FP5 TRANS4M-R

Transforming Europe's Rail Freight

Europe's Rail Joint Undertaking
Flagship Project 5 - TRANS4M-R

An update on DAC deployment and future developments

RAIL LIVE 2023, Madrid

30 November 2023

The project is supported by the Europe's Rail Joint Undertaking and its members.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Europe's Rail Joint Undertaking. Neither the European Union nor the granting authority can be held responsible for them.

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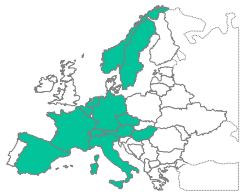
EU-Rail JU – Flagship Project 5

95 Million € TPC

Workstream Seamless

Facilitating **multimodal and intermodal** logistics across borders



Collaboration of 71 European partners from the whole railway sector

30% by 2030

Increasing the modal split for rail freight

FP5TRANS4M-R Transforming Europe's Rail Freight

Innovation Project for European Rail Freight funded by the EU

The **Digital Automated Coupler (DAC)** is the central enabler of the project

European Green Deal

Workstream FDFTO

Digitalising and Automating Freight Train Operations

Demonstrating new technology up to **TRL 8**

Europe's Rail

Part of Europe's Rail

We are part of EU-Rail JU

… embedded in the EU-RAIL Multi-Annual Work Programme

Network management planning and control & Mobility Management in a multimodal environment

Digital & Automated up to Autonomous Train Operations

Intelligent & Integrated asset management

A sustainable and green rail system

+ Exploratory Research and other activities

Digital Enablers

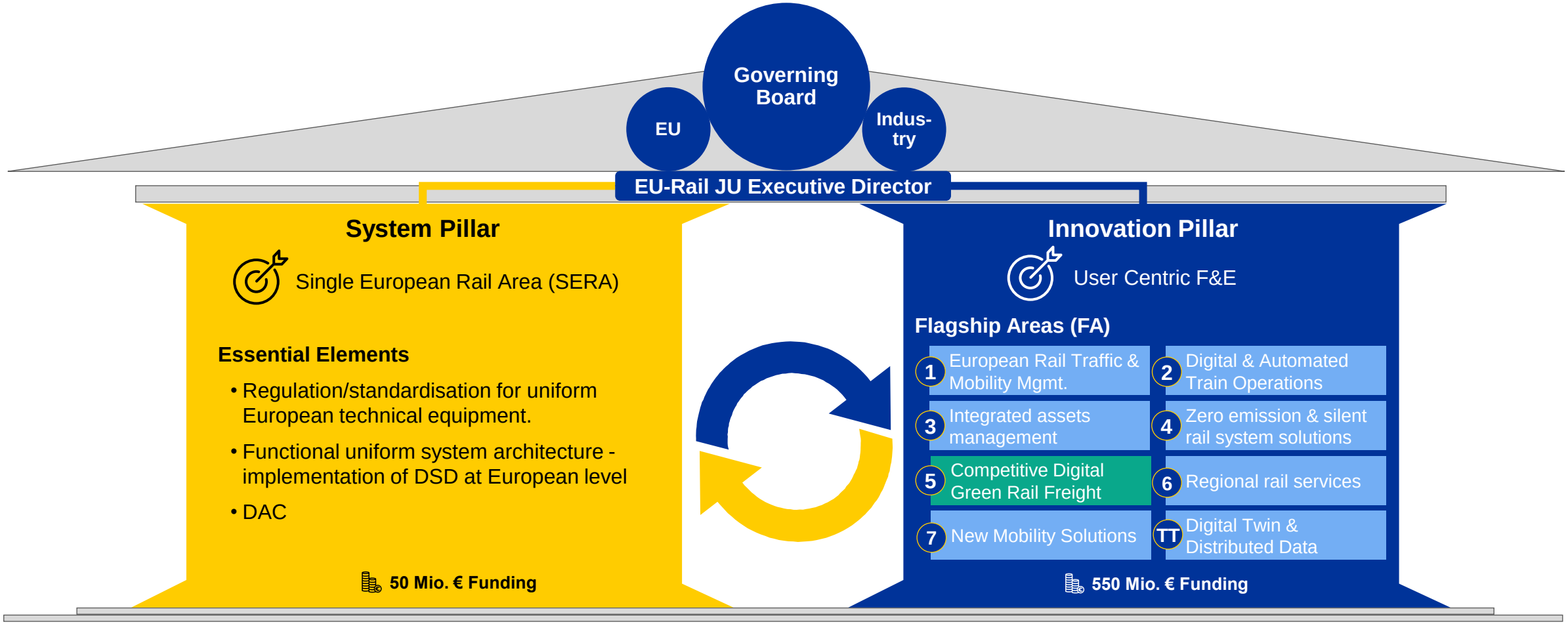
Innovation on new approaches for guided transport modes

