ECOTRACK: Two years of experience

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There are questions that railway infrastructure managers have repeatedly been asked over the years both by the senior management staff of the railways and by the public, and to which they have never been able to give a straight answer. These questions are of the type: "What is the average quality of our main lines? Or of our high speed lines? What tamping costs are to be expected in future and what renewal costs? What about rail-only renewal costs and how will these change if we decrease the budget by 10% or postpone the works planned till 2001 or 2002? ECOTRACK can provide the answers to these and many other questions. The benefits of using ECOTRACK are manifold and obvious. There are, however, also additional or side benefits that either precede or accompany ECOTRACK and which could even be obtained without purchasing ECOTRACK itself. These benefits concern the feasibility study that usually comes as an introduction to ECOTRACK. Moreover, there are new benefits and powerful new capabilities to be expected from the proposed extensions and additional modules.

Introduction

Studies into Efficient Infrastructure showed that a new approach for condition-based, reliability-oriented maintenance management is needed that would enable higher loads and speeds for lower LCC. In today's environment, achieving efficient infrastructure can only be accomplished with proper maintenance management to help in the decision-making process that would be directed towards maximum track safety and reliability. The essence of modern railway infrastructure management is that it relies on the diagnostic concept, i.e. on condition-based deterioration models as well as on criticality and urgency analyses of all key infrastructure components.

On the other hand, if we take into account the size of the railway networks and the complexity of the relationships between the various parameters and their joint or separate influence on track infrastructure component condition, we can easily see that there is an enormous amount of data that has to be handled and processed in order to reach a diagnosis. This clearly points towards the inevitable use of computer-aided decision support systems. This was the reason behind the development of the ECOTRACK software intended for optimum planning of railway track maintenance and renewal work.

ECOTRACK was developed under ERRI project D 187 and finalised in March 1998 at a seminar held in Lausanne, Switzerland, which marked the beginning of the implementation phase. Since then, and during development, a number of articles have been published on the subject. However, only now, after about two years and some progress in the implementation and use of ECOTRACK are some new aspects emerging and becoming increasingly pronounced. This paper is about these new aspects and experience acquired from two years of use of ECOTRACK software.

Implementation of ECOTRACK

Until now, we have been able to witness different approaches towards both the implementation and the use of ECOTRACK. While some of the railways and contracting companies followed the suggestion from ERRI and Techdata that advantage should be taken of the feasibility study, other railways decided to start to implement the system completely on their own.

The ECOTRACK implementation overview looks to date as follows:

- one railway is actively using it (SNCB/NMBS)
- two railways have finalised feasibility studies (CFF/SBB and RAILTRACK)
- two other railways have officially ordered feasibility studies but have not completed them (FS had a kick-off meeting at the end of November 1999, NS - still pending)
- two railways are implementing it without feasibility studies, i.e. on their own (CD, SZ)

- a number of contracting companies are showing an interest (GTRM, AMEY Rail, Ltd.) and one is performing an assessment process (Balfour Beatty)
- negotiations are in hand in REFER, SNCF, EFRTC, TTCI, Moroccan Railways, Banverket.

Differences in approach were already clear from the examples of the SNCB/NMBS, CD and SZ. SNCB/NMBS started with implementation at headquarters, where ECOTRACK is used both for general management purposes such as estimating necessary resources, producing a variety of statistics, making thematic maps and handling budget management, and for planning purposes, for example case studies and controlling M & R work proposals from the regions. Only after more than a year of using ECOTRACK did SNCB/NMBS start with its implementation in one of the regions and start using it for real planning purposes. The reason for this approach was mostly to do with the way in which existing databases were run and administered, namely centrally for the most part, i.e. at headquarters. Therefore, since to use ECOTRACK it is always necessary to transfer data from the existing databases and data systems into ECOTRACK, it was found that the easiest way to do this was at the very place where the data was collected (i.e. headquarters).

At SNCB/NMBS they have also successfully used ECOTRACK for the detection of track sections on TGV lines with abnormal behaviour for purposes of then conducting further deeper analyses (*Figs. 1-2*).

