# The sustainable freight railway: Designing the freight vehicle – track system for higher delivered tonnage with improved availability at reduced cost

# SUSTRAIL

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## D1.3

## OVERVIEW OF COMMON FREIGHT WAGON VEHICLES AND ECONOMIC DATA

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# Executive Summary

One of the key objectives of Work Package 1 is to benchmark the existing rolling stock in operation on the selected routes and countries. For this purpose, Task 1.3 Rolling Stock aimed to collect specific technical and economic data and analyse the existing solutions considering the perspectives of different partner organisations (infrastructure managers, operator, rail authority and manufacturer). Considering the nature of the information to be collected, the work was organised in three specific sub-tasks, respectively:

- Sub-task 1.3.1 Overview of vehicles in operation;
- Sub-task 1.3.2 Detailed overview of common freight wagon vehicles;
- Sub-task 1.3.3 Data collection for economic assessment of common freight wagon vehicles.

The collection of European freight vehicle data from the countries of partner organisations was organised into three stages using specific forms which were designed in consultation with representatives from the other SUSTRAIL work packages.

Section 2, ***Methodology and Tools***, presents the specific activities which had to be carried out in each sub-task. Aspects such as sources of information to be used, selection criteria and stages of data collection are detailed for each sub-task.

Section 3, ***Overview of Vehicles in Operation***, details the objectives, activities and results of Sub-task 1.3.1. Sub-task 1.3.1 is to gather general vehicles characteristics that would enable SUSTRAIL to ensure that any technical solutions from the wide range of possible freight vehicles in selected case studies countries were taken into consideration. The first form, which was to be completed for this report, aimed to record summary data on the range of representative vehicles that are used in the participant countries which should be taken into account in the development of the future SUSTRAIL vehicle. This included both locomotives and freight wagons which are most commonly used in service today and those that are most likely to be in service over the next 10-20 years.

Section 4, ***Detailed Overview of Common Freight Wagon Vehicles,*** presents the second form, intended for completion at this stage (Sub-task 1.3.2), for gathering more detailed data for selected representative freight wagons. SUSTRAIL partners were requested to select the most representative types of wagons from the list provided in the previous stage, and to fill up the form with various technical specifications of wagons and their components. Some general economic data were also included in this form.

As result of Sub-tasks 1.3.1 and 1.3.2, a database of representative freight vehicles and a summary of their characteristics has been developed which will enable the SUSTRAIL team responsible for developing the novel vehicle to select the most representative vehicles in operation and the main priorities. However, it was found that the gathering of more detailed data and the wagon models required will present difficulties due to commercial sensitivities or a lack of adequate data in some instances.

Section 5, ***Data Collection for Economic Assessment,*** details the approaches which will be mainly used for the economic assessment to be carried out in WP 5, respectively Life Cycle Costing (LCC) and Reliability, Availability, Maintainability and Safety (RAMS). A specific form was developed and used to collect information on the availability and ownership of such LCC and RAMS data related to the freight rolling stock. This information will be the basis for the collection of specific parameters to be used for the economic assessment in WP 5.

The final section, ***Conclusions and Future Work,*** summarises the most relevant findings arising from the analysis of the captured data, and suggests some directions to complete and accomplish Task 1.3 by the end of Work Package 1.

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# 1. INTRODUCTION

The objective of Work Package 1 is to provide a benchmark of the current freight 'system' to establish the existing 'zero state' for subsequent comparative and enhancement activities. The benchmark is designed to provide information to support evaluation of the key system parameters which will ultimately influence and determine improvements towards freight sustainability and competitiveness.

Task 1.3 Rolling Stock has to gather and deliver details of specific rolling stock operating on the routes selected as case studies within SUSTRAIL project. This involves provision of information regarding representative locomotives and freight wagons. The collection of rolling stock data was planned in three stages using different forms which were designed in consultation with representatives of the other work packages.

The main subject of this report is the gathering of general, technical and economic data of representative vehicles from the organisations of partner countries. The forms had to be completed by the partner organisations with activities connected to selected routes, which were requested to provide as much of the required data as possible. These data have to enable the SUSTRAIL partners working on vehicles to identify a selection of representative freight wagons to be further discussed and analysed by the other work packages.

Considering the three dimensions of sustainability for rail vehicles (environmental, social and economic), the benchmarking of existing rolling stock has to take into account a large diversity of specifications and parameters characterising different aspects, such as:

- Performance (technical specifications on components, dimensions, mass, speed, accelerations, etc.);
- Exploitation (volume, tare, capacity, loading/unloading, types of freight, energy costs, availability of procurement, etc.);
- Environmental issues (noise, gas emissions, recycling, etc.);
- Reliability and maintainability (maintenance costs and times, failures, availability of technical solutions, etc.).

For these purposes, the task was structured on three individual sub-tasks, with different objectives, both of technical and economic nature. The methodology developed and used to collect data and the main outcomes are presented in the next sections.

# 2. METHODOLOGY AND TOOLS

## 2.1 Sources of information

Specific data regarding the rolling stock in operation on SUSTRAIL selected routes and other connected routes in these regions have to be collected from the project partners. The information provided should be the result of SUSTRAIL partners' knowledge and expertise according to their activities related to this topic.

Considering the selected routes and the project structure, data on rolling stock have been collected from ***6 partners***, active in different domains in ***4 countries***, i.e.:

**I. Infrastructure managers:**

- NR (Network Rail, UK)
- ADIF (Administrator of Railway Infrastructures, Spain)
- NRIC (National railway infrastructure company, Bulgaria)

**II. Operator:**

- BDZEAD (Bulgarian State Railways, Bulgaria)

**III. Railway authority:**

- AFER (Romanian Railway Authority, Romania)

**IV. Manufacturer (maintenance)**

- SIRV (CFR SIRV Brasov, Romania)

The possibility of collecting data from other representative European stakeholders was also considered and discussed at the beginning of the project. Although such input may have been beneficial to the project, offering a larger database for benchmarking and validating the available information on selected routes/countries, involving other external organisations would have required the allocation of supplementary project resources (in terms of effort and/or funding) which were not available.

Although information on a comprehensive range of freight vehicles and locomotives was obtained, some of the partners above were not able to provide certain categories of data due to the limitations of their expertise and activities (e.g., SIRV could not provide data on locomotives as they do not manufacture/repair such vehicles; NRIC has not provided an overview of vehicles used by all operators on their route(s); AFER and SIRV were not expected to deliver economic data). However, it is expected that this will not affect the project progress adversely.

## 2.2 Collection of data

The collection of rolling stock data was carried out in ***three stages***, using ***specific forms*** which were developed in consultation with partners from other work packages. The forms were designed taking into account the description and requirements of Sub-tasks 1.3.1-1.3.3.

Based on input received from project partners, ***two sets of forms*** were developed within Sub-tasks 1.3.1 and 1.3.2 of the project to collect the specific information from the responsible partners mentioned above, respectively:

- ✓ *Sub-task 1.3.1 Overview of vehicles in operation* – the set included 2 forms/templates considering the main technical characteristics and specifications and some general economic information on: A. Locomotives; B. Wagons.

- ✓ *Sub-task 1.3.2 Detailed overview of common freight wagon vehicles* – a detailed form/template including specific technical details of selected freight wagons and their main sub-systems and components.

The forms used to collect information are presented in **ANNEX 1. Templates for Data Collection**. In order to provide a user-friendly interface, accessible and easy to fill in, the forms include, where possible, facilities such as drop-down menus (to allow multiple choices), explanatory comments and notes. The characteristics and specifications were required in ***standard format*** (as regulated by EN, TSI, UIC or national standards) to ensure compatible data. The standard specifications or the regulation to be used are indicated in the forms, either within drop-down menus or as comments.

The forms were circulated to all partners responsible to provide data, and their input was collected, summarised and analysed.

In *Sub-task 1.3.3 Data collection for economic assessment of common freight wagon vehicles,* the focus is on the availability and ownership of freight rolling stock data related to LCC and RAMS for each of the three case study routes, data which will be needed for economic assessments in later work packages (mainly WP5). Specific forms (questionnaires) were developed and circulated to infrastructure manager partners.

## 2.3 Selection criteria

Considering the large diversity of freight vehicles, the partner organisations to provide information were recommended to select the representative locomotives and wagons based on the following ***main criteria***:

I. ***Utilisation*** of different classes/types of vehicle in the past 10-20 years. This criterion should be the essential one to select the most representative types of vehicles, from different classes, to be included in Form 1.3.1 *Overview of vehicles in operation*.

II. The ***actual trends of market demand*** in terms of:

   a. Types of freight and services on railways;

   b. Wagons (classes/types) to supply the gaps in certain types of freight (not necessarily those with the highest utilisation – Criterion I).

The second criterion should be the essential one (without neglecting Criterion I) for producing the shortlist of the most representative wagons to be included in Form 1.3.2 *Detailed overview of common freight wagon vehicles.* Finally, the economic data have to be collected just for the same shortlist of the most representative freight wagons, as selected by the partner organisations.

