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

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Review of SICA and Signalling Renewals Volumes Final Report

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Version	Sections	Amendment Details
Draft A	All	Initial draft for client review
Draft B	All	Incorporation of Network Rail and ORR comments
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Executive Summary

Asset Management Consulting Limited (AMCL) is the Independent Reporter for Asset Management to Network Rail and the Office of Rail Regulation (ORR). As part of its reporter role the company was tasked with reviewing Network Rail's use of its Signalling Infrastructure Condition Assessment (SICA) tool in forecasting sustainable signalling renewal volumes for Control Period 4 and beyond. The key objective of this work was to document the framework in which the SICA tool is applied, its role in the business planning process in terms of determining remaining asset lives and renewal priorities, and the impact of other factors on the actual renewal volumes planned and delivered.

This document summarises AMCL's findings and recommendations relating to the review of the application of the SICA tool and its outputs in the business planning process.

The key findings are as follows:

1) The SICA tool is well understood within Network Rail and currently achieves the purpose for which it was designed, namely to logically prioritise the short-mid term renewals workbank. There are, however, opportunities to improve the tool and supporting processes that should be considered by Network Rail.
2) Network Rail does not currently have a suitable tool for determining longer term renewals volumes and is therefore unable to demonstrate that signalling assets are managed sustainably and to achieve minimum whole life costs. Therefore Network Rail should develop and implement models for this purpose to support its plans for CP5.
3) There is no clear approach defined by Network to demonstrate sustainability of renewals volumes for PR13 and beyond and this needs to be developed and agreed with the ORR.

These findings are discussed in more detail together with appropriate recommendations in the body of the document.

The process included an overview of the literature on SICA and its application in the business, along with data analysis and interviews with SICA stakeholders and customers. The review included both SICA's use in Network Rail's central business planning processes, alongside the other drivers of signalling renewal volumes, and also in the Network Rail Routes to inform local decision making and renewals plans. The findings include both observations on the use of SICA in business planning for the Periodic Review 2008 (PR08) and also progress to date in developing the approach and tools to support the Periodic Review 2013 (PR13).

AMCL has found that the SICA tool itself appears to be well understood within the Route and central Signalling teams, including knowledge of the strengths and limitations of the tool in providing estimates of condition and forecasting renewals requirements. It is therefore considered that the short to medium term 'bottom-up' understanding of likely renewals requirements (i.e. for the next control period) and the relative priority is carried out consistently across the Routes and consolidated centrally through an established process. This results in a logically prioritised workbank, although this does not necessarily mean it achieves the lowest whole-life cost. However, there remain opportunities to improve the SICA tool’s use at this level that should be addressed as part of a forward strategy for the SICA tool. There are also opportunities to improve the data capture and peer review processes in the short-term. These are unlikely to have any safety impact (as other processes are in place to safeguard against this), but could have a material impact on the use of the tool in estimating the remaining life of an interlocking for planning purposes.

It is AMCL's assessment that Network Rail does not have a clearly defined set of complementary whole-lifecycle cost (WLCC) models that can be applied to the signalling asset portfolio to generate a 'top-down' view on what the longer term renewals requirement is likely to be and how this interacts with the other key business drivers of signalling renewal. The current Infrastructure Cost Model (ICM) approach is based on implementing a workbank that has already undergone several iterations to incorporate a variety of business drivers and overlays, rather than a set of generic assumptions for the life profiles of interlockings and their elements. The current 35-year life assumption for future renewals used to justify longer-term sustainability, is not clearly justified and does not align to the SICA notional lives. Network Rail has acknowledged this and is developing a three-tier approach to its modelling for PR13 (introduced in section 5.4.1). This includes the creation of Tier 2 WLCC models, but until these are in place Network Rail cannot demonstrate that it is adopting a renewals strategy that is consistent with its longer-term vision for the railway, and that the funding requirements identified represent a minimum whole life cost approach that is sustainable in the long-term. AMCL has identified specific steps that Network Rail could take to develop this approach as part of the PR13 process, outlined in the recommendations below.

In addition, there are some aspects of the SICA tool as an overall condition assessment measure that will need to be reviewed before it can be used to effectively monitor longer-term asset stewardship. The current model is understood to be designed to be used for prioritisation and as an engineering management tool (in Tier 3 of the proposed approach), not to provide robust forecasts of remaining life for the purpose of internal and external monitoring of asset stewardship. Potential areas of improvement to the model and interpretations of its results are therefore also recommended.

The key recommendations from this audit are therefore:

1) Network Rail should formalise its strategy for improving the SICA tool and supporting processes in its role as a Tier 3 tool to support Route Engineers, by October 2011. This strategy should include a plan with clear timescales, milestones and deliverables for each of the following:
    a. Short-term improvements to the Signalling Schemes Asset Data Store (SSADS) data capture and peer review processes to cover key supporting information and trend data, including the root causes of significant movements in element scores. Network Rail should formalise the capture of learning from its peer review processes to demonstrate consistency across assessments and that significant deviations can be identified and explained. The strategy should include a review of the additional supporting information collected by the Routes (such as Asset Condition Reports), to determine which information needs to be routinely captured in SSADS for business planning purposes;
    b. Longer-term improvements to the tool itself, including a full review of the regression analysis (including uncertainty), notional lives, sample selection and inputs;
    c. Evaluation of the benefits of a simplified Primary SICA tool and a decision on its future application;
    d. Revision of assessment frequencies to reflect overall asset criticality and notional lives; and
    e. Improved understanding of an interlocking's condition at its mid-life point (e.g. through a Secondary SICA) to assess its degradation to date and the impacts of any interventions already carried out.
2) Network Rail should develop and implement Tier 2 models based on whole life cycle cost (WLCC) analysis to determine renewal forecasts for key interlocking and element types. These models should be used to inform the work volumes and costs for the IIP (Initial Industry Plan) and therefore should be in place by September 2011. Further development of these models is recommended during 2012 in order to support the work volume and cost submissions within the SBP (Strategic Business Plan). A plan for the development of these models including clear timescales, milestones, deliverables and treatment of uncertainty

should be created, by May 2011 for IIP and October 2011 for SBP, to demonstrate that Network Rail will include the following capabilities:

a. Differentiation between the main types of interlocking and elements to reflect asset criticality and notional lives, so that a greater degree of transparency is available;

b. To improve the line of sight between strategic planning and bottom-up condition-led planning, the whole life cost analysis should differentiate between the key drivers of long-term renewal (e.g. ERTMS, Operations Strategy and Enhancements) so that the condition-led optimisation is dependent on the longer-term driver and the impacts of changes to these strategies can be evaluated;

c. The impacts of minor works and other interim interventions should be transparently captured and analysed as part of the above to form the basis of long-term minor works budgets;

d. The models governing condition and degradation over time should be informed and refined by data captured through the SICA tool to date; and

e. Internal benchmarking of the condition of interlockings that use similar technologies and have similar installation dates should also be used to inform the WLCC analysis.

3) Network Rail should set out and discuss with the ORR the proposed approach for PR13 in terms of demonstrating sustainability and stewardship in the context of its overall Asset Management Strategy, in the form of a plan including clear timescales, milestones and deliverables. This should form the basis of the demonstration in the Strategic Business Plan and therefore should be in place by December 2012.

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1 Introduction

1.1 Background

AMCL (Asset Management Consulting Limited) is the Independent Reporter on Asset Management to Network Rail and the ORR (Office of Rail Regulation). Having held the role during the 5-year Control Period 3 (CP3) the company was reappointed for CP4 in April 2009.

As part of this mandate Network Rail and the ORR have instructed AMCL to undertake a review of Network Rail's Signalling Infrastructure Condition Assessment tool (SICA) and its use in the company's business planning process as a means of forecasting the signalling renewal volumes. This includes a review of the other elements of the business planning process that influence the planned renewal volumes as these elements can complement or override the SICA forecasts.

This report documents AMCL's findings regarding SICA, its use in the business planning process and the evidence for the delivery of sustainable renewal volumes by Network Rail.

1.2 Objective

The defined audit objective was to follow up on the key recommendation of AMCL's assessment of changes to signalling work volumes between publication of the Strategic Business Plan update (SBPu) and Delivery Plan update, namely:

An assessment should be undertaken of the effectiveness of the SICA process to effectively predict remaining life future renewal volumes as this is the main basis for Network Rail's assertion that the signalling work volumes are sustainable in the longer-term.

1.3 Scope

The overall review scope was defined as:

1) Review the way in which the remaining useful life of signalling assets is determined from SICA condition scores both for elements and for an overall interlocking:
    a. Is the assumed relationship between condition and remaining useful life (i.e. the assumed degradation) fully documented both for elements and for an overall interlocking?
    b. Is the assumed degradation justified?

   c. Has the same assumed degradation been used when calculating minimum whole-life cost?
   d. How is the assumed degradation updated to reflect increased understanding of actual condition?

2) Assess how the remaining useful lives predicted by the SICA model compare against the informed views of Network Rail's signalling engineers.
3) Review the extent to which the predicted renewal dates within the SICA model are revised due to new information on an interlocking or because of other drivers for renewal, such as capacity increase, ERTMS, resource and planning constraints, etc.
4) Review whether the process by which SICA condition scores are used to develop signalling renewals plans is robust and represents sustainable Asset Management:
   a. Are whole-life costs including maintenance, renewals, full and partial refurbishment and the effects of replacement before end of useful life (e.g. due to enhancement) fully considered?
5) Review the extent to which the use of SICA is foreseen as a basis for planning of signalling renewals into CP5 and beyond:
   a. Is the approach being proposed and/or adopted appropriate for producing robust and sustainable plans?

1.4 Structure of this Report

The remainder of this report is set out to meet the above scope.

- Sections 2 and 3 set out the overall approach to this review and provide background context on Network Rail's signalling asset base and the organisation managing it.
- Section 4 reviews the SICA model and its estimation of remaining asset lives to address points 1 and 2 in the scope.
- Section 5 reviews the use of SICA in forecasting renewals volumes, including:
  - Its role in PR08 to address points 3 and 4 in the scope; and
  - Development of the PR13 approach to address point 5 in the scope.
- Section 6 considers other issues in demonstrating sustainability of renewals volumes and recommendations for how this could be developed further.

2 Methodology

2.1 Approach

The review considered the SICA tool and its role in business planning processes from both a top-down and bottom-up perspective, to provide a comprehensive review on the strengths and weakness of the tool in terms of determining sustainable levels of future renewal volumes. The study draws upon findings based on material from several sources:

- Publicly available material on Network Rail's policies and plans;
- Internal Network Rail documentation and supporting analysis on SICA and the business planning process;
- Existing reviews of the SICA tool and its outputs; and
- Interviews with key Network Rail personnel, from both headquarters and Route teams, to cover the full planning process.

The approach is illustrated in Figure 1.

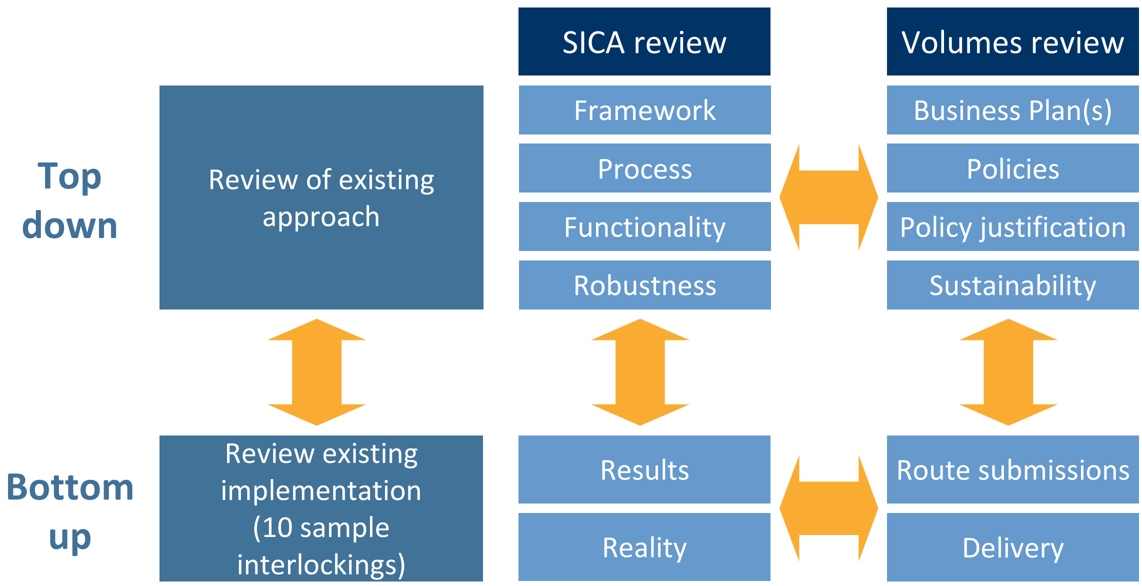

Figure 1 Illustration of Methodology and Interactions

2.2 Interview sessions

The scope of the interview sessions was agreed at a kick off meeting with Network Rail at which several themes were identified, along with the key personnel required to discuss each theme. The interviews were arranged by Network Rail and are summarised in Table 1. Alan Ross

(Head of Asset Management (Signal & Telecoms)) and Andy Smith (Senior Business Planning Specialist (S&T)) were the main contacts throughout the review, with Andy Smith organising and attending most interviews. Only attendees other than Andy Smith are shown in the table below (except for the SICA tool and process session).

Theme	Session	Date	NR Attendees	Role
SICA theory and process	SICA history	6/1/11	Brian McKendrick	Lloyds Register Rail
	SICA tool and process	21/12/10	Andy Smith	Senior Business Planning Specialist (S&T)
Policy development	PR08 and PR13 policy development	5/1/11	John Alexander	Principal Policy Development Specialist (S&T)
			Jerry Morling	Strategy Engineer for Signalling (during period under review)
Business Planning	PR08 approach	21/12/10	Paul Mann	Principal Signalling Principles Engineer
	ICM and role of Planning	20/1/11	Dan Boyde	Strategic Planning Manager [Policy & Modelling]
			Gareth Drakes	Strategic Planner
Detailed interlocking discussions	South East (covering Kent & Sussex Route, Anglia Route)	11/1/11	Andrew Coleman	Route Asset Manager (S&T) - Anglia
			David Fleming	Route Asset Manager (S&T) - Kent & Sussex
			Kenneth Gray	Senior Renewals & Enhancements Engineer (S&T) - Anglia
			Ian Griffiths	Senior Renewals & Enhancements Engineer (S&T) - Kent & Sussex
			Kevin Leech	Renewals & Enhancements Engineer (S&T) - Anglia
	LNE	12/1/11	Adrian Moss	Route Asset Manager (S&T) - LNE
			Bill Troth	Senior Renewals & Enhancements Engineer (S&T) - LNE
	LNW-North	13/1/11	Paul Darlington	Route Asset Manager (S&T) - LNW-North
			Andrew Reid	Renewals & Enhancements Engineer (S&T) - LNW-North
			Colin Saunders	Senior Renewals & Enhancements Engineer (S&T) - LNW-North

Table 1 Interview Sessions and Attendees

To minimise the burden on Network Rail in terms of resources, preparatory material was sent out before the interview sessions to allow the attendees to prepare. Any follow-up questions arising from the interview sessions were co-ordinated through Andy Smith.

2.3 Analysis

Where sufficient data was available, analysis was undertaken to provide evidence to support the findings against the questions asked in the Scope (Section 1.3). Details of the approach to the analysis are given alongside the findings.

2.4 Detailed Interlocking Studies

As part of the scope of this project it was agreed that as well as reviewing the SICA tool from a theoretical perspective and its application at a network level, it was also important to see how the tool is used in practice to inform renewals decisions for specific interlockings. A sample of ten interlockings was suggested by Network Rail, based on the following criteria:

- Cover all three main interlocking types covered in SICA (mechanical, relay-based, electronic);
- Cover a range of sizes (as measured in Signalling Equivalent Units (SEUs));
- Cover a varying range of conditions (Green Plus through Red);
- Cover a range of Routes; and
- Provide some examples of issues associated with using SICA for forecasting renewals dates.

To limit the amount of personnel that Network Rail would need to provide for these sessions, the sample was limited to interlockings from four (Engineering) Routes, covered in three sessions as shown in Table 1. The set of interlockings proposed by Network Rail was approved by ORR and is summarised in Table 2. Detailed summaries of the review of the SICA assessments and supporting evidence for each interlocking are provided in Appendix D:. Specific examples that support the evidence from the main analysis are referred to throughout the main document.

Note that although many of the interlockings are in the overall 'Green' category, the actual drivers of renewals plans and underlying conditions of elements differ, meaning the sample has provided a range of Routes, types, sizes, condition and issues for consideration.

Interlocking	Route	Type	SEUs	Latest SICA	Renewals scenario
Victoria Eastern	Sussex	RRI	218	Green (12.9)	Renewals requirement accelerated by internal wiring degradation
Stewarts Lane	Kent	RRI	650	Green (15.2)	Comparator for Vic East
Oulton Broad North	Anglia	Mech	38	Green (11.8)	ERTMS deferral means condition-driven intervention is required
Whitlingham	Anglia	Elec	52	Green+ (20.2)	Performance issues and obsolescence are the key drivers here, not condition
Marchey's House	LNE	Mech	18	Yellow (9.5)	Life extension until potential for Route rationalisation can be exploited
Trent SSI (Robin Hood)	LNE	Elec	60	Green (19.4)	Good condition but being upgraded as part of route rationalisation
Holme	LNE	RRI	44	Green (13.4)	Life extension of internal wiring to meet future ERTMS upgrade
Bransty	LNW-North	Mech	24	Yellow (9.7)	Criticality of asset means it can be maintained in Yellow/Red condition until Route enhancement opportunity identified
Crewe (PSB)	LNW-North	RRI	542	Green (17.2)	Life extension opportunities to meet a deferred enhancement
Norton SB	LNW-North	Mech	6	Green (12.2)	High-level score masks underlying issues requiring life extension

Table 2 Interlocking sample summary

Note: for a definition of an SEU see the Network Rail document: Definition of Signalling Equivalent Units (SEU) and Volume Reporting – BP001.

2.5 Additional Research

To compare to good practice outside of Network Rail, AMCL drew upon its knowledge from working with other rail and Asset Management companies, along with desktop research into other approaches for condition assessment, deferral of large projects and determining sustainable long-term replacement rates.

2.6 Existing reviews

As per the scope outlined in section 1.3, this review is intended to be a standalone assessment of the SICA tool and its use in forecasting sustainable renewals. However, the desktop research and interview session with Brian McKendrick highlighted the existence of two ORR reviews from 2005 produced by Lloyd's Register Rail:

- Independent Assessment of SICA using PAS 55 as a Guide (Lloyd's, 2005 (1)); and
- SICA Application and Business Planning Review (Lloyd's 2005 (2)).

Therefore, where there is an overlap with the existing reviews this has been clearly stated in this report. Both of the 2005 reports identified issues and made recommendations as to the ways in which SICA and its application in business planning could be improved. Not all recommendations apply to the scope of this review, but where any issues are relevant, this report captures whether these have been addressed by Network Rail or remain a concern.

In addition, AMCL had itself carried out a review of an earlier version of the SICA model and its application in Railtrack East Anglia Zone in 2000 (AMCL, 2000). Once again, while this is a standalone assessment, where any issues that were raised ten years ago have still not been fully addressed this is raised in this report.

3 Signalling Asset Management

3.1 Overview

This section describes some of the basic data systems, processes, roles and responsibilities for Asset Management of signalling within Network Rail. It also provides some background as to the make up of Network Rail's signalling asset base.

3.2 Asset Information and Data Capture Processes

Network Rail has introduced the Signalling Schemes Asset Data Store (SSADS) to act as the common interface for signalling asset data (Network Rail, 2010 (5) and SEA & Network Rail, 2010). It was introduced to overcome perceived limitations of the SICA Information System (SIS) and Interlocking Data Cards (IDC) database. It stores core information on sites and equipment, SICA templates and results, and works planning.

SSADS has been the main tool used to provide data on the SICA assessments, both at a portfolio level for all assets and for individual sites. Supporting information (where available) is now stored in SSADS and so electronic copies of many of the documents discussed in the Route interview sessions were available directly from SSADS (via Andy Smith).

The introduction of SSADS addresses some of the concerns raised in earlier reviews of the SICA and business planning processes (Lloyds, 2005 (1)). However, the system is only two years old, so where different routes have diverged in the generic supporting information captured on a routine basis, it will take time to build a consistent picture across the network. While a detailed review of all information stored in SSADS is outside the scope of this review, the detailed interlocking sessions identified examples of the additional supporting information (such as Asset Condition Reports), either kept locally (in the Route) or uploaded into SSADS where it can be accessed by other SSADS users (see Appendix D: section D.x.2 and D.x.5 for each site). Locally stored information is therefore not always available centrally. Similarly, while information may be on the system, from the detailed interlocking sessions it is clear that some of it is only accessible through opening non-standard reports stored in the system in Adobe Acrobat's pdf format. Storing these on SSADS does mean that their availability across Network Rail has been improved, but there is some way to go before this information is optimally integrated into other Asset Management processes.

3.3 Signalling Asset Management Organisation

Network Rail moved to an organisation structure based on its core processes in November 2009 (Network Rail, 2010 (1)), which included the creation of an Asset Management directorate to better align the Asset Management activities across engineering, maintenance and project delivery.

Figure 2 illustrates AMCL's understanding of Network Rail's current organisation structure across the Process Led Organisation (PLO), the core directorates of which are shown in the chevrons. The relevant elements of the core organisation have been mapped against these chevrons, with the central and Route-based elements highlighted to help illustrate the roles of the teams in the business planning processes for signalling assets.

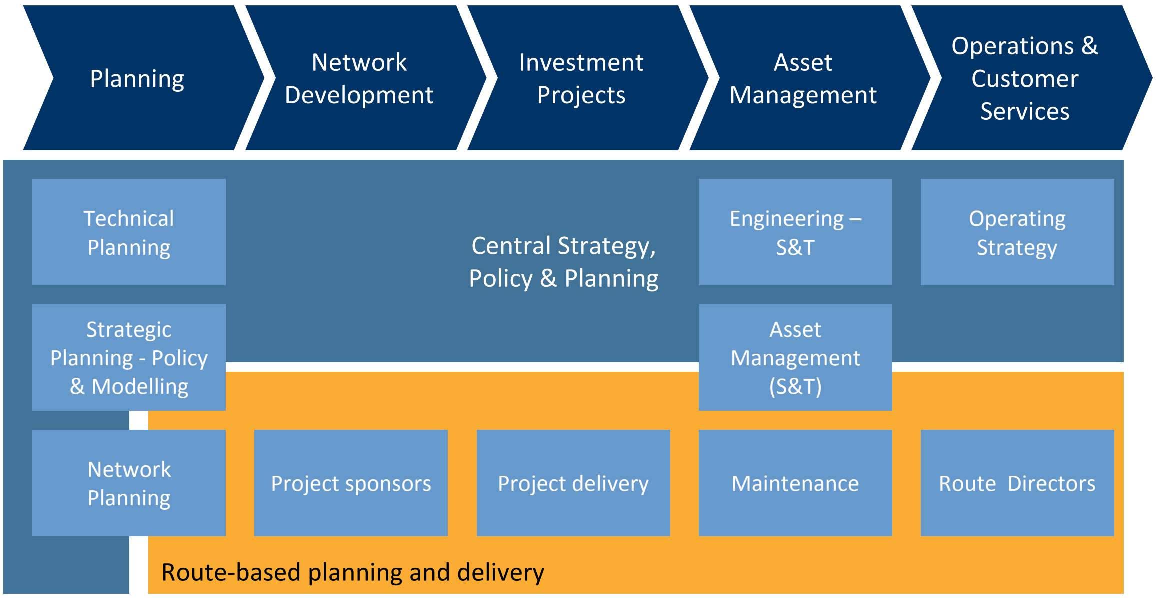

Figure 2 Simplified illustration of Network Rail organisation structure for Signalling planning

Within the Asset Management directorate, Engineering is responsible for the policy, standards and assurance, with Asset Management (S&T) applying the above policy and standards to the asset base and creating appropriate business plans for delivery. Network Rail stated that the Technical Planning and Strategic Planning teams now work closely with the Engineering (S&T) and central Asset Management (S&T) teams to develop policies that are consistent with the company's strategic goals and target outputs, and bring together the resulting plans into a consolidated plan for the network. This also needs to take into account the Operating Strategy, looking for opportunities to use infrastructure improvements to streamline operations delivery, which is driven by Operations & Customer Services. How this process works in Periodic Reviews and recommendations for its improvement are discussed in section 5.

