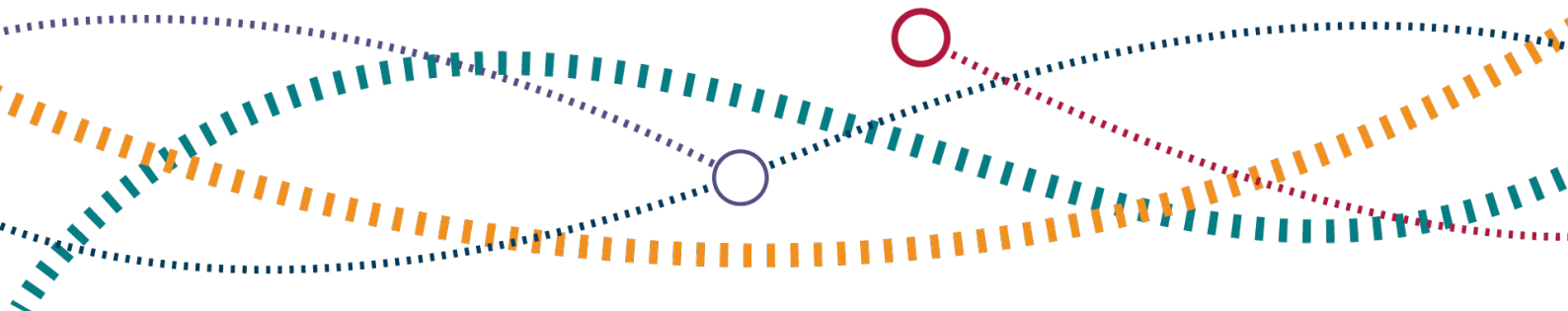




Network Rail's approach to Maintenance

Targeted Assurance Review

16 August 2022



Executive Summary

Maintenance is the process of maintaining asset condition by regularly inspecting it and intervening to improve its condition and sustain its performance, when necessary, via a maintenance activity. Network Rail (NR) define it as, "...the day-to-day upkeep of the network...".

NR operates under its Network Licence; a core obligation is securing the operation, maintenance, renewal and enhancement of the network in order to satisfy the reasonable requirements of its customers and funders, in accordance with best practice and in a timely, efficient and economical manner.

This Targeted Assurance Review (TAR) is part of a continuing ORR assurance activity to understand and inform the Office of Rail and Road (ORR) of NR current state and developing approaches to maintenance. Its findings will inform ORR's business as usual monitoring and contribute to our considerations for Periodic Review 2023 (PR23).

This report identified five key observations:

- (1) The **type of maintenance performance data** provided meant the effectiveness of maintenance activities was inferred, as opposed to directly linking cause and effect.
- (2) **Route leadership** roles (i.e. Infrastructure Directors and Heads of Maintenance); where both roles are responsible for the delivery of maintenance and compliance with standards, however, Infrastructure Directors consider maintenance within a holistic, whole system-based approach.
- (3) Routes are undertaking **performance management** independently using **informal** methods; relying heavily on individual experience lacks maturity within the asset management system, where independency is causing a barrier to collaboration and sharing of practice between Routes and Regions.
- (4) Variations in the **delivery and accessibility of performance data**, where different data to manage maintenance performance is provided at various times within a week or period, often nullifying or voiding data received only hours beforehand, limiting the ability to manage and utilise the data in a reasonable way.
- (5) **Lack of reflection**, where plans are not retrospectively reviewed to ascertain if they could be developed and improved.

- 2.1 Upon issue of the Periodic Review in 2018, the 2019 publication of [NR's Delivery Plan for CP6](#) states maintenance spend to be circa £9 billion, recognising the substantial cost of maintain the railway. Where NR agreed to deliver a number of a maintenance tasks, known as 'volumes' for a total of £9 billion within the control period; throughout CP6 ORR monitors NR's progress against the Delivery Plan. In particular, ORR undertakes detailed reviews at each Revised Forecast (RF) at Period 4, 8 and 11 to hold NR to account against the PR18 final determination and the NR CP6 Delivery Plan. In comparison, renewals costs in the Delivery Plan were determined to be £18.5 billion.
- 2.2 The maintenance budget is held at Route level, by the Infrastructure Director or Head of Maintenance (refer to Figure 2.1 and Figure 2.2) who are then accountable to the regional managing director.

2.2.1 Activity Based Planning (ABP)

- 2.3 In the final year of CP5, NR implemented an Activity Based Planning (ABP) tool, which introduced a bottom-up maintenance resource planning process and cost estimating tool for those assets maintained by the MDUs. The tool makes a direct link between planned maintenance activity and planned costs and headcount. For example, the ABP tool would break down the number of drainage inspections in one MDU in every four-week period, along with the expected cost and headcount of this work.
- 2.4 The approach considers the activities (known as Maintenance Standard Tasks (MSTs)) required to maintain each asset and the labour, plant, materials and cost required to that maintenance activity.
- 2.5 The number of MSTs has been rationalised and standardised across all MDUs and structured to differentiate between planned maintenance (e.g. inspections, cyclical tasks, etc.) and reactive maintenance, typically known as, 'work arising', (e.g. pumping water after heavy rain, etc.).
- 2.6 The costs are developed using each MDUs own records of time taken to complete standard jobs, non-productive time, number of plant shifts required and labour rates, etc.
- 2.7 It is the responsibility of the MDU, where the Head of Maintenance/ Infrastructure Director is accountable, to maintain accurate data in Ellipse (an asset register tool) and update year to date volume actuals. NR's Activity Based Planning and Reporting Policy V0.4 sets out the procedure for using ABP to plan and report

maintenance volumes and the associated cost. It refers to planning in the context of ABP and how it links to the Ellipse and Hyperion systems.

2.3 Organisational structure

2.8 Each of NR's 14 Routes has either a Head of Maintenance or Infrastructure Director who is responsible for the delivery of maintenance and compliance with standards. At the time of writing this report, post-PPF, Regions have adopted different approach to organisational structures; there are two generic high-level organisational structures, as shown in Figure 2.1 and Figure 2.2.

Figure 2.1 Maintenance organisational structure: Scotland & Wales and Western (W&W)

