PR13 M&R Review

Main Report

Version 1.0

A Report for Network Rail and the ORR
from Asset Management Consulting Limited (AMCL)

The Institute of Asset Management PATRON
IAM endorsed ASSESSOR
IAM endorsed TRAINER

amcl

Version: Version 1.0
Date: 03/05/2013

Approval:

Compiled by: Dave McLeish
Reviewed by: Martin Pilling
Authorised by: Richard Edwards

Version History:

03/05/2013 - Version 1.0, Incorporation of final comments
18/04/2013 - Draft B, Incorporation of factual accuracy comments
22/03/2013 - Draft A, Initial document for client review

Executive Summary

On 7th January 2013 Network Rail published its Strategic Business Plan (SBP) for the five-year period from April 2014 to March 2019. AMCL (Asset Management Consulting Limited), as the Independent Reporter (Part B – Asset Management) to both Network Rail and the Office of Rail Regulation (ORR), was commissioned to undertake a review of Network Rail's Asset Policies and their application in the organisation's planning approach. The scope of the review included Network Rail's Asset Policies for Signalling, Level Crossings, Electrical Power & Fixed Plant and Telecoms. The review and its findings are documented in this report.

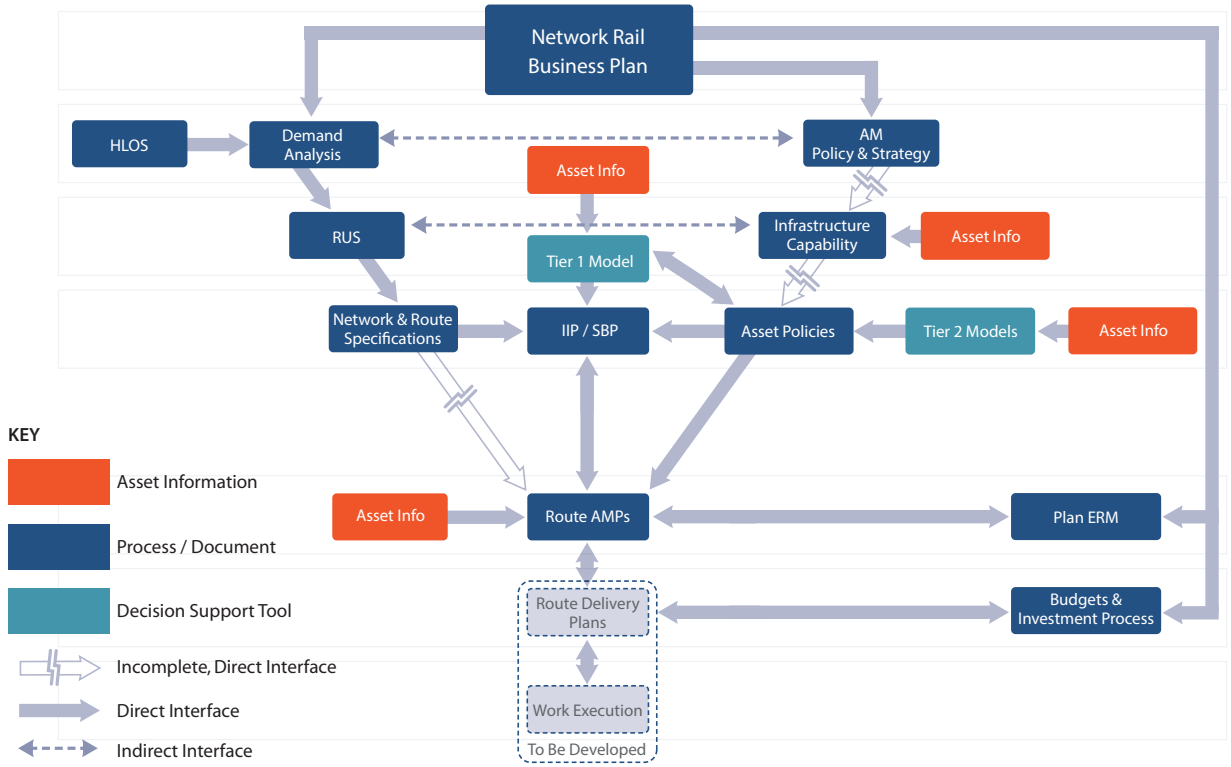
The review was effectively a focused sub-set, specific to the SBP submission, of a wider ranging AMCL Asset Management capability maturity assessment undertaken at approximately the same time. Therefore, to avoid duplication, no specific recommendations are included in this report. Any recommendations emanating from this work will be integrated as part of the wider assessment report[1].

The review found that Network Rail had undertaken a significant level of effort and documentation production to evidence its SBP. This was particularly notable in the area of whole-life cost justification and the refinement and application of Asset Policies since IIP (Initial Industry Plan) which document Network Rail's view of the most appropriate management of its asset base. The Asset Policies within the scope of this review were all found to have been positively revised since the previous review in September 2011. AMCL's assessment of the relevant Asset Policies against the ORR's defined tests of Robustness, Sustainability and Efficiency is shown below:

1 *SBP AMEM Assessment, Draft A, AMCL, 4th April 2013*

Demonstrated	Robust	Sustainable	Efficient
Signalling			
Electrical Power			
Telecoms			
Level Crossings			

Our overall assessment of Network Rail's strategic planning process at SBP, using the same methodology as at September 2011 for consistency, is shown in the diagram below.



As a result of the work completed by Network Rail since 2011, particularly with respect to Asset Policies and associated models, the core of the diagrammatical process is considered to be generally sound. However, in AMCL's opinion, there are two key areas of capability not fully developed or where interfaces are considered not fully effective at the SBP stage:

1) The full demonstration of line-of-sight from organisational Business Plans and the HLOS down to asset interventions and asset performance on the ground:

    a. Progress has been made since IIP with the consideration of HLOS and the production of ten Route Specifications. However, the link from Route Specifications to Route AMPs (or Route Plans) is high-level and largely engineering judgement based. With the notable exception of TRAIL modelling undertaken for Western Route and the Crossrail and Thameslink projects, there are no asset specific RAMS targets by Route produced as part of the standard planning process that AMCL is aware of. This makes the value for money of the planned asset interventions difficult to justify.

    b. Additionally, whilst use has been made of available data for the asset disciplines within the scope of this review, there appears to be limited empirical evidence to support the understanding of the direct impact of the asset interventions on asset performance or other appropriate Asset Management measures such as RAMS targets.

    c. It is understood that Reliability for the Route is essentially 'flat-lined' at the CP4 exit rate, but if industry output requirements were to change it would be difficult and more onerous to demonstrate that the revision of asset intervention plans would achieve the revised requirements without the complete line-of-sight including RAMS targets.

2) The update and alignment of Asset Management Policy and Strategy have not formally kept pace with the extensive developments elsewhere in the strategic planning process. The Asset Management Policy and Strategy documents have not been formally updated and published since February 2011. Whilst there is nothing inherently wrong with these current documents, it could also be argued that they do not reflect the new capability within Network Rail in the strategic planning space, or the new Asset Management System and devolved organisational structure. Also, it is within this aspect of the process that the development of different overall funding scenarios is likely to be considered, such as a baseline scenario to achieve HLOS, increased spend to reduce risk or increase performance, minimum spend to maintain safety, etc. This scenario optioneering would then feed into alternative Infrastructure Capability options and the Asset Policies for subsequent development. Network Rail has evidenced revised draft versions of the Asset Management Policy and Strategy and that they include consideration of Operational as well as Engineering factors. However, these were not in place at the time of the review.

Although this is not considered material with respect to the robustness of the urrent CP5 SBP submission in AMCL's view there is a risk of misalignment between the submission and the revised Asset Management Policy and Strategy, when published, which may impact the long-term sustainability of the current plans. Relating to point 1) above there is also currently a lack of clarity about how infrastructure capability at the Route level is defined, expressed and modelled for different scenarios

Overall, Network Rail has demonstrated significant development throughout the strategic planning process since IIP. This combined with the recently published Asset Management System (SBPT3003), which defines Network Rail's wider Asset Management approach, including strategic planning, is considered to provide a sound platform for continuous improvement.

With respect to the Asset Policies themselves, Network Rail's identified ten-step development process remains fit-for-purpose in AMCL's opinion. Although devolution has seen a significant organisational restructure within Network Rail, the application of the Asset Policies is considered to have been reasonably well demonstrated in both 'top-down' modelling and 'bottom-up' Route Plans. For the asset disciplines considered, Signalling, Level Crossings, Telecoms and Electrical Power and Fixed Plant, the Route Plans subsequently form the core of the SBP submission with respect to maintenance and renewals costs and volumes.

The review has identified a number of risks to, and opportunities for, the robustness of the maintenance and renewal elements of the SBP submission. These are detailed throughout the report and aligned with the following key review areas:

- Progressive Assurance – a period of scrutiny of the SBP process development and application prior to the publication of the SBP;
- The strategic planning process, including the impact of devolution;
- The development of the relevant Asset Policies and their application;
- Strategic planning tools;
- Whole-life cycle cost analysis tools;
- The ten Route Plans from the devolved Routes; and
- The published SBP documentation and associated costs and volumes data.

The following provides a summary of the key short and medium to long-term opportunities identified by AMCL in this review to further assure the robustness of current and future funding submissions.

Short-Term

1) Formal revision of the corporate Asset Management Policy and Strategy to support the revised and enhanced strategic planning process responsible for the SBP.
2) Continue the rollout of Tier 2 models to the Routes to support better Asset Management decisions at the Route level.
3) Continue the development of asset information for strategic modelling and Asset Management decision making at Route level, particular examples include condition data and Unit Costs for Electrical Power and Fixed Plant.
4) Development of Route level business cases and delivery plans for Renewal and Maintenance efficiencies.
5) Further assurance that identified maintenance funding is demonstrably aligned with the quantity of maintenance planned.
6) Develop a formal maintenance policy or strategy for the optimised and integrated application of the various maintenance efficiency initiatives across the asset base.
7) Revisit the CP5 deliverability assessment and uncertainty analysis to assure that the risks are fully and appropriately quantified and mitigated.

Medium to Long-Term

8) Demonstrate clear alignment between the planned asset interventions and overall business objectives, including asset specific RAMS targets.
9) Develop further optioneering of appropriate overall funding scenarios for SBP submission, such as minimal whole-life cost, lowest cost to maintain safety, minimised risk, etc. to provide alternatives to funders, assure the stability of existing plans and demonstrate value for money.
10) Long-term Asset Management planning should become a core part of the 'day-job' for Network Rail and the devolved Routes to facilitate the less onerous production of strategic business plans as snapshots of a continuously managed long-term plan. This should be supported by a formalised development programme with key development milestones aligned with internal process iterations and significant external factors such as the HLOS.
11) Develop a consistent and comparable format for Route Plans and integrated data tables in terms of the degree of justification for deviation from Asset Policy or modelled numbers.
12) Develop a standardised and consistent format for SBP submission, including data tables and comparability between control periods.

Contents

1 Introduction

1.1 Background

On 7th January 2013 Network Rail published its Strategic Business Plans (one for England & Wales and one for Scotland) for the five-year period from April 2014 to March 2019, known as Control Period 5 (CP5). These documents, and the accompanying catalogue of supporting evidence, form the basis of Network Rail's business plan to meet the needs of customers and other stakeholders. They also provide Network Rail's response to the Government's High Level Output Specification (HLOS).

AMCL (Asset Management Consulting Limited) is the Independent Reporter (Part B) to both Network Rail and the Office of Rail Regulation (ORR). As part of that role AMCL was commissioned to undertake a review of Network Rail's Asset Policies and their application in the organisation's planning approach. The review was to consider the application of the Asset Polices both as part of Network Rail's Strategic Business Plan (SBP) submission in January 2013 and during a period of Progressive Assurance prior to that.

The work follows on directly from a previous review of Network Rail's Asset Policies undertaken by AMCL in late 2011[2], following publication of Network Rail's Initial Industry Plan (IIP). The IIP is a predecessor to the final SBP published on 7th January 2013.

The SBP review and its findings are documented in this report and are primarily intended to inform the ORR in defining its final funding determination in response to Network Rail's SBP. The output is also intended to provide a constructive review for Network Rail to support the organisation's continuous improvement.

An overall summary and key findings of the review are documented in this report. Further detail, analysis and findings are documented, as appropriate, in an accompanying Appendices document.

2 *Initial Industry Plan 2011 Review - Final Report, Version 1.0, 20th December 2011, AMCL*

1.2 Scope

The predefined scope was to review the progress that Network Rail had made in development of its Asset Policies and associated strategic planning tools, whole lifecycle cost analysis tools and key network and asset sustainability and performance measures. The scope included assessment of:

- The evidence supplied by Network Rail during the period of 'Progressive Assurance' (approximately May to December 2012) relating to its proposed CP5 Asset Policies and their application;
- The final CP5 asset policies submitted by Network Rail in support of its SBP in early January 2013; and
- The application of Network Rail's Asset Policies in developing SBP cost, volume, output and efficiency projections.

Although AMCL undertook an equivalent review[2] at the IIP stage for a larger range of asset disciplines, AMCL's restricted scope for the SBP review documented here consisted of the following asset disciplines:

- Electrical Power;
- Signalling;
- Level crossings; and
- Telecoms.

The scope for each asset discipline included review of:

- Asset Policy documents;
- Strategic planning tools;
- Whole lifecycle cost analysis tools (for Electrical Power only);
- Route Plan documentation; and
- SBP documentation including costs, volumes and outputs tables.

The initial scope outlined above was subsequently augmented to include a more detailed review of the integrity of Network Rail's strategic planning tools and whole lifecycle cost analysis tools, used in support of the SBP. The defined scope of this additional work was:

- Strategic Planning models – a review of the computational accuracy of the strategic planning tools for Electrical Power, Signalling and Telecoms.
- Whole Lifecycle Cost (WLCC) models – a review Network Rail's own quality assurance work on the computational accuracy of the Electrical Power whole lifecycle cost analysis tool only.

1.3 Approach

In summary the approach to this review was undertaken in two key phases:

1) Progressive Assurance - from approximately May 2012 to December 2012 AMCL undertook a rolling programme of draft documentation and process reviews as Network Rail progressed through the final stages of SBP development. Along with the desktop review of Progressive Assurance evidence provided, the approach included direct review meetings with key Network Rail stakeholders at both the central and Route levels. This included review of Network Rail's strategic planning framework / process, Route Plan templates, Route Plan guidance documentation and other Network Rail central communications with the Routes. The Progressive Assurance review was undertaken against a nominal programme of Network Rail evidence submission milestones and Independent Reporter feedback presentations to both Network Rail and the ORR.

2) SBP Review - following the publication of Network Rail's SBP on 7th January 2013, AMCL undertook a detailed desktop review of Network Rail's Asset Policies and associated strategic planning tools, whole lifecycle cost analysis tools and relevant supporting evidence. This was augmented by a suite of detailed questionnaires submitted to key Network Rail stakeholders (see Appendices A-D of the Appendices document accompanying this report), both within the central organisation and within the recently devolved Route organisations. Following receipt of the completed questionnaires AMCL attended ORR led challenge meetings for each of the asset disciplines within AMCL's scope during January 2013. These preceded meetings with each of the ten devolved Routes during February 2013. AMCL also attended ORR led challenge meetings with the central Network Rail organisation relating to key maintenance and renewal plans during January 2013 and led asset discipline specific challenge meetings at Route level (see Appendix E of the Appendices document accompanying this report). Any issues or clarifications not closed out via the various meetings identified were managed via a question log process to source responses from Network Rail.

Reporting, including interim presentations to the ORR and Network Rail, was largely completed during early March 2013 and subject to the standard Independent Reporter review and revisions protocol.

1.4 Interface with other Independent Reporter Mandates

As part of its duty of care to both Network Rail and the ORR, AMCL is responsible for assuring an integrated approach which minimises duplication of effort and findings from its relevant mandates. There were a number of Independent Reporter mandates being undertaken by both AMCL and Arup (Independent Reporter - Part A) which were being implemented simultaneously with this review. The following sections outline the key interfaces with the most relevant mandates.

1.4.1 SBP AMEM Assessment (AMCL)

AMCL has previously undertaken assessments of Network Rail's Asset Management capability using its AMCL Asset Management Excellence Model™ (AMEM), further details of the AMEM can be found in Appendix F of the Appendices document accompanying this report.

In 2006 AMCL conducted a full review, assessing Asset Management capability against 20 key activities. In mid-2007, the findings of the 2006 review were translated into AMCL's 'Asset Management Vision', which set out the level of Asset Management maturity that the reporter considered achievable by 2009.

In 2009 AMCL conducted a Best Practice Review Update, which assessed Network Rail's Asset Management capability against 23 key activities. This updated the findings of the 2006 review, but with the focus on activities identified as being 'high priority' in terms of CP4 delivery.

In May 2010 AMCL produced an Asset Management Improvement Roadmap, which defined the Asset Management capabilities that AMCL believed Network Rail should develop for each of the key regulatory milestones, i.e.:

- June 2011 as the publication date for the 'Initial SBP' for CP5 (which became the IIP and the delivery date moved to September 2011);
- January 2013 as the publication date for the SBP for CP5 (the focus of this review); and
- April 2014 as the start of CP5.

As a result of the above, an assessment of Network Rail's overall Asset Management capabilities using the AMCL Asset Management Excellence Model™ (AMEM) was undertaken simultaneously to this review in early 2013.

The scope and objectives of the simultaneous AMEM assessment are summarised below:

1) *Complete a full AMEM assessment, in accordance with a specified methodology and priorities, to include all six disciplines of Track, Signalling, Structures (including Earthworks), E&P, Telecoms and Operational Property. Assessments of Track, Signalling, Structures and E&P to be given higher priority to allow separate reporting of these categories if required.*
2) *Include an assessment of the Asset Management activities that are the responsibility of the Centre and those activities that are now the responsibility of the Routes, across a sample of Routes.*
3) *Update the AMEM assessment findings and maturity scores for the six AMEM Groups and 23 Activities. Present findings on a national and Route basis, where possible. Align the findings with the 39-subjects as defined in the Institute of Asset Management's 'Asset Management Anatomy', and present separately.*
4) *Review capability against the agreed SBP capability trajectory, providing commentary on discrepancies.*
5) *Report on close-out of any recommendations that have been stated as complete by Network Rail but not yet verified.*
6) *Assess Network Rail's status in closing out the two outstanding PAS 55 major non-conformances, and if Network Rail is not able to achieve full certification, provide reasons why and recommend a programme of work (including timescales) to achieve compliance.*

The review documented in this report is effectively a focused sub-set, specific to the SBP submission only, of the wider ranging AMEM assessment detailed above. Therefore, to avoid duplication, no specific recommendations are included in this report. Any recommendations from this review are captured as part of the AMEM assessment report[3]

1.4.2
PR13 M&R Progressive Assurance and SBP Submission (Arup)

Arup, as the Part A Independent reporter, undertook an equivalent mandate to that defined in Section 1.2 of this document for the following asset disciplines:

- Track;
- Operational Property/Buildings;
- Structures;
- Earthworks; and
- Drainage.

The Arup review was undertaken simultaneously with AMCL's review. Although reporting independently, AMCL and Arup worked closely together and met on a regular basis to assure consistency of review approach and process across the Network Rail asset base. Overall governance of the integrated reviews was managed via regular quadripartite sessions between the Independent Reporters, Network Rail and the ORR.

1.4.3
PR13 Review of M&R Unit Costs (Arup)

Under a separate mandate[4], Arup was also commissioned to review in detail the Unit Costs utilised by Network Rail in the development of the SBP submission. The strategic objective of Arup's review was to determine the degree of progress Network Rail had made in developing and applying Unit Costs to support and substantiate its SBP M&R expenditure and efficiency projections. Arup was also requested to provide an independent review and opinion of the nature and quality of Network Rail's M&R unit cost data and analysis, as well as non-unitised cost data and analysis, and their applicability and suitability for CP5 expenditure and efficiency planning, including by operating Route.

3 SBP AMEM Assessment, Draft A, AMCL, 4th April 2013
4 Arup Mandate AO/034

The use of Unit Costs in Asset Policy application and planning is relevant to AMCL's review documented in this report and this is discussed where appropriate. However, for avoidance of duplication, the detail of the make-up, progress and assessment of Network Rail's Unit Costs is documented separately by Arup.

1.4.4
PR13 Review of M&R Efficiencies (Arup)

Arup was also mandated[5] to undertake a detailed review of the make-up, application and deliverability risk of the efficiencies identified by Network Rail in its SBP for CP5. Again, the identification, application and likely achievement of efficiencies is relevant to the AMCL review documented here and is discussed where appropriate. However, the detailed review of these efficiencies is captured in the relevant Arup report.

1.4.5
Audit of Asset Data Quality (Arup)

A fourth Arup mandate[6] relates to an audit of Network Rail's data quality. Data quality is crucial to the assurance of and confidence in Network Rail's SBP submission. Arup was mandated to review Network Rail's asset data (inventory and condition) in order to test currency, completeness and accuracy against the relevant requirements of Network Rail's Network Licence and the particular needs of the company's planning process for CP5.

Unfortunately, although on-going review and discussion has been held with Arup throughout this review process, the formal outputs of the Arup audit were still under review by Network Rail and the ORR and were consequently not made available to AMCL.

As a result, AMCL considers that the ORR should take into account the final agreed findings of the Arup data quality audit relevant to Signalling, Level Crossings, Electrical Power & Fixed Plant and Telecoms when reviewing this report.

5 Arup Mandate AO/035
6 Arup Mandate AO/028

2 Progressive Assurance

2.1 Approach & Milestones

Essentially the role of the initial Progressive Assurance stage of this review was to allow the Independent Reporters and the ORR to gain on-going and cumulative assurance of Network Rail's SBP submission through the monitoring of its development. It was also intended to facilitate early review of relevant documentation, as it became available, prior to the intensive period of review from publication of Network Rail's formal SBP on 7th January 2013 up to the final reporting period in March 2013.

With the impact of devolution within the industry, the Progressive Assurance stage was particularly focused on Network Rail's development process at Route level and the relevant interaction with the central organisation. The key objective of the Progressive Assurance process defined by the ORR[7] was as follows:

Network Rail to provide evidence to answer the following questions:

- *What is the process being used to ensure production of robust business plans by operating route? (To include process map and clarification of the role and interaction of asset policy, strategic planning models, route based asset management plans, efficiency benchmarking.)*
- *How will route based asset management plans be presented in the SBP? (Include draft templates and descriptions.)*

Nominally, this was to be achieved via a Network Rail evidence submission milestone of 30th April 2012, followed by an Independent Reporter (AMCL and Arup) review presentation on 30th May 2012. Both these milestones were met to a large degree but in reality the Progressive Assurance process was more organic. Network Rail was constantly developing and improving its documentation and outputs for the SBP submission throughout the period and AMCL and Arup continued to review evidence as it was provided. This process was overseen and governed by regular quadripartite meetings between the relevant parties.

7 *PR13 Progressive Assurance - Milestone 2, ORR*

In terms of the Asset Management element of Network Rail's Route Plans, Network Rail identified the following key milestones in the iterative development process:

- March 2012 Route Plan Iteration - Network Rail provided Route Asset Management Summary documents (the basis for the Asset Management section of the future Route Plans) for each of the ten Routes. These were supported by initial Route Analysis Pack (RAP) spreadsheets for each of the ten Routes. Accompanying this evidence was an initial 'Operating Route Asset Management Summary' template document developed by the East Midlands Route.
- May 2012 Route Plan Iteration - Network Rail provided sight of further iterations to the ten Route Plan documents but the core focus was on initial costs and volumes templates per Route. These were captured in a set of format spreadsheets (RAPs) to support the future integration into Network Rail's Hyperion financial system. These also included IIP modelled numbers to allow initial variances to be identified. Network Rail also provided a range of supporting evidence, including a draft of the then developing overall Asset Management System process flowchart and accompanying RACI[8] as well as briefing and guidance materials provided to the Routes.
- September 2012 Route Plan Iteration - Network Rail identified that the September iteration of the Route Plans would be the initial full and formal Route Plans, including sign-off from the relevant Route Managing Director (RMD). These would provide more refined costs and volumes for CP5 including justification for variance to Asset Policy and IIP modelled numbers. They would also include the first material details on efficiencies by Route for CP5. Unfortunately, the Independent Reporters did not receive or gain sight of the September iterations of the Route Plans. This was understood to be due to Network Rail's 'Plan Executive Review Meeting (Plan ERM)' review process initiating a cross-network review and subsequent changes to the documents which negated the value of the review in the interim.
- September 2012 Route Meetings - AMCL and Arup undertook a limited sample of Route meetings with the Directors - Route Asset Management (DRAMs) and other key Route stakeholders during September. The Routes visited were Scotland, LNE and Wessex.
- January 2013 SBP Submission - the final Route Plans and other associated documentation and evidence was submitted by Network Rail. This represented the first time AMCL (and Arup) had seen the developing Route Plans since the May 2012 iterations.