At the Route level, elements of all directorates are responsible for working together to determine the requirements for the route, develop solutions that will provide these and deliver the required work. Network Planning is responsible for consolidating the longer term overall plans into the network plans through the Route Utilisation Strategies (RUSs) and within each directorate there are also teams providing assurance and governance roles to support consistent decision making across the organisation. Note that the Route structures within each part of the organisation have evolved over time and are not always consistent. For example, the LNW operational Route is managed as two routes (LNW-North and LNW-South) for Asset Management purposes, whereas two operational Routes (Kent and Sussex) are managed as one for Asset Management purposes.

As part of this review, Route interviews, including detailed discussion of the suggested interlockings were conducted predominantly with the Route Asset Manager for S&T (RAM) and the Senior Renewals and Enhancements Engineer for S&T, with specific input from other members of their team responsible for the SICA assessments (such as the Renewals and Enhancement Engineer).

The RAM role is to pull things together for the overall asset, so that the best performance is achieved for minimum cost and the asset delivers what is expected by the key stakeholders. The RAM is responsible for making sure that condition-driven renewals identified by SICA are aligned to the longer-term Route aspirations. As part of the new organisation structure this role is intended to work more closely with other elements of the business. As well as the Renewals & Enhancement Engineering team, the RAM team has a Maintenance Support Team that works directly with the Maintenance organisation in the Route.

In addition, the RAM is intended to work closely with Route-based personnel from Network Planning, Network Development, Investment Projects, Maintenance and Operations & Customer Services. Several meetings and tools were described that help align the objectives of the different functions with those of the overall route, including:

- Route Strategy Planning Group (RSPG), bringing together all of the functions to discuss future plans for the Route;
- Route Interface Review Group (RIRG), a six monthly meeting that also brings in Train Operating Companies (TOCs) and Freight Operating Companies (FOCs) to discuss plans and aspirations;
- Route Investment Group, also involving TOCs;

- Route Requirements Planning, deals with sections of the route with each Asset / Enhancement team to integrate plans and plot schemes;
- Route Reliability Infrastructure Group (RRIG), Maintenance-led group to look at infrastructure solutions to reliability and performance improvement; and
- Route Asset Management Plans (RAMPs), repositories for all information on the assets in the Route so that delivery plans can be jointly agreed and optimised.

It is AMCL's understanding that all Routes adopt broadly the same structure for the above meetings. It is worth noting that the interfaces with the other stakeholders, including the TOCs and FOCs, do appear to provide a better alignment across the organisation and industry as a whole. All RAMs gave examples of longer-term schemes that would impact upon their engineering decisions. However, it is out of scope for this study to determine whether these meetings are effective or what improvements could be made.

The Route Renewals and Enhancements Engineering team reports in to the RAM and focuses on the engineering view of S&T requirements for the Route, reviewing and challenging results from the SICA assessments and then using these to build the business plans, cross-checking SICA-led renewals against other enhancement projects, other asset requirements (such as remodelling of switches and crossings (S&C) and longer-term strategies). They are also responsible for creating engineering remits for S&T projects to meet the outputs defined by the project sponsor (in Network Development) and evaluating different options.

3.4 Signalling Asset Base

In terms of disaggregating the asset base, the level of granularity under consideration in this review is the interlocking area, namely the interlocking itself, the external, lineside equipment controlled by the interlocking (including signals and points machines) and the cabling and other equipment connecting these. Approximate interlocking populations based on data in the material reviewed are shown in Table 3. Each of these broad headings can contain several different technologies delivering that type of interlocking, and Network Rail therefore has to manage a diverse range of assets. The Signalling Equivalent Units (SEUs) for each type of interlocking are also shown, reflecting the size and complexity of the area controlled by the interlocking. The older, mechanical interlockings generally control simpler areas of the network, while the relay and electronic systems can be very complex. It can also be seen from the table that the largest segment of the population is the relay-based interlockings. As these reach the end of their lives it is important that Network Rail establishes whether these should be upgraded to an electronic equivalent, or whether they should be renewed like-for-like.

Main sub-division	Quantity[1]	SEUs[2]	Average SEUs per interlocking
Mechanical	600	11,842	20
Relay	787	33,781	43
Electronic	343	17,192	50
Total	**1730**	**62,815**	**36**

Table 3 Interlocking Asset Populations by Type

[1] Source: Network Rail (2007)

[2] Source: Ove Arup (2009)

4 SICA

4.1 Introduction

This section deals with findings related to the use of SICA as a tool to estimate remaining lives of signalling assets and hence forecast future renewal volumes. Firstly, AMCL's understanding of the background and theory of the Primary and Secondary SICA tools and their use in forecasting remaining lives is presented. Findings are then presented against each of the key steps in the tools and these are summarised to address scope elements 1 and 2 from section 1.3.

4.2 Background

The following content detailing the background and development of SICA is taken from the presentation provided by Lloyd's as part of this review (Lloyd's, 2006 (1)).

The privatisation in 1994 established Railtrack as the Infrastructure Controller of the national rail network. Railtrack required an objective method of assessing signalling infrastructure condition to assist in the prioritisation of equipment renewal and interlocking replacement. Key objectives of the condition assessment process were to:

- Be risk based;
- Complement engineering judgement; and
- Provide a consistent and systematic method of assessing condition to allow national investment priorities to be established.

The Signalling Infrastructure Condition Assessment (SICA) process was developed based on the principles of an existing condition assessment method under British Rail. The steps in the development of the tool and process are shown in Figure 3.

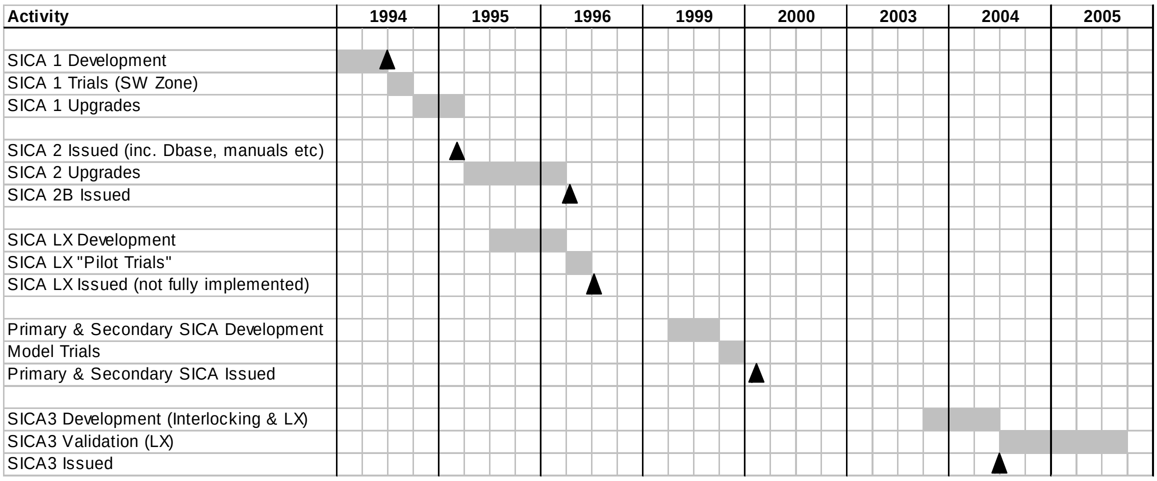

Figure 3 SICA Development Timeline

The broad principles behind the original SICA tool are consistent with the current model. Capture of specific indicator data on safety and performance formed part of the original remit to cover risk prioritisation but these were later dropped in favour of capturing grades reflecting more generic levels of safety and performance (e.g. ‘average’, ‘better than average’). These safety and performance constituents of the tool were removed as other more robust sources of information were considered by Network Rail to be available. These are used by the engineer in forming the overall view of the condition, performance and supportability of the asset. Similarly a Level-Crossings module was dropped during the initial development, although this has since been re-introduced.

4.3 SICA Methodology

4.3.1 Overview

The SICA tool exists in both Primary and Secondary forms, for both Interlockings and Level Crossings. This review has focused on the Interlocking assessments (both Primary and Secondary) although some of the findings will be relevant to the Level Crossings tool as it is based on the same methodology.

The core of both Primary and Secondary versions is the Secondary SICA tool. The Primary SICA acts as a simplified interface to the underlying Secondary SICA worksheets, designed as a 'SICA lite' approach that could be applied with considerably less effort. The following descriptions refer to the Secondary SICA model. The differences in the Primary model are then summarised.

This is followed by observations on the methodology for both models and its potential impact on the high level condition scores, remaining life forecasts and hence use in business planning processes.

4.3.2 Interlocking Secondary SICA

The Engineer input to the model is to complete a set of **Checklists** for each element to score the condition, performance (as a relative grade) and other contributing factors for each of the key elements. This consists of a multiple-choice selection of scores for each question (with the opportunity to add comments if required). These answers are given on a scale of 1 to 5 (with 1 reflecting an 'Excellent' position and 5 an 'Unacceptable' position). The definitions of what 1 to 5 mean for each question for each element are stated on the element's input sheet.

Where several instances of a given component are present, there is an opportunity to take a sample of these and score the inputs for each.

The questions are grouped under headings corresponding to the following **Key Condition Factors (KCF)**:

- **Equipment condition** [C] – covering perceived condition of the equipment itself, including questions based on installation dates, visual inspection and fault history.
- **Maintenance & faulting requirements** [M] –relating to factors impacting on the maintainability of the element, including labelling, access and availability of spares.
- **Compliance to standards** [S] – including both installation standards and compliance of element features with current standards.
- **Modification history** [H] – capturing information on previous modifications.
- **Environment** [E] – environmental features such as current and historic ambient temperatures.
- **Trend** [T] – key features that could impact on the future condition of the asset, including the manufacturer of the element or the anticipated trend in condition.

Note that the above examples are sample questions under each KCF and not all elements have these questions under each KCF. Note also that some questions can be allocated to two or more KCFs (although the data is only input once). For example, for Location Cases, questions C2 and S7 are both 'How would you describe the installation standard of the wiring?', with C2 taking an input from the assessor and then S7 reading from the same cell.

Where a sample has been taken for the element, the score for each question is averaged using a Root Mean Square (RMS) formula. This weights the worse performing elements more heavily than an arithmetic mean average would.

The scores for each of the KCFs are multiplied by specified coefficients to give an overall score which is interpreted as a **Lifeline Position**. This is a point on the interval 0 to 1 where 0 indicates a newly installed element and 1 the point of life expiry. As the combination of scores for the KCFs can fall outside of the [0 to 1] interval it is truncated, to a [0.3 to 1] interval. It is stated in the documentation that this is intended to avoid overstating the remaining lives of the elements and overall site.

Elements have a **Notional Life** based on the expected life under average conditions. The above **Lifeline Position** based on the KCFs for the element is applied to the element's Notional life to give a **Nominal Life (Remaining Life)** which is the estimated remaining life for this element at the time of the assessment. This is then classified according to where the remaining life falls in the intervals shown in Table 4.

Condition band	Remaining life
1 - GREEN PLUS	>20 years
2 - GREEN	10 years to 20 years
3 - YELLOW	3 years to 10 years
4 - RED	Less that 3 years

Table 4 Outputs from SICA Model

Note that a condition band of 5 is also stored in SSADS for elements that have not yet been assessed.

The remaining life for each element is also combined into an overall **Site Remaining Life** (i.e. for the overall interlocking and all elements). Once again this uses a weighted averaging calculation. Generic weightings are held in the model and are based on the importance of an element. The averaging process then weights the relative contribution of each element to an overall site's remaining life. The overall process is illustrated in Figure 4.

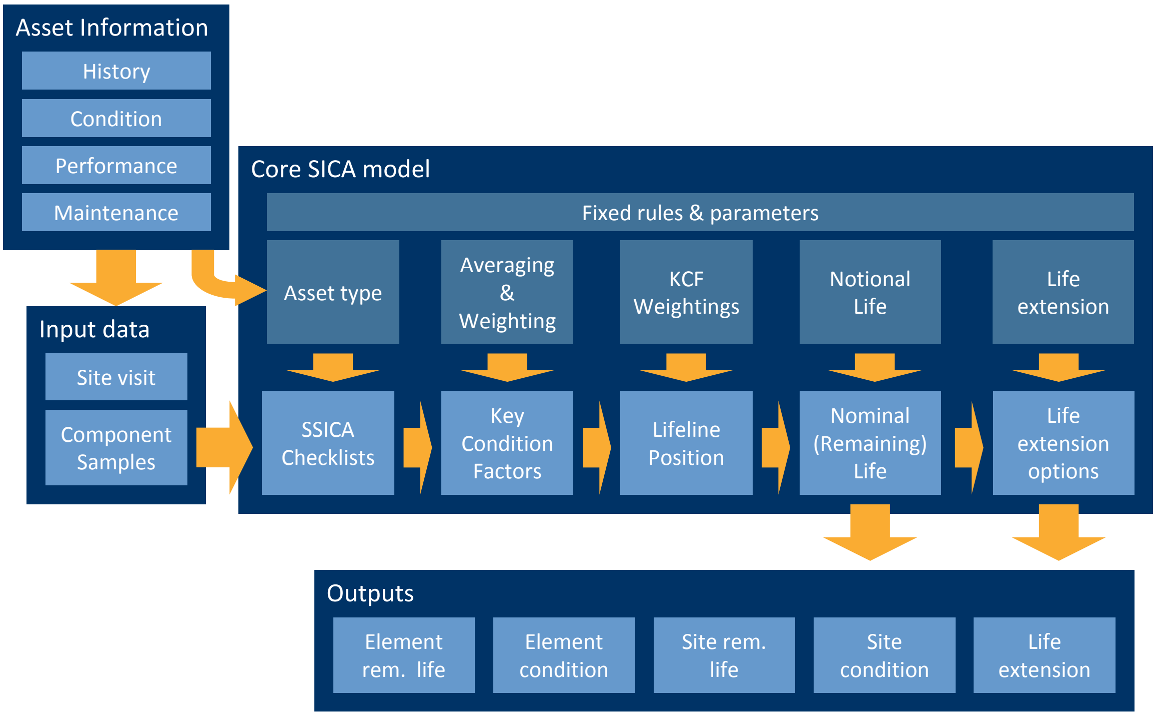

Figure 4 Illustration of Secondary SICA Process

4.3.3 Interlocking Primary SICA

The Primary SICA tool only differs from the Secondary SICA in terms of the number of inputs and outputs to the model, and that it doesn't have to be carried out at the site. The core model, including the condition factors, weightings and conversion to remaining life estimates all use the methodology described in Section 4.3.2.

From the discussion with Brian McKendrick, Andy Smith and the supporting evidence in Lloyd's (2006 (1)), AMCL's understanding is that Primary SICA was introduced to be a 'SICA lite' approach that could be carried out as a desktop study based on available data and local knowledge. The purpose of the tool is to determine whether any actions are likely to be required in the near future (within 10 years), and hence whether a full Secondary SICA report is needed to determine in more detail the condition of the site. The output sheet for Primary SICA therefore presents site life and element scores as the condition bands in Table 4. The remaining lives associated with each element are stored in the assessment spreadsheet and are extracted from this and stored in SSADS.

The input checklists are simplified to pick out the key questions that drive the Secondary SICA condition assessment as follows:

- The elements forming the assessment are restricted to those that are understood to have most impact on the remaining life.

- No sampling is required as an overall checklist is completed for each element type.
- The options available range from the full five options of the Secondary SICA model to a binary 'Yes/No' choice.

These are mapped to a full Secondary SICA assessment on hidden sheets in the tool, with each option allocated an equivalent SICA score. There is an option to fill in any comments in the input sheet as a full accompanying report is not required.

The key differences (highlighted in red) are illustrated in Figure 5. The key thing to note is that although the core model still performs the same functions, as there is less confidence in the inputs the formal outputs are restricted. Only the high-level condition measures for the elements and the site are given (the remaining lives and life extension impacts are greyed out as these are not standard outputs).

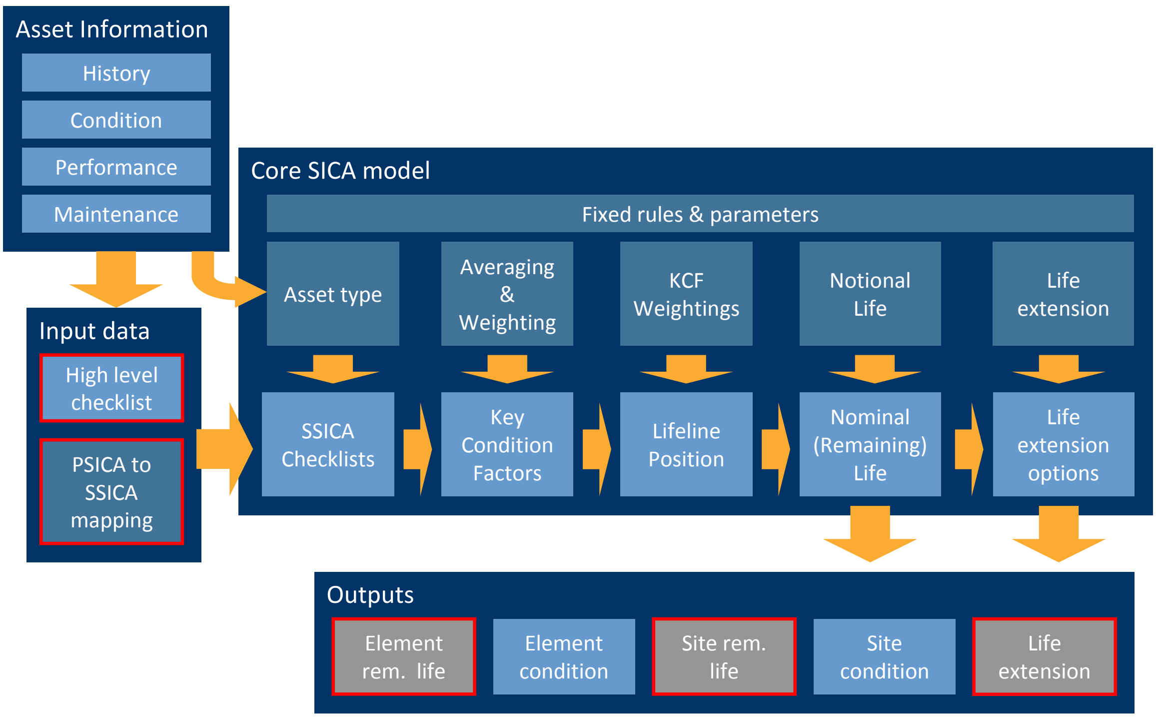

Figure 5 Primary SICA - Differences from Secondary SICA Model

4.3.4 Next Assessment

An additional output from both SICA models is a recommendation for the next type of assessment and the interval within which it should be carried out, shown in Table 5. SSADS uses this output to generate a target re-assessment date for each interlocking.

Score	From Primary SICA	From Secondary SICA
1 - GREEN PLUS	PSICA within 10 years	
2 - GREEN	PSICA within 5 years	
3 - YELLOW	SSICA within 2 years	SSICA within 3 years (or update condition following renewal work)
4 - RED	SSICA within 6 months (or update condition following renewal work)	SSICA within 1 year (or update condition following renewal work)
5 - NO PREVIOUS	SICA within 5 years of asset being in commission	

Table 5 Next Due Assessment Based on Condition Scores

4.3.5 Updating Previous Assessments Based on New Condition Information

The new SICA score will overwrite the previous score as the latest view of the remaining life of the site and elements. Each assessment is treated as independent, although SSADS does allow historic SICA records to be kept for each interlocking, which means some trend analysis could be performed. In some Routes the Engineers will use the supporting documentation (e.g. Secondary SICA report and Asset Condition Report) for the previous assessment as a template for the new assessment, so changes can be more easily tracked and explained.

4.4 Review of SICA Methodology

4.4.1 Overview

In this section the observations from the review of the methodology outlined in Section 4.3 are presented. These are based on the stages carried out in an assessment, namely:

- Input data;
- Conversion of input data into condition factors;
- Conversion of condition factors into lifeline position;
- Conversion of lifeline position into remaining life; and
- Use of SICA model outputs.

The overall findings are then summarised.

4.4.2 Input Data

The checklists for both the Primary SICA and Secondary SICA models appear to be clearly defined and hence should be completed consistently by a suitably trained signalling engineer familiar with the site and with access to the required historic records, such as installation dates and modification history. The input data (in terms of the checklist answers) contained in the SICA assessments is therefore generally considered likely to be of good quality and suitably robust. However, from discussions with both HQ and Route teams, in particular from the detailed interlocking discussions, it was clear that the tool took some time to be established and the quality of early assessments may not be as high as more recent assessments.

For example, in the discussion of Victoria Eastern (see section D.2), it appears some of the early Primary SICA assessments were grouped so individual sites may have been averaged. Holme had two Primary SICAs carried out within a short space of time (see section D.8), which saw quite different assessment results. Similarly, from the discussion of Oulton Broad North (see section D.4), assessors had differed on not just the SICA scores but also on the 'facts', namely the type of mechanical frame present. While it is important that assessors are allowed to take an unprejudiced view, where there are significant differences this should be reviewed and understood, especially before any trend analysis is performed.

ORR's existing review of SICA (Lloyd's, 2005 (1)) had highlighted assessor competence as a potential issue. While on-site validation of SICA assessments was outside of the scope of this review, from our discussions with Network Rail it would appear that much has been put in place to try and address this competence issue, including:

- Training and mentoring of SICA assessors;
- SICA assessments being carried out in-house;
- Independence of SICA assessor from the delivery team; and
- Peer review process and the SICA review group to bring consistency between assessments.

The Secondary SICA checklist criteria appear to be well defined, with clear descriptions of what constitutes the element being in each of the 1 to 5 categories. It is possible to input decimal points and in some of the detailed interlocking assessments this had taken place. It is not clear what benefit this would bring, as it is introducing a more subjective view into what has otherwise been a relatively objective scoring system.

The choice of the Primary SICA equivalents appears to be less clear. For example, some questions are given 'good / acceptable / unacceptable' options, while others are just 'good / unacceptable'. In simplifying the input sheet for the Primary SICA, the quality of the assessment may have been compromised.

4.4.3 Condition Factors

The input scores are mapped to overall condition factor scores for the element. For the Primary SICA there is an initial step in which the checklist score is converted into the Secondary SICA score on the hidden worksheet. From this point there are two steps:

- Averaging across the sample; and
- Weighting individual questions into overall condition factors.

The averaging process is to take a 'root mean square' of the scores for each individual asset in the sample (or Primary SICA scores allocated to that question). This is intended to give a greater weighting to assets in poorer condition. However, at this point some of the information on the variability within the sample is lost. An example of the averaging process for a specific interlocking is given in section D.11.4 for location cases. This demonstrates that while the overall score may appear fine for the sample, different actions may need to be taken for specific elements in the sample.

Similarly, there is an issue as to the impact of omission on the scores for an element. For example, in the discussion of Marchey's House (see section D.6) it was observed that if an element cannot be accessed for an assessment, no score will be captured. The omission of an element could have consequences if the element is not of a similar condition to those sampled. If the element is in better condition, it would mean that the remaining life of the asset is underestimated which would lead to over-forecasting in terms of renewals volumes requirements. If the element is in worse condition, or inaccessible due to safety reasons then this would lead to an overstated overall score. While the local Route team will have the knowledge that this has happened and will be able to monitor and mitigate this risk, it is unlikely to show up at a network-wide level.