Another use of ECOTRACK that has proved very successfully at SNCB/NMBS is budget management, or more precisely cost comparisons for delaying and/or combining work schedules. *Figures 3 and 4* show two planning options: the original (*Fig. 3*) and an alternative option (*Fig. 4*). The difference between these two options lies in combining the ballast renewal scheduled for 1999 with sleeper renewals planned for 2002 and

Fig. 1 : Repair/wear TGV line - normal section

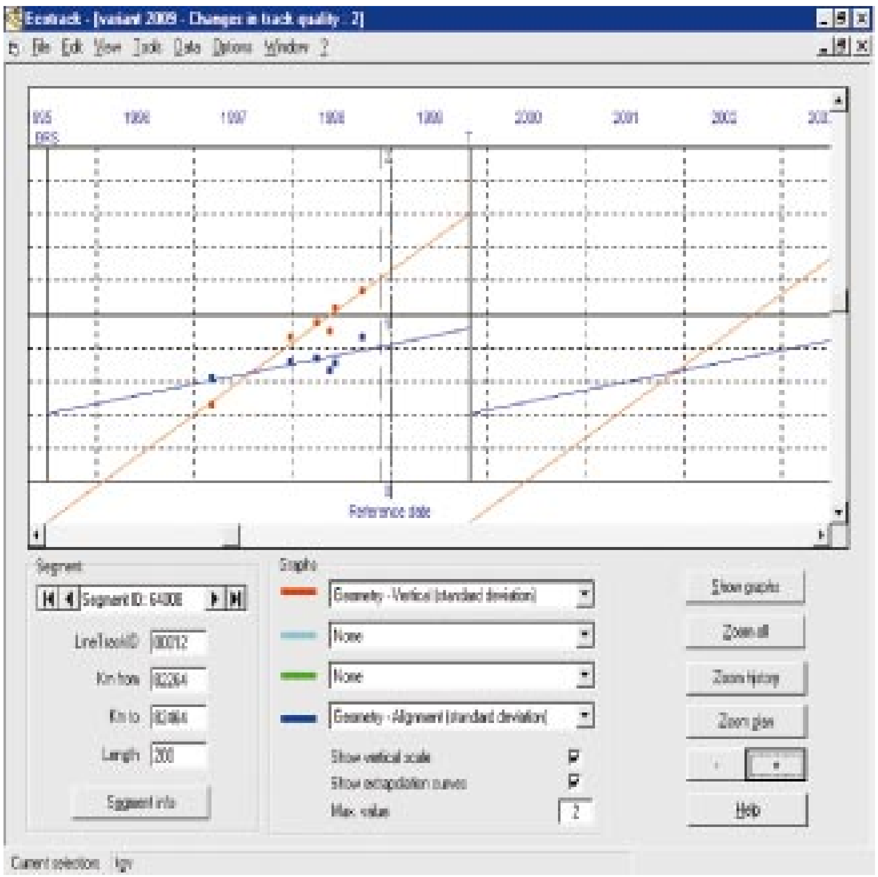


Fig. 2 : Repair/wear TGV line section with abnormal rate of wear

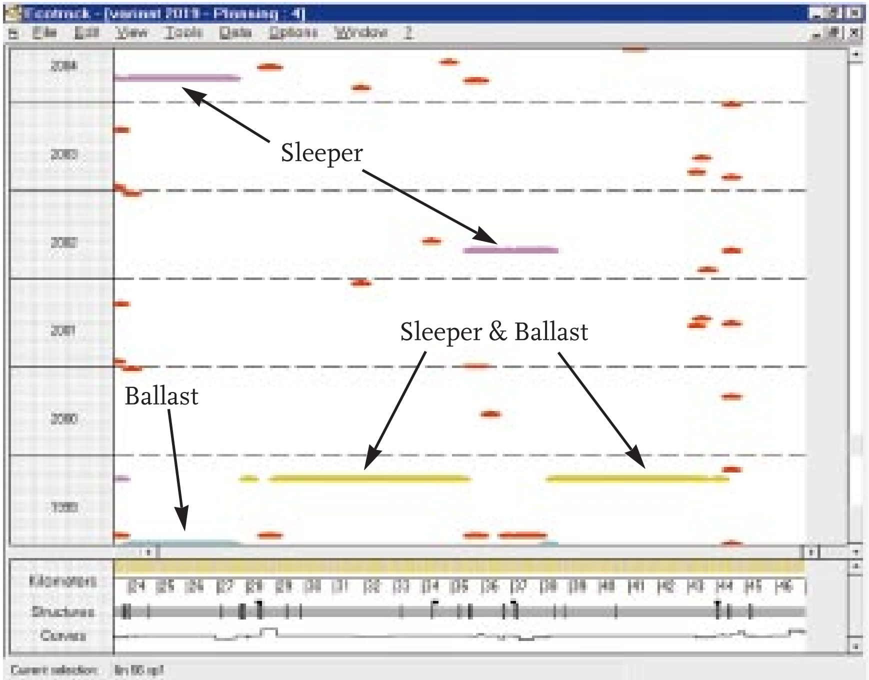


Fig. 3 : Original schedule

2004 to form a ballast and sleeper renewal programme and moving this together with already combined sleeper and ballast renewal operations to the year 2002 (*Fig. 4*).