# 3. OVERVIEW OF VEHICLES IN OPERATION

The first form, dedicated to *Sub-task 1.3.1 Overview of vehicles in operation*, included two spreadsheets to gather data on:

A. Locomotives;

B. Wagons.

The study on freight wagons has been developed and detailed further within Sub-task 1.3.2. Considering also that the analysis of locomotives, as part of the freight transport system to be developed within SUSTRAIL project, is limited to WP1, and will not continue in later work packages, more consistent information was needed to finalise this topic within WP1. For these reasons, the spreadsheet on locomotives is more comprehensive and detailed in this first form.

Where applicable, data were requested in standard format, according to the regulations in force. The main specifications and characteristics to be captured in Form 1.3.1 *Overview of vehicles in operation* are presented below.

Partner organisations have provided inputs consisting of between 3-11 entries in spreadsheet "A. Locomotives" and between 11-30 entries in spreadsheet "B. Wagons". All data were summarised and are presented in **ANNEX 2. Summary of Representative Locomotives** and **ANNEX 3. Summary of Representative Freight Wagons**).

The database is to be periodically reviewed and updated by all responsible partners until the finalisation of WP 1. The outcome will feed into WP2 and WP3.

## 3.1 Locomotives

- **General description**
  - ✓ Model / Class:
    - National and/or European (as used by builder);
    - UIC identification marking (according UIC 438-3 - Identification marking for tractive stock);
  - ✓ Fabrication Years;
  - ✓ Builder (name, country);
- **Technical characteristics**
  - ✓ Motive power type;
  - ✓ Type of:
    - Electric current (electric locomotives);
    - Power transmission (diesel locomotives);
  - ✓ Axle arrangement (acc. UIC 650 – Standard designation of axle arrangement on locomotives and multiple-unit sets classification);
  - ✓ Power;
  - ✓ Maximum speed;
  - ✓ Weight;
  - ✓ Starting tractive effort;
  - ✓ Fuel tank volume;
  - ✓ Bogies' type;
  - ✓ Braking system;

- **General economic data:**
  - ✓ Indicative price;
  - ✓ Number of locomotives in operation (average/national level);
  - ✓ Utilisation /goods moved/year;
  - ✓ Operational costs;
  - ✓ Lifetime;
  - ✓ Maintenance interval;
  - ✓ Average yearly maintenance costs;
- **Emission limits:**
  - ✓ Noise (compliance to TSI CR Noise);
  - ✓ Exhaust gases (acc. EC Directives on emissions from non-road vehicles).

## 3.2 Wagons

- **General description**
  - ✓ Model / Type:
    - National and/or European (as used by builder);
    - UIC identification marking (acc. UIC 438-2 - Identification marking for freight rolling stock);
  - ✓ Class (acc. UIC 571-1, 2, 3, 4 – Classification of goods wagons);
  - ✓ Builder (name, country);
- **Technical characteristics**
  - ✓ Track gauge;
  - ✓ Wheel diameter;
  - ✓ Number of axles;
  - ✓ Length over buffers;
  - ✓ Tare weight;
  - ✓ Loading capacity;
  - ✓ Exploitable capacity:
    - Floor area;
    - Volumetric capacity;
  - ✓ Bogies' type;
  - ✓ Braking system;
- **General economic data:**
  - ✓ Indicative price;
  - ✓ Utilisation /goods moved/year;
  - ✓ Lifetime.

# 4. DETAILED OVERVIEW OF COMMON FREIGHT WAGON VEHICLES

The second form, dedicated to *Sub-task 1.3.2 Detailed overview of common freight wagon vehicles*, aimed to collect detailed information on selected wagons, respectively the most common classes/types with a relevant market demand as well (as required by the selection criteria).

The form was designed to capture both the main characteristics of the wagon, as a whole, and the technical specifications of the most important sub-systems and components. To ensure the complete description of selected wagons, some of the specifications included within the previous form had to be repeated within this more comprehensive template. The main specifications and characteristics to be captured in Form 1.3.2 *Detailed overview of common freight wagon vehicles* are presented below.

Network Rail (NR) has provided a shortlist consisting of six types of freight wagons belonging to four classes. The details are presented in the summary in **ANNEX 4. Detailed Characteristics of Selected Freight Wagons**.

The collection of detailed wagon data is to continue until the end of Work Package 1. The final results are to be collated and analysed mainly by the operator organisation (BDZEAD).

## 4.1 General wagon characteristics

- ***General description***
  - ✓ Model / Type:
    - National and/or European (as used by builder);
    - UIC identification marking (acc. UIC 438-2 – Identification marking for freight rolling stock);
  - ✓ Class (acc. UIC 571-1, 2, 3, 4 – Classification of goods wagons);
  - ✓ Builder (name, country);
  - ✓ Type of freight;
- ***Wagon's technical characteristics***
  - ✓ Track gauge;
  - ✓ Wheel diameter;
  - ✓ Number of axles;
  - ✓ Length over buffers;
  - ✓ Distance between bogie pivots;
  - ✓ Height of the floor from the track;
  - ✓ Tare weight;
  - ✓ Loading capacity;
  - ✓ Max. axle load;
- ***Exploitation specifications***
  - ✓ Exploitable capacity (as applicable):
    - Floor area;
    - Loading width;
    - Loading length;
    - Loading height;

- Volumetric capacity;

✓ Maximum speed (empty / max. load);
✓ Minimum curve radius;
✓ Special characteristics/facilities;

## 4.2 Specifications of main sub-systems and components

- ***Bogie***
  - ✓ Type of bogie;
  - ✓ Weight;
  - ✓ Dimensions (width / length);
  - ✓ Wheelbase/bogie axle base;
  - ✓ Height of the bogie pivot centre above the top of rail at a wagon tare of 20 t;
  - ✓ Suspension;
- ***Wheelsets***
  - ✓ Nominal wheel diameter;
  - ✓ Type of wheels;
- ***Axleboxes***
  - ✓ Model;
  - ✓ Axle bearing;
- ***Braking system***
  - ✓ Model;
  - ✓ Type;
  - ✓ Material;
- ***Body*** (relevant details: types, material, load/unload, etc.)
- ***Body to bogie connection*** (details on technical solution)
- ***Noise reduction measures*** (details on technical solutions, if any).

# 5. DATA COLLECTION FOR ECONOMIC ASSESSMENT

A key element of the overall assessment of novel SUSTRAIL vehicles is the assessment of their economic impacts. This will require comparative economic assessment of both existing and novel vehicles, most especially for the most common types of freight vehicles.

SUSTRAIL will conduct these analyses in Work Package 5 using a variety of relevant approaches, most particularly the ***Life Cycle Costing (LCC)*** approach and assessment of ***Reliability, Availability, Maintainability and Safety (RAMS)***, but also a comprehensive ***economic evaluation*** which will take into account impacts of the innovation on key stakeholder groups. LCC and RAMS analyses need to take into consideration impacts throughout the entire life cycle of the developed system 'from cradle to grave' (i.e., from conception and design, through manufacturing, testing and operation until end-of-life, disposal or recycling). Due to the complexity of the rail sector and its major economic and strategic importance, essential concepts and methods for RAMS have been defined, agreed and catalogued within the **EN 50126-1:1999 standard** *"Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)"*. This standard provides the framework within which SUSTRAIL will work. In the current context, RAMS analysis must use relevant data relating to rolling stock, including data on whole system effects, this data relating to three distinct levels:

- System level (locomotive, wagon)
- Sub-system level (bogie, braking system, body, engine, etc.)
- Component level (frame, wheels, brake threads, springs, etc.)

Available RAMS and LCC data need to be collected for various items specific to rolling stock and systems that will be selected for development within SUSTRAIL:

- Reliability:
  - ✓ Mean Time Between Failure (MTBF) for corrective maintenance
  - ✓ Mean Time Between Maintenance (MTBM) for preventive maintenance
  - ✓ Failures (types, frequency, etc.)
- Availability:
  - ✓ Delays due to failures/maintenance
  - ✓ Alternative available solutions during failures/maintenances
- Maintainability:
  - ✓ Mean Time to Repair (MTTR)
  - ✓ Mean Down Time (MDT)
  - ✓ Mean Maintenance Hour (MMH)
- Safety:
  - ✓ Hazard Rate
  - ✓ Number of incidents/accidents.

Cost elements that need to be considered at a detailed level include elements such as labour costs and unit prices for spare parts. Such data facilitates detailed primary economic analysis of the most representative freight wagons in use, or proposed for use, on the railways of the partner organisations.

Infrastructure partners were asked to investigate and determine data ownership and availability, and to complete spreadsheets providing as much detail as possible in these respects for their own country. The responses are encouraging, in that they identify that much of the data that will be required for LCC, RAMS and economic analysis is held by a relevant

organisation in the rail industry, or else that sufficient information will be available to build up some form of modelled cost estimate for the parameters that will be required. The precise location of data varies and, as might be expected, is particularly widely dispersed in countries such as the UK where vertical separation of the rail industry is more advanced. In some instances, data may be held by more than one organisation. Where the infrastructure organisation itself does not hold the data, it is not always clear at this stage how much detail and disaggregation of data can be obtained, and further investigation into this will be required.

Table 5.1 provides an overview of ***availability and ownership of data*** relating to specific freight rolling stock (e.g., wagons, locomotives) relevant to LCC, RAMS and economic appraisal in the three case study countries under investigation.