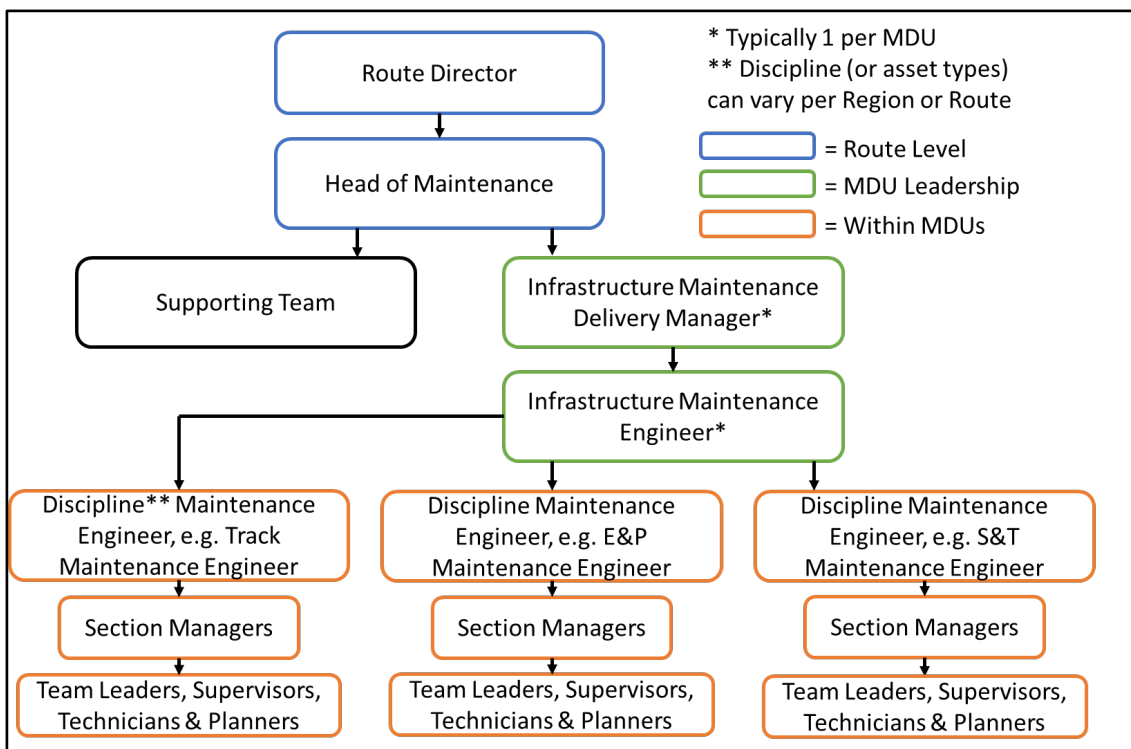
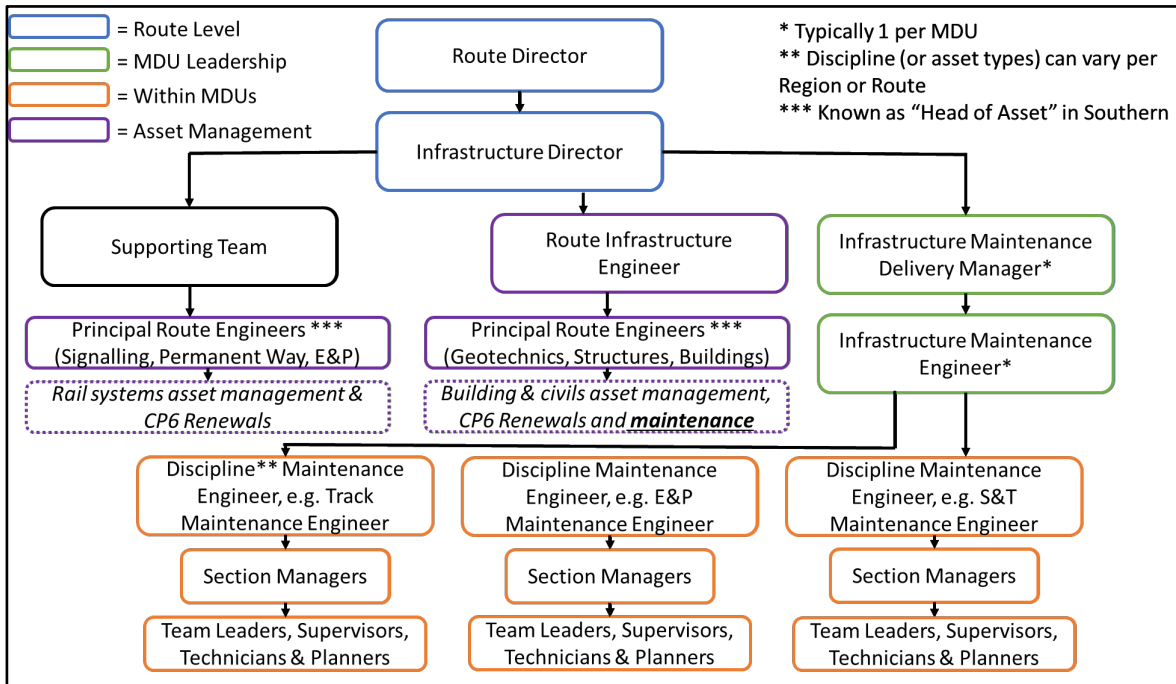


Figure 2.2 Maintenance organisational structure: Eastern, North West & Central (NW&C) and Southern



2.9 A summary of responsibilities for each role is shown below:

- (a) **Route Director:** responsible for operations, maintenance and renewals in their respective Routes including the management of day-to-day delivery of train performance and relationships with their local train operating companies.
- (b) **Infrastructure Director:** accountable for CP6 delivery which includes responsibility for leading and directing the development, optimisation and safe implementation of the Route Asset Management Plan (RAMP) to meet customer requirements and deliver route and network targets. The Infrastructure Director acts as a client for all route project delivery (maintenance, renewal and enhancement) throughout the project lifecycle.
- (c) **Head of Maintenance:** Responsible for the CP6 delivery of maintenance within their Route. This includes the maintenance activities delivered by the MDUs only, to meet route targets.
- (d) **Route Infrastructure Engineer:** responsible for the whole engineering life cycle of infrastructure assets within the Route, including maintenance, renewals and enhancements and spanning from current performance to the business planning horizon. This includes managing development and delivery of the RAMP to meet Route and network objectives.

(e) **Principal Route Engineer or Route Head of Asset – Rail Systems:**

These roles support the Route Infrastructure Engineer and specialise in just one asset type (e.g. track or signals)

- (i) **Principal Route Engineer** responsible for the whole life cycle of their discipline assets within the Route from the maintenance to enhancement and from current performance to the business planning horizon. This includes the management of development and delivery of the discipline RAMP to meet Route, Region and network objectives.
- (ii) **Head of Asset** leads the delivery of their disciplines RAMP for those assets within a defined geography to a medium-term horizon, this includes provision of a comprehensive support service to the Infrastructure Director and maintenance teams focussed on specified MDUs and provide a route based, single point of contact, engineering support service to maintenance teams for their discipline.
- (f) **Infrastructure Maintenance Delivery Manager (IMDM):** responsible for leading and directing the delivery of maintenance and project work within the MDU to standards and budget. This includes the continual drive for improvement in safety, business performance and efficiency. This role includes the scoping and instruction of in-year reactive renewals.
- (g) **Infrastructure Maintenance Engineer (IME):** responsible for leading and directing the maintenance engineering team in the efficient delivery of inspection, maintenance and project related works for all infrastructure assets to meet relevant standards. The roles include a requirement to drive culture transformation for safety and asset performance creating continual improvement and deliver safety, compliance and performance strategies to deliver a compliant, well performing asset.
- (h) **Maintenance Engineer:** Inspections, maintenance, and faulting; supported by Assistant Engineers, Sections Managers, Team Leaders, etc.

2.10 In addition to the above, the Director of Engineering and Asset Management (DEAM) and their team sets policy and application of engineering standards for the Region; develops long term asset policies and strategies; and provides specialist engineering expertise, as required.

2.11 Regions are supported by a network wide team, the Technical Authority for NR. Focussing on train performance and safety through technical leadership, assurance

and expert support across asset management, engineering, maintenance, etc. This includes, for example, the Head of Maintenance, Principles & Standards who is the company and industry expert for maintenance, their role includes direction of the development of maintenance strategy within the context of the railway system.

