IRRBB WEBINAR
SUSTAINABILITY AND NEW DIGITAL TRENDS FOR HEAVY HAUL
BASIC RULES FOR USING zoom
You can join remotely via your computer, tablet, smartphone (ZOOM Cloud Meetings by zoom.us) or phone.

Computer is best.
• **Ethernet cable connection** is recommended for stability and speed

• Identify yourself with “Company - Name Firstname”

• **Turn off your mic and video when not speaking**

• And remember to turn on your mic when speaking
• Russian and English interpretation is available

• Доступен синхронный перевод с английского на русский язык

• Click on the language button located towards the bottom right of this screen, and select the language you want to listen to in the meeting

• Нажмите на значок планеты внизу экрана и выберите русский канал
• **Use the chat functionality** for direct messaging to everyone at once (for example to ask a question after a presentation)

• The chat box will be monitored
• This webinar will be recorded
Agenda
09:00 – 09:01: Opening
Mr Vladimir Andreev – UIC IRRB Chairman, Head of the Technical Policy Department JSC « Russian railways »

09:01 – 09:06: Welcome
Mr Christian Chavanel – Director of UIC Rail System Department

09:06 – 09:10: Welcome - Introduction
Mr Vladimir Andreev – UIC IRRB Chairman, Head of the Technical Policy Department JSC « Russian railways »

09:10 – 09:15: Moderator’s Word of Introduction
Dr Boris Lapidus – Honorary IRRB Chair, Chair of the Joint Scientific Council of JSC “Russian railways”

09:15 – 09:35: 1. China Railway’s Heavy-Haul Comprehensive Test and Practices
Mr Xiong Xin – Senior Researcher, Locomotive and Car Research Institute, CARS

09:35 – 09:55: 2. Future European developments of automatic digital couplers
Mr Bo Olsson – Chief Strategist, Head of Shift2Rail Programme, Trafikverket
09:55 – 10:15: 3. Environmental challenges and new digital opportunities for railway freight transportation. UK Experience
Mr Phil Smart – Policy Manager, Rail Freight Group (RFG)

Dr Mikhail Mekhedov – Deputy Director General, JSC "VNIIZHT"

10:50 – 11:00: 5. Organisation of heavy haul traffic. SUEK experience.
Mr Ilya Pershin – Director for Planning and Development of Railway Infrastructure, JSC “SUEK”

11:00 – 11:50: Panel discussion

11:55 – 12:00: Closing remarks
Mr Vladimir Andreev – UIC IRRB Chairman, Head of the Technical Policy Department JSC « Russian railways »
Opening
Opening – Welcome - Introduction

Mr Vladimir Andreev
IRRB Chairman

Mr Christian Chavanel
Director of UIC Rail System Department
VISION OF RAIL 2030
FOUR TRANSFORMATIONAL TOPICS
VISION OF RAIL IN 2030
TECHNICAL IMPLEMENTATION

- TRANSPORT MODAL SHIFT
- INCREASE OF THE RAILWAY CAPACITY
- CCS & FRMCS
- AUTOMATION
- LIGHTER TRAINS
- RAILWAY DIGITAL MODELLING
- FRUGAL ECO-DESIGN
- REDUCTION OF RAILWAY NOISE
- BIODIVERSITY
- GREEN ENERGY, HYDROGEN AND BATTERIES
- DIGITISATION IN RAIL FREIGHT
- GREEN LOGISTICS
- RESILIENCE OF RAILWAY INFRASTRUCTURES AND ROLLING STOCK TO CLIMATE CHANGE
- OPERATIONAL RESILIENCE TO CLIMATE CHANGE
- PREDICTIVE MAINTENANCE
- MULTIMODAL E-TICKETS
- INCLUSIVITY
- ACCESSIBILITY
- ACCELERATION OF THE CYCLE OF INNOVATION

By 2030, cars and buses are being used less because more freight and passengers than ever are using the rail. High-speed rail traffic has doubled globally from today’s levels and is now competing with aviation well on all short and some medium haul routes, many airlines have stopped their short haul services and are working closely to connect with rail. Following the Covid dip, rail passenger numbers have recovered and IFRS market share has increased by 20% from pre-pandemic levels. Rail now takes 11% of global freight traffic and 12% of passenger traffic.

Mobility services take a systems approach, led by a global decarbonisation strategy that the three "avoid, shift, improve". Electrification and automation has helped to change the use of individual vehicles and firsts and rail is the backbone of the e-mobility chain. Private ownership is declining, and shared fleets of electrical vehicles are interconnecting semesters with logistics and public transport systems adapted in real-time to demand.
Moderator’s Word of Introduction

Dr Boris Lapidus
Honorary IRRB Chair, Chair of the Joint Scientific Council of JSC “Russian railways”

IRRB Webinar, Sustainability and New Digital Trends for Heavy Haul, 14 December 2021
China Railway’s Heavy-Haul Comprehensive Test and Practices

Mr Xiong Xin
Senior Researcher, Locomotive and Car Research Institute, CARS

IRRB Webinar, Sustainability and New Digital Trends for Heavy Haul, 14 December 2021
Heavy Haul Railway Comprehensive Test and Application in China

Xiong Xin
Associate Researcher, China Academy of Railway Sciences Corporation Limited
UIC IRRB webinar

December 14, 2021
Overview of Heavy Haul Railway Transport in China

Heavy Haul Railway Comprehensive Test

Application of Heavy Haul Railway Comprehensive Test

Summary and Outlook
I. Overview of Heavy Haul Railway Transport in China

According to the State Council’s requirements - “launching a campaign against pollution, focus on winning the Blue Sky Protection Campaign” and “adjusting the transportation structure to see decreased highway transport volume but increased railway freight volume”, the China State Railway Group’s total freight volume and the share in freight market of China have been increasing in recent years, the railway freight volume was 4.552 billion tonnes with the share of 9.8% in the total freight market in 2020. The traffic volume of heavy haul railway transport is continuously increasing.
I. Overview of Heavy Haul Railway Transport in China