Please note that the above list is not exhaustive and is intended only to summarise the key milestones relating to the independent assurance of the development of the Route driven costs and volumes submitted in the SBP for CP5. Network Rail interfaced extensively with AMCL, Arup and the ORR throughout the Progressive Assurance period and provided a range of evidence, draft documents and models to support the review. Further details of this can be seen in the Progressive

8 *Assigns the following duties to the process - Responsible, Accountable, Consulted, Informed*

Assurance report presentations included in Appendices G - K of the accompanying Appendices document. These consist of the following AMCL interim review presentation milestones comprising report presentations jointly compiled with Arup:

- 29th May 2012;
- 16th August 2012;
- 14th September 2012;
- 23rd November 2012; and
- 4th December 2012.

The key findings from each of these review points is summarised chronologically in the following sections to demonstrate the level of cumulative assurance gained through the Progressive Assurance process.

2.2 Key Findings

2.2.1 May 2012 Interim Review Presentation

AMCL and Arup's joint opinion at the May 2012 review was that although the work was early in its development and we had had limited visibility of end products at the time, Network Rail had evidenced progress with the March 2012 iteration of the Route Plans. We considered that Network Rail had made significant progress with an emerging overall process, which was being adopted and implemented by the Routes, but there was still a considerable way to go in terms of its formalisation.

Key findings included:

1) The Asset Management element of the SBP Route Plan submission appeared unlikely to be as detailed as the Route Asset Management Plans (RAMPs) previously produced for each of the 305 Strategic Route Sections (SRSs);
2) The level of detail underpinning the Route submissions was unclear at that time;
3) The reconciliation between the 'top-down', strategically modelled costs and volumes, with the 'bottom-up' Route based costs and volumes was still to be undertaken and was considered to be potentially the most challenging part of the process; and

4) The relative 'balance-of-power' in terms of the final SBP submission between the central organisation, responsible for the 'top-down' view, and the 'bottom up' view of the Routes would be critical in defining the degree to which Asset Policies would be applied in practice for CP5.

Finally, AMCL and Arup considered that Network Rail may be circa six-months behind our opinion of the optimal development stage for that point in the process. This was based on opinion and experience in other industries only and did not represent a quantitative analysis.

2.2.2 August 2012 Interim Review Presentation

The interim findings presented in August considered evidence submitted by Network Rail up to and including 15th August 2012. As well as the May 2012 iterations of the Route Plans and associated costs and volumes, this included a number of briefings, presentations and further supporting evidence from Network Rail.

A key factor of uncertainty in our findings at this stage was that the Government's HLOS had only been recently published (16th July 2012) and its impact on the Route Plans and overall SBP submission was still to be clarified by Network Rail.

Other key findings at this stage included:

1) Progress had been demonstrated between the March 2012 and May 2012 iterations of the Route Plans, including refinement of the costs and volumes for CP5;
2) The May 2012 iterations of the Route Plans were based on the single option funding scenario of *"current railway plus investments"* established at IIP;
3) As anticipated, the maturity of the Route Plans varied by Route and asset discipline;
4) An overall approach was being adopted and implemented by the Routes with guidance form the central organisation but it appeared to be a adopting a 'step-by-step' approach with no clear overall SBP development plan or Gantt Chart proffered by Network Rail;
5) We had not yet met with the Routes so the level of detail underpinning the Route submissions remained unclear, as did the Routes' understanding of an overall development plan or process;
6) The application of relevant Asset Policies within the Route Plans was evidenced but the concurrent further development and refinement of some Asset Policies was noted as a risk in a number of the draft Route Plans;
7) The necessary disaggregation of Asset Management outputs was not considered

explicit or related directly to Routes or asset disciplines within Routes. It was therefore difficult to establish 'line-of-sight' (alignment) between what was being planned to happen on the ground during CP5 and the overall corporate objectives and performance outputs. This is effectively the *"value for money"* question;

8) There were continued concerns relating to the formal reconciliation of 'top-down' modelled costs and volumes from IIP and the 'bottom-up' Route Plans being developed. These concerns included the 'balance-of-power' between the Routes and central organisation, identified in the May 2012 presentation above, and whether the IIP modelled costs were considered a 'target' or a 'constraint';

9) Related to this, it was also considered at the time unclear as to how cross-Route / cross-asset discipline prioritisation would be considered in the development process;

10) Unit costs were evidenced as being considered but were at a relatively early stage of integration within the Route Plans; and

11) An extensive focus on efficiencies was also evidenced, although it did not appear clear to AMCL at that stage if efficiencies were being targeted on optimised baseline work plans or being targeted as efficiencies whether the underlying work pan was the most effective or not.

An industry wide risk to the formulation of the Route Plans and ultimately the CP5 SBP was also identified at this stage in the form of Route Efficiency Benefit Sharing (REBS) plans and further potential Alliancing between Network Rail Routes and Train Operators (already in place in Wessex Route at the time). As Independent Reporters AMCL and Arup had limited insight into these on-going industry discussions at the time but the potential risk and benefits were highlighted.

2.2.3
September 2012 Interim Review Presentation

The interim findings presentation in September 2012 was a relatively simple update to the previous May and August findings. The core findings and risks identified in the previous two sections largely remained at this stage. Key updates included:

1) The provision of an overview presentation by Network Rail of draft Asset Policies and associated models for some asset disciplines, although no 'full-set' of Asset Policies and models across a single asset discipline was available at the time;

2) The continued development of some Asset Policies at the time was considered a risk to alignment between final Asset Policies and Route Plans, which were due to be published internally to Network Rail at the end of September 2012;

3) Route Output Specifications had been produced by Network Rail following due analysis of the HLOS requirements. AMCL considered that although there was a clear line-of-sight between the HLOS and the Route Output Specifications this was still not

demonstrable between the Route Output Specifications (which detailed PPM, CaSL and Delay Minutes at the Route and Train Operator level) and their disaggregation to asset discipline or asset type specific Asset Management outputs at Route level; and

4) There was further, emerging, evidence provided by Network Rail of reconciliation dialogue between the Heads of Asset Management (HAMs) from the central organisation and the DRAMs and Route Asset Managers (RAMs) in the Routes.

At the September 2012 findings update AMCL and Arup also reiterated the opinion that Network Rail were circa six-months behind what we considered an optimal position in terms of developing the CP5 SBP. We considered that, ideally, a 'baseline' CP5 SBP would have been established prior to the HLOS becoming available.

2.2.4 November 2012 Interim Review Presentation

Our findings at the November 2012 interim presentation focused on the following key factors:

1) The emerging availability of draft Asset Policies and Tier 2 Whole-life Cycle Cost (WLCC) models (see Section 5).

2) The findings from the three DRAM meetings in Scotland, LNE and Wessex Routes held in September 2012. The key findings from the Route meetings are included in Appendix J of the accompanying Appendices document but a summary of the most salient points includes:

    a. Devolution had occurred relatively recently and there were new structures, roles and people at the Route level which impacted on the rate of development and maturity of the Route Plans;

    b. The SBP/Route Plan process was considered to require significant effort and resources had been stretched in some cases;

    c. The maturity of Asset Policies varied significantly across the asset disciplines and late availability or changes to the Asset Policies was an issue for Route Plan alignment assurance and production;

    d. No formal process was identified by the Routes for reconciliation of 'top-down' and 'bottom-up' costs and volumes. However, the overall SBP milestones were said to be understood, there had been reasonable guidance from the central organisation and there were robust and regular HAM/RAM reconciliation discussions with governance and change control processes in place;

    e. Explanation of any deltas between Route Plans and Asset Polices and/or IIP numbers was noted as a key element of the development process by all three Routes; and

f. Efficiencies were generally considered by the Routes to be the least developed element of the Route Plans at the time of the meetings.

3) The lack of access to the September 2012 iteration of Network Rail's Route Plans;

4) Associated with the point above was the consequently limited opportunity for the Independent Reporters to be able to undertake further planned Route visits to discuss the September Route Plan documents prior to the publication of the SBP;

5) The reiteration of the concerns relating to line-of-sight and the apportionment of appropriate Asset Management or RAMS[9] targets below the generic Route level; and

6) A concern that there was no clarity at the time, from the Independent Reporter perspective, as to how Network Rail's current maintenance regimes contributed to relevant RAMS targets, what the gaps were, if any, and how maintenance was being optimised within Network Rail to achieve future targets.

2.2.5 December 2012 Interim Review Presentation

The December 2012 interim presentation centred on the joint AMCL and Arup proposed approach to undertake further Route level assurance of the maintenance and renewal costs and volumes for the imminent CP5 SBP submission. It was considered by the Independent Reporters that this was required, in addition to the ORR's planned challenge meetings, due to:

1) A number of key factors which had not been definitely clarified during the Progressive Assurance period, including:

   a. The relatively high-level overall development process presented by Network Rail to date;

   b. How the process had been applied by the various Routes to achieve Asset Policy alignment and reconciliation of 'top-down' and 'bottom-up' costs, volumes and efficiencies;

   c. The level of variation in maturity and robustness of Route Plans across the Routes, largely engendered by the lack of access to the Route Plans from the May 2012 iteration onwards;

   d. The level of derivation of the final SBP submission from the 'bottom-up' or 'top-down' sources; and

2) The anticipated level of detail, specifically in relation to the underpinning data and analysis for Route based costs, volumes and efficiencies, to be included in the SBP. Although this issue would be inherent in any organisations' strategic plan, such as the SBP, it was felt that a 'deeper-dive' was required to support the overall review and subsequently the ORR's own final determination on the robustness of the SBP submission.

9 *Reliability, Maintainability, Availability, Safety*

The AMCL and Arup proposed approach, which was accepted and implemented by Network Rail and the ORR, is detailed in Appendices A-E of the Appendices document accompanying this report.

2.3 Progressive Assurance Summary

Overall the Progressive Assurance process was beneficial and informative, particularly gaining an understanding of the approach from a Route level via the three sample DRAM meetings in September 2012. The process as a whole allowed clear evidence of the developing nature of Network Rail's ten Route Plans, Asset Policies, associated models and the iterative overall approach.

However, the benefits were limited to a degree by an apparent lack of definition around the overall plan and the inherent emerging nature of the relevant evidence base throughout the period. Due to the nature of the development of the SBP and associated Route Plans for CP5 further interaction with Routes during the Progressive Assurance period would have been beneficial. Appropriate knowledge of the 'on the ground' plans and the data, analysis and engineering judgement that underpins them is considered essential to the understanding and assurance of any regulated funding submissions, although AMCL does accept that this was complicated in this instance by the recent devolution in the industry and the subsequent availability of key resources in the Routes.

For future review processes it would be beneficial for Network Rail and the ORR to establish and agree further definition around review milestones (e.g. timing and evidence to be submitted) ahead of the process starting. We would also propose that future SBPs (which by definition provide only a snapshot of Asset Management plans) should become less onerous for Network Rail to produce. In AMCL's experience the processes and systems for the development of funding submissions should be part of the 'day job' for heavily regulated and publically funded organisations such as Network Rail. The outputs for such submissions should simply be the current live plan for the next five-years, or appropriate period of time, and readily available from standard, integrated, business-as-usual processes and systems. The level of confidence in the stability of the plans will vary with time horizons but appropriate long-term Asset Management plans should be maintained on an on-going basis.

3 Network Rail's Strategic Planning Process

3.1 General Approach

As outlined in Section 2, there were challenges with understanding the formal process associated with the development of Network Rail's Asset Management plans for CP5 during Progressive Assurance. This process was subsequently clarified by Network Rail in the SBP submission catalogue published in January 2013, as shown in the diagram below.

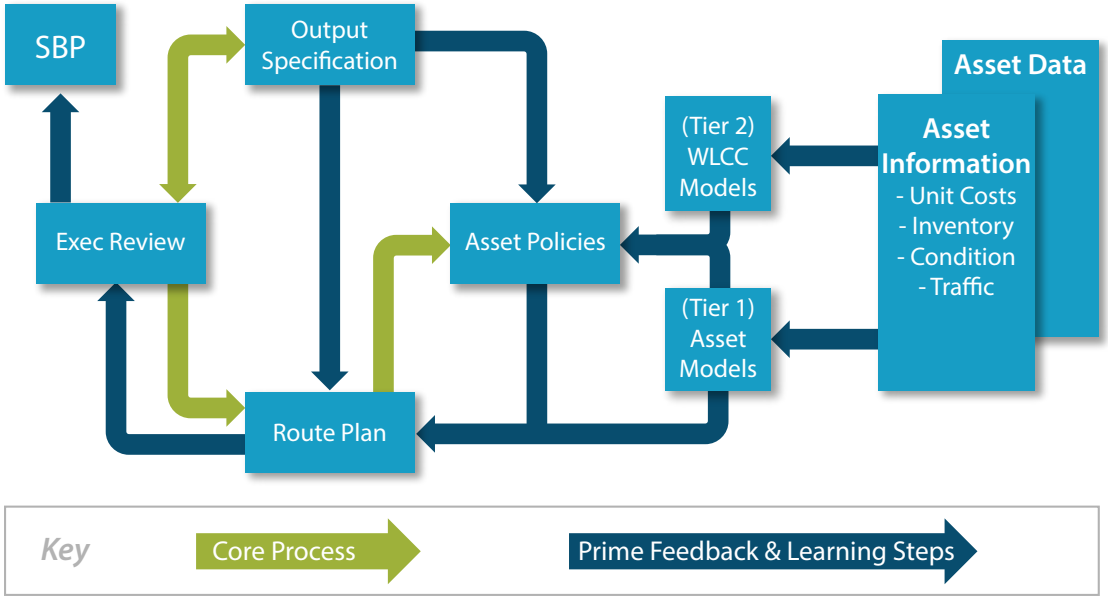


Diagram **1** *Network Rail's Overall Approach to SBP Development (SBPT223)*

Diagram 1 highlights the iterative nature of the process adopted. Some iteration is considered both unavoidable and essential to the optimal development of the Route Plans and overall SBP, however as discussed in Section 2 AMCL has had limited visibility of the scale of iteration that occurred post the May 2012 Route Plans. The robustness of the process depicted above is also inherently reliant on timely availability of key documents; such as the latest Asset Policies to support each iteration of the Route Plans. Availability and late changes to Asset Policies were identified as an issue during

the Progress Assurance Route meetings. This has led to challenges in ensuring alignment between the final Asset Policies and the Route Plans/SBP.

In general for CP5 this appears to have been mitigated by the close interaction between the HAMs and RAMs during the iterative process. However, the overall robustness of Network Rail's process is reliant on setting and delivering against appropriate milestones for each step of each iteration. This is an area where AMCL considers Network Rail could provide greater assurance of the process.

Also notable in the diagram are the iterations of the Route Plans with the Executive (Plan ERM) review. The scale and multitude of these iterations is not known as the September 2012 Route Plans and further iterations through to SBP were not made available to the Reporters. Although these iterations may not have been material, it is not possible to endorse the robustness of the overall process without an auditable trail.

At the IIP stage[10], AMCL summarised the status of Network Rail's strategic planning process as shown in the diagram below.

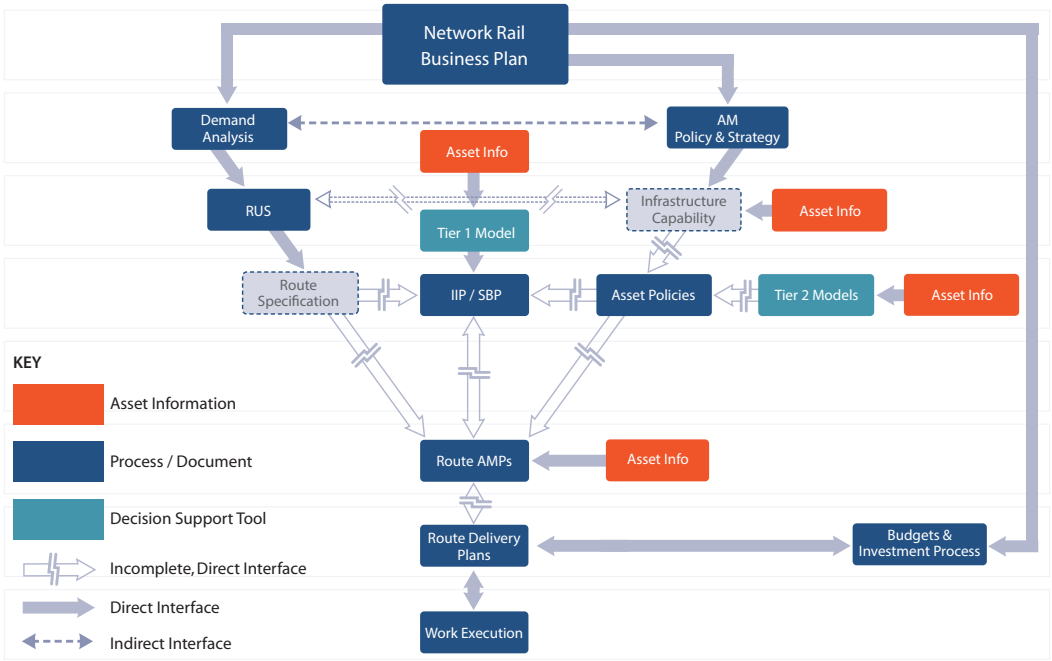


Diagram 2 AMCL's View of Network Rail's Strategic Planning Process (IIP)

10 *Initial Industry Plan 2011 Review - Final Report, Version 1.0, AMCL, December 2011*

The work identified that the foundations of a good practice process, which included whole-life cost justification and demonstrable line-of-sight, were being developed. The review also noted that there were some gaps and a number of missing links in the process at the time. However, it was recognised that significant work was still on-going within Network Rail including further development of the Asset Policies, associated WLCC and strategic planning models and collating the key asset data necessary to populate the models and inform the Asset Policies.

It was also considered at the time[11], that it would be possible - though challenging - for Network Rail to fill the remaining gaps and complete the integration of the capabilities and interfaces prior to the submission of the SBP in January 2013.

Having completed the Progressive Assurance and SBP review and considered Network Rail's iterative approach shown in Diagram 1, AMCL's opinion of the extent to which these capabilities and interfaces were working in practice to produce the SBP is shown below.

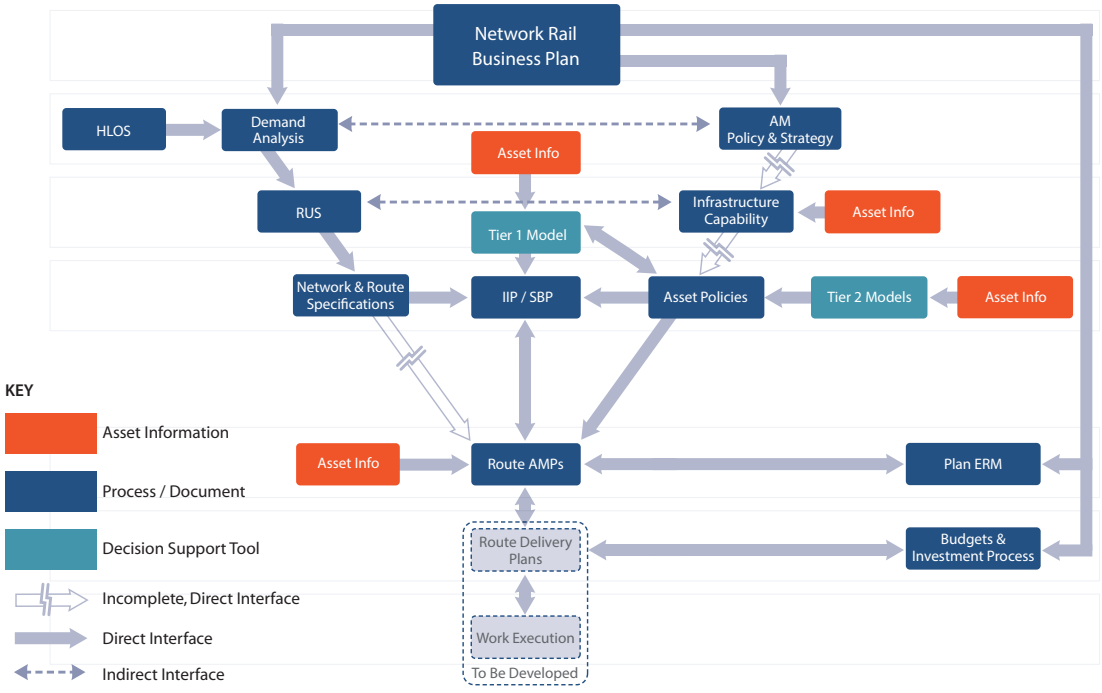


Diagram **3** *AMCL's View of Network Rail's Strategic Planning Process (SBP)*

A significant amount of work has been completed, particularly with respect to Asset Policies and associated models and the core of the diagrammatical process is considered to be generally sound. However, there are two key areas of capability not fully developed or where interfaces are considered not fully effective at the SBP stage:

11 2011 AMEM Assessment, Version 1.1, AMCL, December 2011

1) The full demonstration of line-of-sight from organisational Business Plans and the HLOS down to asset interventions and asset performance on the ground:

    a. Progress has been made since IIP with the consideration of HLOS and the production of ten Route Specifications. However, the link from Route Specifications to Route AMPs (or Route Plans) is high-level and largely engineering judgement based. With the notable exception of TRAIL modelling undertaken for Western Route and the Crossrail and Thameslink projects, there are no asset specific RAMS targets by Route produced as part of the standard planning process that AMCL is aware of. This makes the value for money of the planned asset interventions difficult to justify.

    b. Additionally, whilst use has been made of available data for the asset disciplines within the scope of this review, there appears to be limited empirical evidence to support the understanding of the direct impact of the asset interventions on asset performance or other appropriate Asset Management measures such as RAMS targets.

    c. It is understood that Reliability for the Routes is essentially 'flat-lined' at the CP4 exit rate, but if industry output requirements were to change it would be difficult and more onerous to demonstrate that the revision of asset intervention plans would achieve the revised requirements without the complete line-of-sight including RAMS targets.

2) The update and alignment of Asset Management Policy and Strategy have not formally kept pace with the extensive developments elsewhere in the strategic planning process. The Asset Management Policy and Strategy documents have not been formally updated and published since February 2011. Whilst there is nothing inherently wrong with these current documents, it could also be argued that they do not reflect the new capability within Network Rail in the strategic planning space, or the new Asset Management System and devolved organisational structure. Also, it is within this aspect of the process that the development of different overall funding scenarios is likely to be considered, such as a baseline scenario to achieve HLOS, increased spend to reduce risk or increase performance, minimum spend to maintain safety, etc. This scenario optioneering would then feed into alternative Infrastructure Capability options and the Asset Policies for subsequent development. Network Rail has evidenced revised draft versions of the Asset Management Policy and Strategy and that they include consideration of Operational as well as Engineering factors. However, these were not in place at the time of the review. Although this is not considered material with respect to the robustness of the current CP5 SBP submission in AMCL's view there is a risk of misalignment between the submission and the revised Asset Management Policy and Strategy, when published, which may impact the long-term sustainability of the current plans. Relating to point 1) above there is also currently a lack of clarity about how infrastructure capability at the Route level is defined, expressed and modelled for different scenarios.

Overall, Network Rail has clearly demonstrated significant development throughout the strategic planning process since IIP. This combined with the recently published Asset Management System (SBPT3003), which defines the wider Asset Management approach, including the associated RACI, is considered to provide a sound platform for continuous improvement and integration of strategic planning. The following diagram provides an overlay of Network Rail's Asset Management system process against AMCL's diagrammatic view of the approach, which shows good alignment.