The identification of the available relevant LCC and RAMS parameters to be collected and the development of specific forms for freight rolling stock will continue until the end of Work Package 1, and will liaise with Work Packages 2 and 5.

**Note:** For wagons and locomotives, the data requested included unit price, operating life, utilisation, maintenance intervals and costs, and emissions rates – see the data templates in Annex 1. Only an incomplete set of data was returned (Annex 2, final columns shaded) highlighting the gaps in the initially available data and the need to focus on specific vehicles and systems.

**CODES**

Y Infrastructure Organisation has the data;
T Infrastructure Organisation advises that train operating companies possess the data;
M Infrastructure Organisation advises that train operating companies may have the data;
O Infrastructure Organisation advises that another organisation possesses the data;
P Infrastructure Organisation advises that another organisation may have the data;
X Infrastructure Organisation understands that the data does not exist;
U unknown / not ascertained to date;
V more than one organisation holds relevant data;

Suffix /I indicates that whilst some data exists, it may be incomplete.

**Table 5.1** Overview of availability and ownership of freight rolling stock data

| **ROLLING STOCK DATA** | | **BULGARIA** | **SPAIN** | **UK** |
|---|---|---|---|---|
| **Data category** | **Indicator** | **Availability** | | |
| **RAMS** | | | | |
| RELIABILITY | Failure rates | M | P | V |
| | Critical items and functions | M | P | V |
| | Boundary conditions | M | P | V |
| AVAILABILITY | | V | P | V |
| MAINTENANCE | Preventive (either condition-based or time-based) | M | P | V |
| | Corrective | M | P | V |
| SAFETY | Incident numbers | V | P | O |
| | Accident numbers | V | P | V |
| **LCC COST DRIVERS** | | | | |
| *Technical* | Track standards | Y | P | V |
| | Maintenance regime | T | P | V |
| | Speeds | T | P | V |
| | Freight flows | T | P | V |
| | Timetable | V | P | Y |
| | Rolling stock | T | P | Y |
| | Train lengths | V | P | V |
| | Axle loads | V | P | Y |
| | Track/train interface | Y | P | V |
| | Technologies employed | V | P | V |
| *Economic* | R&D | T | P | V |
| | Investments/disposals | T | P | V |
| | Maintenance costs – preventive | U | P | V |
| | Maintenance costs – corrective | U | P | V |
| | Operating costs | T | P | V |
| REVENUE AND USER BENEFIT DRIVERS | | | | |
| Track Access Charges | | V | P | Y |
| Service quality | | U | P | V |
| Capacity | | Y | P | V |
| Availability | | U | P | V |
| Demand | | T | P | V |
| ‘Zero state’ revenue | | T | P | T |
| ENVIRONMENTAL PERFORMANCE | | | | |
| Noise | | U | P | V |
| $CO_2$ | | U | P | V |

# 6. CONCLUSIONS AND FUTURE WORK

Once all the data from project partners have been assembled, summarised and analysed, then a final selection of representative vehicles can be made. The selection includes wagons of different classes/types, with different ages, speeds, capacities, etc. Meanwhile, the selection is dependent on how easily the detailed data on associated vehicle models were provided by partner organisations.

## 6.1 Locomotives

The analysis of the Summary of Representative Locomotives (ANNEX 2. Summary **of Representative Locomotives**enables the following conclusions:

- **Motive power:** both Diesel and Electric powered locomotives are being successfully used for freight transport on selected routes and wider, in partner countries. However, Diesel locomotives are still the most common ones (e.g., the Class 66 in UK), but the Electric locomotives are preferred on freight routes that have a consistently high traffic volume, or in areas with advanced rail networks;
- **Power transmission** *(for Diesel locomotives):* the Diesel-Electric transmission is definitely the most common and widely used (considering its reliability and economic advantages as well);
- **Axle arrangement:** two common solutions were identified - Co'Co' and Bo'Bo'. Few models are using a B'B' arrangement.
- **Power:** the following ranges were identified:
  - ✓ Diesel powered freight locomotives: 2000-2750 kW (lower power models for lighter trains: 1500-1700 kW);
  - ✓ Electric powered freight locomotives: 4600-6700 kW (lighter models: 3000-4000 kW)
- **Braking system:** usually tread brakes / shoe brakes (just few new solutions using disc brakes on axle were identified);
- **Lifetime:** 35 – 46 years (economic lifetime: 25 – 40 years);
- **Shunting freight locomotives:** Diesel powered (400-1000 kW).

## 6.2 Wagons

The analysis of the Summary of Representative Freight Wagons (ANNEX 3. **Summary of Representative Freight Wagons**) and preliminary detailed characteristics in ANNEX 4. **Detailed Characteristics of Selected Freight Wagons ANNEX 2. Summary of Representative Locomotives**enables the following conclusions:

- **Classes in operation:** two categories of most common wagons in operation on selected routes and wider in partner countries were observed:
  - ✓ ***Flat wagons:*** Class R – ordinary flat wagon with bogies;
    Class S – special flat wagon with bogies; and
    Class L – special flat wagon with separate axles.

    The flat wagons are intensively used – mainly in UK and Spain, but an increasing demand was also remarked in Bulgaria and Romania. This trend is mainly due to their utilisation for intermodal freight, and, also, to the alternative freight possibilities (wood, steel, auto, etc.) offered by the special models.
  - ✓ ***Open high-sided wagons:*** Class E – ordinary high-sided wagon;
    Class F – special high-sided wagon.

    The open high-sided wagons have the major share of freight in Bulgaria and Romania due to particularities in economic sectors of New Member States, but with a decreasing trend of their utilisation. These classes have also a high utilisation in UK (probably the 3rd share as tonne-km) and Spain (but not on the selected route for SUSTRAIL). Although the demand for these classes is still high and will always keep an important share on the market due to specific types of freight (bulk and aggregates), the supply offered by the existing fleets seems to be more than sufficient considering the actual trends.

Apart from these two main categories, other types of wagons of different classes were reported to operate on selected routes/countries, such as:

- Class G – ordinary covered wagons (highly used in Bulgaria);
- Class Z – tank wagons (for oils, bitumen, etc.);
- Class U – special wagons (for cereals, powders, etc.);
- Class I – refrigerated vans;
- Class K – ordinary flat wagon with separate axles (for bulk);
- Class H – special covered wagons;
- Class T – goods wagons with opening roof.

- **Age of the wagons** in operation: a vast range (between 4 – 37 years) was recorded, depending on the types of wagons, builder, etc. The highest diversity of older wagons (over 30 years) was observed to operate on the selected route in Spain;
- **Bogie type:** Y25 bogie is the most common and widely used for recorded freight wagons (different versions, depending on type of wagon, builder and country). However, other types were also reported: Y33, TF25, Y21 (the most common in Spain), etc.;
- **Braking system:** all reported wagons are equipped with tread brakes / shoe brakes.

## 6.3 Economic data

The scope of the economic data required was defined in as much detail as possible, and some basic economic data was requested, including unit price, operating life, utilisation, maintenance intervals and costs, and emissions rates. The returned data was incomplete, and a more focused set of data requests will be necessary once scoping work is complete, e.g., focusing on a shortlist of wagons and locomotives, and systems to be developed within SUSTRAIL.

An assessment was made of the availability and accessibility of the data that will be required for the later detailed economic analysis in WP5. The information provided will allow us to pursue the necessary data when it is required for the specific wagons, locomotives and systems.

## 6.4 Future work

A comprehensive list of locomotives and representative freight wagons used on the selected routes was obtained. During the remaining time of WP1, the SUSTRAIL partners will continue to work to fill in any key gaps in the data to ensure that WP2 and WP3 have all the data they require. This will include the following activities:

- Review and updates of data in **ANNEX 2. Summary of Representative Locomotives** and **ANNEX 3. Summary of Representative Freight Wagons**;
- Completion of **ANNEX 4. Detailed Characteristics of Selected Freight Wagons**;
- Completion of the final section with comments and conclusions regarding the collected data, to enable a valuable input to WP2 and WP3.

Regarding the economic data, the next steps will follow as the scope of the work is defined within SUSTRAIL, including the selection of systems for close study and development. Hence future work includes: agreement on and collection of specific data for LCC and RAMS once the selected SUSTRAIL innovations have been specified; wider economic data relevant to the vehicle-track systems and route sections to be selected.