Another example of the above was from Whitlingham (see section D.5), where lack of Cable Routes caused a low score in a Primary SICA, but in the follow-up Secondary SICA, the Cable Routes scored highly, not because this had been addressed but because what little routing existed was in good condition. Once again, for the Route Engineer this may not be an issue as through local knowledge they would be aware of this, but how this would be reflected overall is unclear.

The weighting of individual questions scores into the total condition factor score also raises questions on the sensitivity of the parameters to the individual questions. Some questions appear to be 'averaged out' in the process, especially for equipment condition where many factors are assessed. However, the Trend factor is often driven by one or two key questions and therefore can show much higher volatility, particularly if triggered by a binary question in a Primary SICA.

This Primary to Secondary SICA transformation along with the averaging and weighting process complicates what should be a relatively straightforward translation from the key inputs to the desired output, namely the remaining life estimate. It also makes it harder to review the assumed relationships between these input data and the remaining life estimates, and to collect information to validate and challenge these relationships. For an example of the impact of the relative weightings of the Primary SICA inputs see section 4.4.4. It would be unwise to extrapolate the results from the averaging seen in Whitlingham (see section D.5) across the whole portfolio to estimate the overall impact, but a review of the impacts of averaging should form part of future SICA model development.

Note that the above issues with averaging and lack of transparency should already be known within Network Rail and ORR, having been identified in the existing SICA review (Lloyd's, 2005 (1)). From the evidence seen in this review it would appear that these issues remain unresolved.

4.4.4 Lifeline Position

AMCL has reviewed the formulae used in the SICA model to convert the KCF scores into an overall lifeline position. AMCL is not challenging the formulae themselves as this is outside of the scope and they are generally accepted by Network Rail and ORR as being robust, having been peer reviewed by Signal Engineers over the life of SICA and through Network Rail's internal processes. However, the sensitivity of the remaining life estimates to the input parameters is dependent on these formulae and therefore needs to be evaluated.

The functional specification document that Lloyd's Register has provided for Network Rail (Lloyd's, 2006 (2)) does not explain the justification for the underlying parameters and it is not clear what further evidence has been built up over the time that SICA has been in use to confirm the relationship between the condition triggers and the remaining life estimate. It was stated in Lloyd's (2005, (1)) that the parameters are derived from a multiple regression carried out in conjunction with researchers at Imperial College during the early development of the model. It was also raised as a concern in the same report that this analysis is not reviewed and revised on a regular basis. From discussions with Network Rail, some progress has been made in reviewing the parameters and considering the impact of possible changes. However, assumptions within SICA including those on notional lives (and therefore remaining lives) are not being formally updated as historical data is collected (e.g. through review of the regressions and repeat modelling). A formal review would increase the understanding of degradation and therefore give more confidence in the stability of the parameters and the variability of the condition bands and remaining lives output by the SICA models. This could form a future area of research for Network Rail.

In addition, some parameters have much higher influence than others, and in most cases much of the variation in the lifeline position is explained by three or four parameters, particularly in the Primary SICA case. For example, in the Primary SICA checklist for Relay-based interlockings, Q1 'How would you describe the installation standard of the interlocking?' contributes approximately 35% in terms of determining the lifeline position, and with Q6 'What is the state of the interlocking?' and Q7 'How would you describe the physical appearance of the interlocking?' this figure goes up to 60%. Correspondingly, half of the questions asked have very little impact (<5%) on the overall lifeline position. Similar behaviour was seen in the sheets for other interlockings, and when questioned, Route Engineers said that there were certain elements that were much more critical to the overall renewal decision than others. This suggests that the Primary SICA tool could be simplified such that the link from input triggers to output actions is clearer and the 'black box' calculations are avoided.

A similar suggestion was mentioned in Lloyd's (2005, (1)) for the overall SICA model, although it concluded that this could potentially lose some of the strengths. AMCL's analysis would suggest that it would not be appropriate to over-simplify the Secondary SICA model, but that the Primary SICA tool is a potential candidate for simplification. This could then enable the current condition-risk based approach to incorporate other criticality measures.

Given the above, it would appear that movements in the lifeline position are likely to be volatile step changes, triggered by certain condition parameters crossing a threshold. Even linear functions such as age (given installation date) are parameterised to a 1-5 scale that means 1-10 years shows as 1 and 11-20 years as 2. An improved understanding of these should form part of the review of the evidence behind the existing degradation models. Internal Wiring appears to be a particular element where the degradation models are not fully understood and the sensitivity to certain trigger points happens at the key 7-10 year point in terms of remaining life (see the discussions on the Victoria interlockings in sections D.2 and D.3 for example, along with several of the other interlockings where internal wiring is the key driver of renewal requirements).

In addition, by truncating the lifeline position to a minimum of 0.3 (30%), Network Rail will understate the remaining life of assets in their early lives. While this will have no impact on the use of SICA as a prioritisation tool for short-term renewals requirements, this has implications for strategic planning and sustainability assessments.

4.4.5 Remaining Life

The application of the notional life to the lifeline position appears reasonable, providing that the lifeline positions accurately reflect how much life has been consumed and providing that the notional life is updated to reflect actual lives being achieved. However, due to the range of notional lives, it is not clear what the benefit is of aggregating these up to a site level in determining the overall condition. Good practice for whole life cost analysis suggests that the level of granularity at which an asset is modelled should reflect the level at which interventions are implemented.

Within SICA, the impact of the above is that elements at the same point in their lifecycle will be treated differently based on the notional (and hence remaining) life. For example, the notional lives differ for each main type of interlocking, so at a lifeline position of 60% the overall SICA result will differ as demonstrated in Table 6.

Interlocking type	Notional life	Remaining life at 60% Lifeline Position	SICA category
Mechanical	40	16	GREEN
Relay	30	12	GREEN
Electronic	20	8	YELLOW

Table 6 Impact of Notional lives on SICA Categories

This suggests that the way in which the interlockings and their elements are managed should differ, rather than applying the same SICA rules to all categories of interlockings. This is particularly true of Power Operated Points, where the truncation of the lifeline position coupled with the (relatively) low life of the asset (10.2 years) means that all Power Operated Points come out at a maximum condition rating of Yellow. This would suggest that the standard SICA output is not the best tool for managing these elements.

The overall averaging issues were clearly illustrated through the sites used in the detailed interlocking discussions. Oulton Broad North (section D.4) shows similar scores at the site level in both assessments, but the underlying drivers (and hence likely renewal requirements) have changed in that the state of the Semaphore Signals has dropped considerably. At a high level it would appear the site was degrading slowly (over five years the remaining life drops by less than one year), but this potentially masks the underlying issue, namely the degradation of individual elements which will drive the next intervention.

Existence of notional lives within SICA for condition assessment purposes contradict the overall lives published in the Signalling Policy (a flat-rate 35-year life). It was explained to AMCL that the '35-year life' was an average across asset types that was not used in determining specific renewals requirements in CP4. It was however used as the basis for long-term forecasting in future control periods (see section 5.2). In addition, Figure 1 on page 148 of Network Rail's 2007 Signalling Policy (Network Rail, 2007) is potentially misleading and for the PR13 policy submissions ORR should expect Network Rail to differentiate between the types of assets based on the evidence from SICA and other asset information.

4.4.6 Use of SICA Model Outputs

It is clearly stated in section 6.5.1 of the SICA Handbook (Network Rail, 2008) that:

Remaining life should not be used as an absolute estimate of remaining life for a signalling element of an installation but should be used as a key determining factor in ranking condition between sites in order to help prioritise subsequent renewals and investment.

A concern raised in the earlier AMCL report (AMCL, 2000) was on which 'life' is reflected in both the input notional lives for each asset type and the output remaining life from the model. AMCL states four different definitions of life reflecting different drivers:

- Safety, the point at which the safety performance of the asset is no longer ALARP;
- Design, which was the designer’s interpretation of the asset’s physical life with respect to its intended operating context (reliability and cost to maintain);
- Technology, which is the susceptibility of the asset to changes in technology (obsolescence); and
- Economic, which is a measure of the overall impact of the asset on the business with respect to alternative replacements.

The SICA user manual for version 4 (Network Rail, 2010 (4)) is still considered by AMCL to be unclear on exactly what the output means in terms of the above. This is less of an issue when used as a comparative tool, but in terms of whole life costing and demonstration of asset stewardship this remains an issue.

The view of the majority of the Route Engineers interviewed was that the outputs from the model are adequate in supporting their decision-making processes. The tool identifies the right priorities that are generally consistent with what the Engineers know about the asset and the views of Maintenance. This is consistent with statistical analysis carried out in the earlier report by AMCL (AMCL, 2000) on a sample of results from an earlier version of the SICA model, which concluded that the ranking (and hence priorities) were broadly consistent between assessor and SICA. The peer review process would appear to validate this on a more regular basis, although the type of analysis undertaken by AMCL does not appear to have been formally repeated since 2000.

The Engineers normally focus on the detailed outputs to identify the worst performing element as these are most likely to drive renewal dates, the high-level averages are generally considered of less use.

The Route Engineers stated that the Primary SICA tool is used to determine the priorities for full Secondary SICA assessments and they view the Secondary SICA assessments as producing reasonable estimates of remaining lives for the purposes of prioritising work, with two notable exceptions:

- *Mechanical Interlockings*: The engineers from LNW-North suggested that the scores from the SICA model were overly pessimistic and that they took most of their views on what was required from the local maintainer (see examples In D.9 and D.11).
- *Internal Wiring*: The issue of internal wiring was brought up in several of the Route sessions as this was seen as an area in which the SICA model was not able to accurately predict remaining lives due to the non-linear degradation profile. In the supporting evidence for the Victoria interlockings it was shown that for internal wiring at the Green/Yellow borderline the estimates were sometimes considered overly pessimistic or optimistic by the engineers. As this can be a key driver of the need for a full renewal, the robustness of these forecasts should be investigated further.

However, while the outputs may be suitable for the engineer's purposes, the analysis and discussions suggest that the output condition scores and remaining life estimates are subject to some uncertainty. While this is mitigated to some extent through the peer review process, there are implications for the renewals forecasting process and high-level condition and sustainability monitoring. The strengths and limitations of the model for these purposes are considered further in section 5.

4.4.7 Next Assessment

SSADS automatically generates the target date for the next assessment through the process described in Section 4.3.4 and the rules in Table 5. The rules appear to provide a reasonable risk-based prioritisation for allocating assessment resources to an asset based on condition, in that assets in good condition are monitored through Primary SICA and those in poorer condition through Secondary SICA. The SICA model assumes that the average remaining life degrades in a linear fashion (truncated for the early years) such that for a site with an assumed 30-year life (e.g. a relay-based interlocking), the remaining age profile and hence inspection interval would broadly follow that in Figure 6 (note borderline cases are assumed to be favourable as the assessment should take place within the interval).

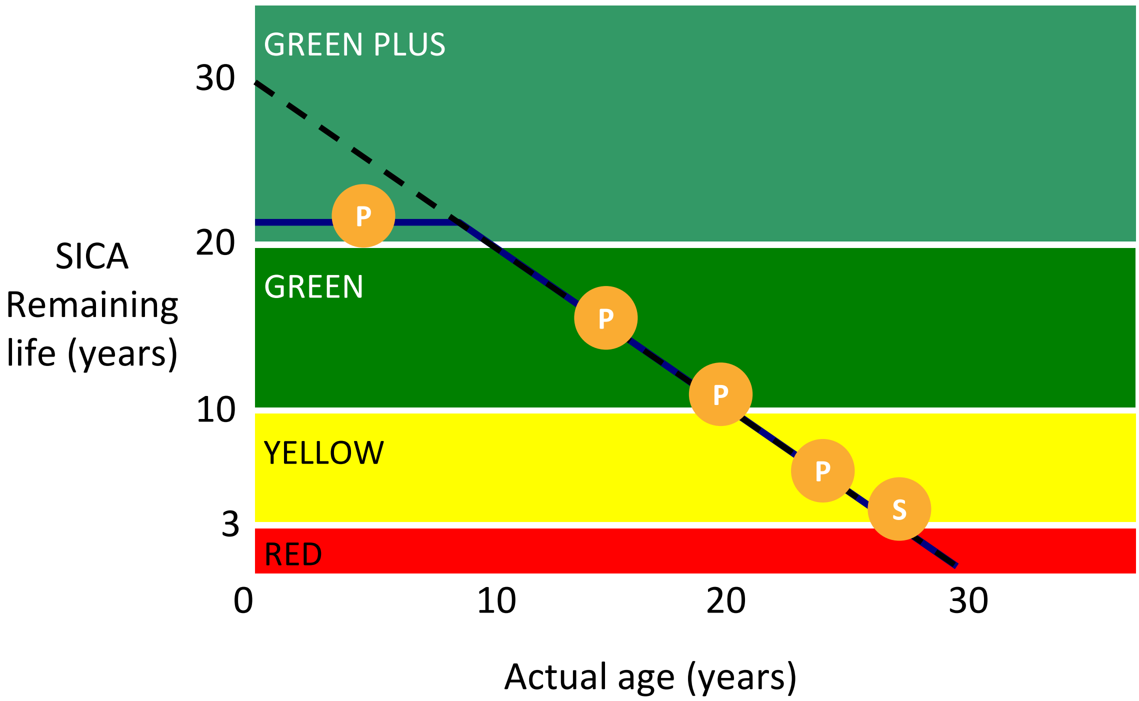

Figure 6 Degradation and Assessments

The Network Rail standard stipulates that a Secondary SICA is undertaken within two years of a Primary SICA identifying that the overall site life is yellow or can indeed be done in place of a Primary SICA at the discretion of the RAM. Therefore the first time a full Secondary SICA is expected to take place is when the asset is borderline condition between Yellow and Red (27 years into its life). Similarly, at the point where the asset has a remaining life of 10.1 years (and hence is rated 2-Green) the next assessment would be a Primary SICA within 5 years (i.e. at 5.1 years remaining life). If severe degradation was experienced during this interval (e.g. Internal Wiring degradation), this would not be captured through the SICA model until it could potentially be too late to implement the desired intervention in a cost-effective way.

In practice the Route Engineers can exercise discretion, within the constraints of the Network Rail standard. However, given the low level of confidence in the Primary SICA model, it would appear that there will always be a large proportion of the asset base for which very little robust information will be available at any given point in time. Based on the latest snapshot of SSADS data (December 2010), for approximately 60% of sites the latest assessment is a Primary SICA. Once again, Route Engineers will have a better awareness of the potential issues at the site than the Primary SICA can capture (as well as access to other information), but from a central Asset Management or external perspective there may not be sufficient information of robust quality to make a meaningful assessment of condition of the portfolio. Primary SICA seems to fulfil its purpose of determining whether a more detailed follow-up is required but there is a separate requirement to understand the condition of the whole portfolio for long-term forecasting which is not fulfilled.

Also, assessment frequencies are based entirely on the condition of the asset and do not reflect other measures of criticality and risk. Given the importance of certain interlockings from a route criticality perspective, the frequencies of SICA assessment should be reviewed based on overall criticality, not just condition, to improve the information available on key interlockings.

4.4.8 Peer Review and Consecutive Assessments

The SICA assessments are seen as an independent standalone assessment that should not be influenced by the results of the previous assessment. This is helpful in terms of providing an objective snapshot of priorities at a given point. The peer review process at the moment therefore focuses on confirming that the current assessment has been carried out correctly.

However, changes between assessments give additional information on several factors, such as:

- Actual degradation rates;
- Impact of maintenance and minor works on condition; and
- Volatility of engineer's assessments.

It is also an opportunity to correct any factual inaccuracies in previous assessments and/or supporting documents, so that longer-term trend information can be built up. At the moment Network Rail does not appear to have a formal process for capturing the root causes of unexpected changes in assessment scores. Network Rail therefore needs to understand the drivers of changed condition, including the impact of interventions, to fully understand degradation and hence inform its whole life costing and development of policy. It is understood that SSADS is now able to capture minor works information which should help inform the interventions on an asset and hence their impacts in future.

4.5 Summary of Findings on the SICA model

This section has reviewed the use of the SICA model to determine the remaining life of signalling assets for both elements and an overall interlocking. It has considered the relationships between the condition and remaining life, their justification and link to asset lives. It has considered how the asset lives in the model compare to the average 35-year asset life assumed in the policy (Network Rail, 2007) and utilised in business planning processes. It also looked at how data is updated on reassessment. The evidence has been based both on results across the portfolio, from the theory of the model and also from the specific discussions on each interlocking.

In conclusion, the SICA model appears to be an appropriate tool to support the Route Engineers in their decision making processes and has the following strengths:

- The SICA tool appears well established and effort has been made to improve the consistency and quality of the input information since earlier reviews through the peer review and user group processes.
- The outputs from the Secondary SICA model are well understood by the engineers who have to use them on a regular basis and it works well as a prioritisation tool for identifying short-term renewals requirements.
- The Primary SICA model acts as a sensible preliminary check as to whether a Secondary SICA is likely to be required in the near future.

However, there are aspects of the SICA model that limit the purposes for which it can be used with confidence and therefore there is scope to improve:

- On Network Rail's own advice, the output from SICA is not to be used as an absolute estimate of remaining life.
- The Primary SICA inputs are relatively crude, which is desirable to keep the process simple but means that the outputs from the Primary SICA are not very robust. For a large number of interlockings (~60%) the latest assessment is a Primary SICA, which has implications for renewals forecasting, high-level condition and sustainability assessment.
- The process of averaging across a sample may produce misleading results at both an element and a site level. This is of particular concern where elements are omitted from an analysis.
- The notional lives in the model do not map directly to the asset lives in the current signalling policy and the relationship between the two is not clearly documented.
- The justification for the theoretical relationships and weightings within the SICA model to convert input data into condition factors and hence lifeline position is not well documented. Although the peer review process suggests that these relationships still hold, it is not clear that the underlying analysis has been reviewed or repeated with additional data.

- Some of the theoretical relationships appear to be driven by one or two inputs, which would lead to step changes in lifeline position and hence under / overstating remaining life at certain points.
- It was stated that the model does not always produce reliable estimates for the Internal Wiring and Mechanical Interlocking element types and these are significant drivers of future renewals requirements.
- Truncating the remaining life of a (relatively) new asset will understate remaining life during this period, with implications for strategic planning and sustainability assessments.

In addition, there are aspects of the SICA process that could be improved:

- Factual information outside of the SICA assessment (such as asset types, installation dates and modification history) is not currently stored on a consistent basis across Routes, and even within a Route factual information has been seen to differ between assessments.
- The Peer Review process does not appear to review historic information alongside the latest assessment on a consistent basis. Discrepancies between assessments do not always appear to be understood and clearly documented.
- Assessment frequencies are based solely on condition and do not reflect the overall criticality of the interlocking (e.g. by incorporating route criticality).

While there are flaws with the SICA tool in its use as a decision support tool for Route Engineers, it is not expected that any of the above issues would have a material impact on safety. The Routes have other processes in place, including regular inspection by the local Maintainer, to manage the asset on a day-to-day basis. However, the above issues will impact on the ability to forecast appropriate renewals dates and demonstrate stewardship and sustainability. These impacts are covered in sections 5 and 6 respectively. Recommendations for how the above issues should be addressed are then outlined in section 7.

5 Use of SICA in Forecasting Renewals Volumes

5.1 Overview

As observed in Section 4.3, the SICA assessment produces an estimated remaining life forecast that can be input into the business planning process. However, it is clearly stated in the SICA standard (see section 4.4.6) and throughout the SICA material that the emphasis is on this being an *estimate* that is used to *prioritise* upcoming renewals based on condition, rather than as a robust estimate of remaining life.

In this section the role of the SICA remaining lives is considered alongside the other drivers of renewals volumes as part of Network Rail's PR08 business planning processes and in creating intervention strategies for each interlocking. The extent to which the PR08 process relied on SICA for business planning tasks is established, and the capability of SICA to support these tasks is then reviewed, to address points 3 and 4 of the scope (see section 1.3). Network Rail's proposed approach for PR13, including the role of SICA, is then outlined to cover point 5.

This section concludes with AMCL's recommendations on how the use of SICA in forecasting renewals volumes is developed alongside alternatives as part of the PR13 process.

5.2 PR08 Business Planning Process

5.2.1 Background

The background and context to the PR08 approach to business planning was established through discussions with Paul Mann (Principal Signalling Principles Engineer), Andy Smith (Senior Business Planning Specialist (S&T)) and Jerry Morling (Strategy Engineer for Signalling during PR08). Key themes worth noting include:

- PR08 was the first time since privatisation that a long-term network-wide work bank was to be created.
- The SICA assessment cycle was still in progress, so the evidence base was incomplete.
- There was little recent history of renewal.

Therefore to produce forecasts of likely renewals volumes, several key assumptions needed to be made, sometimes based on limited evidence.

The first assumption was the average life of a signalling asset, as a driver of what percentage of assets would need to be replaced on a yearly basis given this expected life. A range of notional lives existed in the SICA model, so to create a 'rule of thumb' these lives were averaged based on the type of asset and likely intervention. For example, the approach for a mechanical interlocking in PR08 assumed a 70-year life including a mid-life overhaul (which differs from the notional life assumption in SICA shown in Table 6).

Carrying out this exercise across the type and number of signalling assets on the network resulted in a 35-year average life which was then applied to the portfolio of 65,000 SEUs led to a steady state average of approximately 1,900 SEUs/year[3]. Note the approximate value of 65,000 SEUs used for this calculation differs from the stated volumes in the policy captured in Table 3. The current SEU count is 64,373. The first version of the 40-year plan was therefore based on the available SICA target renewals dates, followed up with a 35-year renewal assuming a move to a computer-based interlocking. This gave a plan with several peaks and troughs which were subsequently smoothed to aid delivery as the early 2000s had seen an overheated market and the aim was to ramp up from existing levels to a stable workbank.

In addition to the overall SEU levels, Network Rail had to consider other factors, including:

- The deliverability of the workbank, such as the number of major commissionings (>200 SEUs) in progress at any given point in time;
- The Territory Renewal Date (TRD), now termed the Engineer's Renewal Date (ERD). This is based on the condition (through the SICA date), compliance to safety standards and obsolescence issues.
- Any further aspirations for the Route including any planned enhancements or other projects.
- Interim remedial work where projects were to be deferred; and
- Other minor works requirements.

The above inputs were then aligned and grouped into projects in an iterative process. Alongside the main renewals identified through the above process, the Minor Works baseline came from historic data. Revisions to minor works figures were based on what needed to be done if baseline full SEUs were changed (i.e. less full renewals means more minor works).

These iterations formed the basis of the submissions for the Initial Strategic Business Plan (ISBP), Strategic Business Plan (SBP) and Strategic Business Plan Update (SBPu). With each iteration, new condition data was available from further SICA assessments that could influence the priorities within the existing workbank. Hence for each submission a lot of manual

[3] By taking 65,000 SEUs / 35 years. Note that as the type of renewal required was better understood this figure was revised down as some interventions would not amount to a full SEU count.

manipulation was required to create the overall work bank due to the interdependency between numerous factors that can influence the optimal renewals date for each asset.

Note that the 2007 Signalling Policy (Network Rail, 2007) has remained the policy in place used for justification of all the signalling plans since, with only changes to the operating environment under which the policy is being applied (e.g. new condition information, changes to ERTMS schedules, etc.) being used for justification of changes to the resulting volumes.

5.2.2 Infrastructure Cost Model

The above workbanks were input directly into the Infrastructure Cost Model (ICM), with the type of intervention specified along with unit costs for these interventions. For PR08 all of the main modelling assumptions on degradation and the types of intervention were carried out off-model in the manual manipulation discussed in section 5.2.1. The ICM was solely used to turn the workbank into a fully-costed plan for the network. The capability of the ICM for PR08 and aspirations for PR13 were discussed with Dan Boyde (Strategic Planning Manager [Policy & Modelling]) and Gareth Drakes (Strategic Planner).

