A Report to Network Rail
and the ORR
from
Asset Management
Consulting Limited

Version: Draft B
8th January 2008

Independent Reporter – Part C Interim Review of Network Rail's 2007 Asset Policies

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APPROVAL				
Version	**Date**	**Compiled by**	**Reviewed by**	**Authorised by**
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Asset Management Consulting Limited File Ref: 007/174				

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AMENDMENT HISTORY		
Version	**Sections**	**Amendment Details**
Draft A	All	Initial draft for comment
Draft B	Various	Amendments made following Network Rail initial review

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Executive Summary

In October 2007 Network Rail published a revised suite of asset policies and policy justifications, in support of its Strategic Business Plan for Control Period 4 (CP4). As part of the role of Independent Reporter for Asset Management, AMCL was commissioned by Network Rail and the ORR to review each of the 2007 policies and policy justifications to:

1) Assess the progress made since the June 2006 policies were published;
2) Assess the degree to which each document substantiates the stated technical solution, interventions and frequencies by means of evidence and supporting analysis;
3) Assess the extent to which justification is provided to demonstrate that the asset policies represent the most economically efficient, minimum whole life cost solutions;
4) Identify short-term developments and additional supporting information that should be provided by March 2008 to support the evaluation of the CP4 Strategic Business Plan; and
5) Identify medium-term improvements to ensure the asset policies and policy justifications achieve the level of maturity set out in the Asset Management Vision for Network Rail[1] by June 2011, in time to support the Initial Strategic Business Plan for Control Period 5.

This document summarises the process used to undertake a desk-top review of the 2007 asset policies against a best practice framework and describes the current strengths of the policy documents and the opportunities for further development. It also includes the findings from a series of workshops held with Network Rail where the policies and policy justifications were presented by Network Rail.

The key findings for each of the asset groups are as follows:

- **Track** – the track asset policy and policy justification are the most developed of the asset groups, which is consistent with the criticality analysis undertaken by Network Rail which identified track as one of the priority development areas. The policies are well structured and form a good basis for further development. Some additional supporting information has been identified to be provided by March 2008 but the key challenge for track is to develop more robust cost-risk analysis by 2011 to demonstrate that the renewal criteria and maintenance / inspections regimes are robust and represent the lowest whole life cost solutions.

[1] Asset Management Vision for Network Rail, Version 1.0, AMCL, 24th September 2007

- **Signalling** - the asset policy sets out the expected life for each of the above and provides a number of policy statements on the inspection, maintenance, life extension and renewal of these assets. However, the 2007 policy and policy justification are virtually the same as those published in June 2006 and the analysis that underpins the policy statements is often not presented in the policy justification document. It is understood that some analysis on renewal options was undertaken within the signalling scenarios work undertaken a few years ago but this does not appear to have been updated or cross referenced in the policy or policy justification. There also appears to be little analysis or justification underpinning the maintenance regimes to demonstrate that these are optimised or to demonstrate how these regimes will deliver the output requirements defined in the HLOS, in particular those relating to asset performance.
- **Telecoms –** the asset policy justification includes high level failure modes and consequences of the telecoms asset group and outlines the principles behind the mitigation regimes and maintenance and inspection processes. It also describes the renewal, enhancement and replacement criteria. However, the level of analysis within the asset policy justification that underpins the policy statements does not appear to demonstrate that the policies represent lowest whole life cost. Further development of this whole life cost analysis represents the biggest challenge for the telecoms asset group.
- **Electrification and Plant** – the policy and policy justification for OLE renewal and maintenance, including the deterioration and whole-life cost analysis, have been developed to a relatively high level of maturity. OLE was identified as one of the high priority development areas in the Network Rail criticality analysis undertaken last year. The key challenge for E&P is to develop the policy and policy justification for the other key E&P activities to the same level of maturity as those developed for OLE. Another key challenge for E&P is to collate and analyse good quality defect and failure data to support this analysis, a process that has recently commenced within OLE.
- **Operational Property** – The 2007 asset policy and policy justification is the first publication of these documents for operational property and these documents form a good foundation for future development. One of the key observations from the operational property policy is that the definitions of the A to C policy choices appear to address two separate issues:
  - The functional capability of the asset compared to required demand and level of service;
  - The remaining life or physical condition of the asset.

  This is potentially confusing for stakeholders who are seeking to understand these policies and the impact the application of these policies has on the CP4 Strategic Business Plan.

Further clarification of these policy definitions should be provided as a matter of urgency to support the ongoing assessment of the CP4 Strategic Plan for operational property.

- **Structures** – The structures policy and policy justification has been developed significantly since the June 2006 issue. There is better analysis and justification for the replacement criteria of structures assets and the description of the Civil Engineering Cost and Strategy Evaluation (CECASE) tool and its application demonstrates improved supporting analysis. The key opportunities for structures are to provide greater clarity on the definition and application of policies B & C and their impact on whole life cost management and to provide greater justification for the good, fair and poor boundary scores used within the Structures Condition Marking Index.

In conclusion, in our opinion, Network Rail's level of maturity in the development of policy and policy justification in Track and OLE compares favourably with the leading rail administrations and utility organisations' level of maturity. These two areas in particular have developed significantly since the June 2006 policies were published which is consistent with the priorities that were defined through the criticality analysis Network Rail undertook in 2007. Many of the other policies and policy justifications are less mature and have not developed much since 2006. In our opinion, Network Rail should build on the results achieved for Track and OLE and continue to develop all the asset group policies and policy justifications if it is to achieve the level of maturity of a world class organisation and if it is to deliver the significant efficiencies and performance benefits that will result from optimised maintenance and renewal regimes.

Contents

1 Introduction

1.1 Background

Asset Management Consulting Limited (AMCL) has been appointed as the Independent Reporter to Network Rail and the Office of Rail Regulation (ORR) for Part C Services – Asset Management. In 2006 this remit included undertaking a best practice review of Network Rail's Asset Management activities using AMCL's Asset Management Excellence Model ™ (AMEM).

The best practice review included interviewing a cross section of people from Network Rail's organisation, using a structured set of questions, and reviewing various sources of evidence. The results from the interviews, in conjunction with the review of evidence, were used to score Network Rail against the assessment criteria within the AMEM [2]. The best practice review examined generic processes used across Network Rail and focused on the following three engineering disciplines for asset specific processes:

- Signalling;
- Track; and
- Structures.

One key source of evidence that was identified early on in the best practice assessment was Network Rail's asset policy document, published on 30th June 2006 and the supporting asset policy justifications. The asset policies were, and still are, critical to a number of asset management activities within Network Rail. In light of this criticality to overall asset management activities, AMCL was also commissioned to undertake a review of the 2006 asset policies and policy justifications for Signalling, Track and Civil engineering (which includes structures), in order to help inform Network Rail's plans for the further development of the asset policies.

The output of AMCL's 2006 asset policies review was a report [3] outlining the strengths and benefits of the suite of asset policies and opportunities for further development in accordance with Asset Management good practice.

[2] Best Practice Review Final Report, Version 1.1, AMCL, 6th February 2007
[3] Review of Asset Policies, Version 1.0, AMCL, 16th August 2007

In October 2007, Network Rail published a revised suite of asset policies, in support of its Strategic Business Plan (SBP) for Control Period 4, which built on the opportunities identified by Network and through the AMCL best practice review. The asset policies and associated asset policy justification documents published by Network Rail in 2007 are:

- Track;
- Signalling;
- Telecoms;
- Electrification and Plant;
- Operational Property; and
- Civil Engineering Structures.

AMCL was commissioned by both the ORR and Network Rail to review these 2007 policies. The ORR required a rapid desk-top review to help inform their overall review of the CP4 Strategic Business Plan. This was followed by a series of workshops where Network Rail presented the justification for each the asset policies. The findings in this report are based on both the desk-top review and the information presented at the workshops.

1.2 Objectives

The objectives of this work were to:

1) Assess the progress made since the June 2006 policies were published;
2) Assess the degree to which each document substantiates the stated technical solution, interventions and frequencies by means of evidence and supporting analysis;
3) Assess the extent to which justification is provided to demonstrate that the asset policies represent the most economically efficient, minimum whole life cost solutions;
4) Identify short-term developments and additional supporting information that should be provided by March 2008 to support the evaluation of the CP4 Strategic Business Plan; and
5) Identify medium-term improvements to ensure the asset policies and policy justifications achieve the level of maturity set out in the Asset Management Vision for Network Rail by June 2011, in time to support the Initial Strategic Business Plan for Control Period 5.

In undertaking this review, AMCL was instructed to focus not on the policy statements themselves but on assessing if the policy justifications demonstrate a clear rationale and justification for the policy statements being the optimum way of managing the relevant assets.

2 Methodology

2.1 Process

The process followed to undertake the review is shown in the following diagram.

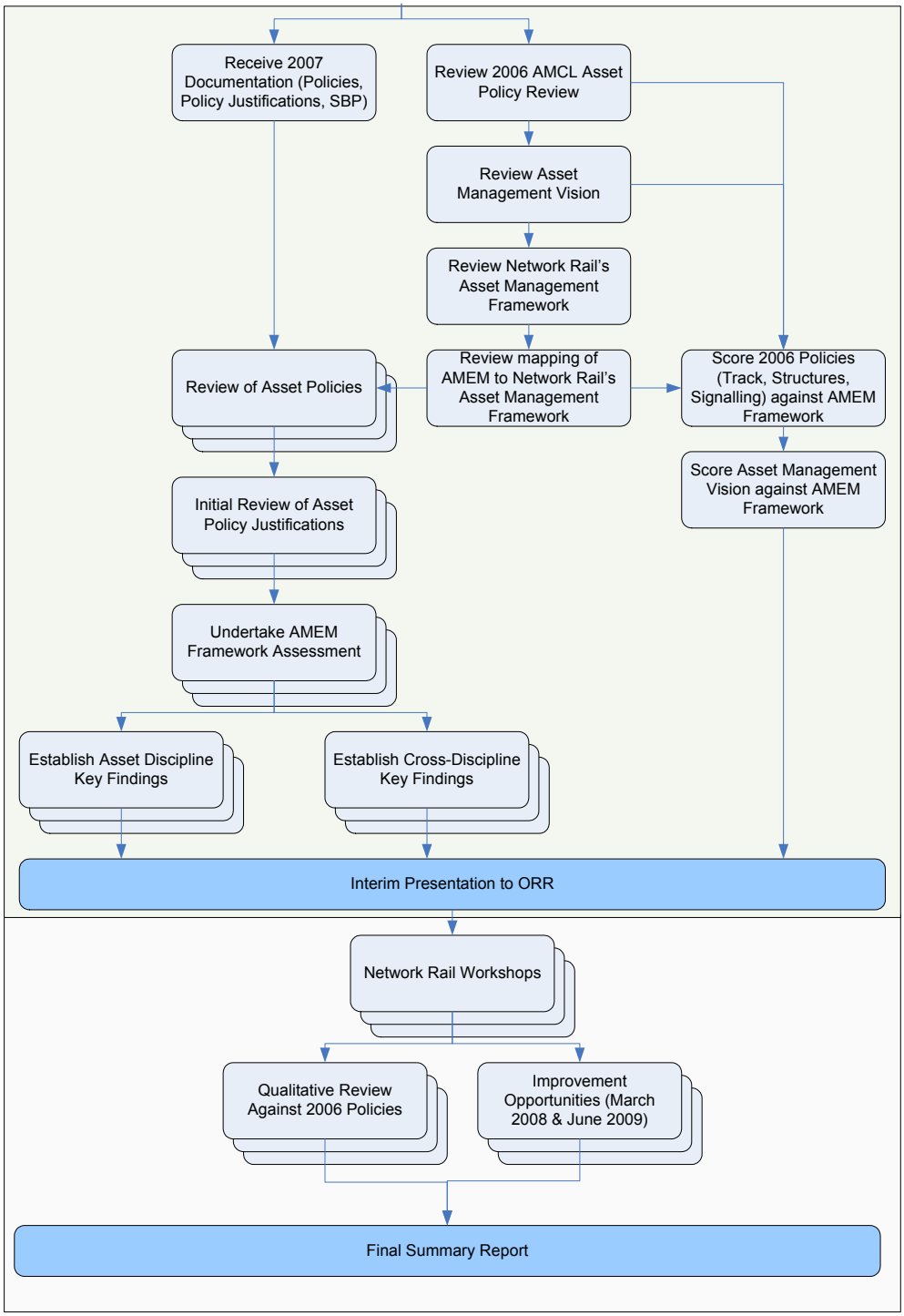

Diagram 1. 2007 Asset Policy Review Methodology

2.2 Constraints

The review was undertaken subject to the following constraints:

- The review was undertaken based on a limited suite of documents, namely:
    - Network Rail's Strategic Business Plan for Control Period 4, October 2007; and
    - Network Rail's October 2007 Strategic Business Plan – Supporting Document - Asset Management; which incorporated the asset policies and asset policy justifications for the following asset types:
        - Track;
        - Signalling;
        - Telecoms
        - Electrification and Plant;
        - Operational Property; and
        - Civil Engineering Structures.
- The review was undertaken without access to any referenced supporting analysis, such as asset type specific Decision Support Tools (DSTs), so was reliant on the evidence of any outputs provided in the asset policy justifications.
- Similarly, the validity and accuracy of underlying asset information and data presented within the asset policies and justifications was taken at face value.
- The interface with Network Rail personnel was limited to the workshops, which were held for all asset groups except Telecoms.
- The review was primarily desk-top based with input from the workshops
- Direct interface with ORR personnel during the review was limited to the ORR remit defined interim presentation.
- The review was subject to the defined time constraints.

