RailKonsult

## Office of Rail Regulation

# Review of European Renewal and Maintenance Methodologies

### Study Overview

### Reference BBRT-2012-RP-0000a

The authors of this report are employed by Balfour Beatty Rail Technologies. The work reported herein was carried out under a Contract placed on 5th March 2008 by the Office of Rail Regulation. Any views expressed are not necessarily those of that Office.

## Executive Summary

This Report was commissioned by the Office of Rail Regulation in order to gain an improved understanding of best practice maintenance and renewal techniques used elsewhere in Europe.

The review of each individual activity included consideration of the differences in approach, potential benefits which arise from adopting best practice and any issues associated with implementing the revised approach, including identification of safety concerns and timing of implementation.

In some cases, although progress has been started in introducing the practice into Britain it has not yet been fully developed. In others, the identified best practice represents a different approach to that currently employed.

The table below summarises the maintenance and renewal activities selected together with an assessment of the potential opportunities to improve efficiency if each practice was to be widely applied in Britain.

It is to be noted that the analysis reported below is not a rigorous business case assessment, for example capital investment requirements are excluded and no discounted cashflows have been considered. It is, however, included to provide an indicative view of the potential operational opportunities available if similar approaches were adopted in Britain.

| | Activity | Source | Potential Savings | |
|---|---|---|---|---|
| 1 | Asset Inspection, Condition Assessment and Decision Making | Netherlands and Germany | 20% (Note 1) | £11.75m |
| 2 | Reuse of Serviceable Track and Signalling Components | Switzerland and Netherlands | 37% (Note 2) | £5.8m (Note 2) |
| 3 | Partial Renewal of Switch and Crossings | Sweden and Switzerland | 13% | (Note 3) |
| 4 | High Output Formation Renewal | Germany and Netherlands | 40% | £9.1m (Note 4) |
| 5 | High Output Stressing | Switzerland and Germany | (Note 5) | |
| 6 | Lightweight Platforms | Netherlands | 25% | (Note 6) |
| 7 | Use of Dedicated Teams | Various | (Note 7) | |

**Notes:**

Note 1 Includes savings from reductions in foot and train based inspections, plus improved targeting of maintenance activity.

Note 2 Only savings from recycling of rails quoted in summary table.

Note 3 Savings calculated on life cycle basis rather than annual expenditure.

Note 4 Savings based on use of train for both formation rehabilitation and some ballast renewal activity.

| | |
|---|---|
| Note 5 | Assessment indicates a reduction in the cost of stressing of £10k per renewal item, but an annualised figure has not been calculated. |
| Note 6 | Savings calculated on construction cost of a typical platform extension. |
| Note 7 | Efficiency savings resulting solely from use of dedicated teams has not been separately identified. |

**Acknowledgements**

RailKonsult wish to acknowledge the support and assistance received from the following organisations in compiling this report:

- Compa Tech bv;
- Erdmann Softwaregesellschaft mbH;
- Eurailpool GmbH
- Plasser and Theurer UK
- ProRail;
- Railcare;
- SBB (Swiss Federal Railways);
- Sersa; and
- Strukton Railinfra.

## Contents

# 1.0 BACKGROUND

## 1.1 Introduction

As part of its research into the Periodic Review 2008, ORR commissioned RailKonsult in March 2008 to review current European track engineering best practice. The objective was to identify typical methods, approaches, techniques and systems that RailKonsult considered to be examples of European best practice and are well suited for adoption by the British rail industry.

These activities have been chosen as representative of different asset management approaches adopted by other European railway organisations. The review for each individual activity included consideration of the differences in approach, potential benefits that arise from adopted the revised approach and any issues associated with implementing the revised approach, including identification of safety concerns and timing of implementation.

As with most work of this type, it was not our intention to focus upon areas in which current British practice represents European best practice. Instead we searched only for methods, approaches, techniques and systems which would improve efficiency and asset performance in Great Britain and could be introduced within Control Period 4 at the latest.

