Track and S&C Technical Strategy 2020-2040

THE WORKING DRAFT……

Vision

A cost effective track system which is safe, reliable and resilient, meets emerging capacity and service requirements and contributes to the growth of the economy.

Designed, built and maintained by competent engineers, technicians and operatives with the skills required in an information-rich (digital?) railway industry.

Purpose

1. *Establishes a framework for the effective development of improved track engineering technologies, aligned with national and Regional policies and priorities, including across system interfaces*
2. *Supports collaboration between Regions, TA and other functions to deliver Regional asset strategies*
3. *A framework for defining and developing the company-wide track engineering capabilities & competencies required to deliver the vision*
4. *Supports the development of technologies that reduce the life cycle cost of the track asset*

Assumptions

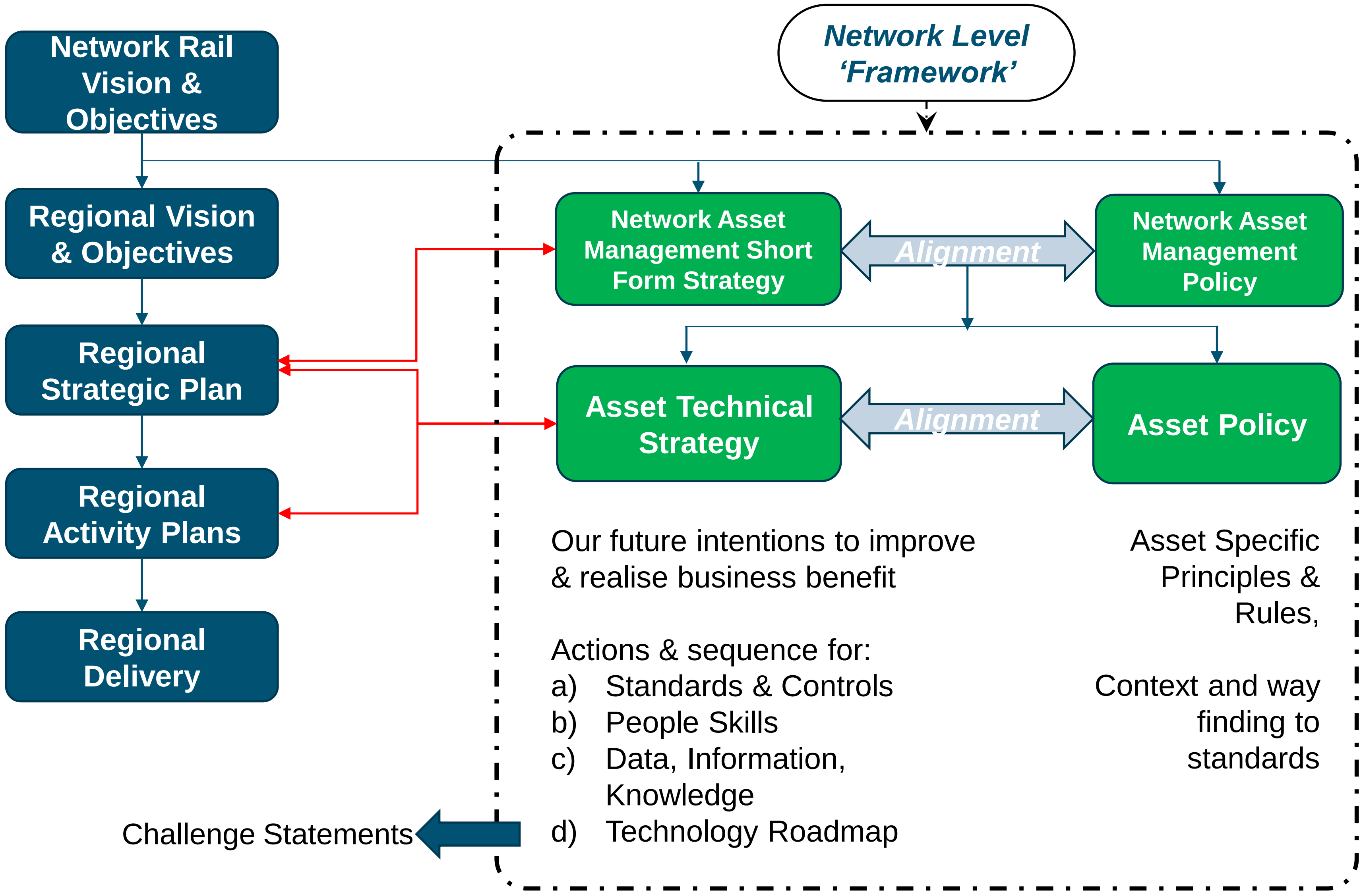
The railway system design principle of steel wheels running on steel rails remains unchanged

Future societal demands on the railway will be no less than today

Network Rail's license conditions will remain unchanged

The technical strategy applies to a single national entity

Where does the track and S&C technical strategy fit in ?