Regional rail services / Innovative rail services to revitalise capillary lines

Sustainable Competitive Digital Green Rail Freight Services

We are part of EU-Rail JU

... and part of the Innovation Pillar



Grant Agreement – Project Structure

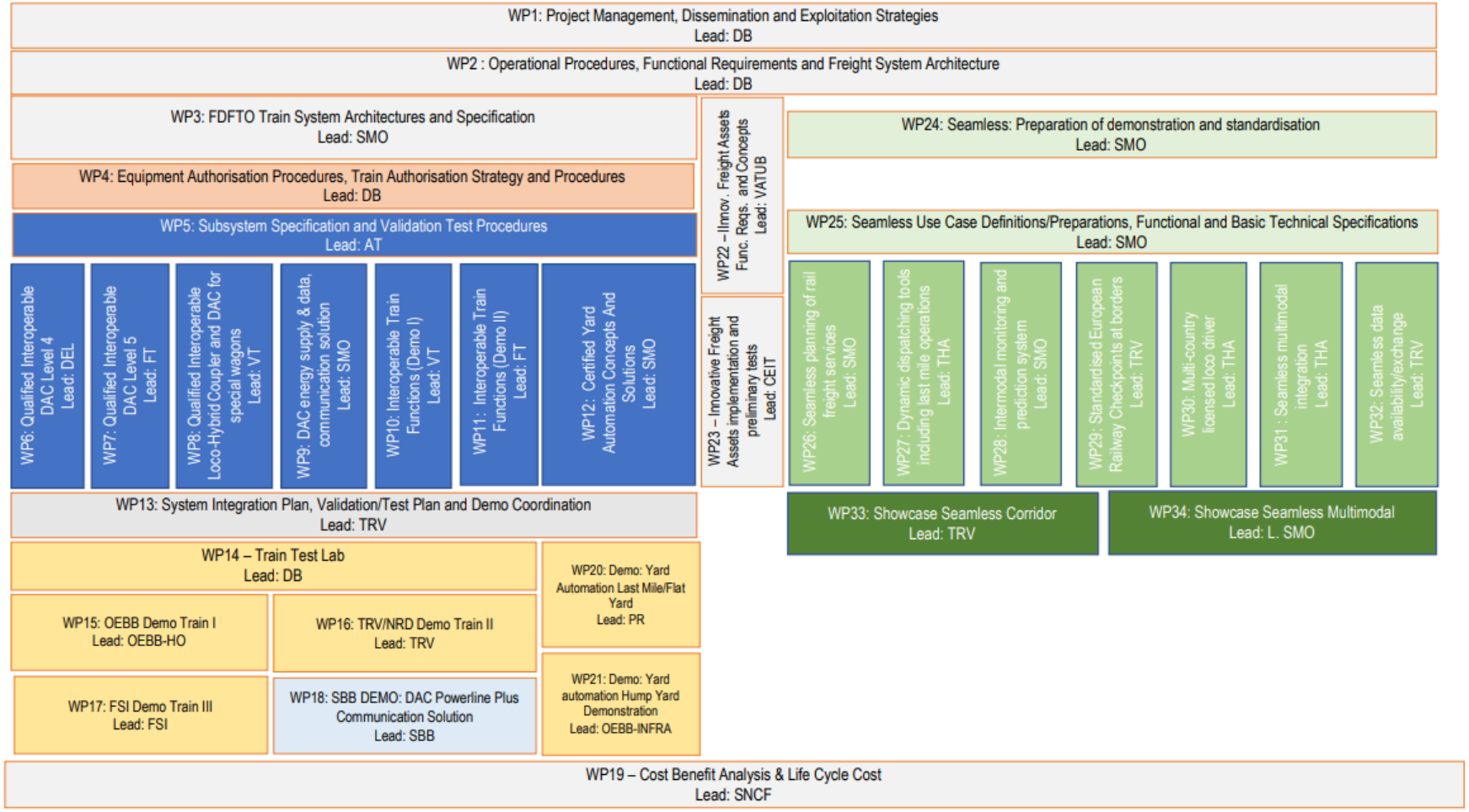


Figure 4 FP5-TRANS4M-R Work Package Structure

The challenges for EU rail freight

Capacity

+ 50% rail freight

- 55% GHG emissions

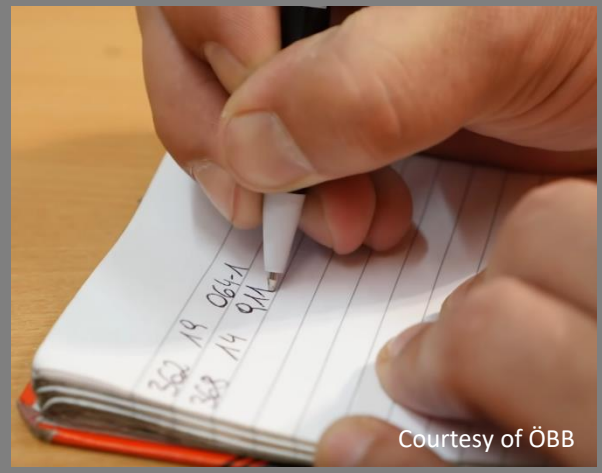
by 2030

from bottleneck
to green backbone

Productivity

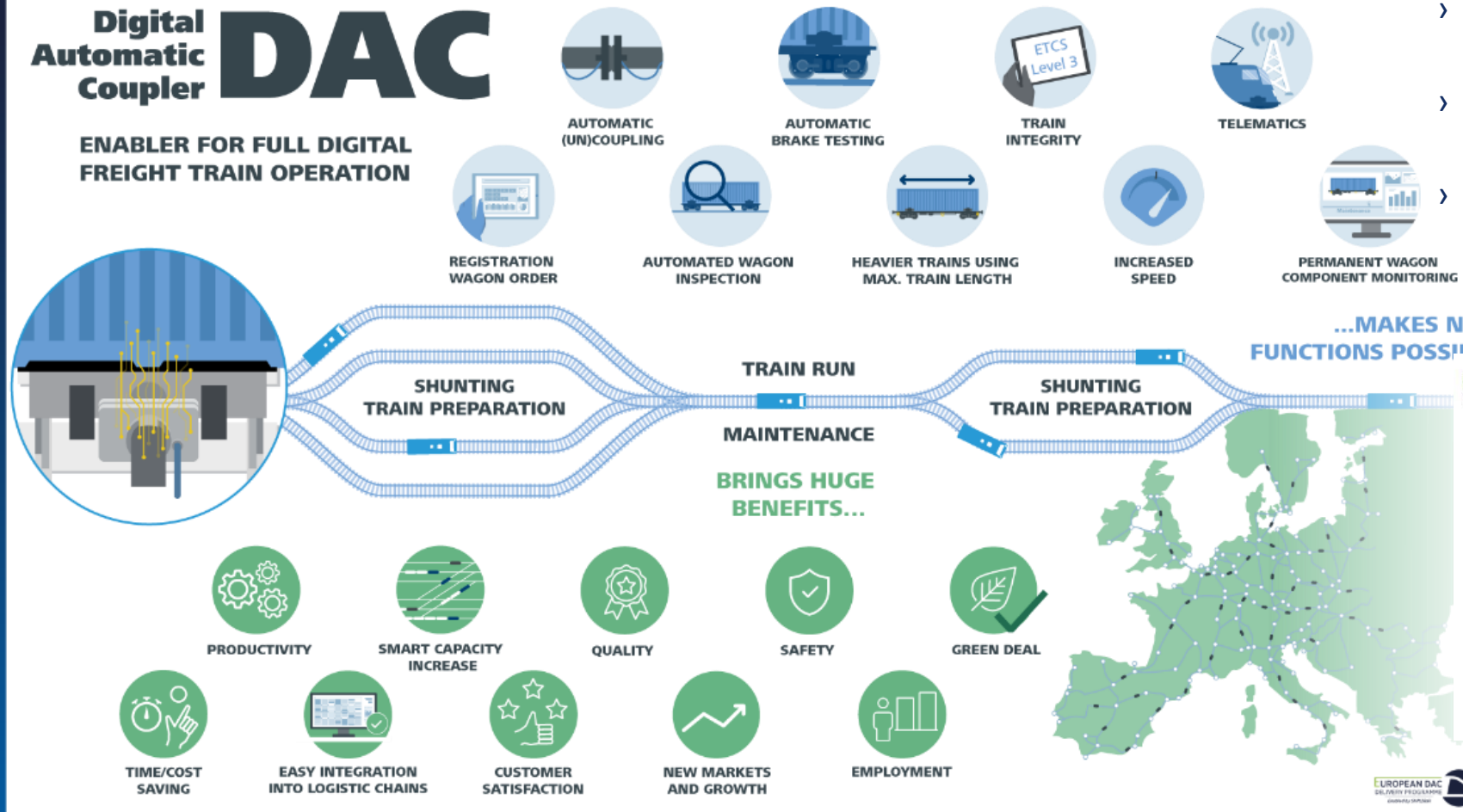
from manual intervention
to automation

Quality

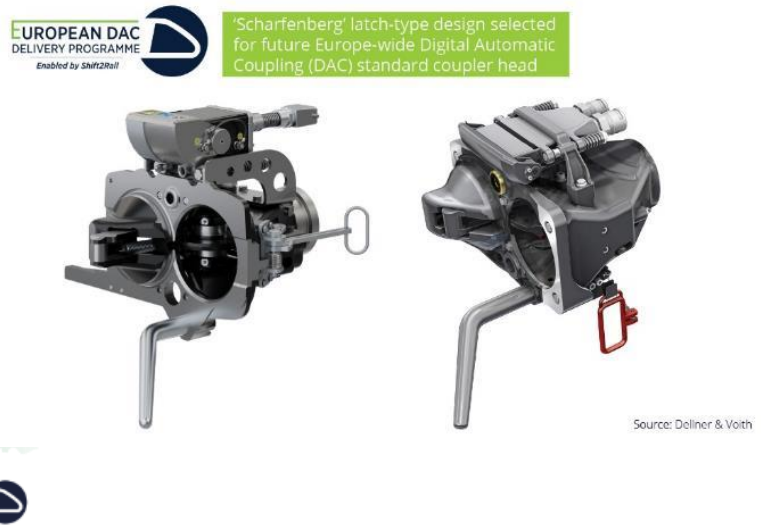


from paper
to digital

DAC for Full Digital Freight Train Operations



- **more than just a coupler**
- key and unique **enabler for numerous applications**
- allowing more **use cases** to **generate** a max. possible **benefit**
- the backbone for **“full digital freight train operations”** in order to transform European rail freight