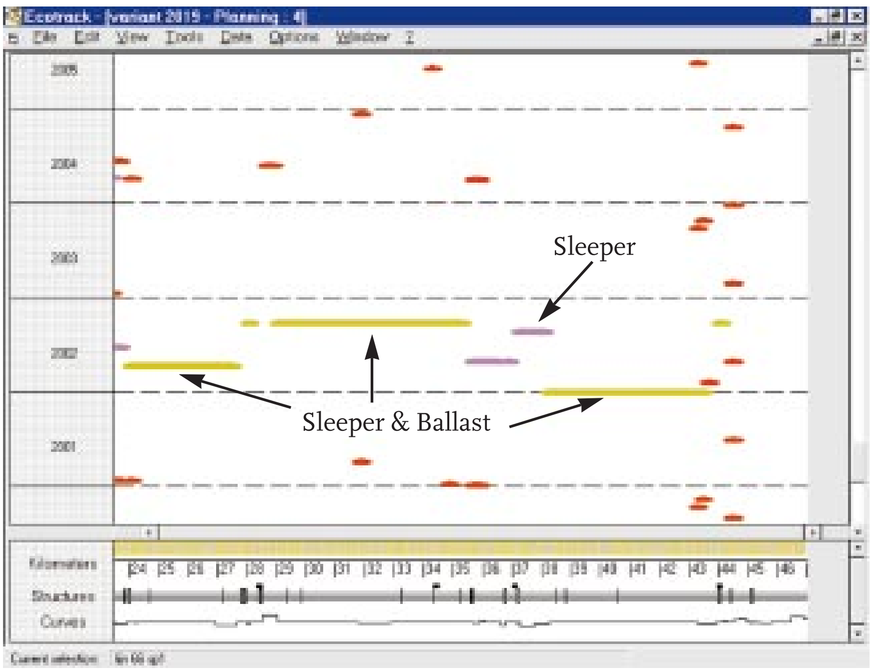
The whole process resulted in a quite substantial savings, as can be seen from *Fig. 5*.

On Czech Railways (CD), however, where implementation took place with the help of local forces in the form of in-house personnel and a third-party consulting company (DATEX Ltd., Hradec Kralove), the process began from bottom up, i.e. in one of the regions with a plan to extend the system to other regions, if results in the guinea-pig region proved satisfactory, perhaps not implementing it at all at CD headquarters. The reason for this approach was again dictated by the organisational structure of Czech Railways, since existing data is mostly managed by the regions. The regions therefore had the greatest insight into data organisation and structures, so for the CD it was only logical to start with ECOTRACK at regional level. The consultant also made a language conversion of ECOTRACK using the built-in option to modify all menus and technical terms and convert them into the user's language (Czech on this occasion). This made it far easier for the local engineers to work with ECOTRACK.

Slovenian Railways (SZ) adopted a more combined approach by comparison with the above two in that they engaged the Transport Institute in Ljubljana to help them with the implementation of ECOTRACK at headquarters level and to devise an interface connection to the existing GIS database system.

In the UK, implementation took a somewhat interesting course. Railtrack and Balfour Beatty were both very interested in performing an evaluation of ECOTRACK. For the purpose, Railtrack engaged the University of Birmingham's School of Civil Engineering to resolve implementation problems and adapt ECOTRACK to the somewhat specific UK conditions (e.g. miles instead of metric system, etc.), and consider the possibility of using ECOTRACK as a shell Expert System on an already developed British rule base. At the same time, Balfour Beatty is extensively testing the system both by evaluating its suitability for UK conditions and by comparing the results (e.g. work schedule) produced by the system with existing planning tools and practices. In addition a number of other UK contracting companies are closely watching the above developments, anxiously awaiting the outcome and closely following conferences and seminars like the

Fig. 4 : Alternative schedule



ECOTRACK User Group meetings to learn about new experiences.

