IPIC 2021– 16 June

HIGH-CAPACITY ROAD TRANSPORT

FOCUSSING INNOVATION ON
SMARTER MOBILITY SOLUTIONS FOR SMARTER POLICIES

Efficiency improvement up to 33% by 2030

The AEROFLEX project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 769658

Speakers

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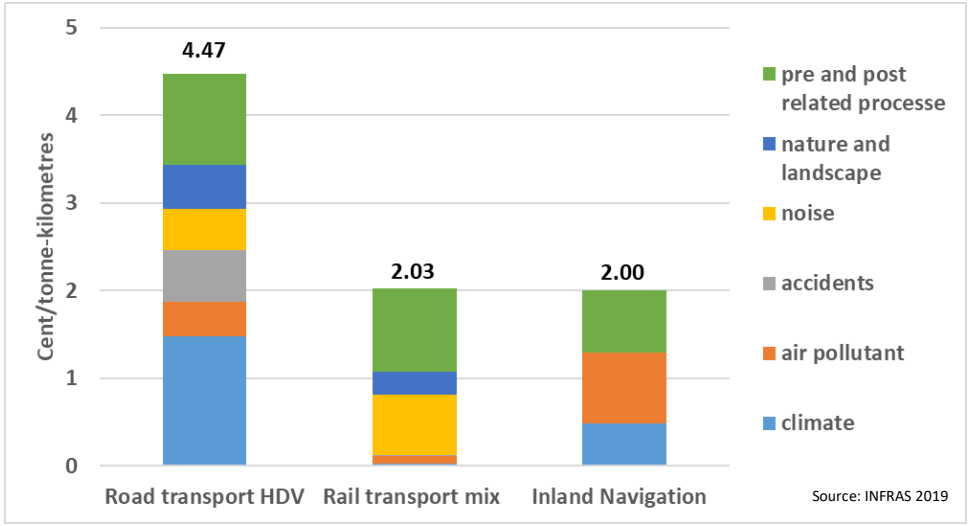
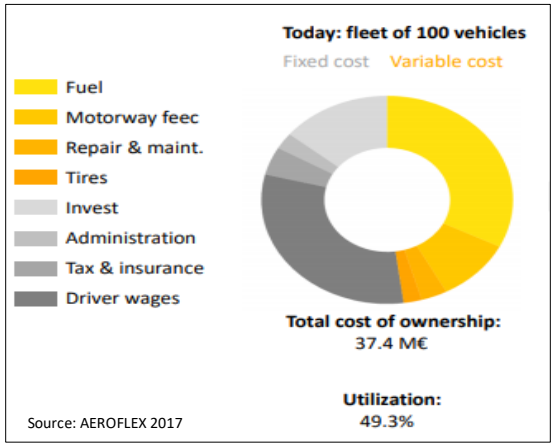
Agenda

Update AEROFLEX project	Ben Kraaijenhagen
Impact of High-Capacity Vehicles on the future developments in the Logistics sector	Andreas Lischke Christoph Jessberger
Q&A	
Optimization of trailer loading with PUZZLE®	Agnes Eiband
Q&A	
Cargo Volume Detection	Pierre de Rochambeau Gafur Zymeyri
Q&A	Ben Kraaijenhagen
Wrap-up	

Challenges addressed within AEROFLEX

- Transport sector app. 25% of the total CO2 emissions in Europe*
- Growth of demand of transport app. 20% by 2030*
- Green Deal target for transport 90% CO2 reduction by 2050*
- The cost for transport
  - Road transport; climate impact and accidents > 50% of ct/tkm
  - Pre and post related processes app. 1ct/tm
    (20-25% for road and 50% for rail & inland navigation)
- The TCO of a typical long-haul fleet
  - Driver wages and fuel > 66%
  - Utilization app. 49%
- AEROFLEX project targeted an efficiency improvement up to 33%, meaning less:
  - **CO2 emissions and impact on climate**
  - **Road accidents, injuries and fatalities**
  - **TCO and vehicle kilometers per ton freight**
  - **Cost pre & post related processes**

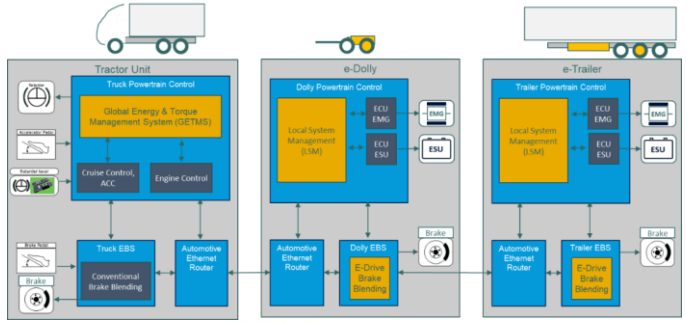


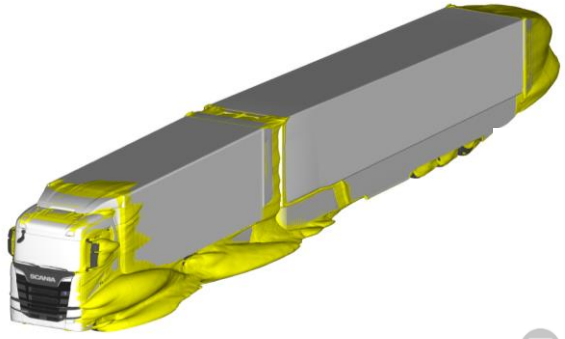


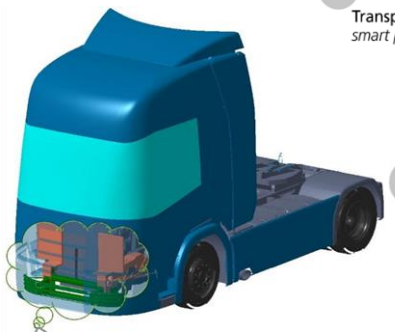
*White paper 2011, Freight transport development until 2050 (European Environment Agency 2007), https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

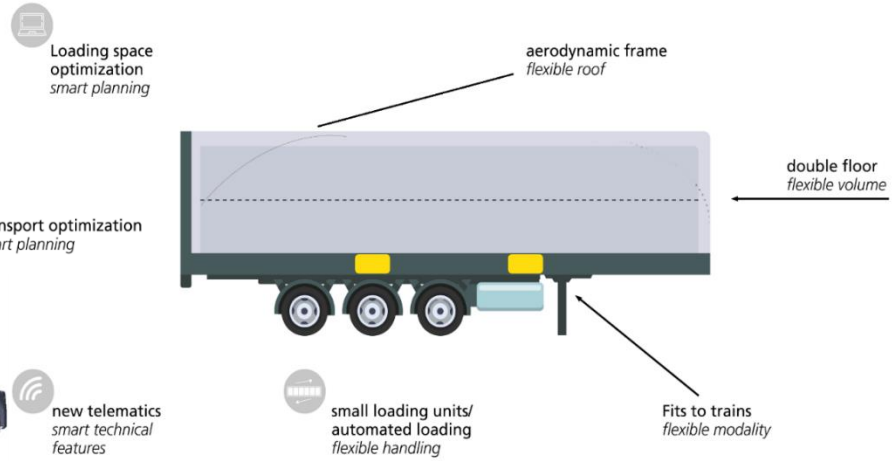
AEROFLEX technologies & innovations

- An **Energy Management Powertrain** architecture for distributed powertrains
- A **Smart Steerable Dolly** for EMS vehicles and automated yard operations
- **Active Aerodynamic Devices** for the complete vehicle, adaptable to the logistics task
- **Smart Loading Units and Tools** for more effective loading space utilisation and multimodal transport
- **Front-end design** for more safety and survivability for driver, road users and VRU

