scripts completed (75% of assets)

Aerial Survey Data Capture
- Entire network viewable with high resolution imagery and LIDAR data (for surface and terrain modelling)

STORE

Asset Data Store
- Contains more than 2 terabytes of data
- Consolidates more than 20 source systems in to 1 place Provides the sole source of data into LADS
- Enables Decision Support Tool (DST) benefits in CP6

Geo-RINM Viewer
- 8,000 current users
- Will be available to external users
- 150 data layers of rail information
- Aerial survey imagery

EXPLOIT

Linear Asset Decision Support Tool
- Approximately 600 users
- Now includes Overhead Line Equipment

Operational Property Decision Support Tool
- £27.6m benefits realised

Signaling Decision Support Tool
- C. £39m benefits forecast

Track Decision Support Tool
- £32m benefits realised
- £52m additional forecast CP5

EP Decision Support Tool
- £0.5m benefits forecast
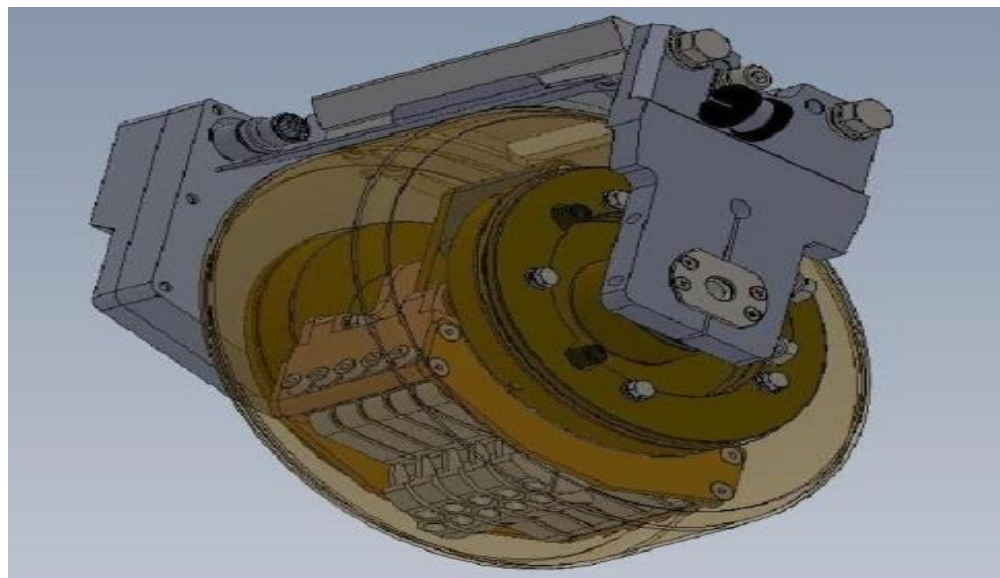
Broken Rails – 1998-99 to 2018-19