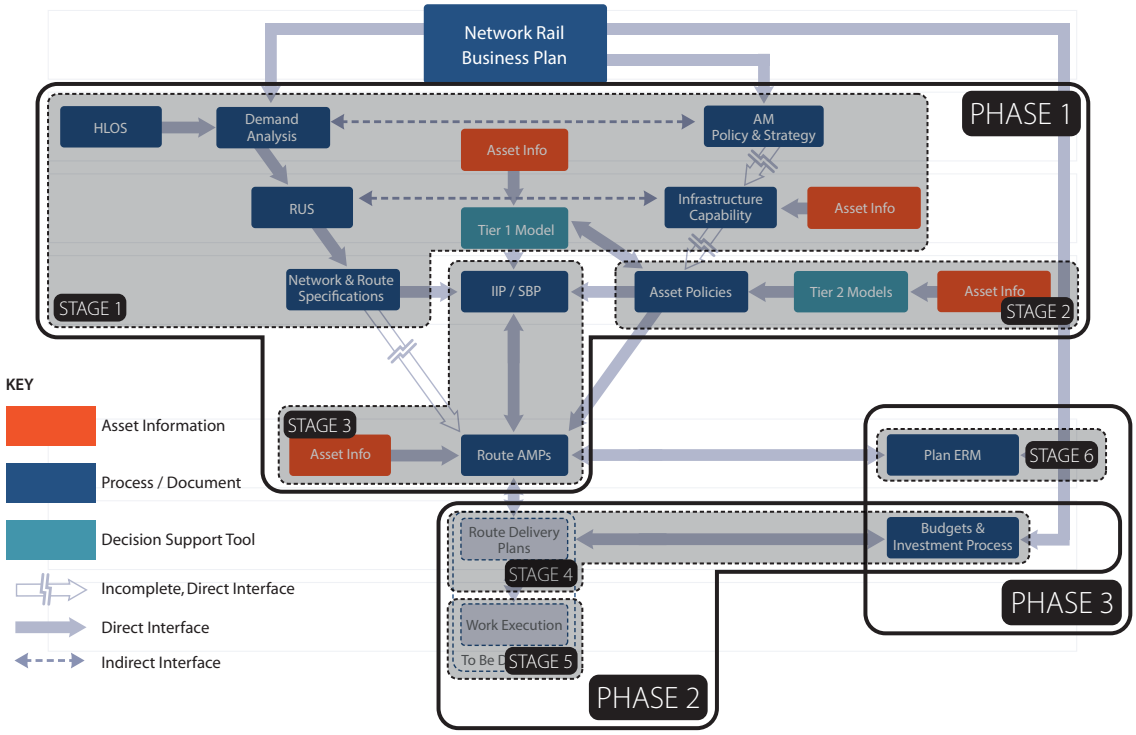


Diagram 4: Alignment of AMCL's View with Network Rail Asset Management System

The new Asset Management system is not yet considered fully embedded and effective within the newly devolved organisation at this stage. As discussed above the revised Asset Management Policy and Strategy are yet to be established. Key to its future effectiveness and particularly the strategic planning element, is the assurance that key asset information (the orange boxes in Diagram 4) will be developed to inform and optimise the strategic decision making process. To achieve this, Network Rail must continue to assure that the Asset Data Improvement Programme (ADIP) and longer-term ORBIS[12] asset information programme deliver the right asset information, in the right format, at the right time. The successful and timely combination of these factors should facilitate a significantly less onerous and more effective on-going strategic planning process.

This should also enable the capability to consider a range of viable funding scenarios at SBP. Whilst the IIP considered 'current railway', 'current railway plus investments' and other potential funding scenarios which offered 'spend-more to get-more' options to funders, the SBP is at its highest level a single option submission. Multiple investment scenarios are seen in a number of regulated industries to provide options for funders and mitigate risk of under investment against single option scenarios for Asset Management organisations.

3.2 Impact of Devolution

Devolution has seen a significant organisational restructure and reassignment of roles and responsibilities within Network Rail. The SBP is a nominally 'bottom-up' plan, although this does vary by asset discipline, which relies on the DRAMs and RAM teams within the Routes to assure the application of and alignment with Asset Policies.

There has been evidence during this review process of the benefits of this approach, including application of the Asset Policies with greater and more direct knowledge of the particular circumstances at Route level and direct ownership of the Route Plans and their development.

The devolved structure has also seen a 'healthy tension' between the central organisation, responsible for the development of Asset Policies and the Route organisations which are now responsible for implementation of the Asset Policies. There has been evidence of both direct involvement of the RAM teams with Asset Policy development and direct challenge from the RAM teams to the Asset Policy. For those Asset Policies within AMCL's scope of work, the challenges have generally related to the flexibility of the Policies to align with the specific circumstances of the Route, rather than any fundamental issues.

However, there have been a number of deviations from Asset Policies across a number of Routes. Whilst this is healthy and to be expected, the impact of devolution is that the final decision as to whether to comply with Asset Policy or not comes down to the Routes. Ultimately the DRAM makes the final decision on the maintenance and renewal costs, volumes and efficiencies within the Route Plan. Whilst again, this is a logical approach, it highlights the issue raised in Section 3.1 that tardy production and communication of Asset Policies could lead to misalignment with Route Plans, especially when Route teams are under pressure to produce documentation. As stated previously, this risk appears to have been mitigated by regular communication between HAMs and RAMs of

Asset Policy developments and their implications prior to formal provision of the revised Asset Policies.

Devolution has also increased the need for Asset Management knowledge and decision making capability across the Routes as well as the central organisation. To assure value for money a whole life cost approach is required. As discussed in the section above, Network Rail has made significant progress in the development of WLCC models across the asset disciplines, however, there has been limited deployment of the resulting WLCC models to the Routes for use in their own planning processes, although this varies by asset discipline. Signalling in particular has developed a wide range of Route specific case-studies to support the Route level decision making and demonstrate greater robustness of CP5 plans. This has not been so evident across other asset disciplines, and even for Signalling the modelling process itself is understood to have been undertaken by the modelling experts within the central organisation.

AMCL understands that Network Rail is in the process of deploying the Tier 2 models to the Routes and a number of the RAM teams had recently undergone initial training on the use of the models when we met with them in February 2013. This Route based capability was not in place during the development of the Route Plans and SBP to AMCL's knowledge. This represents a future opportunity to improve the consistency of decision making within the Routes and the alignment of 'top-down' and 'bottom-up' plans.

Related to this issue is a risk that devolution has diluted the number of competent Asset Management resources across the central organisation, the general Route teams and the asset discipline specific RAM teams within each Route. A formal assessment of this was not part of the scope of this review. However, a number of vacancies within the RAM teams - although not at RAM and above level - were noted by the Routes during discussions (see Appendix E). Again, the potential impact of these vacancies and the general Asset Management competence of the more widely dispersed Asset Management organisation under devolution is not part of this review but is a clear risk for on-going mitigation. It is noted that this mitigation is supported in part by the RACI definitions in Network Rail's Devolution Handbook[13] and the Asset Management System (SBPT3003).

13 *Handbook to Devolution Phase 2, Version 4, Network Rail, October 2012*

4 Asset Policies

4.1 General Approach

As previously described, the Asset Policies have continued to improve since IIP, supported by the concurrent development of enhanced WLCC and strategic planning models (see Section 4.2).

As was noted during the Progressive Assurance phase of this review (Appendices G-K) ideally the models, particularly the WLCC models, would have been developed prior to the main revision of the Asset Policies for CP5. This would have allowed the WLCC models to more consistently and directly drive the development of the Asset Policies. In practice it is understood that although this was the case in some elements of some Asset Policies, in general terms the WLCC models were used to validate rather than drive the Asset Policies. This relates directly to previous discussions in this report regarding the necessity for milestones and timeliness of delivery in Network Rail's iterative SBP development process (Diagram 1).

With respect to the Asset Policies themselves, Network Rail's ten-step development process, shown in Table 1 below, remains fit-for-purpose in our opinion.

Development Step	Description
1. Asset Description	Asset types, location, volumes, configuration, interfaces
2. Historical Analysis	Trends in asset age, cumulative duty, remaining life, condition, failures, service impact, historical work volumes and costs
3. Asset Criticality	Prioritisation – so rigour of analysis is proportionate to impact of assets on safety, train performance, costs
4. Route Criticality	Basis for differentiation of policy according to location of asset on network
5. Asset Degradation	Analysis and quantification of degradation mechanisms, links to asset failure and service impact
6. Intervention Options	Existing and potential intervention types, effectiveness of interventions, unit cost
7. Output and Intervention Scenarios	Specification of infrastructure service requirements and range of intervention options to be analysed
8. Modelling / Decision Support Tools	Whole lifecycle costing models and models for forecasting activities, expenditures and outputs at portfolio level
9. Investment Optimisation	Comparison of results from analysis of range of intervention options and output scenarios
10. Policy Selection	Preferred intervention regime based on lowest whole life cost and other factors; specification of intervention rules to support development of route asset management plans

Table 1: Network Rail's Ten-Step Asset Policy Development Process

Combined with the supporting models the process provides a logical and sequenced approach for the development of justifiable whole-life cost based asset intervention policies. Because of the scale and complexity of the analysis involved, capturing all the relevant outcomes tends to result in large documents which may be unwieldy or impracticable for use on a day-to-day basis. This is a simple production factor which Network Rail has considered different options for in the past but could impact the essential understanding, acceptance and integration of the Asset Policies throughout the organisation. This was mitigated during the development of the Route Plans and SBP by the HAM / RAM interface discussions and the development of Asset Policy aligned 'workbank rules' for some asset disciplines to support the RAM teams in developing their asset intervention volumes and costs.

The availability and quality of historical failure rates, condition data and subsequently degradation rates varies across the asset disciplines. Where one or more of these is poor it is one of the limiting factors in the robustness of the Asset Policy emanating from the generic process. Another general area of variance across asset disciplines is the robustness of the asset criticality approach. These variances are discussed in more detail for the assets disciplines within AMCL's scope in Sections 4.4 to 4.7 but represent some of the key limitations on the inputs to the Asset Policies at SBP.

4.2 Supporting Tiers of Modelling

To support the development, validation and application of Asset Policies and to facilitate the central forecasting of longer-term asset intervention volumes, costs, efficiencies and outputs Network Rail has used the following three tier approach to modelling:

- Tier 1 – Strategic planning models (formerly known as Infrastructure Cost Models (ICMs)) which forecast work volumes, outputs and expenditures for an asset discipline, such as Signalling or Telecoms (see Section 5);
- Tier 2 – Strategic WLCC models which calculate the whole life cost for single asset types within an asset discipline, such as Point Machines within Signalling or Concentrators within Telecoms, for a range of asset intervention options and utilisation scenarios (see Section 6); and
- Tier 3 – Tactical models that support the specification and prioritisation of asset interventions in Asset Management plans, such as the Route Plans.

The tiered approach, although recently developed and still being refined, is considered by AMCL to represent good practice although the full integration and effectiveness of the models within the overall organisation and processes is still evolving. As discussed in Section 3 the development of the models has largely filled what was identified by AMCL as a significant gap in the whole-life cost justification of Asset Management plans in CP4.

4.3 Robustness/Sustainability/WLWS Cost Assessment

At the IIP stage AMCL assessed the relevant Network Rail Asset Policies against the ORR's defined test of Robustness, Sustainability and Efficiency (see Appendix L of the accompanying Appendices document). A summary of our findings at the IIP stage is shown below, with a key as follows:

- **GREEN** indicates that, in our opinion, the Asset Policy fully meets the criteria for Robustness, Sustainability and Efficiency.
- **AMBER** means partially meets the criteria for Robustness, Sustainability and Efficiency but does not yet fully demonstrate compliance; and
- **RED** means there is little evidence that the criteria have been met.

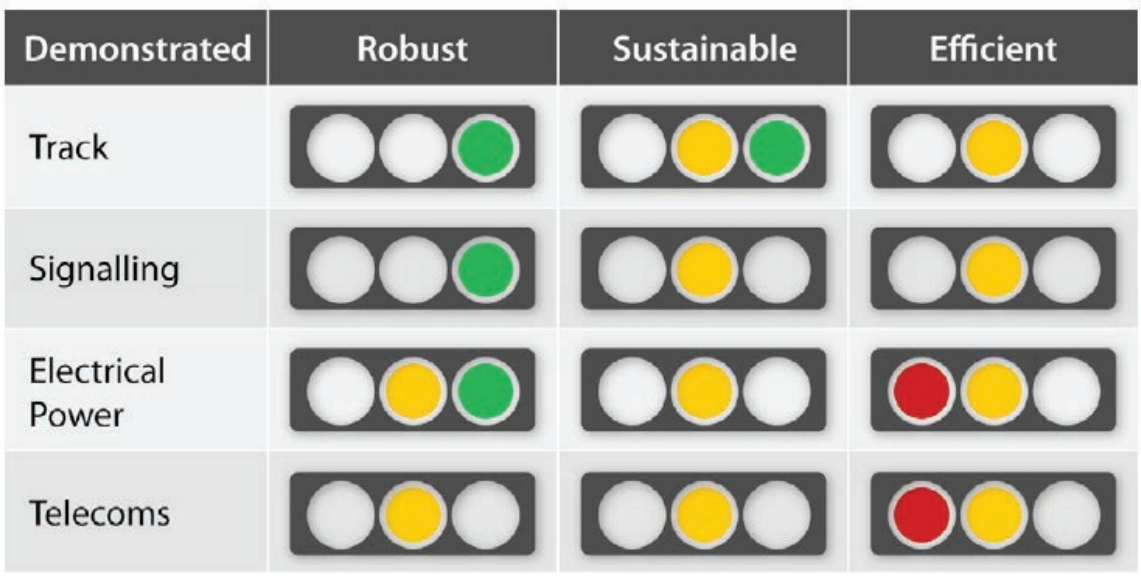


Diagram **5**: AMCL's Robustness, Sustainability and Efficiency Assessment of Asset Policies (IIP)

A like-for-like comparison against all the asset disciplines shown in the diagram above is not possible as Track is not within AMCL's scope for the SBP review.

A summary of our findings from the SBP review is shown in Diagram 6.

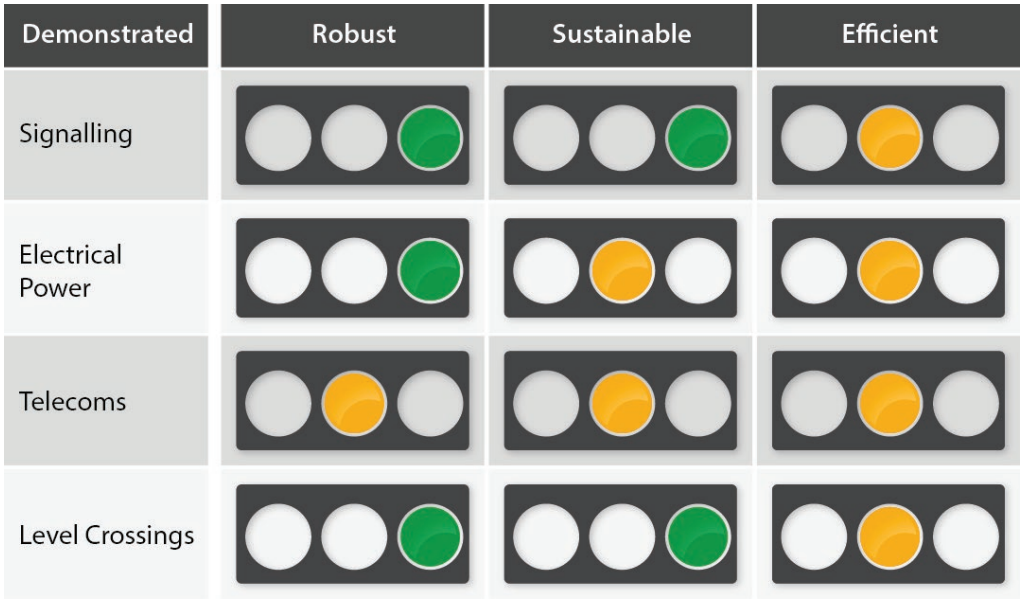


Diagram 6: AMCL's Robustness, Sustainability and Efficiency Assessment of Asset Policies (SBP)

These findings align with the relevant asset discipline assessments of the Asset Policies undertaken by Network Rail and published in SBPT223.

Diagram 7: Network Rail's Assessment of Asset Policy Maturity (SBPT223)

This appears to reflect a fair and reasonable assessment by Network Rail which understands both the strengths and weaknesses of the Asset Policies and the associated areas of further development and demonstration of outputs.

Although sufficient assurance is provided by the Asset Policies, the associated modelling and Route Plan alignment to support the **GREEN** assessment of Robustness for the Signalling and Electrical Power asset disciplines, AMCL has identified the following risks:

1) The 'targeted renewals' approach adopted in the latest Signalling Asset Policy has not been tested in practice to demonstrate the achievement of the necessary outputs; and
2) The revision of the Electrical Power Asset Policy from an age-based approach in CP4 to a condition-based approach in CP5, though still utilising asset age as a proxy for asset condition in a number of cases, has not been tested in practice to demonstrate the achievement of the necessary outputs.

AMCL's review of the Network Rail Routes' maintenance and renewal plan alignment with the relevant Asset Policy is discussed further in Sections 4.4 to 4.7 and 7 of this document.

4.4 Signalling

4.4.1 Overview

The CP5 Signalling Asset Policy is based around three core themes:

1) Alignment with Network Rail's Network Operating Strategy (NOS) which intends to reduce Operational costs by consolidating control centres and installing new technology, such as Traffic Management systems, to reduce Operational headcount. NOS acts as a key driver for increased Signalling renewals during CP5.
2) Alignment with the industry-wide move towards the European Rail Traffic Management System (ERTMS) via the initial migration of Signalling systems to the European Train Control System (ETCS). This also acts as a key driver for Signalling renewals during CP5, although a number of Routes are not scheduled to install ETCS for a number of decades.
3) Condition-driven renewals, including, where appropriate, application of 'targeted renewals', e.g. renewal of specific assets rather than major interventions on asset-systems, to achieve greater whole-life cost optimisation in the current asset base.

There is also a move towards the use of Modular Signalling as a more cost-effective option on lower criticality network routes.

As discussed previously, AMCL has found the Asset Policy to generally meet the ORR tests of Robustness and Sustainability, with the Efficiency test subject to further completion of Tier 2 model case studies. It is also considered that the associated modelling demonstrates a minimum whole-life cost approach for standard renewals.

However, among the key drivers for renewals expenditure in CP5 are NOS and ETCS, which could be argued as enhancement rather than renewal type activities. Regardless of the funding mechanisms the timing of the rollout of both NOS and ETCS raises both risks and opportunities in AMCL's opinion:

- NOS - the rollout of NOS has been predicated on a business case which is outside the mandate of this review but is understood to be considered generally robust by the ORR. Whilst there are undoubtedly Operational cost benefits to the consolidation of control centres and reduction in Operational headcount, it is critical that the business case also considers destroyed asset life, i.e. the residual value in any assets being replaced via a NOS renewal prior to the expiry of the assets' lives. This is particularly relevant for any accelerated NOS rollout such as the 9% increase in spend on NOS interventions in LNE Route. The whole-life cost of new asset creation must be assured to also consider the cost of any associated asset rationalisation.
- ETCS - the ETCS rollout is acknowledged to be currently aligned with the wider industry ERTMS programme and the appropriate fitment of rolling stock technology. Whilst the initial rollout of the technology occurs in CP5 for some Routes a number of others are not impacted for 30 plus years. AMCL has not seen evidence that opportunities have been considered for earlier rollout of ERTMS in specific Routes where capacity and access are currently a particular concern. Although out of scope of this review, consideration of how these issues could potentially be mitigated by implementation of ERTMS should be undertaken subject to appropriate business case and wider industry alignment. Acceleration of ETCS/ERTMS rollout, cognisant of the points made above about destroying asset value, is not a scenario considered in the SBP.

4.4.2 Application of Asset Policy

Although devolution has changed the organisational structure and strategic planning process of Network Rail, the asset intervention plans for Signalling remain based on 'bottom-up' workbanks at both the Route and strategic modelling levels. To achieve this, the Route workbank is extracted and input directly to the ICM (Tier 1) model and includes every interlocking and SEU, although the final SEU count is taken from the SSADS (Signalling Schemes Asset Data Store) database.

During the review it was evidenced by Network Rail that the RAMs are provided with all relevant modelling output from the central organisation, which is based on SICA[14] derived condition renewal requirements. The availability of SICA data also informs the prioritisation of works across different assets and systems within the overall Signalling asset base, although this is reliant on SICA inspections being up to date. AMCL has previously reviewed the use of the SICA tool in detail and made a number of recommendations for its development.[15]

With a SICA informed theoretical renewal date, the RAMs then consider the specific contexts of the Route and its asset base to establish Engineers Renewal Dates where appropriate and continue through an iterative workbank development process as shown below.

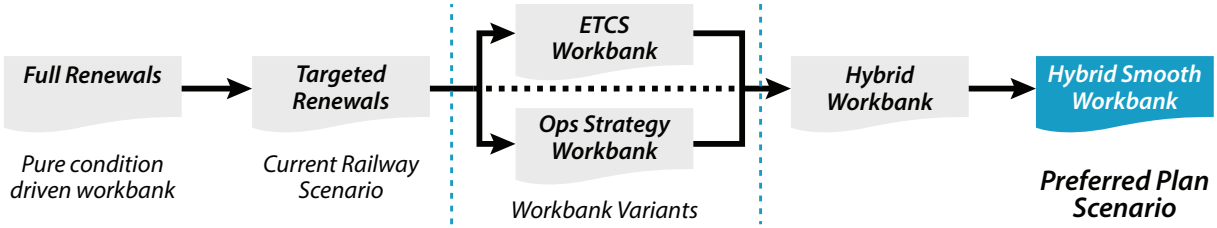


***Diagram* 8:** CP5 Signalling Workbank Iteration

The RAMs apply the Asset Policy derived workbank rules to establish appropriate worktypes. Workbank rules used in the development were included in the published SBP Policy. Although, full alignment with the final SBP revision of the Signalling Asset Policy had not been validated by the Routes when AMCL met with them in February 2013, this was not considered an issue due to the consistent HAM/RAM interaction and knowledge of any changes. The actual document followed for workbank development was "CP5 Signalling Workbank Rules" and was considered to have remained consistent throughout the SBP development process except for an amendment relating to the NOS to allow for the removal of 'islands' of recontrol.

14 *Signalling Infrastructure Condition Assessment*
15 *Review of SICA and Signalling Renewals Volumes, Version 1.1, AMCL, May 2011*

As a matter of note, none of the Signalling RAM teams met with had available a 'signed' copy of the latest Signalling Asset Policy.

The workbank development process progressed from full workbank, through targeted workbank, ERTMS workbank (driven by train fitment), NOS workbank (driven by the national business case), Hybrid workbank (merging the targeted ERTMS and NOS workbanks) and finally a Hybrid Smoothed workbank. To achieve the final smoothed workbank the Hybrid Workbank is reviewed and refined with the relevant Network Rail Investment Projects (IP) team, who in turn work with the relevant Framework Contractor (see Section 4.4.6).

The management of workbank variations was clearly evidenced through a Change Control process and qualitatively justified. Where deviation from Asset Policy was proposed by a Route, this was also managed through change control and nominally justified and agreed with the HAM. As previously discussed, the DRAM has the final authority on the asset interventions within the Route Plan. This has inherent risk of deviation from Asset Policy but no consistent and material deviation was noted without relevant justification at Route level (see Appendices C and E for specific details).

The overall variance between IIP modelled numbers and Route Plans submitted as SBP was analysed by Network Rail in SBPT223, as shown below. Please note this analysis considers Signalling and Level Crossing expenditure combined.