<table>
<thead>
<tr>
<th>Rolling Stock</th>
<th>Model</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-power AC-drive electric locomotive</td>
<td>HXD1/HXD2</td>
<td>Axle load: 25t; output power at wheel rim: 9,600kW</td>
</tr>
<tr>
<td></td>
<td>FXD1B/FXD2B</td>
<td>Axle load: 27t/30t; output power at wheel rim: 9,600kW</td>
</tr>
<tr>
<td>Heavy-duty wagon</td>
<td>C80E for general use</td>
<td>Axle load: 27t; empty weight: 26.5t; payload: 80t</td>
</tr>
<tr>
<td></td>
<td>C80E for coal transport</td>
<td>Axle load: 25t; empty weight: 20t; payload: 80t</td>
</tr>
<tr>
<td></td>
<td>C96 for coal transport</td>
<td>Axle load: 30t; empty weight: 24t; payload: 96t</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heavy-haul Line</th>
<th>Length/km</th>
<th>Axle Load/t</th>
<th>Traction weight/10,000 t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datong-Qinhuangdao Railway</td>
<td>653</td>
<td>25</td>
<td>2.1</td>
</tr>
<tr>
<td>Tangshan-Hohhot Railway</td>
<td>706</td>
<td>25</td>
<td>1.05</td>
</tr>
<tr>
<td>Watang-Rizhao Railway</td>
<td>1267</td>
<td>30</td>
<td>1.15</td>
</tr>
<tr>
<td>Haolebaoji-Ji’an Railway</td>
<td>1816</td>
<td>30</td>
<td>1.05</td>
</tr>
<tr>
<td>Shuozhou-Huanghua Railway</td>
<td>598</td>
<td>25</td>
<td>2.1</td>
</tr>
<tr>
<td>Shenmu-Shuozhou Railway</td>
<td>270</td>
<td>25</td>
<td>1.08</td>
</tr>
</tbody>
</table>
### I. Overview of Heavy Haul Railway Transport in China

<table>
<thead>
<tr>
<th>Railway Name</th>
<th>Main Locomotive</th>
<th>Main Wagon</th>
<th>Latest Running Train Consist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datong-Qinhuangdao Railway</td>
<td>HXD1 and HXD2</td>
<td>C80</td>
<td>30,000t heavy haul combined train test was conducted in 2014</td>
</tr>
<tr>
<td>Tangshan-Hohhot Railway</td>
<td>HXD1 and HXD2</td>
<td>C80</td>
<td>10,000t heavy haul unit train was put into operation in 2018</td>
</tr>
<tr>
<td>Watang-Rizhao Railway</td>
<td>HXD1 and HXD2 FXD1B and FXD2B</td>
<td>C80E and C96</td>
<td>12,000t heavy haul unit train was put into operation in 2020</td>
</tr>
<tr>
<td>Haolebaoji-Ji’an Railway</td>
<td>HXD1 and HXD2</td>
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</tr>
<tr>
<td>Shuozhou-Huanghua Railway</td>
<td>HXD1 and HXD2</td>
<td>C80</td>
<td>20,000t heavy haul combined train was put into operation in 2016</td>
</tr>
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</tr>
</tbody>
</table>

◆ New train consists have undergone heavy haul railway comprehensive test before putting into operation on heavy haul railway lines.
◆ The heavy haul railway comprehensive test have helped solving many practical problems in heavy haul train operation.
II. Heavy Haul Railway Comprehensive Test

Test System:
- Rolling stock test system
- Railway Infrastructure test system
- Communication test system
- Power supply test system

➢ Improve transport efficiency
➢ Increase the margin of operational safety
➢ Reduce the operation costs
The wireless network distribution test system consists of several test sections among which the wireless bridge is used for communication connection among sections, and one section serves as the monitoring center.
**II. Heavy Haul Railway Comprehensive Test**

### 1 Rolling Stock Test System

- A fiber-based test system consisting of the Ethernet switch, optical network unit and optical splitter
- Clock synchronization of all devices by GPS to get access to video and voice signal

### Fiber-based Distribution Test Technology

**Key technical issues in the test**
- Reliability of connection to long-distance optical network.
- Increase of long-distance multi-node luminous flux.
- Distribution of luminous power in the best proportion to reduce the optical loss of each test section.
II. Heavy Haul Railway Comprehensive Test

1 Rolling Stock Test System  
- Analysis of longitudinal dynamic performance under train traction and braking
- Analysis of dynamic performance of locomotives and wagons under train traction and braking
- Analysis of operating performance under different track conditions

Train Operation Data Analysis

[Graphs and data analysis]
II. Heavy Haul Railway Comprehensive Test

2 Railway Infrastructure Test System

Typical tracks and bridges of Datong-Qinhuangdao Railway, where 20,000t combined train is operated, have undergone the dynamic performance test.
The communication test system is used to test the field strength coverage, electromagnetic environment and service quality of mobile communication network of heavy haul railway as well as the application functions of the communication device for synchronization operation of locomotives.

➢ Unattended operation of ground test server
II. Heavy Haul Railway Comprehensive Test

4 Power Supply Test System

Test operation parameters of traction power supply of substations, AT posts and Section posts in the operation section of heavy haul trains. Adopt remote monitoring technology of traction substation.
Overview of Heavy Haul Railway Transport in China

Heavy Haul Railway Comprehensive Test

Application of Heavy Haul Railway Comprehensive Test

Summary and Outlook
III Application of Heavy Haul Railway Comprehensive Test

➢ Solve problems of new consists before putting into operation, to improve transport efficiency
Improvement of rolling stock technology, infrastructure reinforcement and reconstruction, optimization of wireless network signal and train operation

➢ Solve problems in long-term operation, to increase the margin of operational safety
Optimization of locomotive and wagon parameters and train operation.

➢ Support operation & maintenance of rolling stock, to reduce the operation costs
Optimization of maintenance classification and system and verification of train dispatching management
Traction weight: 20,000t -> 30,000t, heavy haul transport comprehensive test were conducted on Datong-Qinhuangdao Railway in 2014.