For their part, ECOTRACK User Group meetings have been raising more and more interest, an assertion confirmed by the increase in the number of participants between the initial meeting in Lausanne in March 1998, the meeting in Paris in 1998 and the latest one in Brussels in October 1999. The next is scheduled for London on 4 October 2000.

The purpose of these User Group meetings is multiple: exchanges of information, presentation of upgrades, presentation of new modules and initiation of new projects.

It is both interesting and encouraging to see how much enthusiasm there is among current and potential ECOTRACK users and how much work has been put into implementing the system and improving its capabilities. This shows the extent of the confidence companies are prepared to place in ECOTRACK output and the decision-making support it offers.

On the other hand, there have been some problems in the past two years of ECOTRACK implementation. These are mostly related to the ongoing reorganisation of the European railways, which has resulted in many people in charge of the design of ECOTRACK or well acquainted with its capabilities being given different positions within their companies, to the uncertainties as to who would henceforth be responsible for ECOTRACK implementation, and to the need to educate these new people in ECOTRACK (i.e. what it can really do) all over again. Another thing also observed was the general lack of resources (time, people) the railway companies were able to allot to the implementation of ECOTRACK. Despite the obvious willingness and enthusiasm about implementing ECOTRACK and the confidence infrastructure managers all over Europe were prepared to place in it, they proved unable either to assign their own time or that of other qualified colleagues to take charge of implementation. Furthermore, there was also the general unavailability of the data required, in spite of the fact that most of the railways claimed they had such data at their disposal. In fact, data was inconsistent or missing and some was not even being collected at all. All of this caused great problems in running ECOTRACK or at least prevented maximum value from being derived from the expertise that ECOTRACK could provide.

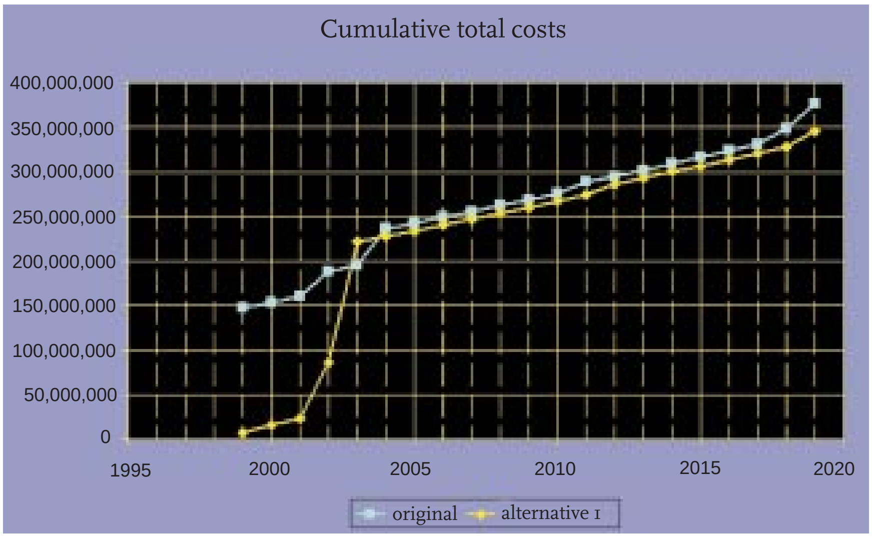


Fig. 5 : Aggregate cost comparison of the two alternatives

Technical support

There are various ways in which ERRI and Techdata are providing ECOTRACK users with the support they need in the implementation process. This takes the following forms:

- Support from the ECOTRACK website:
  - via the ERRI website: www.erri.nl
  - directly from the Techdata website: www.techdata.net/ECOTRACK
- Hotline support for all users by e-mail
- Delivery of new releases via the website
- Periodical publication of frequently asked questions and answers
- Publication of news
- Publication of references
- Implementation of an ECOTRACK demonstration on the website
- Transfer of questions concerning marketing to ERRI.

But the most significant form of technical support is the opportunity provided to ECOTRACK users to benefit from the feasibility study that can be performed for them. This feasibility study covers all the most important aspects and problems regarding ECOTRACK implementation on specific railways or by specific contractors, or in any other environment.