5.2.3 Changes from SBPu to DPu

In ORR's Final Determination (ORR, 2008) the funding levels for signalling renewals were set at a lower level to those anticipated in the SBPu. In addition, certain enhancements were not funded, which potentially limited the options for a Route and hence the optimal solution for a given interlocking. Therefore, between the SBPu and the Delivery Plan (DP) and Delivery Plan Update (DPu) further iterations of the above process were required. Additional condition data was also available where a further SICA assessment had been completed in the intervening period.

The overall volumes between the SBPu and the DPu did not change by a large degree, but the prioritisation and hence phasing of particular projects was changed. ORR therefore expressed concern as to whether the volumes being delivered by Network Rail in CP4 could be demonstrated to be sustainable. Network Rail used SICA condition data as part of its justification.

5.2.4 Role of SICA

The SICA process and tool was therefore used in several ways through the PR08 process to inform and justify condition-driven renewals, including:

- Forecasting initial renewal dates, by providing an initial condition-driven view to both inform the Territory plans and also to be used by HQ as an overall cross-check;
- Informing longer-term condition-driven renewals volumes and hence the target level for deliverability;
- Prioritising condition-driven full renewals where no longer-term plans existed;
- Informing the required activities for condition-driven life extension where future intervention was known, so full renewal was being deferred to take advantage of these longer-term plans (e.g. introduction of ERTMS);

In addition, following the publication of the Final Determination (ORR, 2008), Network Rail used SICA in the preparation of its CP4 plans, including:

- Justifying deferral of condition-driven renewals from CP4 where new, favourable condition data was available; and
- Re-prioritising condition-driven renewals activity where enhancements (including ERTMS) have been postponed.

The other, non condition-based drivers that can influence renewals dates can be grouped into the following main themes:

- **Future plans** - longer-term enhancement plans (including ERTMS and Operating Strategy);
- **Current issues** - specific issues that require an intervention but may not be picked up by SICA (such as safety risks, maintainability and obsolescence); and
- **Deliverability** - alignment with other projects and resources available.

For examples of each of the above, see the 'Key Business Planning Drivers' section of each of the examples in Appendix D

5.3 Effectiveness of SICA

Section 5.2.4 set out the role SICA played in the PR08 and CP4 delivery planning processes. The effectiveness of SICA in performing these tasks is a direct corollary of the strengths and limitations highlighted in section 4.4. The relevant issues are therefore summarised in Table 7. However, the use of SICA in justification of deferrals needs further explanation as it is only apparent from analysing the SICA outputs across the whole portfolio over time. This is given in section 5.3.1.

Use (from section 5.2.4)	Issues (from section 4.4)	Options
Forecasting initial renewals dates	Truncation limits remaining lives to a maximum of 70% of notional life. Primary SICA is not intended to forecast meaningful remaining life estimates. The averaging within SICA can mask underlying renewals requirements in the overall site score. Certain elements are known to degrade at rates that are not consistent with SICA.	Develop tool capable of producing simplified forecasts based on key drivers to be used alongside SICA
Informing longer-term condition-driven renewals volumes	Primary SICA being used as long-term forecast for 60% of assets. The calculation supporting the '35 years' average life used for long-term planning in PR08 was not transparent and does not reflect known differences in notional lives.	Use above tool to create long-term (unconstrained) renewals forecasts. Above tool should be able to differentiate between assets.
Prioritising condition-driven full renewals where no longer-term plans exist	No major issues - SICA helps support this process.	Retain SICA as Tier 3 tool (see section 5.4.1) for supporting prioritisation.
Informing the required activities for condition-driven life extension where future intervention is known	No major issues - SICA helps inform this process. However, life extension requirements ('minor works') and their impacts are not currently captured and analysed.	Retain SICA as Tier 3 tool (see section 5.4.1) to support tactical life extension. Use SICA logic to inform the life extension modelling in the WLCC models. Capture life extension work and analyse impacts.
Justifying deferral of condition-driven renewals where new condition data is available	See section 5.3.1.	WLCC models will show overall impact of deferral across portfolio Alternative models to be developed to pick up impacts of deferral
Re-prioritising condition-driven renewals activity where enhancements have been postponed	Long-term changes to plan need to be known for SICA to help manage the uncertainty.	High level strategies need to be agreed (where possible) with any uncertainties reflected in plans

Table 7 Summary of findings from use of SICA in PR08 and recommendations

The above issues do not necessarily mean that the PR08 volumes are inappropriate or unsustainable, but equally it is difficult to demonstrate that they are sustainable. The main issue is that the SICA tool is being used for purposes outside of its core strengths. There also does not appear to be a company wide consistent approach to linking the renewals plans to whole-life costs and hence evaluating the impacts of early replacement or deferral. Subsequently, for PR13 Network Rail should develop and implement longer-term renewals forecasting models which are based on whole life cost analysis for key interlocking and element types. Further detail on how these options can be developed are outlined in Appendix B:.

5.3.1 Justification of Deferrals

As part of the DPu (Network Rail, 2010) it is stated that the justification of deferring renewals was based in part on additional condition data on sites that were due for renewal. Network Rail has since clarified that the output from SICA was not the sole criterion used by the RAM in making any decision to defer. However it is understood to have been the primary trigger for identifying sites where there was potential for renewals to be deferred. The use of condition data for this purpose would seem reasonable if it was absolute, and there was enough confidence in the SICA forecasts of remaining lives to justify re-planning of renewals on this basis.

However, as stated in section 4.4.6, SICA forecasts do not reflect absolute remaining life. For a site to qualify as a candidate for deferral it would need to be demonstrated that the SICA condition score had moved by a greater margin than that which would be expected for a 'normal' site on re-assessment. Therefore, the 'normal' movements in re-assessment should be evaluated to provide a baseline against which these exceptional movements can be compared.

To illustrate this, consider an engineer returning to a site that was previously in 'reasonable' condition after a 5-year gap. It could be expected that for a well-maintained site without any extreme drivers of degradation, the site is likely to score broadly the same as it previously did (as many of the factors in the SICA checklists do not appear to be time-dependent). It is therefore unlikely that the SICA output will have reduced by the 5 years that have formed the underlying renewals planning assumption.

Using the dataset of all SICA assessments from SSADS, sites in the above scenario were identified, namely:

- Original Primary SICA was carried out and scored 2-Green ('Reasonable' condition); and
- Follow-up Primary SICA was carried out 5 years later.

The residual life estimates for the site from the original Primary SICA (ranging from 10 to 20 years) were analysed, along with the expected lives for the follow-up (given 5 years deterioration) and the actual remaining life estimates from the follow-up. These are plotted in Figure 7.

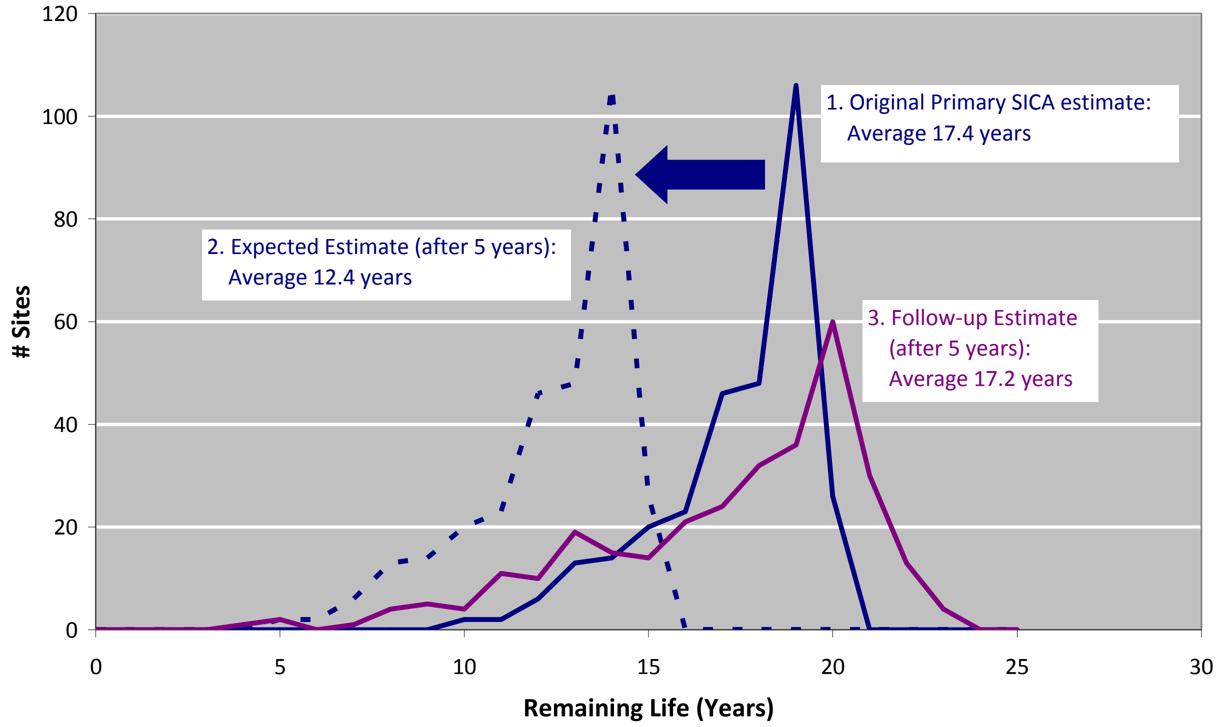

Figure 7 Primary SICA Remaining Life on Re-assessment

This clearly shows that the spread of the estimates from the follow-up is much higher than expected. The average remaining life from both SICA assessments is broadly the same. This indicates that the original SICA assessments have underestimated the life of the site. There could be several reasons for this (e.g. good maintenance, spot element renewal or minor works), but unless these are tracked and understood the SICA decommissioning date is not robust to reassessment. This suggests that the current notional lives assume little or no maintenance or minor works, which would therefore mean the resulting remaining lives are underestimated.

Similarly, for a site in poorer condition, once this has been flagged by the assessor and local maintenance and engineering is aware of the risk, it is unlikely that the Route team will allow this to deteriorate at the expected rate. For example, air conditioning can be installed in relay rooms to minimise the speed of wire degradation. Using the dataset of all SICA assessments from SSADS, a similar analysis was therefore carried out for sites in this scenario, namely:

- Original Secondary SICA was carried out and scored 3-Yellow ('Poor' condition); and
- Follow-up Secondary SICA was carried out 3 years later.

The residual life estimates for the site from the original Secondary SICA (ranging from 3 to 10 years) were analysed, along with the expected lives for the follow-up (given 3 years deterioration) and the actual remaining life estimates from the follow-up. These are plotted in Figure 8.

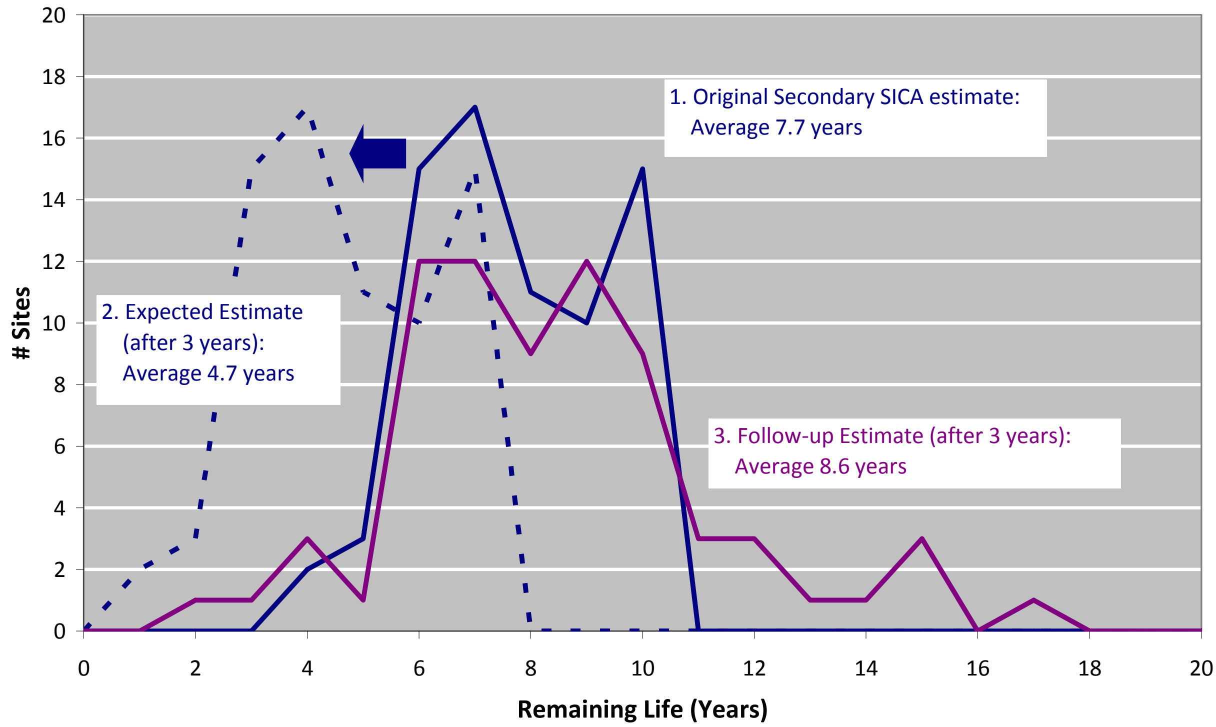

Figure 8 Secondary SICA Remaining Life on Re-assessment

Once again, the estimates from the follow-up assessment are well above those expected based on 3 years deterioration of the site from the original assessment. For assets in this condition band it is likely that spot element renewals, minor works, or additional maintenance have been carried out to manage the deterioration, but unless these impacts can be tracked and reflected in the assessments, it appears that the original SICA assessment has, on average, under-estimated remaining life. This has implications for strategic planning and determining the renewals requirements during a Periodic Review. If remaining lives are consistently under-estimated and no compensation is made for this in the later stages of the business planning processes, then the funding requirement will be overstated.

This analysis is extended to cover both of the above scenarios with other intervals between assessments in Appendix A: (as not all assessments are carried out after 5 or 3 years for Primary and Secondary SICA respectively). The analysis demonstrates that the above results are consistent across all interval years and both SICA assessments appear to be underestimating remaining life. Therefore a change in remaining life through a SICA re-assessment cannot be used on its own as a justification for deferral, as it is likely the original assessment had understated the remaining life.

5.4 Proposed approach for PR13

5.4.1 Model Framework

Network Rail has identified a requirement to improve its Asset Management capability through developing Whole Life Cycle Cost (WLCC) models for its key assets. These sit in Tier 2 of its overall modelling framework shown in Table 8. The ICM (see section 5.2.2) is considered a Tier 1 model working at the portfolio / network level. SICA is a Tier 3 model supporting tactical decisions on what to do to best manage a signalling asset. Tier 2 models will include those required to support policy development and justification.

Tier 1	Strategic models which forecast work volumes, condition, performance and expenditures for a portfolio or network of assets.
Tier 2	Strategic models which calculate the whole life cost for single asset type or interacting system of several assets (generic not specific location) - for a range of possible renewal, maintenance and utilisation options.
Tier 3	Tactical models which support the specification of physical maintenance and renewal work in route Asset Management plans.

Table 8 Network Rail Modelling Tiers

The above framework is aiming to encourage consistency across the Tiers, so that each model can be scaled up or down to an appropriate level of granularity and information on key parameters and relationships can be shared.

5.4.2 Current Status

From discussions with personnel in both the Asset Management HQ and Planning & Regulation teams, the aspiration to move to the framework in Table 8 is shared across the company. However, it is also clear that a suitable model (or set of models) does not currently exist to support the Tier 2 processes, in particular for policy development. Therefore in PR08 (and the subsequent justification of changes to the plans) SICA has been used to 'fill the gap', and the shortfalls identified in section 5.3 have had to be addressed through manual manipulation of the workbank.

As the main Tier 1 model, the ICM is already utilised and some improvements have been made to its functionality, although discussions with the Planning team suggested this had some way to go. Similarly, SICA will continue to be used as a Tier 3 tool to support tactical decision making by engineers and (subject to some of the issues raised in this review) this is where it appears to be strongest. Network Rail has identified the need for the WLCC models but these have not yet been developed for signalling assets. The current set up remains broadly similar to that used in PR08 and is illustrated in Figure 9, based on discussions with the Strategic Planning [Policy & Modelling] team and Network Rail's latest thinking on the role of Tier 2 WLCC models.

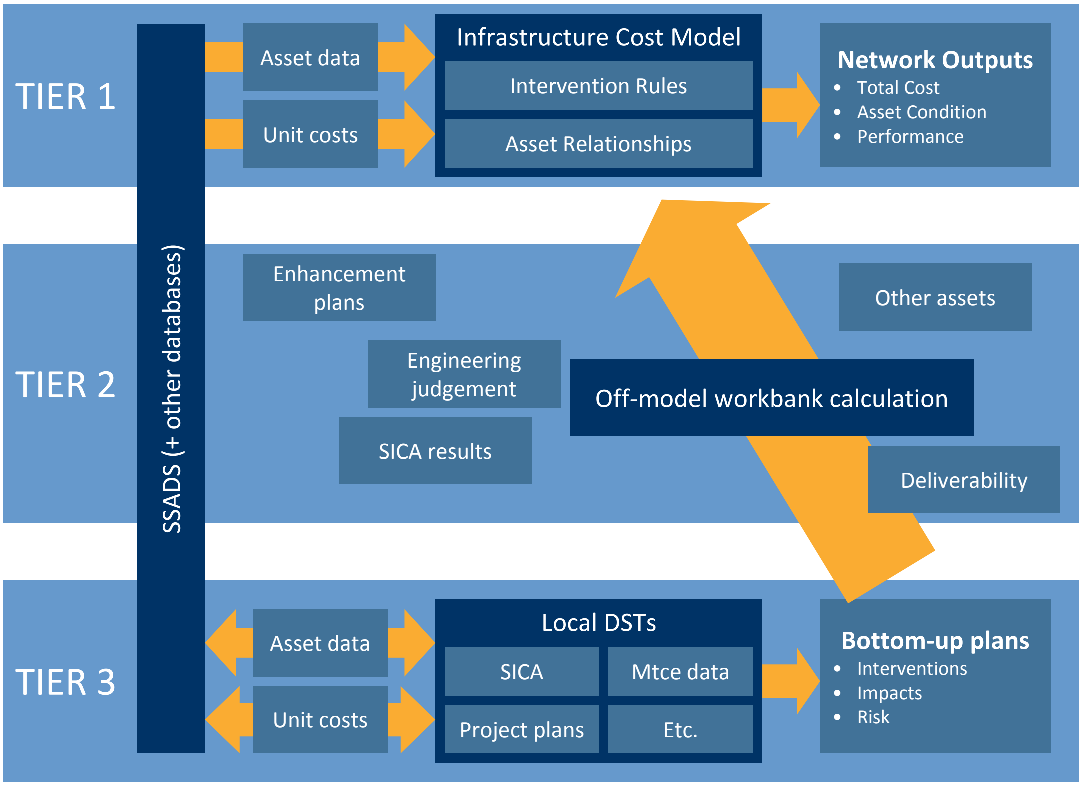

Figure 9 'As is' Modelling Framework

5.5 Summary of Findings on role of SICA in PR08 and PR13

This section has reviewed the use of SICA in the business planning processes for PR08 and PR13, identifying issues and options for addressing them (in section 5.3). It has highlighted that the main weakness in PR08 arose from using SICA for purposes that are outside of its original scope due to the absence of any Tier 2 WLCC tools. Network Rail has already identified the need to create these Tier 2 tools for PR13.

It is expected that these WLCC models will fit into the proposed Tier structure as Tier 2 models, with SICA and ICM retained (and ideally improved) in Tier 3 and 1 respectively. This is illustrated in Figure 10, based on the discussion with the Strategic Planning [Policy & Modelling] team and Network Rail's latest thinking on WLCC tools. Recommendations for capabilities of these tools are summarised in section 7. Options that Network Rail could consider as part of the development of these models are given in Appendix A:.

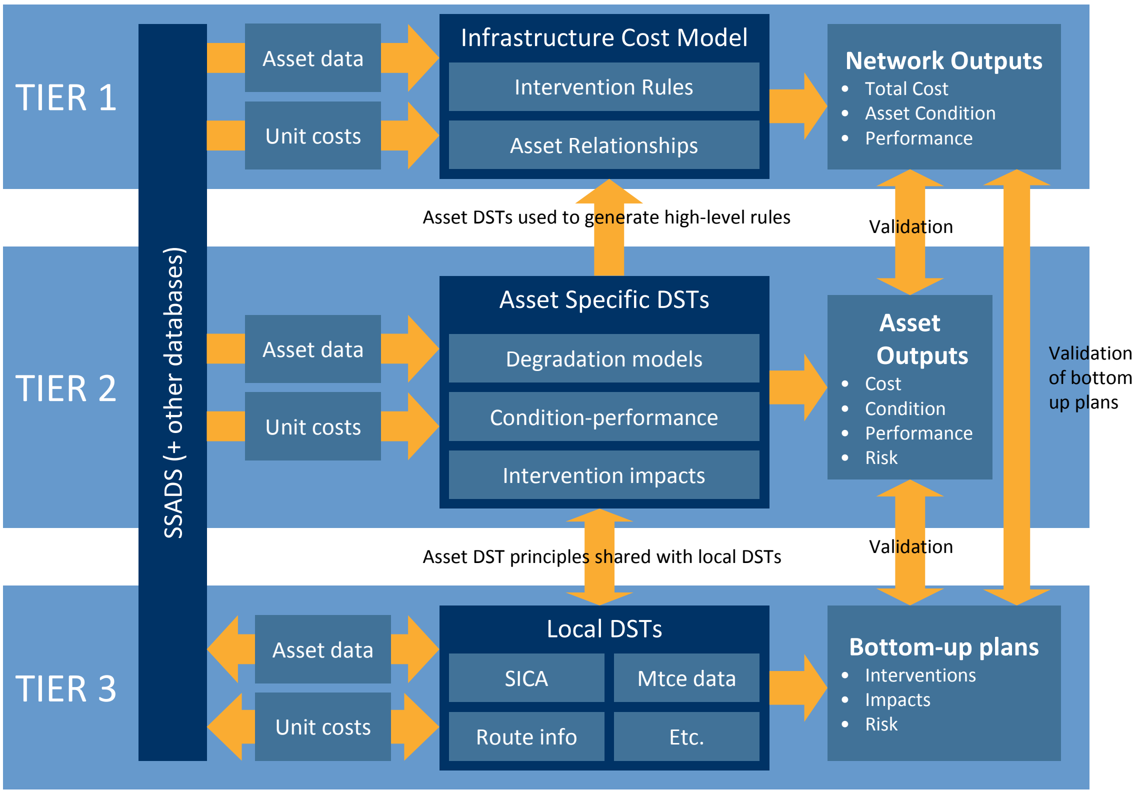

Figure 10 Potential Modelling Framework

6 Assessing Sustainability and Stewardship

6.1 Overview

Given the issues with the SICA model identified in section 4.5, there are clear issues with the way in which it is used by Network Rail to demonstrate stewardship and sustainability of its signalling renewal plans. Improvements to the SICA tool and development of WLCC models will go some way towards this, however there are additional issues with demonstrating sustainability and stewardship that should also be considered. These are outlined in this section, with recommendations for how these should be addressed in section 7.

6.2 Sustainability of Long-Term Strategies

Network Rail's Asset Management Strategy should support its business objectives. It is not clear whether Network Rail has made firm commitments to delivering ERTMS (other than where this is required through the European Union) and its Operating Strategy within specified timeframes. The context in which sustainability of the Asset Management approach is measured and judged is therefore uncertain and not currently reflected in the policy. Asset Management decisions that optimise the migration from the existing state to a desired future state could be sub-optimal if the future state changes. Examples of this have been seen in the postponement of ERTMS on certain Routes leading to a requirement for additional interim renewals.

Other companies are experiencing similar challenges in justifying the sustainability of their proposed long-term strategies to stakeholders and funders. Brief case study examples of introducing ERTMS in the Netherlands and Denmark are given in Appendix C:.