Traction weight: 10,000 -> 20,000t, heavy haul trains were put into operation on Shuozhou–Huanghua Railway in 2016.

The existing line of Tangshan-Hohhot Railway was reconstructed for 10,000t heavy haul trains in 2018.

10,000t heavy haul trains were put into operation on the new line of Haolebaoji-Ji'an Railway in 2019.

Traction weight: 5,000t->10,000t->12,000t, Axleload: 25t->27t->30t, the development of heavy haul trains operated in Watang-Rizhao Railway from 2018 to 2020.
In 2014, the operation test of 30,000t heavy haul train on Datong-Qinhuangdao Railway organized by China Railway Corporation was conducted successfully.

Suggestions were made for train control, strengthening of power supply capacity and improving reliability of communication system.

3,971m-long train, with a total traction weight of 31,050t, composed of 320 cars, including 315 normal cars and a test car.
One of the conclusion, the advantages of adding SS4 DC drive electric locomotive at the train rear were verified:

- significantly improving the air braking of the train, releasing synchronization, and reducing the longitudinal coupler force of the train;
- improving the overall traction capacity of the locomotive under test;
- improving the distribution of the electrical braking forces of the whole-consist locomotive;
- rheostatic braking applied during cyclic braking bringing a stabilizing function on the catenary voltage rise.

**Lightweight Transport Efficiency**

Datong-Qinhuangdao Railway

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**Graph Caption:**

![Graph showing longitudinal force (kN) for various points labeled K04, K141-K179, K189, K211, and K275-325. The graph compares different test scenarios and shows the force variations across these locations.]
III Application of Heavy Haul Railway Comprehensive Test

**Improve transport efficiency**

- **10,000t heavy haul comprehensive test on Watang-Rizhao Railway**
  - November 2017
  - December 2014
  - Putting into operation

**Watang-Rizhao Railway**

- **Trial operation of 30t axle load train on Watang-Rizhao Railway**
  - 2018-2020
  - January 2018
  - Putting into operation of 10,000t train
  - 2020
  - Putting into operation of 12,000t train

With the C80E for general (axle load 27t), the operation of 12,000t train.

With the C96 for coal transport (axle load 30t), the operation of 12,000t train.
III Application of Heavy Haul Railway Comprehensive Test

- Improve transport efficiency
- Watang-Rizhao Railway

With the same 27t axle load, the comparison between 12,000 t and 10,000 t train:

- Give full play to the locomotive capacity, with an increase of the traction tonnage of the same tractive locomotive by 12.5%.
- The longitudinal force level is controllable, but the coupler force increases by 5~6%.
- The train operation is detailed to make sure the operating performance.

Comparison between pure air braking and ECP braking of wagons for 30t axle load and 12,000 tons:

- The maximum coupler force is reduced by about 50%.
- The braking distance is reduced by about 8~14%.
- The average speed on long and steep downslopes is increased by nearly 20 km/h.
III Application of Heavy Haul Railway Comprehensive Test

Increase the margin of operational safety

I. Tracing test of 20,000t train to realize parallel test of the train at different positions.

II. Irregular replacement of test sections.

III. Remote download and real-time analysis of data.

✓ Optimization of train operation mode.
✓ Verification of parameter adjusting effect of rolling stock.
✓ Optimization of maintenance standard of braking system
Reduce the operation costs

Operation failure

TPDS

TADS

TWDS

THDS

TFDS

Comprehensive evaluation

Adjust the maintenance schedule and recommend scope of maintenance in real time

Evaluation methods are studied and confirmed according to comprehensive test.
Calculate vehicle operating mileage and track running trajectory based on big data.

Calculate vehicle operating mileage and running trajectory according to the networked records of the train number and time information obtained by the monitoring device. The running trajectory can assist the train dispatcher in arranging detention for repair, addition of vehicle and maintenance.

The operating mileage is verified by conducting the comprehensive test, with an error of less than 0.5%. Tracking of running trajectory can be used to facilitate operation and maintenance dispatching.
Overview of Heavy Haul Railway Transport in China

Heavy Haul Railway Comprehensive Test

Application of Heavy Haul Railway Comprehensive Test

Summary and Outlook
In order to reduce environmental pollution, China has gradually increased the share of freight transport via railway and decreased that via highway in recent years. Now, the share of turnover of freight traffic via railway is about 16% in China which is relatively low. China’s heavy haul railway has been developed stably in recent years, to meet the requirements of freight transport.

The heavy haul railway comprehensive test and other means are conducted to continuously improve the operating performance of heavy haul trains, increase the margin of operation safety and achieve sustainable development of heavy haul railway.

With digital means, the maintenance classification and system are optimized and the operation cost reduced to achieve sustainable development of heavy haul railway transport.

5G and other wireless network technologies will be applied to upgrade the heavy haul railway test platform, improve the test level of train operation and promote the development of heavy haul railway technologies.
THANK YOU!
“Future European developments of automatic digital couplers”
Future European developments of automatic digital couplers

Bo Olsson, Chief Strategist, Head of Shift2Rail Programme, Trafikverket

UIC IRRB Webinar “Sustainability and New Digital Trends for Heavy Haul”
14 December 2021
Intro

DIGITAL AUTOMATIC COUPLING

https://youtu.be/TQ7HImPljyA
The challenges for EU rail freight

Capacity
+ 50% rail freight
- 55% GHG emissions
by 2030
from bottleneck
to green backbone

Productivity
from manual intervention
to automation

Quality
from paper
to digital
Processes today – and tomorrow

manual freight wagon coupling

automatic freight wagon coupling

Courtesy of ÖBB

Courtesy of DAC4EU consortium
European DAC Delivery Programme enabled by Shift2Rail

Key Benefits
- Increasing infrastructure capacity
- Increasing rail freight efficiency
- Make modal shift possible: +50% by 2030, +100% by 2050
- Delivering the European Green Deal