# ANNEXES

## ANNEX 1. Templates for Data Collection

### 1.3.1 OVERVIEW OF VEHICLES IN OPERATION - A. LOCOMOTIVES

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***A. LOCOMOTIVES***

| No. | Model / Class | | Fabrication Years | Builder (name, country) | Motive power type | Type | | Axle arrangement (UIC classification) | Power (kW) | Maximum speed (km/h) | Weight (tonnes) | Starting tractive effort (kN) | Fuel tank volume (l) | Bogies' type | Braking system | Indicative price (€) | Number of locomotives in operation (average/national level) | Utilisation / goods moved/year (tonnes*km) | Operational costs (€/km/tonne?) | Lifetime (years) | Maintenance interval (days) | Average yearly maintenance costs (€) | Emission limits | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | Electric current (electric locomotives) | Power transmission (diesel locomotives) | | | | | | | | | | | | | | | | Noise (compliance to TSI CR Noise) | Exhaust gases (EU emission standard) |
| | | | | | | | | | | | | | | | | | | | | | | | | |
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### 1.3.1 OVERVIEW OF VEHICLES IN OPERATION - B. WAGONS

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge | Wheel diameter | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Lifetime (years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
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# 1.3.2 DETAILED OVERVIEW OF VEHICLES IN OPERATION – WAGONS

SUSTRAIL **WP1 - Task 1.3: Rolling Stock**
**1.3.2 DETAILED OVERVIEW OF VEHICLES IN OPERATION**

| GENERAL CHARACTERISTICS | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Type of freight | Track gauge | Wheel diameter | Number of axles | Length over buffers (mm) | Distance between bogie pivots (mm) | Height of the floor from the track (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Max. axle load (tonnes) | Exploitable capacity | | | | | Maximum speed | | Minimum curve radius (m) | Special characteristics/ facilities |
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | | | | | Floor area ($m^2$) | Loading width (mm) | Loading length (mm) | Loading height (mm) | Volumetric capacity ($m^3$) | Empty (km/h) | Max. load (km/h) | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
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| COMPONENTS | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOGIES | | | | | | | | WHEELSETS | | AXLEBOXES | | BRAKING SYSTEM | | | BODY (please specify relevant details: type, material, load/unload, etc.) | BODY TO BOGIE CONNECTION (please specify details on technical solution) | Noise reduction measures (if any) |
| Type of bogie | Weight (t) | Width (mm) | Length (mm) | Wheelbase/ bogie axle base (mm) | Height of the bogie pivot centre above the top of rail at a wagon tare of 20 t (mm) | Suspension | *to be completed* | Nominal wheel diameter (mm) | Type of wheels | Model | Axle bearing | Model | Type | Material | | | |
| | | | | | | | | | | | | | | | | | |
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# ANNEX 2. Summary of Representative Locomotives

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***A. LOCOMOTIVES***

| No. | Model / Class | | Fabrication Years | Builder (name, country) | Motive power type | Type | | Axle arrangement (UIC classification) | Power (kW) | Maximum speed (km/h) | Weight (tonnes) | Starting tractive effort (kN) | Fuel tank volume (l) | Bogies' type | Braking system | Indicative price (€) | Number of locomotives in operation (average/national level) | Utilisation / goods moved/year (tonnes*km) | Operational costs (€/km/tonne?) | Lifetime (years) | Maintenance interval (days) | Average yearly maintenance costs (€) | Emission limits | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | Electric current (electric locomotives) | Power transmission (diesel locomotives) | | | | | | | | | | | | | | | | Noise (compliance to TSI CR Noise) | Exhaust gases (EU emissions standard |
| **NR (Network Rail, UK)** | | | | | | | | | | | | | | | | | | | | | | | | |
| 446 | Class 66 | | 1998-2008 | General Motors | Diesel | | Diesel-electric | Co'Co' | 2460 | 120 | 129.6 | 409 | 6400 | Co-Co | Tread brakes / Shoe brakes | 2,000,000 | 446 | | | 45 (20 economic) | refuelling every 2 days | 60000 | | |
| 50 | Class 90 | | 1987-1990 | BREL crewe Works | Electric | Alternating current AC | | Bo'Bo' | 3730 | 120 | 84.5 | 258 (not starting) | | Bo-Bo | Tread brakes / Shoe brakes | 2,400,000 | 50 | | | 46 (20 economic) | An exam/ 28 days | 60000 | | |
| 30 | Class 70 Powerhaul | | 2009 | General Electric US and Turkey | Diesel | | Diesel-electric | Co'Co' | 2750 | 120 | 135 | 534 | 6000 | Co-Co | Tread brakes / Shoe brakes | 2,400,000 | 30 | | | 47 (20 economic) | | 60000 | | |
| **ADIF (Administrator of Railway Infrastructures, Spain)** | | | | | | | | | | | | | | | | | | | | | | | | |
| 269 | | 9671 | 1984 | WESA/MACOSA/ATE INSA/GEE/MELCO | Electric | Direct current DC | Diesel-electric | Bo'Bo' | 3100 | 160 | 88 | | | BoBo | Tread brakes / Shoe brakes | | 131 | | | 35 | | | NO | Stage II |
| 250 | | 9671 | 1985 | MTM/CAF/BBC/KM | Electric | Direct current DC | Diesel-electric | C'C' | 4600 | 160 | 124 | | | Monomotor y birreductor | Tread brakes / Shoe brakes | | 40 | | | 35 | | | | |
| 251 | | 9671 | 1984 | CAF/MACOSA/WESA /GEE/MELCO | Electric | Direct current DC | Diesel-electric | B'B' | 4650 | 160 | 138 | | | | | | | | | | | | | |
| 252 | | 9671 | 1996 | SIEMENS/CAF/GEC | Electric | Direct current DC | Diesel-electric | Bo'Bo' | 5600 | 220 | 90 | | | | | | 15 | | | | | | | |
| 334 | | 9371 | | | Diesel | Direct current DC | Diesel-electric | | | | | | | | | | | | | | | | | |
| 253 | | 9671 | | | Electric | Direct current DC | Diesel-electric | | | | | | | | | | | | | | | | | |
| 333 | 333,400 | 9371 | 2002-2003 | ALSTOM | Diesel | | Diesel-electric | Co'Co' | 2237 | 140 | 120 | | | | | | | | | | | | | |
| **NRIC (National railway infrastructure company, Bulgaria)** | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| **BDZEAD (Bulgarian State Railways, Bulgaria)** | | | | | | | | | | | | | | | | | | | | | | | | |
| BDZEAD1 | 46E | 42 | 1965-1971 | SKODA, Czech Republic | Electric | Alternating current AC | | Bo'Bo' | 3060 | 110 | 84.8 | 275 | | | Tread brakes / Shoe brakes | | | 163,793 | 0.96 | 46/40 | | | | |
| BDZEAD2 | 64E | 43 | 1971-1975 | SKODA, Czech Republic | Electric | Alternating current AC | | Bo'Bo' | 3060 | 130 | 84.3 | 259.6 | | | Tread brakes / Shoe brakes | | | 968,455 | 0.72 | 40/36 | | | | |
| BDZEAD3 | 68E1 - E5 | 44 | 1975-1981 | SKODA, Czech Republic | Electric | Alternating current AC | | Bo'Bo' | 3060 | 130 | 87.2 | 259.6 | | | Tread brakes / Shoe brakes | | | 797,970 | 0.81 | 40/30 | | | | |
| BDZEAD4 | 68E6 - E7 | 45 | 1982-1984 | SKODA, Czech Republic | Electric | Alternating current AC | | Bo'Bo' | 3060 | 130 | 87.2 | 283 | | | Tread brakes / Shoe brakes | | | 1,074,234 | 0.75 | 29/27 | | | | |
| BDZEAD5 | LE 5100 | 46 | 1985-1986 | Electroputere-Craiova, Romania | Electric | Alternating current AC | | Co'Co' | 5245 | 130 | 128 | 401.7 | | | Tread brakes / Shoe brakes | | | 1,219,077 | 0.60 | 26/25 | | | | |
| BDZEAD6 | 56E1 | 61 | 1991-1994 | SKODA, Czech Republic | Electric | Alternating current AC | | Bo'Bo' | 960 | 80 | 74.2 | 212.9 | | | Tread brakes / Shoe brakes | | | 11,640 | 1.86 | 20/17 | | | | |
| BDZEAD7 | LDE2100 | 6 | 1966-1975 | Electroputere-Craiova, Romania | Diesel | | Diesel-electric | Co'Co' | 1540 | 100 | 117 | 313.9 | 4880 | | Tread brakes / Shoe brakes | | | 295,266 | 3.22 | 45/36 | | | | |
| BDZEAD8 | V300/ТЭ 109/BR 231 | 7 | 1972-1980 | LTZ Lugansk, Ukraine | Diesel | | Diesel-electric | Co'Co' | 2200 | 100 | 120 | 386 | 4000 | | Tread brakes / Shoe brakes | | | 417,708 | 2.08 | 39/31 | | | | |
| BDZEAD9 | DVM2 | 51 | 1965-1969 | Ganz Mavag, Hungary | Diesel | | Diesel-electric | Bo'Bo' | 440 | 80 | 63 | 182.5 | 1200 | | Tread brakes / Shoe brakes | | | | | 46/42 | | | | |
| BDZEAD10 | V60 | 52 | 1965-1974 | LEW Hennigsdorf-Berlin, Germany | Diesel | | other | other | 480 | 60 | 61.4 | 123.6 | 1800 | | Tread brakes / Shoe brakes | | | | | 46/17 | | | | |
| BDZEAD11 | LDH 125 | 55 | 1970-1985 | FAUR Bucharest, Romania | Diesel | | Diesel-hydraulic | B'B' | 920 | 100 | 70 | 155 | 3086 | | Tread brakes / Shoe brakes | | | 30,756 | 9.07 | 41/26 | | | | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***A. LOCOMOTIVES***

