

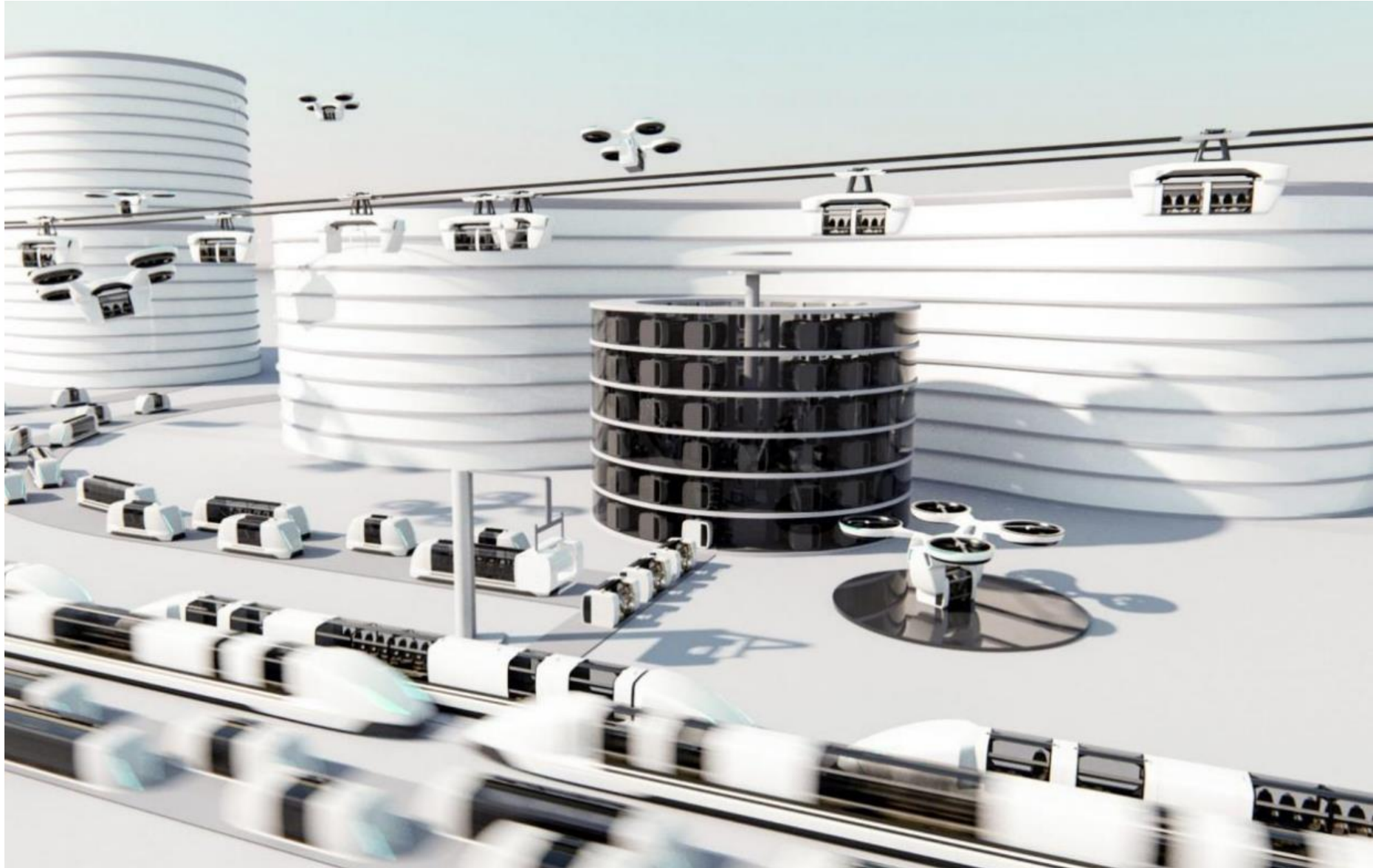
Pods4Rail Mid-Term Event

Science Fiction became Reality

Motivation, Vision, Results and Challenges

04. February 2025

Welcome to Team "Science Fiction"



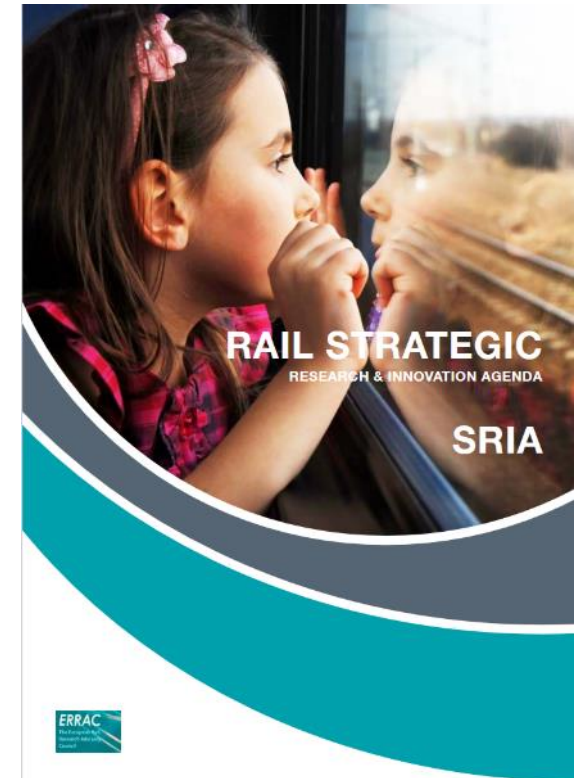
Sometimes it is time to dream

To dream of things that could be but are not yet.

Sometimes it is time to think about dreams further,
dreams that could become reality,
to take dreams to a new dimension.

Years ago, a vision was created, and with knowledge
and expertise, it was taken to another level.

Years ago, this vision became part of a strategic
agenda.



Sometimes it is time to react



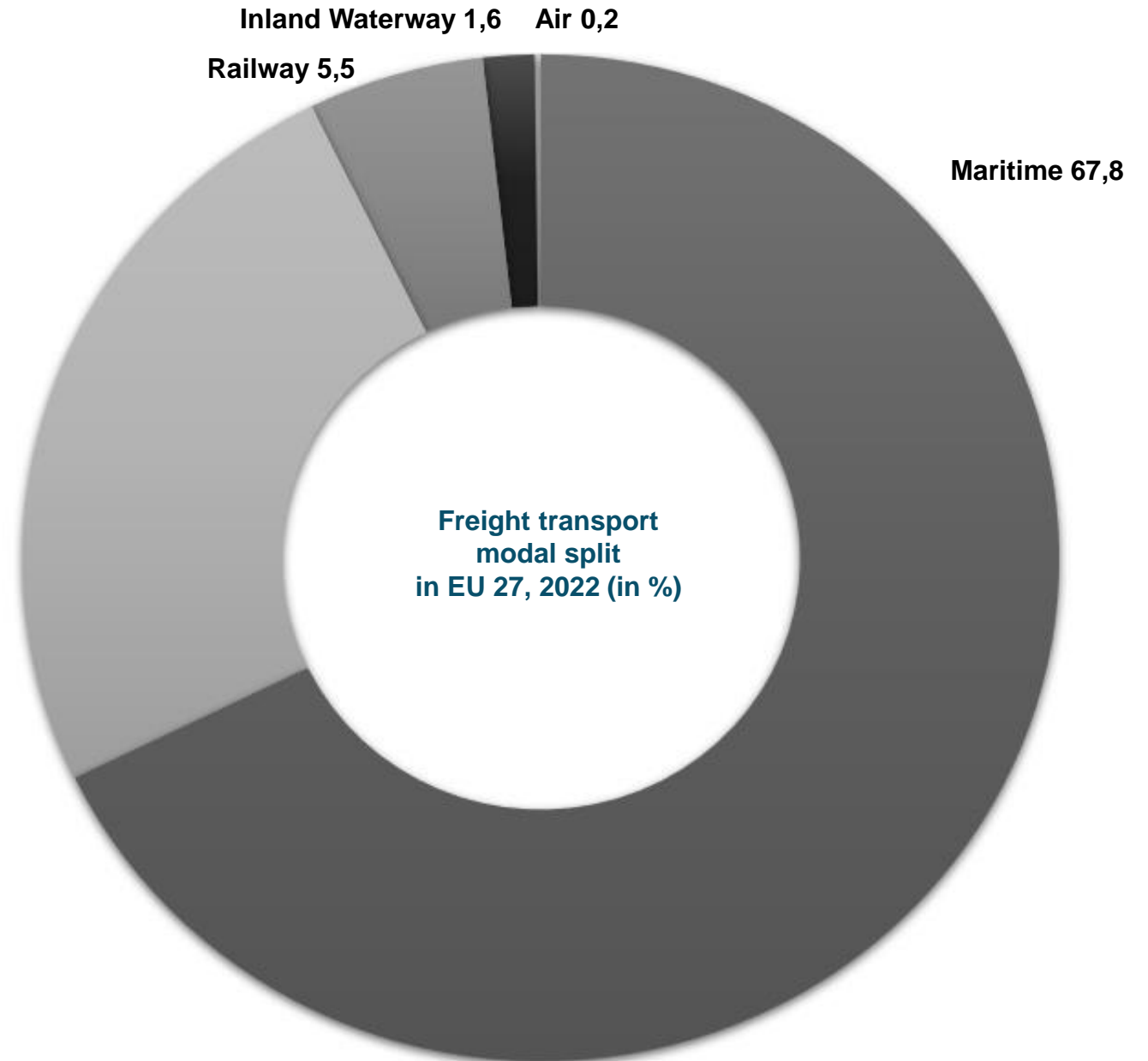
We all know that today, more than ever, it is important to preserve our planet for future generations.