Aim
- Selection of an open, fully functional, operationally tested, safe, sustainable European DAC open model ready for industrialization and deployment (assessments of available solutions, testing and demos)
- Deliver final open design of the selected model by the end of 2021 of which interoperability and safety requirements to be incorporated to TSI, Green Deal & Digitalization Package 2022
- Identify necessary add-on automation components and integrate them
- Identify migration and business plans compatible across Europe as well as the necessary resources to match them
- Communication and dissemination to facilitate DAC deployment in Europe

Enabler

This work is enabled by Shift2Rail to ensure technology and oversight independence, with a major role for the railway operating community as major future customer of the operational changes introduced, to meet final logistic customer expectations.
Implementation: focusing on employees, operations & safety

• Scope is defined
  • drawing attention to **shunting staff** as well as to technical inspection staff and train drivers
• Safety is key
  • highlighting the protection / prevention of **accidents**
  • respecting safety-relevant regulation - the evaluation and adaptation of safety-relevant regulation is mapped in other projects - will be central and definitely be taken care of
• Sustainable **employment opportunities**
  • qualification and further training
  • need for having at least the same or even better level of professional educated employees: in the course of digitalization, the need for additional services will increase
  • increased productivity pushing modal shift – reduction of staff in specific fields will be overcompensated by the associated general shift in traffic and - with new operating processes - require new better qualified jobs
EDDP – the European DAC platform

as per 30/11/21

65 DIFFERENT ORGANISATIONS (09/21: 59)

> 230 PARTICIPANTS

19 DIFFERENT COUNTRIES

ORGANISATIONS BY TYPE

<table>
<thead>
<tr>
<th>RUs/IMs</th>
<th>IMs</th>
<th>WKS</th>
<th>INDUSTRY</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>2</td>
<td>14</td>
<td>13</td>
<td>20</td>
</tr>
</tbody>
</table>

USA: 2 observers
The DAC and automation benefits

**rail freight sectoral**

- **Capacity**
  - Smart capacity, more efficient than conventional extension & much faster

- **Productivity**
  - Reduction of time/efforts (€), increase of system speed and asset efficiency

- **Quality**
  - Increased flexibility and reliability, innovative customer services and information

- **Worker’s & rail safety**
  - Automation of manual processes, invest in human capital

- **Economics & employment**
  - 10+ bn EUR value creation in Europe
  - better work-places in rail

- **Green Deal**
  - - 10 to -20 mn tons CO₂ equiv. p. a.

**society & environment**

- **Competitiveness**
  - new markets and growth

**Green Deal**

- 10+ bn EUR value creation in Europe
- better work-places in rail

**Economics & employment**

- 10+ bn EUR value creation in Europe
- better work-places in rail

**Capacity**

- Smart capacity, more efficient than conventional extension & much faster

**Productivity**

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**Economics & employment**

- 10+ bn EUR value creation in Europe
- better work-places in rail

**Green Deal**

- - 10 to -20 mn tons CO₂ equiv. p. a.
## Implementation: DAC and automation use cases

<table>
<thead>
<tr>
<th>Functionality (DAC/automation use case)</th>
<th>Basis</th>
<th>additional automation component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Automated coupling + manual uncoupling</td>
<td>DAC*</td>
<td>-</td>
</tr>
<tr>
<td>2 Automatic brake test &amp; calculation of braking capacity</td>
<td>DAC*</td>
<td>automatic braking test device</td>
</tr>
<tr>
<td>3 Recording of train composition</td>
<td>DAC*</td>
<td>-</td>
</tr>
<tr>
<td>4 Heavier trains &amp; longer trains (within existing infra limitations)</td>
<td>DAC*</td>
<td>(elimination of buffers, modified new vehicle design)</td>
</tr>
<tr>
<td>5 Increased payload</td>
<td>DAC*</td>
<td>-</td>
</tr>
<tr>
<td>6 Train integrity (for moving block ops.) + abandon of rear signal</td>
<td>DAC*</td>
<td>train integrity system (+ ETCS level 3)</td>
</tr>
<tr>
<td>7 Increased speed via improved longitudinal forces</td>
<td>DAC*</td>
<td>-</td>
</tr>
<tr>
<td>8 Increased speed via better braking performance</td>
<td>DAC*</td>
<td>electro-pneumatic brake</td>
</tr>
<tr>
<td>9 Wagon condition/performance info (incl. derailment detection)</td>
<td>DAC*</td>
<td>wagon telematics</td>
</tr>
<tr>
<td>10 Telematics for customers</td>
<td>DAC*</td>
<td>wagon telematics</td>
</tr>
<tr>
<td>11 Automated parking brake</td>
<td>DAC*</td>
<td>automated parking brake system</td>
</tr>
<tr>
<td>12 Automatic uncoupling (remote)</td>
<td>DAC*</td>
<td>actuator + automated parking brake system</td>
</tr>
<tr>
<td>13 Automated technical wagon inspection</td>
<td>DAC*</td>
<td>wagon telematics + video gate + infra check points</td>
</tr>
<tr>
<td>14 Longer trains up to 1500m</td>
<td>DAC*</td>
<td>(infrastructural adaptations +) ep-brake/distributed power</td>
</tr>
</tbody>
</table>

### Future automation use cases

15 Dynamic coupling and uncoupling

DAC* actuator + dynamic coupling system

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### Benefits allocation to process steps

<table>
<thead>
<tr>
<th>Shunting</th>
<th>Train prep</th>
<th>Train run</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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</table>

Heavier trains

<table>
<thead>
<tr>
<th>more trains on same network</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

Heavier & longer trains

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1. **Cost-benefit assessment for all use cases**
2. **Selection of use cases and linked technology packaging for roll-out to be defined based on CBA results**

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* * incl. infrastructural adaptions for safe DAC operation (e.g. buffer stops,...)
## Indicative overall time plan