The framework of the feasibility study comprises several very important features:
- Organisation and participation in a kick-off meeting with the railways or other companies/users involved
- Initial installation of ECOTRACK
- Preparation of a test data set (data has to be delivered by the user)
- Production of the feasibility report
- Presentation of the feasibility report
- Demonstration of ECOTRACK using the client's particular network data
- Organisation of a training session and/or workshop with the network's test data.

Perhaps the most important features of those listed above are the preparation of a test data set, production of the feasibility report and, above all, the demonstration of ECOTRACK with user data. If we take a closer look at these features, it becomes clear that most of the potential problems concerning the implementation of ECOTRACK can be resolved at feasibility study level, which speaks volumes about how beneficial this study could be to potential users, particularly since it would leave them with a clear base on which to work at the implementation stage.

The contents of the feasibility study report also show the usefulness of the information made available to the potential user:
- Organisational aspects
  - Current network situation report
  - Maintenance and renewal procedures
  - Decision base
  - Planning procedures
- Technical feasibility of data management
  - Existing data
  - Compliance with ECOTRACK tables
  - Conversion complexity
  - Decision rules
    * ECOTRACK rules
    * User-specific rules
    * Threshold values
- Financial aspects
  - Materials
  - Human resources
  - Range (maximum - minimum)
- Installation and operating requirements
  - Tasks
  - Task performers
  - Duration
- Recommendations
  - Variants of ECOTRACK implementation
    * Planning instrument
    * Controlling instrument
  - Variants of ECOTRACK database concept
    * Central database server
    * Synchronisation of local databases
    * Local databases

  } • Description • Advantages • Disadvantages • Conclusion • Proposal

Extending ECOTRACK

Already at the Lausanne seminar which marked the beginning of the implementation phase, some ideas emerged as regards possibilities for extending and broadening the capabilities of ECOTRACK. These included:
- Optimisation modules
  - Costs
  - Track availability
  - Equipment capacity
- Additional data and activities
  - Rail profile data
  - Rail grinding profiles
- Modules for other infrastructure components
  - EcoSwitch
  - EcoBridge
  - EcoCat(enary).

Subsequently some of these ideas were transformed into separate projects such as EcoBridge, which is in the running to become an EU project, while others are still pending (e.g. EcoSwitch and EcoCat). However the ideas that showed the greatest potential and proved the most feasible were those connected with optimisation. However, after investigation, it was concluded that these aspects could not be analysed separately but required joint consideration. This resulted in a new proposal being put to the User Group meeting in Brussels in October 1999 for developing a so-called joint Resource Optimisation Module that would cover all the different types of resources and address the problems of their complex relationships.

The resources considered were:

- Track Possession Periods (TPP), a counterpart of availability
- Machinery
- Manpower
- Materials
- Budget.

It was estimated that current railway maintenance management practices and decision-support systems like ECOTRACK lacked resource management methodology and the related aspect of work planning. So far work has been planned on the basis of the quality and age factors, which may be the most important but are not the only aspects. In other words, the ability and conditions regarding current performance of the types of work involved and, most of all the resources required and available, have not been taken into consideration. However, it is also a fact that the difference between the resources required and those available could present a very important constraint to the performance of the work planned and is a major parameter in any further adjustments to the work schedule.

Moreover, in the present railway environment hallmarked by an increase in traffic on many railways and the burning issue of reorganisation, i.e. separation of infrastructure from operations, the general view is that this kind of decision support:

- is even more necessary than ever,
- is feasible,
- can bring substantial savings.

This is why a systematic estimation of resource requirements was becoming an essential need for every infrastructure manager, and by introducing a resource allocation optimisation methodology, infrastructure managers would finally be provided with the information and tools they needed.

The ultimate goal, therefore, was the creation of a resource optimisation module, which could be defined as a type of consistency optimisation system, producing as output a work schedule to be optimised to achieve the best possible combination of all resources, while at the same time providing valuable information about resource requirements.

In addition to the main goal of a resource optimisation module, there would be a number of side deliverables that would also emerge from research on this topic. Any attempt to perform optimum resource allocation unavoidably leads to the problem of inadequate resources, which can be resolved, roughly speaking, in two ways:

- increasing the amount of the particular resource (enlarging the budget, buying/renting machines, employing/borrowing extra staff, etc.),
- rescheduling activities (postponing, advancing and/or combining).