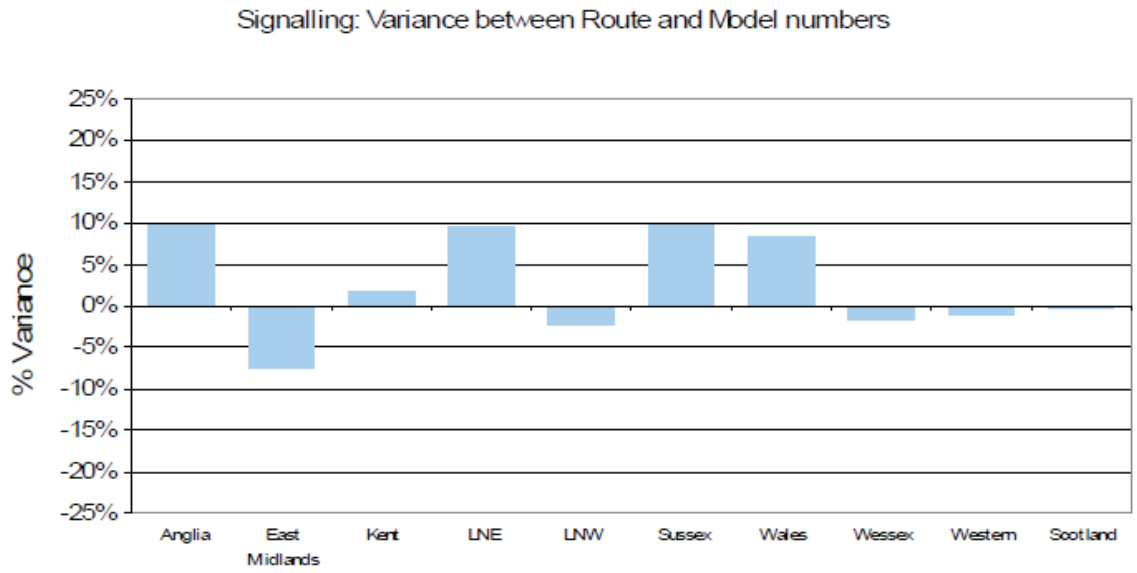


***Diagram* 9:** Variance of Total Forecast Renewal Expenditure over CP5 to IIP Modelled Numbers - Signalling

The key variations were generally justified by the Routes and largely driven by changes to the NOS rollout and Route specific factors such as asset condition knowledge and work packaging. See Appendix E of the accompanying Appendices document for further details. The key drivers for the largest deltas were identified by Network Rail as:

- Anglia - changes in Level Crossings volumes and costs;
- East Midlands - reduced costs resulting from changes to level Crossing interventions;
- LNE - change in NOS interventions;
- Sussex - increase in minor Signalling works; and
- Wales - Port Talbot HLOS scheme.

With respect to Minor Works, the Network Rail Routes also clearly demonstrated the relevant workbank and its development in accordance with the workbank rules which are aligned with Asset Policy. In terms of budget allocation, the Routes identified that there was no specific cash threshold or documented rules to differentiate Minor Works from Opex or Capex funding. The approach was considered as a general 'rule of thumb'. An example given was the conversion of filament signals to LED type being classified as Capex as it is a change to the asset, as opposed to a like-for-like replacement. AMCL does not consider this a material issue which impacts the robustness of costs for CP5 but it is an area which could be more formally defined to assure full understanding of funding requirements and allocation for stakeholders in the future.

As with the other workbanks, the Minor Works acts as an input to the ICM (Tier 1) for overall costs and volumes. However, there are two parallel workbanks developed to ensure that national spend is controlled and this makes monitoring and configuration control of the workbanks more onerous. The process is managed via the HAM/RAM Change Control process, supplemented by the various stakeholder meetings and communications, which was well evidenced by Network Rail. We did not identify any specific risks to the CP5 SBP as a result of this approach but would identify it as an area of potential risk given the values of Signalling 'Minor works / life extension' during CP5:

- CP4 Actual / Forecast = £442m;
- CP5 Pre-efficient = £619m (largely due to revisions to Asset Policy); and
- CP5 Post-efficient = £542m.

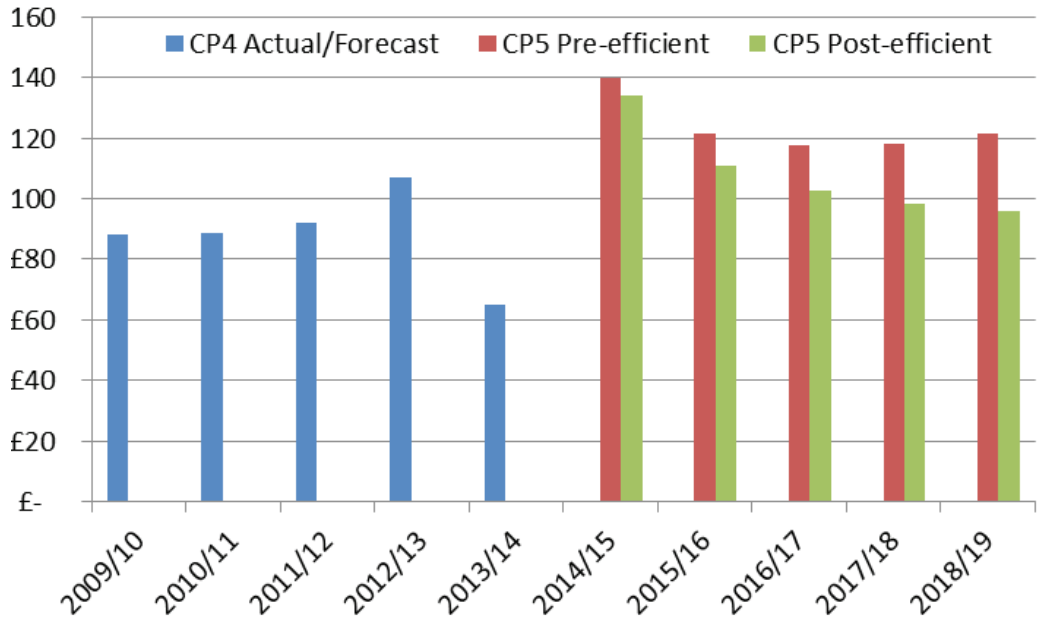


***Diagram* 10:** Network Rail Signalling Minor Works/Life Extension Costs (£millions)

4.4.3 Asset Information

With respect to the underlying asset data upon which the renewals planning process was based, Network Rail clarified that:

- The Route teams are informed by the SICA process, which was generally shown to be up to date in the Routes, and regular site visits;
- The base asset list is also validated between SICA and SSADS;
- SEU counts were validated at the IIP stage of the SBP development programme and SICA availability was subsequently validated for SBP; and
- There was also on-going validation and review with the HAM team throughout the SBP development process.

Following the validation of the SEU count as part of the process, it is considered that combining this with up to date SICA scores provides a reasonable asset data set for the development of renewal plans. Although AMCL retains some concerns around the accuracy of nominal asset lives and potentially conservative degradation curves informed by SICA (see Arup report[16] on the Signalling WLCC (Tier 2) model), the availability of a fully up to date SICA database is the key underpinning asset information to support the SBP development process.

16 Arup Mandate AO/035

4.4.4
Unit Costs

As per Section 1.4, the detail of the Unit Costs analysis is being undertaken by Arup under a separate mandate.

In general terms, Network Rail's Signalling Unit Costs and their use are considered comprehensive and well defined in relative terms to other asset disciplines. A consistent suite of worktypes and associated Unit Costs are defined via Framework Contract rates on a Route-by-Route basis. The relevant Unit Cost rates were evidenced as applied in the Route Plans based on sample audits during RAM meetings.

Discussions with the RAM teams on Unit Costs identified that:

- The SEU rate includes a figure for remote condition monitoring equipment fitting and this is documented in the 'Signalling Unit Rates and Assumptions' document;
- Unit Costs were developed using Contractor average rate (including geographical factors and efficiencies), then addition of a contingency, Network Rail Project Management and other costs, to produce a bottom-up rate;
- Variances in Unit Costs across the Routes are largely due to differences in core contractor rates;
- The bottom-up development of Unit Costs for worktype 2 was demonstrated by one RAM team; and
- For minor works the costs are based on historical data of equivalent works and the build-up is documented in the local Route workbank.

With respect to the overall use of unitised costs, Network Rail identified that:

- CP5 total post efficient signals spend = £3,490m;
- CP5 total post efficient unit cost driven spend = £2,556m;
- CP5 total post efficient non unit cost derived spend = £934m; therefore
- % of spend that is not covered by unit costs in ICM = 27%.

This high-level analysis defines a higher ratio of non-unitised costs than was apparent at the Route level sample audits and in the general impression of the use of Unit Costs provided by the RAM teams. See Section 7.4 for discussion of Maintenance costs and the associated use of Unit Costs.

4.4.5 Efficiency

As per Section 1.4, the detail of the Efficiencies analysis is being undertaken by Arup under a separate mandate.

This Section provides an overview of the CP5 renewals efficiencies for Signalling. Maintenance efficiencies are more generic and are considered in Section 7 of this document.

For the Signalling asset discipline, including Level Crossings, Network Rail has estimated that up to 10% (£380m) of embedded efficiencies, i.e. those efficiencies captured in the revised Asset Policy for CP5, will be realised. This includes the application of an embedded scope assumption of 10% SEU volume reduction against 'full' resignalling worktypes.

On top of these embedded efficiencies there is an 18% efficiency target for Signalling in CP5, second only to Track and level with Electrical Power in terms of overall magnitude. The 18% consists of 16% Unit Rate efficiencies and a further 2% 'stretch' efficiencies.

At the time of the review there were no specific plans available for the 2% 'stretch' efficiencies but Network Rail clarified it expected this to be achieved through ERTMS and ORBIS efficiencies and other value engineering savings. It was noted that Network Rail considered specified ERTMS efficiencies inappropriate within the SBP given the current development status at that stage, even though there are conventional aspects of ERTMS.

The average of 16% efficiency in unit rates over CP5 consists of the following:

- 9% supplier efficiencies;
- 3.5% NR efficiencies; and
- 3.5% collaborative working.

It is understood that the efficiencies have been centrally implemented in the ICM and the Routes have not sought to build a bottom up view. The Routes reviewed each centrally identified efficiency and decided which efficiencies to accept. Although each efficiency has a centrally defined business case, the absence of Route context specific business case and documented local delivery plans for the efficiencies is considered by AMCL to challenge the robustness of the potential efficiency gain at this stage.

At a Route level, the profile of pre to post-efficient spend in the Signalling asset discipline can be seen in Diagram 11.

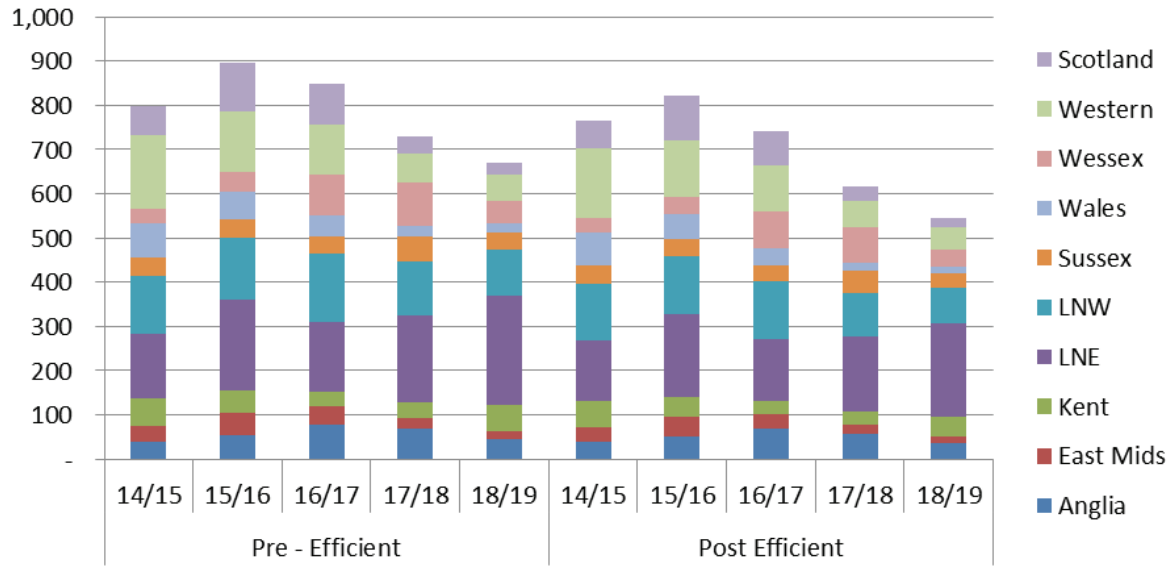


***Diagram* 11:** Signalling Efficiency Forecasts by Route (£millions)

The variable cumulative efficiencies accepted per Route and captured in the Route Plans for Signalling are shown in Diagram 12.

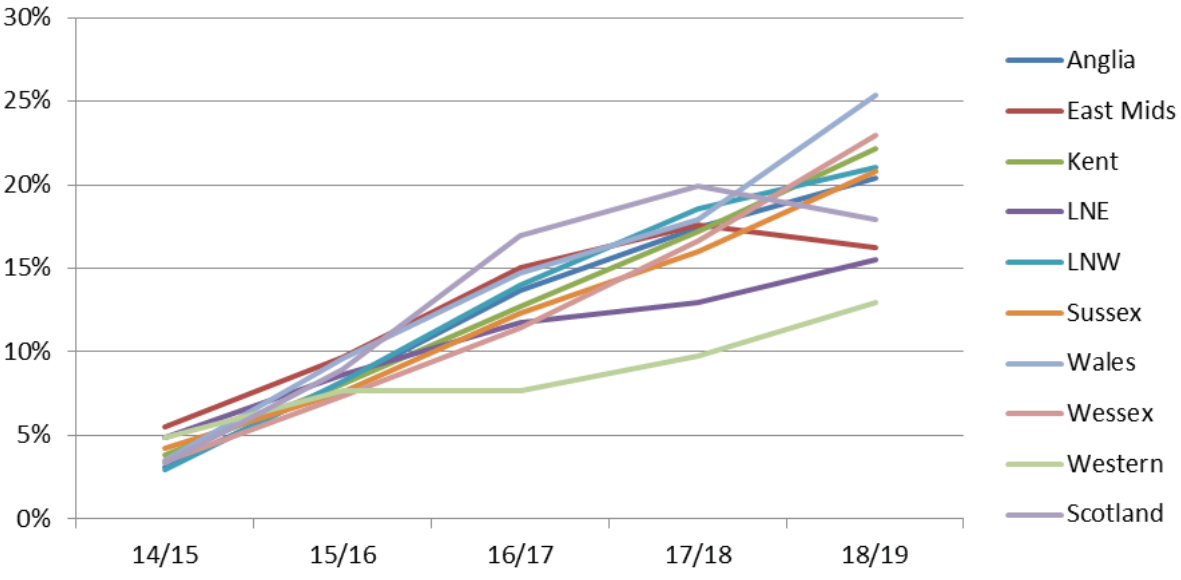


***Diagram* 12:** CP5 Efficiency Profile by Route

Key factors to ensure the delivery of these efficiencies were identified by Network Rail as:

- Contractual requirements on suppliers to deliver efficiencies;
- Contractual rights to use secondary suppliers if primary suppliers fail to achieve efficiencies;
- Contractual rights to competitively tender up to 20% of work in each Framework Contract area;
- Establishing a partnering approach with suppliers, including providing suppliers with visibility of the long-term workbanks to manage the efficient retention of skilled workforces and provide confidence in long-term workloads; and
- A focus on a 'right first time' approach which generates more robust remits and minimises costly contractual changes.

The establishment of the Framework Contracts and the transfer of a large proportion of the efficiency risk to suppliers on a contractual basis, allied with the other initiatives identified, appear to provide a robust approach to achieving the 16% efficiencies.

The existence of unidentified 'stretch' efficiencies for CP5 is considered a risk to the robustness of CP5 funding submissions. The risk is recognised and accepted by Network Rail but it is considered delivery of the efficiency may require on-going monitoring during CP5 to assure that efficiencies are being identified in appropriate areas.

4.4.6 Deliverability

The approach to Signalling deliverability assurance at this stage is understood to be that the Route RAM teams liaise with the relevant Network Rail Investment Projects (IP) team to review issues and potential work packaging and smoothing options. In turn, IP liaise with the relevant Framework Contract suppliers to undertake an equivalent review. Issues are then managed on an iterative basis.

In practice, it was noted by the Routes (see Appendix E) that tripartite reviews involving Route teams, IP and suppliers were relatively common place and would appear sound practice.

None of the Routes identified any material issues with Signalling deliverability through CP5 and felt they had been appropriately assured by IP against the current workbanks. In Network Rail's own deliverability assessment (SBT3302), the only significant constraint noted is the limits on specific

key competences (Signal testers, etc.) at key bank holiday renewal dates. Network Rail considered this a risk that could be managed via detailed planning closer to the dates.

As a result of the above findings and the relatively early stage of the deliverability assessment and delivery plans for CP5, no significant deliverability issues were identified for Signalling. In AMCL's opinion this is relatively surprising given the approximately 63% increase in pre-efficient Signalling renewals spend from CP4 to CP5. This may require further review prior to the publication of Network Rail's CP5 Delivery Plan.

4.5 Level Crossings

4.5.1 Overview

For CP5 Network Rail has developed a separate Level Crossings Asset Policy for the first time. This is considered to be a significant advance in the management of Level Crossings as a system and includes consideration of:

- Safety - achieving the most efficient management of the road/rail interfaces at Level Crossings; and
- Performance - determining the most efficient and effective way to manage Level Crossings as a system within Network Rail.

The new Level Crossings Asset Policy recognises safety risk as a key driver and is seeking to augment the 27% reduction in risk forecast in CP4 with a further 8% reduction in CP5, with elimination of Level Crossings the primary option to reduce risk where feasible. As previously stated (see Diagram 3), AMCL considers the direct links between planned asset interventions and high-level outputs such as this currently constrained.

The overall approach to development of the Level Crossings workbank and application of Asset Policy and development of Unit Costs is similar to the approach for Signalling as a whole, as discussed in the previous section. Condition intervention timing and options remain largely as per the overall Signalling asset discipline, with opportunities to reduce risk incorporated into the decision criteria. This in turn is supported by a Level Crossings specific Tier 1 model, which brings together safety and economic considerations. The review of that model is outside of AMCL's mandate for this work and is being considered by Arup as part of its overall review of Network Rail's SBP[17].

17 *Arup, SBP Review Report, March 2013 (TBC)*

The opportunity to reduce Operational costs associated with Level Crossings is also a key part of the Asset Policy and examined as part of the overall NOS. As can be seen in the chart below Level Crossings expenditure goes up from approximately £200m in CP4 to approximately 550m (pre-efficient) in CP5. The reason for this increase in spend is largely due to volumes increases driven by NOS. Approximately 93% of Level Crossings spend was identified as managed through wider Signalling works.

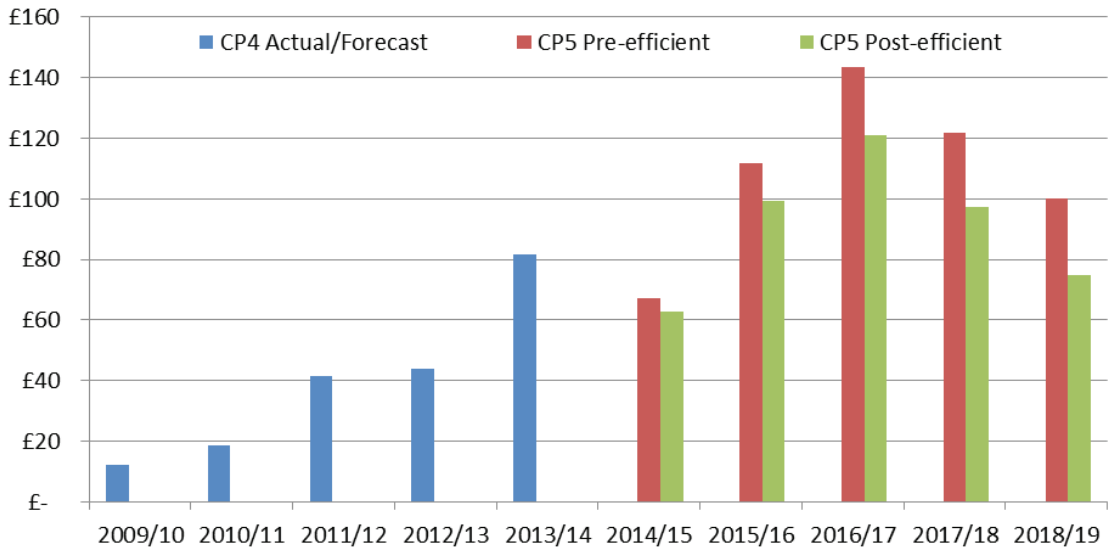


***Diagram* 13:** Network Rail Level Crossings Costs (£millions)

AMCL retains the same concerns related to the impact of NOS on residual asset lives for Level Crossings as discussed in Section 4.4 for the wider Signalling asset base.

The key challenge identified by Network Rail is to reduce the timescale associated with Level Crossing interventions, including the issues impacting on its ability to modularise the delivery of Level Crossing upgrades.

At the Route level Network Rail demonstrated the equivalent workbank development process and stages used in the wider Signalling approach for all 'signalled' Level Crossings. This included considering the ALCRM (All level Crossing Risk Model) score, intervention plans and workbank iterations through to the final Hybrid Smoothed workbank. It was also noted that:

- The intention is to align Level Crossings renewals/work with major signalling renewals whenever possible and this was demonstrated for a number of significant renewal schemes;

- There are general workbank rules for Level Crossings but they don't currently cover all eventualities and some works are aligned with other sources of funding, such as the national Level Crossings Safety Fund (£65m for England and Wales and £10m for Scotland as per HLOS); and
- For Level Crossings work identified as extra work during the early stages of a major signalling renewal, the funding could be sourced from a number of options including the Level Crossing Safety Fund.

In AMCL's opinion there is currently a need for further work to be undertaken to fully understand how the centrally controlled Level Crossings Safety Fund is to be both managed and attributed at Route level.

Other key areas of potential further assurance relating to Level Crossings spend include:

- The continued focus on the use of MCB-OD (Manual Controlled Barriers - Obstacle Detection) technology to reduce operational costs and mitigate risks at Level Crossings. Initial trials and early fitment of the technology, particularly in the Anglia and East Midlands Routes, has seen technical issues (such as in snow) and reliability concerns emerge. Further assurance of the long-term sustainability of the technology from both safety and performance aspects may be required.
- The availability of appropriate Level Crossings specific competence within the devolved organisation. The former core Level Crossings team in the central organisation has been dispersed across the devolved Routes, largely as part of a restructuring which sees Level Crossing manager positions established in each Route. Whilst this is logical, it has greatly reduced the central organisation lead team on Level Crossings in the short-term, which may impact on further derivation of appropriate technology and management of a modular and cross-network optimised approach. It is not possible to identify specific risks as a result of these changes currently but is considered by AMCL to be a factor which Network Rail should continue to monitor and mitigate, as required.

4.5.2 Efficiencies

Level Crossing specific efficiencies are identified from two key sources:

- Framework Contracts - effectively the same approach to Framework Contract as discussed in relation to Signalling but with specific Level Crossings contracts in place to achieve a forecast Efficiency of £61.3m (10.2%) over CP5; and
- Inspections - use of vehicle-mounted LiDAR (Light Detection and Ranging) systems to enhance and reduce costs of vertical profiling of Level Crossings and achieve forecast efficiencies of £28.8m (79%) over CP5.

Subject to appropriate performance and reliability of the LiDAR technology AMCL has not identified any material concerns with these proposed efficiencies. As per Section 1.4, the detail of the efficiencies analysis is being undertaken by Arup under a separate mandate.

4.6 Electrical Power and Fixed Plant

4.6.1 Overview

Network Rail's Asset Policy for Electrical Power and Fixed Plant has been substantially revised since CP4. The core change has been a move from an aged based Asset Management approach to a condition based approach. The Asset Policy also includes specific consideration of:

- Electrical safety factors which had been previously raised by the ORR and includes options for the retrospective application of safety initiatives identified as part of the on-going Isolation Safety Review project; and
- Improved management of Power Supply Capacity, which had been raised as an issue by AMCL in a previous review[18].

Diagram 14 shows the proposed renewals expenditure for Electrical Power and Fixed Plant combined during CP5 and, highlights the impact of the revised Asset Policy, including the focus on electrical safety and maintaining outputs in CP5 across an increased asset base with improved

18 Asset Management on Sussex Route to achieve Sustainable Performance, version 1.0, AMCL, 12th December 2011

asset condition knowledge in some areas. The increase in expenditure in the final year of CP4 is examined further in Diagram 15.