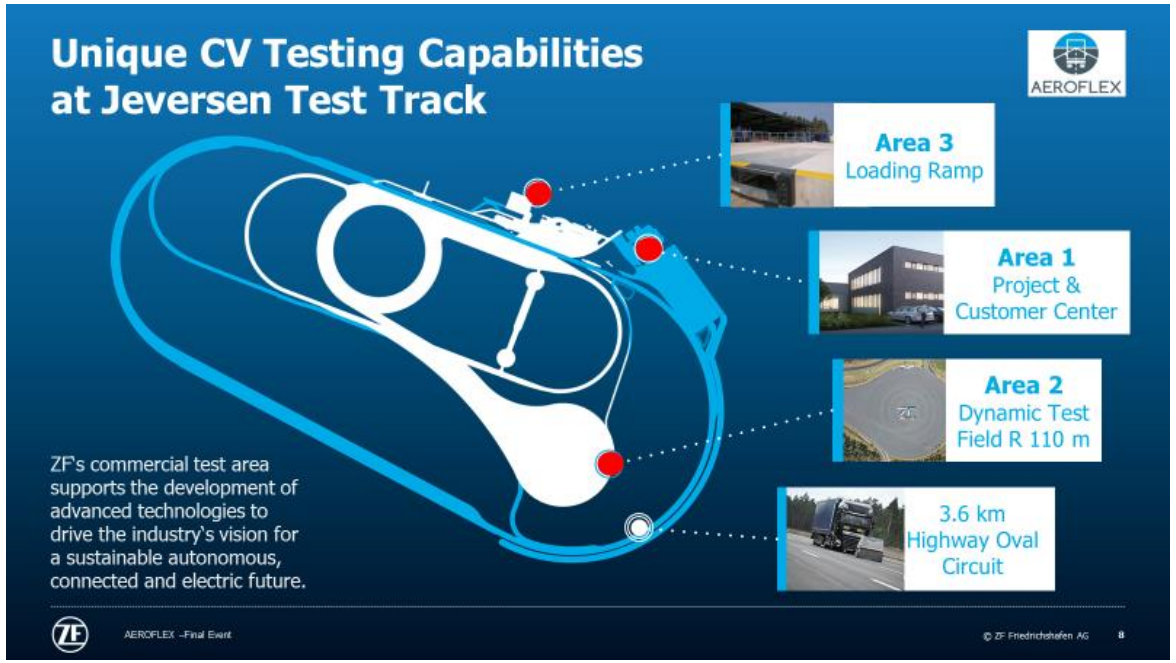








We proudly announce the AEROFLEX Final event



- **SAVE THE DATE**
  Final event, 28 September 2021
  Full day hybrid event and interaction
- **Registration open**
- **Go to** https://aeroflex-project.eu

The AEROFLEX project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 769658

Impact of High-Capacity Vehicles on the future developments in the Logistics sector

Andreas Lischke, DLR German Aerospace Center

Stephan Kirsten, DLR German Aerospace Center

Christoph Jessberger, MAN Truck & Bus SE

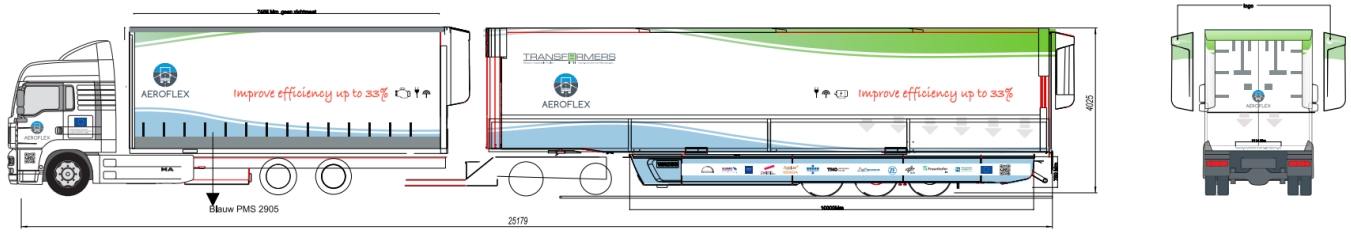
Tim Breemersch, Transport & Mobility Leuven

The AEROFLEX project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 769658

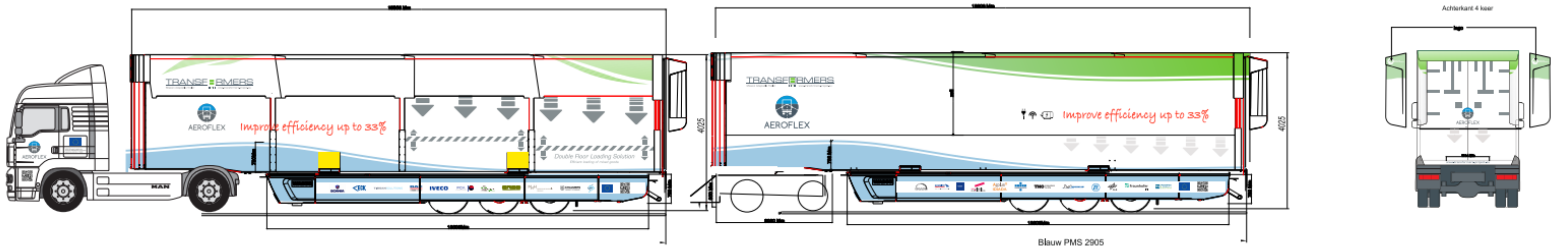
AEROFLEX innovations – impact on logistics

- Which impacts will AEROFLEX innovations have?
  - on logistics with a link to Physical Internet
  - on CO_2 emissions of freight transport
    - related to freight transport – modelling approach
    - related to selected freight transports – a use case perspective

European Modular System 1 (EMS 1)



European Modular System 2 (EMS 2)



AEROFLEX innovations for the Physical Internet

Hybrid Electric, distributed powertrain:

- Environmental benefits for trucking

Steerable e-dolly:

- Autonomous or remote maneuvering of loading units in logistics nodes
- Drivers can focus on driving

- Storing of separate electric power at the e-dolly
- Less relative fuel consumption per cargo unit (e.g., per tkm)
- Logistics processes on logistics yards (e.g., Logistics hubs, intermodal terminals or big warehouses) could be optimized
- Parking of trailers on limited parking spaces (e.g., at motorway parking places or in terminals) could be efficiently organized
- Less staff required due to the implementation of autonomous or remote maneuvering processes

AEROFLEX innovations for the Physical Internet

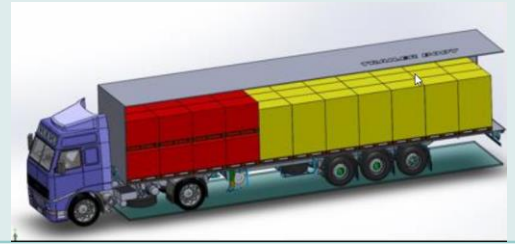
- Higher Efficiency in planning: optimize use of loading space (volume and weight)
- Energy efficient trucking (trips and tours): less relative CO_2 emissions per transported cargo unit
- Addressing modular concepts and a digital transport process planning (e.g., by using artificial intelligence)

