

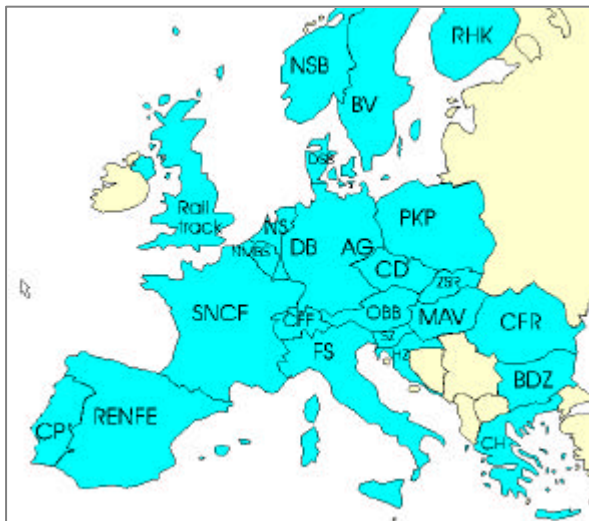
# ECOTRACK : Experiences from Implementation and Use

Ing. Stanislav Jovanovic (ERRI/TU Delft), Dr Imrich Korpanec (ERRI)

**Summary:** *About two years experience with ECOTRACK implementation and use have shown that the program clearly lives up to expectations and its output can be relied on. ECOTRACK is starting to be the major software program for track maintenance and renewal in Europe. During these first two years we have witnessed a rapid build-up of trust in the decision support offered by ECOTRACK amongst current and prospective users. This is clearly shown by the fact that not only more and more railways but also contracting and consulting companies are deciding to use ECOTRACK. However, while such a response from European companies is perhaps not so much of a surprise because many of them participated in the development of ECOTRACK, it is very interesting and encouraging to see a lot of interest from such as the US. Moreover, the proposed extensions and additional modules will further increase the capabilities of this program and the benefits that can be gained from it.*

## Introduction

The ECOTRACK software program was developed in project D 187 of the European Rail Research Institute (ERRI) which is based in Utrecht in The Netherlands. The program was finalised in March 1998 at the seminar in Lausanne, Switzerland, which effectively marked the beginning of the implementation phase. A number of articles have already been published about ECOTRACK, both during development and since the seminar in Lausanne. However, it is only now after about two years when progress has been made on many railways concerning implementation and use of ECOTRACK that new aspects of the program are beginning to make their mark. This paper is about these new aspects and about the experience gained from two years of using the ECOTRACK software.



**Fig 1: Networks participating in the development of the ECOTRACK system**

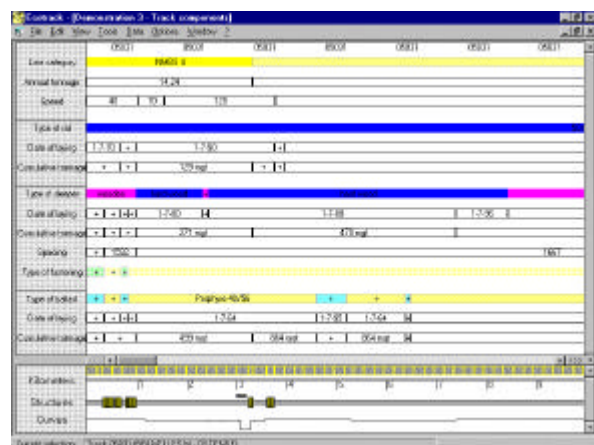
The studies on Efficient Infrastructure showed that a new approach is needed for condition-based, reliability-centred management of maintenance so that heavier loads can be transported at higher speeds with lower LCC. In today's environment it is only possible to achieve Efficient Infrastructure if decision-making is supported by a proper maintenance management system that is geared to maximum track safety and reliability. This was basically why ERRI and the UIC decided to develop the ECOTRACK program.

Furthermore, since the essence of modern railway infrastructure maintenance management lay in diagnostics, i.e. condition-based deterioration models as well as criticality and urgency analyses of all the key infrastructure components, the diagnostics concept was chosen as the backbone of ECOTRACK.