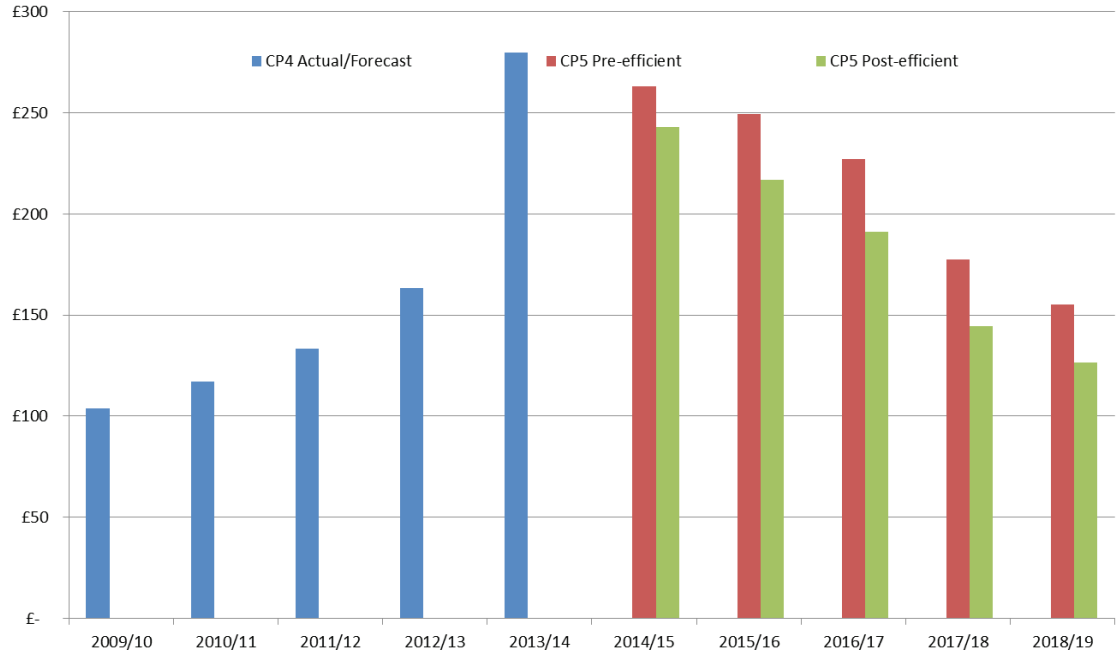


***Diagram* 14:** Combined Electrical Power and Fixed Plant Expenditure (£millions)

The impact on the breakdown of costs across the variable asset base between CP4 and CP5 (pre-efficient) can be seen in Diagram 15.

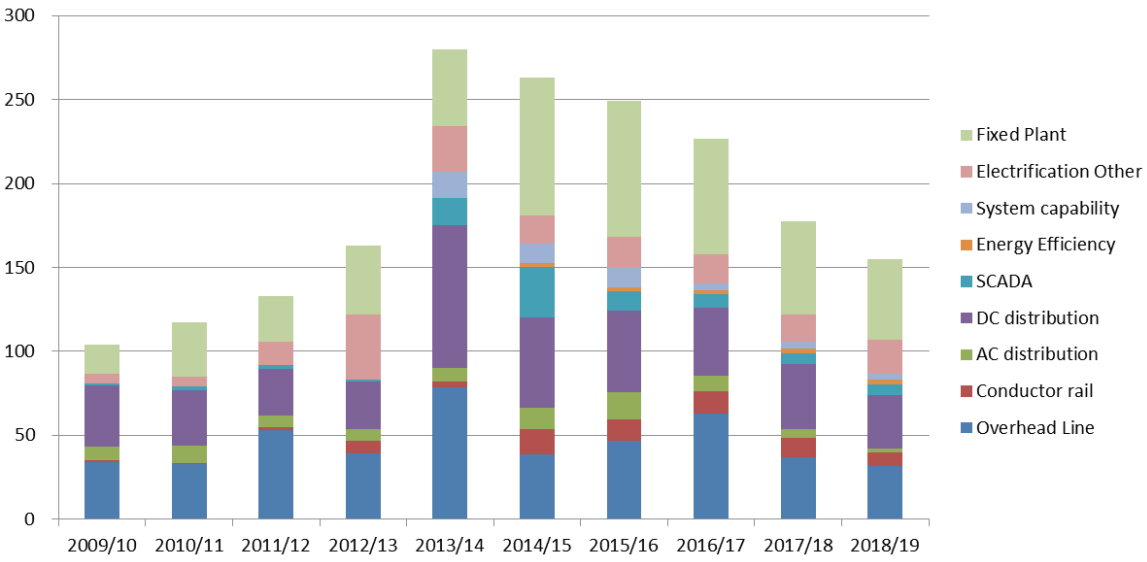


***Diagram* 15:** CP4 to CP5 (pre-efficient) Expenditure (£millions)

Whilst on-going major renewals of Overhead Line, such as in Anglia Route, are understood to be partly responsible for the increase in costs in the final year of CP4 and early years of CP5, Overhead Line asset interventions as a whole for CP5 have moved to less high volume campaign changes and more mid-life refurbishment activities.Whilst campaign changes are not precluded where required the main change is the scope and differentiation of condition re-setting interventions by criticality band. The Asset Policy and associated modelling has identified this approach as a more efficient way to re-set wire run condition and maintain outputs over the long term.

DC Distribution expenditure is understood to reduce in CP5 as the revised Asset Policy moves from the age based to condition based intervention approach. However, where condition data is unavailable age is used as an intermediate parameter for condition.

The use of age as a proxy for condition is an approach used across the Electrical Power asset base where necessary. This factor combined with the currently untested outputs of the revised Asset Policy, is considered by AMCL to be one of two key risks to the robustness of the CP5 SBP for the asset discipline.

This is further demonstrated by the increase in expenditure between CP4 and CP5 for Signalling Power Supplies, which is captured under 'Fixed Plant' in the above analysis. Increased expenditure is understood to be required to mitigate an aging and increasingly unreliable asset base which can have significant impact on overall performance. However, discussions with the Routes confirmed that Signalling Power Supplies was currently an asset type with one of the lowest (though increasing) levels of asset information maturity.

The second key risk identified by AMCL is that the Asset Policy documents are understood to have been evolving as the Route Plans were being developed. As a result both 'interim' (July and September 2012) and 'final' (December 2012) versions of the Asset Policy were referred to by the Routes. Verification of compliance with the 'final' (January 2013) Asset Policy was confirmed by the Routes as being 'on-going' at the time of the discussions. The Routes stated this process was expected to completed in March 2013 but that in theory the SBP Submission should be considered as compliant with either the July 2012 or September 2012 (dependent on Route) 'interim' Asset Policy until then.

Whilst this presents a risk to alignment between the final Asset Policy and the Route based costs and volumes submitted at SBP (as identified by AMCL during Progressive Assurance - see Section 2) it is understood to have been mitigated by the following:

- The variances and changes to the EP Asset Policy were dealt with in 'change control' between the HAM and the RAM teams and the completion of change control Logs was well evidenced during the review; and
- It was stated that although the Asset Policy document was updated during this period the key principles did not change, other than for conductor rail and the main policy amendments related to the safety initiatives which were central overlays in the SBP.

The implications of these changes are being assessed as discussed above at the time of writing and it is not currently known if the latest Asset Policy validation process will identify any misalignment between the latest Asset Policy and the SBP submission.

4.6.2
Application of Asset Policy

The application of the revised CP5 Asset Policy for Electrical Power and Fixed Plant was driven by 'top-down' modelling which was subsequently reviewed by the RAM teams to validate and revise the proposals in line with local contexts. The overall approach is captured in Diagram 16, as provided by Network Rail.

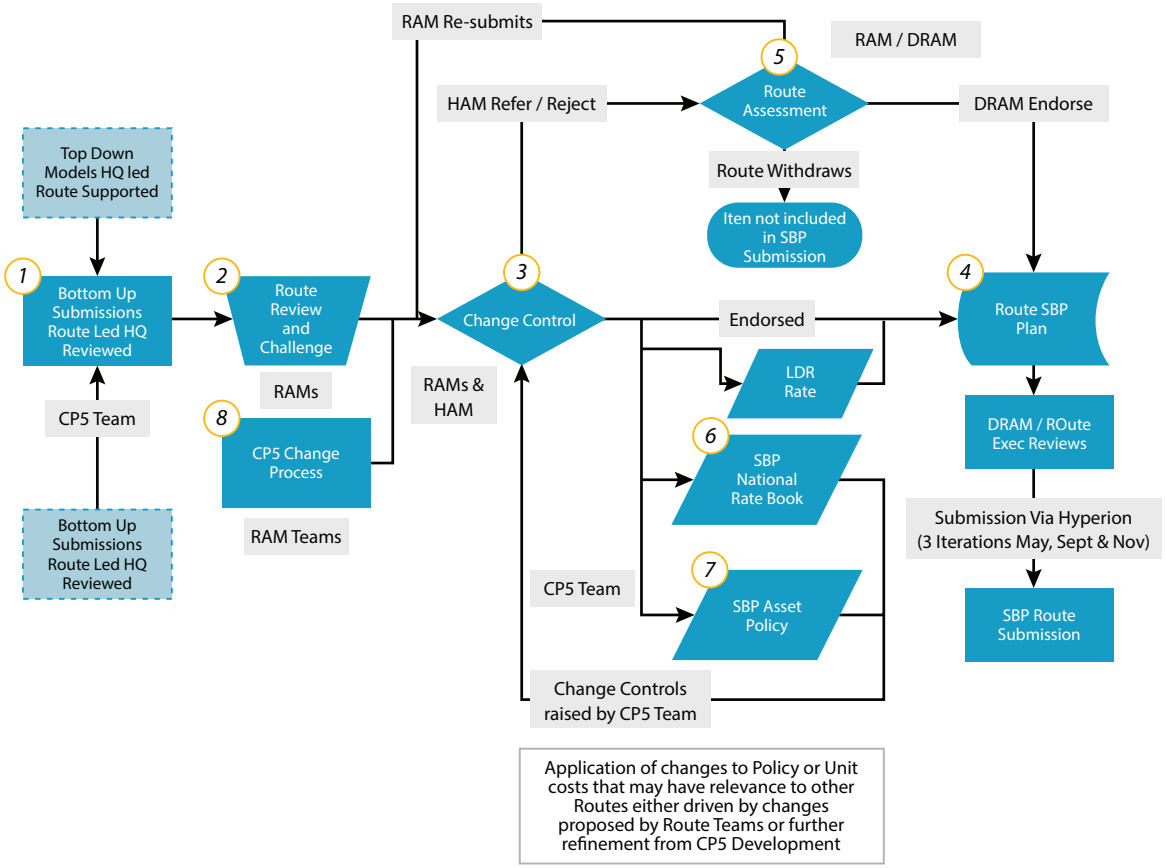


***Diagram* 16:** Network Rail's Electrical Power & Fixed Plant Route Plan Development Process

The 'bottom up' plan is understood to have been developed via the application of Asset Policy to an originally unconstrained workbank (i.e. not necessarily fully aligned with Asset Policy) which was based on condition data for key assets where available. For example, points heating and DC sub-stations have a condition scoring methodology but this represents only a portion of the asset base. Other assets have regular measurements applied as a proxy for condition, e.g. discharge gas testing, top-up requirements for 33kv fluid filled cables and insulation resistance testing for 650v cables. A degree of engineering judgement is understood to have been applied to these measurements to determine condition where necessary.

The RAM teams validated the modelled volumes using the 'bottom-up' workbanks, Route based asset knowledge, and other local factors e.g. network capability issues. The development of validated Route Plans for modelled assets was considered in parallel with the emerging Asset Policy documentation, as discussed in the previous section.

The workbank was updated through well evidenced change control and interaction between the HAM and RAMs. Where planned activity deviated from Asset Policy this was considered through the same process, with DRAM input required before any deviations were included in the final plans.

Criticality to service was considered for assets in the workbank and was subsequently used, together with engineering judgement and modelling, to produce the final submitted Route Plans. However, it was noted that due to the variance in the asset base included within the asset discipline and the range of maturity of the associated asset condition and criticality measures, the prioritisation of work across the asset discipline was limited to engineering judgement by the RAM teams.

Overall, the application of Asset Policy and its management via HAM/RAM interaction is considered sound by AMCL. However, in AMCL's opinion, the lack of comparable asset condition and prioritisation data in a consistent manner across the asset discipline, combined with the current model development being limited to the most critical asset types[19], induces risks relating to the overall optimisation of the workbank.

4.6.3 Asset Information

Network Rail has noted that the successful implementation of the revised Asset Policy and further confidence in the delivery of the required CP5 outputs is dependent on several enabling activities, including the following relating to asset information:

- *Enhanced asset information data quality– through our Asset Data Improvement Programme /ORBIS programme to improve intervention decision making activities;*
- *Improved business as usual asset condition data collection – to improve knowledge of asset degradation mechanisms; and*
- *Improved system utilisation knowledge through increased energy measurement and SCADA facilities.*

A significant amount of work on asset information for Electrical Power and Fixed Plant assets was noted by AMCL during the IIP and SBP development phases, particularly with respect to the ADIP. This is particularly the case for key asset types, where condition information was held or collated to support the 'top-down' modelling process. However, at Route level it was noted that the completeness and quality of the asset information, particularly asset condition information, was variable across the asset base. Formal condition assessments were noted as limited by the availability of staff to undertake them and the '1-5 condition scoring' required by the revised Asset Policy was used in generic terms at 'line-of-route' rather than at individual asset or component level. Particular issues related to Signalling Power Supplies, which had only been transferred to

19 *IIP 2011 review - Tier 2 Model for Electrical Power, Version 1.0, AMCL, April 2012*

the asset discipline at the start of CP4, and conductor rail in the South East region, where the use of the Conductor Rail Monitoring System (CRMS) was noted as not yet in day-to-day use but was prioritised over CP5.

4.6.4 Unit Costs

As per Section 1.4, the detail of the Unit Costs analysis is being undertaken by Arup under a separate mandate.

During CP4, Unit Costs for the asset discipline were generally acknowledged as less than optimal and a range of rework and development of further Unit Costs has been undertaken to support the CP5 SBP submission. This has been facilitated by data collection undertaken in parallel with internal benchmarking activities and the collection of project data in accordance with Network Rail's Cost Analysis Framework (CAF) requirements. It is understood that as well as detailed analysis and review by the relevant Network Rail IP teams the revised Unit Costs have also been reviewed by the RAM teams to assure buy-in.

The revised Unit Costs were built bottom-up from labour, plant, materials and an historical data based risk factor of 8% and then iterated to include:

- Contractor costs;
- Network Rail development costs;
- Network Rail design costs;
- Network Rail project management costs, which include IP and sponsorship costs and incorporate 'Support & Overhead' costs; and
- Network Rail possession management costs.

The Unit Costs are also negatively adjusted to account for forecast efficiencies over the period.

Overall, AMCL considers the revised Unit Cost for the asset discipline to be a significant improvement over previous control periods but the level of completeness and justification remains an opportunity.

The use of LDRs (locally derived rates) is still considered by AMCL as a prominent feature of the submission for the asset discipline, with an approximate 50/50 split of unitised and non-

unitised costs estimated in the submission by the Routes. One example is Anglia Route where approximately 54% (£85m) of funding for CP5 Overhead Line renewals is based on LDRs which is largely driven by the GE Project.

Locally derived rates are understood to have been developed by the Route teams using similar Unit Costs where possible, amended to take account of historical knowledge of recent projects, technical and local factors. The proposed LDRs were subsequently reviewed by the central organisation and an uplift of 3% applied to the LDRs in September 2012 to index for 2012/13 prices.

The issue of asset information also impacted Unit Costs where it is understood for Signalling power distribution the 'top-down' methodology for cost derivation was used in preference to 'bottom up' due to the lack of asset information.

The actual provenance of the LDRs utilised was found by AMCL to vary by Route, with some clearly more justified than others and derived from a mixture of sources such as live project costs (as is the case for the GE Project in Anglia Route), bespoke estimates or engineering judgement. However, although the use of LDRs may be appropriate in some cases, due to the variable evidence of their provenance at a Route level for the SBP and the lack of overall LDR development framework to assure the accuracy and reasonableness of the approach there are risks of inaccuracy and duplication in their use.

4.6.5 Efficiency

As per Section 1.4, the detail of the Efficiencies analysis is being undertaken by Arup under a separate mandate.

This Section provides an overview of the CP5 renewals efficiencies for the asset discipline. Maintenance efficiencies are more generic and are considered in Section 7 of this document.

As defined in SBPT3114, the noted potential embedded efficiency of the revised Asset Policy over CP5 is 18.8%, although this value does vary when considered over longer time periods, i.e. CP6 and CP7. However, it is clearly defined that a key enabler to this is further development of the asset information via the ORBIS programme. In order to provide a conservative estimate the business case proposes a declared embedded efficiency of 10.7%, or £154m. Notably, SBPT220 identifies

a final embedded efficiency saving of 10% or £104m, which would appear inconsistent but was confirmed by Network Rail as taking precedence as the higher absolute saving in the business case largely results from using the total E&P related costs i.e. including the 'faster isolations' works presented in the Investment Plan (SBPT224).

In terms of non-embedded efficiencies, the Electrical Power and Fixed Plant asset discipline does not currently have the established Framework Contracts across the asset base that the Signalling asset discipline benefits from. National Framework Contracts are understood to be in place with Siemens and ABB for 25kv switchgear from which the Routes are expected to benefit.

Further efficiency opportunities were identified by the central organisation with support from an external consultancy and included benchmarking against the Electricity Supply Industry, where appropriate, and other railways. To deliver the identified renewal efficiency savings four key initiatives have been identified by Network Rail:

- *EP1 - Programme optimisation: ensuring that there is an accurate forward view of the planned work, which is locked down and communicated to suppliers enabling improved supplier capacity management driving lower unit costs;*
- *EP2 - Standard scheme design: design effort is optimised by developing and leveraging standard scheme designs where possible;*
- *EP3 - Procurement: using standard specifications and market stimulation to expand the potential suppler base before leveraging volumes to drive down unit costs for materials and services; and*
- *EP4 - Delivery model: deploying the right workforce to the right projects using Tier 1 or Tier 2 contractors where appropriate but also building on the existing internal teams to develop capability.*

It is noted that these initiatives will commence in CP4 to realise benefits during CP5 and beyond.

The scale of the net benefits for each Efficiency business case is defined in the table below.

Efficiency	Net Saving (£millions)	Percentage of Total CP5 Renewals Spend
EP1 - Programme Optimisation	10.16	0.95%
EP2 - Standard Scheme Design	46.32	4.32%
EP3 - Procurement Initiatives	31.20	2.91%
EP4 - Delivery Model Initiatives	42.30	3.95%
Total	129.98	12.14%

Table 2: Electrical Power Renewal Efficiency Initiatives

The Efficiency delivery action plan was centrally led by the HAM team with involvement of the RAMs and teams. The actual level of involvement was described in varying degrees by the central organisation and the RAM teams. As with Signalling there is also considered by AMCL to be limited assurance to date of the achievement of the efficiencies at a Route level, including a lack of Route level business cases.

At a Route level, the profile of pre to post-efficient spend in the Electrical Power and Fixed Plant asset discipline can be seen in the chart below.

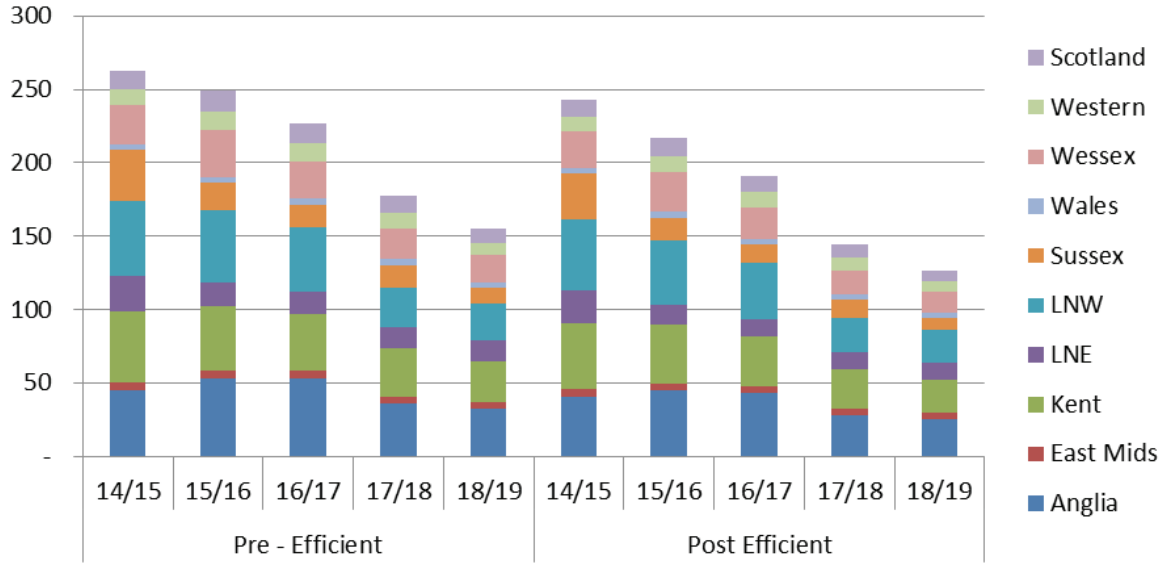


Diagram 17: Electrical Power Efficiency Forecasts by Route (£millions)

The variable cumulative efficiencies accepted per Route and captured in the Route Plans for Electrical Power and Fixed Plant are shown in Diagram 18 below.

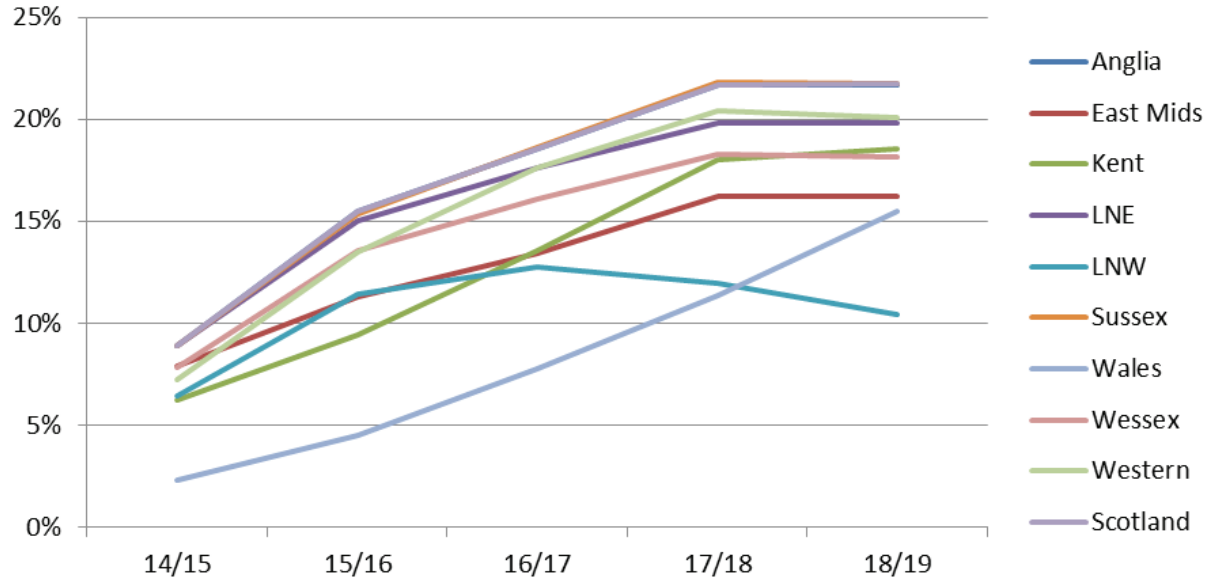


***Diagram* 18:** Electrical Power CP5 Efficiency Profile by Route

4.6.6 Deliverability

Due to the scale of new electrification and major Overhead Line renewals planned during CP5, Network Rail has identified that demand is likely to exceed the current market supply in key resources such as supervisors, managers, engineers and technical specialists.

The Asset Policy has considered the development of plans to support overall deliverability, including the phasing of Overhead Line intervention regimes and prioritising hook switch replacement on a risk basis. It also identifies key skill gaps and mitigation plans via the Network Rail 'Professional Development and Training' organisation and the current and future establishment of electrification specific training centres around the country.

Specifically for CP5 deliverability Network Rail has identified (SBPT3302) a range of mitigating actions:

- An integrated programme to analyse deliverability risks nationally;
- An IP Electrification resourcing strategy which is being jointly implemented with industry;
- Earlier supplier engagement and co-ordinating resources nationally;
- IP working with Route teams to agree technical specifications as early as possible; and
- The introduction of innovation for new electrification technology, being co-ordinated between IP and the new Central Energy Services organisation within Network Rail.

All of the above mitigations appear logical. However, AMCL would also consider them relatively standard practice which should arguably be in place already and therefore provide further assurance to the SBP deliverability at the point of publication.

At the time of writing, a number of the deliverability mitigations appear to be at an early stage of development. This may require further review prior to the publication of Network Rail's CP5 Delivery Plan.

4.7 Telecoms

4.7.1 Overview

The Telecoms Asset Policy and its application have both been managed by Network Rail's central organisation for CP5. Although maintenance and first line response is still managed via the Maintenance organisations in the Routes, supported by Area Telecoms Managers, there are no Telecoms specific RAM teams in the Routes. As a result AMCL has had less exposure to the tactical detail of the Telecoms approach for the CP5 SBP.

