



REPID

Project Introduction and First Results

A Framework and Tool for handling
Eco-design and environmental
requirements for new Rolling Stock

REPID Partners:





Table of Contents

1	EXECUTIVE SUMMARY	3
2	WHY THIS PROJECT?	4
3	PROJECT OVERVIEW	5
	EXPECTED RESULTS.....	5
	STRUCTURE OF THE WORK.....	6
	CO-OPERATION WITH THE PROSPER PROJECT	6
4	COMMON ENVIRONMENTAL LANGUAGE	7
	ECO-EFFICIENCY AND THE RELATION TO USE OF EPI'S.....	7
	STANDARDISED LISTS AND INFORMATION NEEDED TO SUPPORT DFE.....	8
	ACTUAL PROGRESS IN REPID.....	9
5	REPID DATABASE AND SOFTWARE SOLUTION	10
	WEB APPLICATION	10
	INTEGRATION WITH CAD/PDM SOFTWARE	11
6	REPID NETWORK AND LEGAL BODY	12
	THE REPID NETWORK.....	12
	A LEGAL BODY FOR REPID.....	12
7	THE REPID PROJECT	14
	PROJECT MANAGER	14
	STEERING GROUP	14
	REPID CONTACTS	14

ANNEX 1: LIST OF REPID INDICATORS

ANNEX 2: ECO-PROCUREMENT GLOSSARY



1 Executive Summary

Despite the general environmental advantages of rail there is a need for continuous environmental improvements and documentation of these efforts. In order to improve such parameters there is a need for a common environmental language to fully integrate environmental considerations into product development and procurement projects of rolling stock.

The REPID project has been launched as the natural follow up to the successful EU funded RAVEL project running from 1998 to 2001. The RAVEL project developed a framework methodology for handling Design for Environment (DFE) and a first web-based solution for environmental communication between the different railway stakeholders.

The two-year REPID project started 1st August 2002 with budget of 257.000 Euro funded by the European Commission. The objectives of the REPID project is to provide, based on the results of the RAVEL project:

- A **framework** with a **juridical body for dealing with standardisation** of Environmental Performance Indicators EPI and data formats within the railway industry
- A **tool for improving usability** of Environmental Performance Indicators EPI and data formats”

The REPID Network would be made alive in two ways, by hosting meetings for the network and by providing a web-site (<http://www.railway-procurement.org>). In order to make the REPID results come into practise, there is a need for a legal body within the framework of UIC and UNIFE to treat the aspects of standardised EPI's and material lists. Therefore a “REPID Board” is being launched at the network meeting.

One main building block in the project is the REPID methodology (coming from the RAVEL project) which set up a link between the concept of Eco-efficiency and environmental performance indicators (EPI's) for the railway industry. An initial set of indicators has been defined in the REPID project based on the policy of UNIFE and UIC and using results from the projects RAVEL and PROSPER. Also, there is a need for a standardised data format and material list.

The REPID methodology is supported by a database and a software solution. The database is the foundation of all functionality in the REPID system. A database model supports a structured management of design projects. These designs can be analysed and compared in order to generate reports and achieve environmental targets. A web interface and a CAD integrated software has been developed based on the RAVEL workbench tool, and will be the first generation of the REPID tool.

Looking ahead, there is a need for further co-operation and communication between all railway stakeholders to succeed in improving environmental performance of rolling stock in the entire life cycle. Here the relation with other ongoing projects, especially the UIC funded project PROSPER, is crucial.



2 Why this project?

In the last two decades the focus on environmental issues has gradually forced business in general to take initiatives to react to market requirements or public opinion. The most forward-looking industries have already taken on board the concept of “environment” and “sustainable development” into their long-term product development in order to improve not only the environment or their corporate social responsibility but also their competitiveness.

In the railway sector with its public service obligation and close links to national and regional governments, it is even more important to be able to respond to the political as well as the market requirements. Despite the general environmental advantages of rail there is a need for continuous environmental improvements and documentation of these efforts done in our business. The UIC funded project PROSPER will facilitate this improvement of environmental performance by making a guideline for environmental requirements to rolling stock.