In addition, given the size of the railway networks and the complex relationships between the various parameters and their joint or separate influence on the condition of track components, there is clearly an enormous amount of data to handle in diagnostics. This was another reason why computer-aided decision-support was obviously required. ECOTRACK, a decision-support system for optimum planning of railway track maintenance and renewal, was therefore developed.

## Different ways of using ECOTRACK

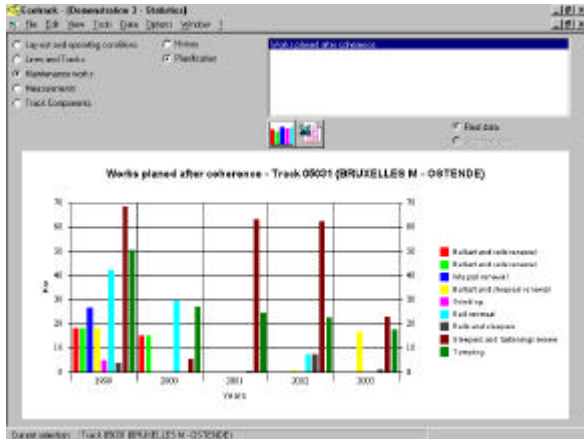
The two years experience have shown a number of different ways of using ECOTRACK. Of course the main purpose – i.e. planning M&R work – is unchanged, but certain additional, “secondary” uses for ECOTRACK have also emerged. For example, the program can be used as a powerful database-management tool for existing track data: it enables a track manager to (finally) see all the track components



**Fig. 2: View of track components**

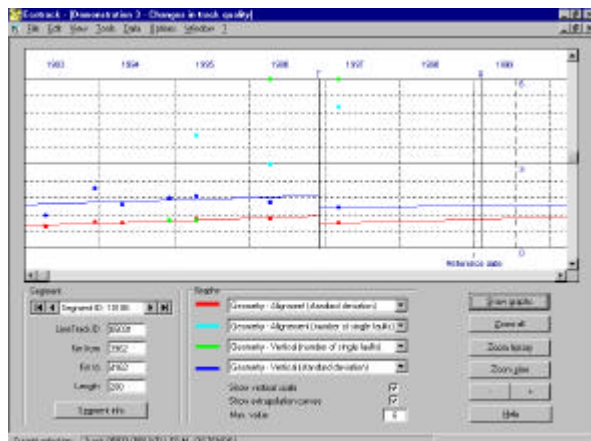
clearly (Fig. 2) with their exact location, all the line characteristics (e.g. category, tonnage, speeds, types of

rail, sleeper and ballast with date of laying and cumulative tonnage, all the structures, switches, etc.), as well as detailed statistics regarding layout and operating conditions, maintenance work (past and future - Fig. 3), measurements (of rails and track geometry and the other track components, and all this data is easily transferable into Excel worksheets.



**Fig 3: View of statistics - Work planned**

Similarly, ECOTRACK can show the user the changes in track quality (Fig.4), both past and future (extrapolated), which is an invaluable option.