- In 2018/19 we had 93 broken rails, the lowest ever a compared to our previous best of 95 in 2016/17
- This represents a reduction of 90% in 15 years
- 50% increase in traffic over the same period with reducing access
- How do we achieve 50 by 2030? – 30 by 2050?
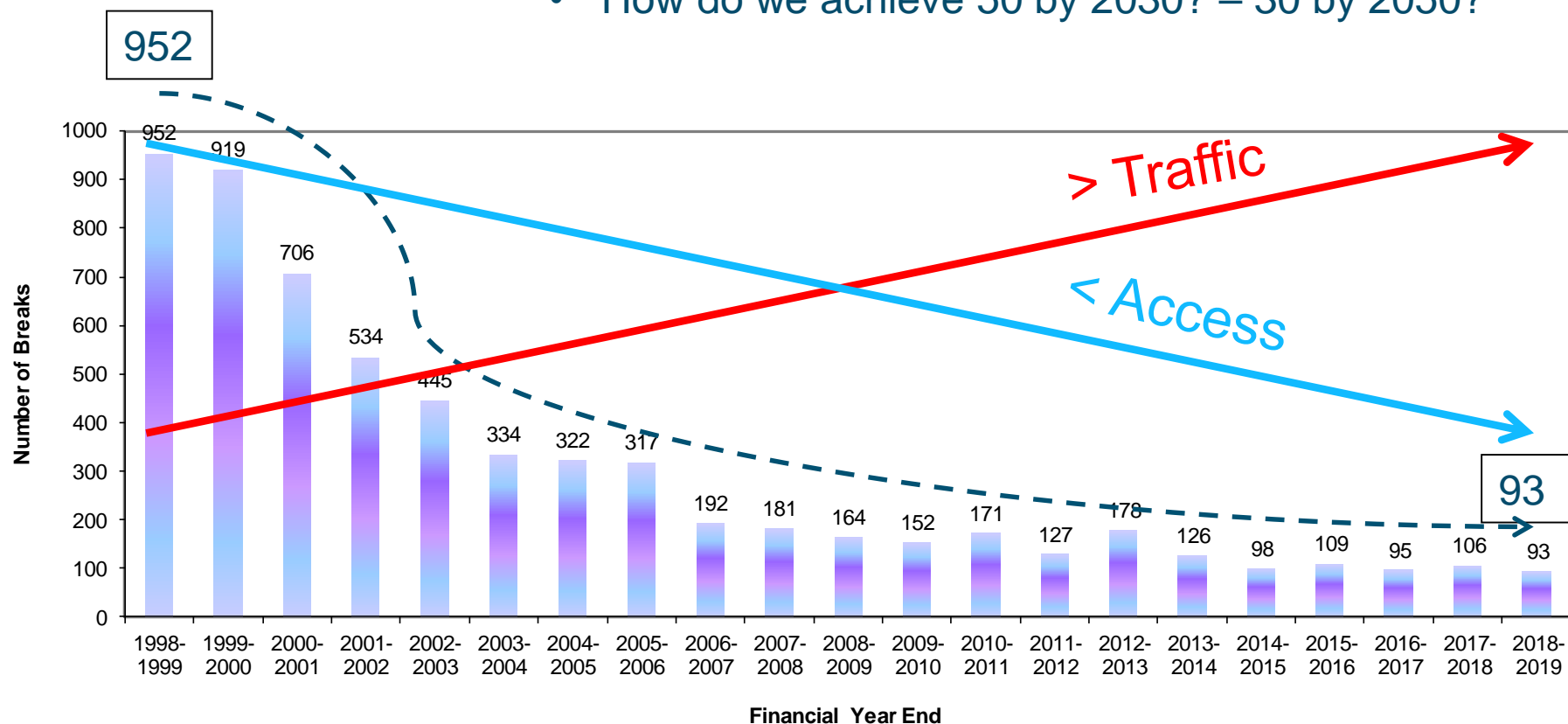
Asset Reliability - Service Affecting Failures
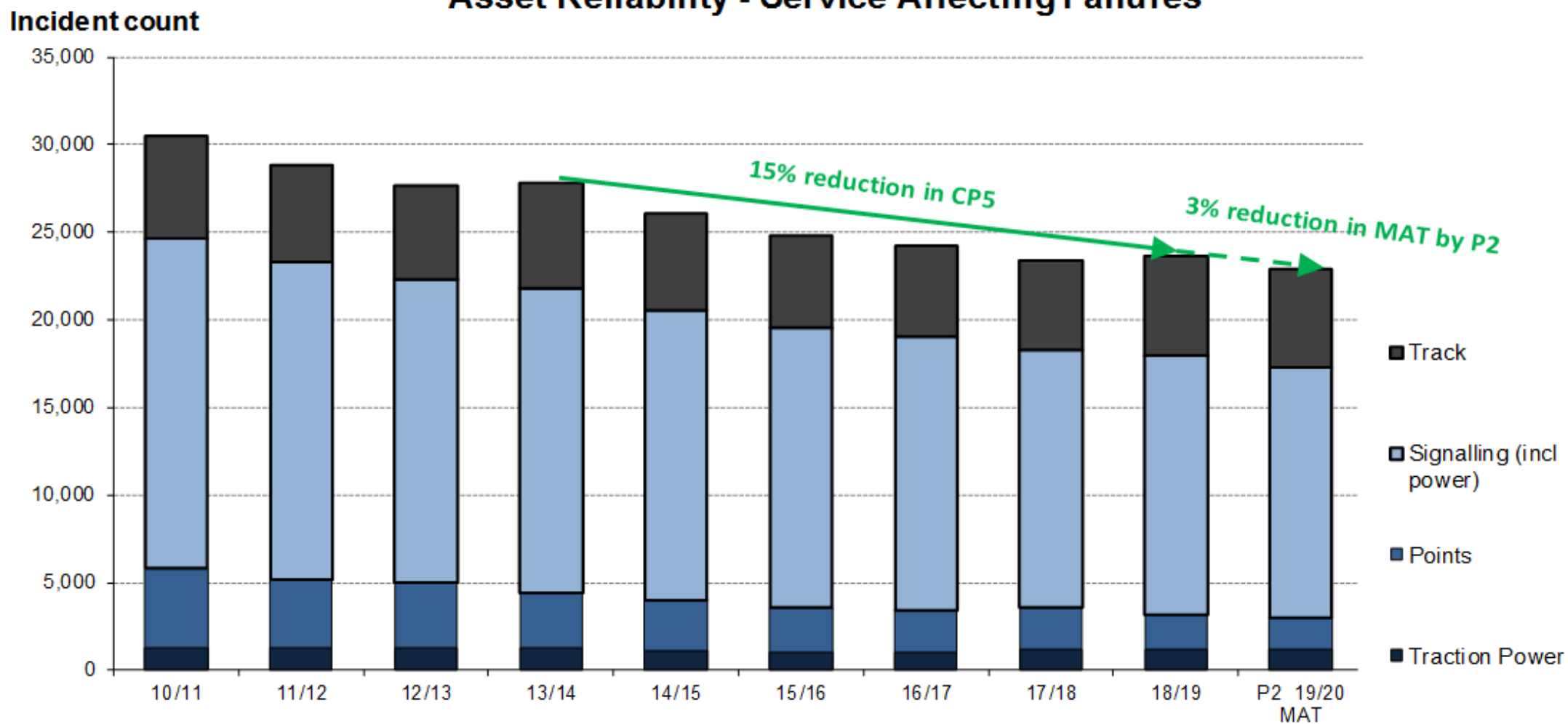
Incident count