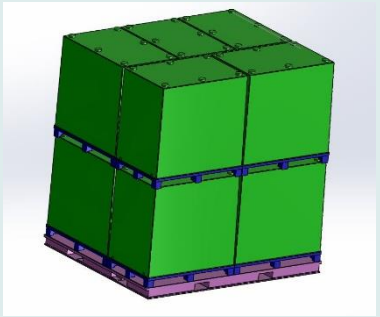
Aerodynamic design of the full vehicle

- Less fuel consumption per cargo unit

Modular, adaptable loading unit

- Perfectly in line with Physical Internet concept
- Optimization with puzzle software
- Robust on all transport modes



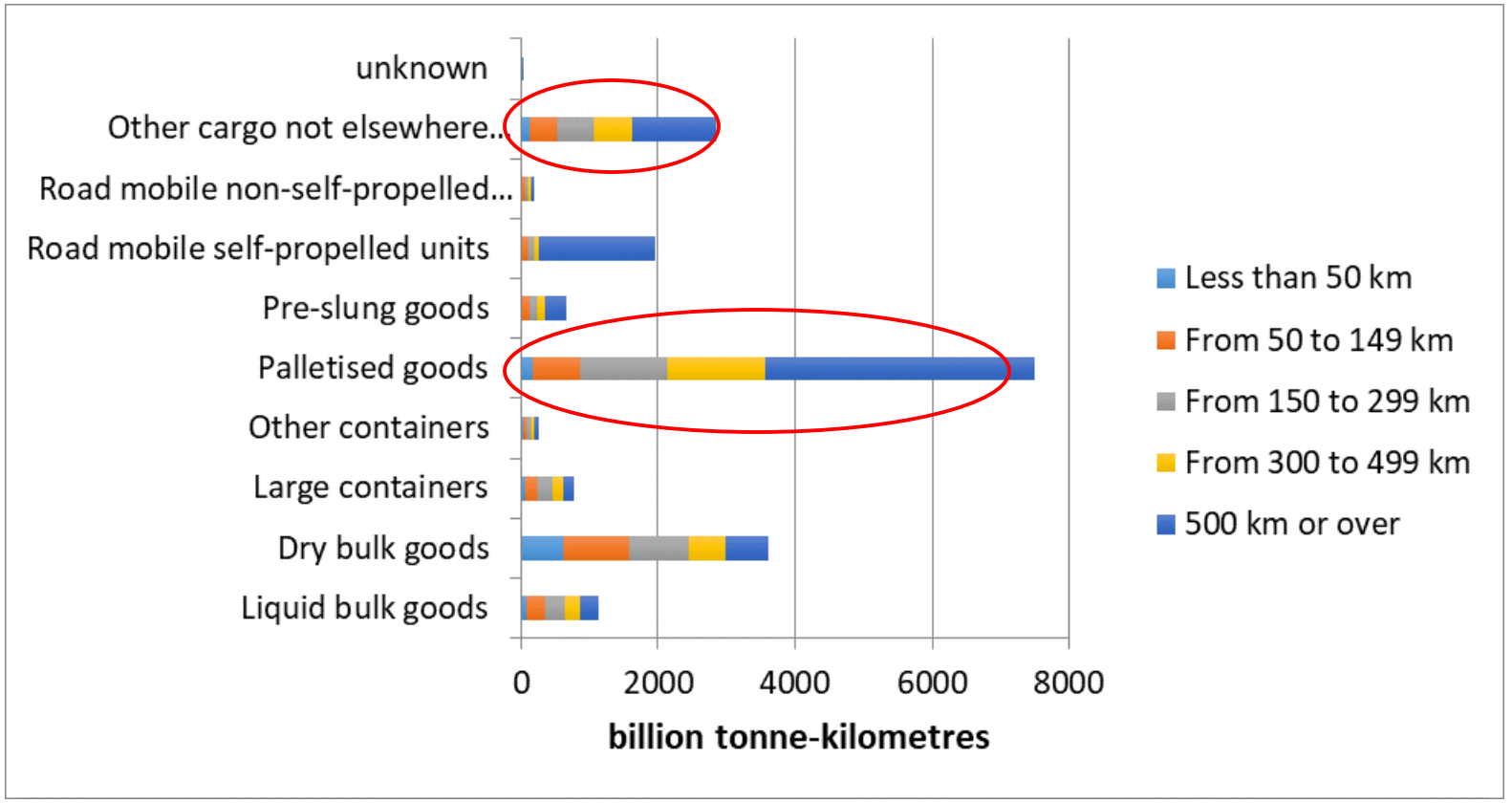


Impact – on freight market

Identify market for High-Capacity Vehicles – European Modular System (EMS)

- address cargo transport with the expected highest tonne-kilometres on long road haulage
- address growing cargo groups
- limit a reverse modal shift from rail/IWW to road transport
- contribute to a reduction of CO_2 emissions generated by EU freight transport

Characterization of transported cargo in EU-28 in 2016 (EUROSTAT)



Impact – on freight market (modelling approach)