We all know that we must protect the world we live in, the environment, the climate.

We all know that as part of the transport system, we can make a significant contribution to save resources, reducing emissions and creating a better future.

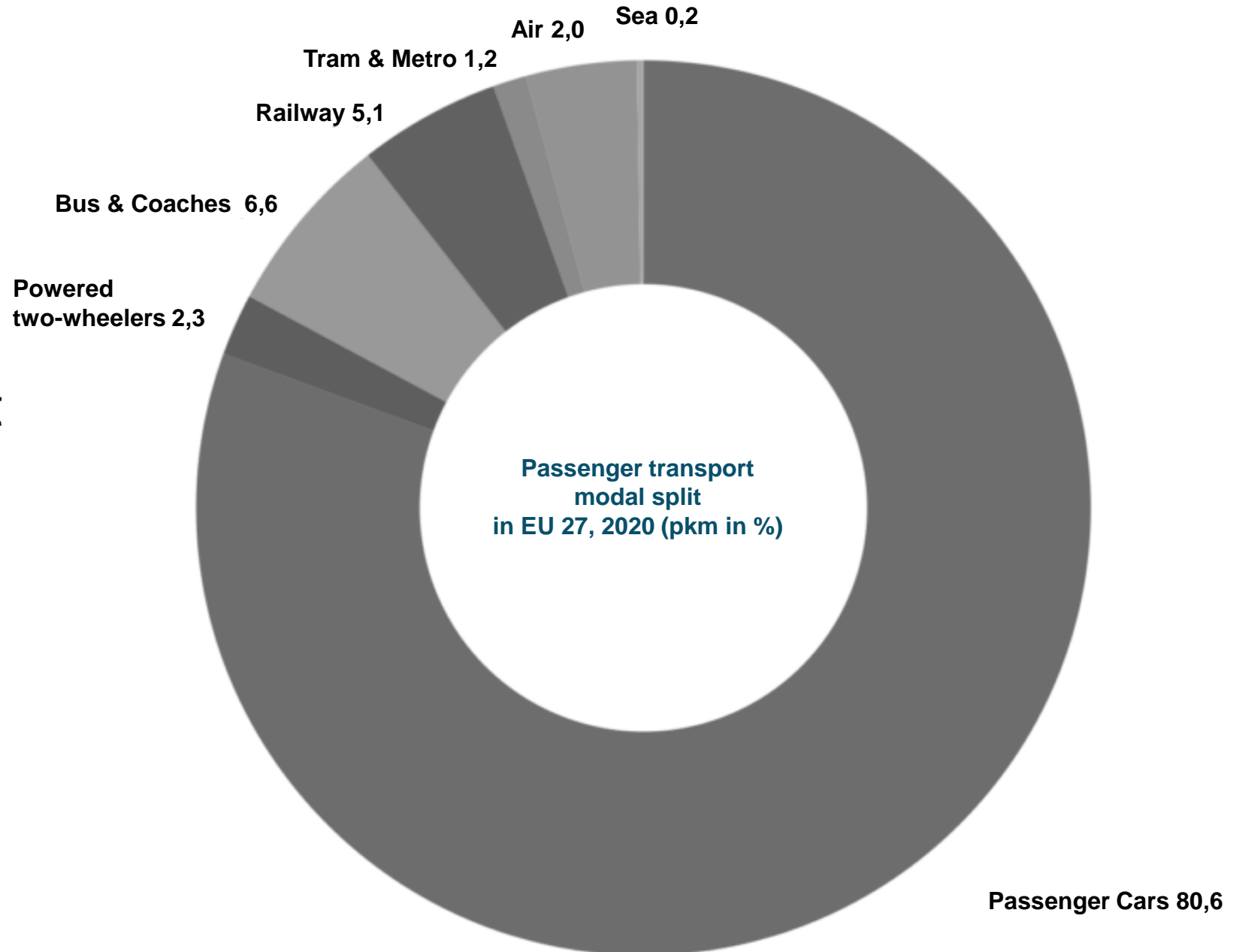
But are we on the right track?

The modal split between the different modes of freight transport does not tend to change radically from year to year at EU level.



Public transport is needed to reduce Green House Gas emissions and pollutant emissions stemming from daily mobility.

But are we doing enough?



How to Change?

The European Green Deal says:



Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, the European Green Deal will transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind

Transport and the European Green Deal

The transport system is critical to European businesses and global supply chains.



Our goal of being the first climate-neutral continent by 2050 requires ambitious changes in transport.

A clear path is needed to achieve a 90% reduction in transport-related greenhouse gas emissions by 2050.

Making transport sustainable for all!

Three objectives of the EU Transport Policy

Making the European transport system more **sustainable, smart and resilient**



- **Sustainable:** zero-emissions vehicles, ports and airports, urban mobility, greening freight transport, pricing carbon
- **Smart:** connected and automated multimodal mobility, innovation and artificial intelligence
- **Resilient:** reinforcing the Single Market, fair and just mobility, improving transport safety and security

The strategic elements in the railway sector is named “*accelerating the shift to **sustainable and smart mobility***”.



Making the railway system
work better for society.

Smart Mobility is the Interface between Technology and Mobility

Smart Mobility means:

- more flexibility
- more efficiency
- smart connection
- fewer emissions
- available at any time, everywhere

Autonomous vehicles



Electromobility



Intelligent Operation



Mobility-Applications



Does Smart Mobility mean “Mobility as a Service”?

“Mobility as a Service” is set to revolutionise public transportation

Today it integrates various modes of transport into a seamless, interconnected network, allowing users to plan their entire commute through a single digital gateway.

But are applications
enough?



Why does “Mobility as a Service” not allow truly seamless transport?

Why do we still have to change from one mode of transport to another in public transport?

Why is door-to-door passenger transport a privilege of car owners?

Where is the intermodality?

Why does intermodality for public transport today still not work, as it could work?

Because each mobility system optimises itself.

Because we do not think in holistic systems.