| No. | Model / Class | | Fabrication Years | Builder (name, country) | Motive power type | Type | | Axle arrangement (UIC classification) | Power (kW) | Maximum speed (km/h) | Weight (tonnes) | Starting tractive effort (kN) | Fuel tank volume (l) | Bogies' type | Braking system | Indicative price (€) | Number of locomotives in operation (average/national level) | Utilisation / goods moved/year (tonnes*km) | Operational costs (€/km/tonne?) | Lifetime (years) | Maintenance interval (days) | Average yearly maintenance costs (€) | Emission limits | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | Electric current (electric locomotives) | Power transmission (diesel locomotives) | | | | | | | | | | | | | | | | Noise (compliance to TSI CR Noise) | Exhaus gases (EU emiss standar |
| **AFER (Romanian Railway Authority, Romania)** | | | | | | | | | | | | | | | | | | | | | | | | |
| AFER1 | | 438-3: seria 189 | 2009 | Siemens, Germany | Electric | Alternating current AC | | Bo'Bo' | 6400 | 140 | 88 | 300 | | | Disc brakes on axle | | 2 | | | 40 | | | | |
| AFER2 | | 438-3: seria 016 | 2010 | Siemens, Germany | Diesel | | Diesel-electric | Bo'Bo' | 2000 | 140 | 80 | 235 | | | Disc brakes on axle | | 2 | | | 35 | | | | |
| AFER3 | | 438-3: seria 465 | 1992 | ABB Scandia, Germany | Electric | Alternating current AC | | Bo'Bo' | 4000 | 160 | 80 | 300 | | | Disc brakes on axle | | 6 | | | 40 | | | | |
| AFER4 | | 438-3: seria 232 | 1980 | Woroschilowgrad, Ukraine | Diesel | | Diesel-electric | Co'Co' | 1700 | 70 | 121 | 340 | | | Tread brakes / Shoe brakes | | 8 | | | 35 | | | | |
| AFER5 | | 438-3: seria 474 | 1985 | Electroputere Craiova, Romania | Electric | Alternating current AC | | Co'Co' | 6600 | 120 | 126 | 440 | | | Tread brakes / Shoe brakes | | 50 | | | 40 | | | | |
| AFER6 | | 438-3: seria 610 | 1980 | Electroputere Craiova, Romania | Diesel | | Diesel-electric | Co'Co' | 1600 | 120 | 116 | 340 | | | Tread brakes / Shoe brakes | | 1200 | | | 35 | | | | |
| AFER7 | | 438-3: seria 430 | 1980 | Electroputere Craiova, Romania | Electric | Alternating current AC | | Bo'Bo' | 3400 | 120 | 80 | 146 | | | Tread brakes / Shoe brakes | | 150 | | | 40 | | | | |
| AFER8 | | 438-3: seria 840 | 1975 | Remarul Romania | Diesel | | Diesel-hydraulic | B'B' | 940 | 100 | 68 | 190 | | | Tread brakes / Shoe brakes | | 800 | | | 35 | | | | |
| AFER9 | | 438-3: seria 425 | 1975 | France | Electric | Alternating current AC | | Bo'Bo' | 4130 | 130 | 80 | 150 | | | Disc brakes on axle | | 30 | | | 40 | | | | |
| **SIRV (CFR SIRV Brasov, Romania)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Do not manufacture/repair locomotives. | | | | | | | | | | | | | | | | | | | | | | | | |