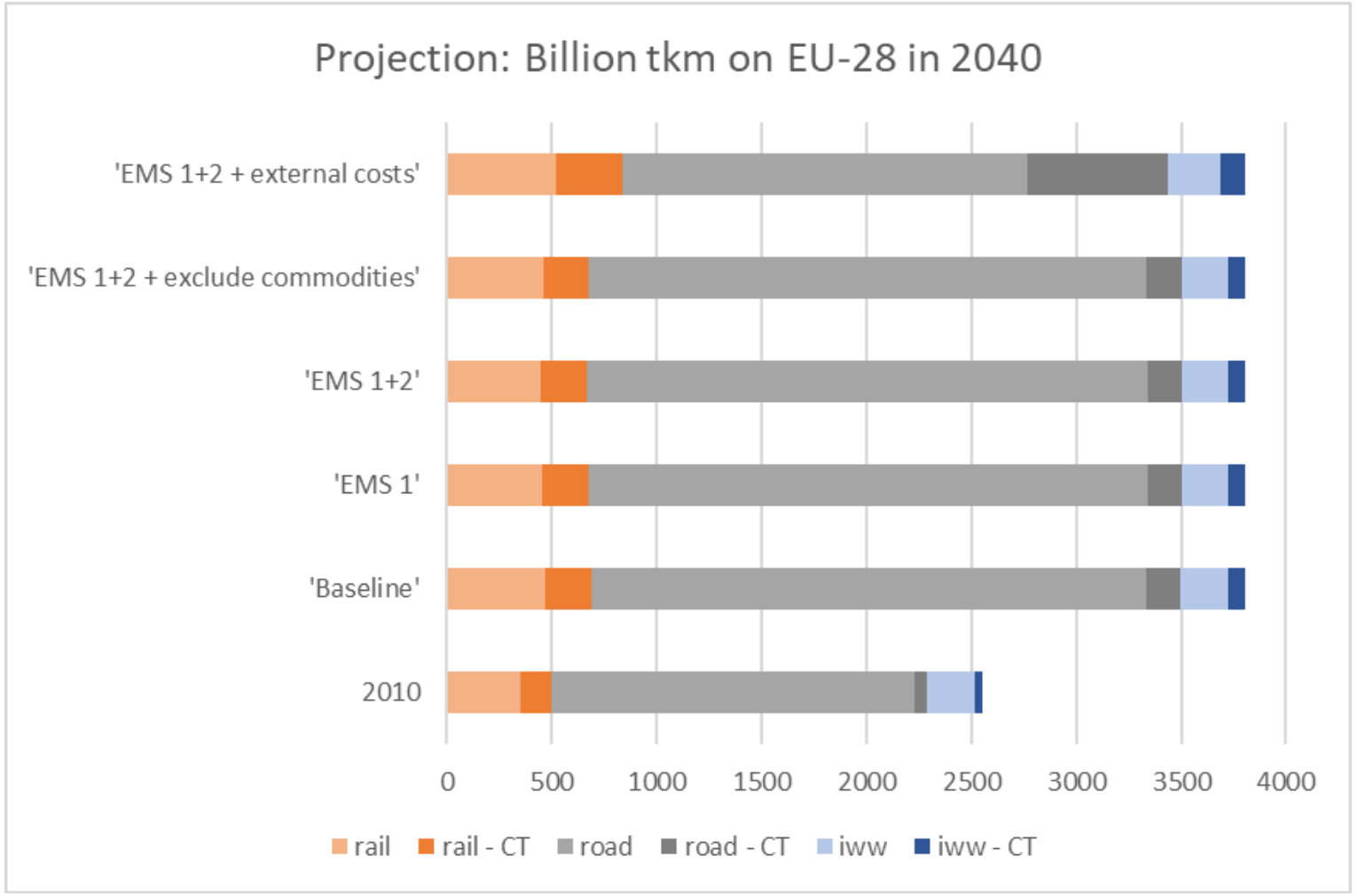
Comparison EMS by five scenarios

- show the impact on
  - Modal split
  - Mean split – shift to EMS

- baseline: increase of tonne-kilometres over all modes

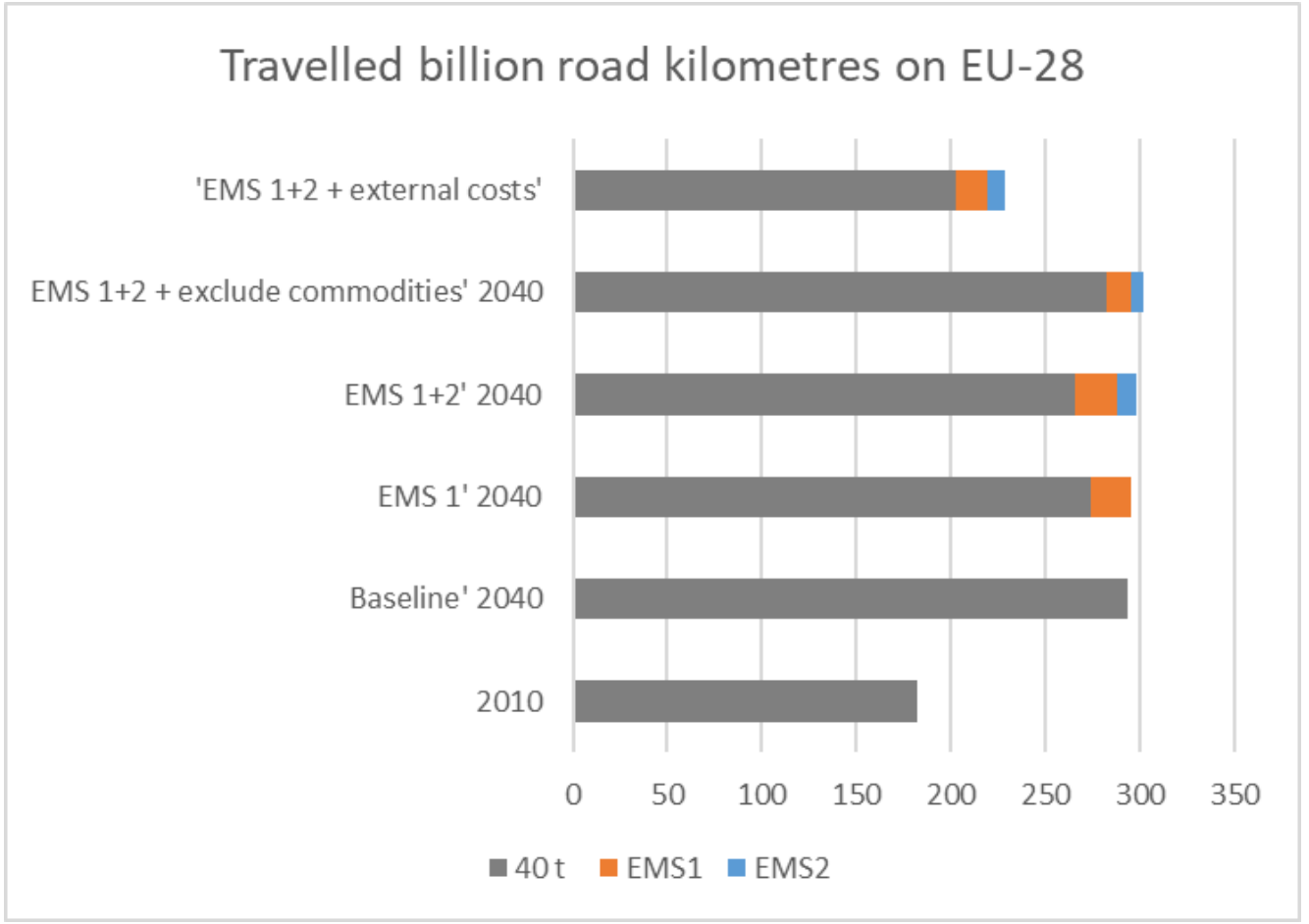
- road +0.7 to +1.1 % increase compared to baseline in scenario with EMS (without external costs), rail and IWW decrease -1.7 to -3.2 %

- Scenario ‘EMS + external cost’ reduction on road transport by -7.4 %
  rail IWW grows by 18-22 %



Impact – on vehicle mileage (modelling approach)

- Baseline: increase of road mileage between 2010 and 2040 of HDV (above 12 tons GCW) by 61 %
- EMS 1 could realize up to 7 % of mileage of HDV above 12 tons GCW
- EMS 2 could realize up to 5.5 % of mileage of HDV (above 12 tons)
- volume of mileage is decreasing only in scenario EMS + external costs by -22 %



Impact – on CO_2 emissions (modelling approach)

- Only in scenario ‘EMS + external costs’ whole freight transport CO_2 emissions decrease by 39 Mio. tonnes – 18 % compared to baseline scenario

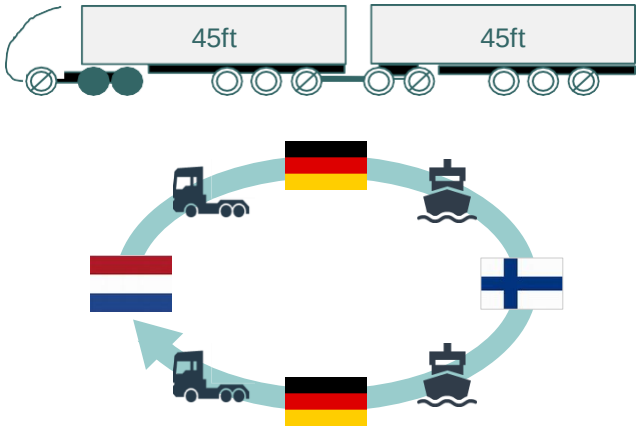
- Higher efficiency of road transport will shift to more road freight transport

- Avoid a shift to road freight transport and benefit the transport system, through
  - a level playing field between modes through appropriate compensation measures
  - preserve the markets of rail and inland waterway transport

Results of two use cases with EMS

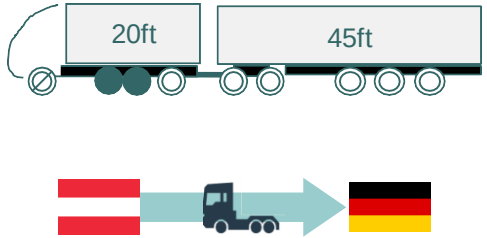
Use case 1:

- **CO_2 emission reduction potential of -25,81% (-129.6 kg CO_2)** due to efficiency gains of EMS2
  (prime candidate 6.1; 74 t vs. 40 t GCW permissible)
- Intermodal logistic chain (road & water)
- Multiple countries involved (Netherlands, Germany, Finland)



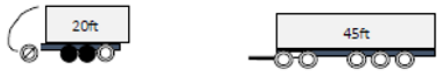
Use case 2:

- **CO_2 emission reduction potential of -32,44% (-72.0 kg CO_2)** due to efficiency gains of EMS1
  (prime candidate 3.2; 60 t vs. 40 t GCW permissible)
- Single mode logistic chain (road)
- Multiple countries involved (Austria, Germany)



Overall results of use cases with EMS

- 53 % of the interviewees vote for the following Prime Candidates (see table on the left)
- EMS 2 is the most preferred prime candidate (11.7 % of interviewees)
- Average savings potentials by EMS with maximum load (€/tkm, cost/tour or CO_2e WTW) show high efficiency achievements related to all use cases

No.	Prime Candidate	Share of votes
6.1		11.7 %
2.1		9.7 %
3.1		9.7 %
1.4		9.3 %
2.2		6.6 %
4.7		6,2 %
1.3		10.1 %

KPI	€/tkm	Cost/tour	CO_2 WTW
Standard average load	18.7% (10.9)	19.0% (11.2)	20.9% (11.3)
Maximum load; average savings for all use cases	-28.2% (16.4)	-28.1% (16.5)	-25.8% (33.7)

Conclusions

- AEROFLEX road transport innovations for the Physical Internet:
  - ultra-flexible
  - capable of moving high volumes at high speeds
  - much greater efficiency than past technologies

- Road transport is best supported by a strong wired network (rail, IWW and maritime)
  - to achieve even greater efficiency
  - at higher volumes
  - between the main nodes (consolidation centers of the network)

- Macroscopic freight modelling compares different scenarios to show:
  - a positive impact on whole EU freight transport
  - the need of an intelligent regulation
  - the potential of scaling up the existing benefits of use cases to the EU road transport level

- Use cases show, that on a transport related level transport costs (€/tkm) and CO_2 emissions could significantly be reduced