The key changes to the Asset Policy for CP5 are the introduction of service levels and interventions linked to asset criticality and the management of customers in three service groups.

Service levels appear to provide formal agreements between customers and the service provider and revised maintenance intervention regimes have been developed to support each service levels. As per the Network Rail assessment of Asset Policy Robustness, Sustainability and Efficiency - see Section 4.3 - AMCL considers that the revised approach, although logical and seen in practice in other industries, remains untested in the GB railway context.

It has also been identified by Network Rail that service level trials will only be completed in the second year of CP5, prior to full implementation of the new regimes. This would appear to introduce a level of risk to the necessary funding requirements for CP5 which has not been quantified to AMCL's knowledge.

The three service groups (Customer Services, Network Services and Railway Operational Services) are intended to inform technology strategy and focus the requirements of network management, people competence and skills. Customer Services is the most significant in terms of renewal volumes and costs for CP5, particularly with respect to Station Information and Security Systems (SISS) renewals. Network Services includes the construction of the Networks Operations Centre (NOC) and integration with Network Rail's NOS, Traffic Management and Electrification programmes. With the planed completion of the FTN and GSM-R technology rollouts within CP4 the Railway Operational Services has less impact on CP5 costs and volumes. Although, there was some apparent inconsistency with the allocation of FTN related funding in CP5 noted in some SBP sources.

The impact on costs between CP4 and CP5 as a result of this can be seen in the diagram below.

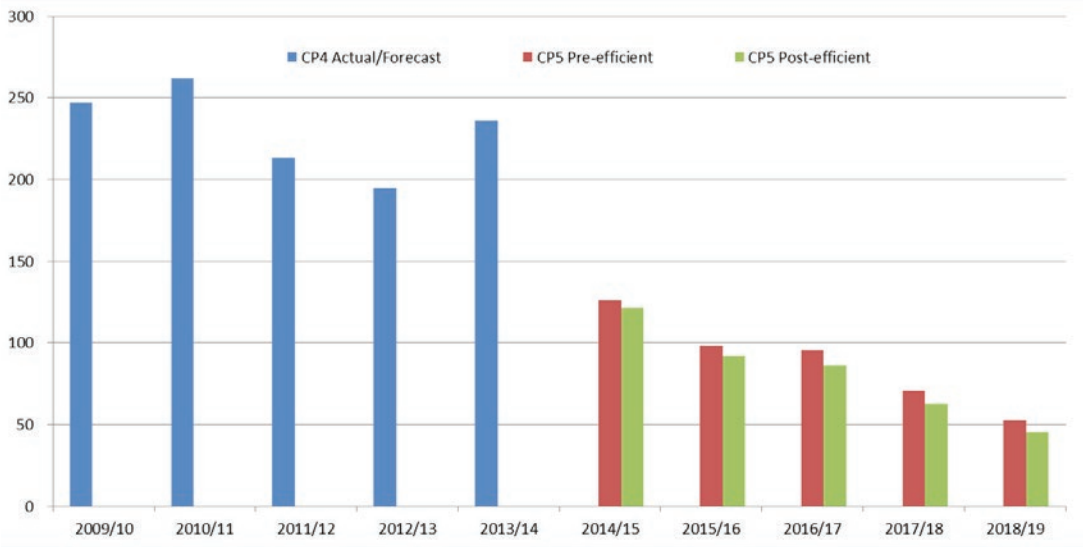


***Diagram* 19**: Telecoms Expenditure (£millions)

CP5 pre-efficient expenditure is approximately 62% less that CP4 expenditure as a result of the nominal completion of the FTN/GSM-R programme and the revised Asset Policy. The impact of the major renewal schemes completing in CP4 against pre-efficient expenditure for CP5 can be seen in the diagram below.

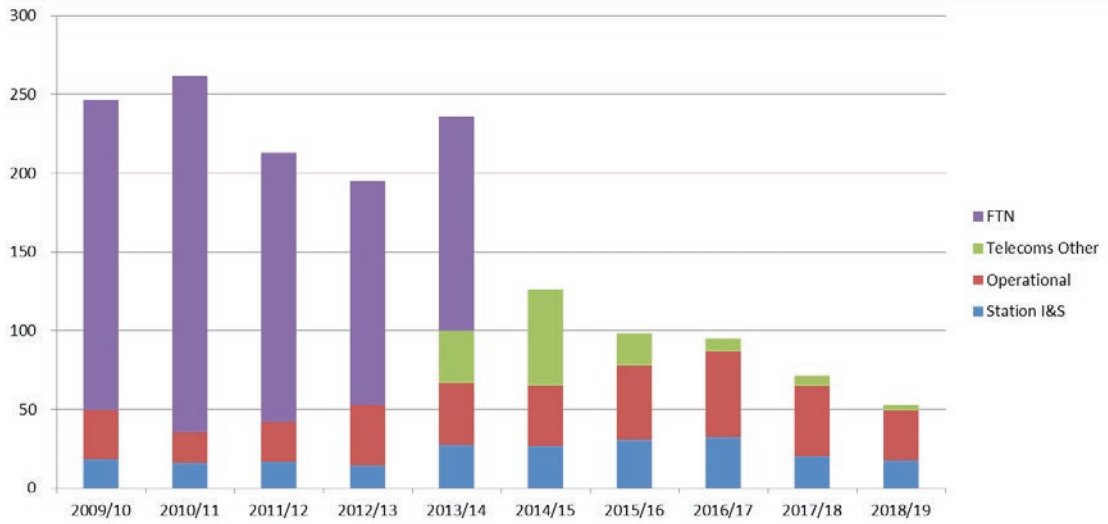


***Diagram* 20:** Telecoms Renewals - CP4 (Actual/Forecast) to CP5 (Pre-efficient) (£millions)

A key driver stated in the Telecoms Asset Policy for CP5 is the management of system obsolescence. Network Rail noted directly that obsolescence is a specific risk area in the FTN and GSM-R infrastructure, which it also identifies as 'very high' criticality Telecoms infrastructure. Furthermore, Network Rail also identified that should earlier than forecast replacement of FTN and GSM-R infrastructure be required as a result of obsolescence (or any other factor), investment currently planned for CP6/CP7 would have to be bought forward. AMCL notes some degree of obsolescence risk is considered in the 'Uncertainty Analysis' provided as part of the SBP publication and in the Asset Policy for a limited number of targeted renewals. Network Rail also clarified that obsolescence, is dealt with in one of two ways:

1) Where issues are currently known then these have been included within our plans albeit as cost profiles or non-unitised work types. For example, we know that GSM-R system components will require upgrades for both hardware and software without which the system would become unsupported by the supplier within the period of CP5.

2) Where issues are emerging then these have been included within our thinking behind portfolio QRA work.

However, it is AMCL's opinion that in general there is very limited linkage between the 'key' issue of obsolescence and the costs and risks considered in the Asset Policy and the associated modelling. This concern is augmented in our view by the fact that the most critical Telecoms assets - FTN and GSM-R - have not yet been modelled within the Tier 2 WLCC model (discussed further in Section 4.7.2). This is considered by AMCL to constrain the demonstrable Robustness, Sustainability and Efficiency of the Telecoms Asset Policy.

The limitations in the current Tier 2 modelling for Telecoms are also considered by AMCL to impact the demonstrability that Telecoms failures causing greater than 10 minutes delay can be maintained at CP4 output levels when the asset base is also increasing significantly. Although the Tier 2 decision support tool does not model at the portfolio level, like the Tier 1 model does, it is designed to inform the Tier 1 model. For each asset type considered the Tier 2 model is defined by Network Rail (SBPT3014) to model the "*impact of decisions on maintenance and renewal interventions and costs, and on asset related outputs (including age, condition, reliability and service risk) are modelled and links established between inputs and outputs*". Without this modelled understanding across a greater degree of the asset base and the most critical assets (FTN and GSM-R) to inform the Tier 1 model, AMCL considers the robustness of the output measure forecasts to be potentially compromised.

Overall development of the Asset Policy and management of the Telecoms asset portfolio within Network Rail now sits with the recently formed (2011) Network Rail Telecoms (NRT), as part of the central organisation. NRT's role is to be responsible for the asset life cycle, policy, development, delivery and support of the Telecoms asset base. NRT's stated vision is "*to be the rail industry's number one outstanding service provider of choice and to become a significant player in the UK communication market space*."

To support this role and vision NRT's structure includes:

- Customer and Service Management;
- Asset Design and Delivery;
- Product Development;
- Information and Network Security;
- Infrastructure Engineering and Field Operations;
- Network Operations & Assurance;
- Business Change; and
- Strategy.

There is a logic to the integrated, central management of the Telecoms network(s) within the organisation, as is there in considering the opportunity for commercial advantage via the utilisation of the various networks within NRT's control. However, a balance has to be assured between the commercial endeavour and providing value for money to funders. Unlike other asset disciplines, Telecoms does not have a direct Route based RAM and ultimately DRAM team who are independently responsible as end clients for sign-off of the scheme specification and acceptance

of the finalised scheme into the Route system. Instead the central organisation has regional teams responsible for the specification of telecoms systems, led by managers with principally the same accountabilities as the route RAM. They work with the Route DRAM/RAM and maintenance teams to manage the fit and performance of the telecoms system on each Route but do not come under the line management of the Routes or have the same Route specific objectives. It is that role of direct and independent 'intelligent client' to monitor and apply checks and measures to the scheme delivery agent that AMCL believes becomes potentially more ambiguous within a single entity organisation such as NRT. Network Rail has clarified that:

- The Professional Head plays the key role as intelligent client for Telecoms services delivered for operational railway use and the development and introduction of new operational services;
- Asset renewals or enhancement programmes have sponsors/project teams that build on requirements captured in standards and specifications to specify telecoms requirements specific to their application; and
- These engagements will also need to consider and have agreed appropriate service levels applicable to the overall performance required of that system.

This, along with the dispersed regional teams within the central NRT organisation, provides assurance that the risk is being considered but further definition and detail of alignment of objectives with individual Routes would provide greater assurance against the SBP submission.

4.7.2 Application of Asset Policy

Telecoms is a centrally derived asset discipline, resulting in the SBP cost and volumes submission being essentially the 'top-down' modelled numbers. In general this is considered to assure good alignment of the SBP plan with Asset Policy.

It is understood that renewals volumes and costs are based on first intervention dates and worktypes, derived offline in the Tier 3 Telecoms DST (Decision Support Tool). The Tier 2 model is used to derive further intervention cycles for an asset type, although assets, including the most critical assets are currently modelled in the Tier 2 model. Outputs from both these Tiers of modelling then inform the Tier 1 (ICM) model, which is aligned with Asset Policy and provides the 'top-down' plan.

The detail of the Tier 2 modelling for Telecoms is being undertaken by Arup[20]. However, it is

20 Arup Mandate AO/035

understood by AMCL that what Network Rail defines as 'very high' criticality assets (FTN and GSM-R) were not modelled prior to SBP as the intention was to prioritise assets for modelling based on impact on CP5 costs and there was not a high level of lifecycle data available for FTN and GSM-R at the time.

It is also understood that Network Rail intends to expand the model to include the most critical assets in the future. In AMCL's experience this would bring the Telecoms asset discipline more into line with current common practice whole-life cost modelling approaches.

4.7.3 Unit Costs

As per Section 1.4, the detail of the Unit Costs analysis is being undertaken by Arup under a separate mandate.

The number of Telecoms Unit Costs for CP5 has increased four-fold over CP4 with existing and new Unit Costs aligned with the three service groups identified in the Asset Policy. This is considered by AMCL to be a significantly stronger position than previously. It is also further assured by the central organisation concurrently developing the revised Unit Costs and Asset Policy. This provides good confidence of appropriate and consistent Unit Costs being used throughout the strategic planning process.

It is understood by AMCL that the Unit Costs were derived from CAF data, where available. Where CAF data was not available, recent projects or peer group estimates are understood to have been used.

Key points of note with respect to the robustness of the derivation of Unit Costs for Telecoms in the CP5 SBP are:

- The defined Unit Rates are subject to a number of key assumptions (SBPT3075);
- There is some variation in Unit Costs by Route, most notably in Wales and Western Routes; and
- The Telecoms Unit Rate and Assumptions submitted as part of CP5 SBP include a single line entry in the business plan for 'abnormals' within CP5 of over £7m.

4.7.4 Efficiency

As per Section 1.4, the detail of the Efficiencies analysis is being undertaken by Arup under a separate mandate.

This Section provides an overview of the CP5 renewals efficiencies for the asset discipline. Maintenance efficiencies are more generic and are considered in Section 7 of this document.

Network Rail identified embedded efficiencies of 5% (£22m) over CP5 as a result of the revised Asset Policy. The key renewal efficiencies are based on the following key steps in the supply chain:

- Workbank Planning - total efficiencies over CP5 of approximately £31.5m based on Workbank Lockdown (3.0%), Direct procurement (2.0%) and Packaging by Volumes (4.02%) and the assumption of achieving 70% lockdown of workbanks by year three of the control period;
- Technology - total efficiencies over CP5 of approximately £0.5m based on materials cost savings;
- Efficient Design - total efficiencies over CP5 of approximately £3m based on an assumption that bringing design costs in house for GRIP stages 1-4 will achieve a 10% saving giving an overall efficiency of 0.88%. This also assumes existing headcount and no additional training costs due to existing resources and competences within the organisation; and
- CCTV Contracts and Procurement - total efficiencies over CP5 of approximately £0.8m based on procurement efficiencies for Managed Stations.

As with other asset disciplines the business cases appear to exist at a strategic central level only and the robustness of tactical delivery appears limited to AMCL at this stage.

The NRT Plan (SBPT3226) also identifies one of the major risks to the SBP is the £35m unidentified stretched efficiency contained within the plan for Telecoms.

At a Route level, the profile of pre to post-efficient spend in the Telecoms asset discipline can be seen in the chart below.

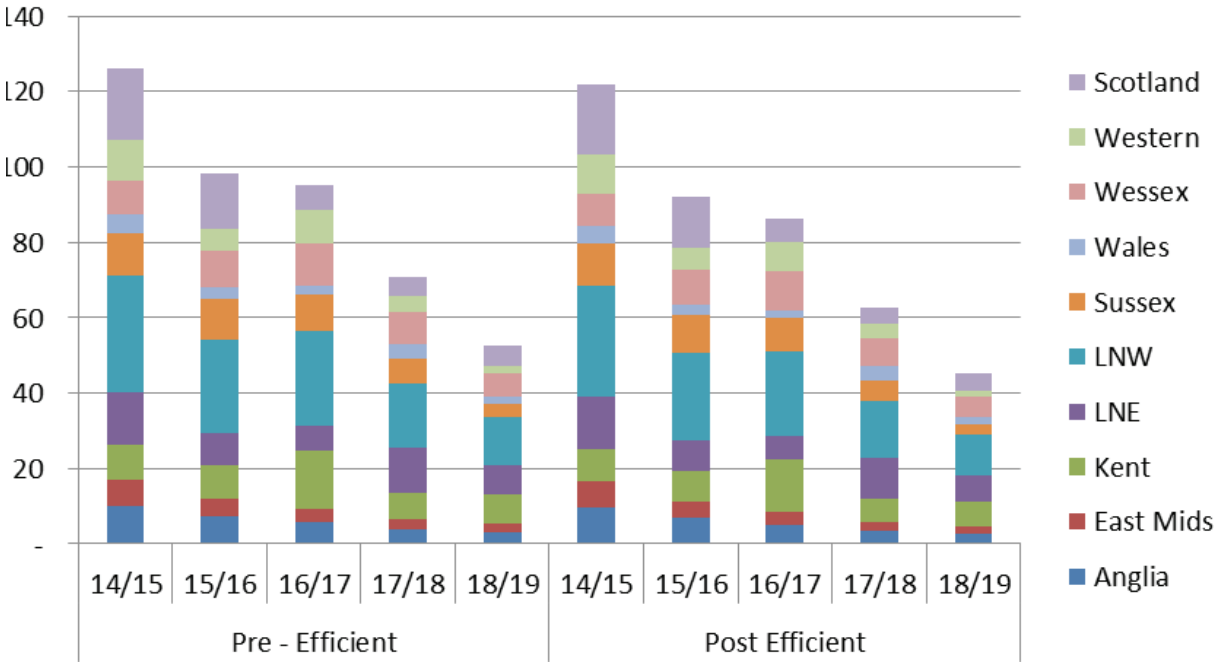


Diagram **21:** TelecomsEfficiency Forecasts by Route (£millions)

The variable cumulative efficiencies for Telecoms are shown in Diagram 22 below. The alignment of the various Routes' Efficiency profiles, relative to other asset disciplines, is considered reflective of the central organisation based approach to Telecoms.

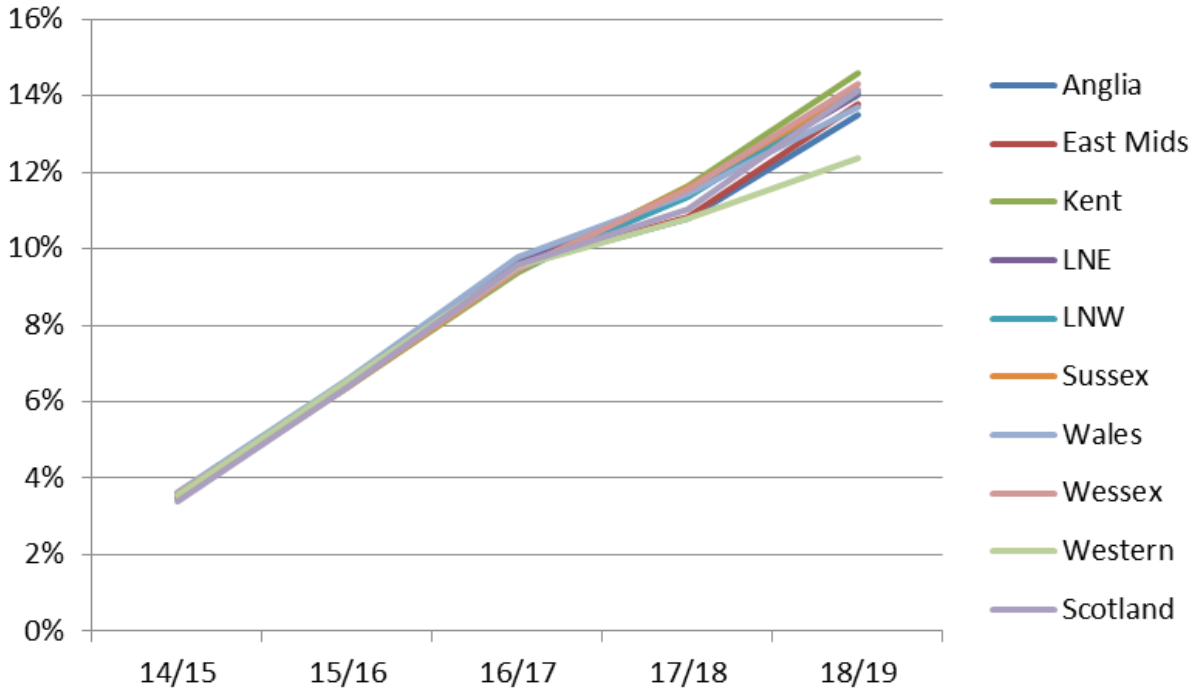


Diagram **22:** TelecomsCP5 Efficiency Profile by Route

4.7.5 Deliverability

No Telecoms specific issues were identified in the CP5 Deliverability Plan (SBPT3302). This is supported by a comparison of overall volumes to those achieved in previous control periods and further assured by anticipated iterations of resource smoothing, including the development of the CP5 Delivery Plan.

AMCL has not identified any material concerns with respect to deliverability of the Telecoms renewal plans, although we do note the following for consideration:

- At the time of writing, NRT is reviewing with the Routes the time that Network Rail's direct workforce will spend on maintaining the asset against working on capital projects;
- The use of legacy technology and services alongside modern technology will require continued monitoring and management of workforce and contractor competences; and
- The clarification of long term SISS asset renewals responsibilities remains an issue but is included within Network Rail's submission for CP5.

5 Strategic Planning Models

5.1 General Approach

As discussed previously, to support the development, validation and application of Asset Policies and to facilitate the central forecasting of longer-term asset intervention volumes, costs, efficiencies and outputs Network Rail has used the following three tier approach to modelling:

- Tier 1 – Strategic planning models (formerly known as Infrastructure Cost Models (ICMs)) which forecast work volumes, outputs and expenditures for an asset discipline, such as Signalling or Telecoms;
- Tier 2 – Strategic WLCC models which calculate the whole life cost for single asset types within an asset discipline, such as Point Machines within Signalling or Concentrators within Telecoms, for a range of asset intervention options and utilisation scenarios; and
- Tier 3 – Tactical models that support the specification and prioritisation of asset interventions in Asset Management plans, such as the Route Plans.

5.2 Modelling Principles

The key principles of each of the models within AMCL's scope of work for this review are detailed in Section 8 of each of the following relevant Asset Policies and are therefore not repeated here:

- Signalling - SBT3011;
- Electrical Power and Fixed Plant - SBPT3012; and
- Telecoms - SBPT3014.

5.3 Key Findings

AMCL undertook a review of Network Rail's own assurance processes in relation to the Tier 1 models. Whilst the quantity and level of detail of assurance and uncertainty analysis is significant, there are a few key issues that have been identified at this stage which may impact the level of confidence in the quality uncertainty analysis:

- Involvement of routes in the uncertainty analysis process;
- Consolidation between top-down and bottom-up views of uncertainty;
- Accuracy of SBP uncertainty figures based on preliminary uncertainty analysis;
- Further development of uncertainty analysis process in the near future;
- Varying levels of uncertainty analysis detail between asset groups; Telecoms in particular appears to have a lower level of detail; and
- Alignment of conclusions and supporting data between different documentation.

The following sections consider the key findings from a detailed review of the Tier 1 models for each of Signalling, Electrical Power and Telecoms. The detailed findings of the review can be found in Appendix M of the accompanying Appendices document.

The RAG (Red, Amber and Green) formatting, applied where appropriate, provides a high-level overview of AMCL's assessment of inconsistencies only and should be considered in conjunction with the detail provided in Appendix M.

The rows with the following headings provide a summation of a sensitivity analysis of key costs and volumes within the Tier 1 models and identify those asset types where changes to costs and volumes have the most significant impact on output costs:

- High Costs, Low Volumes (over CP5) - increase in volumes will contribute to substantial increase in overall costs;
- Low Costs, High Volumes (over CP5) - increase in volumes won't contribute to substantial increase in overall costs; and
- High Costs, High Volumes (over CP5) - increase in either costs or volumes will contribute to substantial increase in overall costs.

	Signalling	Telecoms	E&P
Unit Costs	Some inconsistencies for Signalling worktypes 51-52, 60, 62 and 64. Consistent alignment for Level Crossings	Consistent alignment.	Consistent alignment.
Maintenance Volumes	Consistent alignment.	No maintenance values in T0.	No maintenance values in T0.
Maintenance Costs	Consistent alignment.	Consistent alignment.	No maintenance values in T0.
Renewals Volumes	Consistent alignment.	Consistent alignment.	Consistent alignment.
Renewals Costs	Consistent alignment.	Consistent alignment.	Consistent alignment.
Degradation	Tier 1 degradation modelling consistent with Tier 2.	Tier 1 degradation modelling consistent with Tier 2.	Tier 1 degradation modelling consistent with Tier 2.
Policy Alignment	Tier 1 modelling consistent with Asset Policy.	Tier 1 modelling consistent with Asset Policy.	Tier 1 modelling consistent with Asset Policy.
*High Costs, Low Volumes (over CP5)**	None identified.	None identified.	None identified.

	Signalling	Telecoms	E&P
*Low Costs, High Volumes (over CP5)***	MCB-OD (conversion of existing MCB/MCB CCTV): Total Cost - £59.93m Total Volume – 82	Clock: Total Cost - £4 m Total Volume – 292 Power: Total Cost - £1m Total Volume – 155 Help point: Total Cost - £1m Total Volume – 124 DOO Mirror: Total Cost - £2m Total Volume – 110 PETS: Total Cost - £2m Total Volume - 70	LV cables: Total cost - £39.631m Total volume – 948.464 Structure renewal: Total cost - £36.008m Total volume – 621 LV switchgear renewal: Total cost - £25.913m Total volume – 332 Rewiring: Total cost - £9.81m Total volume – 278 Mid-life refurbishment: Total cost - £18.07m Total volume - 316
*High Costs, High Volumes (over CP5)****	MCB-OD full installation: Total Cost - £295.001m Total Volume - 297	CCTV: Total cost - £39m Total volume – 4,596 CIS: Total cost - £33m Total volume – 2,565	Signalling power distribution: Total cost - £163.13m Total volume – 2810.112
Other	Lack of alignment between asset headings in costs and volumes output within T0 makes it hard to compare.	Lack of alignment between asset headings in costs and volumes output within T0 makes it hard to compare.	Lack of alignment between asset headings in costs and volumes output within T0 makes it hard to compare.