In order to improve such environmental parameters that have not before been a fully integrated part neither of product development nor procurement project requirements, there is a need for a common environmental language. In this light, the REPID project has been launched as the natural follow up to the successful EU funded RAVEL project running from 1998 to 2001 (see below).

The RAVEL project developed a framework methodology for handling Design for Environment (DFE) and a first web-based solution for environmental communication between the different railway stakeholders. These results were so promising that the consortium was encouraged to launch REPID as a follow up project to let the results come into practise – for the benefit of the rail industry, society and the environment.

The RAVEL project in short

The RAVEL project with a budget of 3.3 million Euro was 50% funded by EU. The scope of the project was *“to develop a workbench consisting of a set of tools that enables the designer to improve the eco-efficiency during their entire life cycle by at least 25% (compared to older comparable products)”*.

RAVEL was developed by experts in Bombardier Transportation, SJ (Swedish Railways), DSB (Danish Railways), ABB (Sweden), Woodville Polymer Engineering along with universities partners (Chalmers, Sweden and KU Leuven, Belgium) and a consulting partner (GEP, Germany).

Today you are still able to obtain the remarkable results using this web-site link: <http://www.ravel-project.de>. Also the RAVEL final results have been published in a book by KU Leuven University Press “Integrating Eco-Efficiency in Rail Vehicle Design” edited by Wim Dewulf, Joost Duflou and Åsa Ander (ISBN 90-5867-176-3).



3 Project Overview

The REPID project started 1st August 2002 with a budget of 257.000 Euro funded entirely by the European Commission as an accompanying measure under “Industrial and Materials Technologies” in the FP5. It is a two-year project bringing the following partners together:

- UIC, International Union of Railways (www.uic.asso.fr)
- UNIFE, Union of European Railway Industries (www.unife.org)
- Chalmers University, IMI (Industrial Environmental Informatics) (www.imi.chalmers.se)
- SEMCON, Software developer, Sweden (www.SEMCON.se)
- Deutsche Bahn (www.bahn.de)
- Bombardier Transportation (www.transport.bombardier.com)
- Alstom Transportation (www.transport.alstom.com)

The project plan outlines the following objectives for REPID:

“The purpose of this project is to ensure that the EU funded RAVEL project results are made available to the European railway industry. The objectives of the REPID project is to provide, based on the results of the RAVEL project:

- A **framework** with a **juridical body for dealing with standardisation** of Environmental Performance Indicators EPI and data formats within the railway industry
- A **tool for improving usability** of Environmental Performance Indicators EPI and data formats”.

Expected results

The REPID project is planned to have delivered the following results by August 2004:

- Two Network Meetings (April 2003 and April 2004)
- REPID Methodology including Basic Training programme
- List of REPID environmental performance indicators and their definitions (First edition)
- Manual on REPID data management
- REPID Material database (First edition)
- Software solution including documentation (First edition)
- Strategy and business plan for the REPID framework, legal body and IT tool

Structure of the work

Due to the two main objectives the project partners are working on different levels: a) UIC and UNIFE for the network and dissemination part, b) IMI and SEMCON for the IT/Data part and c) Alstom, Bombardier, DB in a support and test function between the two levels. The roles of the different partners can be explained in a simple way in figure 1 below:

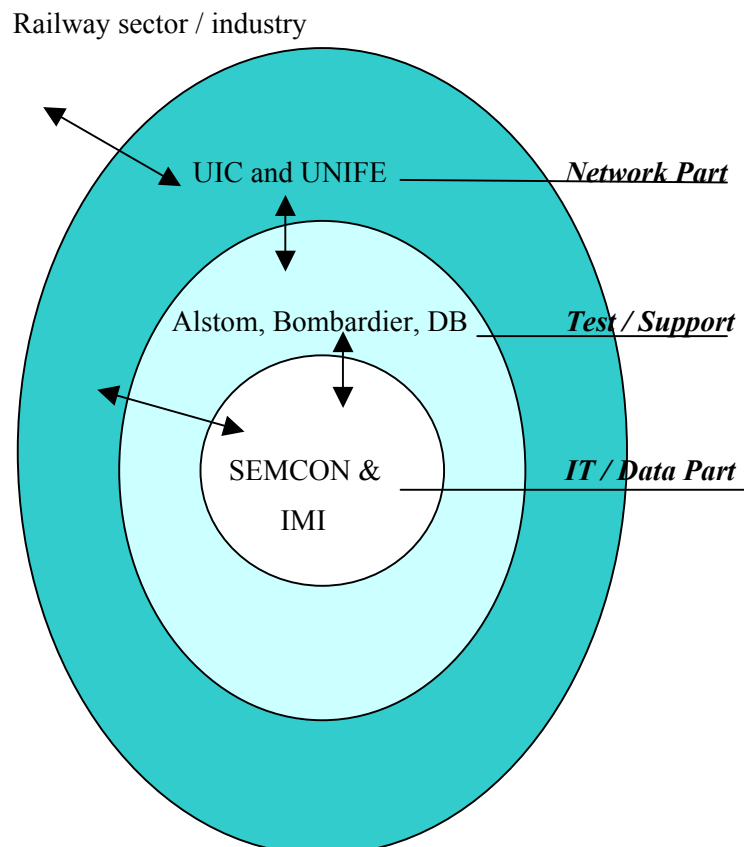


Figure 1. The REPID project is structured according to the objectives

Co-operation with the PROSPER project

In order to succeed with REPID it has been decided to have close co-operation with the UIC funded PROSPER project. This is natural since the target audience of the two projects are more or less the same and that useful user input from the operators are needed to form the REPID indicators. PROSPER will as a main result produce a UIC Environmental Procurement Guideline for rolling stock.

It is planned that the results of the REPID project are being disseminated to all relevant stakeholders in the railway industry. This means that the common language (the methodology), the indicators, the software, and the material database are handed over to UIC and UNIFE members for free. However, in order to implement the software in e.g. existing PDM systems an additional implementation cost has to be added. Later updates of the software, material lists, environmental database, indicators would be subject to agreements with UIC/UNIFE and/or simple market conditions.

4 Common Environmental language

The common environmental language in the railway industry will be provided by the REPID methodology, which is coming from the former EU funded RAVEL project. It is formed to support all companies involved in the complete supply chain of rail vehicles. The main principle of this methodology is the link between the concept of Eco-efficiency and environmental performance indicators (EPI's) for the railway industry. In this way a certain rolling stock would have a number of indicators describing the environmental performance for the entire life cycle as shown in Figure 2. The definition of "baseline" and "target" is not a part of the REPID project; this would be investigated further in the PROSPER phase II project.

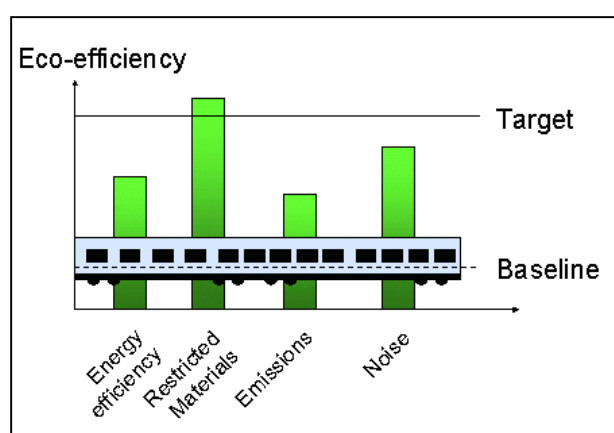


Figure 2, Relation between Eco-efficiency and environmental performance indicators (EPI's). An arbitrary baseline as well as target value are indicated

To enable a common environmental language there is a need for a set of common environmental performance indicators, standardised data format and material list. An initial set of indicators has been defined in the REPID project based on the policy of UNIFE and UIC and using results from the projects RAVEL and PROSPER.