Impact Q&A

topics	specifics	Comments

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AEROFLEX

Optimization of trailer loading with PUZZLE®

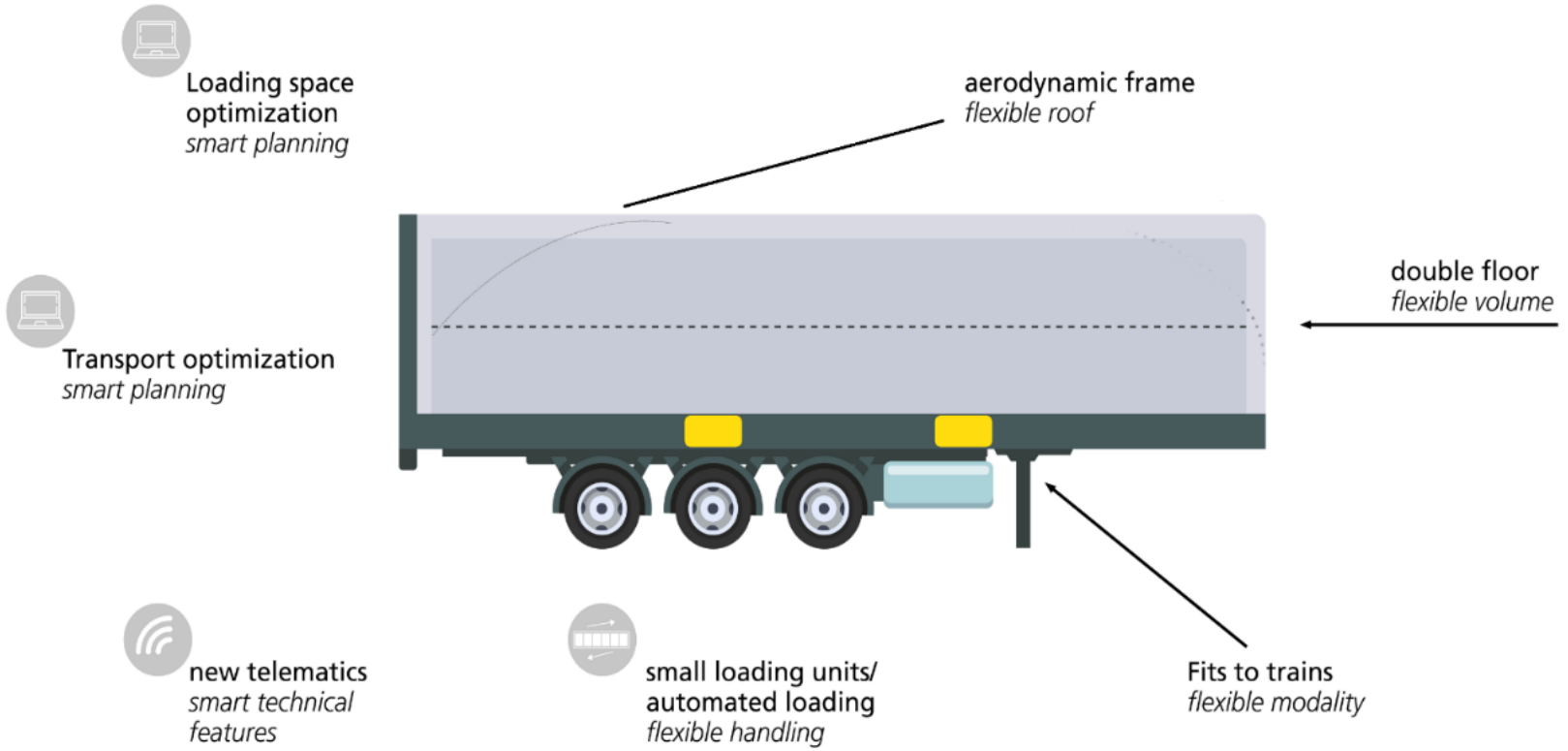
IPIC Conference 2021

Dr. Agnes Eiband, Georg Wichmann, Max Schellert
Fraunhofer IML, Dortmund

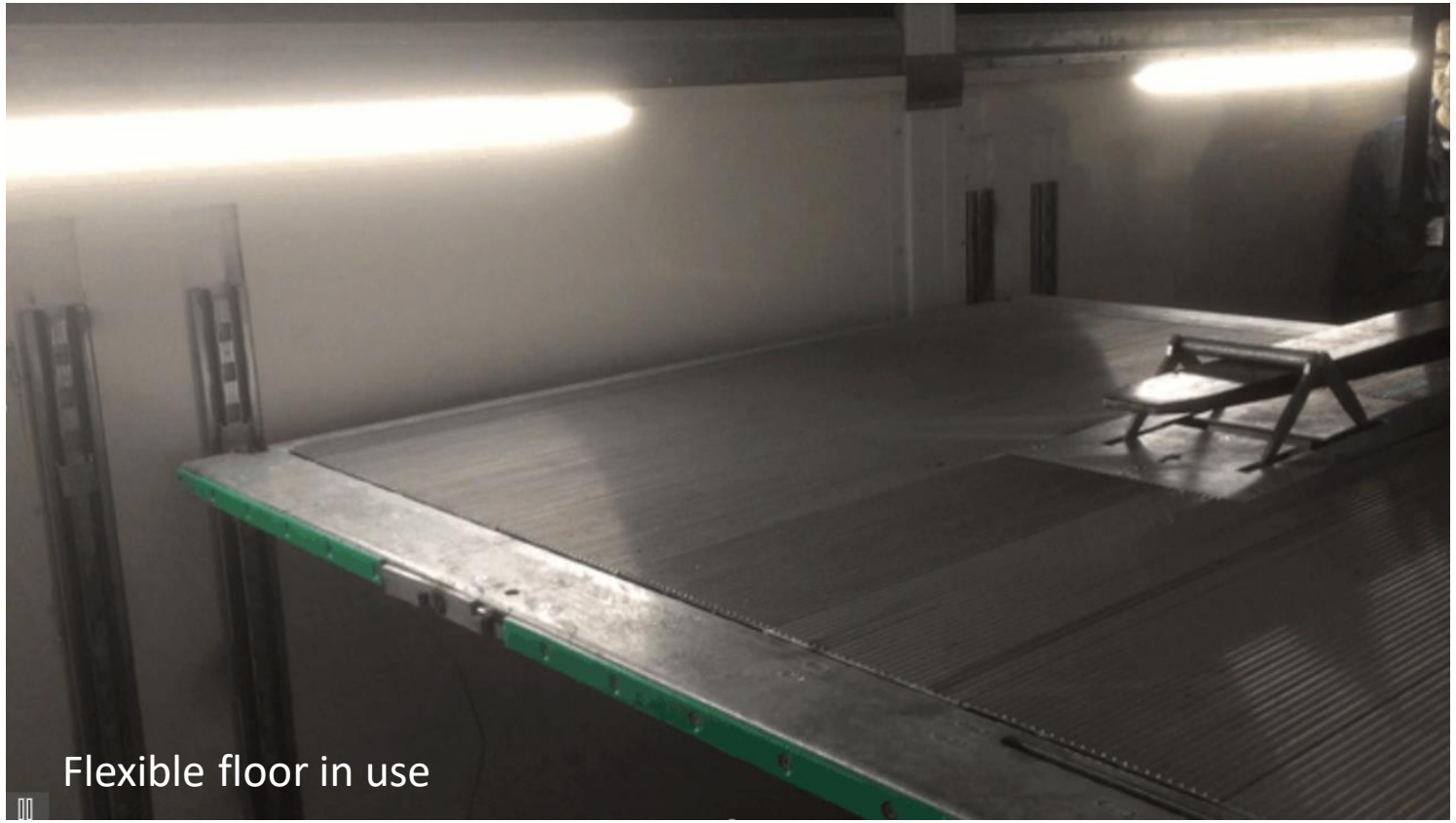
The research leading to these results has received funding from the European Union

Smart and Flexible Loading Units

- Selected range of smart and flexible elements



Basic problem: flex floor planning



Source: VanEck

- Tested use case of P&G
- Transported goods:
  - palletised goods
  - non-stackable
  - different heights
  - collectibles
- Loading unit:
  - Special double floor semi-trailer

Basic problem: flex floor planning

Source: VanEck

- Flexible double floors offer a higher loading capacity in semi-trailers.

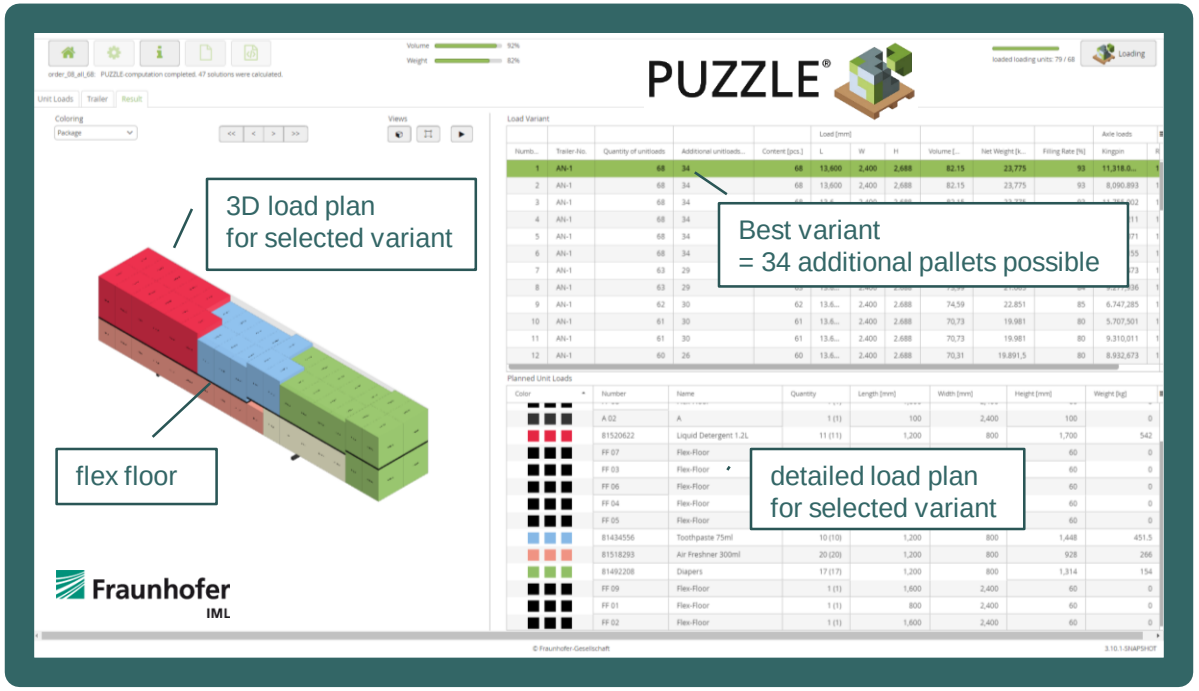
  More pallets per trailer
  = less trailer needed

- But!
- Too many options for manual optimization
- Flex floor usage only if needed
- Respecting legal weight criteria:
  - balancing
  - maximum weight

Solution:
PUZZLE® algorithms applied for trailer loading problem

- PUZZLE for pallets and boxes = used for many years for optimization of pallet packing
- PUZZLE for Aeroflex semi-trailer = application of the algorithms to the trailer loading problem

Example



Test result 2020

Demonstration at P&G use-case within AEROFLEX project

38% higher filling rate
+
Fast and easy planning

Source: Fraunhofer IML

Questions to the audience

- What do you need most for your business?

Loading plan (3D)

Loading plan (table)

other loading unit types

other loading equipment

Which functions?

Future ideas

Double-floor trailer

Max. weight check

Combination with route planning

Weight balancing check

PUZZLE Q&A

topics	specifics	Comments

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AEROFLEX

Cargo Volume Detection

IPIC Conference 2021

Pierre de Rochambeau, Gafur Zymeri

ZF Group

The research leading to these results has received funding from the European Union

ZF: The Perfect Match for Autonomous, Electrified & Connected Commercial Transport

Solving the Industry's Key Challenges

Focused on Safety

Solutions for the protection of road users, driver comfort and cargo integrity

Focused on Efficiency

Product and system solutions for the reduction of operational costs **(TCO)** as well as lower **CO2 emissions**

Focused on Smarter Operations

Connectivity **solutions** delivering smarter operations across the fleet ecosystem (fleet mgmt. predictive maintenance, digital applications)

Cargo Management learnings from market validation

Efficiency, security and integrity keeps shippers and carriers awake at night

EFFICIENCY

- There is a need, but little incentive for increasing efficiency - transport is just too cheap.
- Current business models and pricing structures do not offer enough incentive.

Providing **transparency** in the chain by **tracking cargo** and **trailer** is a desire.

SECURITY

- Fail proof systems do not exist - false alarms all around.
- Theft of cargo and the security of driver are major issues. In the EU alone, there was 173M€ worth of cargo theft in 2020.