Use cases: DAC core system and DAC applications (Full Digital Freight Train Operations)

benefits =

gains in the processes (time, system time, cost savings, capacity, reliability, quality, safety)

+ induced modal shift

DAC core system

- **Automated coupling & manual uncoupling and digital backbone**
- **Recording of train composition**
- **Automatic (in-train and remote) uncoupling**
- **Heavier & longer trains (within existing infra limitations)**
- Increased payload
- Increased speed via improved longitudinal forces

DAC shunting

- Automated parking brake
- Draining of auxiliary air tanks
- Automated air valve
- Rear view camera for train driver
- Proximity detection
- Sound signals when train in motion

DAC train preparation

- **Automatic brake test & calculation of brake capacity**
- Automated technical wagon inspection

DAC train run

- **Train integrity**, enabling ETCS L3 moving block operations
- Increased speed via better braking performance
- Multiple loco traction and trains up to 1500m
- Derailment detection

DAC telematics (wagon & goods monitoring)

- Predictive / preventive maintenance
- detection of cargo condition
- Cargo surveillance, intrusion alarm
- Wagon data & loading information on mobile device

DAC loading & unloading

- Automatic loading/unloading processes (replacement of hydr/pneum components, electro-mechanical actuators for bridge plates, automated cargo securing, heating elements for defrosting, …) via ext. energy supply
- illumination for worker's safety & interior

All DAC-related activities

Europe's Rail Flagship Project 5	EDDP	development/follow-up of migration roadmap, sector–wide coordination, risk management, prep. of decision-making	EC/ERA	Europe's Rail System Pillar	ESOs

DAC/"Full Digital Freight Train Operations"

target operat. proc.
functional requ'mts
system architecture
tech. development
testing & demos
tech. specification
authoris. dossiers

FP 5 FDFTO sounding boards

Technology (mirroring & sector feedback)

Operational Procedures (mirroring & sector feedback)