# ANNEX 3. Summary of Representative Freight Wagons

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Lifetim (years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **NR (Network Rail, UK)** | | | | | | | | | | | | | | | | | | |
| 916 | FEA Bogie Container flat | UK only | R - Ordinary flat wagon with bogies | 2003- 2007 | Marcroft (UK) Greenbrier (Poland) | 1435 | 860 | 4 | 20240 | 20.5 (FEAB) | 61.5 | | | Y25 / Y33 | Tread brakes / | near to 70000 (50000 in 2003) | | |
| 125 | FLA 'Lowliner' bogie container flat | UK only | S - Special flat wagon with bogies | 1991 - 2005 | Powell Duffryn / Trinity Romania | 1435 | 520 | 4 | 14200 | 17 | 18 | | | LTF13 | Tread brakes / Shoe brakes | | | |
| 35 | KFAContainer flat | UK only | R - Ordinary flat wagon with bogies | 1988 - | Rautarukki Finland | 1435 | 860 | 4 | 19350 | 20 | 40 | | | Y25 | Tread brakes / Shoe brakes | | | |
| 700 | FSA/FTA Bogie Container Flat | UK only | R - Ordinary flat wagon with bogies | 1991-1993 | Arbel Fauvet France | 1435 | 860 | 4 | 19350 | 20 | 40 | | | Y33 | Disc brakes on axle | | | |
| | IKA 2-unit 'megafret' container flat | Sffggmrrss | S - Special flat wagon with bogies | 1998-9 | Arbel Fauvet France | 1435 | 730 | 8 | 31300 per 2-unit | 39 per 2-unit | 45 per 2-unit | | | Y25 variant | Tread brakes / Shoe brakes | | | |
| 100 | FAA Bogie Well container | UK only | S - Special flat wagon with bogies | 1999 | Thrall Europa | 1435 | 860 | 4 | 19350 | 33.5 | 40 | | | Y33 | Tread brakes / Shoe brakes | | | |
| 300 | MBA/MCA/MDA/MOA bogie open wagon | UK only | E - Ordinary open high-sided wagon | 1998 -2003 | Thrall Europa | 1435 | 915 | 4 | 19600 approx | 30 | 71.2 - 71.9 | | | 3-piece NACO swing motion | Tread brakes / Shoe brakes | | | |
| 125 | PHA 56t 2-axle self discargehoppers | UK only | U - Special wagon | 1988-1990 | Powell Duffryn | 1435 | 840 | 2 | 7600 approx | 11.6 | 38.4 | | | Gloucester pedestal | Tread brakes / Shoe brakes | | | |
| 242 | HHA Coal Hoppers | UK only | F - Special open high-sided wagon | | Greenbrier Polar | 1435 | 840 | 4 | 19600 | 28 | 74 | | | TF25 | Tread brakes / Shoe brakes | | | |
| 75 | KQA/KTA pocket container wagons | UK only | S - Special flat wagon with bogies | 1997-2000 | Rautarukki Finland | 1435 | 840 | 4 | 19800 | 23 | 67 | | | Y25 | Tread brakes / Shoe brakes | | | |
| 322 | PCA bulk powder tank | UK only | Z - Tank wagon | 1988 | Powell Duffryn | 1435 | 914 | 2 | 12500 | 12.8 | 38 | | | 2-axle | Tread brakes / Shoe brakes | | | |
| 84 | JSA covered steel wagon | UK only | H - Special covered wagon | 1996-2007 | Marcroft / WH Davis UK | 1435 | 840 | 4 | 12500 | 20 | 32 | | | BSC axle-motion | Tread brakes / Shoe brakes | | | |
| 555 | JNA Bogied ballast spoil wagons | UK only | E - Ordinary open high-sided wagon | 1998-1999 | Marcroft | 1435 | 914 | 4 | 15500 | 26 | 64 | | | NACO axle motion 3-piece | Tread brakes / Shoe brakes | | | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Lifet (ye |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **ADIF (Administrator of Railway Infrastructures, Spain)** | | | | | | | | | | | | | | | | | | |
| MA5 | 469.000 to 469.175<br>469.500 | 22714352086-3 to 110-1<br>26714352001-8 to 109-9<br>26714370000-8<br>4174352055-5 to 065-4<br>45714352039-5 to 094-0 | L - Special flat wagon with separate axles | 1995 | | 1668 | | 4 | 27000 | 27.7 | 21.5 | | | | Tread brakes / Shoe brakes | | | |
| MMB | 254.001 to 254.200<br>254.202 to 254.602 | 32714765001-1 to 401-3<br>81714764000-4 to 199-4 | S - Special flat wagon with bogies | 1977-1978 | | 1668 | | 4 | 12040 | 21.8 | 58.2 | | | Y21-Rse | Tread brakes / Shoe brakes | | | |
| MMB9 | 254.701 to 254.740 | 32714789001-3 to 040-1 | S - Special flat wagon with bogies | 2002 | | 1668 | | 4 | 12040 | 20.4 | 69.6 | | | Y21-Lse | Tread brakes / Shoe brakes | | | |
| MMQC | 550.001 TO 550.183 | 8174541000-4 TO 297-6 | S - Special flat wagon with bogies | 1976-1977 | | 1668 | | 4 | 19900 | 24.7 | 55.3 | 50 | | Y21-Cse | Tread brakes / Shoe brakes | | | |
| MC | 450.641 TO 460.031<br>450.127 TO 450.428 | 22714428401-4 TO 728-0<br>41711428001-9 TO 200-7 | L - Special flat wagon with separate axles | 1998-1999 | | 1668 | | 2 | 13860 | 12.15 | 27.85 | 27 | | | Tread brakes / Shoe brakes | | | |
| MC3 | 470.001 TO 470.100<br>470.101 TO 470.800 | 22714433000-7 TO 099-9<br>22714433100-5 TO 799-4 | L - Special flat wagon with separate axles | 1991-1992<br>1989-1991 | | 1668 | | 2 | 13860 | 12.5 | 32.5 | | | | Tread brakes / Shoe brakes | | | |
| MC4 | 480.000 TO 480.156<br>480.201 TO 480.330 | 22714433800-0 TO 956-0<br>22714439001-9 TO 130-6 | L - Special flat wagon with separate axles | 2000-2001 | | 1668 | | 2 | 15080 | 12.8 | 32.2 | | | | | | | |
| MCI | 000.000 | 24714433800-8 TO 999-8 | L - Special flat wagon with separate axles | 1989 | | 1668 | | 2 | 13860 | 12 | 33 | | | | | | | |
| MMC | 452.001 TO 452.410<br>452.502 TO 452.750 | 81714540000-5 TO 397-5<br>32714542000-3 TO 249-6 | S - Special flat wagon with bogies | 1971-1975<br>1978 | | 1668 | | 4 | 19900 | 21/20 | 58/60 | 39 | | Y21-Cse | | | | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Life (ye |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **ADIF (Administrator of Railway Infrastructures, Spain)** | | | | | | | | | | | | | | | | | | |
| MMC3 | 452.321 TO 452.500<br>452.762 TO 453.689<br>452.751 TO 453.726 | 81714549000-6<br>TO 098-0<br>36714570011-1<br>TO 938-5<br>32714570000-8<br>TO 975-1 | S - Special flat wagon with bogies | 1974-1975<br>1980-1981<br>1980-1982 | | 1668 | | 4 | 19900 | 20/19,8 | 60/60,2 | 39 | | Y21-Cse | Tread brakes / Shoe brakes | | | |
| MMC3E | 453.801 TO 453.950 | 32714252001-1<br>TO 150-6 | | 2002-2003 | | 1668 | | 4 | 19740 | 19.7 | 70.3 | 44 | | Y21-Lse | Tread brakes / Shoe brakes | | | |
| MMP | 260.001 TO 260.050 | 81714589000-7<br>TO 049-4 | S - Special flat wagon with bogies | 1985 | | 1668 | | 4 | 16440 | 18 | 44 | | | Y31-CE | | | | |
| JPD | 701.001 TO 701.748 | 41712251001-5<br>TO 748-1 | H - Special covered wagon | 1985-1987 | | 1668 | | 2 | 14020 | 16.1 | 23.9 | 33 | 72 | | Tread brakes / Shoe brakes | | | |
| JJ2 | 000101 TO 001.200<br>002.001 TO 002.475 | 32712850000-3<br>TO 374-2<br>32712850576-2<br>TO 846-9<br>81712851001-0<br>TO 020-0 | H - Special covered wagon | 1979-1980 | | 1668 | | 4 | 21700 | 30 | 50 | 53 | 137 | Y21-Cse | Tread brakes / Shoe brakes | | | |
| JJ4 | 002.476 TO 002.675 | 32712850375-9<br>TO 574-7 | H - Special covered wagon | 1990 | | 1668 | | 4 | 21700 | 29 | 61 | 53 | 137 | Y21-Lsse | | | | |
| **NRIC (National railway infrastructure company, Bulgaria)** | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **BDZEAD (Bulgarian State Railways, Bulgaria)** | | | | | | | | | | | | | | | | | | |
| BDZEAD1 | Res | 393 | R - Ordinary flat wagon with bogies | 1974-1978 | BG | 1435 | 920 | 4 | 19900 | 24 | 56 | 51 | | Y25 | Tread brakes / Shoe brakes | | 49,387,854 | |
| BDZEAD2 | Smmps | 472 | S - Special flat wagon with bogies | 1982 | BG | 1435 | 920 | 4 | 14040 | 20 | 80 | 39.7 | | Y25 | Tread brakes / Shoe brakes | | 12,332,772 | |
| BDZEAD3 | Eaos | 540 | E - Ordinary open high-sided wagon | 1979 | BG | 1435 | 920 | 4 | 14040 | 20 | 58 | 36 | 73 | Y25 | Tread brakes / Shoe brakes | | 566637397* | |
| BDZEAD4 | Eaos | 596 | E - Ordinary open high-sided wagon | 1978 | BG | 1435 | 920 | 4 | 14290 | 20 | 60 | 36 | 72 | Y25 | Tread brakes / Shoe brakes | | | |
| BDZEAD5 | Uagpps | 933 | U - Special wagon | 1980 | BG | 1435 | 920 | 4 | 15290 | 22.5 | 57.5 | | 85 | Y25 | Tread brakes / Shoe brakes | | 79881071* | |
| BDZEAD6 | Uaces | 932 | U - Special wagon | 1978 | Serbia | 1435 | 920 | 4 | 19040 | 27 | 54 | | 66 | Y25 | Tread brakes / Shoe brakes | | | |
| BDZEAD7 | Uaces | 932 | U - Special wagon | 1984 | BG | 1435 | 920 | 4 | 12040 | 19 | 61 | | 54 | Y25 | Tread brakes / Shoe brakes | | | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Life (ye |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **BDZEAD (Bulgarian State Railways, Bulgaria)** | | | | | | | | | | | | | | | | | | |
| BDZEAD8 | Fals | 665 | F - Special open high-sided wagon | 1982 | BG | 1435 | 920 | 4 | 12790 | 24 | 56 | | 75 | Y25 | Tread brakes / Shoe brakes | | 108,070,282 | |
| BDZEAD9 | Gabs | 181 | G - Ordinary covered wagon | 1980 | BG | 1435 | 920 | 4 | 21700 | 27 | 53 | 52 | 137 | Y25 | Tread brakes / Shoe brakes | | 23,641,459 | |
| BDZEAD10 | Zas | 785 | Z - Tank wagon | 1979 | BG | 1435 | 920 | 4 | 12240 | 19 | 61 | | 37 | Y25 | Tread brakes / Shoe brakes | | 50680383* | |
| BDZEAD11 | Zas | 795 | Z - Tank wagon | 1985 | BG | 1435 | 920 | 4 | 13040 | 20 | 60 | | 56 | Y25 | Tread brakes / Shoe brakes | | | |
| BDZEAD12 | Zas | 798 | Z - Tank wagon | 1977 | BG | 1435 | 920 | 4 | 14240 | 20 | 59 | | 71 | Y25 | Tread brakes / Shoe brakes | | | |
| BDZEAD13 | | 874 | I - Refrigerated van | | | 1435 | 920 | 4 | 21040 | 36 | 43 | 42 | 86 | Y25 | Tread brakes / Shoe brakes | | 23,238 | |
| BDZEAD14 | Habis | | H - Special covered wagon | | | 1435 | | | | | | | | | | | | |
| **AFER (Romanian Railway Authority, Romania)** | | | | | | | | | | | | | | | | | | |
| AFER1 | Gags seria 1951 | UIC 438-2 | G - Ordinary covered wagon | 1975 | UVA, Romvag Romania | 1435 | 1000 | 4 | 17020 | 25 | 70 | 40 | 90 | ORE, H | Tread brakes / Shoe brakes | | | |
| AFER2 | Ks seria 3317 | UIC 438-2 | K - Ordinary flat wagon with separate axles | 1975 | Meva Romania | 1435 | 1000 | 2 | 13860 | 13 | 35 | 35 | - | - | Tread brakes / Shoe brakes | | | |
| AFER3 | Rgs seria 3555 | UIC 438-2 | R - Ordinary flat wagon with bogies | 1980 | UVA, Romvag, Meva - Romania | 1435 | 1000 | 4 | 19900 | 24.5 | 70 | 51 | - | H, Y25 | Tread brakes / Shoe brakes | | | |
| AFER4 | Fals seria 6650 | UIC 438-2 | F - Special open high-sided wagon | 1980 | UVA, Romvag, Meva - Romania | 1435 | 920 | 4 | 14540 | 25 | 70 | 38 | 75 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER5 | Eaos seria 5301 | UIC 438-2 | E - Ordinary open high-sided wagon | 1985 | UVA, Romvag, Meva - Romania | 1435 | 920 | 4 | 14000 | 21 | 70 | 36 | 72 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER6 | Uagps seria 9332 | UIC 438-2 | U - Special wagon | 1985 | UVA Romania | 1435 | 920 | 4 | 14840 | 23 | 70 | 40 | 80 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER7 | Tals seria 0666 | UIC 438-2 | T - Goods wagon with opening roof | 1978 | UVA Romania | 1435 | 920 | 4 | 14540 | 28 | 70 | 41 | 68 | H | Tread brakes / Shoe brakes | | | |
| AFER8 | Zas seria 7965 | UIC 438-2 | Z - Tank wagon | 2000 | Meva Romania | 1435 | 920 | 4 | 13440 | 24.8 | 70 | - | 73 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER9 | Zaes seria 7878 | UIC 438-2 | Z - Tank wagon | 1980 | Meva Romania | 1435 | 920 | 4 | 12160 | 24 | 70 | - | 60 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER10 | Ucs seria 9123 | UIC 438-2 | U - Special wagon | 1976 | Meva Romania | 1435 | 1000 | 2 | 9000 | 12.5 | 35 | - | 24 | - | Tread brakes / Shoe brakes | | | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Life (ye |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **AFER (Romanian Railway Authority, Romania)** | | | | | | | | | | | | | | | | | | |
| AFER11 | Faccpps seria 6936 | UIC 438-2 | F - Special open high-sided wagon | 1984 | UVA Romania | 1435 | 920 | 4 | 14040 | 26.5 | 70 | 37 | 38 | Y25 | Tread brakes / Shoe brakes | | | |
| AFER12 | Hbbillss seria 2461 | UIC 438-2 | H - Special covered wagon | 2001 | Bombardier France | 1435 | 920 | 2 | 16700 | 16.85 | 40 | 44.8 | 121.7 | - | Tread brakes / Shoe brakes | | | |
| AFER13 | Sgs seria 4542 | UIC 438-2 | S - Special flat wagon with bogies | 2001 | Romvag Romania | 1435 | 920 | 4 | 19640 | 20 | 70 | 49 | - | Y25 | Tread brakes / Shoe brakes | | | |
| AFER14 | Shimmns seria 4673 | UIC 438-2 | S - Special flat wagon with bogies | 1999 | Romvag Romania | 1435 | 920 | 4 | 14040 | 30 | 90 | 25.5 | - | Y25 Lsd | Tread brakes / Shoe brakes | | | |
| **SIRV (CFR SIRV Brasov, Romania)** | | | | | | | | | | | | | | | | | | |
| SIRV 1 | Sgnss | | S - Special flat wagon with bogies | 2005 - | Meva, Romania | 1435 | 920 | 4 | 19640 | 20 | 70 | 45 | | Y25 | Tread brakes / Shoe brakes | | containers | |
| SIRV 2 | Gas/Gass | | G - Ordinary covered wagon | 1999 - | Romvag, Romania | 1435 | 920 | 4 | 16520 | 23 | 55.5 | 40 | 95 | Y25 | Tread brakes / Shoe brakes | | weather protected products | |
| SIRV 3 | Gbs | | G - Ordinary covered wagon | 1976 - | Meva, Romania | 1435 | 920 | 2 | 14020 | 14.5 | 25.5 | 33 | 80 | | Tread brakes / Shoe brakes | | weather protected products | |
| SIRV 4 | Eaos | | E - Ordinary open high-sided wagon | 1985 - | UVA, Romania | 1435 | 920 | 4 | 14040 | 21 | 59 | 36 | 72 | Y25 | Tread brakes / Shoe brakes | | bulk products | |
| SIRV 5 | Eacs | | E - Ordinary open high-sided wagon | 1963 - | UVA, Romania | 1435 | 920 | 4 | 14040 | 22 | 58 | 36 | 72 | Y25 | Tread brakes / Shoe brakes | | bulk products | |
| SIRV 6 | Eakkmos | | E - Ordinary open high-sided wagon | 1975 - | Remar, Romania | 1435 | 920 | 4 | 13940 | 31.6 | 48.4 | | 30 | Y25 | Tread brakes / Shoe brakes | | broken stones | |
| SIRV 7 | Eanos | | E - Ordinary open high-sided wagon | 2001 - | Romvag, Romania | 1435 | 920 | 4 | 15740 | 25 | 66 | 39.4 | 82.5 | Y25 | Tread brakes / Shoe brakes | | bulk products | |
| SIRV 8 | Hbikks | | H - Special covered wagon | 1999 - | Romvag, Romania | 1435 | 920 | 2 | 14020 | 17 | 23 | 33 | 78 | | Tread brakes / Shoe brakes | | weather protected products | |
| SIRV 9 | Hbbillnss | | H - Special covered wagon | 2001 - | Bombardier, | 1435 | 920 | 2 | 16700 | 16.85 | 23.1 | 44.8 | 121.7 | | Tread brakes / Shoe brakes | | weather protected products | |
| SIRV 10 | Ks | | K - Ordinary flat wagon with separate axles | 1961 - | Meva, Romania | 1435 | 1000 | 2 | 13860 | 13.2 | 26.8 | 35 | | | Tread brakes / Shoe brakes | | bulky products | |
| SIRV 11 | Rils | | R - Ordinary flat wagon with bogies | 1999 - | Romvag, Romania | 1435 | 920 | 4 | 19900 | 26 | 54 | 51 | | Y25 | Tread brakes / Shoe brakes | | bulky products | |
| SIRV 12 | Rgs | | R - Ordinary flat wagon with bogies | 1970 - | UVA, Romania | 1435 | 920 | 4 | 19900 | 24.5 | 55.5 | 51 | | Y25 | Tread brakes / Shoe brakes | | bulky products | |
| SIRV 13 | Rmms | | R - Ordinary flat wagon with bogies | 1971 - | UVA, Romania | 1435 | 920 | 4 | 14040 | 23 | 57 | 39 | | Y25 | Tread brakes / Shoe brakes | | bulky products | |