15% reduction in CP5

3% reduction in MAT by P2

Legend: Track, Signalling (incl power), Points, Traction Power

X-axis: 10/11, 11/12, 12/13, 13/14, 14/15, 15/16, 16/17, 17/18, 18/19, P2 19/20 MAT

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NetworkRail

OUR MISSION

"Delivering positive outcomes for passengers and freight by inspiring and collaborating across the rail industry to leverage data and emerging technologies"

Intelligent Infrastructure - Ambition

- **We want to:** move from time based, fix-on-fail maintenance, to intelligence-led predict and prevent regimes

- **We need to:** deliver for passengers and freight customers

- **We will do this by:** capturing, analysing and exploiting asset data to help the routes prioritise the most critical work

- **We are targeting:** 10% service affecting failure improvement

- **As a result we will:** safely and affordably improve asset management; reduce faults and service affecting failures; drive greater safety and availability of the railway

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Industry

National
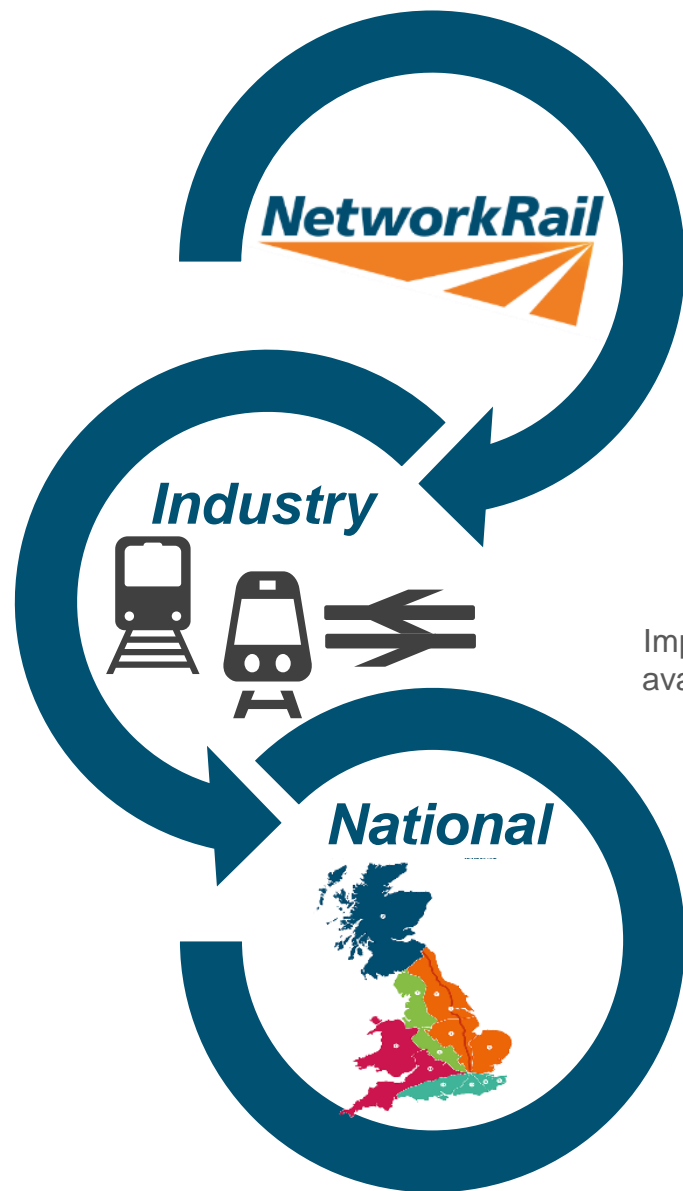
Applying analytics to leverage existing technology
Using FFV to inform maintenance vegetation schedules, targeted interventions through predict & prevent