DAC migration roadmap

11 actions

- Fleet Analyses & rtf Engineering (rtf readiness)
- Retrofit capacity plan (workshops, work-force, components)
- Funding & Financing plan
- CBA (updates)
- Infrastructural & IT adaptations
- Retrofitting plan (traffic & customer sidings analysis, operational plan)
- Investment plan & procurement framework plan
- Placing into service plan (safety, workforce training, rulebooks etc.)
- Other regulatory & legal framework plans

development of efficient & suitable authorisation provisions & requirements

preparing TSI drafts for the EC

TSI revision

operational procedures standardisation (plan & execution)

Technical harmonisation: preparing inputs for ERA TSI drafting process & driving EU standardisation

alignment of rail & DAC system architecture

Executing European standardisation

Full Digital Freight Train

Operators‘ Challenges and milestones

Challenges for operators

- **Standardisation of operational processes:** “Use case" and standardised operating procedures at European level.
- **Migration Fleet of different types of wagons and locomotives in EU:** Installation effort and testing of solutions for wagons and locomotives
- **Training of the staff:** new competences and new operating processes

Milestones achieved

- **Publication of the Preliminary Target Operational Procedures":** New operating procedures integrating FDFT technologies.
- **Opening of the Train Test Lab:** Wagons and Technologies available for testing in the railway environment
- **Functional architecture:** first definition of the new system to be used in demonstrators

- **Next milestones** include the finalisation of the Safety Assessment, publication of the specifications and conclusion of the development phase.

DAC Cost Benefit Analysis: Foundations

The cost benefit analysis is aligned with guidelines from European Commission: “Guide to cost-benefit analysis of investment projects” from December 2014.

“CBA is an analytical tool to be used to appraise an investment decision in order to assess the welfare change attributable to it and, in so doing, the contribution to EU […] policy objectives. The purpose of CBA is to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives.”

In a CBA, two scenarios are compared:

- A baseline scenario, which is not a do-nothing scenario, but rather the most realistic scenario without the investment
- A project scenario (with possible variants), which is considering the investment

DAC CBA update: Main results per technical package

Tech package	Start	Duration	Big bang	Variable	Results 2028-2057 *(mEUR)*	Results 2028-2037 *(mEUR)*
1	2028	6	2031	Total benefits (not discounted)	55,604	6,491
				Total costs (not discounted)	21,357	10,621
				Total benefits (discounted)	29,373	4,815
				Total costs (discounted)	14,307	8,908
				BC-ratio (discounted)	2.1	0.5
				IRR	11%	\
2	2028	6	2031	Total benefits (not discounted)	64,027	7,769
				Total costs (not discounted)	26,590	12,180
				Total benefits (discounted)	33,967	5,765
				Total costs (discounted)	17,433	10,209
				BC-ratio (discounted)	1.9	0.6
				IRR	11%	\
3	2028	6	2031	Total benefits (not discounted)	87,970	11,365
				Total costs (not discounted)	30,043	13,061
				Total benefits (discounted)	47,012	8,439
				Total costs (discounted)	19,428	10,928
				BC-ratio (discounted)	2.4	0.8
				IRR	15%	\
4	2028	6	2031	Total benefits (not discounted)	124,066	16,837
				Total costs (not discounted)	37,770	15,032
				Total benefits (discounted)	66,704	12,508
				Total costs (discounted)	23,895	12,537
				BC-ratio (discounted)	2.8	1.0
				IRR	19%	\

Selection also depending on availability of deployment-ready, reliable "D" products at start of migration

Package 4 benefits and costs require further elaboration

Main conclusions for all technical packages based on the current findings:

1) **DAC project is very beneficial from a societal perspective (30y)**
2) **For a positive business case (10y), public financial support is required**

Interpretation of results

- It is **NOT a completed CBA**, as the work of other work packages which are used as an input for the CBA are not finalised yet. Open points and data to be reviewed, complemented and validated
- Information was typically fragmented and incomplete. Despite continuous efforts, **data quality can be improved**. Feedback is warmly welcomed.
- The transport forecast is partially based on a policy goal: **the doubling rail of freight by 2050. It presumes an average annual growth of ~2.3%**. Important factor to properly interpret results.
- The **CBA does provide an insight into the direction and magnitude** of what DAC implies for the rail sector

Key points to be integrated and/or considered qualitatively

Using updated insights, the CBA may become more positive or negative. All depends on how the new numbers relate to those used today

14 use cases (e.g. derailment detection, see appendix) have not been assessed. Nor have their associated component costs been considered due to data gaps.