2.4 MDU locations

2.12 A list of MDU locations is provided in Table 2.2.

Table 2.2 MDU locations

Region	Route	MDU
Eastern	Anglia	Ipswich
		Tottenham
	East Midlands	Romford
		Bedford
North and East	Derby	
	Central Leeds	
North West & Central	North and East	Central Sheffield
		North Middlesbrough
	East Coast	North York
		North Darlington
		North Newcastle
		South Doncaster
	North West	South Kings Cross
		South Peterborough
	North West	Lancashire & Cumbria
		Liverpool
Central	Manchester	
	Saltley	
West Coast South	Central	Sandwell & Dudley
	West Coast South	Bletchley
		London Euston
Stafford		

Region	Route	MDU
Scotland	Scotland	Edinburgh Glasgow Motherwell Perth
	Kent	Ashford London Bridge Orpington
Southern	Sussex	Brighton Croydon
	Wessex	Wessex Inner Wessex Outer
Wales & Western	Wales	Cardiff Shrewsbury
	Western	Western Central Western East Western South

3. Findings

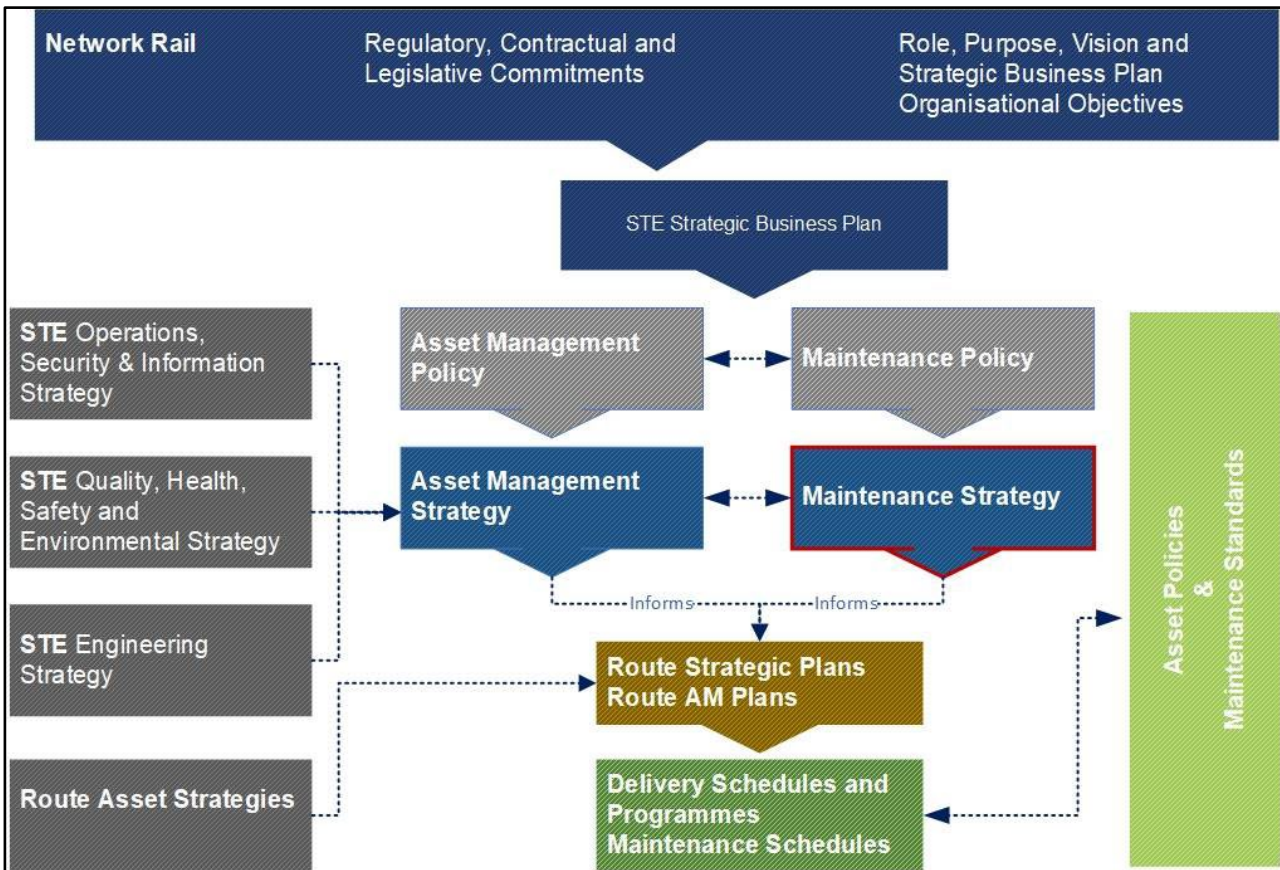
3.1 Document review

- 3.1 This section of the report summarises the information provided by NR and highlights ORR's observations of any areas for improvement. The aim of this section is to identify whether there is a 'line of sight' between NR policies, strategies and standards, and any observations within respect to NR's approach to maintenance within the Regions.

3.2 Maintenance policy and strategy

- 3.2 The Technical Authority (located within the NR 'centre') referred ORR to both the Maintenance Policy (v1.0 dated September 2018) and Maintenance Strategy (v2.8 dated February 2020). However, it should be noted that the Maintenance Policy has now been superseded because of the PPF programme. Each Region is now responsible for preparing their own Regional Strategic Business Plan, and therefore, determining its approach for the delivery of maintenance. Whilst the Technical Authority now only provides assurance and expert support via the Maintenance Strategy.
- 3.3 The Maintenance Strategy highlights the development of tools, processes, systems, information, and technology to enable the devolved Routes to become safer, more efficient and effective, whilst showing alignment with ISO 55000:2014 requirements. It goes on to detail a series of centrally led initiatives that aim to provide clarity over accountabilities and responsibilities between the Technical Authority and the devolved maintenance organisations. The document sets out the framework for how the maintenance organisations within the Technical Authority and the Routes work together. It should be noted that this strategy applies to all operational assets maintained by NR. An extract from the Maintenance Strategy document is provided in Figure 3.1, it highlights the 'line of sight' between the Technical Authority and Route planning. In general, 'line of sight' was demonstrated by the Regions and Routes (refer to Section 3.6.1), where this was supported by interviews with Routes (refer to Section 3.8).

Figure 3.1 Extract from Maintenance Strategy v2.8²



3.2.1 Risk-based maintenance (RBM)

3.4 In summary, risk-based maintenance is a maintenance strategy whereby the maintenance processes should be planned based on failure risks, effects, and calculated costs. Within CP6 NR aims to embed risk-based maintenance principles in standards across all disciplines, the aim of which is to optimise life cycle asset cost and reduce service affecting failures resulting from asset condition. At the start of CP6 NR’s maintenance practice was predominantly based on historic time-based intervals and now (3.5 years into CP6) this largely remains the case. The Maintenance Strategy indicates that it is gradually moving to a semi-predictive, risk-based approach for some asset types and geographic areas.

3.2.2 Performance management framework

3.5 The Maintenance Strategy states the introduction of a “*Performance Management Framework underpinned by a top-down and bottom-up defined set of Performance indicators and Key Performance Indicators*” in CP6, that will enable measurement