The current business strategies do not appear to have been confirmed and justified and therefore Network Rail cannot demonstrate that its Signalling Policy reflects a sustainable approach to Asset Management in the context of these strategies.

6.3 Enhancement Projects

In some cases, where enhancement projects were not funded in the ORR's Final Determination (ORR, 2008), Network Rail has stated the need for additional renewals. Crewe was a particular example of this, discussed in the Route sessions (see section D.10.6). Therefore the interaction between enhancements and renewals expenditure (as classifications of overall capital expenditure) needs to be better understood so that the value of projects (and consequence of deferral) is clearly presented to those making the decision on funding.

6.4 Measuring Financial Sustainability

Network Rail reports its financial position both through the standard Financial Accounts and also the additional Regulatory Accounts. The Financial Accounts are prepared in accordance with International Financial Reporting Standards (IFRS) and therefore should reflect good practice in how the value and depreciation of assets is reported. The question of sustainability can be addressed in some part by how the valuation of the asset base, addition of capital expenditure to this asset base and the annual depreciation (amortisation) charge is treated.

To demonstrate sustainable investment Network Rail would be expected to show that the amount it is investing in its infrastructure is consistent with sustaining the long-term value of this asset base. The rules on asset lives and depreciation that Network Rail uses in its financial statements should therefore be consistent with the policies used for Asset Management and vice versa. IAS 16 in IFRS states:

Each part of an item of property, plant and equipment with a cost that is significant in relation to the total cost of the item shall be depreciated separately.

The current review of the Depreciated Replacement Costs (DRCs) for Network Rail (Arup, 2009) values Network Rail's signalling assets on the basis of data from several different sources:

- A 35-year average asset life from Network Rail's current Signalling Policy as the basis of depreciation rates;
- An average cost per SEU for interlockings; and
- Average Remaining Life figures for each type of interlocking from SICA.

This provides a further example of SICA being used for a purpose that is beyond its original design. The way in which the SICA remaining lives are used at face value within the DRC report suggests that the limitations of SICA and its outputs may not be fully understood.

Other organisations appear able to differentiate between the asset lives of signalling equipment, as shown through a small sample of asset lives taken from the Financial Statements of other international rail organisations in Table 9. As Network Rail is at a point where it is likely to apply different Asset Management policies to different types of signalling infrastructure, it would appear that now would be an appropriate time to review these. Ideally a consistent approach across both Asset Management and economic and financial planning should be agreed with ORR to make assessment of financial sustainability a clear and transparent process.

Country	Company	Range (years)	Source	Notes
Germany	Deutsche Bahn	20	DB, 2010	
Australia	Rail Corporation	20-50	RC, 2010	In determining an asset's useful life consideration is given to its expected usage, its expected wear and tear, technical or commercial obsolescence; and legal or similar limits on its use.
France	Réseau Ferré de France	15-50	RFF, 2010	Asset lives based on recommendations of technical experts in the field.
Sweden	Banverket	25-110	BV, 2010	Includes all rail infrastructure so signalling will fall within this range.
Hong Kong	MTR	5-20	MTR, 2010	Where parts of an item have different useful lives each part is depreciated separately.

Table 9 Sample asset lives from other international rail organisations

The Asset Management organisation should look to the Finance department for support in developing an approach that learns from best practice in terms of asset valuation and depreciation, making it easier to demonstrate financial sustainability of its proposed plans.

For example, the recent incidence of rapid degradation in internal wiring (see several of the examples in Appendix D:) could be considered as a cause for impairment, demonstrating the value lost in the reduction of useful lives. Similarly, where value is being lost through early replacement (such as at Trent SSI (Robhood) in section D.7), this should be reflected in adjustments to the financial valuation of the asset base.

6.5 Monitoring Overall Condition and Stewardship

As stated in section 4.4.6, SICA remaining lives are not intended to be used as an absolute estimate of remaining life but instead as a tool for prioritisation. However, in Network Rail's Annual Return (Network Rail, 2010), the SICA figures are presented with no explanation that this figure does not actually reflect the remaining life. To some extent this is reflected in the confidence level of B3 (equivalent to an accuracy of +/- 10%, with some records out of date), but from the evidence seen of movements on re-assessment the actual level of accuracy appears to be lower than this. Lloyd's (2005 (1)) also observes that SICA outputs aren't currently used in an appropriate way to show compliance with high level corporate objectives.

The SICA grades are still of some use as the underlying condition assessments are relatively robust. However the reliance on the Primary SICA to populate the latest data demonstrates that this can only be a high-level approximation. Yet in assessing overall stewardship, this measure is once again used as the basis. The current measure cannot therefore be used to robustly demonstrate overall stewardship. The use of SICA to inform Network Rail's signalling KPI measure(s) forms part of the review ORR is already undertaking into Network Rail's suite of asset stewardship indicators. The issues that have been identified here should be considered alongside those in the KPI report to develop the future measure.

7 Summary

7.1 Conclusions

In summary, AMCL has found that the SICA tool itself appears to be well understood within the Route and HQ Signalling teams, including the strengths and limitations of the tool in providing estimates of condition and forecasting renewals requirements. This means that the short to medium term 'bottom-up' understanding of likely renewals requirements (i.e. for the next control period) and the relative priority is carried out consistently across the Routes and consolidated centrally through an established process. This results in a logically prioritised workbank, although this does not necessarily mean it achieves the lowest whole-life cost. However, there remain opportunities to improve the SICA tool's use at this level that should be addressed as part of a forward strategy for the SICA tool. There are also opportunities to improve the data capture and peer review processes in the short-term. These are unlikely to have any safety impact (as other processes are in place to safeguard against this), but could have a material impact on the use of the tool in estimating the remaining life of an interlocking for planning purposes.

In addition, it is AMCL's assessment that Network Rail does not have a clearly defined set of complementary whole-lifecycle cost models that can be applied to the signalling asset portfolio to generate a 'top-down' view on what the longer term renewals requirement is likely to be and how this interacts with the other key business drivers of signalling renewal. The current ICM approach is based on implementing a workbank that has already undergone several iterations to incorporate a variety of business drivers and overlays, rather than a set of generic assumptions for the life profiles of interlockings and their elements. The current 35-year life assumption for future renewals used to justify longer-term sustainability is not clearly justified and does not align to the SICA notional lives. Network Rail has acknowledged this and is developing a three-tier approach to its modelling for PR13. This includes the creation of Tier 2 WLCC models, but until these are in place Network Rail cannot robustly demonstrate that it is adopting a renewals strategy that is consistent with its longer-term vision for the railway, and that the funding applied for represents a minimum whole life cost approach. AMCL has identified specific steps that Network Rail can take to develop this approach as part of the PR13 process, summarised in the recommendations below.

In addition, there are some aspects of the SICA tool as an overall condition assessment measure that need some review before it can be used to effectively monitor longer-term asset stewardship and demonstrate sustainability. The current model is understood to be designed to be used for prioritisation and as an engineering management tool (in Tier 3 of the proposed approach), not to provide robust forecasts of remaining life for the purpose of internal and external monitoring of asset stewardship and sustainability. This should be addressed through a combination of improvements to the SICA model and also how its results are interpreted and presented to internal and external stakeholders.

7.2 Recommendations

The key recommendations from this audit are therefore:

1) Network Rail should formalise its strategy for improving the SICA tool and supporting processes in its role as a Tier 3 tool to support Route Engineers, by October 2011. This strategy should include a plan with clear timescales, milestones and deliverables for each of the following:
   a. Short-term improvements to the Signalling Schemes Asset Data Store (SSADS) data capture and peer review processes to cover key supporting information and trend data, including the root causes of significant movements in element scores. Network Rail should formalise the capture of learning from its peer review processes to demonstrate consistency across assessments and that significant deviations can be identified and explained. The strategy should include a review of the additional supporting information collected by the Routes (such as Asset Condition Reports), to determine which information needs to be routinely captured in SSADS for business planning purposes;
   b. Longer-term improvements to the tool itself, including a full review of the regression analysis (including uncertainty), notional lives, sample selection and inputs;
   c. Evaluation of the benefits of a simplified Primary SICA tool and a decision on its future application;
   d. Revision of assessment frequencies to reflect overall asset criticality and notional lives; and
   e. Improved understanding of an interlocking's condition at its mid-life point (e.g. through a Secondary SICA) to assess its degradation to date and the impacts of any interventions already carried out.
2) Network Rail should develop and implement Tier 2 models based on whole life cycle cost analysis to determine renewal forecasts for key interlocking and element types. These models should be used to inform the work volumes and costs for the IIP and therefore should be in place by September 2011. Further development of these models is

recommended during 2012 in order to support the work volume and cost submissions within the SBP. A plan for the development of these models including clear timescales, milestones, deliverables and treatment of uncertainty should be created, by May 2011 for IIP and October 2011 for SBP, to demonstrate that Network Rail will include the following capabilities:

a. Differentiation between the main types of interlocking and elements to reflect asset criticality and notional lives, so that a greater degree of transparency is available;
b. To improve the line of sight between strategic planning and bottom-up condition-led planning, the whole life cost analysis should differentiate between the key drivers of long-term renewal (e.g. ERTMS, Operations Strategy and Enhancements) so that the condition-led optimisation is dependent on the longer-term driver and the impacts of changes to these strategies can be evaluated;
c. The impacts of minor works and other interim interventions should be transparently captured and analysed as part of the above to form the basis of long-term minor works budgets;
d. The models governing condition and degradation over time should be informed and refined by data captured through the SICA tool to date; and
e. Internal benchmarking of the condition of interlockings that use similar technologies and have similar installation dates should also be used to inform the WLCC analysis.

3) Network Rail should set out and discuss with the ORR the proposed approach for PR13 in terms of demonstrating sustainability and stewardship in the context of its overall Asset Management Strategy, in the form of a plan including clear timescales, milestones and deliverables. This should form the basis of the demonstration in the Strategic Business Plan and therefore should be in place by December 2012.

Appendix A: Movement in SICA Remaining Life Estimates

In the analysis of the movements in SICA remaining life estimates in section 5.3.1, two specific cases were presented:

- Primary SICA in condition 2-Green followed by Primary SICA after 5 years; and
- Secondary SICA in condition 3-Yellow followed by Secondary SICA after 3 years.

The analysis showed that for these specific cases, the follow-up SICA estimate did not reflect the expected reduction in remaining life. If this is consistently the case, then it is possible that SICA is underestimating remaining lives, which has implications for condition monitoring for demonstrating stewardship and sustainability.

In this appendix the restriction on the interval between assessments is removed to test the hypothesis, that this is true across a range of intervals. The list of all SICA assessments stored in SSADS was analysed. Where two or more assessments were available, the decommissioning year for the site (as estimated in both assessments) was analysed.

If the decommissioning year does not change, then the site has degraded at the rate expected in the initial SICA assessment. However, if the decommissioning year increases, then the site is degrading more slowly that expected, and SICA has underestimated the remaining life. If the decommissioning year decreases, then the site is degrading more quickly than expected and SICA has overestimated the remaining life.

Therefore the relationship of interest is that between the interval between assessments and the changes in the decommissioning year. This following scenarios were analysed to see if there was an obvious trend:

- Primary SICA in condition 2-Green followed by Primary SICA.
- Secondary SICA in condition 3-Yellow followed by Secondary SICA.

The results are shown in Figure 11and Figure 12 respectively. A simple trend line has been fitted in each case. This demonstrates that the general trend is upwards, and also there is also considerable volatility. In general the SICA model shows a systematic bias towards understating remaining lives. This becomes a major issue when the tool is used for strategic planning and also has implications for high-level condition monitoring and the demonstration of sustainability which is considered further in section 6.

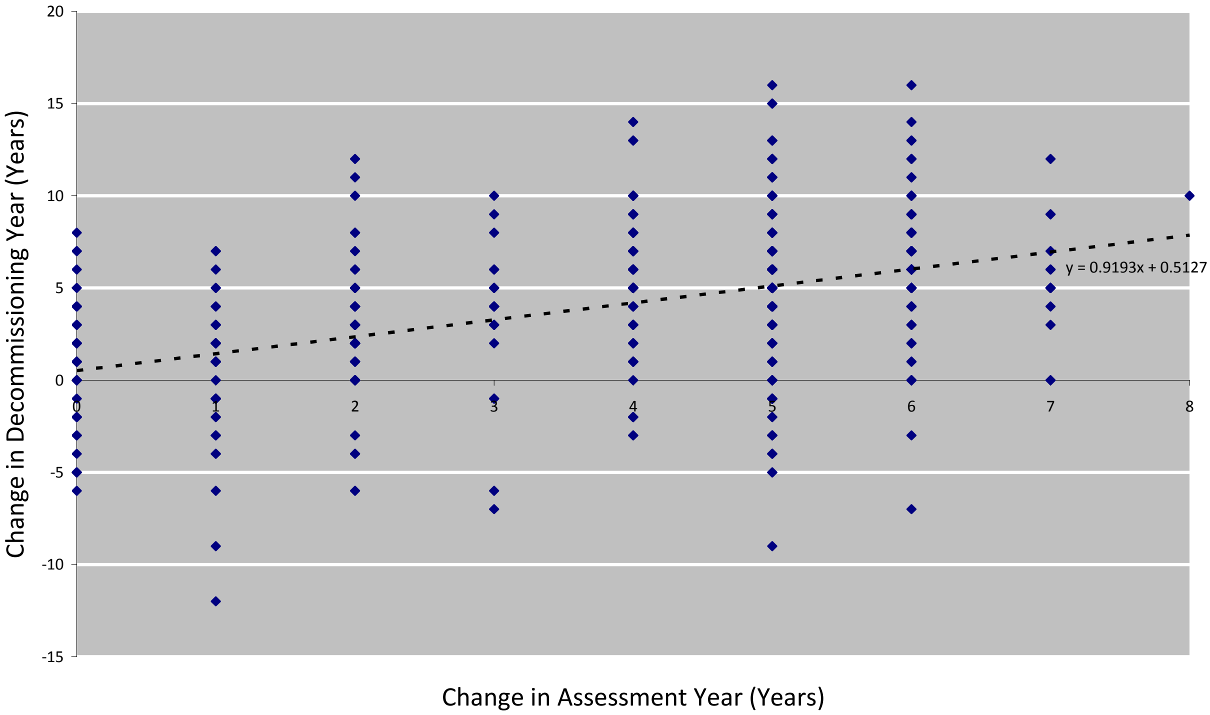

Figure 11 Changes to Primary SICA Results

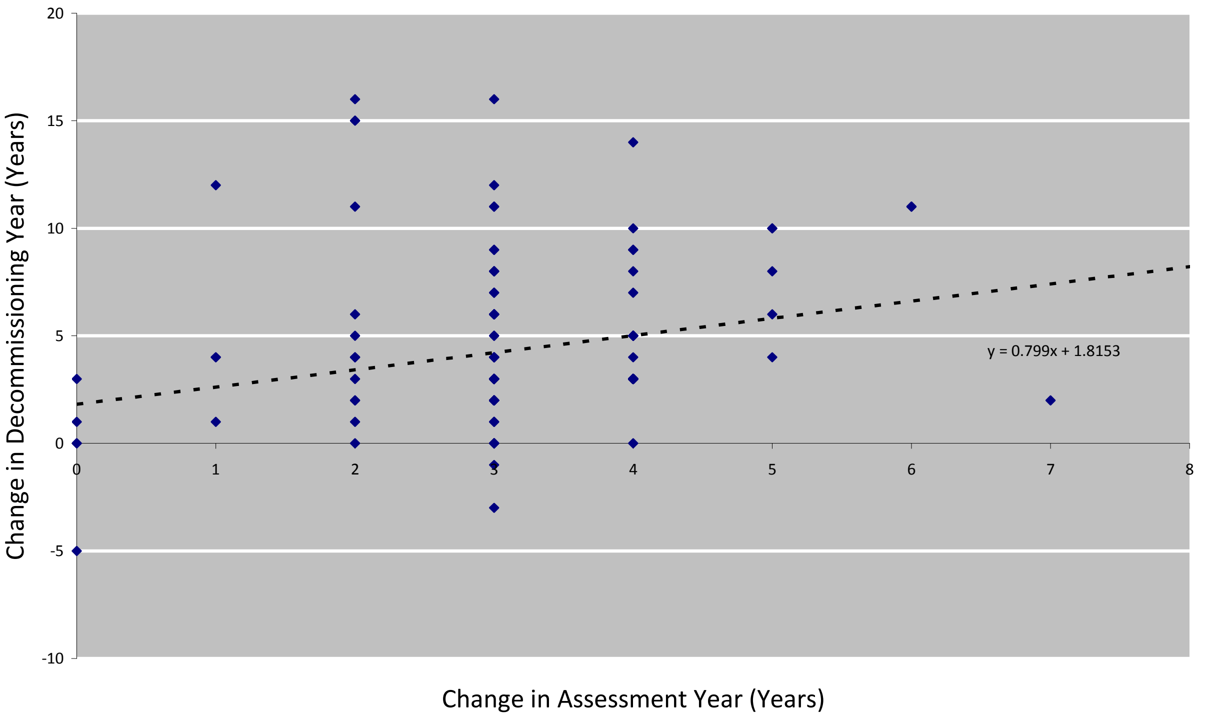

Figure 12 Changes to Secondary SICA Results

Appendix B: WLCC Model Development

This appendix details possible approaches that Network Rail could consider as part of the development of the suite of WLCC models underpinning the PR13 process. This is not intended to be a prescriptive list of features that must be incorporated into the PR13 models, but to provide Network Rail with some guidance on good industry practice and areas that could be researched further.

Differentiation Between Asset Types and Criticality

One of the key concerns with the PR08 policy justification is the 35-year figure used as the average life for all asset types (see Section 4.4.5). This has been explained by Network Rail's Engineers, but some degree of transparency is required in future versions of the policy to demonstrate the underlying understanding of the different assets, where required. In addition, it is known that some of the signalling assets (such as point machines) have lives that are usage based, which will vary across the network.

The WLCC analysis and forecasting models should therefore be able to differentiate between key asset types (e.g. different interlockings) and locations to support the policies. By performing a criticality analysis Network Rail can determine which of its assets have most impact in terms of both cost (of maintenance and renewals regimes) and risk (in terms of service impacts of these regimes, picking up costs of reactive work, performance and safety risks). Efforts can then be focused on collecting data and producing degradation models to provide robust WLCC models for the most critical assets, while low criticality assets can be modelled using simplified rules or existing standards. This approach is good industry practice and features in AMCL's Asset Management training courses, endorsed by the Institute of Asset Management (IAM) and illustrated in Figure 13.

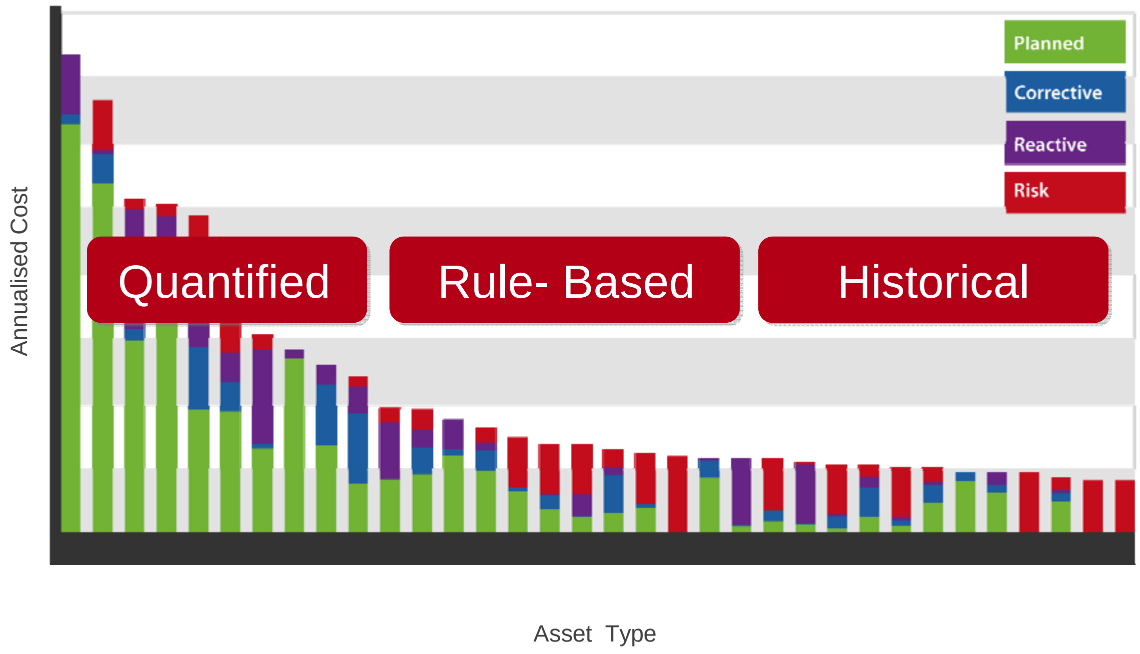

Figure 13 Asset Criticality Approach

Improvement of Line of Sight

For PR08 the initial view of renewals requirements was largely condition based. The other, non condition-based business drivers were added through 'off-model' manipulation, including:

- **Future plans** - longer-term enhancement plans (including ERTMS and Operating Strategy);
- **Current issues** - specific issues that require an intervention but may not be picked up by SICA (such as safety risks, maintainability and obsolescence); and
- **Deliverability** - alignment with other projects and resources available.

For PR08, the approach was evolving for the first time and hence the sequencing of the above strategies and corresponding Asset Management approaches was an iterative process. However, for PR13 there is an opportunity to improve the flow of this process, by identifying the key strategic goals and then optimising (to a certain extent) the Asset Management strategy for the asset type and criticality within these constraints. Any uncertainty can then be reflected in the forecasts.

For example, it would appear that the target upgrade date is the key driver of how a signalling asset is managed (whether this is driven by ERTMS, Operating Strategy or an Enhancement identified through a RUS or 3rd party). Given this target date, there will be a range of options for managing the asset dependent on its current status (predominantly condition-based but also taking into account any maintainability and obsolescence issues). Where the target dates and expected lives align the existing workbank or default WLCC model for the asset is probably appropriate. Where the target upgrade date is later than that suggested by the current status of the asset then there will be options such as life extension, partial renewal and acceleration of the upgrade (or some part of it, e.g. Interfaced SSI). Where the target upgrade date is ahead of that suggested by the current status then this could be an opportunity to defer the upgrade, or reflect the early renewal of the asset through an impairment charge.

These drivers need to be captured as a set of cases, with an optimal 'behaviour' to be determined for each case. The behaviour will consist of a standard set of interventions for an asset in this case. The interventions will need to have costs appropriately phased to reflect the project costs associated with the lead times, generic versions of which Network Rail has already demonstrated (Network Rail, 2010 (3)). These behaviours will need to be justified as minimum cost by the supporting WLCC models, but then can be input directly into the high-level Tier 1 model(s) and applied to the portfolio to test deliverability and funding requirements for different high-level scenarios. An example of how the behaviours could be set up is demonstrated in Figure 14.

Urban Throat RRI DST		Current view of remaining life				
		Now	<5	5-10	10-20	20+
Target upgrade date	In progress	Use Workbank	Use Workbank	Impairment?	Impairment?	Impairment?
	<5	Additional Mtce required?	Use Workbank	Use Workbank	Impairment?	Impairment?
	5-10	Life extension required?	Additional Mtce required?	Default model	Deferral opportunity?	Deferral opportunity?
	10-20	Full renewal required?	Full renewal required?	Life extension required?	Default model	Deferral opportunity?
	None	Default model	Default model	Default model	Default model	Default model

Figure 14 Sample WLCC Model Grid

An advantage in creating a set of simplified behaviours is that the impact of applying these behaviours under different high-level scenarios (such as different degrees of implementation of

ERTMS) can be more easily evaluated using the ICM, without the need to resort to a manual off-model manipulation to create many different workbanks.