2.3 Assessment Framework

AMCL's AMEM was mapped to the *Asset Policies* element of Network Rail's Asset Management Framework as part of the best practice review undertaken in 2006. This same mapping has been used to assess the 2007 policies to allow a consistent comparison. The mapping and a brief explanation of the Asset Management activities covered by each relevant criteria of the AMEM model are shown in the following table. The term NWR used in the table is an abbreviation of Network Rail.

NWR Desc.	Mapped AMEM Activity	Mapped AMEM Criteria	Short Name	Criteria Summary
Asset Policies	Strategic Planning	Renewal and enhancement policies are defined and justified for each asset type as part of the strategic planning process	Renewal Policies	Tests for the existence of asset renewal policies for each asset type, if they define the expected life of the assets and if, at a high-level, the level of supporting analysis appears appropriate to capacity, performance and asset condition requirements.
Asset Policies	Strategic Planning	Maintenance policies are defined and justified for each asset type as part of the strategic planning process	Maintenance Policies	Tests for the existence of asset maintenance policies for each asset type, if they define the reliability and efficiency targets of the assets and if, at a high-level, the level of supporting analysis appears appropriate to capacity, performance and asset condition requirements.
Asset Policies	CAPEX Evaluation	Different options for delivering the renewal, enhancement or capital maintenance requirements are identified	Options Analysis	Tests how well options for delivery of CAPEX projects are assessed at the strategic and tactical levels.

NWR Desc.	Mapped AMEM Activity	Mapped AMEM Criteria	Short Name	Criteria Summary
Asset Policies	CAPEX Evaluation	Criticality analysis is undertaken to determine an appropriate process for evaluating and verifying the capital expenditure requirements for renewal, enhancement or capital maintenance investments	CAPEX Criticality	Tests for the existence of an investment criticality analysis and if it is used to prioritise, evaluate and verify CAPEX projects and business cases.
Asset Policies	CAPEX Evaluation	The evaluation of the capital expenditure requirements for the renewal, enhancement or capital maintenance investment considers the whole-life cost of ownership	Whole Life Cost (WLC)	Tests if CAPEX evaluation processes require WLC analysis, if corporate unit costs are utilised and if WLC templates and renewal criteria have been developed for all major asset types.
Asset Policies	CAPEX Evaluation	Business benefit that will be delivered through the renewal, enhancement or capital maintenance investment has been identified and evaluated	Business Benefit	Tests the consistency of benefits analysis and the associated use of value analysis, a risk based approach, a synergies review and assessment of secondary, or incremental benefits.
Asset Policies	CAPEX Evaluation	A business case is produced for each proposed investment to appropriate confidence levels	Business Case	Tests that a business case is produced which aligns with criticality assessments and demonstrates good practice investment metrics which are assessed on a confidence basis.
Asset Policies	CAPEX Evaluation	Analysis is undertaken to establish if there are benefits to grouping a number of different renewal, enhancement or capital maintenance investments	Project Grouping	Test for the existence of a specific project grouping analysis process that considerers all stakeholders and the overall benefits, financial and safety implications of deferred/premature investment.

NWR Desc.	Mapped AMEM Activity	Mapped AMEM Criteria	Short Name	Criteria Summary
Asset Policies	CAPEX Evaluation	The evaluation of capital expenditure requirements considers the impact of the constraints on the organisation	Constraints	Tests that CAPEX plans consider funding, resource and access constraints and that investment opportunities are prioritised to take account of these constraints and deliver the best return on investment.
Asset Policies	Asset Maintenance	A Criticality Analysis has been undertaken to identify the assets critical to the business	Asset Criticality	Tests for the existence of an asset criticality analysis which considers failure probabilities & consequences and planned & reactive OPEX costs.
Asset Policies	Asset Maintenance	Deterioration characteristics of key assets have been identified	Deterioration Characteristics	Tests if deterioration analysis has been undertaken for key asset types, which takes account of the rate of deterioration and the likely frequency of failure. The impact of climate change is also tested for.
Asset Policies	Asset Maintenance	Asset maintenance policies have been defined for all key assets	Asset Specific Maintenance Policies	Tests if the asset maintenance policy considers asset criticality and deterioration characteristics and defines the most appropriate maintenance approach for all asset types.
Asset Policies	Asset Maintenance	A hazard analysis has been undertaken to identify all hazards associated with key assets	Hazard Analysis	Tests if a Hazard Analysis has been undertaken for key asset types, if the scope has been clearly defined and if a formal methodology, such as FMECA, was utilised.

NWR Desc.	Mapped AMEM Activity	Mapped AMEM Criteria	Short Name	Criteria Summary
Asset Policies	Asset Maintenance	Maintenance tasks have been defined using a logical process	Maintenance Task Definition	Tests if a formal, structured task allocation process has been defined or identified, if it defines tasks logically based on the characteristics of different asset hazards and if it considers the technical feasibility of tasks and existing task definition documentation.
Asset Policies	Asset Maintenance	A loss and consequence analysis has been undertaken to determine the risk associated with asset hazards	Loss and Consequence	Tests if a loss and consequence analysis has been undertaken and if it maps to defined functional failures, identifies all possible end events and the associated financial and safety implications and if appropriate good practice tools have been utilised.
Asset Policies	Asset Maintenance	Activity intervals are based on an assessment of costs and risks	Cost/Risk Analysis	Tests if planned maintenance and minimum actions are based on detailed cost/risk analysis, if the identified process defines when quantitative/qualitative analysis is appropriate and good practice reliability engineering mathematics are used when required.
Asset Policies	Asset Maintenance	Historical asset information has been used to help determine maintenance requirements	Failure and Defect History Analysis	Tests if historic failure and defect data has been subject to sensitivity analysis and used to support the derivation of intervention regimes and validate any cost/risk analysis

Table 1. Mapping of AMEM Criteria to Network Rail's Asset Management Framework

3 Overall Results and Findings

3.1 AMEM Assessment Results

Diagram 2 provides a comparison of the average AMEM scores for the 2007 asset policies and justifications, by Asset Type, along with the average score across all asset types for the 2007 documents.

The overall average for 2007 was calculated at 35%, with Track assessed as the most mature set of documents with an average score of 57%. Telecoms and Operational Property were assessed as the least mature of the asset types, both scoring 23%. It should be noted that these are un-weighted averages of all the assessment criteria and it is proposed to add weightings to these scores when the final version of this report is produced in April 2007.

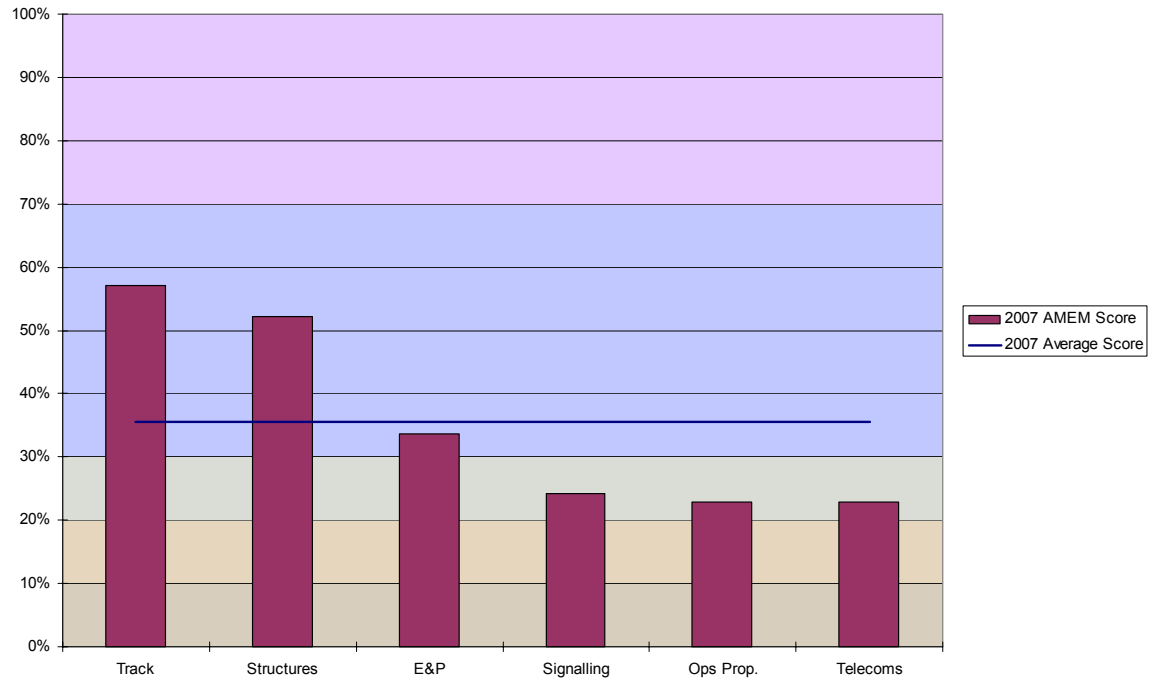

Diagram 2. AMEM Assessment Average Results

It should also be noted that these scores are based on the assessment of the asset policy and policy justification documents and do not take account of any of the additional supporting material that was identified in the December 20076 workshops. There is therefore inevitably a level of uncertainty around these scores which is estimated at +/- 5% at this time.

Based on the International Infrastructure Manual (IIMM) maturity scale used by the AMEM model and shown in Diagram 3, the results in the above chart show that the asset policy document sets for all asset types scored at least in the 'Systematic Approach' range of the AMEM maturity scale. Track, Structures and E&P all scored in the 'Competent' maturity range.

Question Scales	State of Maturity	Percentage
4	Excellence	100
		95
		90
		85
		80
		75
		70
3	Competence	65
		60
		55
		50
		45
		40
		35
		30
2	Systematic Approach	25
		20
1	Awareness	15
		10
0	Innocence	5

Diagram 3. IIMM Maturity Scale

3.2 Assessment of Progress Since 2006

The following diagram provides a comparison of the October 2007 asset policy scores for Track, Structures and Signalling, against the average for the AMEM assessment of the asset policies for the same asset types in June 2006. The comparison is limited to the three asset types as these were the only policies and justifications reviewed by AMCL in 2006. It should however be noted that Operational Property has been split out as a separate asset type in 2007, having been incorporated within the Structures asset type in 2006.