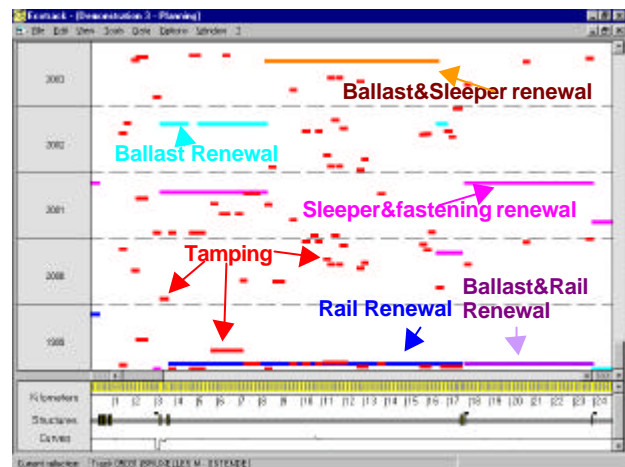


**Fig. 4: View of changes in track quality**

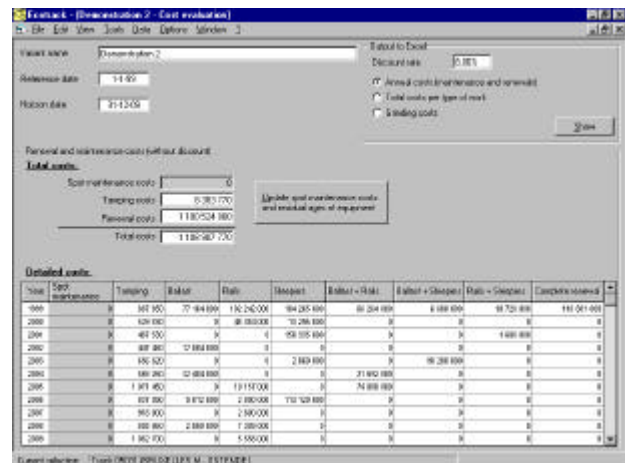
To paraphrase Professor Ebersohn of the University of Pretoria, South Africa, when referring to their AMM<sub>TRACK</sub> system which was developed by Spoornet and AMTRAK NEC and programmed by OPTRAM (the generic name of the system is ORIM): "...sometimes, only looking at the data, displayed in a well organised manner, can provide the manager with a lot of information and help him derive many valuable conclusions." Unlike ECOTRACK, the ORIM system can (to date) only manage and display track data.

As for the most significant ability of ECOTRACK, which is the fundamental reason why it was created (i.e. presenting planning and cost evaluations for M&R (Figs. 5 and 6), two distinct ways of using ECOTRACK have become clear: it can be used as a

planning and/or as a controlling tool. So far we have seen both of these two approaches used, each successfully in their own way.

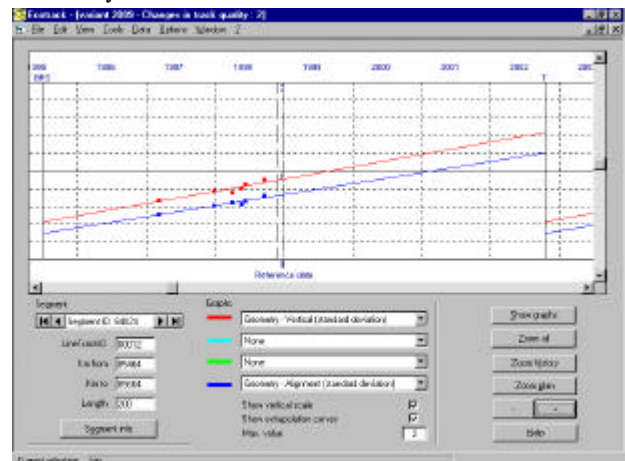


**Fig. 5: M&R planning**



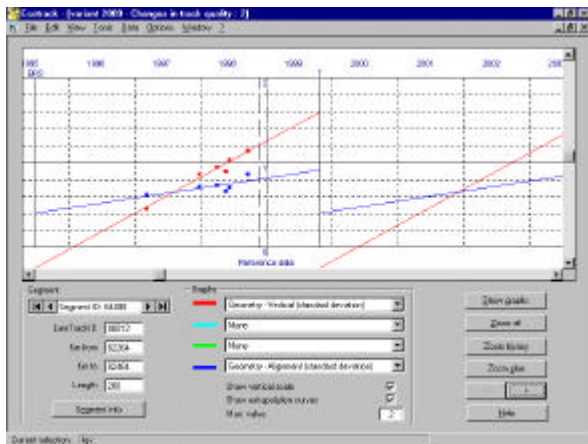
**Fig. 6: Cost evaluation**

The more than two years experience with ECOTRACK on Belgian Railways (NMBS) have shown that the program can be successfully used to control proposals for M&R work from the regions and to check whether the proposed work is really necessary.