Time savings and conversion factors – values depend on how successfully the railway system as a whole adapts to DAC. A topic of ongoing discussions.

Update cost assessment of final DAC design
Update assessment of coupler costs

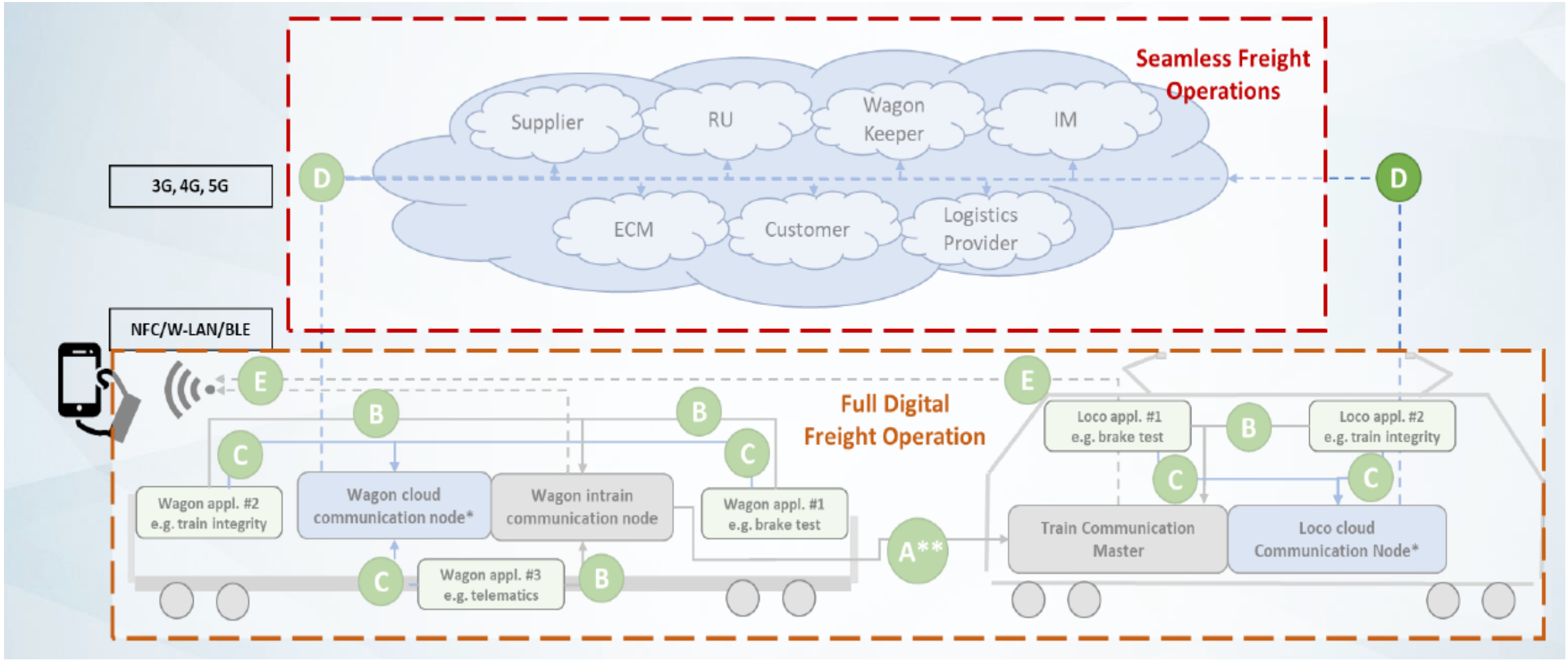
Update implementation cost assessment based on final implementation plan, including e.g. staff training costs