Also shown on the chart is the anticipated AMEM score for asset policies in June 2011, based the section of Network Rail's Asset Management Vision on Asset Policies. A linear analysis has been used to identify interim targets for the asset policies and asset policy justifications for October 2007 and March 2008 that would be required to achieve the level of maturity set out in Asset Management Vision target for June 2011.

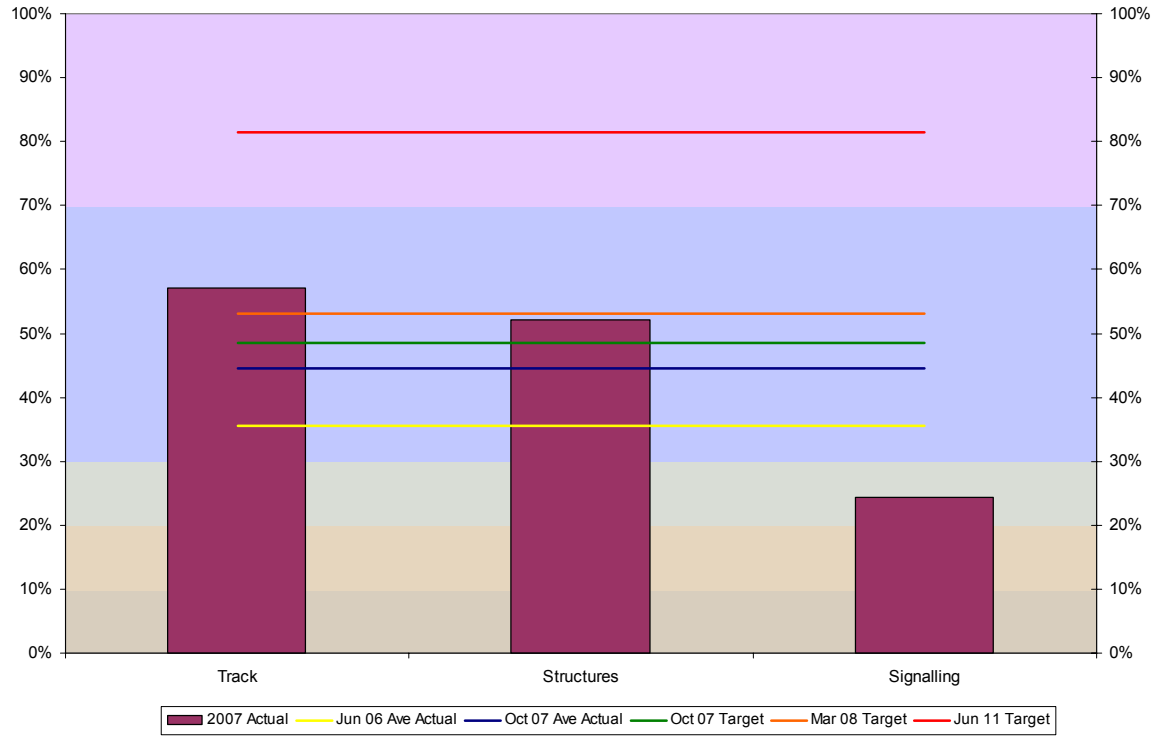

Diagram 4. Comparison of AMEM Assessments for Track, Structures and Signalling

The chart shows that Network Rail has, on average, progressed its asset policy and justification documents for the three asset types against the good practice framework. It can also be seen that the Track and Structures asset types have surpassed the linear Asset Management Vision target for October 2007.

3.3 Key Findings and Opportunities for all Asset Types

Following a cross-asset type comparison of the AMEM assessments and qualitative reviews, the following key findings and opportunities for improvement and further alignment with the best practice framework were identified. It should be noted that these findings and opportunities were found to be generally applicable across the suite of documents for all asset types; however, individual asset types will have varying degrees of maturity for each.

3.3.1 Key Generic Strengths

1) The overall suite of policy and justification documents was found to have generally improved from 2006, as evidenced, for a sub-section of the documents, in Diagram 4.
2) The overall suite of policy and justification documents continues to form a set of statements to ensure a consistent asset management approach to individual asset types throughout the company and provide a good foundation for further development.

3) The foundation for further policy and policy justification development is also supported by the consistent hierarchy of documents for each asset type.
4) A separate asset policy and policy justification for Operational Property, previously incorporated in Structures, has now been developed and will provide, in conjunction with the recently completed data collection exercise in OPAS, a basis for improved Asset Management of Operational Property and further development of the policy documents.
5) As discussed in Section 3.2, for Track and Structures asset types, progress has been achieved, towards and beyond Asset Management Vision maturity targets for 2007.
6) Further to the above, it is anticipated that additional improvements in maturity for all of the 2007 policy documents is achievable by March 2008.
7) In addition, Network Rail recognises a number of key issues and opportunities for improvement with the current suite of documents and has an Asset Policy Development Plan in place to improve in a number of areas.

3.3.2 Key Generic Opportunities

1) Within the policy justifications there does not appear a clear explanation of how the policies will support the delivery of the output requirements defined in the High Level Output Specification (HLOS), for example in terms of reliability or availability targets.
2) In a number of cases the policy justifications appear to reference existing standards and historical practice as the drivers for intervention intervals and actions but do not provide evidence that these interventions and intervals represent lowest whole life cost.
3) References to quantitative analysis and/or Decision Support Tools should arguably be supported by better cross referencing evidence.
4) The asset policies for track are differentiated for the different route categorisations, recognising their different criticality, but this does not appear to be used as a consistent approach to criticality across the other asset types.
5) Where criticality analysis is undertaken for the sub-assets within each asset type, the processes/thresholds to justify this criticality assessment do not appear to be defined.
6) There does not appear to be a clear use of, or referencing to, quantified failure history analysis to support the justification of asset policies.
7) There does not appear to be a consistent approach to analysing and documenting hazards and risk (likelihoods and consequences); although the key hazards are identified for each asset type, it is not clear how these have been prioritised or if any quantification of risk has been undertaken to support the justification of policies.

8) Good practice, network wide initiatives, such as "Intelligent Infrastructure", and their potential impacts on each asset type do not appear to be reflected in the asset policies or justifications.

9) There does not appear to be a holistic systems integration strategy or approach. For example, the asset policy for Signalling states that Axle Counters will be the preferred approach for future train detection, however, the impacts of this, such as loss of rail defect detection, reduced numbers of Insulated Block Joints, etc. are not considered within the asset policy or justification for Track.

10) It is not clear how Network Rail's asset information strategy supports the asset policies and policy justifications or how the future development of the policies is driving the need for better asset information.

3.4 Potential Impacts of Key Generic Opportunities

In reviewing the key generic opportunities it was identified that the potential impacts fall into two main categories. These are:

- Value for Money; or
- Efficient and Economic Practices.

The table below looks at the specific potential impacts of each of the key opportunities identified in Section 3.3.2. At this stage none of these opportunities have been quantified.

Key Opportunity	Potential Impact on Maintenance Activity	Potential Impact on Renewal Activity	Potential Impact on Expenditure
1	Maintenance regimes are likely to be more onerous than required for output requirements	Renewals are likely to be implemented earlier than required to support output requirements	Outputs are achieved at sub-optimal value for money
2	Maintenance intervals and tasks are not optimised	Potential secondary impact of non-optimised maintenance intervals and tasks leading to more rapid deterioration and earlier than required renewal	Over expenditure on maintenance or earlier than optimal capital expenditure on renewals
3	No direct impact	No direct impact	Lack of clarity and justification of economic and efficient approach.

Key Opportunity	Potential Impact on Maintenance Activity	Potential Impact on Renewal Activity	Potential Impact on Expenditure
4	Inconsistent approach to prioritisation of maintenance and resources with respect to business requirements	inconsistent approach to renewals with respect to business requirements	Lack of demonstrable assurance that expenditure is prioritised on business requirements
5	Inconsistent approach to prioritisation of maintenance and resources with respect to business requirements	inconsistent approach to renewals with respect to business requirements	Lack of demonstrable assurance that expenditure is prioritised on business need
6	Lack of demonstrable root cause derived maintenance tasks and limited justification for pro-active measures, such as condition monitoring	Non-prioritised asset replacement projects	Non-optimised value for money
7	Inconsistent approach to prioritisation of maintenance and resources with respect to business risk	inconsistent approach to renewals with respect to business risk	Lack of demonstrable assurance that expenditure is prioritised on business risk
8	Maintenance regimes are not optimised in line with company wide best practice	Strategic plans are not optimised in line with company wide best practice	Non-optimised value for money
9	Inappropriate maintenance activities on interface assets	Missed opportunities for project grouping and company wide whole life cost optimisation	Uneconomic and inefficient approach
10	Maintenance regimes are not optimised due to missing or inaccurate of asset information	Renewal plans are not optimised due to missing or inaccurate of asset information	Non-optimised value for money

Table 2. Potential Impacts of Missed Opportunities

3.5 Asset Type Specific Findings

The following sections provide more detailed results and findings by individual asset type.

4 Track

4.1 Document Overview

4.1.1 Overview of Track Policy

The asset policy for track engineering assets has been written to demonstrate how Network Rail's assets will be managed to meet the requirements of their corporate objectives. It provides guidance as well as justification for the track policy statements.

The purpose of the track system is to enable the transportation of both passengers and freight goods at the range of authorised speeds safely and reliably across the network. The capability of route sections is defined in terms of the gauge capability, speed, maximum axle weight and annual equivalent tonnage of traffic that the track system can accommodate.

The track policy statement consists of 104 policies categorised under the following sub-headings:

- General (performance, construction improvement & clearance);
- Inspection;
- Maintenance;
- Renewal; and
- Interfaces.

In AMCL's opinion, the track asset policy document is comprehensive and is founded on sound engineering principles and judgement. By adopting the new route type format (i.e. Primary & LSE, Secondary and Rural/Freight) this enables the comparison of the different policies to be made far more easily than before. This is an improvement over the previous policy document from 2006.

4.1.2 Comparison to 2006 Policy

The key differences when comparing the current policy with the 2006 document are:

- The overall structure of the document is in a more logical order and easier to follow.
- The new breakdown by route-type format enables an easy comparison to be made of how the policies vary and are tailored to the various requirements.

- The impact assessment section provides the expected cost effect during CP4 for a number of initiatives and is a step forward in terms of providing a quantified analysis.
- Unit cost information is also provided for a number of key assets and activities.
- Overall, the rationale for the policies, which is largely risk-based, is much clearer.

4.1.3 Overview of Track Policy Justification

1) **Introduction** – describes the information and assumptions which are used to justify the policy statements. It also outlines the processes for track in general including the list of consequent policy statements, and provides the planning assumptions as used in the Infrastructure Cost Model (ICM). Service life curves have also been provided for rail, sleepers and switches and crossings.
2) **Plain line** - is then discussed looking at its purpose and providing policy statements for the inspection, maintenance and renewals activities. Population and age profiles are provided and degradation risk is also discussed.
3) **Switches and crossings** - are then discussed in the same way as plain line; covering inspection, maintenance, and renewals activities. Population and age profiles are provided as well as commentary on degradation risk.
4) **Lineside assets** - are also treated in the same way as per the plain line and switches and crossings section.

The key challenge for track is to build on the existing work within the policy justification to develop more robust cost-risk analysis to demonstrate the interventions and periodicities of renewal, maintenance and inspection represent the lowest whole life cost.

4.1.4 Comparison to 2006 Policy Justification

The key differences when comparing the current policy justification with the 2006 document are:

- The format of the document has improved with a side-by-side presentation of the justification on a route type basis (i.e. primary, secondary and rural/freight).
- There is more cost information and quantitative assessment than was previously provided.
- Unit cost information has also been provided for a number of asset types.

4.2 Track Policy Justification AMEM Assessment

The following table identifies opportunities for increased maturity against the AMEM best practice framework.