Eco-efficiency and the relation to use of EPI's

The concept of Eco-efficiency has been established during the last decade in parallel or as a part of the concept of sustainable development. Eco-efficient design demands operative and efficient tools as well as quantitative performance measures and goals. The concept of Eco-efficiency can be used to develop tools for quantitative measurement of the progress towards sustainable development. Eco-efficiency of a product or service can be defined as its combined economical and ecological efficiency.

The following definition of Eco-efficiency has been widely referenced:

“Eco-efficiency is reached by the delivery of competitive-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing impacts and resource intensity throughout the life-cycle, to a level at least in line with the earth's carrying capacity.” World Business Council of Sustainable Development, Eco-efficient leadership, WBCSD, Geneva, Switzerland, 1996



To make this formulation operational, RAVEL established a set of environmental performance indicators (EPI's) to link the impacts a product have on the environment with measurable business activities.

The REPID project has refined these indicators based also on the PROSPER project (see annex page 13). The REPID indicators' properties:

- It is important that the indicators are relevant and describe the environmental performance (the Eco-efficiency) of a product design.
- An indicator need to have a meaning to everyone it concerns.
- An indicator is defined by a description and an algorithm, showing how the calculation is performed.
- They should be practically usable to control for example a design project.
- The calculation of the main part of the REPID indicators is based on environmental properties of the materials used in the train.
- The EPI's are based on the international standard ISO 14031.

All parties in the supply chain; suppliers, sub-suppliers, manufacturers of rail vehicle and railway operators would benefit from having their policy expressed in the terms of the same set of indicators. Furthermore this will facilitate linking environmental considerations to tender, design and purchasing. Indicators can be clustered in different impact categories, e.g. human health and global warming.

Standardised lists and information needed to support DFE

REPID indicators are designed for providing information about the environmental performance of a train. The indicators can be divided into three groups following the life cycle phases of a train:

- Production phase – emissions and waste from the production process including extraction of raw materials etc.
- Operation – the train vehicles environmental impact during operation
- End of life phase – recycling, emissions, waste management etc.

Generally, EPI's are used for the comparison of environmental impact. This comparison takes place at different levels of a rail vehicle: complete train, car, subsystems and component level. However, every component in a train has different values of the indicators because of the different materials used. Therefore the environmental performance of all components has to be handled separately. These values can then be aggregated to obtain the environmental performance of a whole train.

Since a train contains a great amount of components and an even greater amount of materials there is a huge amount of information needed to analyse the environmental performance of a rail vehicle. To facilitate the handle of this information the REPID project has been asked to propose a material list to be used together with the defined indicators. Through a systematic procedure and data management process this material list and material property definitions have been developed within the project. The material property data needed for the calculations have also been acquired in accordance with a data management process including documentation, review and quality assessment.



The agreement on a set of EPI's, a practically useful material list and an open data format (XML) for data exchange are highly important for the success of the REPID project. The standardisation of EPI's and data format within the railway industry is a prerequisite to achieve meaningful and comparable measurement and communication of environmental performance.

Actual Progress in REPID

Based on the policy of UIC and UNIFE and using results from the projects RAVEL and PROSPER, a set of indicators has been defined in the REPID project. IMI has refined these definitions and included procedures that can be used for calculation of the indicators in the database.

The calculations of the Environmental Performance Indicators require a standardised material list. In the REPID project an agreement has been achieved on a material list prepared by IMI in co-operation with UIC, UNIFE and other stakeholders

The material list would have to be adopted by all users of the REPID methodology, therefore the structure and content of the list have been developed carefully. Documentation on the material list has been developed to facilitate the communication.

Chalmers IMI has refined the database model from the RAVEL project, and also created a report describing the information platform. The complete data model has been translated into XML, which is very useful for communication of data. A test database has been created for use by SEMCON during their development of the application. Additionally, a test data set that shall be used for verification of the indicator calculations performed by the SEMCON application has been compiled.

5 REPID Database and Software solution

The REPID methodology is supported by a database and a software solution. The database is the foundation of all functionality in the REPID system. Chalmers IMI has refined the database model from the RAVEL project. The model supports a structured management of design projects. These designs can be analysed and compared in order to generate reports and achieve environmental targets.