**WP1 - Task 1.3: Rolling Stock**
**1.3.1 OVERVIEW OF VEHICLES IN OPERATION**
***B. WAGONS***

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Track gauge (mm) | Wheel diameter (mm) | Number of axles | Length over buffers (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Exploitable capacity | | Bogies' type | Braking system | Indicative price (€) | Utilisation / goods moved/year (tonnes*km) | Life (ye |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | Floor area ($m^2$) | Volumetric capacity ($m^3$) | | | | | |
| **SIRV (CFR SIRV Brasov, Romania)** | | | | | | | | | | | | | | | | | | |
| SIRV 14 | Laads | | L - Special flat wagon with separate axles | 1982 - | UVA, Romania | 1435 | 920 | 4 | 27000 | 27 | 22.5 | 78 | | | Tread brakes / Shoe brakes | | vehicles | |
| SIRV 15 | Sdgkkmss | | S - Special flat wagon with bogies | 1999 - | UVA, Romania | 1435 | 760 | 4 | 23550 | 24.8 | 21 | | | ZDL | Tread brakes / Shoe brakes | | vehicles and containers | |
| SIRV 16 | Shimmns | | S - Special flat wagon with bogies | 1999 - | Romvag, Romania | 1435 | 920 | 4 | 14040 | 30 | 60 | | | Y25 | Tread brakes / Shoe brakes | | sheet rollers | |
| SIRV 17 | Salmmp | | S - Special flat wagon with bogies | 1952 - | UVA, Romania | 1435 | 920 | 6 | 14200 | 31.3 | 80 | 40 | | with 3 axle | Tread brakes / Shoe brakes | | bulky products | |
| SIRV 18 | Faccpps | | F - Special open high-sided wagon | 1980 - | UVA, Romania | 1435 | 920 | 4 | 14040 | 26.5 | 53.5 | | 38 | Y25 | Tread brakes / Shoe brakes | | broken stones | |
| SIRV 19 | Fals | | F - Special open high-sided wagon | 1976 - | UVA, Romania | 1435 | 920 | 4 | 12800 | 25 | 55 | | 75 | Y25 | Tread brakes / Shoe brakes | | coal | |
| SIRV 20 | Falns | | F - Special open high-sided wagon | 2005 - | UVA, Romania | 1435 | 920 | 4 | 15740 | 25 | 66 | | 82.5 | Y25 | Tread brakes / Shoe brakes | | coal | |
| SIRV 21 | Zaes(1) | | Z - Tank wagon | 1988 - | Meva, Romania | 1435 | 920 | 4 | 13440 | 24.9 | 55.1 | | 68 | Y25 | Tread brakes / Shoe brakes | | black and white oil | |
| SIRV 22 | Zaes(2) | | Z - Tank wagon | 1979 - | Gh Dimitrov, Bulgaria | 1435 | 920 | 4 | 14240 | 21.3 | 58.7 | | 71 | Y25 | Tread brakes / Shoe brakes | | black and white oil | |
| SIRV 23 | Zaekks | | Z - Tank wagon | 2000 - | Meva, Romania | 1435 | 920 | 4 | 12160 | 24 | 56 | | 55 | Y25 | Tread brakes / Shoe brakes | | bitumen | |
| SIRV 24 | Zas(2) | | Z - Tank wagon | 1999 - | Meva, Romania | 1435 | 920 | 4 | 13440 | 24.8 | 55.2 | | 73 | Y25 | Tread brakes / Shoe brakes | | black and white oil | |
| SIRV 25 | Zas(1) | | Z - Tank wagon | 1979 - | Meva, Romania | 1435 | 920 | 4 | 12160 | 23 | 57 | | 35 | Y25 | Tread brakes / Shoe brakes | | sulphuric acid | |
| SIRV 26 | Ucs | | U - Special wagon | 1987 - | Meva, Romania | 1435 | 1000 | 2 | 10000 | 13 | 27 | | 25 | | Tread brakes / Shoe brakes | | purverulente products | |
| SIRV 27 | Uacs | | U - Special wagon | 1987 - | Meva, Romania | 1435 | 920 | 4 | 14040 | 26 | 53 | | 44 | Y25 | Tread brakes / Shoe brakes | | purverulente products | |
| SIRV 28 | Uagps | | U - Special wagon | 1966 - | UVA, Romania | 1435 | 920 | 4 | 14840 | 23 | 57 | | 80 | Y25 | Tread brakes / Shoe brakes | | cereals | |
| SIRV 29 | Tadgs | | T - Goods wagon with opening roof | 2002 - | Romvag, Romania | 1435 | 920 | 4 | 14540 | 22.5 | 57.5 | | 72 | Y25 | Tread brakes / Shoe brakes | | bulk products | |
| SIRV 30 | Tals | | T - Goods wagon with opening roof | 1979 - | UVA, Romania | 1435 | 920 | 4 | 14540 | 28 | 52 | | 68 | Y25 | Tread brakes / Shoe brakes | | bulk products | |