There is a need for **reliable** and **affordable** systems.

INTEGRITY

- It's time to open the black box of the trailer.
- Little is known about the state of the cargo in the trailer. This leads to uncertainty for stakeholders and to unpredicted damages and costs of the transport.

Continuous monitoring is the **new norm**.

Volume Sensor: Overview

Presentation Objective

Get constructive feedback and recommendations on solution fit and go to market

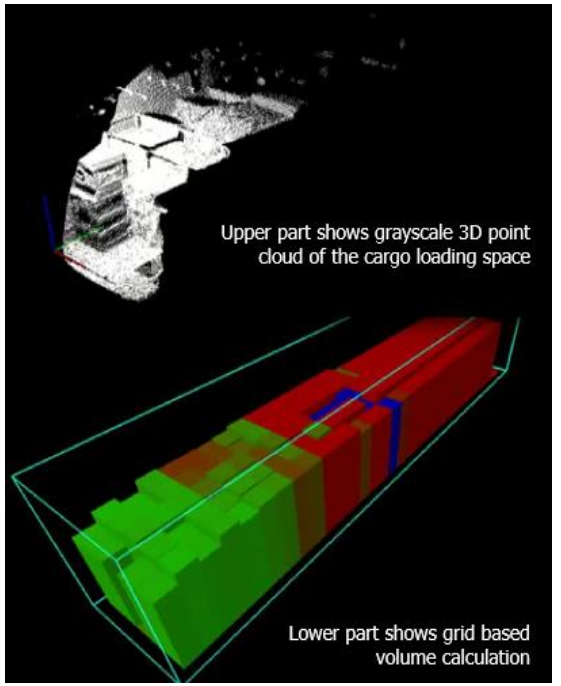
Description

- **Depth-aware sensor** provides real time cargo information to the driver & the fleet manager
- Mounted inside the trailer and **protected** from load/unloading bumps
- Identifies inefficiencies and risks

Beneficiary

- Carriers
- Shippers
- Control Rooms

Visual



Competitive Environment

First cargo systems available with simple cargo tracking technology

No system launch

Technology readiness and system complexity are **delaying** implementation of **advanced solutions**

Value to customer

- **Efficiency** : improves load/unload process, measures performances and avoids down time
- **Security**: detects intruders and provides images
- **Integrity**: detects loose cargo

23% Empty Trucks

35% Stowage Damage

59% Loaded

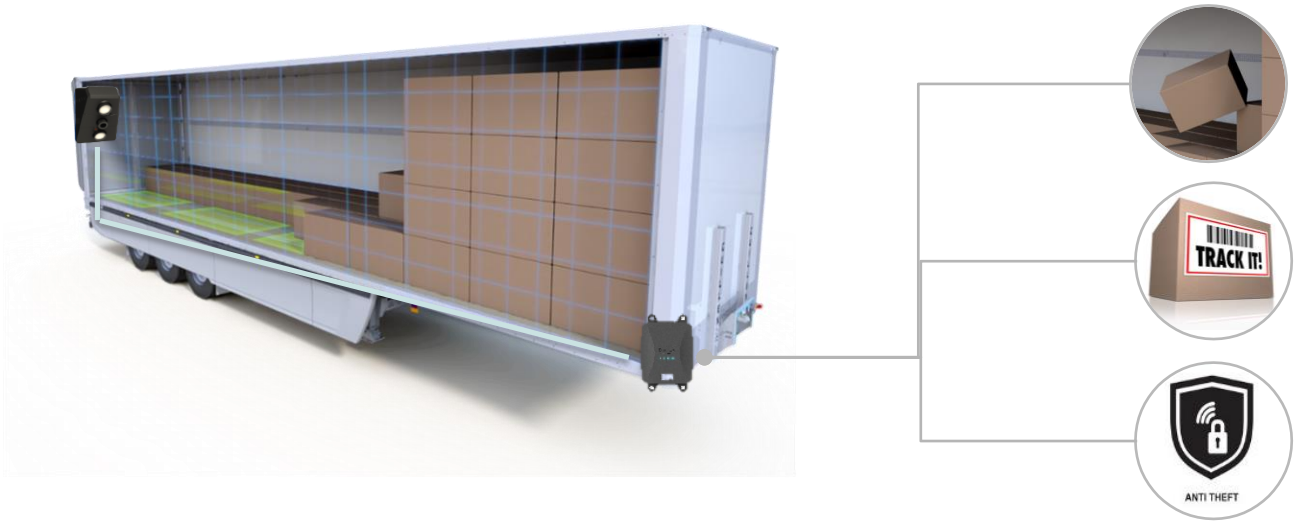
Project Maturity

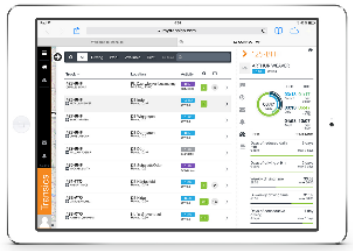
TRL 5: **Prototype in R&D** state

First Proof of Concept completed

System

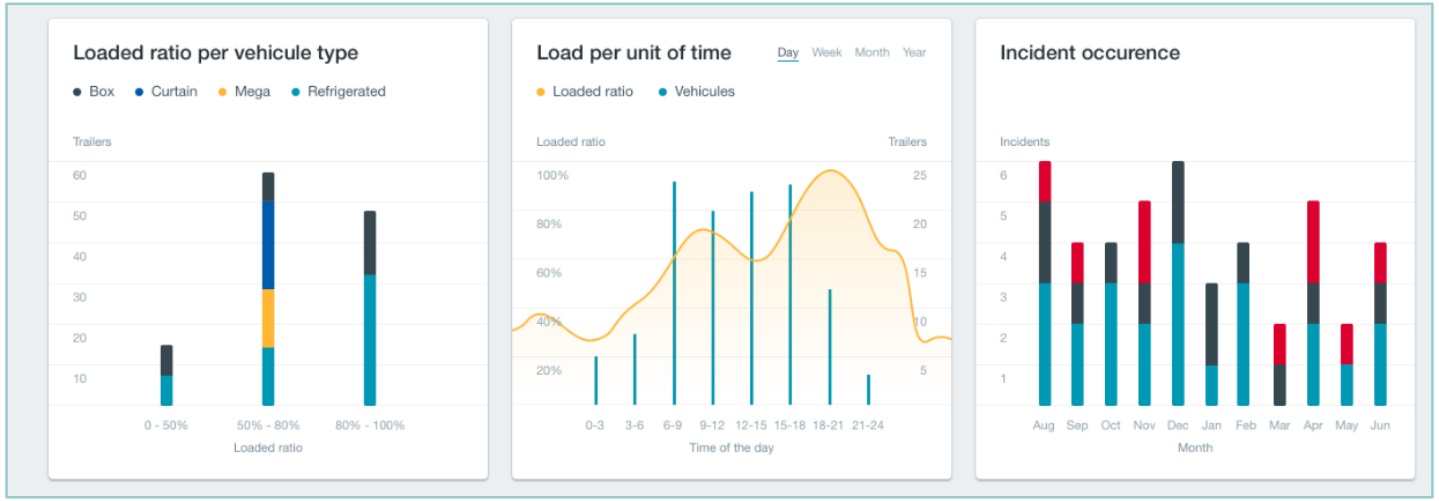
Bringing full visibility of the cargo with one sensor