AMEM Criteria	Opportunities to Increase Maturity
Renewal Policies	Overall the policies scored well in this area. Additional quantitative rather than qualitative analysis, output from the ICM model and costing of the options could improve the score further.
Maintenance Policies	This area has been well covered and scored highly.
Options Analysis	A number of options have been highlighted but a clear explanation for choosing one over the other is not always evident (e.g. Ballast Cleaner vs. Traxcavate). The extent that local conditions affect the policy is also unclear.
CAPEX Criticality	Beyond three years or so the ICM plays a greater role in identifying and prioritising track investment. The confidence in the ICM output has not been verified. A statement of the degree of confidence in the ICM forecasts would be helpful here. The prioritisation process needs further explanation.
Whole Life Cost	The whole life cost analysis for asset types and activities requires better explanation and justification. How rule-based investment is developed on the basis of criticality also requires explanation.
Business Benefit	This area scored well. Considering incremental and secondary benefits could improve the score further.
Business Case	Business cases should be enhanced to include good practice investment metrics. Confidence intervals would also need to be assigned to the costs and benefits to improve in this area.
Project Grouping	How the works are grouped or packaged (including costs and benefits) is unclear in the policy document. For instance if adjoining or adjacent track is close to renewal, is this considered within a possession?
Constraints	This area scored well overall.
Asset Criticality	This area scored reasonably well. With more explanation of reactive maintenance the score could be further improved.
Deterioration Characteristics	This area scored well. To improve further climate change needs to be considered in the deterioration characteristics of track components.
Asset Specific Maintenance Policies	This area scored well.
Hazard Analysis	This area scored well. This could be improved by describing to what extent FMECA analysis has been carried out?
Maintenance Task Definition	This area scored well.
Loss and Consequence	Consideration of probabilities of failure and event tree analysis would increase the maturity.
Cost/Risk Analysis	This is largely governed by the track standards. Further quantified information is required on how planned maintenance and inspection intervals are determined using cost/risk trade-off.

AMEM Criteria	Opportunities to Increase Maturity
Failure and Defect History Analysis	It is unclear to what extent failure, defects and maintenance data is used to determine the planned maintenance programme. It is also unclear whether the service life relations are calibrated periodically using this information. A sensitivity analysis is also required to be carried out by considering inputs such as asset condition, service life curves, unit costs etc.

Table 3. AMEM Assessment Opportunities for Track

4.3 Commentary on Track Policy Justification

4.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) Track is the most mature of the asset policies and has provided the most amount of quantitative evidence in support of the policy statements.
2) The track policy document is comprehensive in content and founded on solid engineering principles and judgement.
3) The layout and format of the document is for the most part logical and well structured.
4) By grouping and analysing the policies by the different route categories, this simplifies the comparative analysis.
5) The policy statement makes good use of illustrations such as the service life curves and the asset population/age data.
6) The inspection and maintenance frequencies are set out in NR/SP/TRK/001 "Inspection and Maintenance of Permanent Way". Further referencing of specific standards could be made in order to highlight the material policies and changes which affect performance and costs.

4.3.2 Key Opportunities

The 2007 policy is an improvement from the previous track asset policy. The opportunities identified in this section relate mainly to providing more quantified supporting evidence as opposed to historic practice or engineering judgment. The following represent the key opportunities for increasing the maturity of the asset policy justification against the AMEM best practice framework:

1) The policy justification document requires rationalisation as, in parts, it is overly detailed, repetitive and tends to read like a standard.

2) The document should highlight material policy changes and the effect they will have on capital and operational expenditure.
3) The Infrastructure Cost Model (ICM) is referred to throughout the policy document. Some further explanation of its functionality, inputs, outputs and limits of accuracy would be useful in understanding how the forecast volumes and costs have been generated.
4) It is unclear what the impact on track maintenance and renewals will be when considering a systems engineering approach. For example, the impacts on track maintenance procedures and costs of moving to axle counter technology for signalling should be included.
5) The basis for how the business case has been produced to substantiate benefits could be made clearer. Perhaps a diagram could be provided to illustrate the process.
6) There is an opportunity to provide greater clarity on the rationale for packaging renewals works, for example rail, sleepers and ballast, and the efficiency savings that such an approach delivers.
7) It would be helpful if the initiatives mentioned in the policy development section and the cost implications were summarised in a table. The SBP mentions efficiency savings of £200m over CP4 but this does not appear to be justified in the policy justification document.
8) Heavy maintenance and partial renewals are mentioned within the policy justification document. The document would benefit from greater clarity on what they consist of, when they would be used and what the impact would be in terms of life extension vs. cost.
9) The effect of climate change is mentioned relating to drainage and earthworks but it is unclear how it will impact the track side vegetation policy and if hotter summers will require any additional preventative maintenance on track.
10) A wheel profile study has been undertaken in Wessex to assess the damage from sub-optimal wheel profiles. However, the policy justification document is unclear on monitoring or Train Operating Company incentives to enable a reduction in wear and tear on the network and what the cost benefits might be.
11) The options analysis for a renewal or intervention could be made clearer. For instance, has a gradual replacement of timber sleepers on secondary or even rural routes with concrete sleepers been considered? Given the cost differences involved, it is not explained at which point spot re-sleepering (using timber sleepers) becomes uneconomic.

It should be noted that additional supporting material was indentified in the December 2007 workshops that may address some of the above opportunities prior to March 2008.

4.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the track policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities take into account the material presented at the Network Rail workshops and include both issues relating to the policy / policy justification and issues relating to the application of these policies in determining the CP4 costs.

4.4.1 March 2008

Although the track policy and policy justification have already achieved the target level of maturity for March 2008, there are a number of opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the Strategic Business Plan and are achievable by March 2008:

1) Provide a worked example for different route categories to explain the criteria for deciding the optimum renewal interventions on the appropriate service life relationship curves.
2) Provide further clarification on any asset type criticality analysis (i.e. prioritisation of investment using risk based methods) and how this is calculated.
3) Produce a process chart and evidence of supporting analysis using decision support tools (DSTs) including from the Infrastructure Cost Model to explain how the policies are applied.
4) Provide additional rationale for the mix of maintenance to renewal and what the key drivers are in determining this e.g. resource constraints, supply chain capacity, access, for both plain line and S&C.
5) Provide failure history analysis to test the service life relationships and provide some empirical data to justify these service life relationships and the assumed outputs within CP4.
6) Explain the impact of scarce resources and how this will be addressed or managed.
7) Provide better explanation for how grouping of renewals and maintenance takes place and the justification for grouping renewals when they occur within a 5 year window.
8) Explain the policy on heavy maintenance, what it comprises of and what the criteria are for applying it.
9) Calculate the uncertainty of the forward programme given the underlying uncertainty of the GEOGIS data etc.

4.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011, and are consistent with the Asset Management Vision:

1) Rationalise the policy document to concentrate on the material track policies which have a significant impact on capital and operating expenditure. The policy document should provide a balanced level of granularity, for instance: the policy of oiling fish plates is perhaps a level too low.
2) Provide additional analysis and evidence on which options for specification and timing of renewals have been considered and why one alternative is better than the other in terms of lowest whole life cost.
3) Provide more robust analysis of the costs and risks associated with the inspection and maintenance regimes for each of the route categories.
4) Provide supporting evidence for the business cases including Net Present Value, Internal Rate of Return and payback analysis to justify the key elements of expenditure.
5) Conduct a sensitivity analysis in order to test alternative options, to identify the critical variables, to guide the collection of asset information and to prioritise investment accordingly.
6) Work on improving gaps and accuracy of the underlying data contained in GEOGIS and other systems to produce a variability range or confidence limits for the outputs.
7) Consider a more holistic or systems approach by examining interfaces with other asset groups e.g. the impact of axle counter technology, further wheel/rail interface analysis etc.
8) Undertake further analysis to assess the impact of climate change on the track assets. For example, considering the effect of hotter summers and the risk of rail buckling occurring.
9) Undertake benchmarking against other European railways to compare Network Rail's unit costs and policies for renewal, maintenance and inspection.

5 Signalling

5.1 Document Overview

5.1.1 Overview of Signalling Policy

The signalling asset policy contains a number of policy statements for each of the following signalling asset types:

- General;
- Signalling Control Systems;
- Interlocking Systems;
- Train Detection;
- Train Protection;
- Signals and Indicators;
- Points Operating Equipment; and
- Level Crossings.

The asset policy sets out the expected life for each of the above and provides a number of policy statements on the inspection, maintenance, life extension and renewal of these assets.

5.1.2 Comparison to 2006 Policy

There appears to be minimal differences between the 2007 signalling asset policy and the 2006 document.

5.1.3 Overview of Signalling Policy Justification

Section 1 of the Signalling Asset Policy Justification document outlines the general principles upon which the signalling asset policies are based. It explains the functions of the signalling asset group and outlines the asset populations within each of the asset sub-groups. It goes on to describe the justification for the general signalling asset policies and the reasoning behind the overall strategies for inspection, maintenance and renewal.

It also describes, in general terms, failure modes of the asset group as well as outlining the main resource constraints and planning assumptions applicable.

The subsequent sections in the policy justification document outline in more detail the justification for each individual asset policy within the various asset sub-groups. These sections expand the failure modes for each sub-group and the reasoning behind the inspection, maintenance and renewal strategies implemented.

However, the analysis that underpins the policy statements to demonstrate that the interventions represent lowest whole life cost is often not presented in the policy justification document. It is understood that some analysis on renewal options was undertaken within the signalling scenarios work undertaken a few years ago but this not appear to have been updated or cross referenced in the policy or policy justification. There also appears to be little analysis or justification underpinning the maintenance regimes or demonstrating how these regimes will deliver the output requirements defined in the HLOS.

5.1.4 Comparison to 2006 Policy Justification

There appears to be minimal differences between the 2007 signalling asset policy and the 2006 document.

5.2 Signalling Policy Justification AMEM Assessment

The following table identifies opportunities for improvement against the AMEM best practice framework assessment.

AMEM Criteria	Opportunities to Improve Score
Renewal Policy Justification	Where like-for-like replacement is available as an option it should be made clear in the policy justification document exactly how the business case for this is formed. It is acknowledged that significant analysis has been undertaken in this regard by Network Rail, and the main opportunities for improvement are centred around summarising that analysis in an appropriate form within the policy and justification documents.
Maintenance Policy Justification	Whilst it is acknowledged that manufacturers' guidelines should be incorporated into maintenance strategies the policies and justifications should include an analysis of the business impact, in terms of cost and risk, of implementing such strategies.
Options Analysis	The policies should consider the local conditions and environment when determining the different options for delivering the required scope of works
CAPEX Criticality	The policies and justification contain no detailed criticality analysis of the signalling asset base. Any analysis that has been undertaken should be included.
Whole Life Cost	Where whole-life costing has been undertaken in relation to renewal business cases or maintenance strategies, this should be explained and included within the justification document.
Business Benefit	The benefit to the business of renewals options should be evaluated using a consistent process that incorporates a risk-based approach. This should be evident within the policy justification document.
Business Case	Any criticality analysis that has been undertaken should be used as an integral part of the business case for renewals, maintenance and inspection policies.
Project Grouping	Where renewals investments have been deferred (using the SICA process as justification) the financial and safety implications should be explicitly highlighted within the justification document.
Constraints	High level resource constraints with respect to the signalling suppliers are outlined in the policy justification document. Any analysis of work volumes and possession analysis that has been undertaken should be explained within the justification document.
Asset Criticality	The policy justification document should explain any criticality analysis that has been undertaken with relation to the signalling asset base.
Deterioration Characteristics	The SICA process effectively monitors asset condition. The deterioration of signalling assets is subject to a high degree of variability and hence monitoring through the SICA process represents an effective way of accounting for the deterioration characteristics.
Maintenance Policies	The justification document should include any analysis that has been undertaken to show that experience and manufacturers' guidelines represent the optimum solution based on cost, risk and overall business benefit.