# ANNEX 4. Detailed Characteristics of Selected Freight Wagons

## *Wagon's general characteristics*

SUSTRAIL **WP1 - Task 1.3: Rolling Stock**
**1.3.2 DETAILED OVERVIEW OF VEHICLES IN OPERATION**

**GENERAL CHARACTERISTICS**

| No. | Model / Type | | Class (UIC classification) | Fabrication Years | Builder (name, country) | Type of freight | Track gauge | Wheel diameter | Number of axles | Length over buffers (mm) | Distance between bogie pivots (mm) | Height of the floor from the track (mm) | Tare weight (tonnes) | Loading capacity (tonnes) | Max. axle load (tonnes) | Exploitable capacity | | | | | Maximum speed | | Minimum curve radius (m) | Special characteristics facilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | National / European (used by the builder) | UIC identification marking | | | | | | | | | | | | | | Floor area ($m^2$) | Loading width (mm) | Loading length (mm) | Loading height (mm) | Volumetric capacity ($m^3$) | Empty (km/h) | Max. load (km/h) | | |
| **NR (Network Rail, UK)** | | | | | | | | | | | | | | | | | | | | | | | | |
| FEA | FEA Bogie Container flat | UK only | R - Ordinary flat wagon with bogies | 2003-2007 | Marcroft (UK) Greenbrier (Poland) | Intermodal | 1435 | 860 | 4 | 20240 | 13940 | | 20.5 | 61.5 | 20.5 | | | | | | 120 | 120 | | |
| FLA | FLA 'Lowliner' bogie container flat | UK only | S - Special flat wagon with bogies | 1991-2005 | Powell Duffryn / Trinity Romania | Intermodal | 1435 | 520 | 4 | 14200 | approx 10000 | | 17 | 18 | 8.75 | | | | | | 120 | 120 | | |
| IKA | IKA 2-unit 'megafret' container flat | Sffggmrrss | S - Special flat wagon with bogies | 1998-1999 | Arbel Fauvet France | Intermodal | 1435 | 730 | 8 | 31300 per 2-unit | approx 13500 | | 39t/2-car | 45/ 2-car | 10.5 | | | | | | 120 | 120 | 150 | |
| FAA | FAA Bogie Well container | UK only | S - Special flat wagon with bogies | 1999 | Thrall Europa | Intermodal | 1435 | 860 | 4 | 19350 | 15388 | | 33.5 | 40 | 18.4 | | | | | | 120 | 120 | | |
| MBA/MCA | MBA/MCA/MDA/MOA bogie open wagon | UK only | E - Ordinary open high-sided wagon | 1998-2003 | Thrall Europa | Aggregate | 1435 | 915 | 4 | 19600 approx | 13834 | | 30 | 72 | 25.5 | | | | | | 120 | 96 | | |
| PHA | PHA 2-axle self discargehoppers | UK only | U - Special wagon | 1988-1990 | Powell Duffryn | Aggregate | 1435 | 840 | 2 | 7600 approx | 4775 | | 11.6 | 38.4 | 25 | | | | | | 120 | 96 | 170 | |
| JNA | Bogied Ballast spoil wagons | UK only | E - Ordinary open high-sided wagon | 1998-1999 | Marcroft | Aggregate | 1435 | 915 | 4 | 15500 | 12000 | | 26 | 64 | 22.5 | | | | | | 120 | 96 | 70 | |
| **BDZEAD (Bulgarian State Railways, Bulgaria)** | | | | | | | | | | | | | | | | | | | | | | | | |
| BDZEAD1 | Res | 393 | R - Ordinary flat wagon with bogies | 1974/1978 | BG | Machines, vechicles, manufactured | 1435 | 920 | 4 | 19900 | 14860 | 1250 | 24 | 56 | 20 | 51 | 2640 | 18500 | 1200 | | 100 | 120 | 180 | |
| BDZEAD2 | Smmps | 472 | S - Special flat wagon with bogies | 1982 | BG | Raw or manufactured | 1435 | 920 | 4 | 14040 | 9000 | 1310 | 20 | 80 | 20 | 39.7 | 3000 | 12500 | 1260 | | 100 | 120 | 180 | |
| BDZEAD3 | Eaos | 540 | E - Ordinary open high-sided wagon | 1979 | BG | Ores and waste products for | 1435 | 920 | 4 | 14040 | 9000 | | 20 | 58 | 20 | 36 | 2850 | 12500 | 3300 | 73 | 100 | 120 | 180 | |
| BDZEAD4 | Uagpps | 933 | U - Special wagon | 1980 | BG | Fertilisers | 1435 | 920 | 4 | 15290 | 10800 | | 22.5 | 57.5 | 20 | | 13300 | | 4100 | 85 | 100 | 120 | 180 | |
| BDZEAD5 | Uaces | 932 | U - Special wagon | 1978 | Serbia | Chemical products | 1435 | 920 | 4 | 19040 | 11800 | | 27 | 54 | 20 | | 13300 | | 4100 | 66 | 100 | 120 | 180 | |
| BDZEAD6 | Uaces | 932 | U - Special wagon | 1984 | BG | Fertilisers | 1435 | 920 | 4 | 12040 | 7800 | | 19 | 61 | 20 | | 54m3 | | 4100 | 54 | 100 | 120 | 180 | |
| BDZEAD7 | Fals | 665 | F - Special open high-sided wagon | 1982 | BG | Ferrous/Non-ferrous metallurgical | 1435 | 920 | 4 | 12790 | 7500 | | 24 | 56 | 20 | | 75m3 | | 4100 | 75 | 100 | 120 | 180 | |
| BDZEAD8 | Zas | 795 | Z - Tank wagon | 1985 | BG | Petroleum products | 1435 | 920 | 4 | 13040 | 7200 | | 20 | 60 | 20 | | 56m3 | | 4270 | 56 | 100 | 120 | 180 | |
| BDZEAD9 | Zas | 798 | Z - Tank wagon | 1977 | BG | Petroleum products | 1435 | 920 | 4 | 14240 | 9200 | | 20 | 59 | 20 | | 71m3 | | 4270 | 71 | 100 | 120 | 180 | |
| BDZEAD10 | Habis | | H - Special covered wagon | | | | 1435 | | | | | | | | | | | | | | | | | |

# *Specifications of subsystems and components*

SUSTRAIL **WP1 - Task 1.3: Rolling Stock**
**1.3.2 DETAILED OVERVIEW OF VEHICLES IN OPERATION**

| COMPONENTS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | BOGIES | | | | | | | | WHEELSETS | | AXLEBOXES | | BRAKING SYSTEM | | | BODY (please specify relevant details: type, material, load/unload, etc.) | BODY TO BOGIE CONNECTION (please specify details on technical solution) | Noise reducti measures (if any) |
| | Type of bogie | Weight (t) | Width (mm) | Length (mm) | Wheelbase/ bogie axle base (mm) | Height of the bogie pivot centre above the top of rail at a wagon tare of 20 t (mm) | Suspension | *to be completed* | Nominal wheel diameter (mm) | Type of wheels | Model | Axle bearing | Model | Type | Material | | | |
| **NR (Network Rail, UK)** | | | | | | | | | | | | | | | | | | |
| FEA | Y25 / Y33 | 4.75 | | 3250 | 2000 | 1050 | Primary coil springs with lenoir link friction damping | | 860 | | | | | | | | Spherical UIC centrebowl and sprung side-bearers | |
| FLA | LTF13 | | | | | | | | 520 | | | | | | | | | |
| IKA | Y25 | | | | | | Primary coil springs with lenoir link friction damping | | 730 | | | | | | | | Spherical UIC centrebowl and sprung side-bearers | |
| FAA | Y33 | 4.1 | | | 1800 | 736 | Primary coil springs with lenoir link friction damping | | 860 | | | | | | | | Spherical UIC centrebowl and sprung side-bearers | |
| MBA/MCA | NACO 3-piece swing motion | 4.52 | | | 1830 | 706 | Rocking sideframes, coil springs and wedge friction damping to bolster | | 915 | | | | | | | | Flat centreplate and spring sidebearers | |
| PHA | Gloucester Pedestal | | | | | | Gloucester Pedestal, primary coil springs with wedge friction damping | | 840 | | | | | | | | | |
| JNA | NACO 3-piece axle-motion | 4.852 | | | 2000 | 760 | Rocking axleboxes, primary coil springs with wedge damping | | 915 | | | | | | | | Spherical UIC centrebowl and sprung side-bearers | |
| **BDZEAD (Bulgarian State Railways, Bulgaria)** | | | | | | | | | | | | | | | | | | |
| BDZEAD1 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD2 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD3 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD4 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD5 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD6 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD7 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD8 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD9 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | 120/130 | skf | Kae | | Cast iron | | | |
| BDZEAD10 | Y25 UIC | 4.6 | 2200 | 3250 | 1800 | 760 | spring | | 920 | Solid wheels | | | | | Cast iron | | | |