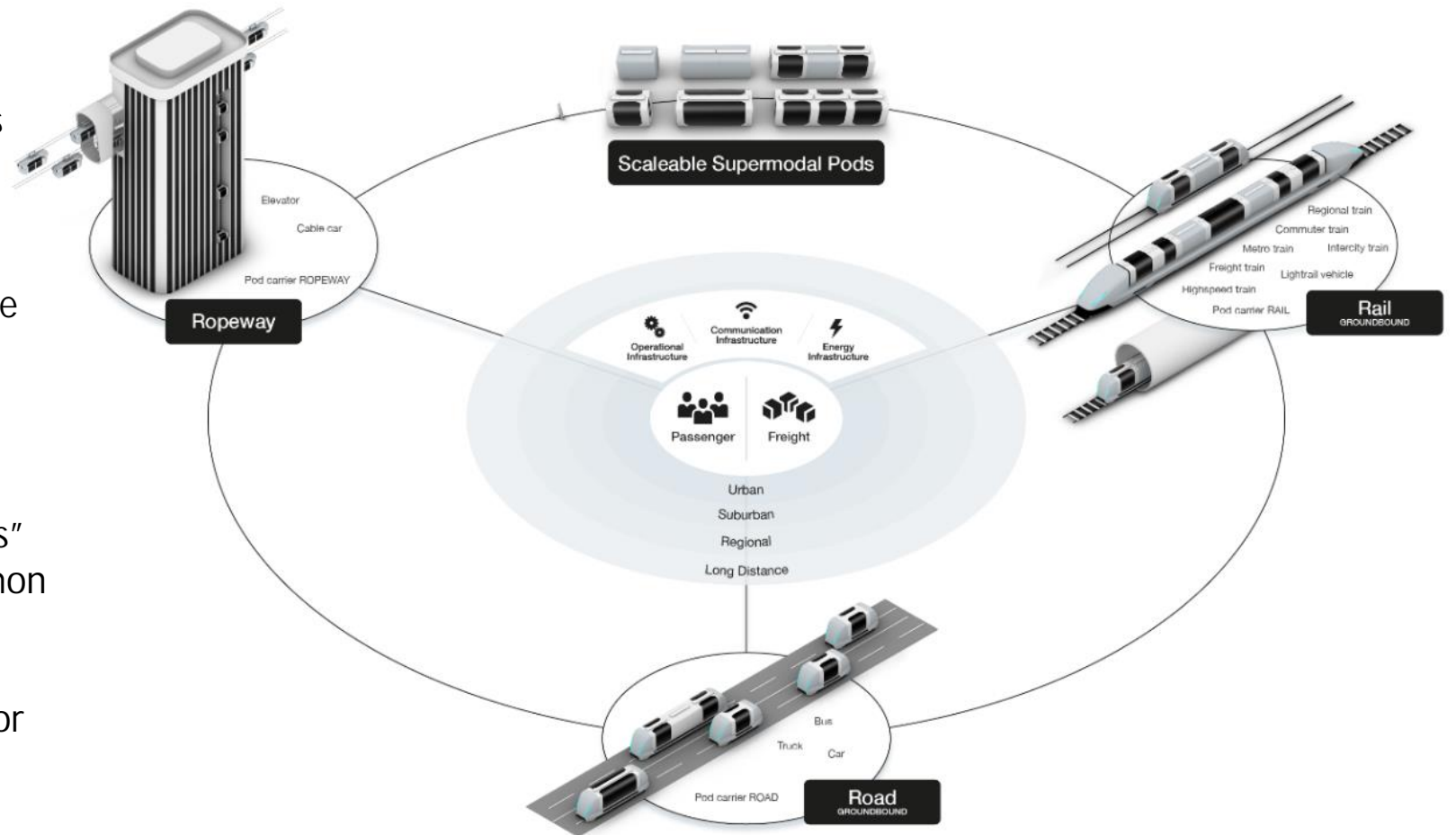
Because we do not have standardised, compatible systems.

Our Intention - Bring Smart Mobility into Reality

Create a Sustainable Supermodality of the Future

Vision and Idea

- Develop a rail based fully autonomous Supermodal Mobility-System for passengers and goods, standardised, scalable and suitable for all transportation modes, according to the actual needs of the end users and the actual traffic situation in the different modes, with three key elements:
 - Moving Infrastructure – intermodally connected by “Pods”
 - Open Platform – based on common standards and standardised interfaces
 - Disruptive Operation Models – for existing infrastructure



It's not just about marketing

Give a vision a foundation

- be realistic
- be economical
- be sustainable
- be scientific

So how to approach the topic?

Clarify whether the idea makes sense and is feasible in all aspects	Create the first technical foundations	Finalise the technical foundations
Technological Assessment	Technical Concept for Transport Units and Operation System	Requirements and Concept Development of the Coupling System
Regulatory Framework and Hazard Analysis	Show Design Variants of Transport Units	Concept for Handling Technology
Analyse and Specify the Idea <ul style="list-style-type: none">• Usable• Economical• Possible	Detailed Concept for one Use Case for a Transport Unit	Technical Concept and Variants for the Carriers
Determine the business potential	Conceptual Development for the Equipment of Transport Units	
Final Feasibility Evaluation	Conceptual Development for Traffic Coordination of Pods System	

Where are we today?

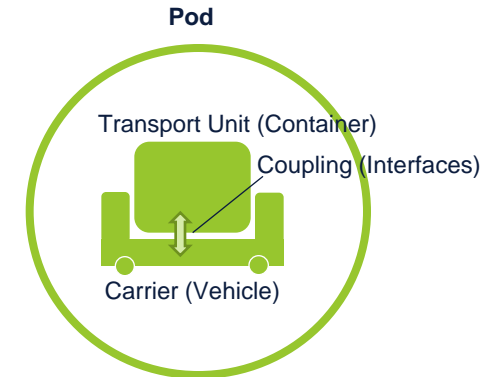
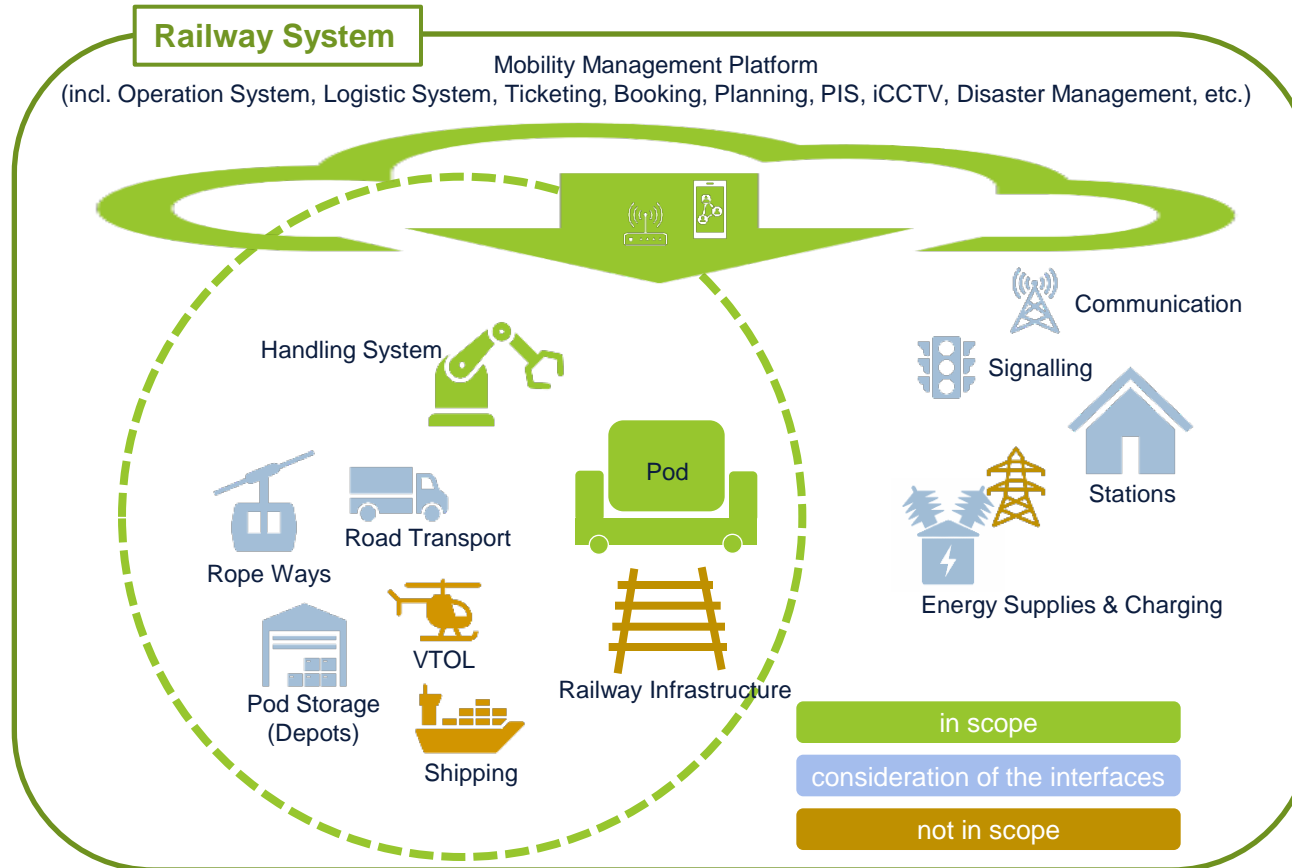
Common understanding of the system

Boundary conditions of the system:

- autonomous operation
- on demand availability
- fully electric driven
- cost-effective
- use of sustainable material
- ...