AMEM Criteria	Opportunities to Improve Score
Hazard Analysis	Whilst the failure modes and consequences of the signalling asset are outlined in the policy justification document, there is a requirement to provide commentary on the methods used e.g. a formal FMECA study.
Maintenance Tasks	The justification document should outline the specific asset hazards that have been identified for the signalling asset group, and how those tasks mitigate the risks.
Loss and Consequence	Any event tree analysis that has been undertaken should be included within the justification document. The financial implications of all possible events should be established as part of the analysis.
Activity Intervals	Any analysis that has been undertaken relating to the quantitative reasoning behind the inspection and maintenance intervals should be included within the justification document.
Asset Information	Where possible, maintenance and inspection regimes should be based on historical defect and failure data.

Table 4. AMEM Assessment Opportunities for Signalling

5.3 Commentary on Signalling Policy Justification

5.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) A consistent approach to asset lives for different signalling assets has been adopted.
2) The SICA process allows Network Rail to monitor the condition and remaining life of the signalling assets and provides a basis for renewals.
3) Extensive analysis has been undertaken as part of the signalling scenarios review, even though this is not fully cross referenced in the asset policy and justification.
4) The long term vision for the signalling asset group involves a move towards in-cab signalling, which is likely to be in line with the ERTMS specification. This could represent a significant increase in the reliability and capacity of the signalling system which could fulfil the long term requirements of the rail network.

5.3.2 Key Opportunities

The following are the key opportunities for improvement of the policy and policy justification based on the desk-top review:

1) The criticality of the signalling assets does not appear to have been evaluated based on the overall business impact. This analysis could be used to prioritise whole life cost analysis to justify the maintenance, inspection and renewal interventions and intervals.

2) There appears to be little justification for the renewal and maintenance policies provided, although it is understood that some work has been undertaken on the analysis of renewal options within the signalling scenarios work undertaken previously by Network Rail.
3) Whilst the SICA process represents an approach to ensuring renewals are undertaken on a consistent basis, there is no justification that the expected lives used within SICA represent the lowest whole life costs.
4) The expected life of signalling assets does not appear to differ between the route categories.
5) There is little evidence provided that the renewal and maintenance regimes defined in the policy will deliver the outputs defined in the HLOS or that failure analysis has been undertaken to verify the effectiveness of the renewal and maintenance regimes.

It should be noted that additional supporting material was indentified in the December 2007 workshops that may address some of the above opportunities prior to March 2008.

5.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the signalling policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities take into account the material presented at the Network Rail workshops and include both issues relating to the policy / policy justification and issues relating to the application of these policies in determining the CP4 costs.

5.4.1 March 2008

This section describes the opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the CP4 Strategic Business Plan and are achievable by March 2008:

1) Include evidence within the policy justification document that a full asset criticality assessment has been undertaken.
2) Although much of the analysis supporting the signalling policies has been undertaken as part of the signalling scenarios work, the outputs of this work should be included in summary form within the signalling policy justification document to bring together that analysis in a single location.
3) Provide additional information to show how the policies have been applied within the Infrastructure Cost Model to determine the work volumes and costs within the CP4 Strategic Business Plan.
4) Provide additional information to show how any assumptions made when the signalling scenarios analysis was originally undertaken have changed and the impact these changes have on both the asset policy and on the costs within the CP4 strategic business plan.
5) Where like-for-like replacement or upgrading to an enhanced asset type is considered as an option, provide the business case for the preferred solution either within the policy justification document or as supporting evidence.
6) Demonstrate how the maintenance and inspection activities defined within the asset policies will deliver the outputs defined in the HLOS, in particular those relating to asset performance.
7) Undertake a sample of sensitivity analysis to assess the impact on cost and risk of moving renewal and maintenance interventions by a defined amount.

5.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011 and are consistent with the Asset Management Vision:

1) Include deterioration characteristics and whole-life cost analysis for all key asset management renewal activities within the policy justification document or as supporting information. This should be consistent with, and cross referenced, to the signalling scenarios and any associated analysis.
2) Provide evidence of better integration between the signalling policy and the ERTMS strategy.
3) Provide analysis to demonstrate how all key maintenance and inspection activities and periodicities represent the optimum blend of cost and risk.
4) Demonstrate that the maintenance and inspection regimes will deliver the required level of asset performance through analysis of historical failure mode data.
5) Specify the information requirements necessary to develop the whole life cost analysis in the policy justification and ensure this is aligned with the asset information strategy.
6) Undertake sensitivity analysis on all poor or missing data to determine the impact on the optimum intervention and the consequent impact on cost and risk.

6 Telecoms

6.1 Document Overview

6.1.1 Overview of Telecoms Policy

The telecoms asset policy document contains an introduction section outlining the function of the telecoms asset group and providing an overview of the asset portfolio. Section 2 of the document gives the asset populations for the various sub-groups, whilst the rest of the document contains the asset policy statements. There are 12 policy statements that are not grouped by asset type.

6.1.2 Comparison to 2006 Policy

AMCL was not requested to undertake a review of the Telecoms policy in 2006 and as a result no comparative analysis has been carried out as it is outside of the agreed work package scope.

6.1.3 Overview of Telecoms Policy Justification

Section 1 of the telecoms asset policy justification document describes, in general terms, the function of the telecoms asset group and the types of assets within it. It describes the high level failure modes and consequences of the telecoms asset group and outlines the principles behind the mitigation regimes and maintenance and inspection processes. It also describes the renewal, enhancement and replacement criteria. Resource constraints and planning assumptions that are applicable to the renewals and enhancements proposed over the next control period are also covered.

The subsequent sections of the policy justification document detail the maintenance, inspection, renewal and enhancement criteria for the following asset sub-groups:

- Bearer Network
- Radio Network
- Lineside Systems
- Station Information & Surveillance Systems

Each section outlines the degradation, failure modes and consequential risks associated with the asset sub-group in question. The sub-group specific maintenance and inspection criteria are

evaluated and explained and any specific resource constraints applicable to that asset sub-group are outlined.

The level of analysis within the asset policy justification that underpins the policy statements does not appear to demonstrate that the policies represent lowest whole life cost.

6.1.4 Comparison to 2006 Policy Justification

AMCL was not requested to undertake a review of the Telecoms policy in 2006 and as a result no comparative analysis has been carried out as it is outside of the agreed work package scope.

6.2 Telecoms Policy Justification AMEM Assessment

The following table identifies opportunities for improvement against the AMEM best practice framework assessment.

AMEM Criteria	Opportunities to Improve Score
Renewal Policy Justification	The processes and methods used within the Decision Support Tools (DSTs) for telecoms need to be explained within the justification document.
Maintenance Policy Justification	Maintenance and inspection regimes are cited as being economic and effective but there is little explanation of how Network Rail is confident that this is the case. The document would benefit significantly from an explanation of the analysis used to determine this.
Options Analysis	The technologies available for meeting the overall asset objectives for telecoms renewals should be evaluated using a business case process that is defined within the policy justification document.
CAPEX Criticality	The documentation would benefit from an explanation of how telecoms assets are prioritised in terms of their business impact and whether or not it is applicable to modify maintenance, inspection and renewals according to this criticality.
Whole Life Cost	Many of the policies are justified as being optimised in terms of whole-life cost. The document would benefit from more explanation of how this analysis has been undertaken.
Business Benefit	The business benefit of renewal options, maintenance and inspection regimes should be analysed according to a risk based approach that is explained within the policy justification document.
Business Case	Renewals are stated as being undertaken based on the output of the DSTs. The justification of these renewals strategies would benefit from clarification of the processes and analyses undertaken by the DSTs.
Project Grouping	There is little in the document regarding the potential benefits of grouping works. Whilst it is recognised that this may not be applicable to much of the telecoms asset group, a formal acknowledgement of this within the justification document would improve it.
Constraints	High level financial constraints and budgetary forecasts could improve the sections relating to constraints.
Asset Criticality	Any analysis that has been undertaken relating to the criticality of the assets should be included within justification document.
Deterioration Characteristics	The justification document would benefit significantly from a full explanation of the methodologies and techniques used by the DSTs to influence the decision making process.
Maintenance Policies	Any analysis that has been undertaken relating to the criticality of the assets should be included within the justification document.
Hazard Analysis	Any FMECA analysis that has been undertaken relating to the assets should be included within the policy justification document and referenced in the policies themselves.

AMEM Criteria	Opportunities to Improve Score
Maintenance Tasks	Describe how maintenance tasks are allocated and if these are based on a rule-based process that aligns with the asset management strategy and vision.
Loss and Consequence	The policy justification document would benefit from loss and consequence commentary and analysis.
Activity Intervals	Periodicities for maintenance and inspection should be justified with cost-risk analyses that are based on the consequences of functional failures.
Asset Information	Asset information requirements should be prioritised based on a sensitivity analysis

Table 5. AMEM Assessment Opportunities for Telecoms

6.3 Commentary on Telecoms Policy Justification

6.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) The asset policy sets out the clear technology choice for Telecoms assets.
2) The Telecoms asset policy outlines the failure modes and consequence for the telecoms asset group.
3) The maintenance and inspection regimes are selected from a number of options as the most effective or economic.

6.3.2 Key Opportunities

The following are the key opportunities for improvement of the policy and policy justification based on the desk-top review:

1) A criticality analysis of the telecoms does not appear to have been undertaken and demonstrated within the documentation. Greater understanding of the criticality of the various assets within the telecoms group would provide the priority for whole life cost analysis to be undertaken
2) Within the policy justification document there is reference to the policies being based on whole-life cost analysis but this analysis is not included or cross references provided.
3) It is not clear how the application of the asset policy will deliver the output requirements defined within the HLOS.

4) It is not clear what asset information has been used to develop and justify the asset policies including the use of sensitivity analysis to understand the impact of missing or poor quality data.

6.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the Telecoms policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities do not take any additional Network Rail material into account as no workshop was held for Telecoms.

6.4.1 March 2008

This section describes the opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the CP4 Strategic Business Plan and are achievable by March 2008:

1) Provide an explanation of how the Decision Support Tools work and how they are used to form the business case for the Telecoms renewal policy and to provide confidence that the renewal policies represent the lowest whole-life cost.
2) Undertake a criticality analysis of the telecoms asset group based on the overall business impact associated with each asset on the network to demonstrate the level of analysis within the policy justification is appropriate.

6.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011 and are consistent with the Asset Management Vision:

1) Include deterioration characteristics and whole-life cost analysis for all key asset management renewal activities within the policy justification document or as supporting information.
2) Provide analysis to demonstrate how all key maintenance and inspection activities and periodicities represent the optimum blend of cost and risk.
3) Specify the information requirements necessary to develop the whole life cost analysis in the policy justification and ensure this is aligned with the asset information strategy.
4) Undertake sensitivity analysis on all poor or missing data to determine the impact on the optimum intervention and the consequent impact on cost and risk.

7 Electrification and Plant

7.1 Document Overview

7.1.1 Overview of Electrification and Plant Policy

The Electrification and Plant (E&P) policy describes the E&P asset portfolio, asset populations, the expected outputs from the assets and the E&P policy statements that will deliver the stated outputs. The policy also sets out the approach to delivering the defined capability and capacity for each route and how the absence of strategic route analysis will be dealt with.

The policy is explicit in stating that the impact of climate change on the assets and their performance is considered.

The asset policy document is formed as follows:

- Section 1 defines the output requirements for E&P assets and describes the approach to capability & capacity and climate change.
- Section 2 provides an over view of the main E&P assets and their function.
- Section 3 lists sixty five policy statements for E&P which are ordered by asset type e.g. OLE, high voltage switchgear, etc.

7.1.2 Comparison to 2006 Policy

AMCL was not requested to undertake a review of the Electrification & Plant policy in 2006 and as a result no comparative analysis has been carried out as it is outside of the agreed work package scope.

7.1.3 Overview of Electrification and Plant Policy Justification

The Electrification and Plant (E&P) policy justification explains the purpose of the assets group, describes failure modes and risks that are common to all E&P assets and the impact on business outputs that might arise from a failure.