Throughout this report, reference is made to current British practice. In the context of this report, this terminology refers to Network Rail controlled infrastructure and not other railway systems within Great Britain such as London Underground.

## 1.2 Study Methodology

A three-phase approach was adopted. The initial phase was to select the elements for review.

The second phase was to compile an initial report for each of the topics. This was developed from desktop studies, using information already available. Review of the initial reports identified areas that required further clarification or detail.

The third phase of the study addressed these areas. Contact was made with a number of European organisations in order to obtain the necessary information. The contact was either by phone, email or direct discussion through a series of overseas visits. The nature of this exercise inevitably limits the amount of information that can be gathered in the time available.

During the course of the review, RailKonsult have contacted the following organisations:

- Compa Tech bv;
- Erdmann Softwaregesellschaft mbH;
- Eurailpool GmbH
- Plasser and Theurer UK
- ProRail;
- Railcare;
- SBB;
- Sersa; and
- Strukton Railinfra.

## 2.0 SCOPE OF STUDIES

### 2.1 Activities Reviewed

The following activities were selected for analysis in this Report.

| | *Practice* | *As observed/applied in* |
|---|---|---|
| 1. | Asset inspection, condition assessment and decision making | Netherlands and Germany |
| 2. | Re-use of serviceable track and signalling components | Switzerland |
| 3. | Partial renewal of S&C | Sweden and Switzerland |
| 4. | High output formation renewal | Netherlands and Germany |
| 5. | High output rail stressing | Switzerland and Germany |
| 6. | Lightweight platform extensions | Netherlands |
| 7. | Use of dedicated teams | Switzerland |

### 2.2 Structure of Reports

The reports cover a variety of engineering activities, primarily dealing with asset management, the application of technology, working practices and the organisation of the workforce. Despite the variety of topics, each report follows the same structure:

- Explanation of the activity under review;
- Description of European best practice;
- Description of current British practice;
- Analysis of the differences between the two including, where possible, quantification of the benefits offered by adopting European best practice;
- Identification of any safety implications; and
- Analysis of the issues surrounding adoption of the practice into the British railway environment.

Whilst references are made to specific products and systems that are in use in particular countries, there may be other products available that provide a similar functionality. The report does not review available alternatives, or their comparative merits. The case studies are included as being indicative of alternative approaches in asset management.

The financial analyses are not rigorous business case assessments, for example capital investment requirements are excluded and no discounted cashflows have been considered. They are, however, included to provide an indicative view of the potential operational opportunities available if similar approaches were adopted in Britain.

## 3.0 SUMMARY OF TECHNICAL REPORTS

### 3.1 Asset Inspection, Condition Assessment and Decision Making

A review was undertaken of European best practice in general asset management. This is realised by fewer, higher quality inspections and a coherent, flexible asset management system.

Track assets are best managed by an effective, efficient but simple process consisting of the following elements:

- Track inspection processes including foot and mechanised inspection, followed by;
- Effective analysis of the data received, leading to;
- The correct decision being made to intervene with maintenance or renewal work.

The benefits identified through the adoption of this practice include:

- Lower inspection costs and higher inspection quality;
- Reduction in the level of incorrect or sub-optimal work be reduced;
- Regular proactive interventions reducing the proportion of more extensive reactive work;
- Improved safety, as hazards such as broken rails and track irregularities would be identified sooner and dealt with.

Based on European experience, it is estimated that it will take three years to fully optimise the benefits of the system, although the benefit streams will start before this.

Potential savings per annum of 20% (£1.94m) are possible by reducing train inspections and, based on Dutch experience, 20% (£3.14m) is possible by improved targeting and planning of tamping machines. Additionally, it has been assessed that adopting European foot patrolling frequencies would result in savings of 75% (£6.67m) if applied in the first instance to Prime and London South Eastern routes in Great Britain.

There would be other, broader, benefits such as reduced life cycle cost through extended asset life, improved safety and train performance.