SEMCON has developed a web interface that will be used for the creation and input of product structures and materials, to create designs for analysis and to generate reports. The interface is based on the RAVEL workbench tool, and will be the first generation of the REPID tool.

SEMCON will develop a structure for formatting data from product data management systems. This will facilitate the import of product structures and material information into the database for analysis. The standard will also make it possible to generate reports and extract data from the tool into other systems. The first step will be integration with CAD software (Catia V5) to show the possibilities of the application.

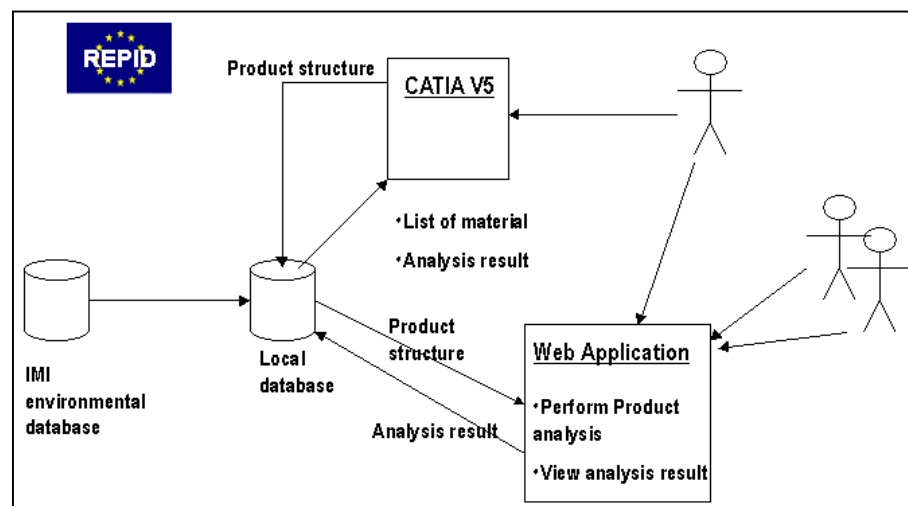


Figure 3, Structure for the REPID IT tool and Database

As can be seen from figure 3, there is basically two types of users. The web application is mainly to be used by railway operators and sub-suppliers and the CAD/PDM tool is mainly to be used by manufacturers. However, other stakeholders could be using the web application as well if they are granted access e.g. to specific rolling stock projects.

Web application

The web application is appropriate for users that are feeding data into the project/product or taking data out to analyse and evaluate. The purpose of the web application is therefore to:

- Handle different designs of a product through projects (ITT)
- Calculate design scores (evaluating tenders)



- Handle material database
- Show information about materials
- Generate reports on calculations

SEMCON has based the web application on the RAVEL workbench application as a starting point of the work.

Integration with CAD/PDM software

For the manufacturers a CAD (Computer Aided Design) or PDM (Product Data Management) tool would be the appropriate solution to handle the environmental information in the design and project phases.

It has been intensively discussed in the REPID project which type of software would be most appropriate to do the integration on. Since PDM (Product Data Management) systems are more widespread used among manufacturers, it could be logic to make an integration into such system.

The problem is that such systems are very complex and always tailor-made to each company. This would mean that REPID should make innumerable solutions to serve all. It would not make sense to make a REPID version custom-made to only one industrial partner.

Therefore a solution with a specific CAD system (Catia V5) has been chosen as the reference from which each industrial partner can choose to make its own implementation. The purpose of the CatiaV5 integration is to:

- Export product structures and material information to the REPID database and the REPID web application.
- Enable the engineer to import and view information about the materials in the REPID database (participation in the DFE process).
- Enable the engineer to view and update information about the Part/Product under construction – such as structure, materials, design scores i.e.