**Fig. 7: Restoration/deterioration of a TGV line - normal section**

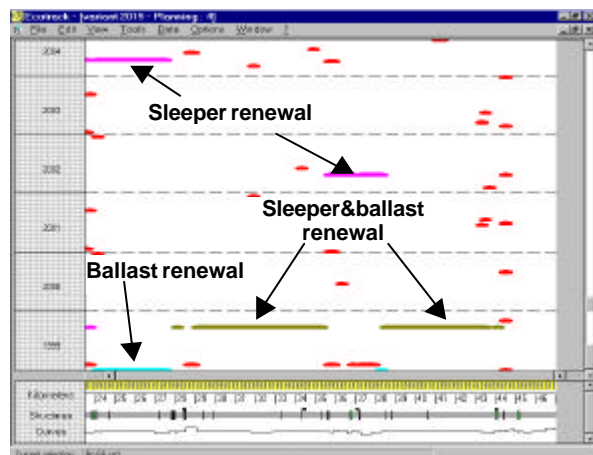
NMBS have also successfully used ECOTRACK to detect track sections behaving abnormally on TGV lines so that further and more detailed analyses can be performed on these sections (Figs. 7-8).



**Fig. 8: Restoration/deterioration of a TGV line - section with an abnormal deterioration rate**

Another use of ECOTRACK that has proven very successful on NMBS is budget management, or more precisely comparing the cost of delaying and/or combining work. Figs. 9 and 10 show two planning options – the original one (Fig. 9) and an alternative (Fig.10). The difference between these two alternatives lies in combining the ballast renewal planned for 1999 and the sleeper renewal planned for 2002 and 2004 into a ballast&sleeper renewal operation and combining that with the existing (already combined) ballast & sleeper renewal work in 2002 (Fig. 11).

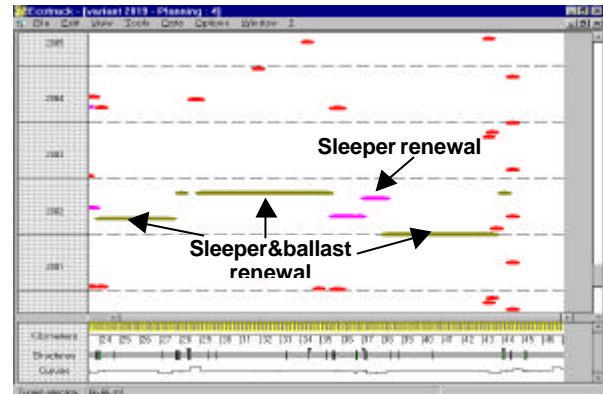
This whole process resulted in significant savings, as can be seen from Fig. 11.



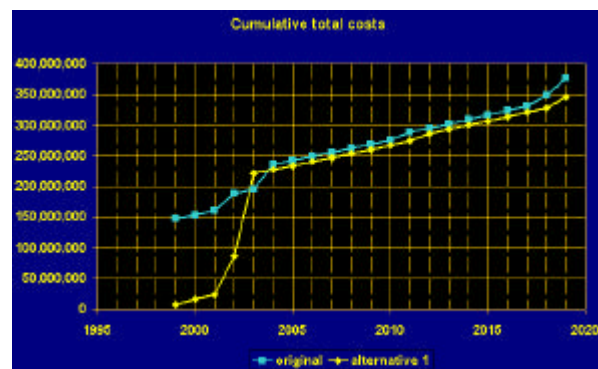
**Fig. 9: Original planning**

However, the main advantage of ECOTRACK is not the presentation of the planning and the clear way in which the work is displayed. The great strength of ECOTRACK lies in the rules on which the planning is based. There are currently 54 of these rules in ECOTRACK by default; these include both familiar

maintenance rules drawn from the years of experience of many of the European railways and the statistical deterioration models resulting from years of research aimed at producing accurate and reliable tools to predict the behaviour of track elements. These are the most valuable element of ECOTRACK which, when correctly combined, produce optimum M&R planning. Unfortunately, these rules are covered by intellectual property rights belonging to ERRI and therefore can not be given here.