Final assessment of DAC maintenance
Final assessment of DAC reliability

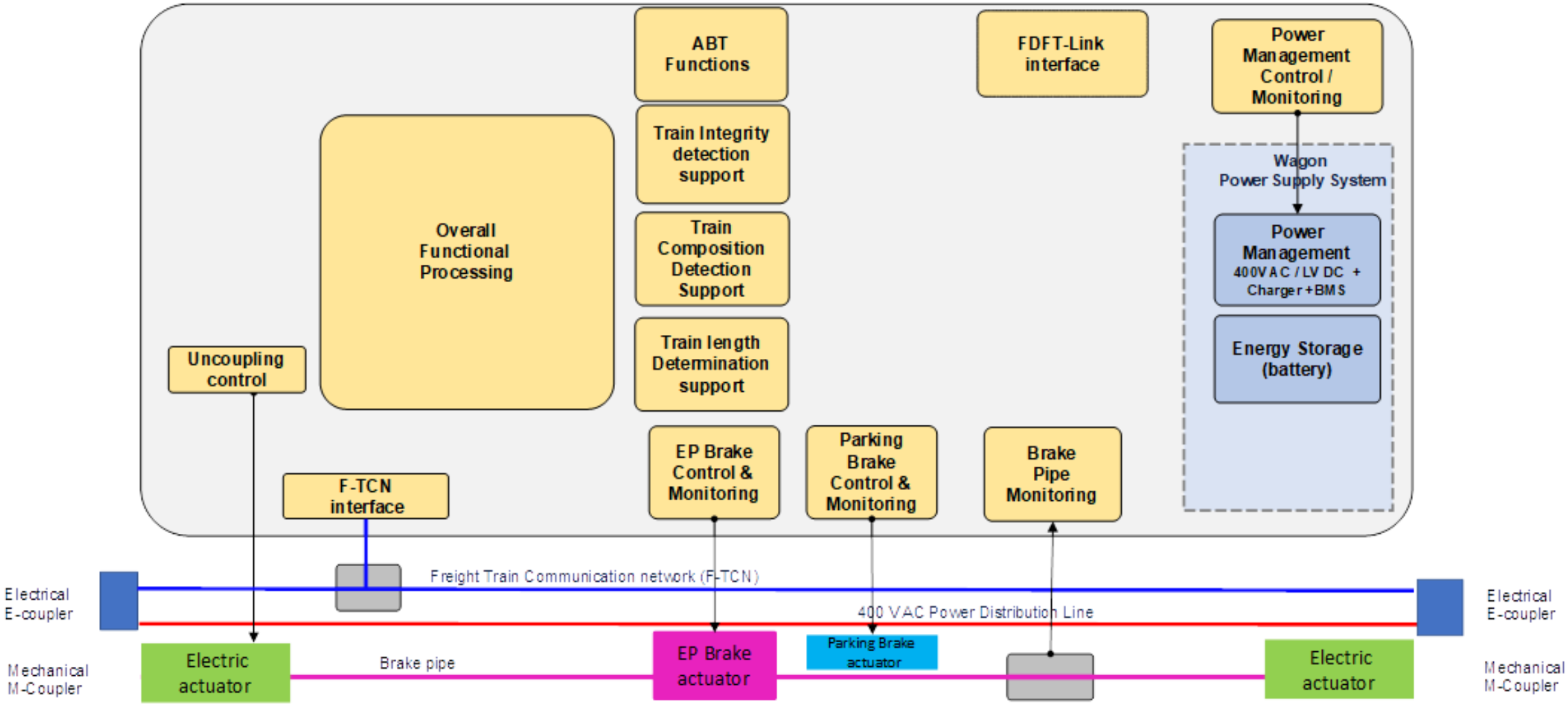
Final assessment administrative and possible authorisation costs

15

DAC – Enabler of future rail freight



Complex wagon system architecture



Source: FP5 - TRANS4M-R - Del 3.1: System Req Spec FDFT

Challenges for the industry

- **System safety:** the automation of processes and procedures currently carried out by specialised personnel will require an adjustment of the Safety Integrity Levels in various areas (software, hardware) with an impact on the costs of the DAC system.
- **Reliability and availability:** increased complexity of the train system intrinsically reduces the reliability and therefore availability of the train itself; the restoration of availability will require the adoption of redundancies in some areas with an impact on the costs of the DAC system
- **Maintenance:** the need for fleet software updates over the life of the system will require standardised, cloud-based download methods. A European body in charge of authorising and synchronising software update actions in harmony with the various ECMs must be established
- **Interoperability of the interfaces:** collaboration for the definition, specification and standardisation of functional interfaces (data, communication protocols), mechanical, electrical, pneumatic needs to take place
- **Supply chain:** production and logistics capacity capable of supporting the migration plan

The prerequisite for the system development?