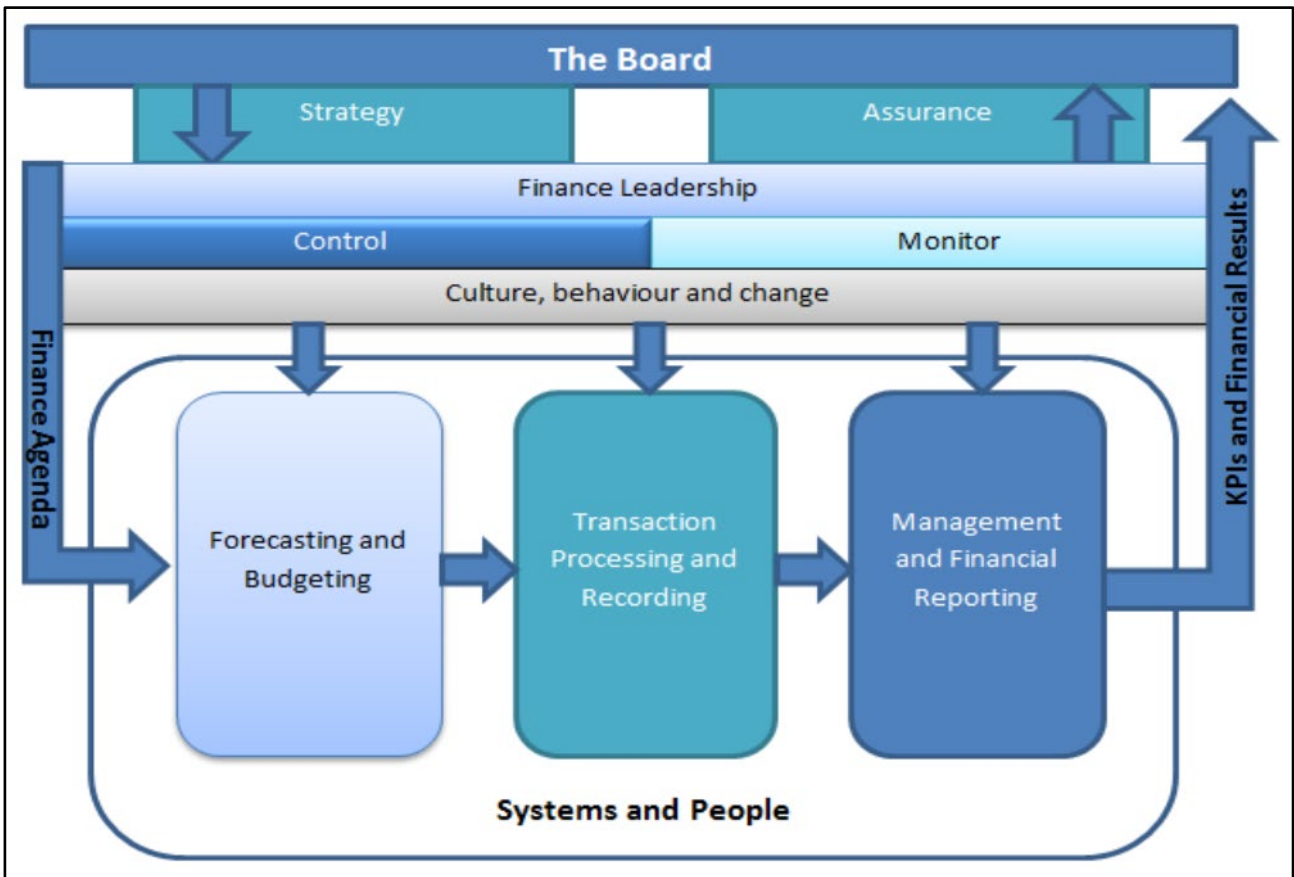
² STE, is now known as the Technical Authority.

of success and progress against the objectives set out in the Strategy. However, due to the implementation of the PPF programme the framework was not introduced by the Technical Authority, instead the responsibility was devolved to the Regions and Routes. For Regional approaches, refer to Section 3.6.2.

3.3 Maintenance finance

3.6 Section 2 of this report has summarised NR's maintenance budget for CP6; held at Route level by the Infrastructure Directors or Heads of Maintenance (refer to Figure 2.1 and Figure 2.2).

3.7 It should be noted that NR's Financial Control Framework (FCF) applies to all internal controls and governance measures within NR, where NR's Accounting Officer is personally accountable to Parliament for: "*safeguarding the public funds for which he or she have charge; for ensuring propriety, regularity, value for money and feasibility in the handling of public funds; and for the day-to-day operations and management of Network Rail*". The FCF is made up of a number of policies, the purpose of the framework is to inform the individual policy holders of their responsibilities and provide a guide to compliance with Managing Public Money. The FCF is shown in Figure 3.2:

Figure 3.2 NR's Financial Control Framework (FCF)

3.4 Improvement areas

- 3.8 At the time of writing this report, NR are exploring a number of activities which could provide improvements for the Routes; some of these activities will form part of NR's maintenance reform programme. These activities range from adopting new technologies, improving existing tools and implementation of new systems.
- 3.9 Furthermore, a number of projects relating to maintenance are planned to enter into delivery in CP7; this includes a track robotic inspection and maintenance vehicle. NR's CP6 Research & Development (R&D) Portfolio projects includes Trackwater 2.0³ and development of the current Switch & Crossing (S&C) Multi-Purpose vehicle (MPV)⁴, which are both intended to benefit maintenance.

³ To enable drainage assets to be maintained in a more efficient risk-based manner using sensors and predictive analytics to target and schedule maintenance activity where and when it is needed. The sensors will detect rising flood water and/or build-up of silt to provide analysis to the host Route to improve targeting of scheduling of maintenance activity.

⁴ To allow collection of additional asset data to reduce the amount of manual inspection and measurement.

3.5 Asset management

- 3.10 In accordance with the requirements of ISO 55000:2014 NR utilise Asset Management Plans, in particular, Route Asset Management Plans (RAMPs). Historically, the RAMP process was a text-based document per MDU, however, Regions in NR recognised the document was seldom used and difficult to update and maintain. As a result, some Regions adopted a new process to modernise asset management planning using a Microsoft PowerBI user interface.
- 3.11 The purpose of the RAMP is to allow the strategic planning process to come together with the delivery mechanism, to deliver business objectives. It defines capital investment to build new assets and renew life expired assets; and operational maintenance regimes to extend the life of assets. However, it is important that all relevant parties (i.e. Route Asset Managers (RAMs) and MDUs), maintain the plan in a live state to realise the benefit.
- 3.12 The RAMP includes:
- Centrally defined corporate/ regulator objectives, i.e. delivery plan for CP6.
 - Regionally defined objectives, i.e. strategic plan.
 - MDU defined objectives, i.e. discipline strategies.
 - Asset performance history, i.e. reporting relating to performance of assets.
 - Maintenance volumes, i.e. reporting relating to progress of planned versus actual work.
 - Maintenance costs, i.e. finance reporting.

3.6 Regional and Route approaches

- 3.13 In terms of Regional maintenance organisations, refer to Figure 2.1 and Figure 2.2, where each of NR's Routes has either:
- Infrastructure Director; or,
 - Head of Maintenance (in Scotland's Railway, Wales Route and Western Route only).

who is responsible for the delivery of maintenance and compliance with standards.

3.6.1 Regional (and Route) strategy and plan

3.6.1.1 Eastern

3.14 Eastern Region provided the Eastern Regional Strategic Plan for CP6 dated February 2021. This includes the maintenance strategy for each Route, where North & East, East Midlands and East Coast will aim to deliver two core initiatives to significantly improve delivery of maintenance:

- Safe and effective working: already implemented in certain parts of the Region, this includes, 'stable, planned cyclical maintenance activity' aiming to move as much maintenance as possible into available possession access; and 'smarter rostering' which designs a roster that fits the access opportunities that exist. NR state that it has led to decreases in backlog and increased work completed on time by helping to plan maintenance work more effectively around available access windows.
- Extending the use of Intelligent Infrastructure (II) including Remote Condition Monitoring (RCM): in CP5 these Routes installed RCM equipment to points, track circuits and a number of other different asset types. By planning to install more equipment, they plan to improve usage of this equipment through 'Predict and Prevent' maintenance which is made up of: development of a MDU 'dashboard' to centralise all information; further rollout of RCM equipment; and, training and support.

3.15 In Anglia, the strategy includes delivery of Plain Line Pattern Recognition (PLPR) to reduce manual visual track inspections; and use of an automated corporate rostering tool linked to payroll to deliver efficiencies based on maximising rosters to terms and conditions and reduced administration in completing manual timesheets.