Life Extension and Minor Works

Historic minor works information including volumes, costs and impacts does not appear to have been well documented. Capturing the works information through SSADS should make this possible, and hence it should be possible to quantify the impact of future strategy and policy decisions on minor works. The standard life extension interventions under each behaviour described above can be converted into minor works volumes that can be priced and funded appropriately. This would bring transparency to an element of cost with a material impact.

Improved Condition and Degradation Models

The current SICA assumptions are that the lifeline position of an asset can be multiplied by its notional life to give the remaining life. The expectation therefore is that for an average element with a 35-year asset life, the degradation would be approximately linear and follow the trajectory shown in Figure 15.

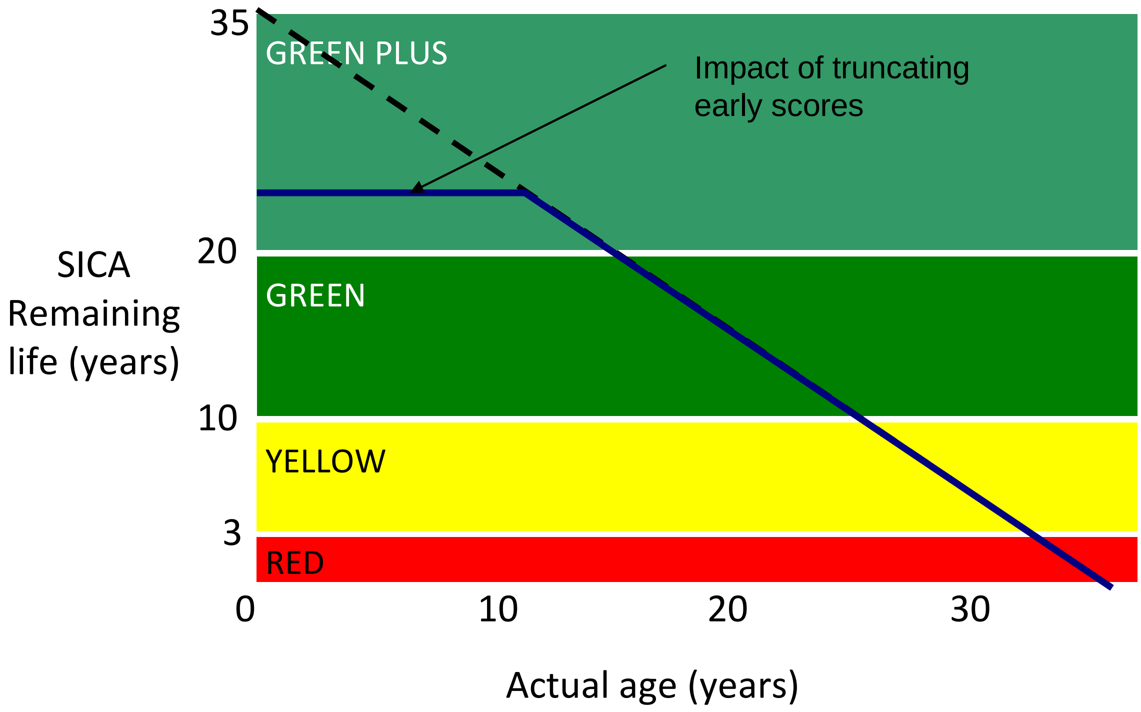

Figure 15 SICA Model Degradation Profile

In practice, actual condition positions measured by SICA do not always follow this linear degradation model, as many of the relationships between the drivers of degradation and the output condition are non-linear. Also, through regular maintenance activity and spot renewal of elements within a sample, the overall condition for an element type can actually improve over time.

It is therefore recommended that the inputs to the SICA model (rather than the outputs) are used to inform the degradation curves for the elements. This will involve determining how each of the input condition factor variables have been observed to degrade over time (e.g. linearly, non-linear but 'predictable' or by unknown triggers). For example, the movements between states (i.e. the checklist boxes) can be modelled using mathematical and statistical approaches to produce a better understanding of the likely degradation of the asset over time. If an element scored 3 in a previous assessment, what is the likelihood of finding it in each state at the next assessment? These expected probabilities can be used to create a 'Transition matrix' between the states which can then be used at a portfolio level to create degradation curves for the population, as shown in Figure 16.

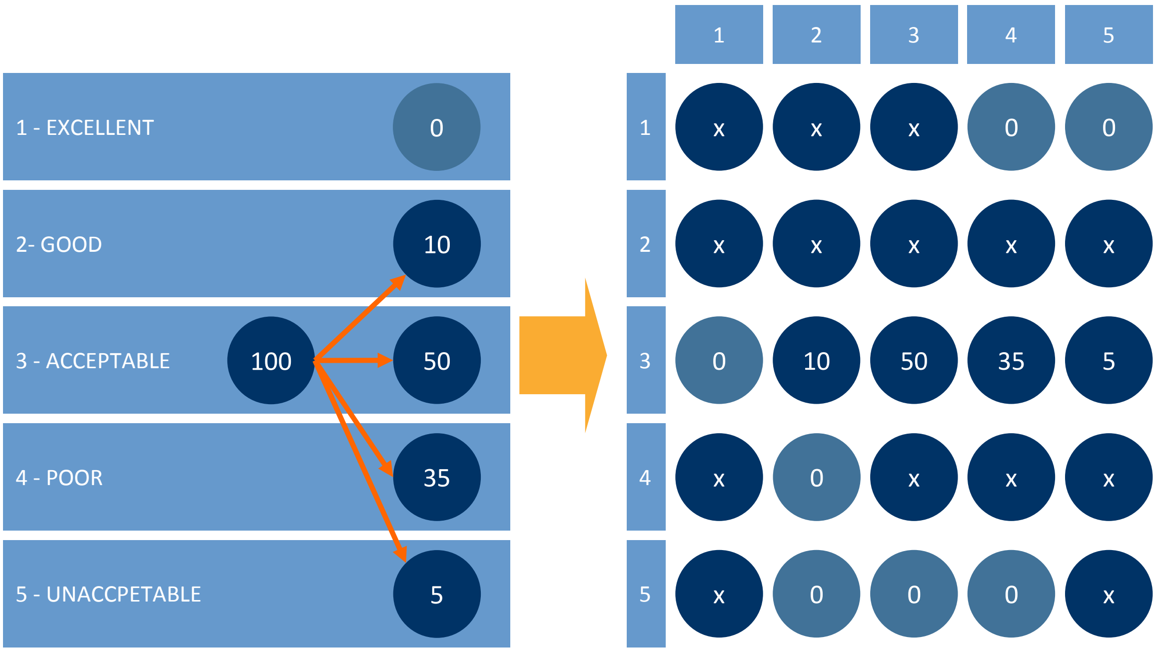

Figure 16 Developing Transition Matrices

This will be a significant piece of research but Network Rail has a wealth of information from the SICA assessments to date. Although no single asset has been monitored for its whole life using SICA, the movements between states for assets at varying stages in their lives should be available to help form an initial view. This could then be extended to assess the impact of interventions. It would be suggested that this type of analysis is limited to the key trigger variables (i.e. the highest weighted questions) for the most critical elements in the first instance.

These degradation curves could then be used in the WLCC by showing the impact of interventions on the element condition. It is therefore also desirable that these condition scores can be linked to performance and risk, so that the impacts of staying in a low condition band are visible through the additional costs of maintenance to offset increased safety and performance risk. Similarly, longer-term, it is also worth considering the interdependency between assets, once the basic simple degradation models have been created.

Internal benchmarking of different signalling assets can also be used to determine the above degradation rates. For example, it was stated in the Route interviews that the London Bridge, Dartford and Victoria signalling schemes all used similar approaches and were introduced at the same time, but the range in asset lives has been seen to vary. Understanding which elements have degraded consistently across all three areas and what factors (e.g. location) have driven the differences will help improve degradation curves. Similarly, where similar products have been installed to different standards, this could be identified and then modelled across the portfolio.

For example, the LNW-North Cumbrian line could be used to help estimate the impact of coastal locations on corrosion degradation if compared to non-coastal elements of similar type. Similarly, evidence collected on the degradation of 1980s Pirelli wiring should be reflected in a degradation curve that can be applied to assets containing wiring of this type.

Appendix C: Brief ERTMS Case Studies

In this appendix two different approaches to evaluating the long-term costs and benefits of moving to ERTMS are presented, along with the implications for the GB rail industry and Network Rail in demonstrating sustainability of its Asset Management strategy.

Netherlands

In the Netherlands, the Ministry of Transport, Public Works and Water Management commissioned a study (Decisio BV and Systra SA, 2010) to review the existing plans of ProRail to introduce hybrid ATB-ERTMS rolling stock against the alternatives of accelerating ERTMS on Dutch rail infrastructure. ProRail's view was that the existing level of ERTMS technology had not been proven to the extent that an acceleration was justified, and its MISTRAL programme for signalling development worked from the principles that adapting rolling stock to work under both configurations and then migrating the infrastructure across would be the best solution. The Decisio & Systra study (2010) came to similar conclusions that both the cost and benefits associated with early deployment of ERTMS were significantly higher, introducing higher levels of risk to the overall programme.

Denmark

As a contrast, Banedanmark (2010) has decided to accelerate the implementation of ERTMS across the whole of its network claiming the decision is justified by "focussing on economies of scale and creating a competitive market situation to ensure the best possible price and quality" and that "the programme also introduces a step change in technology which maximises the possibilities and benefits … [this] includes: higher reliability, higher line speed at selected lines, homogenous high safety and nationwide interoperability." It reaches this conclusion given large areas of its network need full renewal and it views ERTMS as the desired longer-term solution.

Implications for Network Rail

For Network Rail, a high-level evaluation of the proposed strategies for ERTMS and the rationalisation of signalling infrastructure through the Operating Strategy is required to help clarify GB's position and develop the Asset Management approach within this context. For example, from discussions with the HQ Engineers responsible for signalling policy, the existence of ERTMS Level 3 would bring great benefits in terms of capacity increase and rationalisation and therefore could significantly change the long-term strategic approach. However, while ERTMS level 2 remains the likely longer-term solution decisions need to be made in a different way.

Once an understanding of the industry long-term strategy is clear, Network Rail's role in delivering this strategy will be clearer and it can demonstrate the sustainability of its Asset Management strategy in this context.

Appendix D: Detailed Reviews of SICA Assessments

D.1 Overview

This appendix provides a detailed review of the SICA assessments and supporting information, as well as a summary of relevant discussions with the Route Engineers for each of the ten sample interlockings. The Interlocking is listed by Name (Route, Type, SEUs[4]). A brief description of the structure of the review for each interlocking follows.

D.1.1 Site Overview

Information on the interlocking, including location, history, coverage and complexity, as provided in the supporting information and/or discussions.

D.1.2 Evidence Provided

List of SICA assessments by date and type (Primary or Secondary), along with any additional sources of evidence provided and used in the review.

D.1.3 SICA Scores and Movements on Re-assessment

Detail of SICA scores for the overall site and elements, including forecast remaining lives and changes between assessments.

D.1.4 Observations on Movements in SICA Scores

AMCL comments on movements in the SICA scores and implications for the use of the tool in forecasting sustainable renewals volumes with due consideration of any explanations provided in the supporting evidence and/or discussion.

D.1.5 Additional Condition Information from Supporting Evidence

Any other pertinent information relating to condition that was not picked up by the SICA assessment but identified through the interviews and/or supporting documentation.

[4] As per the SSADs information for the interlocking

D.1.6 Key Business Planning Drivers

From the discussion session, what is the current long-term business driver for replacement of the interlocking and hence the short to mid-term plan for managing its condition and any element renewals.

D.2 Victoria Eastern (Sussex, RRI, 218 SEUs)

D.2.1 Site Overview

Information on the site and its history was provided in the Asset Condition Report (ACR) for the Victoria Geographical Interlockings Area accompanying the 2007 Secondary SICAs.

- *Location*: The interlocking is housed near Victoria station.
- *Control*: The interlocking is controlled from Victoria.
- *Type*: The interlocking is a GEC Geographical set designed for the Victoria resignalling scheme
- *Installation dates (where known)*: The Victoria resignalling scheme was implemented in the early 1980s.

D.2.2 Evidence Provided

Three SICA assessments were provided:

- 22nd February 2001 (Primary SICA);
- 21st October 2005 (Primary SICA); and
- 14th June 2007 (Secondary SICA).

In addition the latest Asset Condition Report (ACR) for Victoria (including Victoria Eastern) was provided.

This interlocking was covered in the South East session (covering the Anglia and Kent & Sussex Routes) on 11th January 2011.

D.2.3 SICA Scores and Movements on Re-assessment

Assessment	22/02/2001	21/10/2005	*Change*	02/08/2007	*Change*
Type	Primary	Primary		Secondary	
Internal Wiring Override?	Yes	Yes		Yes	
Overall Condition	Green	Green		Green	
Overall Remaining Life	16.9	18.5	1.6	12.9	-5.6
Forecast Renewal Date	2017/18	2024/25	7	2020/21	-4
Control Period	CP5	CP7		CP6	
Element results:					
Control Panel	-	20.8 (G+)	-	-	
Relay interlocking	17.8 (G)	21.0 (G+)	2.2	19.2 (G)	-1.8
Internal Wiring	13.7 (G)	17.4 (G)	3.7	5.3 (Y)	-12.1
Main Cabling	18.4 (G)	20.5 (G+)	2.1	20.3 (G+)	-0.2
Cable Routes	19.8 (G)	16.2 (G)	-3.6	20.5 (G+)	+4.3
Location Cases	13.0 (G)	-	-	15.0 (G)	-
Power Supplies	21.0 (G+)	21.0 (G+)	0	21.0 (G+)	0
Additional SSICA results:					
Remote Control Media	-	-		16.6 (G)	-
Main Colour Light Signals	-	-		18.6 (G)	-
Power Operated Points	-	-		7.1 (Y)	-
Train Detection	-	-		15.5 (G)	-
GPL Signals	-	-		19.8 (G)	-

Table 10 SICA scores for Victoria Eastern interlocking area

D.2.4 Observations on Movements in SICA Scores

AMCL was advised by the Route Engineers that the 2001 assessments were probably desktop-based (as is accepted for a Primary SICA) and that the more recent results were likely to be the most robust. A suggested check for this was to cross-check against other SICA assessments performed for that route on that date. Doing so revealed that several Victoria interlockings (Blackfriars, Herne Hill, Shortlands and Swanley) had Primary SICA assessments on this date, all of which resulted in the same remaining life score. The Internal Wiring and Relay-based Interlocking element scores were also the same according to information in Appendix B of the ACR. It is believed that the assessment given by the maintainer was based on their overall knowledge of the sites at a desktop without differentiating between sites, as for initial / early assessments the SICA assessments were grouped to give greater coverage. Neither AMCL nor the Route Engineers are able to verify this absolutely as it is possible (albeit unlikely) that all sites in an area did actually have the same condition ratings. With a Secondary SICA assessment a full site visit is required so this data is assumed to be more robust.

The shift in the overall interlocking score is driven largely by the internal wiring override and corresponding reduction in remaining life of the Internal Wiring. This was actually more consistent with the 2001 Primary SICA than the more recent 2005 Primary SICA.

Discussions with the Route Engineers suggested that Internal Wiring is prone to rapid degradation and it therefore seems that the 2005 Primary SICA overstated the remaining life of the internal wiring and hence the site. It certainly appears possible that for Primary SICA assessments carried out at a desktop there is a possibility that an engineer could overlook condition issues given their familiarity with the site, which is why independent peer review is important.

The Route Engineers stated that internal wiring does not degrade in a linear manner and therefore it is possible that such a degree of degradation can happen over a comparatively short period of time. Whittlesford, Gunnersbury and Hither Green were cited as examples, with the type of wiring (Pirelli 1980s) being the key driver of this rapid degradation.

In the discussions, the Route Engineers stated that Victoria has degraded prematurely, especially given the condition of the London Bridge interlockings that were installed 10 years earlier. Dartford was also listed as a potential comparator. The condition of the buildings in which the interlockings are housed was given as the main cause of the wire degradation.

Note that Network Rail is trying to address the issue of internal wiring scores and the SICA user group has reviewed wire degradation at Gatwick as part of the process of better understanding the impact on SICA assessment.

D.2.5 Additional Condition Information from Supporting Evidence

The 19.2 (Green) rating for the interlocking in the 2007 assessment was the highest of the relay interlockings reviewed as part of the overall Victoria assessments summarised in the ACR. The internal wiring score of 5.3 is at the lower end of these assessments, indicating that is was one of the sites in poorer condition. The internal wiring override should pick this up, but the weighting in SICA may not be sufficient for this to have an impact at a site level.

For some of the other Victoria interlockings presented the assessor provided alternative estimates of remaining life based on the SICA forecast being too pessimistic or optimistic. This was not the case for the Victoria Eastern interlocking, which would indicate the assessor believed the estimate to be reasonable.

D.2.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal date
HQ 2006	15/4/2017
Territory	15/4/2016
MP&I	30/11/2012
ERTMS	31/12/2022
Original C1 date (SBPu Baseline)	28/8/2013
Revised C1 date	29/11/2013
Re-revised C1 following ORR determination	2/3/2014

Table 11 Renewals dates from HQ Signalling Business Planning

During PR08 there was a longer-term aspiration to move to ERTMS in 2022. However, the wire degradation issues mean that an intervention is required before then. The overall Victoria report highlights the need for replacement of all of the Victoria interlockings, prioritised by the Internal Wiring remaining lives. It notes that these interlockings could be replaced by interfaced SSI, but that the key external assets are generally expected to need renewal approximately 5 years after the interlockings. The possibility of life-extending the external equipment to the planned ERTMS date is considered and it is highlighted that confidence would be needed in this ERTMS date.

The ERTMS date has since been moved to 2030, meaning that an intervention is required to maintain the existing signalling capability until the introduction of ERTMS. The current plan is to use an ERTMS compatible Interfaced SSI to replace the relays, building in capacity for future enhancements and avoiding the need for significant rework on the introduction of ERTMS. Existing signals will be replaced and the interlocking enhanced to cope with this, working on the principle that if the longer-term replacement strategy is not like-for-like then it should be introduced now.

A significant business driver to the Victoria resignalling is the amount of commissioning activity in the SE London area at the moment. Both the Thameslink and London Bridge schemes are planned and so the Victoria resignalling has to ft in with this, partly due to potential disruption but also due to the availability of design capability and testers.

D.3 Stewarts Lane (Kent, RRI, 650 SEUs)

D.3.1 Site Overview

Information on the site and its history was provided in the Asset Condition Report (ACR) for the Victoria Geographical Interlockings Area accompanying the 2007 Secondary SICAs. Additional information was also found in the notes in the Primary SICA assessment.

- *Location*: The interlocking is housed at Stewarts Lane.
- *Control*: The interlocking is controlled from Victoria.
- *Type*: The interlocking is a GEC Geographical set designed for the Victoria resignalling scheme
- *Installation dates (where known)*: The Victoria resignalling scheme was implemented in the early 1980s. The interlocking dates from 1980/1981 and the associated NX Panel ("VS") at Victoria dates from 1980. Remote control is by a GETS TDM system that was commissioned in 2003/2004.

D.3.2 Evidence Provided

Three SICA assessments were provided:

- 21st December 2000 (Primary SICA);
- 28th September 2005 (Primary SICA); and
- 2nd August 2007 (Secondary SICA).

These dates are all close to the equivalents for Victoria Eastern enabling fair comparisons to be made. In addition information was used from the the latest ACR for Victoria (which also includes Victoria Eastern).

This interlocking was covered in the South East session (covering the Anglia and Kent & Sussex Routes) on 11th January 2011.

D.3.3 SICA Scores and Movements on Re-assessment

Assessment	21/12/2000	28/9/2005	*Change*	02/08/2007	*Change*
Type	Primary	Primary		Secondary	
Internal Wiring Override?	Yes	Yes		Yes	
Overall Condition	Green	Green		Green	
Overall Remaining Life	18.9	17.5	-1.4	15.2	-2.3
Forecast Renewal Date	2019/20	2022/23	3	2022/23	0
Control Period	CP6	CP6		CP6	
Element results:					
Control Panel	-	19.3 (G)	-	-	-
Relay interlocking	21.0 (G+)	21.0 (G+)	0	16.7 (G)	-4.3
Internal Wiring	15.8 (G)	18.0 (G)	2.2	12.7 (G)	-5.3
Main Cabling	18.4 (G)	20.5 (G)	2.1	16.7 (G)	-3.8
Cable Routes	19.8 (G)	12.9 (G)	-6.9	20.5 (G+)	+7.6
Location Cases	18.4 (G)	10.8 (G)	-7.6	13.9 (G)	+3.1
Power Supplies	21.0 (G+)	21.0 (G+)	0	20.5 (G+)	-0.5
Additional SSICA results:					
Remote Control Media	-	-	-	16.6 (G)	-
Main Colour Light Signals	-	-	-	18.1 (G)	-
Power Operated Points	-	-	-	7.1 (Y)	-
Train Detection	-	-	-	15.5 (G)	-

Table 12 SICA scores for Stewarts Lane interlocking area

D.3.4 Observations on Movements in SICA Scores

AMCL was advised by the Route Engineers that the early assessments were probably desktop-based (as is accepted for a Primary SICA) and that the more recent results were likely to be the most robust. A suggested check for this was to cross-check against other SICA assessments performed for that route on that date. The Stewarts Lane assessment was the only assessment carried out on 21/12/2000 so it is unlikely any other interlockings were jointly assessed in this Primary SICA. In 2005 several interlockings underwent a Primary SICA at the same time as Stewarts Lane, but the scores differ sufficiently to suggest these were assessed separately. In addition, notes in the Primary SICA assessment spreadsheet indicate specific issues were highlighted, in particular with troughing routes and location cases, resulting in the low Green / borderline Yellow Cable Routes and Location Cases scores.

With a Secondary SICA assessment a full site visit is required so this data is assumed to be more robust.

The overall interlocking remaining life appears to reduce at a rate that is relatively consistent with the intervals between assessments. However, the individual element scores are more prone to fluctuation with the internal wiring once again the main driver of the interlocking renewal date. It is interesting to note that the sudden drop in remaining life for internal wiring took place between the 2005 and 2007 assessments. Discussions with the Route Engineers suggested that Internal Wiring is prone to rapid degradation and it therefore seems that the 2005 Primary SICA overstated the remaining life of the internal wiring and hence the site. The 2005 Primary SICA did note there were issues with degradation on some wires but clearly not to the extent seen in the following Secondary SICA. As discussed for Victoria Eastern this speed of degradation is plausible.

D.3.5 Additional Condition Information from Supporting Evidence

The 16.7 (Green) rating for the interlocking in the 2007 assessment is at the higher end of the relay interlockings reviewed as part of the overall Victoria assessments summarised in the ACR. The internal wiring score of 12.7 is the highest of the assessments. However, the site assessor provided alternative estimates of remaining life based on the SICA forecast being too optimistic, stating 10 years to be the expected remaining life (a move from Green to borderline Yellow). A similar downward estimation was made for Streatham Junction taking it from Green (10.2 years) to Yellow (9 years). Two interlockings (Shortlands and Swanley) moved in the other direction, from Yellow (9.4 and 9.9 years respectively) to Green (12 years).

This suggests that 10 years is a sensitive point to have a condition threshold for internal wiring as there is some uncertainty around the SICA scores at this boundary. The Route Engineers verified that wiring appearing to have 7-10 years remaining life can drop rapidly to a very poor condition in a couple of years. The fact that sites similar to Stewarts Lane have suffered worse degradation means that the engineer deemed it best to take a conservative estimate of remaining life at the site.