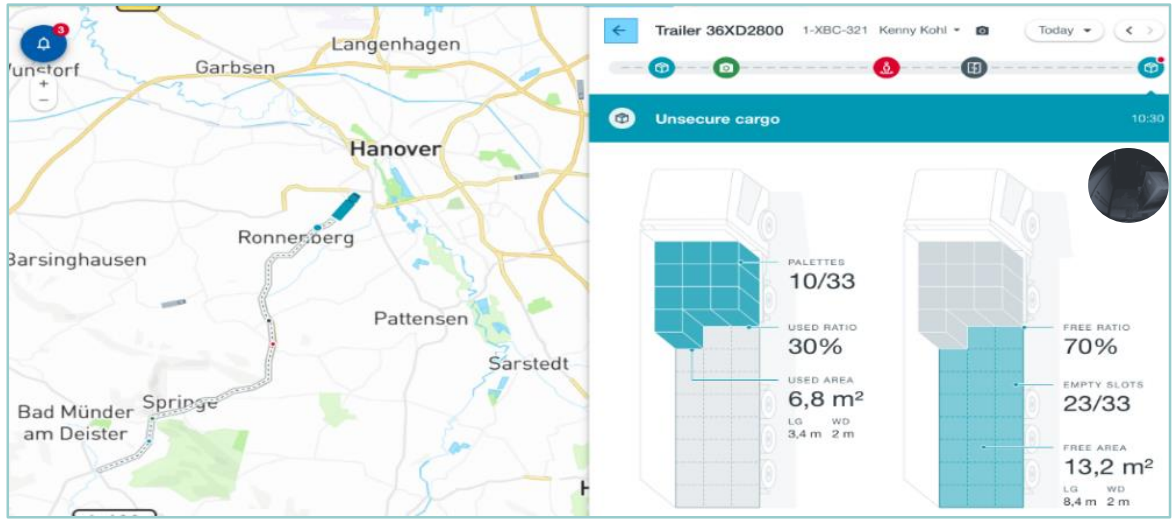


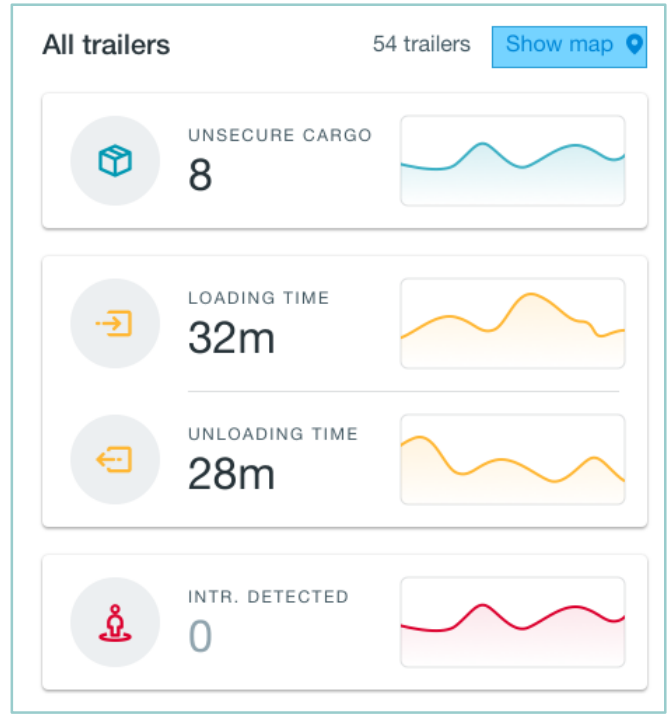


A modular solution allowing a large market reach

Q&A Customer Dashboard Concept



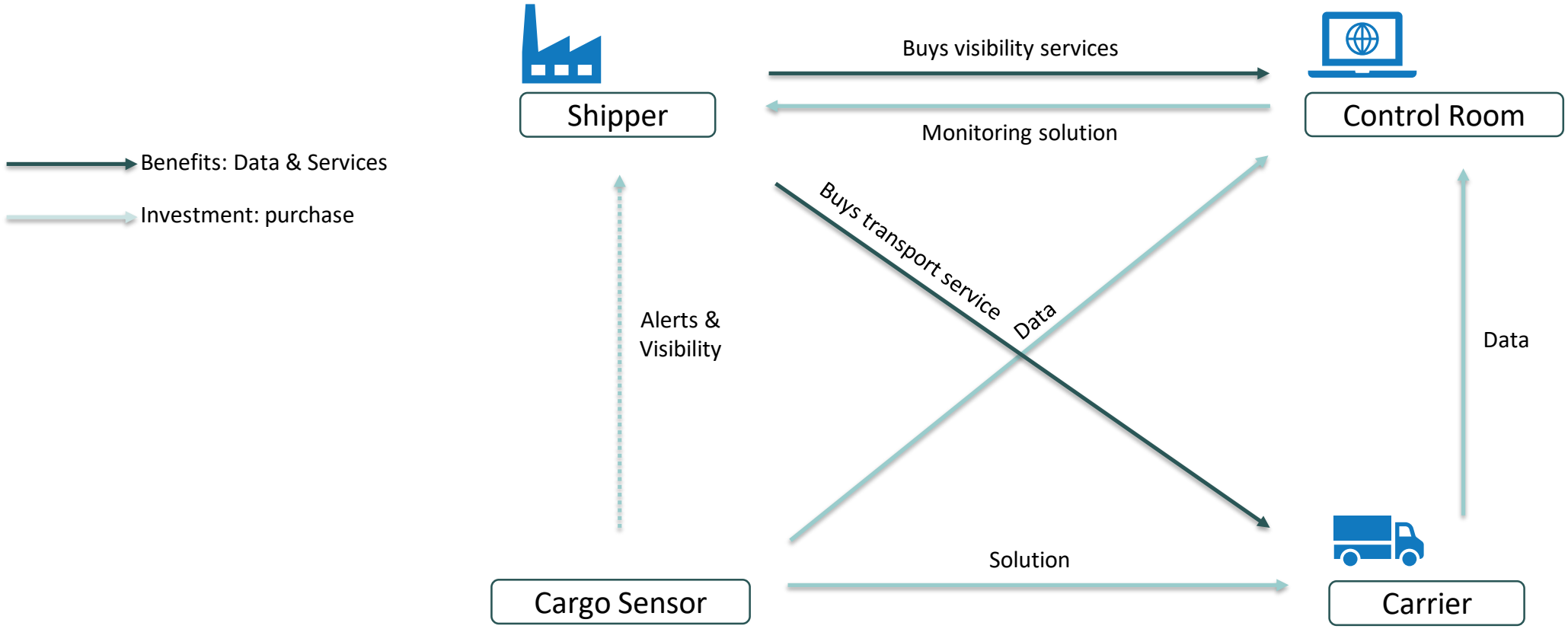




Feedback

What functionality would you expect from the system?

Q&A: Go to Market Dilemma



Dilemma

The Shipper, the Control Room and the Carrier are benefitting from the Cargo Sensor: Who is the customer for such solution?

Cargo Volume Detection Q&A

topics	specifics	Comments

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Wrap up and conclusions

Pre-defined

X
X
X
X
X

Outcome Q&A

X
X
X
x

Thank you

The AEROFLEX project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 769658

Questions (from partners; as back up)

- Question on modelling:

Is the mode shift to road – shown in your modelling results – a problem if road freight vehicles will use more are more renewable energy?

- Question on Use cases:

How many use cases did you analyze, and which kind of tours and countries did you include?

Q&A

Who	Topics	Specifics/question	Comments
Agnes - Andreas	Modeling		
Pierre - Christoph	Use case		
Gafur – Agnes	PUZZLE		
Andreas - Pierre	Market		
Christoph - Gafur	CVD		

Presentation	18-19hr
Return	20-21hr