## 3.2 Reuse of Serviceable Track and Signalling Components

The Swiss rail authorities have a well-established recycling management regime built around a central depot, which receives both track and signalling components replaced as part of their on-going renewals programme. These components are assessed, refurbished and then allocated to subsequent maintenance or renewal jobs as required.

Assets included within this programme include:

- Plain line rails and S&C ironwork;
- Sleepers and bearers;
- Ballast; and
- Point motors and signal heads.

It was noted that in the Netherlands there is a proactive drive to recycle ballast, which can reduce new material requirements by up to 80%. This results in reduced demand for new stone and transportation of both spent and new ballast around the country.

The benefits identified through the use of such policies include:

- Reduction in investment in new components;
- Reduction in lead times for specific components;
- Improved “carbon footprint” for the rail industry;
- Reduction in disposal costs; and
- Reduction in exposure to increased cost of raw materials.

The following elements are required to be in place in order to introduce effective recycling of components to Britain:

- A suitable management process to direct the reuse of recycled components;
- An engineering team to undertake the condition assessments; and
- Suitable premises to refurbish the components.

Efficiencies available include a 75% reduction in the cost of a refurbished point motor compared to buying a new unit and 37% reduction in the cost of rails through the cascading of a third of the removed plain-line rails.

## 3.3 Partial Renewal Process for Switch and Crossings

Partial renewal of switch and crossing layouts generally focuses on the life extension of two components: ballast and timber bearers. Vacuum technology has been developed to efficiently replace life expired ballast in Scandinavia. A method of rehabilitating timber bearers has been developed that enables vertical and horizontal alignment to be returned to construction tolerances. Under-pinning both processes is a philosophy of achieving an

extended life through targeted renewal of life expired components to eliminate vibration and movement.

The benefits identified through the adoption of partial renewal techniques include:

- Postponing need to undertake an expensive complete renewal;
- Reduced plant, materials and manpower requirements (compared to complete renewal);
- Excavation technique that does not damage buried services; and
- Avoiding premature renewal of components.

The required technology is already available within Britain, although issues with respect to the reduced loading gauge do restrict the use of some specialist items of plant.

However, in order to achieve widespread adoption of this philosophy there is a need to develop a suitable work-bank of jobs and convert this into a work programme for delivery. A prerequisite of this will be the development of engineering tools to determine the suitability of each site. This knowledge is available and experience can be transferred from Europe.

Deferring the need for renewal of S&C layouts through adoption of this practice would reduce the cost of this type of work by 13%. Further opportunities for efficiency would be available through the reduction in maintenance input required.

### 3.4 High Output Formation Renewal

There is extensive investment proposed in track renewals in Control Period 4, accounting for around £3,500m of expenditure. Although there is limited direct formation work proposed, rehabilitation is key to achieving good track quality and benefits would be reflected in lower maintenance and generally reduced life cycle cost. Of equal significance, use of this equipment would reduce the amount of complete renewals required during Control Period 4.

Best European practice is to deploy large, specialist items of plant that undertake the complete operation without the need to remove the track. The benefits identified through the use of this system include:

- Capability to rehabilitate track formation without removal of track panels;
- Increased production rates in delivery of formation rehabilitation;
- Potential to undertake renewal with single line possessions;
- Capability to avoid full asset renewal where only the formation has failed; and
- Specialist plant and dedicated team leading to reduced risk of site accidents.

The net result of these benefits is a reduction in possession time requirements, improved asset management, reduction in construction costs and improved safety.

As with other recently introduced European high output machines, some modifications would be required in order to operate existing machines within the British railway environment. However, as demonstrated with these recent investments, such problems can be overcome. It is estimated that such a system could be in full production within three years.

Based on European unit rates, it is anticipated that a direct reduction of at least 40% could be achieved in the operational cost of formation renewal. As previously noted, this excludes consideration of the investment required in new plant.