Objectives

EASY TO USE FOR ALL

LOW EMISSIONS

OPTIMISED TRAIN OPERATIONS

RELIABLE AND EASY TO MAINTAIN

DATA-DRIVEN

OUTCOMES

1. **HAPPY CUSTOMERS**
   The mode of choice for passengers and freight
2. **A VIBRANT RAIL SECTOR**
   An affordable railway that attracts investment
3. **ENRICHED SOCIETY AND STRONGER ECONOMY**
   Accessible rail transport that supports the UK economy
4. **BETTER ENVIRONMENT**
   Sustainable operations with net positive environmental impact

Rail Technical Strategy 2020 – key goals with a track engineering contribution

Objective	Goals	Why?	Current position (2020)	Vision for 2025	Vision for 2040
	Improved reliability and availability of existing systems	Reliability that is appropriate to the role of rolling stock and fixed assets in the system reduces disruption to services and drives cost efficiency through less maintenance. Increasingly complex railway systems raise the likelihood of service disruption through faulty interactions of assets or sub-systems. Greater resilience needed to cope with system stresses including climate change.	The timing of failures is unpredictable resulting in over-cautious inspection and maintenance or emergency intervention and delay. Response to faults can overlook, or take insufficient account of, wider operational implications. Individually reliable components and systems can interact to delay trains.	System resilient to many localised failures. Improved reliability by designing refinements that have high performance impact. Improved availability by accommodating failures to in-service assets with ‘smarter’ operations. Knowledge is routinely applied to improve system reliability, with the workforce guided by data and maintainers engaged in design.	System resilient to most localised failures. All assets performing with a known and appropriate level of reliability at component, sub-system and system levels and causing minimum disruptions.
	Safe and rapid inspection and repair	Targeted interventions based on the condition of rolling stock and fixed assets. Minimised downtime for maintenance and repairs can have significant positive impact on both costs and customer satisfaction. Lower risk to workforce and less disruption can be achieved by more automated inspection and repair methods, and decision support.	Progress towards optimal inspection and monitoring, but remote inspection and monitoring (RCM) and non-destructive testing is only used for a limited set of assets. Where deployed, RCM is starting to move workforce away from live operational environments. Most maintenance and repairs require rolling stock being temporarily removed from service or track possessions. Safety-driven initiatives to reduce workforce risk are focused on improving current procedures.	Condition-based inspection and maintenance (optimised for practicability) is widely used, replacing periodic inspection and maintenance. Widespread use of robotics and AI to identify – and in some cases rectify – asset faults. Workforce has been trained on remote supervision, leading to fewer and shorter withdrawals from service or- track possessions and greater safety.	All assets inform owners about health, degradation of performance and remaining service life. Railway maintenance is highly automated. Workforce typically co-ordinate automated repairs in live operational environments, often remotely.
	Step-change in reliability, availability and whole life cost for new assets	Future railway systems are designed to minimise single points of failure and deliver reliable service including under future climatic conditions. Upgrades of rolling stock and fixed assets are affordable and can deliver lower operating costs and a higher performing railway. Opportunity to create high-value safe roles for our workforce designed to exploit new asset capability.	The case for, and path to, next generation assets is not always clear and whole life cost is considered too narrowly. New generation asset design is not always driven by reliability and availability, especially at a system level. Design thinking and enhancements to the current generation of assets provide insights to inform new specifications. Renewals and mid-life refurbishment present opportunities but are often used to replace like-for-similar.	Maintenance strategy and requirements are always specified at design stage as part of optimising whole life cost. Key train and infrastructure requirements, or equivalents, set at an appropriate level of detail system-level outputs and long-term asset strategy.	New assets designed for availability through non-disruptive repair; easy renewal; and reduced whole life cost and environmental impact. New assets designed for reliability at system level and for future climatic conditions. They do not have single points of failure and include in-built health monitoring. Future transitioning and re-purposing of assets considered as part of design.