The business impacts are wide ranging and include:

- Delay and cancellation of trains (electric and non electric);
- Loss of control of signalling and points systems, leading to delay and cancellation;

- Risk of electric shock, burns and death from contact with exposed live electrical equipment, and
- Explosion and catastrophic failure of oil filled electrical distribution assets (switchgear and transformers), following disruptive fault resulting in damage/injury to people or property.

The policy justification defines how the risks are managed as follows:

- An inspection and maintenance regime based on safety and commercial risk, deterioration rates, anticipated failure modes and identification of work needed;
- An asset replacement regime which uses a set of condition based criteria, and
- Technical investigations to identify and understand root causes of specific failures.

An overview of the inspection & maintenance and replacement criteria is provided along with a statement on the planning assumptions used within the document.

Overhead line equipment for traction supply has been identified as the critical asset within E&P.

The structure of the justification policy follows the same format for each E&P asset however the content is varied. The format is as follows:

- Asset specific policies for inspection & maintenance and replacement are listed.
- A description of the purpose of the asset and the asset population is provided.
- Asset specific degradation, failure modes and consequential risks are defined. The impact of these is stated along with their predictability. Finally, possible mitigation measures are described.
- The means of managing the degradation risk is described for the asset. This section described the mitigation through inspection and maintenance activities. Aside from OLE, the asset policy justification does not make it clear how these activities have been derived.
- Replacement criteria and specification are described for each asset and again, aside from OLE, the asset policy justification provides only high level qualitative analysis to support the decisions.
- Asset performance indicators for the asset are defined.
- Constraints and deliverability issues are considered.

- Planning assumptions for inspection, maintenance and renewals are described for each asset along with any long term implications on these issues.
- A compliance statement is made for each asset policy and supporting documents are referenced.

7.1.4 Comparison to 2006 Policy Justification

AMCL was not requested to undertake a review of the Electrification & Plant policy in 2006 and as a result no comparative analysis has been carried out as it is outside of the agreed work package scope.

7.2 Electrification and Plant Policy Justification AMEM Assessment

The following table identifies opportunities for improvement against the AMEM best practice framework assessment.

AMEM Criteria	Opportunities to Improve Score
Renewal Policy Justification	Greater analysis and commentary is required to justify the CAPEX profile for E&P assets. The level of analysis should be commensurate with the criticality of the route(s) affected.
Maintenance Policy Justification	Aside from OLE, more detailed analysis of maintenance intervals and actions is required.
Options Analysis	While most E&P assets have limited technology choices there are subset options e.g. heat shrink/cold shrink jointing that can aid renewal / maintenance programmes. These should be explored or referenced within the document.
CAPEX Criticality	A business case process, based on the criticality of the asset / routes, should be described within the document.
Whole Life Cost	Greater analysis and commentary is required to demonstrate that whole life costs are considered robustly. The level of analysis and commentary should be commensurate with the criticality of investment be it OPEX or CAPEX.
Business Benefit	Greater commentary and analysis of business benefits derived from maintenance and renewals is required to provide a linkage between investments and business outputs.
Business Case	As stated previously, a business case process, based on the criticality of the asset / routes, should be described within the document.
Project Grouping	Analysis and commentary, proportional to criticality, on opportunities for grouping projects and the anticipated benefits should be explicit within the document.
Constraints	The document would benefit from greater commentary around possession constraints for all E&P assets. A more robust analysis of resources to deliver the SBP volumes would support the justification.
Asset Criticality	As acknowledged by Network Rail the application of criticality assessment to all E&P assets would benefit the justification.
Deterioration Characteristics	The deterioration characteristics commentaries contained within the document would benefit from more detailed analysis by inclusion of forecasts of deterioration and failure rates.
Maintenance Policies	The maintenance policies for all E&P assets should more explicitly reflect asset condition assessment, deterioration characteristics and asset criticality.
Hazard Analysis	Business risk analysis for each asset should be modified to include the likely frequency of occurrence. The document should also reference completed formal studies such as FMECA.
Maintenance Tasks	Save for OLE, there needs to be greater linkage between failure / hazard analysis and the prescribed inspection and maintenance tasks.

AMEM Criteria	Opportunities to Improve Score
Loss and Consequence	The *Impacts on Business Outputs* commentary would benefit from quantitative analysis to demonstrate the impact of failures and thus make the linkage to the mitigation regime(s).
Activity Intervals	Save for OLE the inspection and maintenance intervals for E&P assets require further substantiation.
Asset Information	The asset maintenance and renewal criteria commentaries would be enhanced by showing how asset information e.g. condition, fault history, etc. are considered.

Table 6. AMEM Assessment Opportunities for Electrification and Plant

7.3 Commentary on Electrification and Plant Policy Justification

7.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) The policy justification provides comprehensive analysis of OLE maintenance and renewals with supporting quantitative analysis in the appendices. This is consistent with Network Rail's criticality analysis that prioritised the development programme for asset policies.
2) There appears to be good justification around the OLE campaign changes and the business benefits of deferring some schemes and bringing others forward.
3) The reference to supporting documents provides evidence that there is underlying quantitative analysis for OLE.
4) The document provides a comprehensive description of the E&P asset base and the role and function of each asset.

7.3.2 Key Opportunities

The following are the key opportunities for improvement of the policy and policy justification based on the desk-top review:

1) There is no obvious explanation, aside from OLE, why the E&P policies for maintenance and renewals are apparently applied equally to all route categories.
2) The policy justification for the renewal, maintenance and inspection of non-OLE assets does not appear to be based on the same level of analysis as OLE assets.
3) The asset condition measures and definitions for E&P assets are not always clearly defined
4) Asset performance indicators are also not always clearly defined within the document.

5) There is frequent use of the term *"…as being in line with manufacturers' recommendations and our experience..."* to justify the application of maintenance intervals. There should be more robust substantiation of the intervals and activities.
6) There does not appear to be any analysis of the application and impact of remote condition monitoring and network automation/intelligent infrastructure.
7) There needs to be greater clarity on how capacity and capability of E&P assets impact business risks (drivers) and how assets should be 'sized' to take account of these factors.

It should be noted that additional supporting material was indentified in the December 2007 workshops that may address some of the above opportunities prior to March 2008.

7.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the E&P policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities take into account the material presented at the Network Rail workshops and include both issues relating to the policy / policy justification and issues relating to the application of these policies in determining the CP4 costs.

7.4.1 March 2008

This section describes the opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the CP4 Strategic Business Plan and are achievable by March 2008:

1) Complete and document the criticality assessment for all E&P assets. Clarify if and how the criticality of an asset is used to prioritise renewals and define and document the drivers of renewal work.
2) Provide an enhanced justification, or otherwise, for the non-OLE E&P asset maintenance and renewal policies for all route categories.
3) Provide greater analysis and commentary to justify, against the E&P policy statements, the renewals and maintenance programme for the following high expenditure assets (as defined by the SBP):
    i) SCADA;
    ii) DC HV Cabling;
    iii) AC HV Switchgear, and

iv) DC HV Switchgear.

4) Provide additional information on how capacity and capability of E&P assets impact on business risks and replacement criteria.

7.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011 and are consistent with the Asset Management Vision:

1) Develop the analysis for non-OLE assets to demonstrate that renewal, maintenance and inspection interventions and intervals represent the lowest whole-life cost solutions.
2) Demonstrate that asset condition measures and definitions for all E&P assets are used to drive inspection and maintenance regimes and provide forecasts for renewal activities.
3) Demonstrate that output from asset performance indicators for E&P assets is being utilised to inform inspection and maintenance regimes. The output from the measures should show discrete asset performance and allow analysis at different levels e.g. route, territory and therefore may apply to a 'system' or 'electrical circuit' of assets.
4) Provide assessment and quantitative analysis of the application of remote condition monitoring and network automation/intelligent infrastructure.
5) Demonstrate that suitable business case and governance processes are used in the evaluation and justification of all E&P renewals activities.
6) Provide detailed deterioration forecast and failure rate analysis for all E&P assets. This should be cross-referenced to asset performance measures.
7) Continue to develop the asset defect standards and collate asset information to support the analysis underpinning the analysis within the asset justification document.
8) Demonstrate how the renewal periods for inter-related assets are aligned such that a holistic view of renewals is taken and the benefits of system engineering processes can be exploited.

8 Operational Property

8.1 Document Overview

8.1.1 Overview of Operational Property Policy

The purpose of the asset policy for Operational Property assets is to summarise the key asset policies that Network Rail has developed for the management of its Operational Property assets.

It identifies that the value to the industry of effective asset management of Network Rail's Operational Property is the optimised performance of the assets leading to a reduction in delays, less reactive expenditure and the safe running of trains, all at an optimum whole life cost.

The portfolio of assets is considered by Network Rail to be one of the most complex in the United Kingdom and provides the built environment in which many of Network Rail's Asset Management activities take place. The policy document provides a brief overview of each of the following sub-asset types:

- Non-franchised Stations;
- Franchised Stations;
- Light Maintenance Depots (LMDs);
- Lineside Buildings;
- Maintenance Delivery Units (MDUs); and
- National Delivery Service (NDS) Depots.

The policy document subsequently lists a total of 7 Policy Statements for Operational Property which govern the application of the following suite of Asset Management policies:

- Policy A – Asset Management encompassing the renewal of complete assets which deliver greater functionality and business value.
- Policy B – Asset Management maintaining current levels of functionality and business value.
- Policy C – Asset Management representing the minimum level of intervention to efficiently maintain health and safety and operability in the short-term.

The policy subsequently identifies which of the above policies is applied to each of the sub-asset types based on categorisation of the assets.

One of the key observations from the operational property policy is that the definitions of the policy appear to address two separate issues:

- The functional capability of the asset compared to required demand and level of service;
- The remaining life or physical condition of the asset.

This is potentially confusing for stakeholders who are seeking to understand these policies and the impact the application of these policies has on the CP4 Strategic Business Plan.

8.1.2 Comparison to 2006 Policy

There was no separate asset policy document for operational property in 2006. The 2006 suite of asset policies and policy justification documents mentioned Operational Property within the Signalling document set, in relation to Interlocking asset locations and considered it as a sub-asset type in the Civils (Structures) asset type. There were no Operational Property specific asset policy statements identified.

8.1.3 Overview of Operational Property Policy Justification

1) **General (Introduction)** – reiterates the asset policies, policy statements and objectives of Operational Property. It also provides an overview of the approach and assumptions which are used to justify the policy statements with regards to policy research, impact on business outputs, risk management, inspection, maintenance and renewal criteria and type and the identification of critical assets.
2) **Franchised Stations** – this sub-asset type is then considered specifically, with respect to the relevant policy statements and the purpose of the sub-asset type, along with details of asset types and populations. It then considers failure modes and the asset management regime, including inspection, maintenance and renewals. Finally, asset performance indicators, constraints and assumptions are identified.
3) **Non-Franchised Stations** - this sub-asset type is then considered specifically, following the same format as for Franchised Stations.
4) **Light Maintenance Depots** - this sub-asset type is then considered specifically, following the same format as for Franchised Stations.
5) **Lineside Buildings** - this sub-asset type is then considered specifically, following the same format as for Franchised Stations.

6) **MDUs and NDS Depots** - this sub-asset type is then considered specifically, following the same format as for Franchised Stations.

8.1.4 Comparison to 2006 Policy Justification

There was no separate asset policy justification document for Operational Property in 2006. The 2006 suite of asset policies and policy justification documents mentioned Operational Property within the Signalling document set, in relation to Interlocking asset locations and considered it as a sub-asset type in the Civils (Structures) asset type. Section 12 of the 2006 Civils Policy Justification considers the justification for the generic application of Civils policies to Operational Property.

8.2 Operational Property Policy Justification AMEM Assessment

The following table identifies opportunities for increased maturity against the AMEM best practice framework.