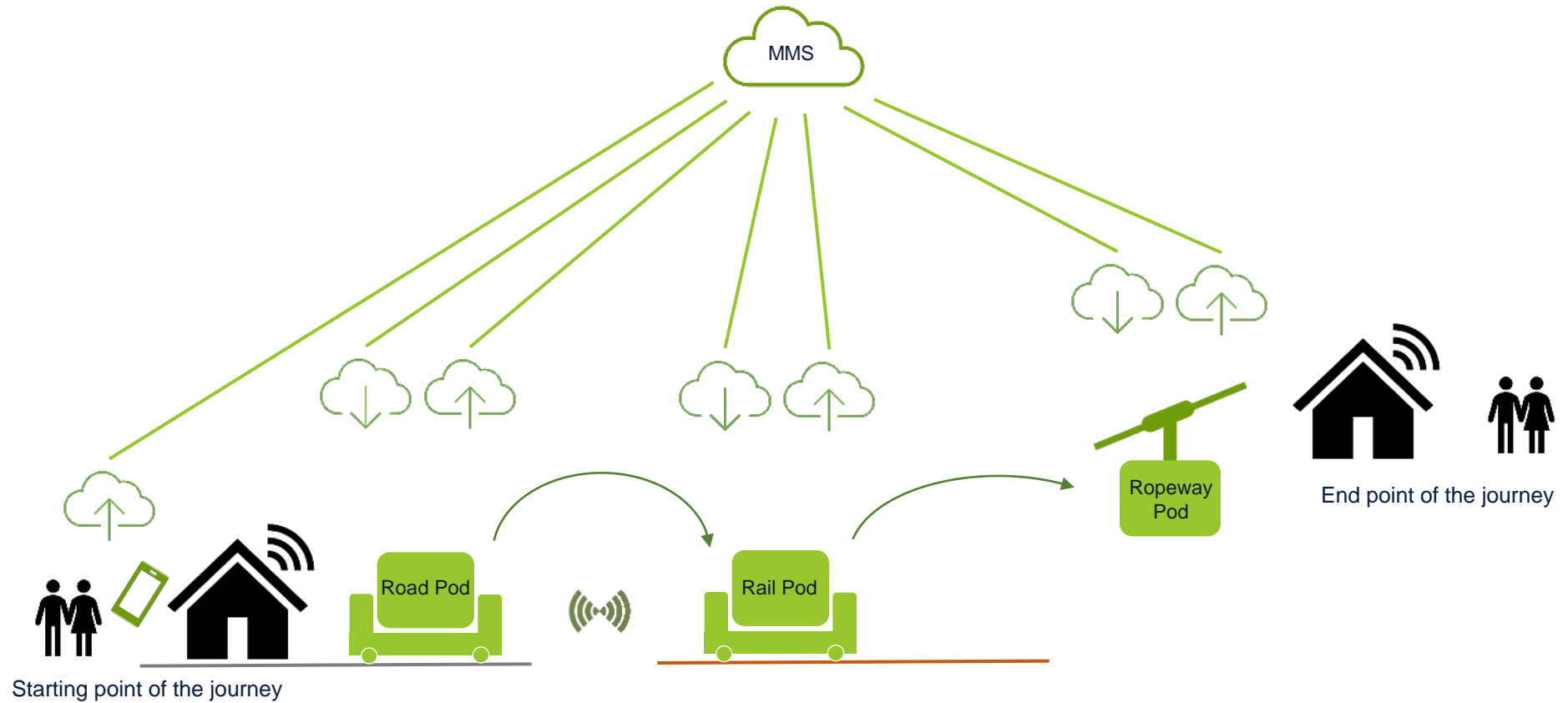
Examining the extent to which there are related concepts or systems

The System ...

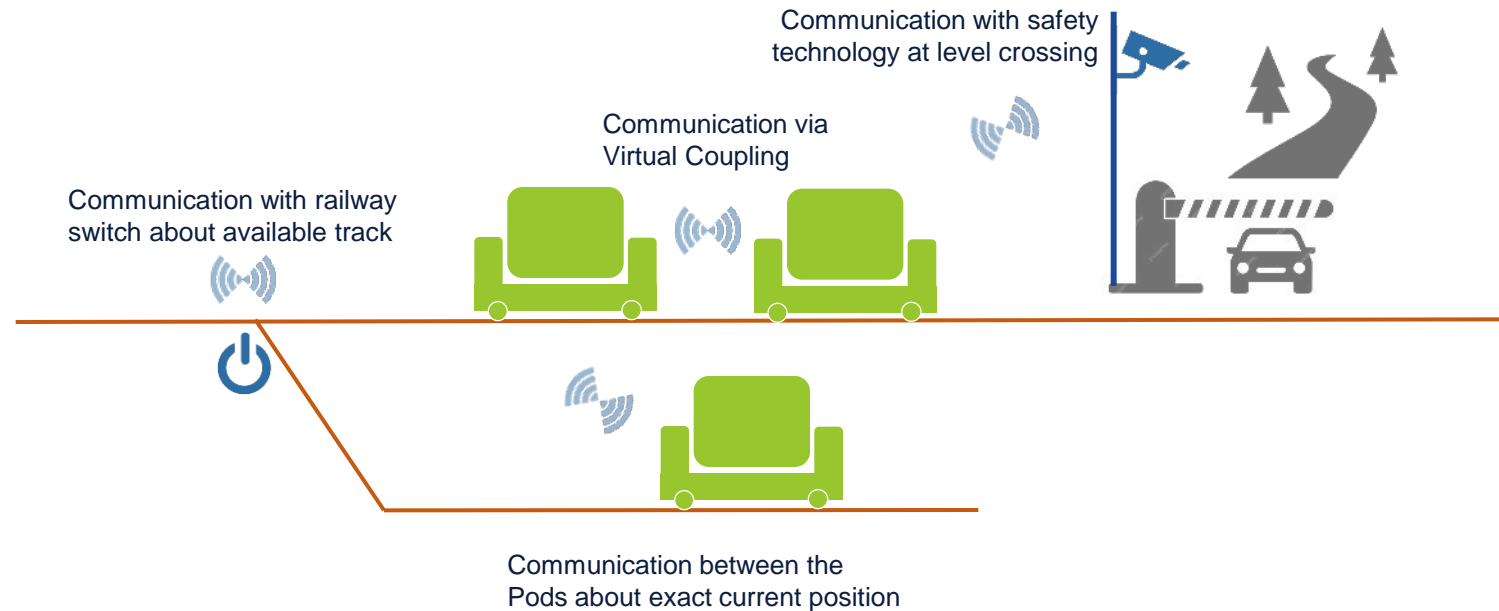


iCCTV ... Intelligent Closed Circuit Television
PIS ... Passenger Information System
VTOL ... Vertical Take-Off and Landing

... how it should work ...



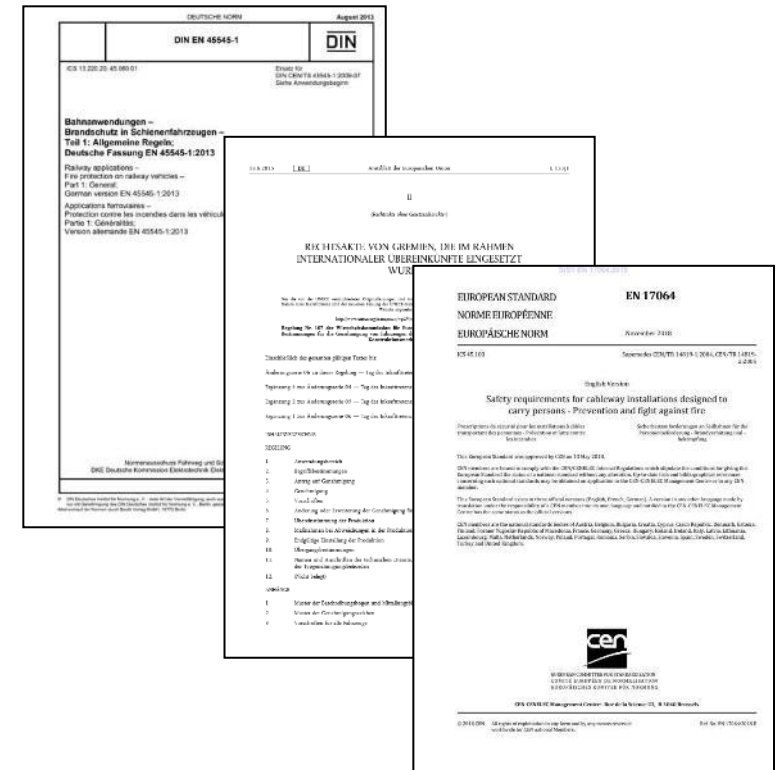
... and how the operation could be



Regulatory Framework

The overview of the existing standards and the safety requirements shows

- there are no uniform requirements for modes of transport
- open regulatory framework for autonomous operation
- serious differences in passenger transport in terms of fire safety, crash safety etc.