D.3.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	15/4/2018
Territory	15/4/2017
MP&I	30/11/2012
ERTMS	31/12/2022
Original C1 date (SBPu Baseline)	28/8/2013
Revised C1 date*	31/12/2021 (2007) 29/11/2013 (2009)
Re-revised C1 following ORR determination	2/3/2014 (2009)

Table 13 Renewals dates from HQ Signalling Business Planning

Note that two dates appeared under the Revised C1 date column in the different snapshots provided (the 2007 data used for the SBPu and the 2009 data used for the DPu)

Note the main drivers for the Victoria area are those for Victoria Eastern (as discussed in Section D.2.6). The SICA assessment of the wire degradation in Stewarts Lane would have made it the lowest priority of the interlockings, which may reflect the late C1 date. However this appears to have been overruled and brought forward by the 2009 plan. According to Network Rail, the main driver of this move is the rapid and still relatively unknown nature of wire degradation and the criticality of Stewarts Lane to the route. As there is a potential conflict with the Thameslink programme, it is possible access to the site could be delayed until 2020. Therefore to minimise the risk Network Rail has decided to bring Stewarts Lane forward with the rest of the Victoria interlockings.

D.4 Oulton Broad North (Anglia, Mech, 38 SEUs)

D.4.1 Site Overview

Information on the site and its history was provided in the ACRs accompanying the Secondary SICAs. The latest data has been taken (2010) with any differences from the 2005 report noted:

- *Location*: Norwich to Lowestoft line (NOL 22m 02ch) adjacent to Oulton Broad North Station in Suffolk.
- *Control*: The signal box controls the junction of the Norwich to Lowestoft line with the East Suffolk line.
- *Type*: Mechanical signal box with a 35 lever McKenzie and Holland frame (note that the frame was down as Saxby and Farmer in 2005 report, which is incorrect).
- *Installation dates (where known)*: The signal box is of timber construction, it dates from 1901 (1885 in 2005 report) and was extended in 1928, when the present frame was installed.

Modifications have built up over time (dates mentioned in the interview included 1979, 1985 and the early 1990s). The uPVC cladding and windows are thought to have been added in the last 10 years. The mechanical signals are 50s/60s installation and go straight into the ground, with the structures not being Health & Safety compliant.

D.4.2 Evidence Provided

Two SICA assessments were provided:

- 13th April 2005 (Secondary SICA); and
- 16th June 2010 (Secondary SICA).

The ACRs dated 19th November 2005 and 29th June 2010 accompanying the above Secondary SICA assessments were also provided as supporting information, along with an illustration of the East Suffolk Line and Norfolk branches route maps and the 'Norwich to Yarmouth and Lowestoft Signal Renewal Options' paper.

This interlocking was covered in the South East session (covering the Anglia and Kent & Sussex Routes) on 11th January 2011.

D.4.3 SICA Scores and Movements on Re-assessment

Assessment	13/4/2005	16/6/2010	*Change*
Type	Secondary	Secondary	
Internal Wiring Override?	Yes	Yes	
Overall Condition	Green	Green	
Overall Remaining Life	12.7	11.8	-0.9
Forecast Renewal Date	2017/18	2021/22	5
Control Period	CP5	CP6	
Element results:			
Mechanical interlocking	26.9 (G+)	18.4 (G)	-7.5
Internal Wiring	3.5 (Y)	6.3 (Y)	2.8
Main Cabling	17.8 (G)	15.6 (G)	-2.2
Cable Routes	20.5 (G+)	19.8 (G)	-0.7
Location Cases	20.2 (G+)	16.6 (G)	-3.6
Power Supplies	20.2 (G+)	14.7 (G)	-5.5
Additional SSICA results:			
Main Colour Light Signals	19.8 (G)	14.5 (G)	-5.3
Semaphore Signals	16.7 (G)	5.5 (Y)	-11.2

Assessment	13/4/2005	16/6/2010	*Change*
Power Operated Points	7.1 (Y)	7.1 (Y)	0
Mechanical Points	8.4 (Y)	7.9 (Y)	-0.5
Train Detection	15.5 (G)	15.5 (G)	0
AWS	17.9 (G)	-	-
Block Instruments	23.9 (G+)	19.2 (G)	-4.7

Table 14 SICA scores for Oulton Broad North interlocking area

D.4.4 Observations on Movements in SICA Scores

As both assessments are Secondary SICA they are directly comparable, which enabled the larger movements to be discussed in the interview session. Overall the site appears to be in broadly the same condition at 2010 as at 2005 (Green, with approximately 12 years remaining life), but the underlying drivers of this overall score and therefore the likely interventions suggested by the SICA model have changed, especially with the large drop in the remaining life of the semaphore signals.

The main mechanical interlocking score has degraded slightly faster than may have been expected simply through time, especially given the mechanical overhaul in 2009. The Route Engineers explained this was due to a more conservative view on the availability of spares, along with better information from the locking fitter.

Internal Wiring is the element driving the need for intervention in the interlocking itself. The 2010 ACR states that the 2005 assessment of Internal Wiring was probably overly pessimistic. In terms of lineside equipment, the 2010 ACR states that the assessment of Semaphore Signals was probably overly optimistic. The assessors are comfortable with the 2010 assessment scores.

The underlying detail in the Secondary SICA sheets for signals suggests that the sample is different for the two assessments, which would explain in part the large swing in the remaining life scores. The 2005 assessment has one entry and the 2010 assessment has three. The 2010 ACR suggests that some of the signals have been renewed / replaced and are in good condition which is not consistent with those in the sample in the 2010 assessment. This could be evidence of the issue in consistency between sampling and the impact of averaging.

D.4.5 Additional Condition Information from Supporting Evidence

The frame was mechanically overhauled in October 2004 and October 2009, and refurbished and painted in 2009/10. The maintainer classified the internal wiring as FAIR/POOR in the 2010 assessment whereas it was assessed as POOR in the 2005 assessment. As no major interventions took place between the assessments this could be a more subjective view by the assessor and or maintainer.

The condition information on individual signals suggests that the overall site is probably not in as poor a condition as the latest SICA suggests. However there are clearly some signals in need of intervention.

D.4.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	9/3/2012
Territory	9/3/2012
MP&I	-
ERTMS	31/12/2013
Original C1 date (SBPu Baseline)	31/12/2013
Revised C1 date	31/12/2013
Re-revised C1 following ORR determination	31/12/2013

Table 15 Renewals dates from HQ Signalling Business Planning

The above dates appear to be consistent as Oulton Broad North was expected to be one of the early candidates for ERTMS. Therefore the condition led requirements were seen to be met by the target ERTMS dates and there were no alternative plans in the SBPu or DPu for the required works should ERTMS be delayed. Therefore in March 2010 when the Norwich to Yarmouth and Lowestoft lines were dropped from the ERTMS programme, Network Rail had to consider alternatives to deal with the condition and operating expenditure issues on these routes.

The option paper considers operational savings through rationalisation of Oulton Broad North and the overlap with Lowestoft and replacement with a control panel at Somerlyton.

D.5 Whitlingham (Anglia, Electronic, 52 SEUs)

D.5.1 Site Overview

Information on the site and its history was provided in the ACRs accompanying the 2010 Secondary SICA:

- *Location*: Norwich to Lowestoft line (NOL 1m 69ch) at junction with Cromer Line, about 2 miles east of Norwich station.
- *Control*: Whitlingham junction, Girlings MSL and Bungalow Lane MSL crossings. It is operated from Trowse Swing Bridge Signal Box along with the rest of the Cromer line.
- *Type*: Electronic - Vital Harmon Logic Controller
- *Installation dates (where known)*: the Cromer line was resignalled in 2000 as a trial site for the Vaughan Harmon interlocking and level crossing predictor / processor technology. In SSADS the interlocking is down as a 1950 installation date.

D.5.2 Evidence Provided

Two SICA assessments were provided:

- 3rd April 2006 (Primary SICA); and
- 19th October 2010 (Secondary SICA).

The ACR dated 27th October 2010 accompanying the above Secondary SICA assessment was also provided as supporting information, along with an illustration of the East Suffolk Line and Norfolk branches.

This interlocking was covered in the South East session (covering the Anglia and Kent & Sussex Routes) on 11th January 2010.

D.5.3 SICA Scores and Movements on Re-assessment

Assessment	3/4/2006	19/10/2010	Change
Type	Primary	Secondary	
Internal Wiring Override?	Yes	Yes	
Overall Condition	Green	Green Plus	
Overall Remaining Life	17.5	20.2	
Forecast Renewal Date	2023/24	2030/31	7
Control Period	CP6	CP8	

Assessment	3/4/2006	19/10/2010	Change
Element results:			
Electronic interlocking	14.0 (G)	10.4 (G)	-3.6
Internal Wiring	22.2 (G+)	22.2 (G+)	0
Main Cabling	20.5 (G+)	20.5 (G+)	0
Cable Routes	0 (R)	19.3 (G)	19.3
Location Cases	20.2 (G+)	19.9 (G)	-0.3
Power Supplies	20.3 (G+)	21 (G+)	0.7
Note: No Additional SSICA results	-	-	-

Table 16 SICA scores for Whitlingham interlocking area

D.5.4 Observations on Movements in SICA Scores

In line with the resignalling being carried out in 2000, the first assessment was a Primary SICA within (approximately) 5 years of the commissioning date. As the overall site score was Green, the next assessment could have also been a Primary SICA. The Route Engineers stated their preference for having Secondary SICA information at approximately the expected mid-life of an interlocking so that a baseline position can be established.

There were known issues with the reliability of the interlocking that may have been the driver of the choice for a secondary SICA. The external condition of the interlocking is good (no internal wiring issues for example), but the performance of the interlocking is poor. The underlying assessment for the interlocking element includes poor scores for the performance (failures), maintainability and support available for this type of interlocking. The engineers stated that it was brought as an example of where performance and obsolescence issues can drive a business case for replacing the system, when a SICA condition assessment alone would not make this apparent.

The Cable Routes score is the other main change. The Primary SICA scoring sheet is relatively crude (5 questions with 3 options (generally reflecting good/fair/poor condition). At face value it would appear that there was a specific major issue with cabling that was sorted between the two assessments. However, the Route Engineers explained that in practice cable routes are only provided in the immediate vicinity of the REB. The score in 2006 reflected the lack of cable route throughout most of the installation. The 2010 score was based on the condition of the limited route that exists. This raises a question linked to the averaging processes in the Secondary SICA - if you do not have enough of an element but the elements you do have are in good condition, what should the score be? It would seem that the Secondary SICA score should be moderated to reflect this, if it is critical to the site condition. While some guidelines exist in the SICA documentation to recommend sample sizes, it is not clear that a consistent approach is being applied.

D.5.5 Additional Condition Information from Supporting Evidence

The ACR captures issues raised by the maintainer. These can be used to cross-check some of the scores in SICA (where there is overlap) and to provide further information where SICA does not explicitly ask for the information. In this case the following issues were identified:

- Concerns that the system is not robust and is prone to intermittent failures which can cause significant train delays.
- The cost and difficulty of obtaining spares for the VHLC system.
- The lack of any meaningful support for the VHLC system by GETS.
- The limited number of competent staff and difficulty obtaining training.

This is consistent with what is reflected in the SICA assessments, although these are offset by the condition scores for the interlocking being relatively high. This illustrates that for some types of interlocking the SICA scores may not always be the best measure of the likely need for a renewal. This is discussed further in Section D.5.6 below.

D.5.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/12/2035
Territory	31/12/2035
MP&I	-
ERTMS	31/12/2035
Original C1 date (SBPu Baseline)	31/12/2035
Revised C1 date	31/12/2035
Re-revised C1 following ORR determination	31/12/2035

Table 17 Renewals dates from HQ Signalling Business Planning

This is an example where the overall condition of the site and relatively recent resignalling means that there is no condition-led case for renewing the site. The proposed renewal dates are based on SICA remaining lives of over 20 years.

However, the obsolescence issues and performance problems that have been highlighted in Section D.5.5 mean that there could be a business case for a performance-led case brought by the maintainer.

D.6 Marchey's House (LNE, Mech, 18 SEUs)

D.6.1 Site Overview

Information on the site and its history was provided in the Secondary SICA Report accompanying the 2010 Secondary SICA and within the Primary SICA report from 2004:

- *Location*: Signal box is located on the BWC at 1m 41c.
- *Control*: Double track area with semaphore signalling and a crossing adjacent to the box - four barriers driven by GWE drive up and down.
- *Type*: Original mechanical interlocking provided by a 15 lever McKenzie and Holland frame and 5 locking trays. Of the 15 only 8 are operational.
- *Installation dates (where known)*: Box built 1895, Frame installed 1960, Wiring from 1973 (Mechanical only).

It was noted in the discussion that the route is rural and freight only.

D.6.2 Evidence Provided

Three SICA assessments were provided:

- 21st July 2004 (Primary SICA);
- 5th July 2007 (Secondary SICA); and
- 27th October 2010 (Secondary SICA).

The Secondary SICA Report (undated) accompanying the 2010 Secondary SICA assessment was also provided as supporting information.

This interlocking was covered in the LNE session on 12th January 2010.

D.6.3 SICA Scores and Movements on Re-assessment

Assessment	21/7/2004	5/7/2007	*Change*	27/10/2010	*Change*
Type	Primary	Secondary		Secondary	
Internal Wiring Override?	Yes	Yes		Yes	
Overall Condition	Green	Yellow		Yellow	
Overall Remaining Life	14.1	6.9		9.5	

Assessment	21/7/2004	5/7/2007	*Change*	27/10/2010	*Change*
Forecast Renewal Date	2018/19	2014/15		2020/21	
Control Period	CP5	CP5		CP6	
Element results:					
Relay interlocking	5.0 (Y)	-		-	
Mechanical interlocking	24.3 (G)	14.2 (G)		18.2 (G)	4.0
Internal Wiring	15.1 (G)	2.7 (R)	-12.4	6.5 (Y)	3.8
Main Cabling	-	14.8 (G)	-	-	-
Cable Routes	19.8 (G)	-	-	-	-
Location Cases	13.1 (G)	9.9 (Y)	-3.2	16.7 (G)	6.8
Power Supplies	6.3 (Y)	10.2 (G)	3.9	10.2 (G)	
Additional SSICA results					
Semaphore Signals	-	2.5 (R)	-	10.7 (G)	8.2
Power Operated Points	-	6.5 (Y)	-	-	-
Mechanical Points	-	8.4 (Y)	-	-	-
Block Instruments	-	8.8 (Y)	-	-	-

Table 18 SICA scores for Marchey's House interlocking area

D.6.4 Observations on Movements in SICA Scores

The original SICA assessments picked up both results for both Relay-based Interlockings and Mechanical Interlockings due to the electro-mechanical nature of the interlockings. External equipment is both mechanical and electrical. The initial (route selection) level of interlocking is provided by the mechanical frame with the relay interlocking providing the remaining levels, (e.g. approach locking, aspect controls, etc.) linking to the external equipment. The relay-based elements of the interlocking are now reflected in the Internal Wiring and Location Cases elements. Therefore the poor score for the Relay-based Interlocking in 2004 is likely to have translated into the very poor score for the internal wiring in 2007.

The Route Engineers explained the movements between the Secondary SICA assessments are largely down to minor works delivered by the Maintainer. However, historically this information has not been explicitly captured in SSADS (although it was stated that in future this will be). The Red status of the Internal Wiring and Semaphore Signals drove like for like replacement by Maintenance, such as wire-by-wire renewals for the Internal Wiring and replacement of the signal elements in worst condition. Similar reference is made to having performed spot renewals on Location Cases, particularly where linked to Internal Wiring degradation.

However, where there exist simple improvement opportunities that can bring immediate operating expenditure benefits that are considered along with Maintenance as business plans are drawn up for the area, particularly for minor works.

It is interesting that the elements assessed varies between assessments. According to the Route Engineers this can happen where access to the site is restricted, through lack of possessions or other safety reasons. This could have an impact on scores. The issue of averaging was also raised here, by not being able to properly assess sites that are not safe to access, the site score may not reflect the sites in unsafe condition. Where this is case the Route Engineers would try to pick this up in the supporting report.

D.6.5 Additional Condition Information from Supporting Evidence

The Secondary SICA written report accompanying the spreadsheet assessment gave further detail on the reasons for the scores in the condition assessments. Mention was made of the late 1970s Pirelli wiring which is known to have issues with degradation and also further detail was given on specific examples of 'Poor' wiring condition compared to the overall 'Fair' assessment.

While some photos and commentary is provided in the Secondary SICA written report it does not go to the level of detail seen in the South East reports. Note that additional photos (and possibly information) is stored outside of the report. There may be an opportunity for LNE to review and adopt the South East template and/or more data to be captured centrally in SSADS.

D.6.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/8/2018
Territory	31/8/2018
MP&I	-
ERTMS	31/12/2032
Original C1 date (SBPu Baseline)	31/12/2032
Revised C1 date	31/12/2032
Re-revised C1 following ORR determination	31/12/2032

Table 19 Renewals dates from HQ Signalling Business Planning

It was stated that for rural, freight-only interlocking areas like Marchey's House, access is relatively straightforward so element renewal delivered through the Maintenance organisation is relatively easy to deliver. It was stated that by sharing business plans with the Maintainer, opportunities for packaging these minor works into a major scheme could be identified. Given recommendations made in the Secondary SICA report, it would seem that several interlockings in this area need replacement and this could be an opportunity for a rationalisation to get operating expenditure benefits. It is not clear if this is reflected in the above dates, which appear to show a renewal date based on ERTMS, although the element life extension approach could possibly be applied to manage the overall site to this date. The current TRD is still targeted at 2018 which is more consistent with the Internal Wiring date.

D.7 Trent SSI (Robhood) (LNE, Electronic, 60 SEUs)

D.7.1 Site Overview

Information on the site and its history was provided through the spreadsheet assessment and discussion around the 2004 Secondary SICA:

- *Location*: Midland & Continental Route, has its own panel in Trent Signalbox.
- *Control*: The 'Robin Hood' line runs from Nottingham to Worksop and was re-introduced as part of a PTE scheme to open up an old coal route as a passenger service
- *Type*: Solid state interlocking.
- *Installation dates (where known)*: the Robin Hood line was opened in stages during the 1990s and the sub-panel was installed in the Trent signalbox as part of the rationalisation of mechanical signalling in the area and introduction of the Nottingham Express Transit..

D.7.2 Evidence Provided

One SICA assessment was provided:

- 1st August 2004 (Secondary SICA).

No written Secondary SICA or Asset Condition reports were provided as it was stated that these are not considered necessary for a new interlocking. Given the condition status of the interlocking a new Primary SICA assessment would not be required for 5 years (i.e. 2009). This would suggest that another assessment is due, although this interlocking may be seen as low risk and hence lower priority.

This interlocking was discussed in the LNE session on 12th January 2011.

D.7.3 SICA Scores and Movements on Re-assessment

Assessment	1/8/2004
Type	Secondary
Internal Wiring Override?	Yes
Overall Condition	Green
Overall Remaining Life	19.4 (G)
Forecast Renewal Date	2023/24
Control Period	CP6
Element results:	
Electronic interlocking	14.0 (G)
Internal Wiring	22.2 (G+)
Main Cabling	20.5 (G+)
Cable Routes	-
Location Cases	-
Power Supplies	-
No Additional SSICA results	

Table 20 SICA scores for Trent SSI (Robhood) interlocking area

D.7.4 Observations on Movements in SICA Scores

As only one assessment was available, comparison between assessments is not possible. The scores for the interlocking reflect a newly installed electronic interlocking and therefore raise some interesting features of the SICA assessments for this type of interlocking.

The interlocking itself will have a maximum life of 14 years due to the 'cap' placed on lifeline position by the SICA model. This is consistent with how this type of interlocking is managed, with SSI technology expected to have opportunities for upgrading after 15-20 years, without impacting on lineside equipment. However, how this is reflected in terms of overall asset condition and sustainability needs to be considered.

It was observed that it is difficult to measure the condition of the electronic interlocking itself as internal data / processing errors are more likely to affect the performance of the interlocking than physical degradation. Once again this may pose problems for condition reporting, even if the underlying asset plans are costed on a whole-life basis and shown to be sustainable.

D.7.5 Additional Condition Information from Supporting Evidence

No supporting condition information was provided other than clarification in the discussion.

D.7.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/8/2012
Territory	1/1/2023
MP&I	24/8/2012
ERTMS	31/12/2024
Original C1 date (SBPu Baseline)	31/12/2012
Revised C1 date	3/4/2013
Re-revised C1 following ORR determination	27/4/2015

Table 21 Renewals dates from HQ Signalling Business Planning

This is an example of an interlocking that is going to be resignalled earlier than required as part of an overall project despite being in pretty good condition. There are clearly benefits to integrating this with the other Nottingham resignalling work for operational benefits, however it also demonstrates that if condition is not the driver of the work in the first place, it is easier to defer the work.

D.8 Holme (LNE, RRI, 44 SEUs)

D.8.1 Site Overview

Information on the site and its history was provided through the spreadsheet SICA assessments and discussions:

- *Location*: East Coast mainline, controlled from Peterborough SB.
- *Control*: Peterborough
- *Type*: Relay interlocking - GEC Geographical AEI-GRS.
- *Installation dates (where known)*: In SSADS as 1900s. The Sep 2003 Primary SICA suggests an installation date of 1980s for the interlocking.

D.8.2 Evidence Provided

Four SICA assessments were provided:

- 15th June 1998 (Secondary SICA);

- 7th September 2003 (Primary SICA);
- 21st October 2003 (Primary SICA); and
- 8th May 2008 (Secondary SICA).

No written Secondary SICA or Asset Condition reports were provided as it was stated that these are currently being created as part of the new remit for work at this area. No report was created during the 2008 Secondary SICA. This interlocking was discussed during the LNE session on 12th July 2011.

D.8.3 SICA Scores and Movements on Re-assessment

Assessment	15/6/98	7/9/03	Ch.	21/10/03	Ch.	8/5/08	Ch.
Type	Secondary	Primary		Primary		Secondary	
Int. Wiring Override?	Yes	Yes		Yes		Yes	
Overall Condition	Green	Green		Green		Green	
Overall Remaining Life	14.4	19.5	5.1	14.4	-5.1	13.4	-1.0
Forecast Renewal Date	2012/13	2022/23	10	2017/18	-5	2021/22	4
Control Period	CP4	CP6		CP5		CP6	
Element results:							
Control Panel	14.0	11.6	-2.4	15.9	4.3	-	-
Electronic interlocking	13.3	21.0	7.7	17.0	-4.0	18.2	1.2
Internal Wiring	14.0	21.9	7.9	4.7	-17.2	8.5	3.8
Main Cabling	9.7	18.4	8.7	18.4	0	20.5	1.9
Cable Routes	19.8	19.8	0	-	N/A	20.5	-
Location Cases	11.7	-	-	-	-	13.3	-
Power Supplies	21.0	21.0	0	21.0	0	16.4	-3.6
Additional SSICA results:							
Remote Control Media	15.2	-	-	-	-	-	-
Main Colour Light Signals	19.8	-	-	-	-	*17.2*	-
GPL signals	15.3	-	-	-	-	-	-
Power Operated Points	7.1	-	-	-	-	-	-
AWS	17.9	-	-	-	-	-	-
Train Describer	17.5	-	-	-	-	-	-
'Old' SSICA only:							
Buildings	24.3	-	-	-	-	-	-
Permanent Way	10.5	-	-	-	-	-	-
Track Circuits	15.5	-	-	-	-	-	-
Level Crossings	10.2	-	-	-	-	-	-

Assessment	15/6/98	7/9/03	Ch.	21/10/03	Ch.	8/5/08	Ch.
Telephones	5.4	-	-	-	-	-	-

Table 22 SICA scores for Holme interlocking area

D.8.4 Observations on Movements in SICA Scores

Note that given the early SICA assessments are believed to be less robust, the assessments starting in 2003 form the basis of the analysis in this section.

The fact that two Primary SICA assessments were taken in quick succession is strange, but demonstrates that Primary SICAs act as a tool to flag issues, in this case the Internal Wiring element. The two assessments were made by different assessors. This may be as a result of the peer review process having been introduced, but records as to why were not available to the Route Engineers, having joined Network Rail after this point. It was stated that in future this sort of information would be captured.