Stable specification

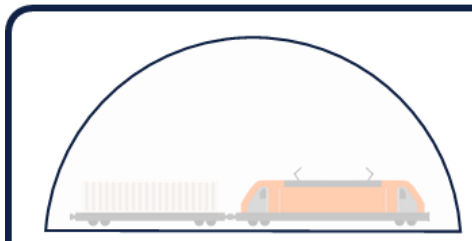
Focus on the DAC set of train functions for full deployment

- DAC coupler incl. energy/data system
- Train composition/wagon order detection
- Automated brake test
- Train integrity & train length determination
- Automated uncoupling (uncoupling in-train from loco)

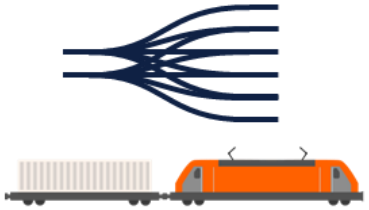
Next actions

- Freezing the baseline specification enabling completion of the development within FP5 - TRANS4M-R timeframe
- Setting up the change management process

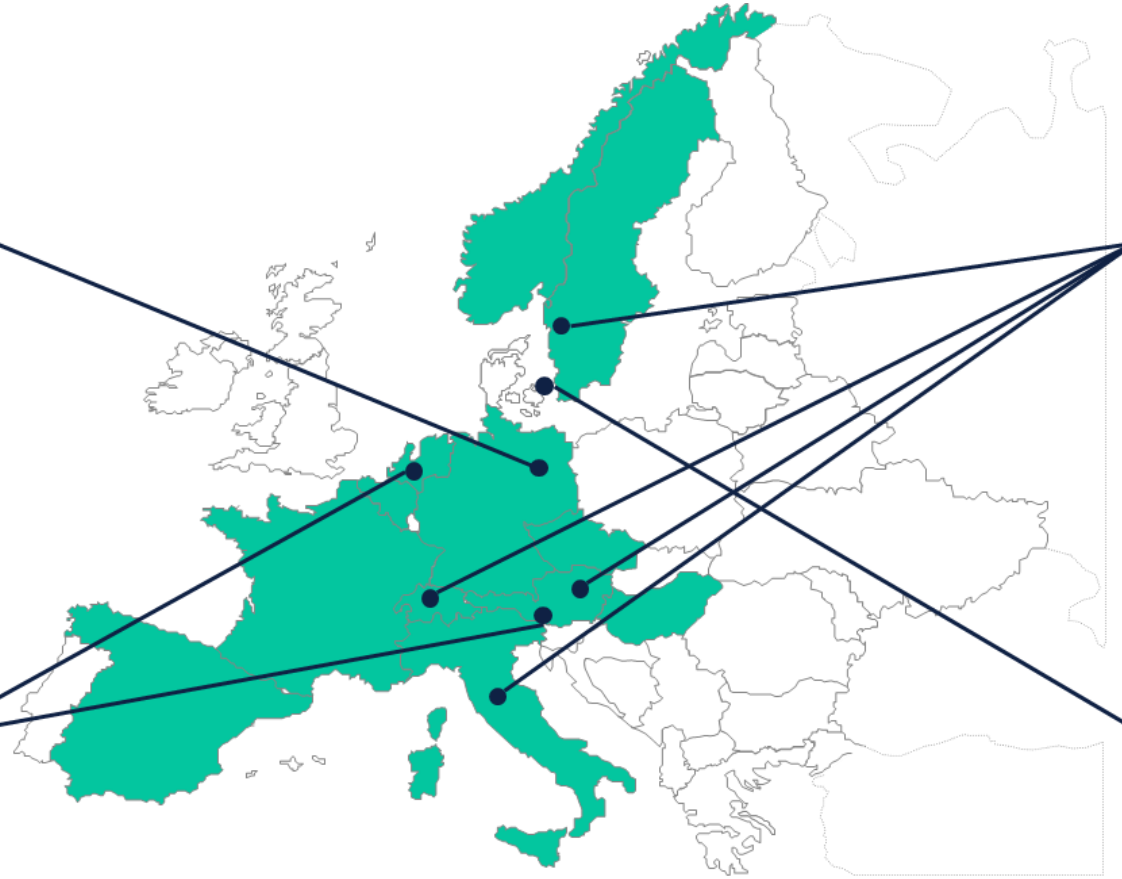
And then? Demonstrators planned



Train Test Lab
(WP 14)



Automated Shunting in Flat and Hump Yard
(WP 20 + 21)



Demo Trains for FDFTO
(WP15 - WP18)

European Checkpoints
(WP29)

Seamless Showcases
(WP33 – WP34)

It is becoming real!

Thanks!

https://rail-research.europa.eu