AMEM Criteria	Opportunities to Increase Maturity
Renewal Policies	Quantified justification of renewals policy with due consideration of output requirements and identification or reference of analysis and costing of the options. Consideration or remaining life in different operating contexts.
Maintenance Policies	Quantified justification of the maintenance policy with due consideration of asset deterioration and criticality.
Options Analysis	Clear justification of options analysis in line with corporate technology strategies and with due consideration of local conditions and environment, i.e. for roofing and metal footbridges.
CAPEX Criticality	Analysis of the investment criticality and the use of this prioritisation to define business case and investment verification requirements.
Whole Life Cost	Quantified analysis of whole life cost, as appropriate for the criticality of the investment, and the definition of whole life cost templates for key assets.
Business Benefit	Evidence of value analysis undertaken in accordance with Policy A and identification of a consistent, risk based approach to business benefit evaluation.
Business Case	Demonstration that business cases are developed in accordance with the criticality of the investment and that the business case uses appropriate assessment metrics and an assessment of confidence in the business benefits.
Project Grouping	Identification of the process used to assess the benefits, costs and safety implications of project grouping, such as stations/lineside buildings by line section or under blockades, etc.
Constraints	One of the strongest areas for Operational Property, however, further consideration could be given to quantified analysis of all constraints, including resources and access/possessions, as well as funding, to demonstrate optimum return on investment.
Asset Criticality	Clarification of the current asset criticality to demonstrate that it quantifiably considers failure probabilities and consequences as well as inspection and maintenance costs.
Deterioration Characteristics	Development of detailed deterioration analysis considering rate of deterioration of assets and any potential impact of climate change.
Asset Specific Maintenance Policies	Further definition of sub-asset type maintenance policies justifications to reflect output requirements for different criticality and quantified analysis of the expected performance of the assets
Hazard Analysis	Clarification of the scope of the hazard analysis and the use of a structured process to demonstrate that all hazards were considered and not just the key hazards identified.
Maintenance Task Definition	Identification and justification of a logical and structured task definition process which considers the characteristics of hazards and task feasibility.

AMEM Criteria	Opportunities to Increase Maturity
Loss and Consequence	Undertaking of a quantified loss and consequence analysis for key asset failures which considers the relevant impacts of all possible end events.
Cost/Risk Analysis	Justification of activity intervals and necessary minimum actions based on a structured and quantified assessment of cost and risk.
Failure and Defect History Analysis	It is unclear to what extent failure, defects and maintenance data is used to determine the planned maintenance programme. It is also unclear whether the service life relations are calibrated periodically using this information. A sensitivity analysis is also required to be carried out by considering inputs such as asset condition, service life curves, unit costs etc.

Table 7. AMEM Assessment Opportunities for Operational Property

8.3 Commentary on Operational Property Policy Justification

8.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) The importance and overall business impact of the asset type has been recognised by the development of a specific policy asset policy and supporting justification.
2) The asset policy and justification documents form a set of statements to ensure a consistent asset management approach to the asset type throughout the company and provide a good foundation for further development.
3) The foundation for further policy and policy justification development should in the future also be supported by the recently completed data collection exercise in the new Operational Property Asset System (OPAS) asset register.
4) Network Rail recognise a number of key issues and are actively working to increase the maturity of the policy justification.

8.3.2 Key Opportunities

It is acknowledged that although the 2007 policy justification document is the first for the asset type and is subsequently less mature in its development, it provides the basis for Network Rail to rapidly develop the asset policy documents. The following are the key opportunities for developing the asset policy justification against the AMEM best practice framework:

1) Policies A, B and C, which are used throughout the asset type do not appear to represent the most economically efficient, minimum whole life cost solutions in all situations and are

potentially confusing for stakeholders who are seeking to understand these policies and the impact the application of these policies has on the CP4 Strategic Business Plan.

2) A general observation is that the linkage between the Strategic Business Plan and the asset policy is not always explicit.
3) The application of the policies does utilise generic criticality assessments but the quantified process and thresholds used to define the criticality for individual asset types is not clearly defined.
4) There does not appear to be clear evidence of a whole life cost modelling based approach to the justification of the asset policies, or the use of supporting analysis such as deterioration modelling.
5) The definition of asset condition and the historical trend of condition is not clear.
6) There does not appear to be clear evidence of a cost-risk optimisation based approach to the justification of activity intervals, or the use of supporting analysis such as rule based task allocation of detailed and comprehensive failure analysis, for example policy statement – 'Ops Prop-2' – states that examinations will be carried out at optimised intervals based on cost and risk but there does not appear to be clear, quantified, evidence to support this.
7) The recent development of an asset register should facilitate the future use of historical failure, defect, maintenance and renewal data to be used to further justify the asset policy statements.
8) It is unclear how the recently completed asset register (OPAS) data population and condition assessment programme has been used to validate or justify the proposed budgets.

It should be noted that additional supporting material was indentified in the December 2007 workshops that may address some of the above opportunities prior to March 2008.

8.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the operational property policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities take into account the material presented at the Network Rail workshops and include issues relating to the policy / policy justification and issues relating to the application of these policies in determining the CP4 costs.

8.4.1 March 2008

This section describes the opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the CP4 Strategic Business Plan and are achievable by March 2008:

1) Provide further clarification of the A to C policy definitions as a matter of urgency to support the ongoing assessment of the CP4 Strategic Plan for operational property.
2) Provide further information on the definition of asset condition and provide an analysis of historical condition against this measure.
3) Provide further clarity and justification of how the asset type criticality analysis is calculated, including justification for quantified thresholds.
4) Develop, or identify if existing, a structured process for assessing criticality of operational property investments and the subsequent business case and verification requirements.
5) Provide further clarity of a how optimised grouping of renewals and maintenance takes place and the associated assessments of costs, benefits and safety implications.
6) Clarify the scope of the hazard analysis and quantify the risk based on a corporate approach to assessment of likelihood and consequence.

8.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011 and are consistent with the Asset Management Vision:

1) Identify and develop the key attributes of the asset register to support the information requirements necessary to develop the asset policy justification.
2) Develop a fully quantified criticality analysis for all assets.
3) Baseline the asset condition across the portfolio and establishment of a regular and appropriate condition assessment process.
4) Develop a whole life cost approach to Asset Management, supported by detailed analysis and whole life cost modelling for the most critical assets.
5) Develop whole life cost templates for the most critical assets to support the policy statements on optimum interventions.
6) Undertake cost-risk analysis to develop optimised intervention intervals for the most critical assets.

9 Structures

9.1 Document Overview

9.1.1 Overview of Structures Policy

The structures policy describes the structures asset portfolio, asset populations, the expected outputs from the assets and the structures policy statements that will deliver the stated outputs.

The assets within the structures groups share a number of common features which set them apart from most other asset groups. Most notably these include:

- Long length of life and slow deterioration rates;
- The assets are generally of bespoke designs to suit their location and with construction reflecting the common technology in use at the time they were built, and
- The assets are capable, with appropriate maintenance, of being kept in service almost indefinitely.

Underpinning the asset policy are five policy statements, policies A – E, which define the actions required to deliver the structures business outputs. Each asset within the structures group is managed by one of the policies. The majority are managed through policies B or C.

The structures asset policy also sets out the approach to delivering the defined capability and capacity for each route and how the absence of strategic route analysis will be dealt with.

The policy is explicit in stating that the impact of climate change on the assets and their performance is considered.

The asset policy document is formed as follows:

- Section 1 defines the business outputs required from civil engineering assets and describes the approach to capability & capacity and the change in operating environment due to climate change.
- Section 2 describes the common features shared by structures asset base, the role of each asset and asset populations.

- Section 3 describes the five policy statements, policies A – E, which define how each asset shall be managed. It then goes on to list twenty three civil policy statements that support policies A – E.

9.1.2 Comparison to 2006 Policy

The key differences when comparing the current policy with the 2006 document are:

- The policy includes a high level statement stating that the impacts of climate change on the operating environment and the asset base are now considered as part of whole life cost evaluation.
- Operational Property is not covered within this policy as it now has its own asset policy and justification.
- The number of policy statements that describe how each asset is managed has moved from three (A - C) to five (A - E). The asset policy has been improved by providing greater clarity around the definition and application of asset policy statements. However, there is no reference to polices D or E within the policy statements numbered Civil-1 to Civil-23.

9.1.3 Overview of Structures Policy Justification

The structures asset policy justification document aims to provide the information and assumptions that underpin the asset policy statements and describes the issues that it addresses.

The document defines the route types that are used in the policy. These are:

- Primary and key London and South East (L&SE) routes;
- Secondary and other L&SE; and
- Rural and freight only.

The document provides a description and purpose of the structures assets and goes on to assess failure modes and the key drivers for asset deterioration. The document then describes how the risks associated with deterioration are managed through the application of five polices, A – E, and how the use of a newly developed policy planning tool (CECASE) has allowed complex policy scenarios to be managed and their application optimised.

The policy justification then considers the examination regime for structures assets and provides a comprehensive commentary on how renewal works is are assessed and justified.

Asset performance indicators for structures assets are defined with an assessment of how the performance indicators are evolving. Constraints and deliverability are assessed and show that the supply of materials and labour over the coming period may be impacted by other major infrastructure projects. Underbridges and earthworks have been identified as the critical assets within this asset group.

The structures justification policy follows the same format for each asset however the content is varied. The format is as follows:

- Asset specific policies for inspection & maintenance and replacement are listed.
- A description of the purpose of the asset and the asset population is provided.
- Asset specific degradation, failure modes and consequential risks are defined. The impact of these is stated along with their predictability and frequency of occurrence. Finally, possible mitigation measures are described.
- The means of managing the degradation risk is described for the asset.
- Replacement criteria and specification are described for each asset.
- Asset performance indicators for the asset are defined.
- Constraints and deliverability issues are considered.
- Planning assumptions for inspection, maintenance and renewals are described for each asset along with any long term implications on these issues.
- A compliance statement is made for each asset policy and supporting documents are referenced.

9.1.4 Comparison to 2006 Policy Justification

The key differences when comparing the current policy justification with the 2006 document are:

- There is better analysis and justification for the replacement criteria of structures assets.
- The description of the Civil Engineering Cost and Strategy Evaluation (CECASE) tool and its application demonstrates improved supporting analysis.

- There is a more comprehensive commentary on the examination and mitigation regime for underbridges which includes the development of risk based examination frequency intervals and the advent of the Civils Asset Register & Reporting system (CARRS).
- There has been an improvement in the planning assumptions for underbridges as a result of the use of the CECASE tool. The document would be further enhanced by the inclusion of some of the key output from the modelling tool(s).
- The inclusion of asset performance indicators for each structures asset.
- There has been a general improvement in the content of the degradation, failure modes and consequential risks analysis.
- Good use of references to supporting studies. Pertinent extracts from these studies would help to support qualitative analysis.

9.2 Structures Policy Justification AMEM Assessment

The following table identifies opportunities for improvement against the AMEM best practice framework assessment.

AMEM Criteria	Opportunities to Improve Score
Renewal Policy Justification	Clarification on the use and application of policies B & C within the Civil Asset Policy Statements is required. The use and application of the SCMI scores also requires clarification.
Maintenance Policy Justification	The criterion scored well, no specific opportunities to improve the score have been identified.
Options Analysis	The criterion scored well, no specific opportunities to improve the score have been identified.
CAPEX Criticality	The business case requirements should take account of criticality. The criticality should define the level of confidence required of the business case.
Whole Life Cost	The asset policy justification document would benefit from a commentary on how the various modelling tools and costs data are used to build up and support whole life cost assessments.
Business Benefit	The policy justification document would benefit from a description of the business benefit that is delivered by investments including any secondary or incremental benefits associated with it.
Business Case	The asset policy justification document should be amended to show how the business case for structures renewal is based on criticality and includes financial justification calculations such as NPV.
Project Grouping	The asset justification policy should make clear how the grouping of structures renewals is achieved and describe any benefits that are derived as a result.
Constraints	Given forthcoming major infrastructure works (e.g. Olympics, Crossrail) there is an opportunity to provide greater clarity around resource availability risks and mitigation plans. Additionally, more information on possession constraints should be included.
Asset Criticality	Complete the work to review the inspection and maintenance periods for structures assets. Document the process within the policy justification.
Deterioration Characteristics	Although it is acknowledged as an issue the asset policy and justification document would benefit from greater analysis and commentary of the impacts of climate change.
Maintenance Policies	The criterion scored well, no specific opportunities to improve the score have been identified.
Hazard Analysis	The policy justification document would benefit from an expanded commentary on the use and application of formal hazard analysis techniques.
Maintenance Tasks	Complete the work to implement risk based examination frequencies.
Loss and Consequence	Increased analysis and commentary on the implications (financial, safety, etc.) of risks.