<table>
<thead>
<tr>
<th>Year</th>
<th>Spec/DAC</th>
<th>Test DAC</th>
<th>Spec/development</th>
<th>Migration planning</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>Draft TSI</td>
<td>DAC type decision</td>
<td>data/energy system + hybrid loco coupler + additional automation components</td>
<td></td>
<td>Fund&amp;Fin scheme</td>
</tr>
<tr>
<td>2022</td>
<td>Operation, procedures</td>
<td>DAC demonstrator</td>
<td></td>
<td>Fund&amp;Fin installed</td>
<td></td>
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<tr>
<td>2023</td>
<td></td>
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<tr>
<td>2024</td>
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<td>2025</td>
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<td>2026</td>
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<tr>
<td>2027-29</td>
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<tr>
<td>30+</td>
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</tr>
</tbody>
</table>

### Spec/development
- Data/energy system + hybrid loco coupler + additional automation components

### Authorisation
- Strategy & planning & preparation

### Tests
- Data/energy system + hybrid loco coupler + additional automation components (« applications »)

### Large scale showcases/demonstrators/commercial pilots
(« early deployment ») + feedback

### Economics
- CBA

### Timeline
- 2021: Draft TSI
- 2022: Operation, procedures
- 2023: DAC type decision
- 2024: DAC demonstrator
- 2025: Data/energy system + hybrid loco coupler + additional automation components
- 2026: Strategy & planning & preparation
- 2027-29: Large scale showcases/demonstrators/commercial pilots (« early deployment ») + feedback
- 2030+: Development funding/financing

### Deployment
- Pre-phase
  - Workshops prep.
  - Start of DAC + additional components production
  - Start of loco retrofit
- Mig/proc
  - DAC tendering/procurement
  - DAC deployment funding/financing

### Indicative
- The timeline is indicative and subject to change.

### Notes
- The timeline includes key milestones and decisions.
- The plan is subject to change based on feedback and progress.

### Authorisation
- Strategy & planning & preparation
DAC tests in Trafikverket

Planned tests

Operational test

– Up to 44 wagons
– DAC level 4/5
– Focus on large scale real operational test of heavy applications (3500 tons)
– Hard winter conditions part of test
– EP brake
– EOT functions
– Wheel sensors
– RU
– Part of Europe Rail Full Digital Train
Any questions?

Shift2Rail EDDP Programme Management

- Mark Topal-Gökceli, ÖBB, mark.topal-goekceli@oebb.at
- Jens Engelmann, railiable, jens.engelmann@railiable.com
- Giorgio Travaini, Shift2Rail, giorgio.travaini@s2r.europa.eu
- Manuel Alarcon Espinosa, Shift2Rail, manuel.alarcon-espinosa@s2r.europa.eu

A single entry point for all Europe and beyond

https://shift2rail.org/european-dac-delivery-programme/

Target
All freight wagons (600,000+) in Europe couple automatically latest by 2030:

- Selection of an open, fully functional, operationally tested, safe and sustainable European DAC open model ready for industrialization and deployment.
- Deliver final open design of the selected model by the end of 2021 of which interoperability and safety requirements to be incorporated to TSI, Green Deal & Digitalization Package 2022.
- Produce efficient and robust solutions providing interoperable wagons and coaches.
- Identify potential European funding to support the migration plan

Would you like to participate to the programme which is open for all?
Click on the button below to fill in the application form.

APPLICATION FORM
Shift2Rail’s Freight Programme

- Projects under Shift2Rail’s Innovation Programme 5 on technologies for sustainable and attractive European Railway Freight have inspired this programme.

- Shift2Rail, a public-private partnership funded under the European Union’s Horizon 2020 programme, contributes to smart and sustainable growth by developing cutting-edge innovative solutions to create railway systems of the future for passengers and freight.
EU DAC Governance – programme and WPs

Programme Management

Mark Topal-Gökceli (ÖBB)  Jens Engelmann (railiable)

WP 1  WP 2  WP 3  WP 4  WP 5  WP 6  WP 7
Technology, Operations and Standardisation  Testing & Demonstrators & Pilot Projects  Migration  Rail System Capacity and Green Deal  Costs, Business Cases and Financing  Communication and Dissemination  Intelligent Rail Freight
“Environmental challenges and new digital opportunities for railway freight transportation. UK Experience”

Mr Phil Smart
Policy Manager – Rail Freight Group

IRRB Webinar, Sustainability and New Digital Trends for Heavy Haul, 14 December 2021
Rail Freight Group

The representative body for rail freight in the UK.

120 rail freight companies
  • Train Operators
  • End Customers
  • Ports and Terminal operators
  • Equipment suppliers
  • Support services
  • Legal and Consultancy firms

Aim to increase the volume of goods moved by rail.
UK Statistics – Construction growing (replacing coal)

Freight by commodity by quarter

Year and Quarter (source UK Office of Rail & Road)

- Coal
- Metals
- Construction
- Oil / petroleum
- International
- Intermodal (all)
- Other

Rail Freight Group
Improving Freight’s environmental performance

- More Electrification needed
- Power upgrades on electrified routes
- More network capacity for freight
- Better timetable priority for freight
- More routes suitable for freight
- Capacity for longer trains
Supporting economic growth

- 1 million homes
- 50-200 million tonnes of building materials
- 2.5 - 10 million road journeys?
Future trends – the ‘Jumbo Train’
Future trends

Moveable Overhead Conductor-rail System (MOCS) FOR FREIGHT TERMINALS

EXTENDED
Conductor-rail in open position to bring the train into the depot.

RETRACTED
Conductor-rail in retracted position allows safe, free access to train roof.
3 Squared ‘BulkSmart’

- Full visibility of complex supply chains
- Live performance data in real time
- Cost management tool
- Yard plan with stockpile information
- Managing arrivals and departures
- In use at HS2 London logistics hub
Future trends

Stadler Class 93 Tri-mode (ROG)

Zephyr 1800e CRAB (DB Schenka)

Clayton Diesel-Battery Hybrid
Creating a sustainable business: Hitachi Rail has devised a concept for a net zero depot.
East Coast Main Line digital signaling

UK on a ‘digital journey’

ETCS trial system in Wales

Plans to roll out on the ‘East Coast’ line

DAC in the UK? – the benefits

• Faster/safer coupling (but not uncoupling!)
• Increased coupler strength (longer trains?)
• Confirmation of train length. ETCS level 3 compatibility (better network capacity)
• Better braking capability allowing faster trains
  • Reduce ‘sectional running times’
  • Review of ‘2/3 rule’
DAC in the UK? Significant doubts!