Table 3: Key Findings of Tier 1 Model Review

* **Implications - increase in volumes will contribute to substantial increase in overall costs**

** **Implications - increase in volumes won't contribute to substantial increase in overall costs**

*** **Implications - increase in either costs or volumes will contribute to substantial increase in overall costs**

5.4 Computational Accuracy

The following sections provide a high-level summary of AMCL's review of computational accuracy of the Tier 1 models for Signalling, Electrical Power & Fixed Plant and Telecoms. More detailed summaries can be found in Appendices N-P of the accompanying Appendices document.

An overall risk rating for each of the models based on the computational structure of the underlying algorithms is included in each of the sections below. However, AMCL did not find any specific, consistent and material issues which were found to impact directly on the modelling of maintenance and renewal costs and volumes for CP5.

5.4.1 Signalling

The key computational accuracy findings with respect to the Signalling Tier 1 model are:

- Split into 2 models (top down and route) which allows an accurate audit trail to be kept between the 2 models.
- 64% risk rating – higher value means more chance of defects.
- Model maintainability issues:
  - Medium to high number of model variables which suggests complex logical modelling;
  - High amount of formulas containing a mix of cell references and numbers meaning that it can be difficult to maintain; and
  - Longest formula is 466 characters – difficult to maintain.
- Some formulas evaluate to an error:
  - However after additional checking, there is significant evidence to suggest that these do not affect the cost & volumes calculations.
- Critical priority sheets within the workbook are the calculation sheets:
  - 801_C_IXL;
  - 802_C_OS;
  - 803_C_MNT; and
  - 804_C_MNTProcess.

- Hidden sheets (these sheets define the hierarchies and geographies of the model and structure the variables. Hence they need to be kept in check as and when the model is updated):
  - 030_S_Dim_CostHierarchy;
  - 032_S_Dim_VolumeHierarchy;
  - 034_S_Dim_Headcount;
  - 036_S_Dim_OutputHierarchy;
  - 040_S_Dim_NetGeog;
  - 050_S_Dim_Scenarios; and
  - 080_S_Dim_ReportControl.

5.4.2 Electrical Power and Fixed Plant

It should be noted that although the core of the Tier 1 model for Electrical Power and Fixed Plant was developed by Network Rail, unlike other Tier 1 models, it was subsequently passed to an external consultancy (ICS) for further development to an agreed specification.

The key computational accuracy findings with respect to the Electrical Power and Fixed Plant Tier 1 model are:

- 64% risk rating - higher value means more chance of defects.
- Model maintainability issues:
  - Evidence of formulas evaluating to an error; and
  - Large number of array formulas, nested if statements, etc. – will be hard to change model if required.
- Critical priority sheets within the workbook are the calculation sheets:
  - 601_C_CostProfile;
  - 611_C_VolProfile;
  - 620_C_AgeProfile;
  - 621_C_AgeProfile_ResultsStore1;
  - 621_C_AgeProfile_ResultsStore2;
  - 630_C_OLE_Lifecycle;

  - 631_C_OLE_resultsStore;
  - 631_C_OLE_ResultsStore2;
  - 640_C_ConductorRail;
  - 641_C_ConRail_ResultsStore; and
  - 641_C_ConRail_ResultsStore2.

- Hidden Sheets - the majority of these new hidden sheets are unpopulated and hence simply make the model a larger file size. The hidden sheets appear to have the same interface and aesthetic values of other Tier 1 models which could indicate a future migration from the interface built by ICS Consulting to the more common Network Rail interface that is used in other models:
  - MenuSheet;
  - 120_I_Workbanks;
  - 010_S_WiringDiagram;
  - 000_S_Dashboard;
  - 700_C_Maintenace;
  - 800_C_NonFinancialOutputs;
  - 910_O_BespokeReport_1;
  - 920_O_SavedScenarioReport;
  - 020_S_VersionControl;
  - 930_O_SavedScenarioData;
  - 998_O_Tier0Export_SRS_RAMP;
  - 036_S_Dim_OutputsHierarchy;
  - 632_C_OLE_ErrorStore;
  - 034_S_Dim_Headcount; and
  - 050_S_Styles.

5.4.3 Telecoms

The key computational accuracy findings with respect to the Telecoms Tier 1 model are:

- 52% risk rating – mid tier risk rating meaning that the model still has a chance of having defects.
- Model maintainability issues:
  - There are no formulas evaluating to error;
  - Large number of array formulas, nested if statements, etc. – will be hard to change model if required; and
  - The "circular references" system warning has been hidden.
- Critical priority sheets within the workbook are the calculation sheets:
  - C_Calc_Volumes;
  - C_Calc_Con_Volumes;
  - C_Calc_Costs;
  - C_NOS_Service_Migration_Costs;
  - C_NOS_14_Future_Line_Volumes;
  - C_NOS_14_Projected_Renewals;
  - C_NOS_14_Costs_&_Volumes; and
  - C_Maintenance_Calc.
- Hidden sheets (these sheets define the hierarchies and geographies of the model and structure the variables. Hence they need to be kept in check as and when the model is updated):
  - 030_S_Dim_CostHierarchy;
  - 032_S_Dim_VolumeHierarchy;
  - 034_S_Dim_Headcount;
  - 036_S_Dim_OutputHierarchy;
  - 040_S_Dim_NetGeog;
  - 050_S_Styles; and
  - 070_S_ReportControl.

6 Whole-life Cost (Tier 2) Models

6.1 General Approach

The general role of the Tier 2 models is as defined in Section 5.1. Network Rail's generic approach to Tier 2 modelling is as shown in Diagram 23 below.

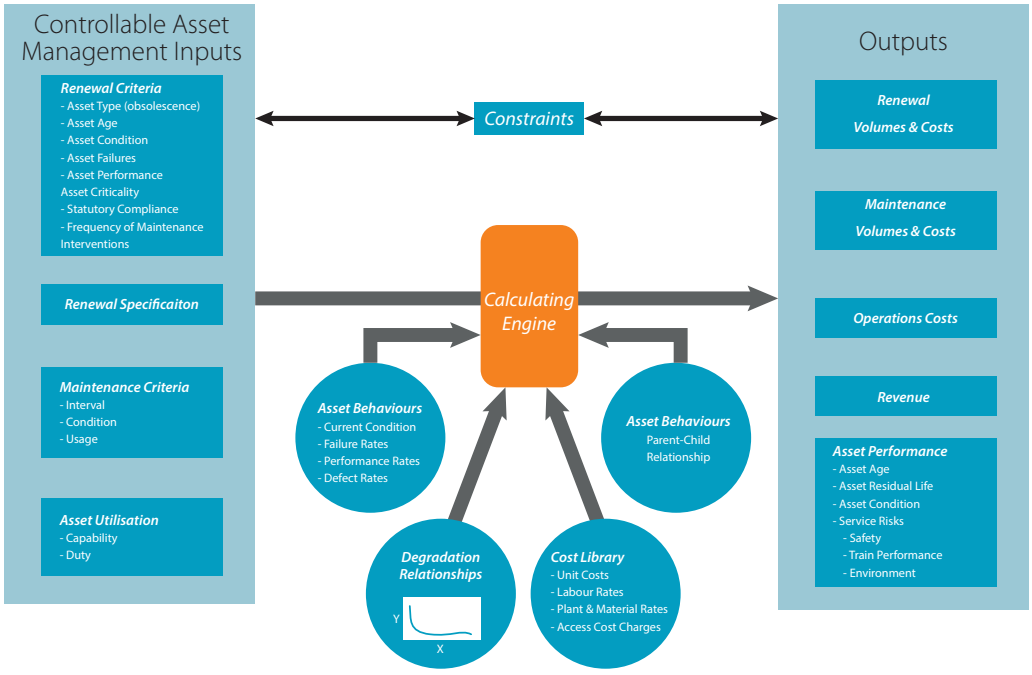


Diagram 23: Network Rail's Generic Approach to Tier 2 Modelling

6.2 Key Findings

The only Tier 2 model included within AMCL's scope for this review is the Tier 2 model for Electrical Power and Fixed Plant. AMCL has undertaken a previous review of this model in 2012[21]. In that review we concluded that the prioritising of the asset types to be modelled in the Tier 2 model in

21 IIP 2011 review - Tier 2 Model for Electrical Power, Version 1.0, AMCL, April 2012

terms of cost and criticality appeared robust but also recommended that further asset types be included in the modelling once the necessary asset condition data gaps had been filled. A detailed assessment of Network Rail's progress at the SBP stage against the recommendations in that report is included in Appendix Q of the accompanying Appendices document.

AMCL also undertook a review of Network Rail's own assurance process for the Tier 2 model for the Electrical Power and Fixed Plant asset discipline. As well as a review session with the Network Rail and ICS development team, the key documentation considered as part of this review was:

- Electrical Power Tier 2 WLCC: Example Case Studies; and
- Test Script for WLCC Phase 2 Tool.

As a result of this assessment AMCL considers that Network Rail has conducted a very thorough quality assurance and uncertainty analysis for the Tier 2 Electrical Power and Fixed Plant model, which appears to demonstrate a higher level of internal assurance than was established for the Tier 1 models. The work undertaken by Network Rail provides sound evidence that the model's functionality was working as intended and calibrated, via engineering expert review, in such a way so as to produce representative output/results relating to age, condition, asset count and costs.

AMCL's remaining concern is that there is no clear and explicit mention of how the underlying VBA code has been validated and assured on a line-for-line basis. It appears that the main way in which the code has been validated is through the use of test scripts and case studies to ensure that results are a direct function of the input data/relationships and not variances in the model functionality/ algorithms. In our opinion, the level of confidence in the model code's robustness would have been increased if there was an explicit line-by-line proofing analysis. However, the cost/benefit of undertaking this onerous analysis would have to be assessed.

6.3 Computational Accuracy

Computational Accuracy of the Tier 2 Electrical Power and Fixed Plant model has been conducted via XLAnalyst to identify key risk areas and samples of the VBA code have been assessed for robustness, accuracy and sustainability.

The computational accuracy analysis focused on the priority areas within the model, namely the "Calculating Engine / Model Core", which contains the Asset Configuration, Asset History, Asset Relationships, and Unit Costs. No issues impacting the overall costs and volumes proposed at SBP were identified.

The following model maintainability risks were identified:

- Formulas with mixed variables and values used which is an issue when updating the model;
- Evidence of formulas evaluating to an error; and
- Evidence of a some long formulas, complex formulas, array formulas, nested 'if statements', etc. – as these formulas are repeated, there could be an issue related to the knock-on effects of making one small error in the original template formula. As these could affect the output of the model samples have been checked and validated and proved satisfactory.

A more detailed summary of the computational accuracy findings is available in Appendix R of the accompanying Appendices document.

7 Route Plans

7.1 Format and Data Tables

Under the devolved organisation Network Rail's CP5 SBP submission was fundamentally based on the ten Route Plans, including Scotland which has a separate HLOS and funding arrangements, as 'bottom-up' plans. As previously discussed the overall balance of the 'bottom-up' or 'top-down' input to the final submission varied by asset discipline but was generally consistent across the Routes.

The Route Plans themselves have followed a largely consistent format which considers the overall business plan for the Route. The key chapters of the documents and associate variances are:

1) Introduction
2) Route Safety Improvement Plan or Route Safety and Sustainability Strategy
3) (*Route*) Performance Improvement Plan or Route Performance and Capability Improvement Plan
4) Capacity and Capability (some Routes only)
5) Route Network Availability Strategy
6) Operate (*Operations/Operating*) Plan
7) Asset Management Plan or Asset Management Strategy
    a. Strategic Overview
    b. Track
    c. Signalling
    d. Earthworks/Geo-technical Assets
    e. Structures
    f. Buildings
    g. Electrification and Plant
    h. Telecoms

i. Level Crossings
j. Drainage (some Routes only)
k. ORBIS (some Routes only)
l. Maintenance
m. Enhancements (some Routes only)

8) Deliverability and Assumptions or Route Delivery Strategy or Deliverability, Data and Assumptions or Route Delivery Strategy, Data and Assumptions

A range of main chapters, covering largely the same subject matter with Route Plan specific nuances, can be seen above. Whilst unambiguous consistency in approach would have been beneficial from a funding review perspective it is noted that the Route Plans are the product of the individual devolved Routes, each of which may have slightly different priorities and objectives. Variance in terms of structure was also identified at the sub-chapter level. This is not considered material to the overall funding submission as the various topics were found to be covered to some degree throughout the Route Plans. However, variance in the degree of granularity of subject matter coverage is considered more material to the justification of the overall SBP submission.

The scope of this review was focused on the Asset Management Plan/Strategy and the associated elements relating to Deliverability, Data and Assumptions in the final chapter.

The presented data tables in the Route Plans, relating mainly to maintenance and renewal costs, volumes and efficiencies were found to be consistent, although high-level across the Route Plans. It is arguable that the level of granularity of data presented in the Route Plans is appropriate for agood practice strategic business plan in generic terms. However, this has to be considered against the fact that the SBP, which the Route Plans are a key element of, is also the formal funding submission for a five-year government subsidy. Best practice would nominally require a more detailed breakdown and justification of the relevant maintenance and renewal numbers per Route as one of the key drivers of subsidy requirements. Significant further detail to augment the high-level numbers was presented in the SBP submission via the provision of various data tables and models. These are discussed further in Section 8 but being able to more directly align the maintenance and renewal numbers within the Route Plans with the supporting narrative may have been beneficial.

The format, scale and detail of the narrative within the Asset Management section of the Route Plans were also found to vary by Route and asset discipline, making direct comparison difficult. Again, this is logically affected by the current context, objectives and priorities of the specific Route

and/or asset discipline. Achieving core content alignment of the narratives to support the costs, volumes and efficiencies and unambiguously justify any deviation from Asset Policy and centrally modelled numbers on a consistent basis may have provided greater assurance and alignment with best practice.

7.2 Process

It is understood that the development of the Asset Management section of the Route Plans is the accountability of the DRAMs, with core input from the RAM and Maintenance teams and final sign-off by the RMD (Route Managing Director) as an integrated part of the overall plan.

As discussed in the section above, the variation in the format and content of the ten Route Plan Asset Management chapters appears to indicate that there is a degree of Route autonomy with respect to their development. The overall production and core structure is consistent and appears to follow the centrally defined template approach to Route Plan development seen in the early iterations during Progressive Assurance (see Section 2).

The need for the Routes to have some autonomy in development of Route Plans is clear as they represent the Asset Management plan of the devolved Route. Asset Management is by its nature though, a nominally integrated and system/network wide concept which requires an overall network approach to fully optimise the potential benefits. A prescribed approach to the specific requirements and structure of the narrative within the Asset Management sections of the Route Plans, with scope for flexibility based on the specific contexts of the Routes, may therefore be beneficial. In AMCL's opinion, based on the centrally disseminated templates and guidance seen during Progressive Assurance, the framework for this approach was established but the end products appear to be more widely varied during their development by the individual Routes than would be ideal.

This appears to have been less formally controlled than other aspects of the Route Plan Asset Management section development, such as the monitoring and change control processes established between RAMs and HAMs. Clear evidence was also identified of some Route involvement with Asset Policy development. This appears to have come through two key channels:

1) Direct input from a sample of relevant RAMs in the Asset Policy and associated modelling development; or

2) Challenges to the Asset Policy or modelled outputs from the RAMs, and DRAMs as appropriate, where the context of the Route required specific variations.

This 'healthy tension' between the central organisation teams and the Route based teams and associated control mechanism were well evidenced, even if the overall process was not clearly detailed and formally documented from a Reporter perspective.

Unfortunately, the level of narrative justification in the Route Plans for deviation from Asset Policy or the associated IIP modelled numbers was again variable across the Routes and asset disciplines. However, with a few exceptions discussed in the following sections, the majority of deviations were able to be justified, on a qualitative basis, during Route based RAM meetings. Gaining a full understanding of these issues would not have been possible based on the SBP submission itself, without the direct input of the Route teams via questionnaires and Route meetings.

7.3 Renewals

The process and inputs to the development of Renewals volumes, costs and efficiencies at a Route level had a range of asset discipline specific nuances but in summary the generic approach appears to be as defined by Network Rail in Diagram 1, i.e.:

1) Iterations of the Asset Policy and associated modelling tools were used to develop baseline 'top-down' CP5 costs and volumes for each asset discipline which were provided to the RAMs;
2) The RAMs reviewed the outputs from the central organisation against their existing 'bottom-up' workbanks and prioritised plans based on criticality, funding constraints and significant enhancements or network strategies, such as Electrification and NOS respectively;
3) The RAMs continued to iterate the workbanks, in conjunction with HAMs through a change control process and briefings on changes to Asset Policy;
4) Any variations or deviations that could not be approved or endorsed by the HAM were reviewed with the DRAMs for final sign-off;
5) Revised Route workbanks were aligned with unitised costs where available, with LDRs developed by the RAM teams in conjunction with IP teams where unitised costs were not available; and
6) Revised, nominally 'bottom-up' costs and volumes were resubmitted to the central organisation for inclusion within the strategic modelling tools to define the final SBP submission.

The above is a very simplistic representation of a long-term and highly iterative process (as discussed in Sections 2 and 3), which is understood to have been subject to degrees of parallel working between the key steps identified above.

In terms of the robustness of outputs from the above process, the sample audits undertaken at the Route level identified that the majority of costs and volumes defined at a high-level in the Route Plan and strategic planning models could be traced back to details of specific worktypes, volumes and Unit Costs or LDRs. However, there were a number of irregularities found between Route held workbanks and costs for EP and Signalling and those published as part of the SBP submission (see Appendix E for specific details). Some of the irregularities were clarified by Network Rail in post-meeting updates provided in response to the issues identified. However, the lack of immediate and direct traceability identified on a simple sample basis may impact confidence in the maintenance and renewal numbers. The sample audits undertaken by AMCL at the Route meetings represented only a very small and random sample base and could not be directly extrapolated in terms of materiality or considered statistically significant.

The application of CP5 efficiencies to the renewals workbanks are based around the following key themes documented in SBPT220:

- Scheduling work differently:
  - Increased weeknight working;
  - Smoother workbanks; and
  - Locking down workbanks earlier/longer workbanks.
- Contracting & supplier base:
  - Working more closely with contractors;
  - Letting the contractor choose how best to deliver the work; and
  - Being a better customer through improved processes.
- Standardisation:
  - Reduced complexity of project and processes.
- Multi-skilling:
  - Fewer people better utilised.

A significant number of these identified renewal efficiencies are procurement and IP based and are likely to require significant input from the central organisation as well as support and local/tactical input from the Routes and RAM teams particularly.

It is understood that the majority of renewal efficiencies were identified and defined by the central organisation, including network wide business cases, and then provided to the Routes for consideration.

The Routes subsequently considered the potential application of the efficiencies in the Route specific context to establish the Route based variations analysed in Section 4. AMCL contends that the assurance of delivery of the renewal efficiencies is currently limited by the lack of Route specific business cases and detailed delivery plans.

The specifics of the renewals efficiencies relating to the asset disciplines within AMCL's scope have already been discussed in Section 4 and will be reviewed in further detail by Arup[22].

The overall efficiencies identified by Network Rail for CP5, by asset discipline, are as defined in Diagram 24.

£m (12/13 prices)	14/15	15/16	16/17	17/18	18/19
Track	8%	11%	13%	16%	19%
Signalling	4%	8%	13%	16%	18%
Civils	5%	7%	9%	11%	14%
Buildings	6%	9%	11%	13%	16%
Electrification & fixed plant	8%	13%	16%	19%	18%
Telecoms	3%	6%	9%	11%	14%
Total	**5%**	**9%**	**12%**	**15%**	**17%**

Diagram 24: Network Rail's CP5 Efficiencies by Asset Discipline (SBPT220)

7.4 Maintenance

The definition of Maintenance (Opex) costs in the Route Plans took a different approach to that of Renewals. The build-up of Maintenance costs within the Route Plans is understood to have been

22 *Arup Mandate AO/035*

developed based on historical headcount, forecast CP4 exit headcount and CP5 considerations including activities resulting from changes in Asset Policies, renewals plans, enhancement schemes, changes in the level of traffic and maintenance efficiency overlays. The final costs presented in the SBP are therefore effectively post-efficient only and nominally derived by the Maintenance teams within the Route. Discussions with RAM teams at Route meetings identified a range of input to the development of Route Maintenance costs, from significant review and involvement, to the costs being effectively provided to the RAM (see Appendix E).

As the Routes have not submitted volume breakdowns it is not possible to robustly assure that the identified costs are appropriate for the actual volume of maintenance work necessary in AMCL's opinion.

It is understood that at the time of writing Network Rail is working to develop maintenance volumes to mitigate this issue. In support of the approach utilised, Network Rail also identified that the workforce required to deliver the then asset maintenance volumes had been modelled as part of the Phase 2B/C restructuring programme in 2010. However, no further modelling of resource needs had been undertaken.

A maintenance activity by MUC (Maintenance Unit Cost) based analysis is understood to have been developed by the central organisation in top-down models for most assets and was made available to the Routes to support the development of bottom-up resource based plans.

It was also confirmed by Network Rail that maintenance hierarchies in Tier 1 models are activity based, owing to the manner in which the organisation models at the portfolio level. The Tier 1 models could therefore support a volume based alignment of maintenance costs. However, in Hyperion, the financial modelling system into which the Routes' costs were collated based on strict input templates, the hierarchy for maintenance is resource based. As a result, the Hyperion finance system does not support a volumes based approach.

It is AMCL's opinion that this limitation in the Hyperion financial system may have impacted on the availability of assured maintenance costs against the actual volume of maintenance work necessary for the CP5 SBP.

With respect to maintenance efficiencies (see analysis being undertaken by Arup under a separate mandate[23] for further details), Network Rail's identified key themes (SBPT220) are:

- Do the right work:
  - Risk based Maintenance: focus effort where it is most likely needed;
  - Standardisation; and
  - Asset Policies.
- Automate to eliminate staff:
  - Intelligent infrastructure;
  - Combining workforces for rapid response and scheduled activity; and
  - Reduce non-frontline staff.
- Improve the productivity of manual tasks through improved working practices:
  - Increased mechanisation;
  - Multi-skilling of workforce; and
  - Greater standardisation of tasks.
- More access to the track; and
- Quicker possessions through automated isolation.

It is also noted that Network Rail is planning significant further overall Opex savings in Operations, Asset management Services and Corporate Services functions, although these are outside the scope of this mandate.

The overall scale of Opex efficiencies in CP5 is shown in the diagram below. This includes a 'stretch' target efficiency of £178m over the period, which is currently unidentified.

Efficiencies in CP5 (£m)	Begun in CP4	New schemes in CP5	CP5 total
Maintenance national	138	56	194
Maintenance local	0	140	140
Operations national	0	115	115
Operations local	10	20	30
Unidentified		178	178
Total	148	509	657

Diagram 25: Network Rail's CP5 Opex Efficiencies (SBPT222)

23 ***Arup mandate AO/035***

For Maintenance specific Opex efficiencies Network Rail has stated that the identified targets are a major challenge, including the relevant 'stretch' efficiencies with no currently identified initiatives.

The £140m local maintenance efficiencies have been developed on a Route basis and are broken down in Diagram 26. The identified values represent a significant saving and whilst they are qualitatively discussed in the maintenance sections of the relevant Route Plans there is considered by AMCL to be limited detail available to assure their achievement at this stage.

Local Initiatives	Total Saving CP5
Local Restructure	71.4
Planning	49.5
Using New Plant	7.7
Reduction in National Campaign Funding	6.0
Standards Challenge	2.2
Track Friendly Trains	1.7
HR / Training	1.4
Total	**140.0**

Diagram 26: Network Rail's Route Based Maintenance Efficiencies (SBPT222)

A number of Routes have aligned largely with the nationally identified maintenance efficiency initiatives, which are summarised in the following diagram.