3.6.1.2 North West & Central

3.16 North West & Central Region provided a summary of CP6 Asset Strategies which includes details of the maintenance strategy for each asset type. For each asset this includes:

- Track:
 - reduced track patrolling following full roll out of PLPR and RBM; and,
 - increase in S&C stoneblowing roll out of new multi-purpose fleet enables greater volume delivery.
- Signalling:

- a significant proportion of signalling equipment is maintained using RBM regimes, CP6 to include a roll out of earth monitoring equipment cases to add to the condition monitoring systems already in place.
- E&P
 - mostly unchanged from CP5, except when undertaking condition monitoring to control the risk of renewal deferral; and,
 - embedment of a new suite of working instructions prior to CP6 resulting in a change of maintenance regime for signalling power assets.
- Drainage & Off-Track
 - improving asset data knowledge, to enable better decision making on asset interventions and to understand their impact on overall asset condition. This improvement is achieved by introducing a dedicated Drainage and Off-track team.

3.6.1.3 Scotland

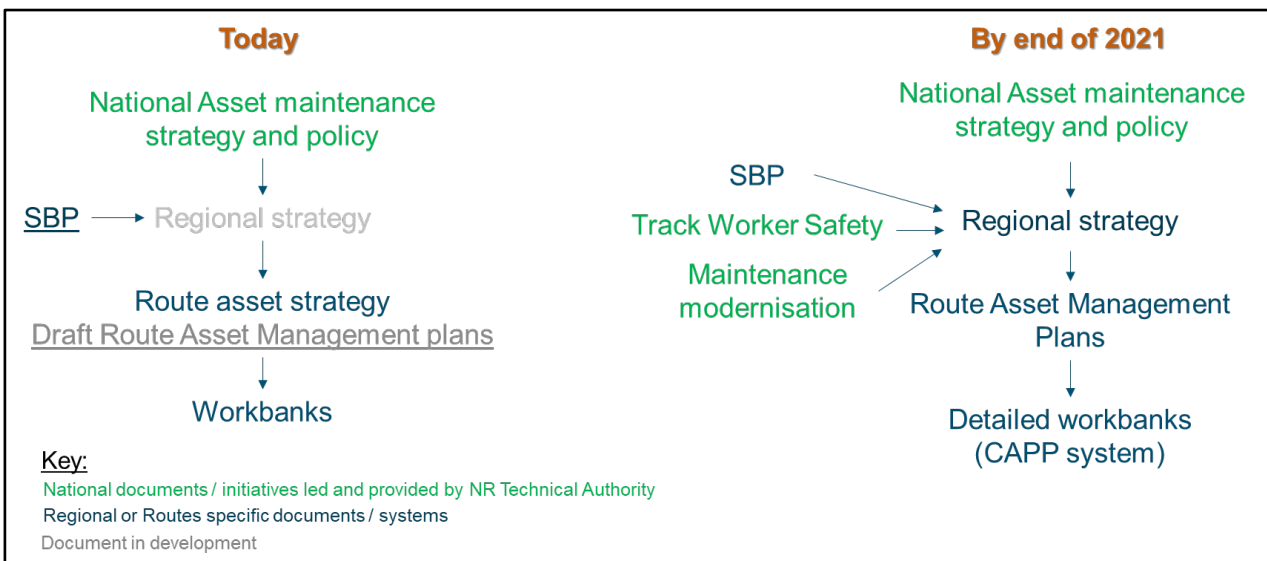
3.17 Scotland Region provided Scotland's Railway Strategic Plan dated March 2020. This includes details of a maintenance strategy, for example, recognition of behavioural change; as well as delivery of planned maintenance volumes to better exploit systems, information and technology to deliver against asset management performance measures. As well as a focus on major vegetation clearance and increasing off-track maintenance resource. The document refers to a data-driven plan based on "Predict and Prevent" maintenance regime, utilising RCM, RBM, train-borne measurement and other technologies to drive the correct intervention at the correct time. Scotland also provided an indication of the RAMP process and outline of the content, but no specific RAMPs were provided.

3.6.1.4 Southern

3.18 Southern Region provided the Southern Strategic Plan dated May 2021; indicating that asset management plans aim to reduce the amount of reactive maintenance, transitioning to more focused, proactive, preventative maintenance. The maintenance strategy highlights the increase in planned maintenance, as well as reactive maintenance expenditure in areas historically impacted by renewals deferrals; and reiterates the shift to targeted preventative maintenance. It includes extended use of RBM and train-borne monitoring

- 3.19 In addition, each Route provided the RAMP, which primarily focuses on strategies to deliver maintenance volumes including specifically for each line (e.g. Three Bridges to Arundel Mainline, etc.). It includes plans for proactive monitoring and aftercare of drains and systems susceptible to flooding in location such as West Croydon and Oxted Tunnel and focus on the root causes for points heating failures during winter months to develop and implement a suitable maintenance strategy.
- 3.20 Furthermore, Southern Region provided a figure highlighting plans for revision of key documentation, refer to Figure 3.3.

Figure 3.3 Southern Region asset management key documentation



3.6.1.5 Wales & Western

3.21 Wales & Western provided the Regional Maintenance Strategy dated January 2021, it highlights themes: safety, efficiency, data, people and sustainability. Furthermore, it details the key activities under each theme for CP6, CP7 and CP8, highlighting target outcomes, planning, etc. sub-activities. The strategy includes example case studies for each theme, for example:

- **Safety:** use of robotics for train and track maintenance, servicing and repairs; to take over high-risk tasks – due to commence CP7.
- **Efficiency:** ‘Predict and Prevent’ performance-based maintenance; complementing routine servicing of assets with trend analysis based on data and mechanical conditions of the actual asset, allowing for real-time monitoring of maintenance requirements.

- 3.22 The Wales Route Strategic Plan and Western Route Strategic Plan (both dated March 2019) were provided. The documents provided high-level information with respect to Operations, Maintenance and Renewals budgets, whilst complementing and further detailing maintenance plans in accordance with the Regional Maintenance Strategy, i.e. highlighting locally driven measures such as introducing a RBM regime for Paddington to Reading to respond to a reduction in maintenance access.

3.6.2 Performance management framework

- 3.23 There is no scorecard measure specifically for maintenance, however, maintenance performance can be inferred from other scorecard measures such as Service Affecting Failures (SAFs) and the Composite Reliability Index (CRI). Furthermore, NR measure Public Performance Measure (PPM), a percentage of train which arrive at their terminating station 'on time' and use it as an inference of maintenance performance.

3.6.2.1 Eastern

- 3.24 It should be noted that the Eastern maintenance strategy makes no reference to a performance framework, and Eastern did not provide details of a framework, or similar, as part of the RFI.

3.6.2.2 North West & Central

- 3.25 NW&C provided examples of their CP6 Year 3 SAF and CRI scorecard as well as MDU specific SAF targets as indicators of maintenance performance.

3.6.2.3 Scotland

- 3.26 Scotland provided CRI reports for CP6 Year 1 and 2 P13, as well as periodic dashboards detailing relevant measures, as indicators of maintenance compliance. The periodic dashboards provided data on Temporary Variations (TVs) (expired, due to expire, rejected), Engineering Verifications (EVs), Special Inspection Notices (SINs), non-compliances to standards, etc.

3.6.2.4 Southern

- 3.27 Southern provided examples of Periodic Business Reviews (PBRs) for: Southern, Sussex and Wessex. These PBRs included monitoring of MST and work arising (i.e. reactive) backlog, operating expenditure (OPEX), actual volumes, access planning performance, vacancies, disciplinary and grievance cases, waste levels, energy use, environmental incidents, and, compliance and assurance (i.e. with respect to inspection compliance).

3.28 Furthermore, Southern provided Route Investment Review Group (RIRG) presentations from the Head of Asset (Track) and Croydon MDU. These presentations included monitoring of poor track geometry, serious rail defects and hot weather; and, points failures, signalling failures, track faults and traction power failures, respectively.

3.6.2.5 Wales & Western

3.29 Wales & Western provided an example Train Service Delivery for a period in CP6, this includes details of delay minutes, poor track geometry, and MST and work arising (i.e. reactive) backlog.