6 REPID Network and legal body

The REPID Network

The REPID Network would be made alive in two ways, by hosting meetings for the network and by providing a web-site (<http://www.railway-procurement.org>). UIC and UNIFE have now made these two functions available. A functioning network is a condition for a successful dissemination. The user group within the network consists of:

- Organisations within the rail sector (Suppliers, manufacturers of rolling stock, owners and operators of trains, refurbishment companies)
- Consultants and authorities acting as Independent assessors for environmental standardisation
- Juridical/legal body for managing standardisation of data formats and EPI
- Neutral expert group specialised in the field of Industrial Environmental Informatics

A legal body for REPID

In order to make the REPID results work in reality, there is a need for a legal body to treat the aspects of standardised EPI's and material lists. This work is not done by other parties in or outside the railway sector. The constitution of a legal body should therefore be done within the framework of the two main railway and rail industry organisations: UIC and UNIFE. This would ensure that there is a neutral ground for the sector to act in this matter and it should put the results for the members in focus.

The legal link to UIC and UNIFE could be handled by appointing one of the organisations as the host organisation. Since UIC already host a similar body (for the MERITS project concerning international electronic ticketing system), it is proposed that UIC host this legal body. The constitution of the legal body will take place by forming a **“Railway Board for DFE & Environmental Procurement Information”**, in daily speaking simply the **“REPID Board”**.

The members in this group should be managers or high level specialists in one of the following areas: technical railway systems, procurement of railway systems, energy-, noise-, or environmental issues, legal aspects or standardisation.

Members of the REPID Board

Members of the **REPID Board** should mainly come from UIC and UNIFE members with the background as described above. The following constitution of the legal body is foreseen, 11-15 members of which:

- One is from UIC Headquarters
- One is from UNIFE Headquarters
- 1-2 are external specialists with links to international standardisation and industrial environmental information.



The members of the REPID Board should initially be appointed by the first REPID Network meeting taking place in April 2003. The network meetings should approve later changes. UIC and UNIFE alternating appoint the chairman for a limited period.

Role and tasks of the REPID Board

It is the role and responsibility of the board to serve and advise the UIC and UNIFE members with the needed decisions within the area described in the “Terms of Reference for the board”.

In order to do so it is proposed to meet regularly 1-2 times a year correlated with the yearly REPID Network meetings.

The Terms of Reference covers a wide variety of activity and this list is only a first draft that should not limit the scope of future activities. The REPID Board should based on evaluation of proper information from the REPID Network meetings, ongoing relevant railway projects, with relation to the research taking place at UIC and at UNIFE have the following tasks:

- Decide on the official railway list of Environmental Performance Indicators
- Approve definitions of each Environmental Performance Indicators
- Approve an official railway material list (including restricted and forbidden materials)
- Issue to appropriate existing bodies standardisation proposals concerning the above mentioned lists and indicators.
- Decide on how to communicate with other user groups / industry sectors
- Create and maintain the link to IEI (Industrial Environmental Informatics) institutions and providers
- Create and maintain the link to appropriate standardisation institutions (like AEIF, CEN, ISO, etc.)
- Handle the long-term hand-over of its tasks to such appropriate standardisation institutions if deemed necessary or useful by the REPID Network.

These tasks should thus be the legal confirmation of decisions taken in the REPID Network. The legal status of such decisions taken by the REPID Board must be investigated further.

Links from the legal body to outside bodies

The REPID Board should have a formal relation to the UIC Commission for technique and Research (CTR). This would ensure that the REPID Board could issue proposals for a UIC technical leaflet (e.g. concerning EPI's) directly to UIC CTR in a conformable way.

The REPID Board should have a formal relation to the AEIF. This would ensure that the REPID Board could issue proposals for procurement formats in a conformable way that would be used European wide.

The REPID Board should also have a formal relation to the CEN and ISO organisation. This would ensure that standards elaborated within CEN and ISO could be checked for conformity with the REPID lists and indicators and vice versa.



7 The REPID Project

Project Manager

Mads Bergendorff, environmental advisor of UIC, is the project manager for REPID and the contact point for the European Commission.