**Fig. 10: Alternative planning**



**Fig. 11: Cumulative cost comparison of the two alternatives**

However, ECOTRACK is also open to new rules, which may be specific to only certain railways' environments, and which those railways can easily input into ECOTRACK. This was an additional basis for negotiations with several railways who had certain rules that only they had been using. The purpose of the negotiations was to determine how these rules could be incorporated into ECOTRACK for their needs and for all other ECOTRACK users.

### Implementation of ECOTRACK

There have to date been a number of different approaches to both the implementation and the use of ECOTRACK. While some railways and contracting companies followed the suggestion of ERRI and Techdata to take advantage of the Feasibility Study, other railways decided to implement completely on their own.

To date, ECOTRACK implementation can be summarised as follows:

- One railway is actively using the program (NMBS).
- Two railways have finalised feasibility studies (SBB, Railtrack). Railtrack has finalised evaluation and started implementation in one of its zones.
- Two other railways have officially ordered feasibility studies but not completed them (FS had a kick-off meeting at the end of November 1999, NS - still pending).
- Two railways have implemented ECOTRACK without a feasibility study, i.e. on their own (ÈD, SŽ).
- A number of contracting companies are showing interest (GTRM, AMEY Rail Ltd.); one is carrying out an assessment (Balfour Beatty).
- A number of organisations are involved in negotiations (REFER, SNCF, EFRTC, TTCI, Moroccan Railways, Banverket).

The differences in approach can be seen from the examples of NMBS, ÈD and SŽ.

NMBS started implementation at their headquarters, where ECOTRACK is used both for general management purposes (e.g. estimating the need for resources, producing statistics, generating thematic maps, and budget management) and for planning purposes (e.g. performing case studies and controlling M&R proposals from the regions). Only after more than a year of using ECOTRACK did NMBS start to implement the program in one of their regions, with a further plan to implement it in other regions and start using it for real planning purposes. NMBS took this approach mainly because of the way that existing databases were administered, which was mostly centrally at NMBS headquarters. Therefore, since ECOTRACK always requires data transfer from the existing databases and data collection systems into the ECOTRACK database, it was easiest to make these transfers at the very place where the data were gathered, i.e. at NMBS headquarters.

On Czech Railways (ÈD), implementation was carried out with the help of local personnel (in-house personnel and one third-party software consulting company - DATEX Ltd of Hradec Kralove). Implementation was bottom-up, i.e. starting in one of the regions with a plan to spread to other regions (after successful implementation in the first region), possibly without implementing the program at all at ÈD headquarters. The reason for this approach was again the organisational structure of the railway whereby the existing data were managed directly by the regions such that the regions had the best insight into data organisation and structure, thus making it logical for ÈD to start implementing ECOTRACK at regional level.

The consulting company also translated ECOTRACK into Czech, i.e. they used the built-in option in ECOTRACK to modify all the menus and technical terms into user-specific menus and terms in Czech. This made it a lot easier for the local engineers to work with ECOTRACK.

Slovenian Railways (SŽ) adopted an approach that combined certain elements of the ÈD and NMBS approaches in that they commissioned the Transportation Institute in Ljubljana to help with the implementation of ECOTRACK at headquarters level and devise an interface connection to the existing GIS-based database system.

The approach to implementation in Britain was also interesting in that both Railtrack and Balfour Beatty were very interested and carried out an evaluation of ECOTRACK. Railtrack commissioned the University of Birmingham (School of Civil Engineering) to solve implementation problems and adapt ECOTRACK to the somewhat specific UK conditions (e.g. imperial instead of metric system) as well as to enable Railtrack to use ECOTRACK as a shell expert-system (based on British rules). Today, after more than a year, the University of Birmingham has done an excellent job in developing some 100 additional, UK-specific rules. They also collaborated with Railtrack to implement ECOTRACK in one of Railtrack's zones (in York) as well as managing to incorporate the data from another major contracting company, GTRM, which is also very interested in using ECOTRACK. At the same time Balfour Beatty has been extensively testing the system, both by evaluating its abilities in UK conditions and comparing the results (e.g. work plan) produced by the system with the existing planning tools and practices. Balfour Beatty has now been testing ECOTRACK for over a year and according to the latest reports they are extremely pleased with its capabilities and are planning to use it in practice. A number of other UK contracting companies are also closely following the development of the work done by Railtrack and Balfour Beatty, as well as following the conferences and seminars such as the ECOTRACK User Group Meetings in order to acquire new information.