Targeted rollout of proven technology
Data sharing with TOCs, increase in fleet availability, reduced rail damage, improved reliability and WLC

PPM Improvements
Improved train performance due to availability, asset performance and reduction in SAFs

Passenger Benefits
Better network reliability, growth of network services and improved passenger experience

Sustainability
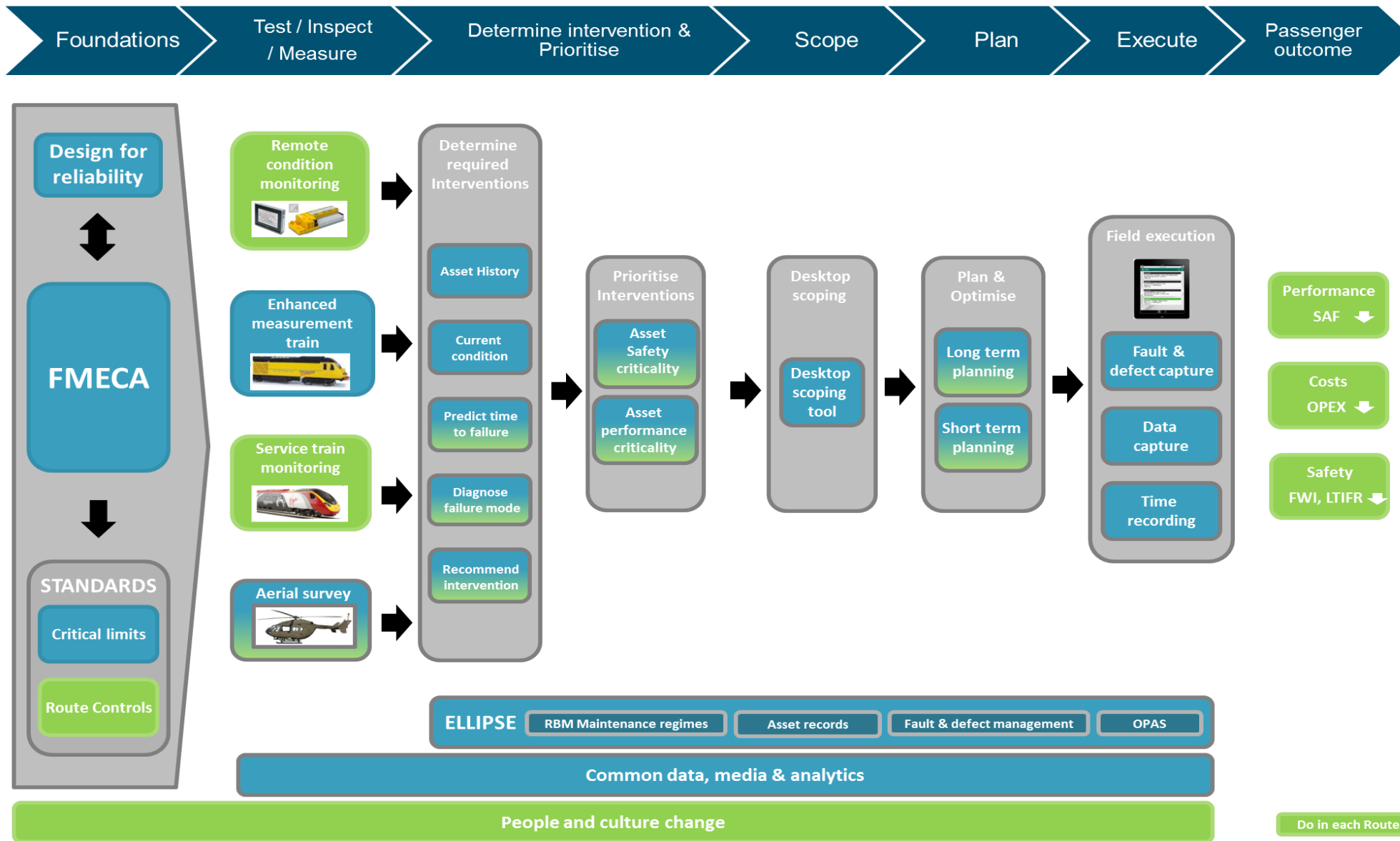Industry-wide sustainability improvements due to increase in efficiency and performance