### 3.5 High Output Stressing System

One example of European best practice utilising production line techniques is the use of rail heaters (to provide the required rail stress) with mobile flash butt welding equipment. The process involves the use of rail trolleys fitted with gas heaters. These are passed over the rail at a suitable speed such that the rail is heated up to the required temperature.

The benefits identified through the use of this system include:

- Stressing and welding activities can be undertaken in parallel, reducing the time required for the overall operation;
- Mechanisation of the process reduces the resource requirements, particularly manpower;
- Standardised approach within a production line environment facilitates the use of dedicated resources, leading to improvements in productivity, quality and safety;

Adoption of heater stressing process also facilitates the use of the mobile flash butt welding technique. This provides benefits such as improved weld quality, welds that can be inspected using standard non-destructive testing methods and reduced unit costs where a number of welds are required in a local area.

In addition to the need to progress through the normal approval processes for new plant and processes, the main implementation issues are cultural: dedicated, high performance teams need to be formed that have a regular work-bank of stressing items to deliver. This implies the requirement for a stable and predictable work bank.

Cost savings achievable in connection with the stressing operation of a track renewal item are estimated to be approximately £10k per item.

### 3.6 Lightweight Platforms

The proposed CP4 enhancement programme includes a forecast of in excess of 20,000m of new or extended platforms. A lightweight modular system has been developed and is currently being used in the Netherlands.

The product consists of preformed polystyrene units with concrete faces on the external sides, bedded on sand and typically finished with a tile or slab layer. Each of the platform units typically weighs 700kg.

The benefits identified through the use of this system include:

- Lightweight modules eliminate need for extensive foundation works;
- Modular approach enables quick installation times to be achieved;
- Use of standard units, rather than bespoke solutions, accelerates both design and procurement processes;
- Use of standard approach increases construction consistency and reduces construction risk;

An initial assessment of the reduction in cost compared to traditional platform construction method indicates a saving of approximately £1,100 per metre, i.e. 25% of construction costs.

### 3.7 Dedicated Teams

There is widespread use of dedicated teams undertaking specific activities, generally within the track renewals environment, across Europe. The focus is placed upon delivering an activity through the use of a dedicated team, covering all of the tasks required to deliver the activity.

The main characteristics of this system are:

- Use of small highly productive teams;
- Contracting by activity rather than by region or even country;
- Well balanced and predictable work bank; and
- Investment in specialist plant, purpose designed for the role.

For example, in Switzerland the renewal of S&C is delivered this way and the work-bank is effectively managed so as to provide continuous work. As a consequence, these teams are continually improving the plant and process that they use. The benefits include:

- Staff fully understand their roles, leading to productivity and safety improvements;
- Dedicated teams delivering specific tasks reduces manpower requirements;
- Reduction in errors and rework; and
- Rationalisation of management structures.

It is not possible to isolate the productivity savings resulting from the use of dedicated teams because they are often intertwined with use of specialist and high output plant. However it is clear that, as in other industries, production line methods deliver work to a higher standard in less time and with fewer people.

## 4.0 CONCLUSIONS

The study has reviewed the European approach to delivering a number of maintenance and renewal activities. Examples of good practice have been identified, which in all cases could be transferred to Britain.

The activities reviewed cover a wide range of subjects. As such, it is difficult to draw a single conclusion. However, whilst preparing the report the following common themes were noted:

- Widespread adoption of latest technology to improve effectiveness and efficiency;
- Use of specialist plant and resources, developed to best deliver the tasks in-hand; and
- Dedicated teams who fully understand the process and are continually finding ways to improving the delivery mechanism.

In order to introduce the identified best practices into Britain, an implementation period of between one and three years would be required for each process. The estimated time periods do not take into consideration the quantum of any other changes being undertaken. However, it is noted that in many cases some progress has already been made in introducing the European approaches.

In overview, potential savings of between 13% and 40% have been identified for each process examined. Additionally, many qualitative improvements in asset management have also been identified.

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