The ECOTRACK User Group Meetings show the increasing interest in ECOTRACK because there has been an increasing number of participants since the initial meeting in Lausanne in March 1998, through the User Group Meetings in Paris in December 1998 and the latest one in Brussels in October 1999. The next User Group Meeting is scheduled for 4 October 2000 in London.

The aims of these User Group Meetings are to exchange information, present upgrades, present new modules and initiate new projects.

It has been both interesting and encouraging to see how much enthusiasm is present among the current and potential users of ECOTRACK, and how much work has been put into implementing the program and furthering its capabilities, clearly showing the confidence the companies in question have in the output and decision support offered by ECOTRACK.

However, some problems have been encountered in the past two years of ECOTRACK implementation. These are mostly related to the ongoing re-organisation of European railways, which has resulted in many people in charge (the people that were either involved in the design of ECOTRACK, or that were well acquainted with its capabilities) being re-assigned to different positions in their companies; there is then uncertainty as to who will then be responsible for the implementation of ECOTRACK as well as the fact that these new people need to learn about ECOTRACK, i.e. what it is and what it can really do. Another problem has been the general lack of resources (time, people) to implement ECOTRACK on the railways. This situation has meant, in spite of the obvious willingness and enthusiasm about implementing ECOTRACK and the trust that it has earned from infrastructure managers all around Europe, that these infrastructure managers have neither had the time themselves nor been able to assign someone else to really lead the implementation of ECOTRACK. Furthermore, there has been the problem of the general unavailability of the required data: in spite of the fact that most of the railways claimed they had the data at their disposal, the data were sometimes inconsistent, missing, or had never been gathered, all of which prevented the users gaining the maximum possible benefit from ECOTRACK.

### **Conclusion**

On balance, ECOTRACK has clearly fulfilled expectations and represents a long-awaited answer to many track maintenance managers' questions. ECOTRACK is providing a solution to the difficult problem of maintaining track at the required quality level for minimum cost, which is especially problematic in the new environment of increasing loads and speeds and changes in responsibilities. ECOTRACK's rules are based on all the key data, including interaction between in-situ conditions to which the track is subjected, track geometry, the condition of track components and the effects of the different M&R activities and methods. ECOTRACK takes into account these highly complex and variable interactions and enables the planner to make comparative analyses (both quantitative and qualitative) of tens of thousands of track sections, thus ensuring the consistent decision-making which was no longer possible using manual methods.

### **References:**

- [1] Rivier R.E., Korpanec I, "Effective management of track maintenance within sight", *Railway Gazette International*, June 1996
- [2] Rivier R.E., "ECOTRACK: Better management of track maintenance", *European Railway Revue*, March 1996
- [3] Korpanec I., Pradier H., "ECOTRACK is ready for testing", *International Railway Journal*, September 1994
- [4] Rivier R.E., "Life Cycle Cost analysis and ECOTRACK: ECOnomical Track", ECOTRACK User Group Meeting No. 1, UIC Headquarters, Paris, 10 December 1998
- [5] Roland Van Leeuwen, NMBS, ECOTRACK Presentation to ECOTRACK User Group Meeting No. 2, Brussels, 6 October 1999
- [6] Jovanovic S., "A Proposal for the ECOTRACK extension - The Resource Optimisation Module", Presentation to ECOTRACK User Group Meeting No. 2, Brussels, 6 October 1999
- [7] Korpanec I., "ECOTRACK implementation to reduce Infrastructure LCC", UIC-CR User Producer Interaction Programme on Track Technology, Beijing, China, 15-18 December 1999
- [8] Jovanovic S., Korpanec I., "A spectrum of Asset Management Systems", Asset Management for Rail Infrastructure Conference, Brussels, Belgium, 28-29 February, 2000