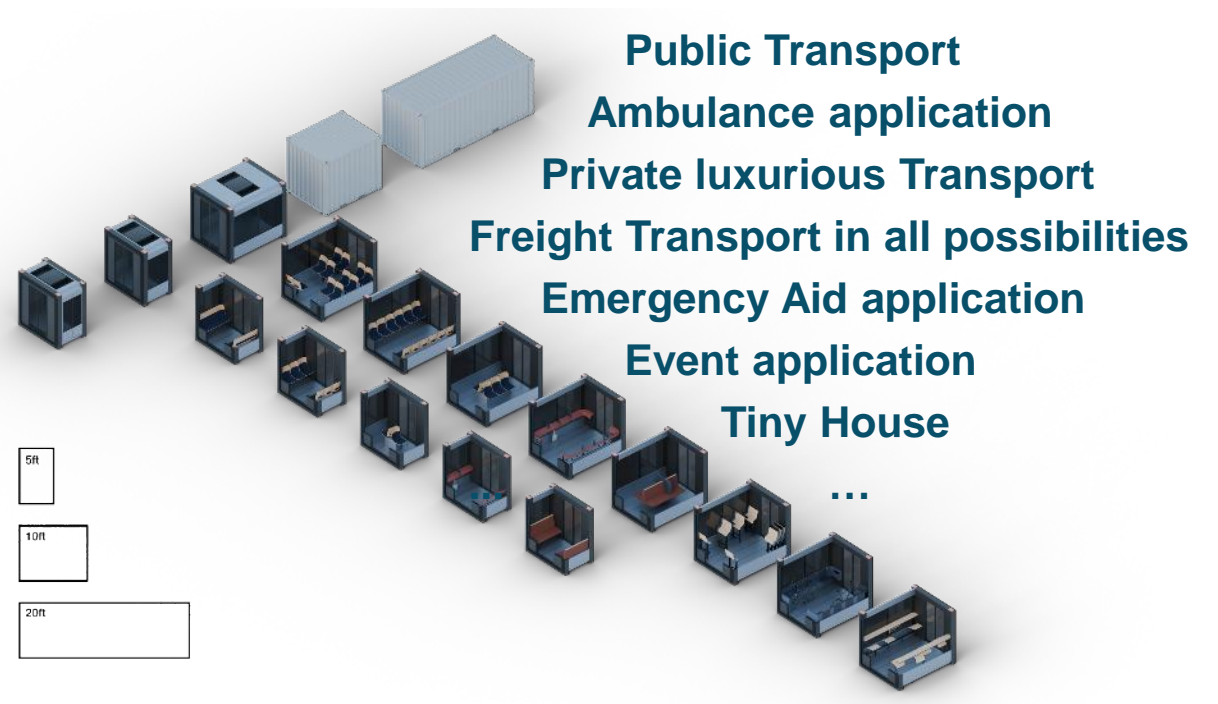


Usable, Economical, Possible?

Usable – Yes!

If we free ourselves from all constraints and think about the opportunities of the system, almost all use cases in the transport sector are possible with the transport units!

Carriers always in use as a “Moving Infrastructure”



Usable, Economical, Possible?

And what about the strengths and weaknesses as well as the opportunities and risks of the idea?

Essential for estimating the system

And within this study, a User Survey with two different target groups was conducted

- general users of public transport
- users from the logistics sector



Usable, Economical, Possible?

Economical – Maybe, but ...

Only a qualitative estimation of the socio-economic impacts of the Pods system could be made.

Target Cost Analysis shows:

- large series should enable cost-effective production
- the service life of a transport unit should be based on the service life of buses
- Carriers should not cost more than an Automated Guided Vehicles
- Transport Units for public or private use should not cost more than a Caravan

Usable, Economical, Possible?

Possible – Yes ...

- that shows our specification of requirements at a high-level

Possible – Yes, but ...

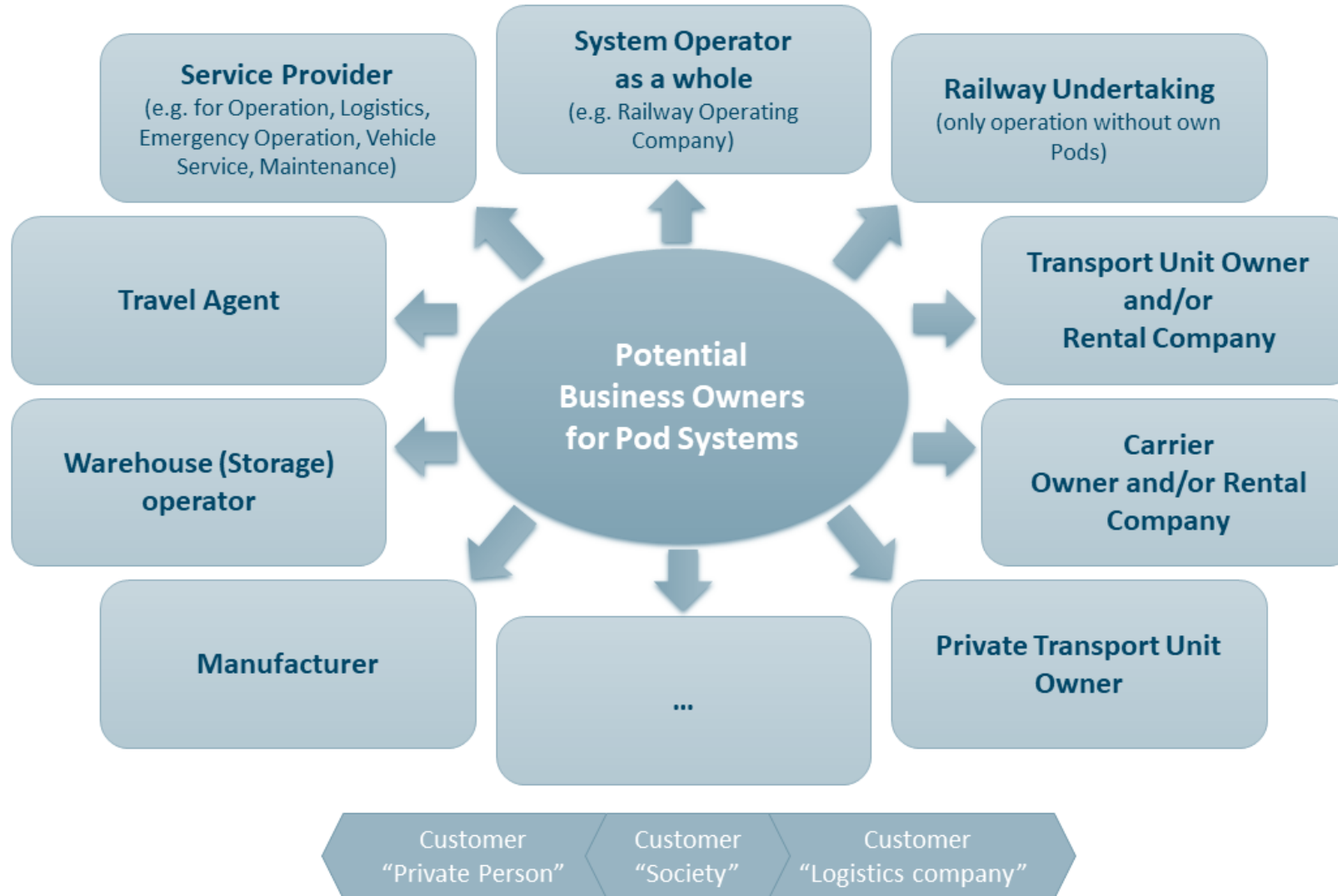
- the technical basis for autonomous driving must be finalised
- restrictions imposed by existing standards must be reconsidered
- new standards must be created

Could there be a Business?

YES!

Design of Transport Unit Interior
Mobile Management System Operation
Maintenance Service Transport Service with own passenger Pods
Data Monetisation Leasing of Transport Units
Logistics for Transport Unit Handling Catering
Leasing of Carriers Operating a Warehouse / Storage
Transport Services Rail Rental of Transport Units
Manufacturing of Transport Units for Freight
Travel Planning / Experience Selling Remanufacturing, Refurbishment
Transport Services Road Data Storage / Cloude Providing
Transport Services Ropeway Transport Service with own Carriers
System Provider for Operation Cleaning Service
Manufacturing of private luxury Transport Units

Potential Business Owners



Possible Business Models analysed

- Manufacturing of Transport Units
- Pod Network Capacity Service for Transport Service Operators
- Freight Transport Service for Cities
- Ride-Sharing Service for Private Passenger Transport (Franchise)
- Data Services Company for Pod System
- Leasing/Rental Service of Carrier for Public Passenger & Freight Transport
- Leasing/Rental Service of Transport Units for Emergency Medical Services
- Leasing/Rental Service of Transport Units for Tourism, Events and Leisure

And the Technology?

3 Aspects had to be considered at first

- to derive a concept for the Transport Units
- to define the interfaces between Transport Units and Carrier
- to derive a concept for the Operation System

Transport Units – How to create?