• Safety case weak in UK.
  • Block trains permanently coupled. Very little shunting and manual coupling.

• Additional cost
  • ‘retrofitting’ of existing wagons
  • Adds cost to new wagons
  • Additional maintenance requirements
  • Provision of batteries for full digital benefit

• Resilience to dust etc.
DAC in the UK – issues and options?

• Fit to new wagons only?
• Retrofit?
  • Selected wagon types only?
• Fit to the ends (only) of block trains?
• Don’t adopt?
• If not DAC then what else?
• Operators cost to be passed on to customers!
  • Customers switch back to road?
• Can ‘state aid’ rules be overcome to allow it to happen in UK?
Thank You

phil.smart@rfg.org.uk

www.rfg.org.uk
15 minutes Coffee-Break
About energy-saving technologies in the transportation process. Experience of the Russian Federation

Михаил И. Мехедов
Deputy Director General of JSC «VNIIZHT»

Михаил Иванович Мехедов
Заместитель генерального директора
АО «ВНИИЖТ»
Technical means and technologies to reduce the carbon footprint
Технические средства и технологии, обеспечивающие снижение углеродного следа

Energy supply technologies and energy consumption of processes
Технологии энергообеспечения и энергопотребление процессов

Traditional carbon-containing technologies
Традиционные углеродсодержащие технологии

- Energy-saving organization of train traffic (Энергосберегающая организация движения поездов)
- Energy-optimal train driving (Энергооптимальное ведение поездов)
- A through system for planning, standardizing and analysing the efficiency of the use of fuel and energy resources for train traction (Система планирования, нормирования и анализа эффективности использования топливо-энергетических ресурсов на тягу поездов)
- Energy-efficient locomotive systems, power plants (Энергоэффективные локомотивные системы, силовые установки)
- Electrification of sections with diesel traction (Электрификация участков с тепловозной тягой)
- Increasing the capacity of the traction power supply system with reduced energy losses (Увеличение пропускной способности системы тягового электроснабжения со снижением потерь энергии)
- Implementation of the concept «Digital Traction Substation» (Реализация концепции «Цифровая тяговая подстанция»)

Green and low-carbon technologies
Зеленые и низкоуглеродные технологии

- Advanced technical means
Перспективные технические средства

- Technical means running on fuel with low carbon content (methane, methane-hydrogen mixture)
Технические средства, работающие на топливе с низким содержанием углерода (метан, метано-водородная смесь)

- Boiler plants (Котельные установки)
- Oil motors (Двигатели внутреннего сгорания)
- Gas turbine plants (Газотурбинные установки)

- Renewable sources of alternative energy
Возобновляемые источники альтернативной энергии

- Solar collectors (Солнечные коллекторы)
- Wind generating sets (Ветровые генераторные установки)
- Heat Pumps (Тепловые насосы)

- Energy Storage
Накопители энергии

- Generation energy (Энергия генерации)
- Generation of recovery (Энергия рекуперации)

- Fuel cell
Топливные элементы

- Hydrogen batteries (Водородные элементы питания)

Digital platform of environmental control and monitoring system
Цифровая платформа системы экологического контроля и мониторинга
<table>
<thead>
<tr>
<th>Technology</th>
<th>Customer</th>
<th>The effect of saving fuel and energy resources on train traction</th>
<th>Implemented by 2021</th>
<th>To be implemented in 2021-2022</th>
<th>Potential implementation volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-saving forecast schedule for freight and passenger trains (Энергосберегающий прогнозный график движения грузовых и пассажирских поездов) Hardware and software complex «Elbrus»; Automated system «Energograph» (АПК ЭЛЬБРУС, АС ЭНЕРГОГРАФ)</td>
<td>Central Directorate of Traffic Control (CD) (ЦД)</td>
<td>2-7 %</td>
<td>The entire network (completion in 2020) Вся сеть (завершение в 2020 году)</td>
<td>Development and maintenance Развитие и сопровождение</td>
<td>-</td>
</tr>
<tr>
<td>The system of energy-efficient planning of train flows in the conditions of repair work (Система энергоэффективного планирования поездопотоков в условиях ремонтных работ) Digital predictive macromodel (Цифровая прогнозная макромодель)</td>
<td>Department of Management of the business unit &quot;Railway Transportation and Infrastructure&quot; (ЦЖД)</td>
<td>1-2 %</td>
<td>Prototype for the South Urals Railway polygon Прототип для полигона Южно-Уральской железной дороги</td>
<td>The entire network in 2022 Вся сеть в 2022 году</td>
<td>-</td>
</tr>
<tr>
<td>Energy-optimal control regimes for freight trains (Энергооптимальные режимы управления грузовыми поездами) Energy Service - System of interaction with locomotive by means of technological radio communication - auto-control system (Энергосервер СВЛ ТР - системы автоведения)</td>
<td>Central Traction Directorate (CT) (ЦТ)</td>
<td>4-6 %</td>
<td>Experiment at the Altaiskaya – Karasuk The Western Siberian Railway in 2019 Эксперимент на участке Алтайская – Карасук Западно-сибирской железной дороги в 2019 г.</td>
<td>Preparing for implementation Подготовка к внедрению</td>
<td>The entire network in 2022-2023 Вся сеть в 2022-2023 годах</td>
</tr>
<tr>
<td>Unified system for planning, standardizing and analysing the efficiency of the use of fuel and energy resources for train traction (Единая система планирования, нормирования и анализа эффективности использования топливно-энергетических ресурсов на тягу поездов) Automated control system of fuel and energy resources (АСУ ТЭР)</td>
<td>Department of Economics (CEU) (ЦЭУ)</td>
<td>2-5 %</td>
<td>The entire network (freight and passenger traffic) Вся сеть (грузовое и пассажирское движение)</td>
<td>The entire network (economic traffic and shunting work) Вся сеть (хозяйственное движение и маневровая работа)</td>
<td>The entire network by special self-propelled rolling stock in 2022-2023 Вся сеть по ССПС в 2022-2023 годах</td>
</tr>
</tbody>
</table>
**Implementation completed in 2020**
(Внедрение завершено в 2020 году):
- 80 thousand km (100% of the network)
  (80 тыс. км (100% сети))