AMEM Criteria	Opportunities to Improve Score
Activity Intervals	Complete the work to review the inspection and maintenance periods for structures assets. Document the process within the policy justification.
Asset Information	Provide commentary on how historic defect data has been used to inform the risk based examination frequency initiative.

Table 8. AMEM Assessment Opportunities for Structures

9.3 Commentary on Structures Policy Justification

9.3.1 Key Strengths

The following are the key strengths of the policy and policy justification based on the desk-top review:

1) Each asset is managed by one of five defined asset policy statements, policies A – E.
2) The document contains a good general description and justification of the approach to structures inspection, maintenance and renewal.
3) There is evidence that the policy application is underpinned by decision support tools. The document would be further enhanced by the inclusion of key output data from these tools.
4) The development and application of the CECASE planning & modelling tool and other systems such as CARRS is a positive step. However, the document would be enhanced by showing how these tools and systems inter-relate as part of the strategic planning process.
5) There is evidence of considered and evolving performance indicators for each asset.
6) There is evidence of progress towards risk based examination frequencies for structures assets. The civils inspection cost profile in the Strategic Business Plan (SBP) aligns with the anticipated outputs from this initiative.

9.3.2 Key Opportunities

The following are the key opportunities for improvement of the policy and policy justification based on the desk-top review:

1) Provide absolute clarity on the definition and application of policies B & C and their impact on Whole Life Cost management.
2) Provide justification for the Good, Fair and Poor boundary scores used within the Structures Condition Marking Index (SCMI). Demonstrate if and how the SCMI scores are used to inform asset deterioration forecasts.

3) Business case requirements and levels of assurance for structures capital expenditure appear to be driven by scheme cost estimates alone. Given the nature of the asset, business case requirements / levels of assurance should be determined by considering a number of factors – cost, safety risk, asset criticality, commercial risk, etc. For example, a low expenditure scheme that presents significant operational or reputational risks should be assessed as robustly as a large spend CAPEX scheme.
4) Complete and document the output of the work that has commenced on assessing the criticality of all structures assets.
5) Complete and document the outputs of the work that has commenced on moving to risk based examination frequencies.

It should be noted that additional supporting material was indentified in the December 2007 workshops that may address some of the above opportunities prior to March 2008.

9.4 Summary of Development Opportunities

This section contains both proposed development opportunities for the structures policy justification to achieve the 2011 target level of maturity and identifies additional information and short-term improvements necessary by March 2008 to support Network Rail's submission of the CP4 Strategic Business Plan. These opportunities take into account the material presented at the Network Rail workshops and include both issues relating to the policy / policy justification and issues relating to the application of these policies in determining the CP4 costs.

9.4.1 March 2008

This section describes the opportunities that we consider will be beneficial to Network Rail and ORR in increasing the level of confidence in the CP4 Strategic Business Plan and are achievable by March 2008:

1) Provide clarity on the definition and application of policies B & C and their impact on Whole Life Cost management. Further, the application of asset policies D & E should be defined by updating the 'Civil-3' policy statement.
2) Provide justification for the Good, Fair and Poor boundary scores used within the Structures Condition Marking Index. Demonstrate if and how the SCMI scores are used to inform asset deterioration forecasts.
3) Complete the work to review the criticality of structures assets and document the output within the policy justification.
4) Complete the work to review the examination frequency intervals for structures assets and document the output within the policy justification. The document should show how historic defect data has been used to inform the risk based examination frequency initiative.
5) Provide greater analysis and commentary on the investment justifications for earthworks and estuarine & coastal defences given statements made regarding climate change.
6) Provide greater analysis and commentary on possible resource constraints to show how the CP4 period structures programme can be delivered against a back drop of multi sector major infrastructure investment programmes.

9.4.2 2011 (Asset Management Vision)

This section is intended to further support Network Rail's own plans for development of the asset policy justification by summarising specific opportunities that we consider to have the greatest benefit to Network Rail in the medium-term, are achievable by June 2011 and are consistent with the Asset Management Vision:

1) The impacts of climate change are acknowledged but not considered robustly within the structures asset policy. While it is acknowledged that 'baseline' data for climate change scenarios is still emerging the structures asset group may be significantly impacted by climate change effects. Therefore, the asset policy and justification document needs to provide greater assurance that Network Rail is assessing the climate change scenarios and translating potential risks on assets into revised policy statements.
2) Describe the process for developing renewal business cases to take account of asset criticality, safety risk, commercial risk and financial measures within the asset policy justification document.
3) Demonstrate how the grouping of structures renewals has been achieved and describe the benefits that were derived as a result.
4) Demonstrate how the use and application of formal hazard analysis techniques have been implemented and incorporated into the definition of maintenance tasks.
5) Demonstrate that the use of good/fair/poor ratings of assets supports a risk based approach to condition assessment methods.

10 Comparison of Network Rail's Asset Policies

The quantitative analysis of Network Rail's June 2006 and October 2007 asset policies and policy justification documents has been carried out by specifically mapping the Asset Policies element of Network Rail's Asset Management Framework to AMCL's AMEM to generate a best practice assessment framework. The unique nature of the framework used by Network Rail makes quantitative comparison with other infrastructure owners difficult. However, from a qualitative perspective, it is AMCL's opinion that:

- The existence and subsequent development of asset policies and policy justifications within Network Rail is positive and is recognised as good practice asset management to support long term business plans and funding requirements.
- Network Rail's level of maturity in the development of policy and policy justification in Track and OLE compares favourably with the leading rail administrations and utility organisations' level of maturity. These two areas in particular have developed significantly since the June 2006 policies were published which is consistent with the priorities that were defined through the criticality analysis Network Rail undertook in 2007.
- Many of the other policies and policy justifications are less mature and have not developed much since 2006.

In our opinion, Network Rail should build on the results achieved for Track and OLE and continue to develop all the asset group policies and policy justifications if it is to achieve the level of maturity of a world class organisation and if it is to deliver the significant efficiencies and performance benefits that will result from optimised maintenance and renewal regimes.

Further to the above, although AMCL is not in a position to divulge the documentation of other Infrastructure owners, the ORR has been provided with senior contacts within:

- Tube Lines Ltd (Metro Rail Sector);
- United Utilities (Water Sector); and
- EDF Energy (Energy Sector).

This provides the ORR with an opportunity to further understand the level of asset policy development and justification in other industries and to support Network Rail in its asset policy development plans.

11 Summary

This project has assessed the status of Network Rail's current Asset Policies and supporting justification documents, as published in October 2007, against a unique, Network Rail aligned best practice framework. It has also assessed the progress of a sub-set of those Asset Policies and supporting justification documents against the equivalent documentation from June 2006.

It was found that two of the three asset types in the sub-set had progressed well when compared to both the June 2006 equivalents and the linear progression targets for Network Rail's Asset Management Vision for 2011.

Additional information and improvements to the policies and policy justifications have been identified for each asset group, for both March 2008 to support the evaluation of the CP4 Strategic Business Plan, and by March 201, in accordance with the Asset Management Vision for Network Rail.

The key findings for each of the asset groups are as follows:

- **Track** – the track asset policy and policy justification are the most developed of the asset groups, which is consistent with the criticality analysis undertaken by Network Rail which identified track as one of the priority development areas. The policies are well structured and form a good basis for further development. Some additional supporting information has been identified to be provided by March 2008 but the key challenge for track is to develop more robust cost-risk analysis by 2011 to demonstrate that the renewal criteria and maintenance / inspections regimes are robust and represent the lowest whole life cost solutions.
- **Signalling** - the asset policy sets out the expected life for each of the above and provides a number of policy statements on the inspection, maintenance, life extension and renewal of these assets. However, the 2007 policy and policy justification are virtually the same as those published in June 2006 and the analysis that underpins the policy statements is often not presented in the policy justification document. It is understood that some analysis on renewal options was undertaken within the signalling scenarios work undertaken a few years ago but this does not appear to have been updated or cross referenced in the policy or policy justification. There also appears to be little analysis or justification underpinning the maintenance regimes to demonstrate that these are optimised or to demonstrate how

these regimes will deliver the output requirements defined in the HLOS, in particular those relating to asset performance.

- **Telecoms –** the asset policy justification includes high level failure modes and consequences of the telecoms asset group and outlines the principles behind the mitigation regimes and maintenance and inspection processes. It also describes the renewal, enhancement and replacement criteria. However, the level of analysis within the asset policy justification that underpins the policy statements does not appear to demonstrate that the policies represent lowest whole life cost. Further development of this whole life cost analysis represents the biggest challenge for the telecoms asset group.
- **Electrification and Plant** – the policy and policy justification for OLE renewal and maintenance, including the deterioration and whole-life cost analysis, have been developed to a relatively high level of maturity. OLE was identified as one of the high priority development areas in the Network Rail criticality analysis undertaken last year. The key challenge for E&P is to develop the policy and policy justification for the other key E&P activities to the same level of maturity as those developed for OLE. Another key challenge for E&P is to collate and analyse good quality defect and failure data to support this analysis, a process that has recently commenced within OLE.
- **Operational Property** – The 2007 asset policy and policy justification is the first publication of these documents for operational property and these documents form a good foundation for future development. One of the key observations from the operational property policy is that the definitions of the A to C policy choices appear to address two separate issues:
  - The functional capability of the asset compared to required demand and level of service;
  - The remaining life or physical condition of the asset.

  This is potentially confusing for stakeholders who are seeking to understand these policies and the impact the application of these policies has on the CP4 Strategic Business Plan. Further clarification of these policy definitions should be provided as a matter of urgency to support the ongoing assessment of the CP4 Strategic Plan for operational property.
- **Structures** – The structures policy and policy justification has been developed significantly since the June 2006 issue. There is better analysis and justification for the replacement criteria of structures assets and the description of the Civil Engineering Cost and Strategy Evaluation (CECASE) tool and its application demonstrates improved supporting analysis. The key opportunities for structures are to provide greater clarity on the definition and application of policies B & C and their impact on whole life cost management and to provide

greater justification for the good, fair and poor boundary scores used within the Structures Condition Marking Index.

A further opportunity for all asset groups that would provide a greater level of confidence in both Network Rail and ORR would be to undertake additional sensitivity analysis on those policy statements that have the highest impact on cost or risk in order to illustrate the impact of increasing or decreasing the level of intervention or the periodicity of the intervention. For March 2008, this analysis may have to be limited to a qualitative analysis, supported by engineering judgement. However, as decision support tools and whole-life cost models are developed, this analysis should move to a more quantified basis. In our opinion, Network Rail should be able to provide this quantified sensitivity analysis for the top 80% of expenditure by June 2011 as a minimum.

In addition, two further developments for the longer term development of asset policies should be considered:

- The development of an asset policy and policy justification for asset information. Asset information plays an increasingly important role in the development of robust asset policies and the association whole life cost analysis. Consideration should therefore be given to developing a policy and policy justification for asset information that is aligned with the requirements of the infrastructure policies as well as the day-to-day operational requirements for asset information.
- Provision of annualised cost of ownership, or equivalent annual cash flow, for all major asset types as part of the policy development process. This will help to allow different technologies with different asset lives and reliability to be compared in an objective manner. It would also enable Network Rail and ORR to determine the steady state funding requirement to maintain existing assets and functionality at an average life. This information, in conjunction with average age information, would be invaluable in assessing whether increasing or decreasing funding requirements across control periods can be justified for a particular asset type.