- dimensioning of the planned modules according to standards as essential limits
- diverse possibilities for individualising the Transport Units
- definition of construction methods and materials in relation to the construction and type of Transport Unit
- clarification of the question of which standards can be advantageously used as a guide



The Base - Standardisation & Modularity

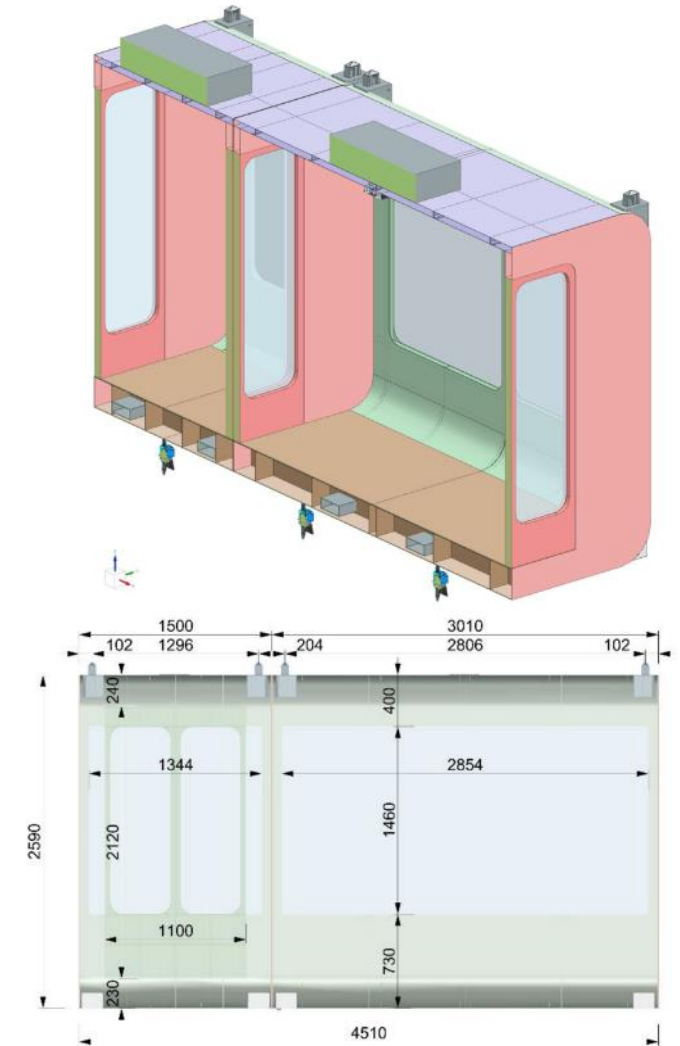
- Application of ISO 668 standard to freight and passenger use cases
- 3 main standard sizes can handle every use case → 5 ft, 10 ft, 20 ft
- Key issues → Location of doors, seats and critical equipment

Pros

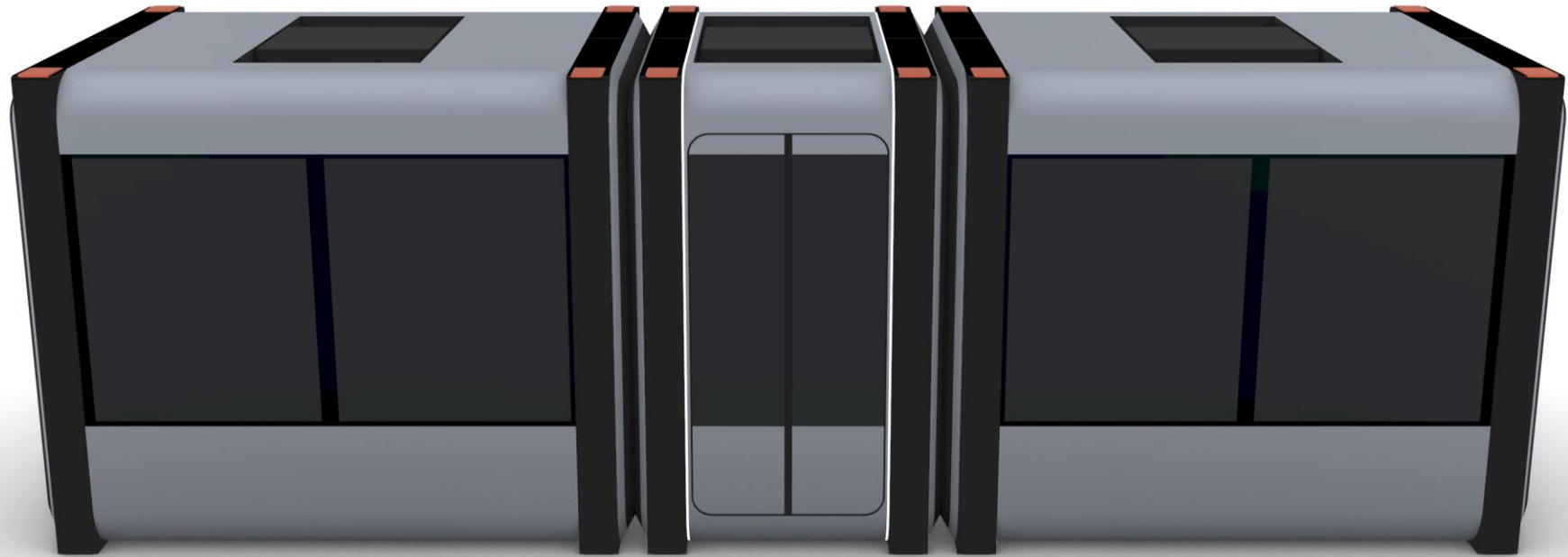
- Standardisation
- Intermodality
- Existing infrastructure
- Fast deployment

Cons

- Individualisation
- Space on road
- Lightweight design

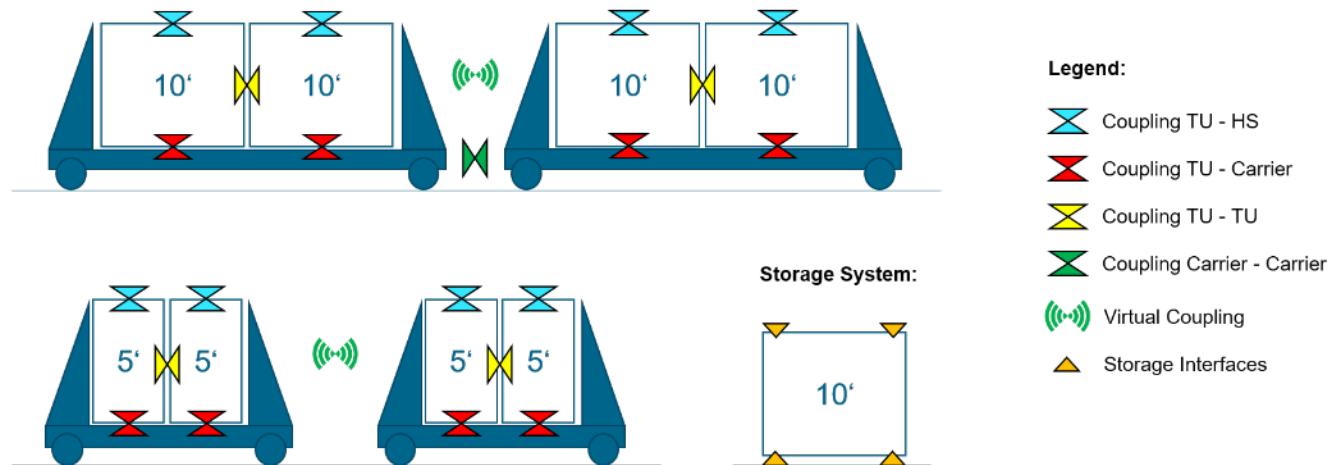


How the Transport Unit Design could be



Interfaces to be considered

- interfaces via standards, however existing standards can only be used in part and bring limitations, so new standards must be created
- the handling of the Transport Units is a key challenge, as cargo and people are moved here, and different sets of rules must be observed
- the type of technology is influenced by overarching goals, in particular the questions of where investments are made, as well as the scalability of Transport Units (TU) and Carriers