3.30 Refer to Section 3.8.2.3 with respect to discussions as part of interviews with Heads of Maintenance and Infrastructure Directors.

Observation 1: Type of maintenance performance data

As part of the RFI process, Regions submitted maintenance performance data that fell into two general themes:

- Scorecard/ performance type measures, i.e. SAFs, CRI, etc.
- Standards and process compliance.

In both types of data, the effectiveness of maintenance activities was inferred, as opposed to directly linking cause and effect. For example, a reduction in asset failures could be inferred as being due to successful maintenance – but it could also be due to better weather, or less trains running.

(Based on Section 3.6)

3.7 Finance

3.7.1 Cost

3.31 Section 2.2 on '2.2 Maintenance costs & budget' provides a summary of the costs associated with maintaining all infrastructure assets and notes that the maintenance budget is held at Route level, by the Infrastructure Director or Heads of Maintenance. Within each Route the budget is split between each MDU, as well as a central budget which covers management, etc. at a Route level.

- 3.32 Each Route is supported by finance business partners, the roles of the finance teams is to act as key business partners to the maintenance delivery teams. Its responsibilities include monitoring and reporting financial position of maintenance, valuing and challenging business decisions (including development business cases), as well as aiding with the identification, quantification, monitoring and assurance of efficiencies being delivered.
- 3.33 To support these activities, budgets are issued to MDUs at the start of each year (as per the SBP) and supplemented with periodic reporting to facilitate understanding of delivery against financial targets. Detailed quarterly forecasting is undertaken to understand any plan changes, emerging risks and opportunities; developed at a MDU level before being progressed through different levels of review within the Region including Infrastructure Director or Head of Maintenance, and Route Director. This is all undertaken in accordance with the Finance policies detailed in Section '3.3 Maintenance finance'.

3.7.2 Volumes

- 3.34 Within each Route maintenance is managed in a similar manner, there is a quarterly volume review process that is aligned to the ABP and RF processes.
- 3.35 The volumes of activity are divided into three categories:
- Cyclical (i.e. MST): driven by asset and frequency, and only impacted by a change to standards, agreed RBM regime or asset changes (i.e. renewals or poor condition, etc.).
 - Target: determined by the asset management teams, for example, certain key track and off-track volume targets are set by the Route/Region asset manager to comply with NR policies. If they need to be changed, for example if the MDU has delivery issues, then the change would need to be agreed with the asset management teams.
 - Estimate: additional volumes which the MDU predicts it will need to do (i.e. the total number of assets they maintain), history of unplanned work in previous years, and trends (e.g. work to clean up after flooding is becoming more frequent in some MDUs).
- 3.36 Typically, MDUs proposed a bottom-up budget, which is then compared against the Route's top-down budget, an iterative process is undertaken until an agreed volume (and cost) is reached.

3.8 Route interviews

3.37 In September 2021, a Head of Maintenance or Infrastructure Director from each Region was selected for interview. The aim of the interviews was to identify alignment between the documentation provided via the RFI process, as well as identify themes and observations pertinent to the understanding of NR's approach to maintenance.

3.38 All Regions apart from Scotland have multiple Routes and the one Head of Maintenance or Infrastructure Director was selected at random with no bias towards a particular Route. The following Routes were interviewed:

- Anglia Route (Eastern Region);
- North West Route (NW&C Region);
- Scotland Route (Scotland Region);
- Kent Route (Southern Region); and,
- Wales Route (W&W Region).

3.39 For interview questions, refer to Appendix B: Head of Maintenance/ Infrastructure Director Interview Framework.

3.40 In general, the information gathered from the interviews correlated with the information provided as part of the RFI process. However, this is no evidence of implementation. Statements made by NR in the interviews were generally consistent with the NR policies and strategies we received through the RFI - and they provided some additional details.

3.8.1 Themes

3.41 A number of themes were identified as part of the interview process where either:

- additional information was provided over and above that of the RFI process;
- a common observation was identified between more than one Route; or,
- discussions included a topic of interest.

3.42 all of which supports further understanding of NR's approach to maintenance.

3.8.2.1 Route leadership

- 3.43 Section 2.3 '2.3 Organisational structure' provides a summary of two generic high-level organisational structure for maintenance delivery in the Routes. A fundamental difference between each structure is the introduction of the Infrastructure Director role in Eastern, North West & Central and Southern Regions as a result of the PPF transformation programme. In Scotland and Wales & Western, maintenance delivery is the responsibility of Heads of Maintenance for each Route.
- 3.44 As shown in Figure 2.1 and Figure 2.2, the Routes with Infrastructure Directorship inherently include both asset management and maintenance under the same leadership. This organisational structure was reinforced during interviews with both Infrastructure Directors and Heads of Maintenance.
- 3.45 Infrastructure Directors were able to provide a holistic, whole system based response to questions relating to collaboration and communication between asset management and maintenance delivery, for example, North West Route highlighted the enhanced ability to plan joint renewal and maintenance access opportunities. In contrast Heads of Maintenance indicated that maintenance delivery is one of many mechanisms available to the asset management teams and recognised that Heads of Maintenance do not have oversight of all asset management activities.
- 3.46 Review of evidence provided as part of this study did not suggest that one organisational approach provides better performance, safety and efficiency than the other.

Observation 2: Route leadership

Infrastructure Directors and Heads of Maintenance are responsible for the delivery of maintenance and compliance with standards. However, Infrastructure Directors responsibilities also include delivery and compliance of all asset management, whereas Heads of Maintenance provide a mechanism for delivery of maintenance for asset management teams.

. Infrastructure Directors were able to respond to questions with a holistic, whole system-based approach. For example, they provided responses based on asset management as a system, rather than the process of only maintenance; demonstrating the fundamental 'alignment' as detailed in ISO55000:2014. It should be noted that review of evidence provided as part of this study did not suggest that one organisational approach provides advantages to the other.

(Based on Section 3.8.2.1).

3.8.2.2 Access

3.47 During all interviews the ability to access the railway was cited as a key requirement for maintenance activity. A number of challenges were acknowledged across all Regions with respect to access:

- the Track Work Safety (TWS) programme, i.e. including but not limited the elimination of ‘red-zone’ or ‘Open Line’ working, would have an impact on the type of access available for maintenance activity. For example, some maintenance activities require daylight working hours, i.e. working at height on a telecom mast.
- lack of holistic oversight with respect to working with Train Operating Companies (TOCs) and Freight Operating Companies (FOCs), in particular where:
 - FOCs can submit Very Short-Term Plans (VSTPs) to access and use the railway.
 - FOCs have ‘ghost paths’ where the line is made available to the FOC, but it ultimately not used.

3.48 It should be noted that Scotland eliminated the majority of ‘open line’ working within the last five years; demonstrating that the challenge of access can be met.

3.49 NR acknowledged there is a need to both maximise access, as well as measure the effective use of that access. Mass transit railways are known to have reactive response times of minutes as opposed to hours. In Anglia, train frequency in some areas is comparable to that of high-frequency sections of Crossrail, where the Route is further challenging its response times to reflect that of a mass transit system.

3.50 ORR’s Railway Safety Directorate issued a letter to NR in July 2019 with respect to inspections of its track worker protection arrangements carried out in 2018 and 2019. The letter clarifies that ‘red-zone’ working is not required to be eliminated, rather that the end point should be to significantly reduce the amount of ‘red zone’ working and virtually eliminate working with unassisted lookout protection.

3.8.2.3 Performance management and maintenance effectiveness

3.51 The Section ‘3.6.2 Performance management framework’ and Observation 1 highlighted that two general types of performance management data was provided

by NR as part of the RFI process: scorecard data and compliance data, where the effectiveness of maintenance activities is inferred from lagging indicator data. Interviews with Infrastructure Directors and Heads of Maintenance corroborated this.