**Development (Развитие):**
- Subsystem of operational rebuilding of train traffic schedule
  (Подсистема оперативного перестроения ГДП)
- Subsystem of calculation of energy intensity of train traffic schedule
  (Подсистема расчёта энергоемкости ГДП)
- Digital forecast macro model (Цифровая прогнозная макромодель)

**Network level of technological control of formation, display and comparative analysis of the train schedule**
(Сетевой уровень технологического контроля формирования, отображения и сравнительного анализа ГДП)

**Data base of the main computing centre**
(БД ГВЦ)

**Central Freight Database (DO-25)**
(ЦБДГР (ДО-25))

**The schedule of executed train traffic «URAL-VNIIZHT»**
(ГИД «Урал-ВНИИЖТ»)

**Automatic transmission of the train schedule to the dispatch control and analysis systems of JSC “Russian Railways”**
(Автоматическая передача ГДП в системы диспетчерского управления и анализа ОАО «РЖД»)

**Subsystem of control and analysis ELBRUS-WEB**
(Подсистема контроля и анализа ЭЛЬБРУС-WEB)

**Autotracking systems for trains**
(Системы автоведения Поездов)

**Development**
- Fabrication completed in 2020
(Внедрение завершено в 2020 году):
- 80 thousand km (100% of the network)
  (80 тыс. км (100% сети))
Objective: Increase in the capacity and energy efficiency of transportation on the network of JSC "Russian Railways"

Цель: Повышение пропускной способности и энергоэффективности перевозок на сети ОАО «РЖД»

**TASKS (Задачи):**

- **Rapid macro-routing of traffic taking into account:**
  Оперативное макропланирование движения с учетом:
  - possessions («окон»)
  - the size of the traffic (размеров движения)
  - the structure of the train flow (структуры поездопотока)

- **Identification of bottlenecks**
  Определение «узких мест»

- **Technical and economic evaluation of train pass management decisions**
  Технико-экономическая оценка управляющих решений по пропуску поездопотока

- **Assessment of infrastructure efficiency**
  Оценка эффективности использования инфраструктуры

- **Forecast of the realisation of plans and normative indicators of train work**
  Прогноз реализуемости планов и нормативных показателей поездной работы

Replication: 2021 - South Ural Railway (Тиражирование: 2021 год – Южно-Уральская ж.д.)
Energy-efficient train control modes (Experiment on the section Ukladochny - Karasuk-3 of the West Siberian Railway)

- Энергооптимальные режимы управления поездами (Эксперимент на участке Укладочный – Карасук-3 Западно-Сибирской ж.д.)

<table>
<thead>
<tr>
<th>Journey parameters</th>
<th>Trip 1</th>
<th>Trip 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of journey</td>
<td>19.09.2019</td>
<td>21.09.2019</td>
</tr>
<tr>
<td>Locomotive type and number</td>
<td>ВЛ80С-075</td>
<td>ВЛ80С-075</td>
</tr>
<tr>
<td>Train number</td>
<td>2424</td>
<td>2424</td>
</tr>
<tr>
<td>Weight of the train, tons</td>
<td>6306</td>
<td>6324</td>
</tr>
<tr>
<td>Number of axes</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>Time according to the schedule, hours: minutes</td>
<td>6:25</td>
<td>6:25</td>
</tr>
<tr>
<td>Actual running time, hours: minutes</td>
<td>6:26</td>
<td>6:29</td>
</tr>
<tr>
<td>Weather conditions</td>
<td>Dry (сухо)</td>
<td>Clear (ясно)</td>
</tr>
</tbody>
</table>

Total power consumption, kilowatt-hour
<table>
<thead>
<tr>
<th>Общий расход электроэнергии, кВт∙ч</th>
</tr>
</thead>
<tbody>
<tr>
<td>14130</td>
</tr>
</tbody>
</table>

-4,8%

13484

- Energy-efficient control is a 4-6% reduction in train traction energy consumption and a 2-5% reduction in CO2 emissions from power generation.

Энергооптимальное управление – это снижение расхода энергии на тягу поездов на 4-6% и выбросов СО2 на генерацию электроэнергии на 2-5%
• Automation of the processes of planning, rationing and analysis of the efficiency of the use of fuel and energy resources for the traction of trains on the network of JSC «Russian Railways»

The main components that determine the energy efficiency of the transport process
Основные составляющие, определяющие энергоэффективность перевозочного процесса

<table>
<thead>
<tr>
<th>Train drivers</th>
<th>Locomotives</th>
<th>Traffic organization</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Машинисты</td>
<td>Локомотивы</td>
<td>Организация движения</td>
<td>Инфраструктура</td>
</tr>
</tbody>
</table>

Goal of the project (Цель проекта)
Повышение эффективности деятельности ОАО «РЖД» в части рационального потребления топливо-энергетических ресурсов на тягу поездов и СПСС

Project objectives (Задачи проекта)

Corporate level
Корпоративный уровень
• Analysis of fuel and energy resource consumption and influencing factors with development of corrective measures (Анализ расхода ТЭР и влияющих факторов с разработкой корректирующих мер)
• Planning and rationing the consumption of fuel and energy resources (Планирование и нормирование расхода ТЭР)
• Evaluating the effectiveness of energy-saving technical means and technologies (Оценка эффективности энергосберегающих технических средств и технологий)

Regional level
Региональный уровень
• Rationing and analysis of fuel and energy resources consumption by depot and type of traffic (Нормирование и анализ расхода ТЭР по депо и видам движения)
• Rational maintenance and distribution of locomotives (Рациональное обслуживание и распределение локомотивов)
• Analysis of energy intensity and additional energy consumption of train flows (Анализ энергоинтенсивности и дополнительных энергозатрат пропуска поездопотоков)