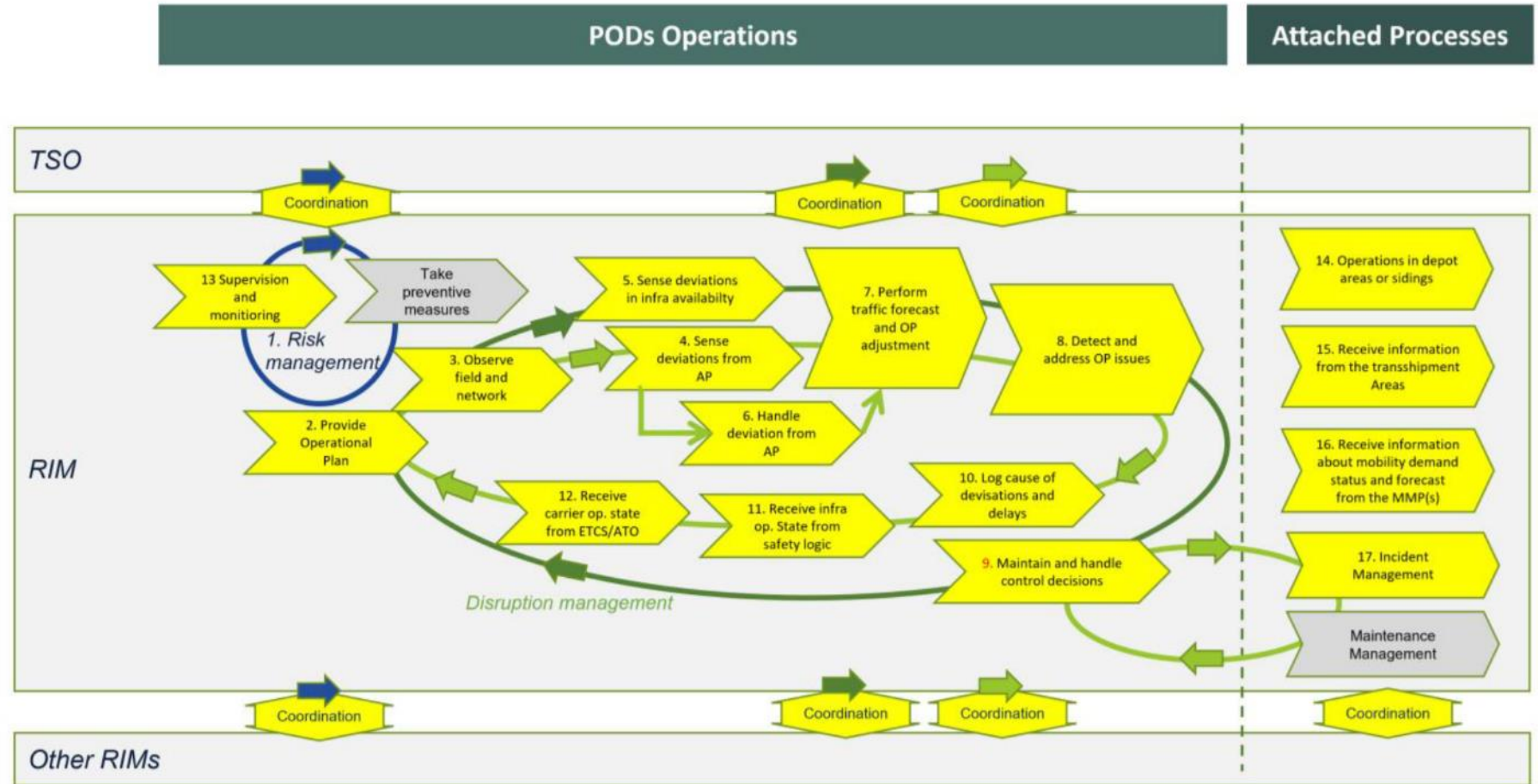
Flexible and standardised locking mechanisms of the Carrier allow several TU-configurations

Operation System

- standards can also be used in the operating system
- most important outcomes → every element must be able to communicate
- it is not necessary to apply a single standard to all domains, but interfaces and responsibilities as well as compatibility must be clearly regulated
- this also allows all relevant safety functions/aspects to be integrated and makes the new system safe and efficient
- so far, the rail sector has offered the most extensive functionality

Operations Management Process

The process of Pods operations follows the EU-Rail System Pillar approach for Traffic Management Systems



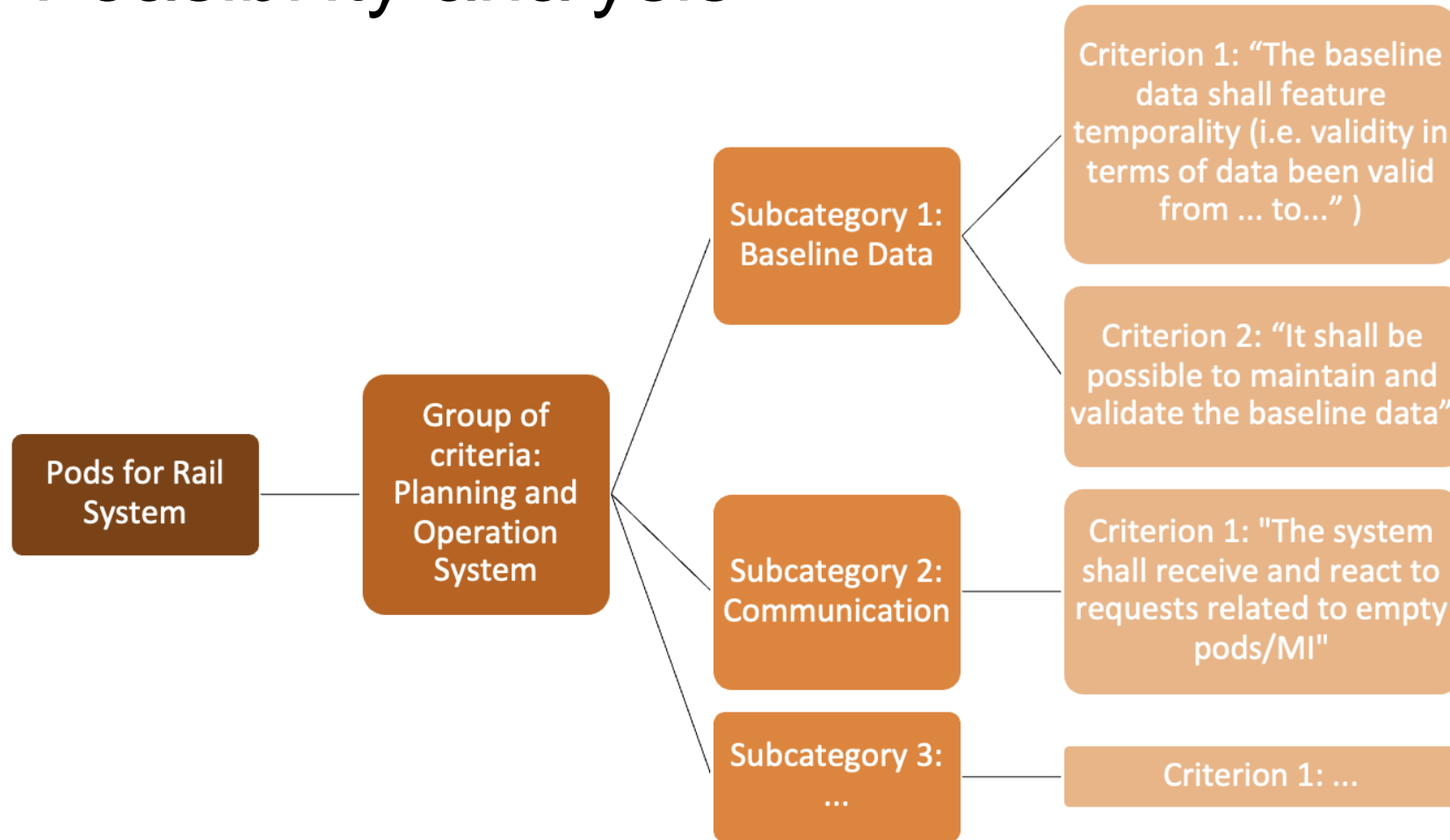
Have we taken the right path?

Final Feasibility Evaluation - Why?

- substantially different functional and technical concept
- specific solution for highly automated, unattended operation
- partially unregulated area
- open economic framework



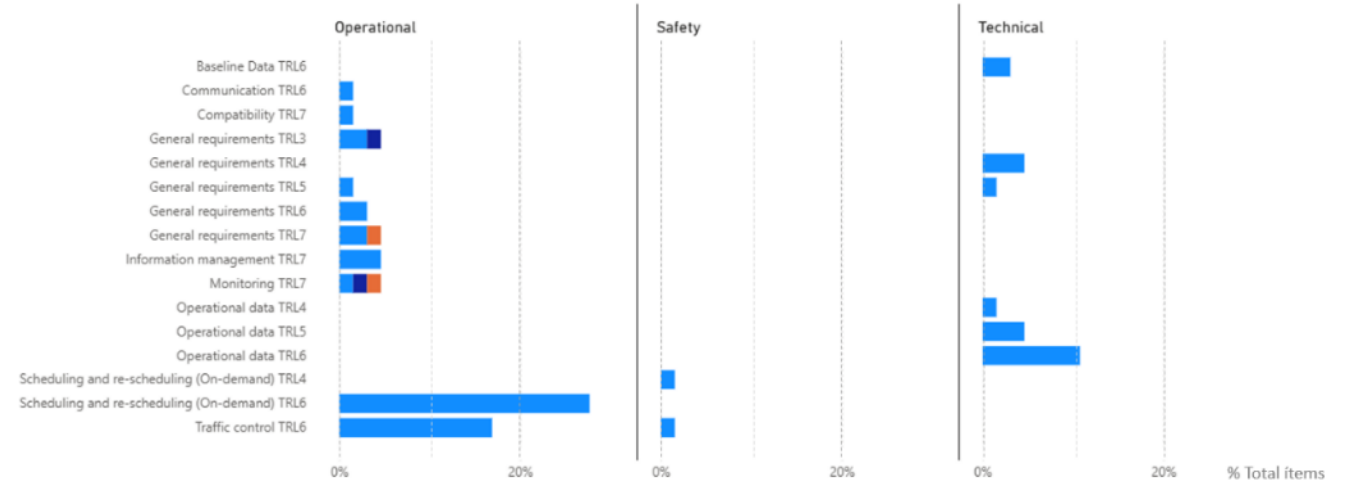
Criteria and Assessment of the Feasibility analysis