Steering Group

A steering group for REPID has been set up to support the work on a management level. The group consists of the following members:

- Susana Martins, UNIFE
- Michael Schemmer, UNIFE (Bombardier)
- Lars Johansson, Chairman of UIC WG Environment (Banverket)
- Gunther Ellwanger, Director UIC Economics, Finance and Environment
- Hans Kling, SEMCON
- Raul Carlsson, IMI, Chalmers University
- Mads Bergendorff, UIC HQ (project manager)

The steering group will meet regularly, next meeting is 3/4 in Paris after the network meeting.

REPID Contacts

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Annex 1:

List of REPID indicators and short definitions

The REPID Environmental Performance Indicators (EPI's) are based on the indicators developed in the RAVEL project.

The EPIs are based on the international standard ISO 14031.

Indicator name	Definition	Group
Amount of forbidden materials	Monitor the amount of prohibited materials in the vehicle.	Production
Amount of restricted materials	Monitor the amount of restricted materials in the vehicle.	
Materials inventory degree	Monitor the degree of declaration of materials in a vehicle.	
Total vehicle mass	Monitor the total weight of the vehicle	
Cradle to gate LCA index	Monitor the environmental impact of materials in the vehicle from a cradle to gate LCA point of view.	
Fraction renewable	Monitor the weight/fraction of renewable materials in the vehicle	
Total number of material	Monitor the total number of materials, according to the REPID material list, in a product.	
Fraction recycled (materials)	Monitor the weight fraction of recycled materials in the vehicle.	
Suppliers with EMS	The fraction of suppliers with EMS, environmental management systems, is calculated.	
Secondary energy use	Monitor the secondary energy use by auxiliaries.	Operation
Total energy use	Monitor life time energy use	
Emissions from wear	The aim of this indicator is to monitor the particulate emissions from wear. These particulate emissions can be harmful to the environment near the roadbed.	
Emissions from diesel vehicles	Monitor emissions from diesel vehicles in compliance with regulations.	
Spare parts and consumables	Check weight/material (if restricted) content of spare parts and consumables.	
Noise	Monitor noise emissions from vehicles in compliance with regulations.	
Electromagnetic fields	Monitor compliance with regulations in different types of electromagnetic fields in the train.	
Marking of selected materials groups	Monitor the marking of polymers in the vehicle. This marking will help the material recycling.	End of life
Existence of product environmental management support	Monitor the availability of different manuals.	
Material recycling rate	Monitor the fraction of materials that can be material recycled.	
Can be incinerated with energy recovery	Monitor the amount of material that can be incinerated with energy recovery.	
Potential amount of hazardous waste	Monitor the amount of potential hazardous waste.	

Table 1, list of REPID Indicators



Annex 2: Eco-Procurement Glossary

CO	Carbon Monoxide (exhaust emission from e.g. diesel engines)
CO ₂	Carbon Dioxide (exhaust emission from e.g. diesel engines)
dB(A)	Decibel (A), measuring unit of noise, additional conditions need to be applied like Max or average value, L _{DEN} (day, evening, night, etc.)
DFE	Design for Environment
EPI	Environmental Performance Indicator (defined in ISO 14031)
HC	Hydro carbons (exhaust emission from e.g. diesel engines)
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IPP	Integrated Product Policy
ITT	Invitation to Tender
K-value	The scientific value for the insulation ability of a material
LCA	Life Cycle Assessment, environmental assessment of a product or a production system
LCC	Life Cycle Costs, economic assessment of a product or a production system
NO _x ,	Nitrogen oxides (exhaust emission from e.g. diesel engines)
PM	Particulate matter (particle emission from e.g. diesel engines)
PROSPER	Acronym for “ <u>P</u> rocedures for <u>R</u> olling <u>S</u> tock <u>P</u> rocurement with <u>E</u> nvironmental <u>R</u> equirements”, UIC funded project
REPID	Acronym for “ <u>R</u> ail sector framework and tools for standardising and improving usability of <u>E</u> nvironmental <u>P</u> erformance <u>I</u> ndicators and <u>D</u> ata formats”, EU funded project
SO ₂	Sulphur dioxide (exhaust emission from e.g. diesel engines)
TSI	Technical Specification on Interoperability
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
XML	IT software language