Supporting Government Strategy
Increased productivity, performance, reliability and connectivity supporting wider government aspirations. Reduced carbon emissions and reduced road congestion driven by improved train reliability

Foundations → Test / Inspect / Measure → Determine intervention & Prioritise → Scope → Plan → Execute → Passenger outcome

Design for reliability

FMECA

STANDARDS
- Critical limits
- Route Controls

Remote condition monitoring

Enhanced measurement train

Service train monitoring

Aerial survey

Determine required Interventions
- Asset History
- Current condition
- Predict time to failure
- Diagnose failure mode
- Recommend intervention

Prioritise Interventions
- Asset Safety criticality
- Asset performance criticality

Desktop scoping
- Desktop scoping tool

Plan & Optimise
- Long term planning
- Short term planning

Field execution
- Fault & defect capture
- Data capture
- Time recording

Performance SAF

Costs OPEX

Safety FWI, LTIFR

ELLIPSE | RBM Maintenance regimes | Asset records | Fault & defect management | OPAS

Common data, media & analytics

People and culture change

Do in each Route

Common

NetworkRail

PROCESS	Specify	Capture	Evaluate	Collate	Analyse	Exploit
PROCESSES	Information Governance Process Data Architecture Detailed data specifications (incl quality criteria) Roles & Responsibility	Data Collection Data maintenance	Data quality measures / tests	Data processing - presentation for use	Information tests and checks verification / validation tests	

Check, Learn & Act

Feedback to specification
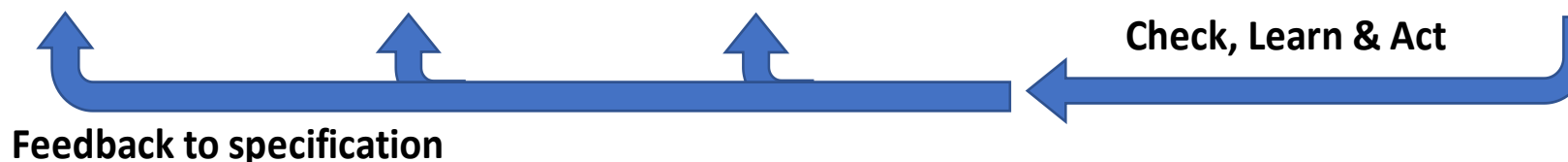
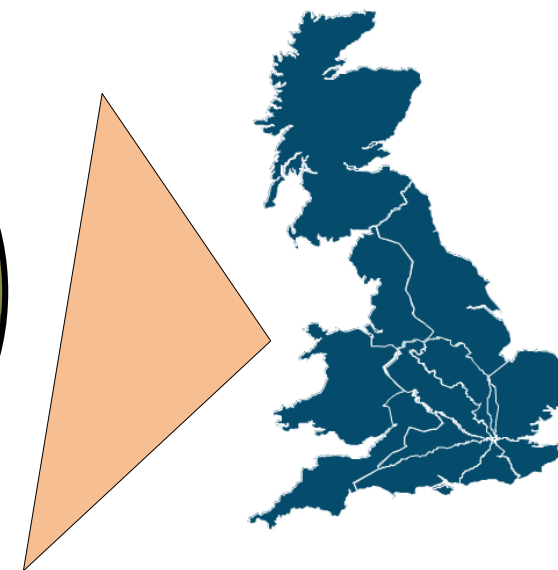## Aerial Survey 2014