This problem will, therefore, also have to be tackled as part of the research and will contribute further substantial added value to the methodology, since it is considered one of railway management's most serious difficulties. A trade-off will have to be found between the benefits of doing the work on schedule for technical reasons (even if it means stepping up certain resources for the purpose) and the consequences of rescheduling (usually postponing) certain work. This alone is a very complex problem which requires definition and quantification of the complex relations between performing and delaying work and the related benefits and consequences for the various players, e.g. society in general, users (passenger and freight), infrastructure managers, train operators, works contractors, etc., which have very different positions and roles, often even conflicting.

The other side deliverables are:

- An estimate of resource requirements
- An estimate of traffic disruptions
- A "what if" analysis to test different resource management policies
- An optimum work schedule
- A cost breakdown, the first prerequisite for true cost optimisation.

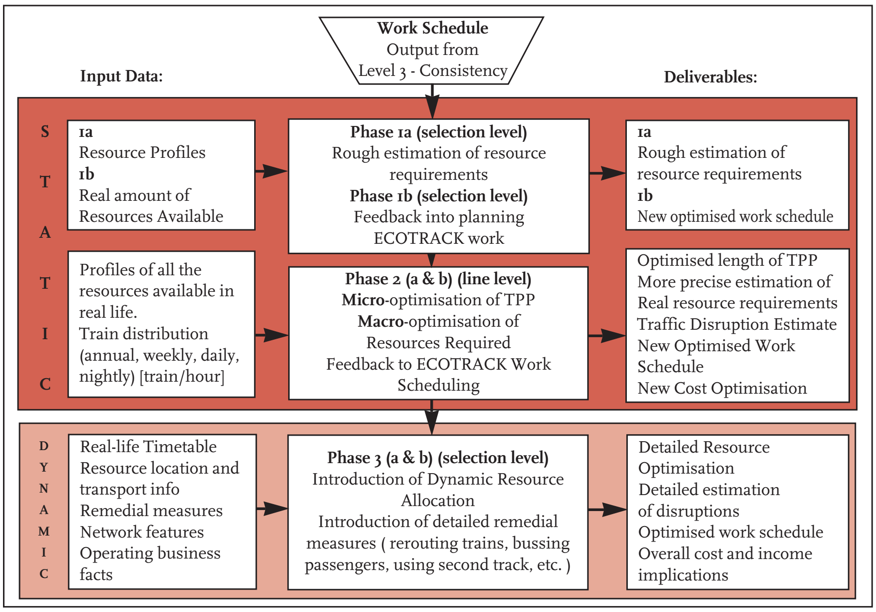
The starting position in the research will be an existing work schedule based on technical aspects. This also reflects the usual situation on the railways where work is proposed (usually by the regions) and the higher authorities are then supposed to approve and assign resources to it. It also tallies with the current maximum scope and capabilities of ECOTRACK.

It is intended that module development should be split into several phases (*Fig. 6*). This staged approach could be viewed in two ways:

- gradual need for new data
- gradual increase in the complexity of the model.

Each of the stages should, however, present major added value for the end users and, during implementation, each stage will have to be validated by the end users, who should then be allowed some time to accept, adjust and start feeling comfortable with this stage before being proposed the next. The same goes for the new data that end users may be required to collect. First of all, it is often necessary for some historical data to be provided, i.e. for data to be collected over a certain amount of time, so that it may be successfully used by the module. In that respect, end users would have to be informed and educated in due time regarding future data needs, with these requirements being thoroughly explained and justified so that users understand and agree to collect data at the appropriate moment, so they have the historical data they need in time for the implementation of the next phase.

Fig. 6 : Phased implementation of the resource optimisation module



Conclusion

From the two years of experience with implementing, using and upgrading ECOTRACK, it has been seen that the interest and trust that the railways, contractors and other potential users are showing and placing in ECOTRACK is growing. Thanks to the railways and contractors that have either decided to go ahead with the implementation of ECOTRACK on their own or have ordered the feasibility study to help them with this task, many of the original, hidden or potential problems have been discovered and resolved, piling up the experience and thus making it easier for new future users to follow suit.

With the new modules that are emerging ECOTRACK will become even more powerful, further facilitating the infrastructure manager's job and bringing larger overall savings.

Lastly, it should not be forgotten that railway track represents highly expensive engineering structures in any environment and thus even marginal improvements in maintenance management could bring huge absolute savings. And ECOTRACK offers much more than just marginal improvements.

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