2020 Track Technical Strategy Themes

1. Optimised design using simulation of components, systems and understanding of duty conditions (digital twin)
2. New materials and advanced manufacturing techniques to eliminate as far as possible degradation and optimise the wheel/rail interface
3. World-leading digital / mechanised / automated construction and maintenance
4. 100% automated, non-intrusive monitoring and fault diagnosis
5. Wisdom-rich asset management and risk management

Rail Technical Strategy 2020
Track workstreams

Objective	Goals	Vision for 2025	Vision for 2040

Improved reliability and availability of existing systems

Tools for better data exploitation

Changes to the standard design of track infrastructure with a proven capability to increase the MTBSAF are funded in CP7 onwards and routinely specified by the regions, targeting assets most critical to performance. E.g. there is a shift from CEN56 to CEN60 infrastructure.

Improved knowledge of system behaviour, degradation and failure modes. This is routinely applied by NR and supply chain partners to improve system reliability and resilience, reducing the reliance on obsolete components.

II / 'big data' generates information about degradation rates to allow a greater level of planned maintenance which is less disruptive to railway operations.

Regions have prepared strategies for and fund the introduction of MTP.

Requirements for current and future asset reliability / availability along lines of route are well-defined and a core part of asset strategies.

The threshold load for wear and fatigue damage to occur is greater than actual 'norm' loading conditions on critical assets.

All assets are performing with a known and appropriate level of reliability at component, sub-system and system levels and causing minimum disruptions.

The number of rail, geometry and hot weather-related service-affecting failures and ESR/TSRs are controlled and continually reducing where this is required by route operations.

Maintenance repairs are longer-lasting and of higher and more consistent quality.

Rail Technical Strategy 2020
Track workstreams

Objective	Goals	Vision for 2025	Vision for 2040

Safe and rapid inspection and repair

Tools for better data exploitation

Vision for 2025

Trainborne track geometry measurement extended to include critical S&C (station areas, freight cross-over roads, high speed turnouts), delivered through enhancements to the existing dedicated fleet of measurement trains.

Unattended measurement from passenger trains in routine use on mainline routes.

Risk-based inspection and maintenance (optimised for practicability, asset criticality and operating context), based on measured degradation rates, is widely used for track geometry management and rail wear and RCF, replacing cyclic inspection and maintenance.

II brings together multiple condition data streams to generate information about potential root causes.

Early implementation of robotics and AI to identify – and in some cases rectify – track faults

Vision for 2040

Full trainborne condition assessment of plain line and S&C assets delivered wherever possible by timetabled passenger and freight rolling stock – supplemented by RCM for continuous monitoring of performance-critical assets.

AI used to process data collected by train for real time analysis of condition.

Critical assets inform owners about health, degradation of performance and remaining service life.

All maintenance regimes are tailored to the design, age, condition and operating context of individual assets, and evolve over time to match changing risk profiles.

S&C self-adjusts to optimise for performance.

Track maintenance is highly automated, delivering efficient and long-term repairs to rail and geometry faults.

Workforce typically co-ordinate automated repairs of rail, switch, crossing and geometry faults in live operational environments, often remotely.

Rail Technical Strategy 2020
Track workstreams

Objective	Goals	Vision for 2025	Vision for 2040
	Step-change in reliability, availability and whole life cost for new assets	Detailed line-of-route operational strategies and output requirements provide clear priorities for implementation of next generation track technology to deliver step changes in reliability and whole life cost. Proposals for next generation track asset designs and materials are supported by compelling business case evaluations and whole life cross-asset cost models. Maintenance requirements are always specified at design stage as part of optimising whole life cost. For higher RIRL innovations there is a defined route to full scale implementation with regional endorsement, supported by asset policy and standards change. Next Generation innovations are part of the CP8 asset policy and regional asset strategies.	New assets designed for availability through non-disruptive repair; easy renewal; and reduced whole life cost and environmental impact. New assets designed for reliability at system level and for future climatic conditions. They do not have single points of failure and include in-built health monitoring. Future transitioning and re-purposing of assets considered as part of design.

Next steps…..