3.52 Further, interviewees indicated that whilst the Technical Authority requires a periodic report with indicators such as backlog, asset failures, etc. from all Routes, the Technical Authority does not define further what should be considered to determine maintenance performance, including maintenance effectiveness. This is due to the devolved nature of the Regions and Routes, where responsibility for maintenance delivery is within the individual Route.

3.53 It should be noted that Routes are undertaking performance management independently, using dashboards, metrics, indicators, etc. This performance management method is informal and based on:

- the individual and valuable experience of individuals within the maintenance organisation of a Route, i.e. Infrastructure Director/ Head of Maintenance, IMDMs and IMEs.
- historical reporting legacies, i.e. metrics or indicators which are, potentially, no longer relevant or required.

3.54 Whilst the adoption of this type of independent management allows for the utilisation of experienced professionals, should an individual no longer be able to fulfil a role, their knowledge and experience could be a significant loss to the organisation, and this does not demonstrate a mature asset management system. Furthermore, there is a lack of resilience with respect to the type of data being used, why it is being used and what it is being used for.

3.55 Further, if each Route within a Region adopts a varying approach, it can be difficult to compare Routes; where the nature of the independency can limit collaboration and best practice sharing amongst Routes, as well as Regions.

3.56 All interviewees responded to questions relating to productivity measurements in a similar manner, citing:

- **Productivity:**
(number of norm hours worked) / (number of hours available)
- **Planning level:**
(number of planned norm hours) / (number of hours available)

- **Plan attainment:**
(number of norm hours worked) / (number of norm hours planned)

- 3.57 Interviewees separately highlighted the high volume of indicators and metrics that were generated at either a national, Regional or Route level. Highlighting that the data was provided at various times within a week and period, often nullifying or voiding data received only hours beforehand. This results in the inability to manage information held within the data in a reasonable way. For example, as data is provided with no standardised 'cut-off', the information to inform decision making can be unclear, and the success of interventions or improvements can be difficult to track.
- 3.58 It was highlighted that a lot of these measures are lagging indicators, confirming the action or state, whereas there is limited use of leading measures which could be used to prevent an unfavourable action or state, or monitor improvement of a favourable state. For example, measuring the number of asset failures, or the number of shifts spent remedying failures are both lagging indicators. Whereas, measuring the condition of assets is a leading indicator and provides an understanding in advance of when an asset is going to perform adversely, so that resources can be assigned to maintain it.

Observation 3: Informal performance management at Route level

Routes are undertaking performance management independently using informal methods based on:

- individual experience; and,
- metrics or indicators, and due to their informality, potentially, no longer relevant or required.

Relying heavily on individual experience lacks maturity within the asset management system, should an individual no longer be able to fulfil a role, their knowledge and experience could be a significant loss to the organisation. Furthermore, there is a lack of resilience with respect to the type of data being used, why it is being used and what it is being used for.

Further, the independency is causing a barrier to collaboration and sharing of practice between Routes and Regions. If each Route within a Region adopts a varying approach, it

can be difficult to compare Routes; where the nature of the independency can limit collaboration and best practice sharing amongst Routes, as well as Regions.

(Based on Section 3.8.2.3)

Observation 4: Delivery and accessibility of performance data

Different data to manage maintenance performance is provided at various times within a week or period, often nullifying or voiding data received only hours beforehand. This limits the ability to manage and utilise the data in a reasonable way.

A significant number of measures are lagging indicators, while there is a limited use of leading measures which could be used to better inform maintenance delivery.

(Based on Section 3.8.2.3)

3.8.2.4 Reflection

3.59 All interviewees were asked about their approach to reflection by considering the following questions:

- How is actual/historical data used when planning maintenance activities? i.e. from historical actuals, rail traffic/ asset use, etc.?
- How do you compare performance of Year 1 to Year 2 to Year 3, etc. (i.e. how do NR holistically review performance and lessons learnt)?

3.60 These questions were identified as a result of business-as-usual activity where it was observed that NR prepare plans and implement those plans, but there are examples where NR do not retrospectively review plans to recognise if they were appropriate, prior to developing further strategies and plans.

3.61 For example, it was identified that NR decommissioned a system used to collect actual traffic data at MDU level, known as 'ACTRAFF'. It was decommissioned in Spring 2020 due to a number of issues which meant it was not producing accurate results (i.e. the map had not been updated since 2009). As a result, ACTRAFF could only acquire 80% of the known traffic movement. Further, prior to

decommissioning the system, only four requests for the data were made in an 18 month period, this recognises that limited use of actual traffic data was being used.

- 3.62 The system currently used by NR is 'NETRAFF' which considers planned (or 'lookahead') passenger and freight paths. Those planned paths plus other information (i.e. line speed) is used to determine the Track Category which is used by the MDU's to determine the required maintenance activities on the track. Where ACTRAFF provided actual data, NETRAFF provides an indication for future data is used to develop future plans. It should be noted that as NETRAFF is a forward planning tool, it takes account of 'ghost paths' where, for example, a freight path might be planned once per week, but only actually uses the path once per month.
- 3.63 A new system is in development to replace both ACTRAFF and NETRAFF, where the aim of the new system is to record actual traffic as well as being used as a forecasting/ planning tool. Implementation of the new system is due in April 2022.
- 3.64 NR indicated that in the absence of the ACTRAFF system NR do use historical trends to develop future plans. It should be noted that as the ACTRAFF system was decommissioned in Spring 2020, the traffic level changes due to the COVID-19 pandemic are not captured, which could result in inaccurate planning inputs and/or introduce inefficiencies into future plans.
- 3.65 The identification of lack of actual data highlighted the concern that NR plan, undertake but lack reflection to understand if the plan developed was successful; e.g. whilst it may have been implemented, could it have been better?, etc.
- 3.66 Interviewees highlighted the use of historical data to predict future trends, i.e. rate of track deterioration/ defects, whilst valuable data, it lacks an understanding of variations in actual freight and passenger traffic which results in different attrition rates.
- 3.67 Whilst year on year performance monitoring is considered, it does not recognise if that plan could have been improved, and therefore, outcomes improved.

Observation 5: Lack of reflection

NR develop plans based on historical data and implement those plans accordingly, however, plans are not retrospectively reviewed to ascertain if they could have developed differently to provide improved outcomes.

This includes, for example, an understanding of the suitability of the data used to develop those plans, i.e. traffic data, actual or predicted, and if it was realised.

(Based on Section 3.8.2.4)

3.8.2.5 Benchmarking

3.68 The interviews highlighted that no formal benchmarking between Regions or Routes was undertaken. However, examples of informal benchmarking between Track Maintenance Engineers (TMEs), Section Managers (SMs), etc. was recognised, in part as an informal method of best practice knowledge sharing. However, this was not formally recorded.

3.8.2.6 RBM

3.69 The implementation and use of RBM (Reliability Based Maintenance) is a common theme within Regional strategies and plans, refer to Section 3.1 '3.1 Document review'. During interviews the use of RBM was highlighted but not discussed in detail. For example, the extent to which each Route and/or asset type is currently adopting an RBM approach is unknown. However, it was notable that relatively newer assets i.e. signalling and electrification equipment tended to be more progressed in adopting RBM. An example of this includes NR's Reliability Centred Maintenance of Signalling Equipment (RoSE).

3.8.2.7 Culture

3.70 The Head of Maintenance in Wales highlighted the role of Programme Manager for Culture Change within the Route. Acknowledging that maintenance culture has changed significantly in the last ten years, the Route identified the benefits of combining leadership with organic culture change to improve maintenance within the Route.

3.71 Wales Route's recently published 'Transforming Maintenance in Wales and Borders' culture strategy document details its approach to maintenance culture. It includes details of programmes and activities, in-progress and planned, for the remainder of CP6. The document primarily aims to improve safety, but there are inherent benefits associated with staff welfare and competence too.