- A national aerial survey of all 16,000km of the network was flown in Summer 2014. Assets were captured within the NR ownership boundary plus 50m either side.

- As part of this aerial survey over 250 helicopter flights were completed in one flying season, capturing over 110,000 individual image tiles and hundreds of millions of LiDAR points of the rail network.

- This imagery was then deployed to the Geo-Route Infrastructure Network Model (GRV) on a route-by-route basis across Network Rail
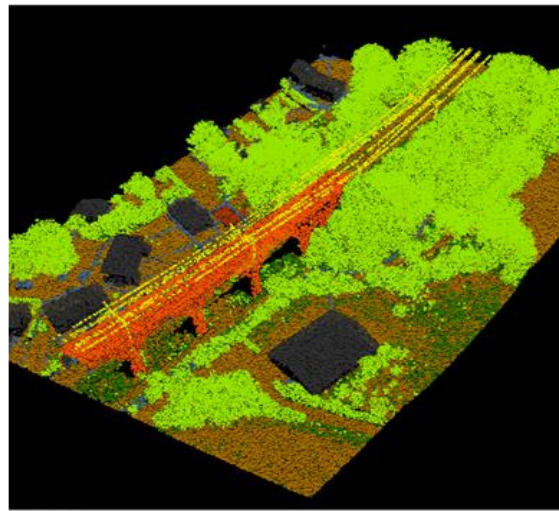
Aerial Survey 2019

- Following the success of the original Aerial Survey, a second survey was carried out by the Intelligent Infrastructure programme to capture images and terrain data with improved clarity

- There are 4 key products that can be used from the aerial Survey data collected
  - Orthophotos (downwards facing imagery)
  - 3D Lidar data
  - Digital Terrain Model (DTM)
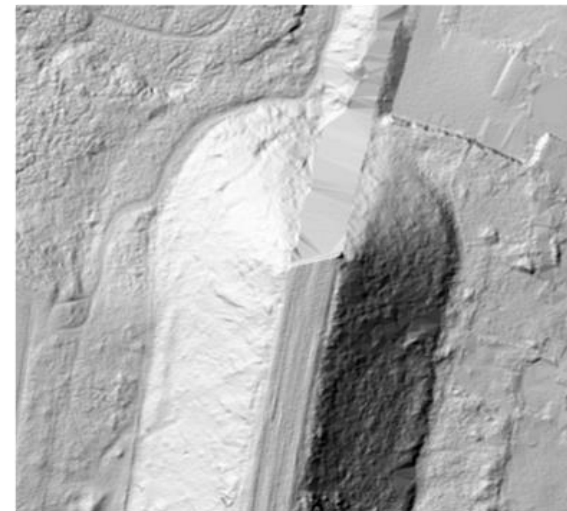 - Digital Surface Model (DSM)

Orthophotos **3D LIDAR Point Cloud** **Digital Terrain Model** **Digital Surface Model**

Intelligent Infrastructure will drive the data-driven railway:

- Giving our engineers access to up-to-data on assets when and where they need it

- Supporting engineering knowledge with trusted data to make better-informed decisions

- Allow the routes to carry out 'predict and prevent' maintenance and renewals

- Move away from outdated 'fix on fail' regimes

- Understand what is likely to go wrong and when and the impact a failure will have on railway

- Intervene 'with the right work, at the right time, in the right place'

Network Rail have established a team of early engagement leads from its routes and functions across the country to support the educational drive to promote science, technology, engineering and maths – STEM – opportunities for young people

The Intelligent Infrastructure programme will take a leading role in supporting this ambition by applying real-world experience for children to make the connection between STEM subjects and the new economy

Britain needs to prepare more young people to fulfil jobs and opportunities in STEM fields due to an aging workforce and to meet the needs of an increasingly innovative and data-driven world market