Linear level
Линейный уровень
• Rationing and analysis of fuel and energy resources consumption by sections and journeys (Нормирование и анализ расхода ТЭР по участкам и поездкам)
• Analysis of energy efficiency and improvement of qualifications of locomotive crews (Анализ энергоэффективности и повышение квалификации локомотивных бригад)
• Monitoring the efficiency of operation and condition of locomotives (Контроль эффективности эксплуатации и состояния локомотивов)

Project implementation phases (Этапы реализации проекта)

2020-2021 years (годы)
Mainline freight and passenger traffic
Магистральное грузовое и пассажирское движение

2021-2023 years (годы)
Functional development, economic and shunting traffic, specialized rolling stock
Развитие функционала, хозяйственное и маневровое движение, СПСС
• Promising energy-saving technology for freight transportation

• Перспективная энергосберегающая технология организации грузовых перевозок

Legend (Условные обозначения):

- start and end terminals (начальные и конечные терминалы)
- sorting terminals (сортировочные терминалы)
- base stations with railhead (опорные станции с боковыми погрузочно-выгрузочными площадками)
- routes of rapid freight trains with permanent composition (маршруты ускоренных грузовых поездов с постоянной составностью)

OVERHEAD REMOVAL TECHNOLOGY will make it possible to eliminate shunting work of locomotives on the way.

Use of electric loading and unloading equipment

Технология отвода контактной сети (ТОКС) позволит исключить маневровую работу локомотивов в пути следования.

Retracted position
JSC VNIIZhT is open to cooperation with all participants in the global rail market, including on sustainable development and carbon reduction.

АО «ВНИИЖТ» открыт к сотрудничеству со всеми участниками мирового рынка железных дорог, в том числе по вопросам устойчивого развития и снижения углеродоемкости.

We propose to consider the possibility of conducting joint research projects, aimed at reducing the carbon content (including energy saving) of energy consumption processes in the framework of IRRB.

Предлагаем рассмотреть возможность проведения совместных научно-исследовательских проектов, направленных на снижение углеродоемкости (включая энергосбережение) процессов энергопотребления, в рамках МСЖИ.
About energy-saving technologies in the transportation process.
Experience of the Russian Federation

Mikhail I. Mekhedov
Deputy Director General of JSC «VNIIZHT»

Михаил Иванович Мехедов
Заместитель генерального директора
АО «ВНИИЖТ»
“Organisation of heavy haul traffic. SUEK experience”

Mr Ilya Pershin
Director for Planning and Development of Railway Infrastructure, JSC "SUEK"

IRRBB Webinar, Sustainability and New Digital Trends for Heavy Haul, 14 December 2021
Heavy haul with a weight of 7,100 tons at the Vostochnyi polygon additionally provides an increase in carrying capacity.

**Transsib (Mariinsk - Nakhodka).**
(electric locomotive - 3ES5K, 3 sections, not axial)

- **Train weight - 6300 tons**
- Formation of the 1st train
  6300/100 = 63 cars (25tf)
- Length of the tracks = 71 cars
- The principle of operation is bogie traction control
- Limits the weight - capabilities of the electric locomotive and the adhesive weight

**BAM (Taksimo - Komsomolsk)**
(diesel locomotive - 3TE10MK, 3 sections)

- **Train weight - 5600 tons**
- Formation of the 1st train
  5600/100 = 56 cars (25tf)
- Length of the tracks = 71 cars
- Limits the weight - locomotive power and the adhesive weight according to traction calculations

**Transsib (Mariinsk - Nakhodka).**
(electric locomotive - 3ES5Kps, 3 sections, axial)

- **Train weight - 7100 tons**
- Formation of the 1st train
  7100/100 = 71 cars (25tf)
- Length of the station tracks = 71 cars
- Principle of operation - axial traction control
- Limits the weight - length of the station tracks

**BAM (Taksimo - Komsomolsk)**
(diesel locomotive - 3TE25K2M, 3 sections)

- **Train weight - 7100 tons**
- Formation of the 1st train
  7100/100 = 71 cars (25tf)
- Length of the station tracks = 71 cars
- Limits the weight - only length of the tracks on the BAM sidings

**Demand = + 240 cars per 1 train**

**Demand = + 450 cars per 1 train**
Successful cooperation between SUEK and Russian Railways on the development of heavy traffic weighing 7,100 tons allows to increase the reserves of the Komsomolsk-Vanino section.

1. 100% of coal trains weighing 7,100 tons are formed from Chelutai station to Vanino and Nakhodka.

When coal is shipped from Chelutai station to the east, only innovative cars with a load of 25tf are selected. In the port of Vanino at the DTU terminal, empty routes with 25tf cars are sorted at the Chelutai station.

An increase in the supply of new 3ESSK/ps electric locomotives to the Transsib sections will allow through traffic of 7,100 tons to Vanino, Nakhodka up to 7 trains per day.

Dispatching of trains from Chelutai station in 2020-21 weighing 7,100 tons, trains per day

- Line routes weighing 6300 tons or less
- Line routes weighing 7,100 tons
In 2021, the successful technology of driving 7,100-ton trains on the Chelutai - Vanino route was "broken" due to the low level of agreed applications for the Chelutai station.
The fleet of diesel locomotives 3TE25K2M and 3ES5Kps continues to grow, which makes it possible to increase the supply of trains of 7100 tons to Vanino and Primorye.

Dislocation of diesel locomotives 3TE25K2M for driving 7100 tons, units.

Dislocation of 3ES5K electric locomotives with axial traction control for driving 7100 tons, units.
Passage of container and heavy-haul trains to the east along key sections of the Vostochnyi polygon in 2021 per day.
Thanks for your attention
Panel discussion

Moderator, speakers, participants
Closing remarks
Stay in touch with UIC:

www.uic.org

#UICrail

Thank you for your attention.