3.72 Examples of initiatives include a Maintenance Forum, held quarterly where all the senior leaders of the maintenance organisation meet, speakers are invited to present fresh, new ideas to improve maintenance. This is supplemented by a Section Manager and Engineer forum (held periodically) to provide a platform for shared experience and best practice. ORR acknowledge this important initiative

that represents best practice and would recommend other Routes and Regions consider the benefits they could gain.

4. Conclusions

4.1 This report provides a high-level summary of NR's approach to maintenance and establishes a more detailed understanding into the current state of that approach, to allow ORR to monitor plans and activities more effectively. Further, it identified a number of areas for improvement.

4.2 A 'line of sight' was broadly identified between NR policy and strategies and Regional/ Route policy and strategies with respect to maintenance; although it should be acknowledged 'line of sight' has diminished since the PR18 final determination. This was primarily evidenced by provision of various maintenance strategy documentation. However, it should be noted that Regions responded via the RFI process with varying responses:

- Wales and Western: a Region specific maintenance strategy document.
- Southern: an overall strategy for the Region, which includes maintenance and RAMPs.
- Scotland: an overall strategy for the Region (i.e. Route), which includes maintenance and an outline of RAMP content.
- Eastern: an overall strategy for the Region, which includes Maintenance.
- North West & Central: individual asset specific management strategies.

4.3 The interviews undertaken as part of this study provided an understanding of compliance and alignment with those strategies. In addition to the documentation received via the RFI process, the interviews highlighted a number of observations pertinent to the understanding of NR's approach to maintenance; refer to Table 4.1.

Table 4.1 Summary of observations

No.	Observation	Details
1	Type of maintenance performance data	<p>As part of the RFI process, Regions submitted maintenance performance data that fell into two general themes:</p> <ul style="list-style-type: none"> ● Scorecard/ performance type measures, i.e. SAFs, CRI, etc. ● Standards and process compliance.

No.	Observation	Details
		<p>In both types of data, the effectiveness of maintenance activities was inferred, as opposed to directly linking cause and effect. For example, a reduction in asset failures could be inferred as being due to successful maintenance – but it could also be due to better weather, or less trains running.</p> <p>(Based on Section 3.6)</p>
2	Route leadership	<p>Infrastructure Directors and Heads of Maintenance are responsible for the delivery of maintenance and compliance with standards. However, Infrastructure Directors responsibilities also include delivery and compliance of all asset management, whereas Heads of Maintenance provide a mechanism for delivery of maintenance for asset management teams.</p> <p>Review of evidence provided as part of this study did not suggest that one organisational approach provides advantages to the other, however, Infrastructure Directors were able to respond to questions with a holistic, whole system-based approach. For example, they provided responses based on asset management as a system, rather than the process of only maintenance; demonstrating the fundamental 'alignment' as detailed in ISO55000:2014.</p> <p>(Based on Section 3.8.2.1)</p>
3	Informal performance management at Route level	<p>Routes are undertaking performance management independently using informal methods based on:</p> <ul style="list-style-type: none"> ● individual experience; and, ● metrics or indicators, potentially, no longer relevant or required. <p>Relying heavily on individual experience lacks maturity within the asset management system, should an individual no longer be able to fulfil a role, their knowledge and experience could be a significant loss to the organisation. Furthermore, there is a lack of resilience with respect to the type of data being used, why it is being used and what it is being used for.</p> <p>Further, the independency is causing a barrier to collaboration and sharing of practice between Routes and Regions. If each Route within a Region adopts a varying approach, it can be difficult to compare Routes; where the nature of the independency can limit collaboration and best practice sharing amongst Routes, as well as Regions.</p> <p>(Based on Section 3.8.2.3)</p>
4	Delivery and accessibility of performance data	<p>Different data to manage maintenance performance is provided at various times within a week or period, often nullifying or voiding data received only hours beforehand. This limits the ability to manage and utilise the data in a reasonable way.</p>

No.	Observation	Details
		<p>A significant number of measures are lagging indicators, while there is a limited use of leading measures with could be used to better inform maintenance delivery.</p> <p>(Based on Section 3.8.2.3)</p>
5	Lack of reflection	<p>NR develop plans based on historical data and implement those plans accordingly, however, plans are not retrospectively reviewed to ascertain if they could have developed differently to provide improved outcomes.</p> <p>This includes, for example, an understanding of the suitability of the data used to develop those plans, i.e. traffic data, actual or predicted, and if it was realised.</p> <p>(Based on Section 3.8.2.4)</p>

In summary, ORR has undertaken an overview of the current state of NR’s approach to maintenance and identified inconsistent practices and immaturity within the maintenance organisation, demonstrated by the five observations detailed in this report. Overall, we have concluded that the ‘line of sight’ from strategic goals and asset management policy ,as stated at the Period Review 18 final determination, is at risk and corrective actions are necessary to strengthen it.

The maintenance organisation does need to improve and ORR’s assessment indicates NR is underperforming due to its immature systems and processes, and dependency on individuals rather than a system. Further, this validates the general direction NR is taking though its maintenance reform programme. This TAR has enabled ORR to prioritise its next level of scrutiny as well as plan its next steps to bring broader focus on system and organisational effectiveness with respect to reform. ORR require NR Regions and Technical Authority to respond to our observations by demonstrating its own plans to address each one. This should be aligned to improving infrastructure maintenance practices and to compliment NR’s strategic aim to improve its relatively immature maintenance organisation. NR should recognise this to include updating maintenance policies and strategies to reflect both the current and developing structure of the maintenance organisation.

5. Acronyms

5.1 A list of acronyms provided in the report is shown in Table 6.1.

Table 5.1 List of acronyms

Abbreviation	Explanation
ABP	Activity Based Planning
CAPEX	Capital Expenditure
CAPP	CAPEX Renewals Management App
CSI	Composite Sustainability Index
CP7	Control Period 7
E&P	Electrification & Plant
EV	Engineering Verification
FCF	Financial Control Framework
FOC	Freight Operating Company
HM Treasury	Her Majesty's Treasury
II	Intelligent Infrastructure
IMDM	Infrastructure Maintenance Delivery Manager
IME	Infrastructure Maintenance Engineer
LNE&EM	London North East & East Midlands Route
LNW	London North Western Route
LUL	London Underground Limited
MDU	Maintenance Delivery Unit
MPV	Multi-Purpose Vehicle
MST	Maintenance Standard Task
NMT	New Measurement Train

Abbreviation	Explanation
NW&C	North West & Central
NR	Network Rail
OPEX	Operating Expenditure
ORR	Office of Rail and Road
PBR	Periodic Business Review
PLPR	Plain Line Pattern Recognition
RAM	Route Asset Manager
RAMP	Route Asset Management Plan
RCM	Remote Condition Monitoring
RBM	Risk-based Maintenance
RIRG	Route Investment Review Group
RoSE	Reliability Centred Maintenance of Signalling Equipment
R&D	Research & Development
SAF	Service Affecting Failure
SBP	Strategic Business Plan
SIN	Special Inspection Notice
SM	Section Manager
S&C	Switch & Crossing
S&T	Signalling & Telecoms
TAR	Targeted Assurance Review
TME	Track Maintenance Engineer
TOC	Train Operating Company
TV	Temporary Variation

Abbreviation	Explanation
TWS	Track Worker Safety
PLPR	Plain Line Pattern Recognition
PPF	Putting Passengers First
PPM	Public Performance Measure
PR23	Period Review 2023
RF	Revised Forecast
RFI	Request For Information
STE	Safety, Technical & Engineering
VSTP	Very Short-Term Plan
W&W	Wales & Western