	Total saving CP5 £m		
Initiative	E&W	Scotland	GB
Risk-based maintenance	30.2	4.7	34.9
Working practices	26.1	4.1	30.2
Indirect organisation	20.5	1.0	21.5
Mechanisation	17.5	3.6	21.1
Asset information – ORBIS	25.1	2.6	27.7
Intelligent infrastructure	10.9	2.0	12.9
Rapid response	3.6	0.2	3.8
Recycling of materials	6.0	2.3	8.3
Contract strategy	8.8	2.4	11.2
Multi-skilling	11.9	2.7	14.6
Standardisation	6.9	0.8	7.7
Total	167.4	26.4	193.8

Diagram 27: Network Rail's National Maintenance Efficiencies (SBPT222)

National business cases have been developed for each of the identified initiatives. It is understood that the Routes considered the national business case and identified the scale of gains applicable to the specific context of the Route. However, again there is limited detail of this available within the Route Plans and associated evidence.

Furthermore, the suite of initiatives identified, although clearly beneficial to some degree on a stand-alone basis have not been demonstrated, in AMCL's opinion, to be part of a formal policy or strategy for the optimised and integrated application of the initiatives to the asset base. For example, specific failure modes, identified via formal FMECAs (Failure Mode, Effect and Consequence Analysis) or other appropriate technique, may be best mitigated by Intelligent Infrastructure, a mechanised approach or a risk based maintenance task(s) but not necessarily all. As a further example, there is a statistically accepted optimal balance between the percentage of assets fitted with remote condition monitoring (Intelligent Infrastructure) and the dis-benefit incurred from the number of false alarms produced.

This level of definition or an overall strategy across the initiatives suite based on Route Criticality or other appropriate assessment does not appear to be currently established. An integrated approach such as this is likely to achieve more optimal efficiencies.

There was also found to be limited confidence in the maturity of some of the maintenance efficiency initiatives in the Route meetings (Appendix E). Risk-based maintenance was considered to be relatively immature and the Route teams were only just beginning to see the initial outputs of the centrally led workstream at the time of the meetings in February 2013. It was also noted in the Route meetings that the nomenclature 'risk-based maintenance' was potentially misleading and the current outputs were more akin to a 'criticality based maintenance' approach.

AMCL's own review of the information supplied in SBP (SBPT3004) supports this view. Network Rail itself has identified that it is currently progressing Stage 2 of a five-stage programme to move from historic maintenance regimes to complex risk-based maintenance regimes. The latter only occurs in Stage 5 and is reliant on a range of future asset information enhancements.

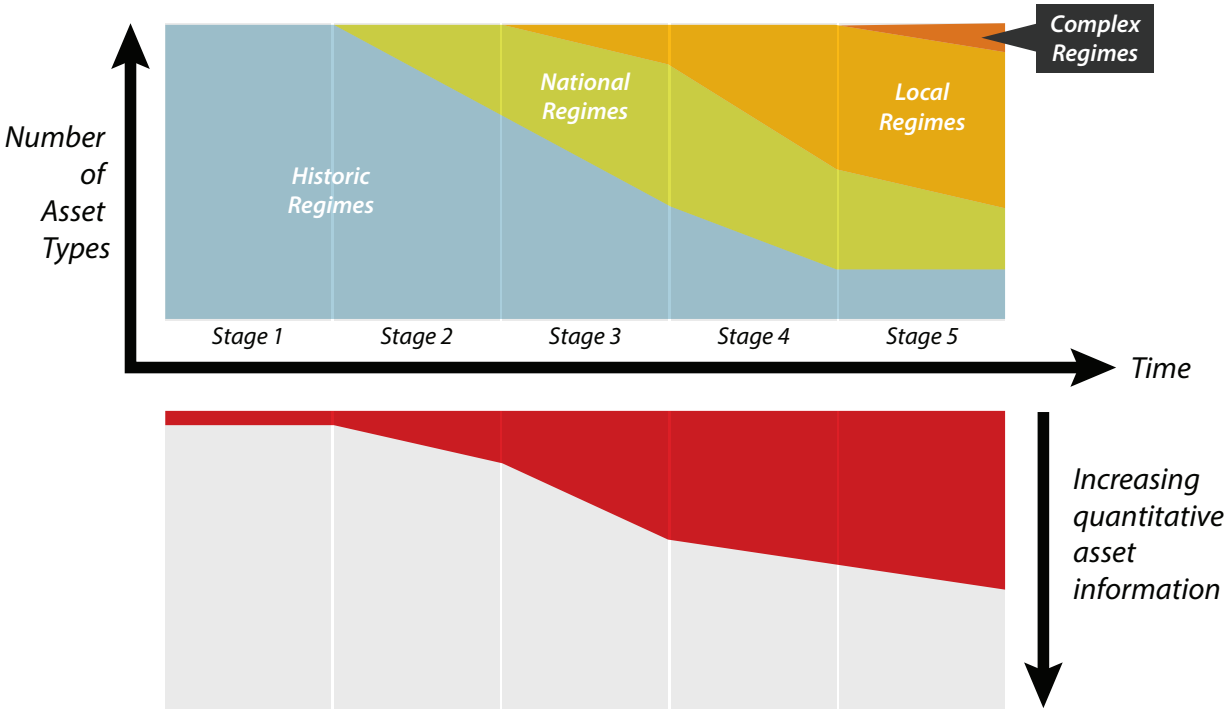


Diagram 28: Network Rail's Strategy for Developing Complex Risk-based Maintenance Regimes (SBPT3004)

Prior to Stage 5 the planned approach appears to be the development of reliability-centred maintenance approaches with progressively more quantified justification. The true efficiencies of risk-based maintenance, gained via quantified cost-risk trade-offs to establish maintenance intervention frequencies, are therefore likely to be some way off. It should be noted that in AMCL's experience the process of developing fully quantified risk-based maintenance regimes can lead to increases in the total quantity of maintenance as well as decreases.

Network Rail's progressively developed approach should assure that appropriate and justified maintenance tasks are developed over time, prior to the establishment of best practice risk-based justifications of maintenance intervals and potential efficiencies.

8 SBP Costs, Volumes & Outputs Tables

8.1 Overview

When Network Rail published its SBP for CP5 on 7th January 2013 it included a number of different sources of key maintenance and renewal costs, volumes and output data within the overall catalogue. These included strategic planning models (Tiers 0 and 1), a data-book and an array of narrative documents incorporating related data tables at various levels of granularity.

The scale of the work to develop such a range of products covering the breadth of assets and geographical locations is notable. The issue raised by the approach is that the management of configuration control and demonstration of alignment across the various products also increases in scale and onerousness.

AMCL considers this may be partly due to the lack of prescribed approach. Other heavily regulated industries in various sectors complete funding submissions against predefined tables and requirements. This may be a future option for the GB rail industry to assure alignment and comparison of funding submissions across control periods. This should also provide clearer alignment and understanding of the submitted volumes, costs and outputs to funders and other stakeholders.

8.2 Key Findings

During our review of the SBP costs and volumes AMCL identified a number of areas of apparent irregularities and areas for further clarification. A number of these were closed out through the meetings with Network Rail's central organisation and Routes. Where this was not possible a series of questions has been raised with Network Rail. Examples of some of these are captured in Appendix S of the accompanying Appendices document.

AMCL's considered findings from the review which may have an impact on overall confidence in the costs and volumes data, are:

- There are a number of discrepancies between the tables incorporated in SBP narrative documents and the more detailed costs and volumes models and tables also published. Network Rail has repeatedly clarified that the SBP Data-book and Tier 0 strategic planning model are the formal sources of costs and volumes data for the CP5 SBP. This is noted by AMCL, however, such discrepancies may have future implications as the top-level SBP documentation is likely to form the basis for any retrospective review of the CP5 funding submission and subsequent determination.
- Minor errors and discrepancies in the detailed SBP cost and volume datasets. These were largely related to importing and exporting of costs and volumes between models and tools which categorise and format the numbers differently.
- The key datasets appear to be complex and convoluted in their alignment and presentation, making it difficult to consistently establish comparable figures at a detailed level. Examples of this include the incorporation of indirect costs in differing ways and the inconsistent grouping of assets such as Electrical Power and Fixed Plant.
- Significant changes between the forecast costs and volumes in the 2012 update to the CP4 Delivery Plan and those captured in the SBP Databook (SBPT3338), see Appendix S.
- The reported inability of the Hyperion financial system to incorporate maintenance volumes, as discussed in the previous section.
- No normalising of Route expenditure by an appropriate means, such as potentially Route miles or Route criticality, to facilitate comparison of value for money by Route submission.

In general, subject to the final detailed analysis of Unit Costs[24] and Efficiencies[25] by Arup, AMCL's considered opinions of the projected costs, volumes and outputs by asset discipline for CP5 are:

- Signalling:
  - We consider there to be demonstrable alignment of renewal costs and volumes with Asset Policy as evidenced by the HAM/RAM reconciliation process and associated Change Control Logs.
  - At a Route level there were no consistent and material issues identified during the seven sample Route meetings and analyses. Minor inconsistencies between final SBP costs and costs contained within Route workbanks were identified for two of the seven sample Routes based on a 'deep-dive' audit of randomly selected costs. Another of the seven sample Routes was unable to fully support a 'deep-dive' audit of randomly selected costs

24 Arup Mandate AO/034
25 Arup Mandate AO/035

due to lack of access to central models on the day of the audit.

- At an asset discipline level the current renewal costs and volumes appear reasonable based on the current NOS and ERTMS/ETCS business cases. However, any changes to the NOS and ERTMS/ETCS business cases could have a significant impact on both CP5 and whole-life asset costs.
- Long-term sustainability outputs forecasts for renewals are considered to be reasonable based on the structured modelling process and currently available asset intervention impact data and engineering judgement, although is some degree of risk currently associated with the specific impact of the move to targeted renewals on long-term outputs. Short-term robustness outputs for renewals are subject to risks associated with the lack of RAMS targets to disaggregate high-level performance outputs to asset level.
- As discussed in section 7.4, maintenance costs are resource based and are not currently considered to fully and robustly assure that the identified costs are appropriate for the actual volume of maintenance work necessary or that outputs will be maintained.

- Level Crossings:
  - We consider there to be demonstrable alignment of renewal costs and volumes with Asset Policy as evidenced by the HAM/RAM reconciliation process and associated Change Control Logs.
  - At a Route level there were no consistent and material issues identified during the seven sample Route meetings and analyses.
  - At an asset discipline level the current renewal costs and volumes appear reasonable based on identified risk targets, the alignment of Level Crossing works with major Signalling schemes and the NOS business case, although they are subject to the timely development and/or refinement of supporting technologies such as LiDAR and Obstacle Detection for use on the network. As with Signalling, any changes to the NOS business case could have a significant impact on both CP5 and whole-life asset costs. There is also a reliance on the availability of competence and resources necessary to manage the timely and effective introduction of technology.
  - Long-term sustainability outputs forecasts for renewals are considered to be reasonable based on the cost and safety risk modelling process. The ability of the Level Crossing Tier 1 model to forecast safety risk against costs/funding is considered a strong aspect of outputs demonstration practice. Short-term robustness outputs for renewals are subject to risks associated with the lack of RAMS targets to disaggregate high-level performance outputs to asset level.

  - As discussed in section 7.4, maintenance costs are resource based and are not currently considered to fully and robustly assure that the identified costs are appropriate for the actual volume of maintenance work necessary or that outputs will be maintained.

- Electrical Power and Fixed Plant:
  - We consider there to be general alignment of renewal costs and volumes with Asset Policy but this is not currently as fully demonstrable as it is for other asset disciplines due to late changes to the Asset Policy in the SBP development process, although these changes are not anticipated to have a material impact on alignment.
  - At a Route level there were no consistent and material issues identified during the five sample Route meetings and analyses. Minor inconsistencies between final SBP costs and costs contained within Route workbanks were identified for one of the five sample Routes based on a 'deep-dive' audit of randomly selected costs.
  - At an asset discipline level the renewals costs and volumes appear reasonable based on the increasing asset base in CP5 and the significantly revised Asset Policy for CP5. The Asset Policy now defines renewal requirements based on criticality and condition instead of age, has a greater focus on electrical safety and considers maintaining electrical power supply capacity headroom. Improvements in asset knowledge have also identified areas of increased activity, in accordance with the revised Asset Policy, over previous control periods. These increases have been driven by an Asset Policy AMCL considers to be greatly improved when compared to previous iterations and the identified activity subsequently represents better overall management of the asset base than previously. However, it is noted that achievement of these costs and volumes over CP5 is reliant on significant development of asset information and embedment of related asset information processes into business-as-usual activities.
  - Long-term sustainability outputs forecasts for renewals are considered to be the best available based on the structured modelling process and currently available asset intervention impact data and engineering judgement, although there are risks associated with the current lack of empirical condition and deterioration data on the forecasting of long-term renewals outputs. Short-term robustness outputs for renewals are subject to risks associated with the lack of RAMS targets to disaggregate high-level performance outputs to asset level.
  - As discussed in section 7.4, maintenance costs are resource based and are not currently considered to fully and robustly assure that the identified costs are appropriate for the actual volume of maintenance work necessary or that outputs will be maintained.

- Telecoms:
  - We consider there to be demonstrable alignment of renewals costs and volumes with Asset Policy, largely as a result of the centralised NRT development process.
  - No sample Route meetings and analyses were undertaken for Telecoms.
  - At an asset discipline level the renewals costs and volumes do not appear unreasonable given the significant increase in the asset base and the scale of costs when compared to the extensive investment during CP4. However, the currently developing 'Service Level' basis of the Asset Policy, which significantly impacts the costs and volumes, provides less confidence in the defined renewals costs and volumes than for other asset disciplines. Confidence in the renewals costs and volumes is also negatively impacted by the current lack of modelling of the most critical FTN and GSM-R asset types and the degree of analysis currently applied to the management of obsolescence of these and other asset types within the discipline.
  - Due to the nature of the asset discipline long-term renewals outputs forecasts (Remaining Years of Life) are generally related to obsolescence and technology factors. As per the renewals costs and volumes, confidence in renewals outputs is also considered to be negatively impacted by the currently developing 'Service Level' approach, lack of whole-life cost modelling for the most critical assets types and the associated obsolescence management analysis. Short-term renewals outputs (Failures > 10 mins. p.a.) whilst still subject to risks associated with the currently developing nature of Telecoms 'Service Levels' should be more rigorously demonstrable based on the specific specification and requirements of the relevant 'Service Level' once fully trialled and implemented.
  - The centrally derived Maintenance costs (including 'Response' costs) for Telecoms are developed 'off-line' in a maintenance plan and provided as an input to the Tier 1 model which subsequently applies MUCs and RUCs (Response Unit Costs) to calculate the maintenance cost per annum. As a result there is considered to be greater demonstrability of the alignment of maintenance costs and volumes for Telecoms than the other assets considered here. Maintenance outputs are also considered to be more demonstrable than other asset disciplines but remain untested with respect to the revised 'Service Level' based Asset Policy.

8.3 Deliverability and Uncertainty

8.3.1 Overview

The review of Deliverability and Uncertainty focused on four key documents incorporated in the CP5 SBP submission:

- SBPT3302 CP5 Deliverability Review; and
- SBPT3283, SBPT3296 & SBPT3297 – Uncertainty Analysis.

8.3.2 SBPT3302 CP5 Deliverability Review

This document focuses on deliverability risks particularly to do with the initial assumptions on the workload, renewals & maintenance, and enhancements. Network Rail has recognised and identified that there are challenging issues that can affect deliverability; examples of which include increased access requirements, signalling tester constraints, shortfall of competences required for the significant Electrification workload, etc.

The document provides a qualitative overview of the identified risks and issues, any mitigation actions and confidence in the deliverability. For Signalling and Electrical Power asset disciplines Network Rail has clearly identified an important set of risks and issues but there appears to be limited quantification and data supporting this. Additionally, for each risk and issue that has been identified, while Network Rail has made recommendations on how to mitigate each of these risks and issue, there appears to be no real consideration of:

- Whether these are the only mitigating actions for the set of risks & issues that have been identified?
- To what extent will these mitigating actions address the risks, e.g. by what percentage will these risks be reduced?

For Signalling, in terms of putting the risk identification and mitigation into context to assess the level of confidence in CP5 delivery, subjective probabilities with minimal justification for the derivation of numeric confidence percentages or qualitative confidence percentages (i.e. high,

medium, low) would be beneficial in AMCL's view. This is also the case for Electrical Power. However, Network Rail does mention that in order to define accurate confidence probabilities, it aims to have more detailed future reviews with project teams and suppliers.

As previously discussed (Section 4.7.5) there is no mention of Telecoms within the SBPT3302 CP5 Deliverability Review document.

8.3.3 SBPT3283, SBPT3296 & SBPT3297 – Uncertainty Analysis

Whilst the SBPT3302 CP5 Deliverability Review document is considered to lack quantitative analysis and rigour, these three documents focus on data driven uncertainty analysis. However, due to the lack of alignment between these three documents and SBPT3302, it is difficult to identify the specific quantitative values that support the identified risks within the previous document.

The purpose of the uncertainty analysis conducted is identified as two-fold:

- How likely are Network Rail to achieve all their planned activities and interventions?
- What is the impact on PPM if Network Rail over/underachieve their activities & interventions?

In order to answer the above questions, Network Rail has used a structured methodology for the uncertainty analysis which has been broken into 3 stages as below:

- Stage 1 – Renewals expenditure
- Stage 2 – Total company expenditure
- Stage 3 – Linking performance to expenditure

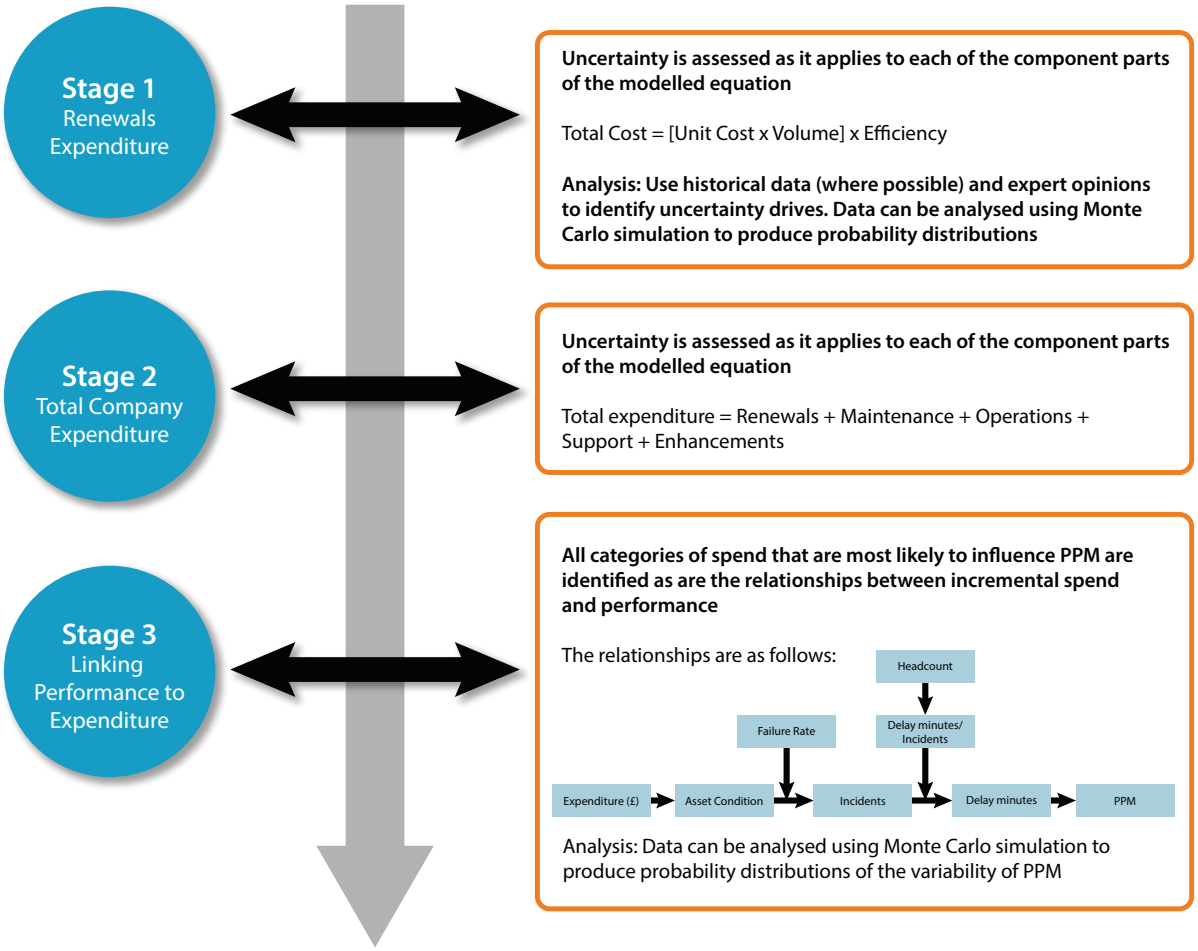


Diagram 29: Network Rail Uncertainty Analysis Methodology

Overall it would appear that the structure used in the uncertainty analysis process is comprehensive, robust and produces some useful output for all asset disciplines. However, there are varying levels of output across Signalling, E&P, and Telecoms. Telecoms is particularly lacking in uncertainty analysis outputs and supporting documentation compared to the other two asset disciplines.

While the results for Signalling and E&P are useful, it is mentioned that all stages of the methodology are under development and it is made clear that the results should be considered as "indicative" only. Under each asset discipline section, Network Rail has specified areas for further developments to improve the uncertainty analysis. However, it is unclear:

- Why Network Rail only considers the high level of analysis conducted as "indicative" (discounting the lack of alignment with SBPT3302),
- Why Network Rail hasn't taken its quantified uncertainty analysis further at this stage; and;
- Whether future uncertainty analysis will be consistent with the method currently used.

The first two points may lower the level of confidence in the SBP as it is dependent on an uncertainty analysis process which hasn't been fully developed yet. With respect to the third point, in the event that a different approach is used for the future and/or different analysis software is utilised, this could change the SBP submitted output results.

It is also worth noting that the current uncertainty analysis is based on a 'top-down' view of uncertainty for each part of the expenditure plan. As Network Rail's SBP submission is nominally based on the Route Plans from the devolved Routes it would appear that uncertainty analysis should be a combination of both 'bottom-up' and 'top-down' analysis as each Route is likely to have its own levels of uncertainty.

9 Summary of Key Opportunities

As stated in Section 1.4 specific recommendations from this review will be integrated within the concurrent and wider ranging AMEM assessment of Network Rail's overall Asset Management capability to ensure there is no duplication. The following sections provide a summary of the key short and long-term opportunities identified by AMCL in this review to further assure the robustness of current and future funding submissions.

9.1 Short-Term

1) Formal revision of the corporate Asset Management Policy and Strategy to support the revised and enhanced strategic planning process responsible for the SBP.
2) Continue the rollout of Tier 2 models to the Routes to support better Asset Management decisions at the Route level.
3) Continue the development of asset information to strategic modelling and Asset Management decision making at Route level, particular examples include condition data and Unit Costs for Electrical Power and Fixed Plant.
4) Development of Route level business cases and delivery plans for Renewal and Maintenance efficiencies.
5) Further assurance that identified maintenance funding is demonstrably aligned with the quantity of maintenance planned.
6) Develop a formal maintenance policy or strategy for the optimised and integrated application of the various maintenance efficiency initiatives across the asset base.
7) Revisit the CP5 deliverability assessment and uncertainty analysis to assure that the risks are fully and appropriately quantified and mitigated.

9.2 Medium to Long-Term

8) Demonstrate clear alignment between the planned asset interventions and overall business objectives, including asset specific RAMS targets.

9) Develop further optioneering of appropriate overall funding scenarios for SBP submission, such as minimal whole-life cost, lowest cost to maintain safety, minimised risk, etc. to provide alternatives to funders, assure the stability of existing plans and demonstrate value for money.

10) Long-term Asset Management planning should become a core part of the 'day-job' for Network Rail and the devolved Routes to facilitate the less onerous production of strategic business plans as snapshots of a continuously managed long-term plan. This should be supported by a formalised development programme with key development milestones aligned with internal process iterations and significant external factors such as the HLOS.

11) Develop a consistent and comparable format for Route Plans and integrated data tables in terms of the degree of justification for deviation from Asset Policy or modelled numbers.

12) Develop a standardised and consistent format for SBP submission, including data tables and comparability between control periods.

This page is intentionally blank

amcl

221 St. John Street,
Clerkenwell,
London
EC1V 4LY
UK

T +44 (0)20 7688 2828
F +44 (0)20 7688 2829
www.amcl.com