Evaluation of technical, operational & safety Criteria

Subcategory	Min TRL	Max TRL
Baseline Data	6	6
Communication	6	6
Compatibility	7	7
General requirements	3	7
Information management	7	7
Monitoring	7	7
Operational data	4	6
Scheduling and re-scheduling	4	6
Traffic control	6	6

Scenario Both Freight Passengers



Operation and Planning System OAS1

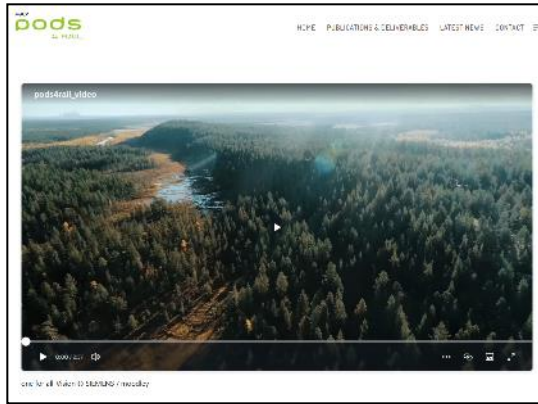
Subcategories	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Baseline Data	0	0	0	0	0	2	0	0	0
Communication	0	0	0	0	0	1	0	0	0
Compatibility	0	0	0	0	0	0	1	0	0
General requirements	0	0	2	3	2	2	3	0	0
Information management	0	0	0	0	0	0	3	0	0
Monitoring	0	0	0	0	0	0	2	0	0
Operational data	0	0	0	1	3	7	0	0	0
Scheduling and re-scheduling (On-demand)	0	0	0	1	0	18	0	0	0
Traffic control	0	0	0	0	0	12	0	0	0

What are our Challenges?

- **How can we achieve high acceptance of the idea of the system?**
 - Should we do more marketing?
 - How can we achieve this?
- **How can we determine financial values for the components and the system for an better economic assessment?**
 - How accurately can we determine manufacturing costs for Transport Units and Carriers?
- **How realistic is autonomous driving on rails?**
 - What is our contribution to the topic?
- **How can the handling process be made simple, convenient and cost-effective?**
 - With this aspect, do we have a cost and acceptance problem for the system?
- **How do we position the system idea and its components in the regulatory environment?**
 - How can we initiate a discussion about changing existing standards?
 - How to define new standards?
 - How to solve the problem with the legal approval of autonomous driving?

How to find information?

Pods4Rail Homepage



TRA 2024 in Dublin



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PODS4RAIL

Pods for the railway – New solutions for tomorrow's rail transport

As the most environmentally friendly means of transport, the railway system will continue to play a leading role in the transport of people and goods in the future. When designing future solutions, the aspect of "Mobility as a Service" plays a significant role, especially beyond the possibilities offered by new communication technology and global digital networking, as "door-to-door" solutions are increasingly required for travellers and logistics customers to offer and not only be able to plan and book end-to-end travel and transport chains. In particular, the reduction of individual road traffic, but also the further shift of freight transport from road to rail, must be further promoted in intermodal "door-to-door" transport and new approaches to solutions must be sought.

1. Introduction

As the most environmentally friendly means of transport, the railway system will continue to play a leading role in the transport of people and goods in the future. When designing future solutions, the aspect of "Mobility as a Service" plays a significant role, especially beyond the possibilities offered by new communication technology and global digital networking, as "door-to-door" solutions are increasingly required for travellers and logistics customers to offer and not only be able to plan and book end-to-end travel and transport chains. In particular, the reduction of individual road traffic, but also the further shift of freight transport from road to rail, must be further promoted in intermodal "door-to-door" transport and new approaches to solutions must be sought.

This is what the Pods4Rail project, funded by the EU as part of the Europe's Rail Joint Undertaking (ERJU) program, has set itself the goal of, in which the idea, which has been initiated by various actors for years, is to use new means of transport for a digitized, autonomous mobility service and a continuous transport chain from "door to door" for the area of rail transport and to create a solution for intermodal transport for both passengers and goods and thus contribute to the necessary transformation of European rail transport. 15 partners from seven European countries are researching this project that started on September 2023 and will run for 30 months.

The most important goal of the project is to use the existing rail transport network and sensibly link it with other means of transport for intermodal transport. The challenges that transport faces under today's circumstances are diverse and subject to major changes. In particular, the demand for sustainable solutions for transporting people and goods forces us to rethink and develop new approaches and ideas for the transport of the future.

Above all, global megatrends, such as environmental protection and climate change, demographic change, urbanisation, digitalisation, and connectivity are having an impact on shaping the transport of the future. The railway as a means of transport plays an exposed role in the mass transport of people and goods as well as in local public transport and individual freight transport. Railway is considered a key driver in pursuing Europe's strategic goal of smart, green, and sustainable growth and is expected to serve as the backbone of the entire European transport system, accounting for less than 2% of final energy consumption in the transport sector [1]. With around 200,000 km of rail network in the EU, rail is one of the most important and environmentally friendly means of transport, whose importance continues to grow and is being developed

Dipl.-Ing. Dirk Winkler
Chief Technology Office,
Siemens Mobility
Project coordinator and project manager,
EU-funded Pods4Rail project
dirk.winkler@siemens.com

Dr. Walter Struckl
Chief Technology Office,
Siemens Mobility
Lecturer at the
Verrna University of Technology
walter.struckl@siemens.com

Maria Traunmüller
Director Strategy and Innovation,
mobility strategy & design group
GmbH
maria.traumue@mobility.com

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Assessing Multimodal Mobility Systems for Benchmarking Rail-Bound Intermodal Pods in ERJU's FA7-Project Pods4Rail

A. Paz Martínez¹, Y. K. Adams², S. Nägele³, V. Laqua³ and D. Winkler¹

¹Institute of Vehicle Concepts, German Aerospace Center, Berlin, Germany
²Institute of Transport Research, German Aerospace Center (DLR), Berlin, Germany
³Institute of Transport Systems, German Aerospace Center (DLR), Braunschweig, Germany
⁴Function Technology & Innovation (SDT), Siemens Mobility GmbH, Erlangen, Germany

Abstract

A "Pod" system, defined as a detachable capsule-chassis vehicle concept operating within a seamless, decentralized and autonomous transport system, presents an innovative solution to transportation challenges. ERJU's FA7 project Pods4Rail aims to explore an intermodal rail-bound autonomous Pod system and its autonomous transshipment onto road and ropeway modes, serving passenger, freight and combined transport needs, using mainly installed infrastructure. This study evaluates several multimodal Pod systems, analyzing their technical, economic and environmental attributes, along with user needs. The findings reveal a lack of a clear benchmark for Pods4Rail, underscoring the project's significance. Nevertheless, features from various concepts hold potential as benchmarks. Additionally, the safety of handling systems in cargo rail-bound detachable systems requires improvement in order to be applied on passenger Pods. The initial economic evaluation shows that the compatibility with existing infrastructure is a critical criterion, as well as its payload and capacity. Environmental criteria align closely with those of economic efficiency, but special attention should be drawn to noise emissions during transshipment. Moreover, exploratory "Future Thinking" interviews revealed potential users' positive attitudes towards Pods, their assumption that this technology would meet their transport needs and could contribute to mitigate the transport sector's negative impact on the environment.

1

Thank You for Your Attention!



Dirk Winkler

Project Manager Pods4Rail

dirk.winkler@siemens.com



Florian Brinkmann
DLR



PhD Roman Čermák
Západočeská
Univerzita v Plzni



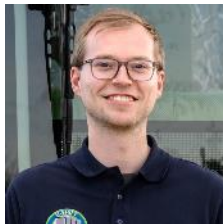
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Gustave Eiffel



Prof. Jesus Felez
Universidad
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Rolf Gooßmann
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Manuel Osebek
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Dr. Walter Struckl
Siemens Mobility
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PROJECT