The overall assessment in September (as stated in the comments) was that the Relay room was in good condition but some wire degradation issues needed to be sorted (despite the site receiving an overall Green Plus for Internal Wiring). The October assessment stated that under the Eastern Region Operational Strategy the panel had changed to an Emergency GB status and stated specific issues with the panel wiring. Holme was re-controlled onto the Level Crossing panel at Peterborough in this case.

Q1 in the underlying checklist for Internal Wiring went from 'Good' to 'Unacceptable' between these assessments, which moved the 'Trend' component from 1 to 5. Along with changes to the other condition data this had a significant impact on the remaining life, highlighting the need for life extension work to be considered.

These SICA assessments also highlight the need for consistency in the Secondary SICA assessments in terms of the elements assessed. It is not clear which lineside equipment needs to be assessed as part of the Secondary SICA but the 2008 assessment captured fewer elements than the 1998 one (changes in definitions aside). The Route Engineers stated that prior to the introduction of SSADS the choice of elements was optional, SSADS now has removed the options and requires more specific detail.

D.8.5 Additional Condition Information from Supporting Evidence

No supporting condition information was provided other than clarification in the discussion.

D.8.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/12/2020
Territory	27/9/2017
MP&I	-
ERTMS	31/12/2018
Original C1 date (SBPu Baseline)	31/12/2018
Revised C1 date	31/12/2018
Re-revised C1 following ORR determination	31/12/2019

Table 23 Renewals dates from HQ Signalling Business Planning

The overall site status in the 2008 assessment is consistent with life extension to the planned ERTMS date. Note that as this is a borderline CP4/CP5 renewal date this will appear to have pushed back some spend into CP5 from CP4.

This effectiveness of this is dependent on the amount of wiring that can be part-renewed. The amount of wiring linked to the geographical side is apparently the key driver of whether a full renewal is required.

There is currently an opportunity to align renewal and life extension work at Holme with the Level Crossings renewals that are required. There are external drivers (TOC pressure and local pressure) to renew / remove the level crossings and this is taken into account in building the business cases for this type of activity.

D.9 Bransty (LNW-North, Mech, 24 SEUs)

D.9.1 Site Overview

Information on the site and its history was provided through the report accompanying the 2008 Secondary SICA (which in turn is based on the 2005 Secondary SICA), additional supporting evidence and discussions:

- *Location*: Cumbrian Coast line (0m 16ch, ELR CBC2) near to Whitehaven station, adjacent to the Irish Sea. The signal box is approximately 200m from the sea and the signals and location cases at the north end of the control area are approximately 50m from the sea.
- *Control*: It works to Workington Main No.2 signal box using absolute block and St Bees signal box using key token block (single line).
- *Type*: Mechanical. 60 levers, 11 of which are operational.
- *Installation dates (where known)*: Bransty houses an LNW Tumbler frame from 1899. In SSADS as 1900s. Rationalisation in 1997 (Corkickle No1 and No2 signal boxes were abolished and the present Key Token instrument installed, with some wiring and labelling renewed in the process). Some location cases renewed at this point and some signals renewed in 2003.

D.9.2 Evidence Provided

Three SICA assessments were provided:

- 18th August 2004 (Primary SICA);
- 18th August 2005 (Secondary SICA); and
- 23rd July 2008 (Secondary SICA).

The detailed report accompanying the 2008 Secondary SICA was provided, which included the content from the 2005 Secondary SICA report as a reference point against which comments were made. The project remit for life extension works at Bransty (dated 20th September 2010) was also provided. This interlocking was discussed at the LNW – North session on 13th January 2011.

D.9.3 SICA Scores and Movements on Re-assessment

Assessment	18/8/2004	18/8/2005	*Change*	23/7/2008	*Change*
Type	Primary	Secondary		Secondary	
Internal Wiring Override?	Yes	Yes		Yes	
Overall Condition	Yellow	Yellow		Yellow	
Overall Remaining Life	7.0	8.9	1.9	9.7	0.8
Forecast Renewal Date	2011/12	2014/15	3	2017/18	3
Control Period	CP4	CP5		CP5	
Element results:					
Relay interlocking	20.4 (G+)	-	-		
Mechanical interlocking	10.9 (G)	3.3 (Y)	-7.6	2.4 (R)	-0.9
Internal Wiring	4.7(Y)	4.5 (Y)	-0.2	1.3 (R)	-3.2
Main Cabling	17.9 (G)	12.6 (G)	-5.3	17.7 (G)	5.1
Cable Routes	2.4 (R)	8.8 (Y)	6.4	18.0 (G)	9.2
Location Cases	3.9 (Y)	8.0 (Y)	4.1	8.7 (Y)	0.7
Power Supplies	9.6 (Y)	21 (G+)	11.4	21.0 (G+)	0
Additional SSICA results					
Main Colour Light Signals	-	10.0 (Y)	-	10.0	0
Semaphore Signals	-	19.8 (G)	-	18.3 (G)	-1.5
Disc Signals	-	8.4 (Y)	-	8.4 (Y)	0
Power Operated Points	-	7.1 (Y)	-	7.1 (Y)	0
Train Describer	-	1.1 (R)	-	9.0 (Y)	7.9
Block Instruments	-	8.0 (Y)	-	10.8 (G)	2.8
AWS	-	-	-	17.9 (G)	-

Table 24 SICA scores for Bransty interlocking area

D.9.4 Observations on Movements in SICA Scores

The overall state of the interlocking and its elements suggests that intervention of some sort is required. The site is impacted on by its coastal setting and therefore increased levels of corrosion. The overall site remaining life has remained in the 'high Yellow' range but significant changes have occurred at the element level.

As for Marchey's House and other mechanical interlockings this site has relay elements that were picked up separately in earlier assessments. The Mechanical Interlocking element is now the only checklist that needs to be completed with the relay information picked up in the internal wiring scores.

The Route Engineers stated that the SICA results for a mechanical interlocking do not necessarily reflect the actual life obtainable from the interlocking. There will be issues with condition where visual condition may not reflect actual capability and performance. While the tool helps flag up issues, discussions with the local Maintainer are important to judge what is required. The Maintainer (in this case a trained lock fitter) will be able to extend the life for long periods of time even though the locking scores stay in the Yellow/Red area. This is partly linked to the criticality of the area, as the site is of low criticality (very rural, one car trains every two hours and some freight) so the existing levels of risk can be maintained with an interlocking in poor condition. Key drivers of the current low SICA score are evidence of copper dust, poor access, lack of spares and a large percentage of redundant locking.

The low Internal Wiring scores are linked to 1980s Pirelli wiring, as for several of the other interlockings reviewed. Several specific examples of deterioration between the 2005 and 2008 assessment are given. This is seen to be the main driver of a requirement for some intervention and has formed part of the case for minor works at this site in the current CP4 workbank (along with Location Cases, of which some are in poor condition).

The improvement in the score for Cable Routes reflects works carried out as part of the Parton abolition project. These minor works have not been tracked historically, but in future will be captured in SSADS so their impact on SICA scores can be traced.

The Red in the 2005 Train Detection element reflects a track circuit in a tunnel that was replaced as part of minor works. However, the track feed units are obsolete so overall the 'Yellow' status is maintained and it is a candidate for renewal.

The small movement in the condition of the Block Instruments element reflects an improvement in the performance of the token machine, although it is still seen as obsolete and in need of replacement.

D.9.5 Additional Condition Information from Supporting Evidence

It was stated in the supporting 2008 SICA report that the general impression of the area is of one beyond mid-life but adequately maintained, with the closest element to life expiry being the signal box internal wiring. The frame is reported as reliable by the signaller. The locking room is poorly lit and access to many parts is precarious. Detailed condition information on each element was provided, both from the 2005 previous report and any updates since.

The neighbouring box at Parton was in worse condition and has now been transferred to Bransty - some improvements are likely to have been made in this transfer.

The Bransty life extension works are detailed in the September 2010 project remit, which include reference to a 'minor works' card. This could be a way of tracking improvements that are made to interlockings across the network to help explain future changes in SICA scores.

D.9.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	3/8/2012
Territory	3/8/2012
MP&I	-
ERTMS	31/12/2034
Original C1 date (SBPu Baseline)	31/12/2012
Revised C1 date	31/12/2012
Re-revised C1 following ORR determination	31/12/2012

Table 25 Renewals dates from HQ Signalling Business Planning

The above renewals intervention date reflects the SICA assessment from 2008 and identify the requirement for works in 2012. As ERTMS is not planned for some time and the current condition is poor, some kind of intervention is required. The September 2010 project remit for the works states that the strategy for resignalling this area is to abolish Bransty signal box by approximately 2020, but states that life extension work should be carried out to try and meet the 35 year approximate service life where affordable. This is targeted for completion by the end of 2013, broadly consistent with the above dates.

The remit and minor works card sets out the requirements for this life extension work. This suggests it would be worth Network Rail investigating these as a source of evidence to be used in establishing a link between SICA scores and life extension requirements and long-term minor works funding submissions.

The discussion highlighted that there are other external business drivers that could affect the longer-term strategy for the Cumbrian Coast line. It is uneconomical to run the boxes in their current configuration which suggests that either an accelerated rationalisation through the Operations Strategy may be desirable. Another possible opportunity is 3rd party funding for improvement due to an external requirement to use the line for transporting nuclear fuel. Once again this shows the interaction between the longer-term strategy and the short/mid-term condition-based requirements in defining an optimal Asset Management strategy for the area.

D.10 Crewe (PSB) (LNW-North, RRI, 542 SEUs)

D.10.1 Site Overview

Information on the site and its history was provided through the report accompanying the 2005 Secondary SICA, additional supporting evidence and discussions:

- *Location*: North West end of Crewe station on the West Coast Main Line, close to Crewe North Junction (ELR is LEC5).
- *Control*: The interlocking controls routes to and from Crewe station and the line to Kidsgrove, via Alsager. Alsager remote interlocking is assessed separately.
- *Type*: Relay - F.W BR930 - BR Std Circuits. All working is by track circuit block.
- *Installation dates (where known)*: Crewe PSB was commissioned in 1985 (Note, in SSADS it is 1900).

D.10.2 Evidence Provided

Two SICA assessments were provided:

- 12th January 2005 (Secondary SICA); and
- 4th February 2010 (Primary SICA).

The detailed report accompanying the 2005 Secondary SICA was provided, which included reference to a peer review Secondary SICA report in 2002 (although this assessment had not been provided). Additional supporting information on the Primary SICA was also provided. Supporting information consisted of the RADR form for Crewe and the Crewe SCC Life Extension Joint Project Remit (from 15th March 2010). This site was covered in the LNW – North session on 13th January 2011.

D.10.3 SICA Scores and Movements on Re-assessment

Assessment	12/1/2005	4/2/2010	*Change*
Type	Secondary	Primary	
Internal Wiring Override?	Yes	Yes	
Overall Condition	Green	Green	
Overall Remaining Life	18.0	17.2	-0.8
Forecast Renewal Date	2022/23	2027/28	5
Control Period	CP6	CP7	
Element results:			

Assessment	12/1/2005	4/2/2010	*Change*
Control Panel	4.3 (Y)	17.3 (G)	13.0
Relay Based Interlockings	21.0 (G+)	21.0 (G+)	0
Internal Wiring	21.8 (G+)	9.9 (Y)	-10.9
Main Cabling	20.5 (G+)	20.5 (G+)	0
Cable Routes	13.0 (G)	20.5 (G+)	7.5
Location Cases	20.2 (G+)	16.6 (G)	-3.6
Power Supplies	19.9 (G+)	17.3 (G)	-2.6
Additional SSICA results			
Remote Control Media	4.3 (Y)	-	-
Main Colour Light Signals	16.0 (G)	-	-
GPL Signals	4.3 (Y)	-	-
Power Operated Points	7.1 (Y)	-	-
Train Detection	15.5 (G)	-	-
Train Describer	9.3 (Y)	-	-

Table 26 SICA scores for Crewe interlocking area

D.10.4 Observations on Movements in SICA Scores

The main movements here are the improvement in the Control Panel and the degradation in Internal Wiring between the two assessments. Detailed information on issues with the Control Panel is available in the Secondary SICA and it is recommended that it was renewed. This appears to be the case from the 2010 assessment and from the description in the Crewe Joint Project Remit that makes reference to the replacement of the panel buttons and improvements in reliability.

The Internal Wiring assessment in the 2005 Secondary SICA report is thorough and includes evidence of existing and potential future degradation was present in some places (including labelling of degradation as 'severe' by Jarvis engineers (undated)). The peer review of 2003 is also referenced as having classified the Relay Room as having borderline 'fair' to 'poor' wiring. However, the overall Internal Wiring score is Green Plus, which would not flag up the issues to an observer unaware of the underlying issues. This could be an example of the sampling and averaging process presenting a misleading picture of the likely future renewals requirement. Certainly by the next Primary SICA (where an overall view is taken), this is flagged as an issue. Note that in the recommendations of the Secondary SICA, the Maintainer is expected to install and/or update wire degradation record cards so that future degradation can be monitored more effectively, so the Territory Engineers at the time did not overlook the issues given the Green Plus score.

D.10.5 Additional Condition Information from Supporting Evidence

It is stated in the supporting 2005 SICA report that the general impression of the area is of one that is approaching mid-life which has been generally well maintained (consistent with an asset that is actually just past a midpoint of a 35 year service life), with the control panel and some trackside equipment requiring replacement.

The report summarises fault data from FRAME (including wrong side failures) along with causes as an indication of the performance of the interlocking.

Detail is given on the condition of the Internal Wiring in each case.

The supporting Primary SICA report also captures the need to keep monitoring the status of the degradation of the internal wiring.

D.10.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/12/2014
Territory	15/4/2015
MP&I	31/12/2014
ERTMS	31/12/2028
Original C1 date (SBPu Baseline)	31/12/2014
Revised C1 date	19/8/2019
Re-revised C1 following ORR determination	19/8/2019

Table 27 Renewals dates from HQ Signalling Business Planning

Crewe was originally planned to be renewed in CP5 but this has been pushed back to CP6 following lack of funding in the ORR Final Determination. Therefore intermediate life extension works are required.

D.11 Norton SB (Runcorn East Station) (LNW-North, Mech, 6 SEUs)

D.11.1 Site Overview

Information on the site and its history was provided through the report accompanying the 2005 Secondary SICA, additional supporting evidence and discussions:

- *Location*: Norton signal box is located at the north east end of Runcorn East station, on the Chester and Warrington lines.
- *Control*: Adjacent signal boxes are Frodsham Junction (to the south west) and Warrington PSB (to the north east).
- *Type*: The signal box is to BR (LMR) type 15 design, housing a LMR Standard tappet frame (both 1972).
- *Installation dates (where known)*: The signal box and frame were both installed in 1972 (Note, in SSADS it is 1900).

D.11.2 Evidence Provided

Two SICA assessments were provided:

- 5th June 2003 (Primary SICA); and
- 14th September 2006 (Secondary SICA).

The detailed report accompanying the 2006 Secondary SICA (dated 12 January 2007) was provided. Supporting information also included the RADR form for Norton SB. This interlocking was covered at the LNW – North session on 13th January 2011.

D.11.3 SICA Scores and Movements on Re-assessment

Assessment	5/6/2003	14/9/2006	*Change*
Type	Primary	Secondary	
Internal Wiring Override?	Yes	Yes	
Overall Condition	Green	Green	
Overall Remaining Life	11.1	12.2	7.3
Forecast Renewal Date	2014/15	2018/19	4
Control Period	CP6	CP7	
Element results:			
Mechanical Interlockings	15.3 (G)	2.6 (R)	-12.7
Relay Based Interlockings	16.8 (G)	-	-
Internal Wiring	8.3 (Y)	7.9 (Y)	-0.4
Main Cabling	3.8 (Y)	20.5 (G+)	16.7
Cable Routes	19.8 (G)	10.8 (G)	-9.0
Location Cases	1.4 (R)	13.5 (G)	12.1
Power Supplies	10.4 (G)	12.3 (G)	1.9
Additional SSICA results			

Assessment	5/6/2003	14/9/2006	*Change*
Main Colour Light Signals	-	9.9 (Y)	-
Power Operated Points	-	8.4 (Y)	-
Train Detection	-	15.5 (G)	-
Block Instruments	-	15.2 (G)	-
Train Describer	-	17.1 (G)	-

Table 28 SICA scores for Norton SB interlocking area

D.11.4 Observations on Movements in SICA Scores

It is stated in the report supporting the 2006 Secondary SICA that the 2003 assessment was carried out by Lloyd's Register Rail. The report also makes two key observations, reproduced in full as they support the general findings of this overall review:

- The overall site estimate of 12.2 years is an interesting average that is produced when scores for equipment at opposite ends of their lives are combined. If taken at face value it will obscure the important, but relatively minor, life extension work required at Norton.
- Some of the individual elements' estimates may also be considered to be slightly misleading averages: location cases are structurally sound (if slightly damp), but several cases house single-cut circuits; train detection uses feed equipment dating from 1973 with modern, retro-fitted, relay equipment that is widely available.

In the overall conclusion, the SICA remaining life is therefore not judged as a suitable means for estimating the renewal requirements for this particular site.

The key changes between the assessments are in the scores for the following elements: Mechanical Interlocking (large drop), Main Cabling (large improvement) and location cases (large improvement).

As for Bransty, the low score for the mechanical interlocking in the Secondary SICA is partly due to the nature of mechanical interlockings, namely the amount of redundant locking and lack of spares. This would generally put the interlocking element score in a 'Yellow' condition as for Bransty . The key driver in this case is the existence of flooding in the locking room, which impacts on the environment and trend scores for the interlocking. The extent to which the flooding represents an issue for the interlocking is discussed in Section D.11.5.

The underlying scores for the location cases reflect the averaging comment above. AMCL has applied the SICA equations to each individual of the seven location case in the sample to see what the remaining lives would be if assessed separately, and found that three would be classified as Yellow, three Green (with one borderline Yellow at 10.2 years) and one Green Plus. So the overall Green assessment for location cases masks the potential need to carry out minor works on the worse performing cases. It is possible that the Red score in the Primary SICA was caused by the consultant wishing to flag the worst case. The Route Engineers stated that the Secondary SICA was considered more representative of the site and that no minor works had been carried out to their knowledge.

D.11.5 Additional Condition Information from Supporting Evidence

The SICA report provided detail on many of the issues above considering the condition of each element. In addition, the Red status of the interlocking due to the impact of flooding in the signal box was discussed. Photographic evidence was provided to demonstrate that the Red status is actually best managed by improving the drainage to remove the flooding rather than by renewing the interlocking itself. The condition issues are therefore sturctural rather than operational. This would bring the score into the Yellow region, that would then put this site in a similar position to Bransty, in that the equipment is maintainable in its current state, but it is a candidate for rationalisation.

The RADR stated that discussions with the Maintainer had taken place that would enable the overall renewal of the site to be deferred.

D.11.6 Key Business Planning Drivers

The key renewals dates used in the business planning process are shown in Table 11.

Source	Renewal Date
HQ 2006	31/12/2011
Territory	31/12/2011
MP&I	-
ERTMS	31/12/2026
Original C1 date (SBPu Baseline)	31/12/2011
Revised C1 date	31/12/2011
Re-revised C1 following ORR determination	31/12/2019

Table 29 Renewals dates from HQ Signalling Business Planning

Norton is, like Bransty, viewed as an opportunity for rationalisation as part of the Operating Strategy. As stated in the SICA report, the overall site score does not appear to reflect the actions required to keep the site operational until this is implemented. However, through discussions with the maintainer, specific minor works and spot renewals have been identified to manage this process and address concerns. Some of which relate to improving the environment rather than works on the interlocking itself.

Appendix E: References

AMCL, 2000. *Railtrack East Anglia Zone: SICA Process Analysis Final Report* [Accessed as Internal AMCL document]

Banedanmark, 2010. *The Signalling Programme: A Total Renewal of the Danish Signalling Infrastructure*. [Online] Available at: http://uk.bane.dk/db/filarkiv/6415/2.%20edition%20-%20endelig%20-%20100301_BDK_SP_UKbrochure2010_www.pdf [Accessed 7th February 2011]

Banverket, 2010. *Banverket's Annual Report 2009*. [Online] Available at: http://www.trafikverket.se/PageFiles/26128/bv_arsredovisng_2009_webb.pdf [Accessed 7th February 2011]

Decisio BV & Systra SA, 2010. *Social Cost Benefit Analysis of implementation strategies for ERTMS in the Netherlands*. [Online] Available at: http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2010/07/12/bijlage-2.html [Accessed 7th February 2011]

Deutsche Bahn AG (DB), 2010. *2009 Management Report and Financial Statements* [Online] Available at: http://www.deutschebahn.com/site/ir/ir__dbag/en/financial__reports/annual__report/shop__annualreport__2009__dbgroup.html [Accessed 7th February 2011]

Lloyd's Register, 2005 (1). *Independent Assessment of SICA using PAS 55 as a guide*. [Online (Archived)] Available at: http://webarchive.nationalarchives.gov.uk/20090902195821/http://www.rail-reg.gov.uk/upload/pdf/lloyds-rail_signalling-sica_assess.PDF [Accessed 2nd February 2011]

Lloyd's Register, 2005 (2). *SICA Application and Business Planning Review*. [Online (Archived)] Available at: http://webarchive.nationalarchives.gov.uk/20090902195821/http://www.rail-reg.gov.uk/upload/pdf/lloyds-rail_signalling-sica_application.PDF [Accessed 2nd February 2011]

Lloyd's Register, 2006 (1). *SICA Briefing* [Presentation supplied by Network Rail]

Lloyd's Register, 2006 (2). *SICA Functional Specification for Network Rail*. [Document supplied by Network Rail]

MTR Corporation, 2010. *Annual Report 2009.* [Online] Available at: http://www.mtr.com.hk/eng/investrelation/financialinfo.php#02 [Accessed 7th February 2011]

Network Rail, 2007. *Network Rail October 2007 Strategic Business Plan Supporting Document: Asset Management*. [Online] Available at:

http://www.networkrail.co.uk/browse%20documents/StrategicBusinessPlan/Other%20supporting%20documents/Asset%20Policies%20301007.pdf [Accessed 7th February 2011]

Network Rail, 2008. *Signalling Infrastructure Condition Assessment (SICA) Handbook*. [Internal standard: NR/L2/SIG/13251]

Network Rail, 2010 (1). *Moving Ahead, Delivering a Better Railway (Control Period 4 Delivery Plan Update 2010)* [Online] Available at: http://www.networkrail.co.uk/epdf/docs/delivery-plan-2010-update/delivery-plan-2010-update.pdf [Accessed 7th February 2011]

Network Rail, 2010 (2). Moving Ahead, Investing in the Future (Annual Return 2010). [Online] Available at: http://www.networkrail.co.uk/epdf/default.aspx/annual-return-2010/ [Accessed 3rd February 2011]

Network Rail, 2010 (3). *2nd March 2010 ORR Signalling Policy Challenge Workshop*. [Presentation provided by Network Rail]

Network Rail, 2010 (4). *SICA4 User Manual*. [Internal document (issue 02, April 2010)]

Network Rail 2010 (5). *Signalling Schemes Asset Data Store (SSADS) 'How to Use' Guide*. [Internal document (version 3, March 2010)]

Office of Rail Regulation (ORR), 2008. *Periodic Review 2008: Determination of Network Rail's Outputs and Funding for 2009-14* [Online] Available at: http://www.rail-reg.gov.uk/upload/pdf/383.pdf [Accessed 7th February 2010]

Ove Arup & Partners Ltd, 2009. *Independent Review of Depreciated Replacement Costs for Engineering Assets*. [Supplied by Network Rail]

Rail Corporation NSW, 2010. *Annual Report 2009-10* [Online] Available at: http://www.railcorp.info/__data/assets/pdf_file/0008/9179/RailCorp_Annual_Report_2009-2010.pdf [Accessed 3rd February 2011]

Réseau Ferré de France (RFF), 2010. *Annual Report 2009* [Online] Available at: http://www.rff.fr/en/investors-224/financial-publications [Accessed 7th February 2011]

SEA & Network Rail, 2010. *SSADS User Manual Issue 3* [Internal document].