Port automation and self organisation

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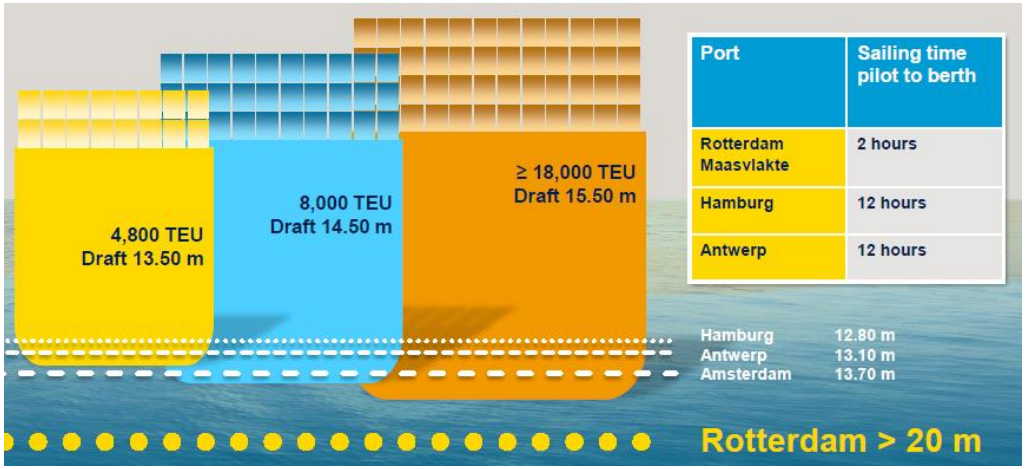
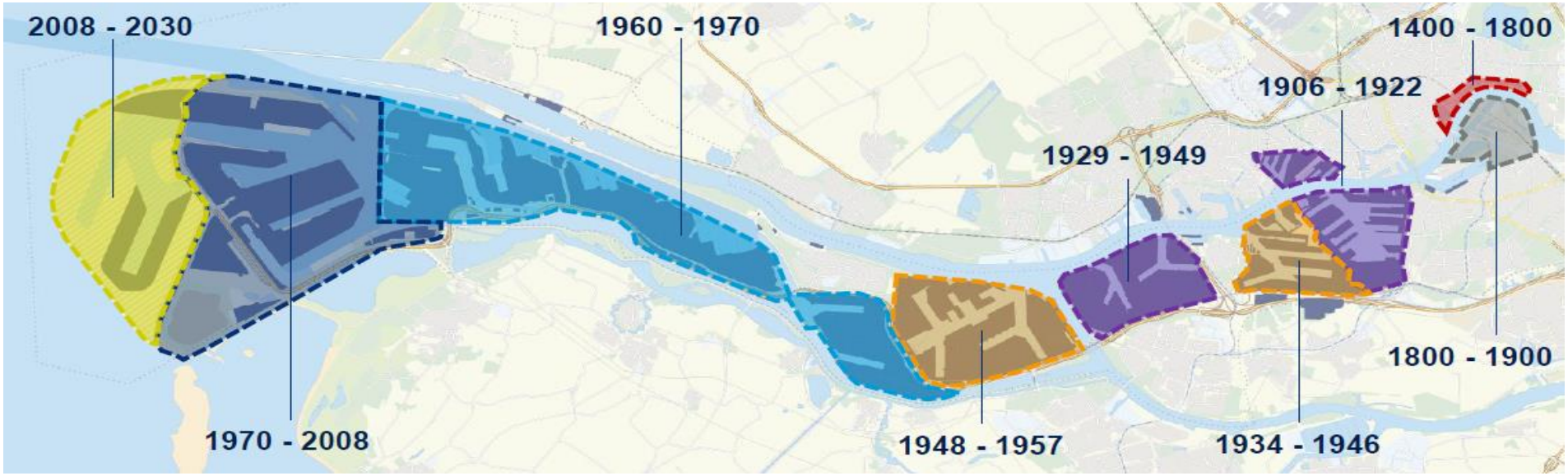
Port of Rotterdam made it happen…

- Largest port of Europe (8th in the world)
- Best port infrastructure in the world (World Economic Forum)
- Access to 500 million wealthy consumers and high population density
- 450 Mton & 12 MTEU/year: 35k sea vessels, 98k barges/year, 7.5 M trucks/year)



...but something hás to change

- 60% activities are fossil-fuel based
- 80% of the assets >50 years old: economically (and technically?) written off
- High energy and feedstock prices in EU
- High labor costs (+battle for talent)
- High land lease costs



Sense of urgency Rotterdam

Challenges:

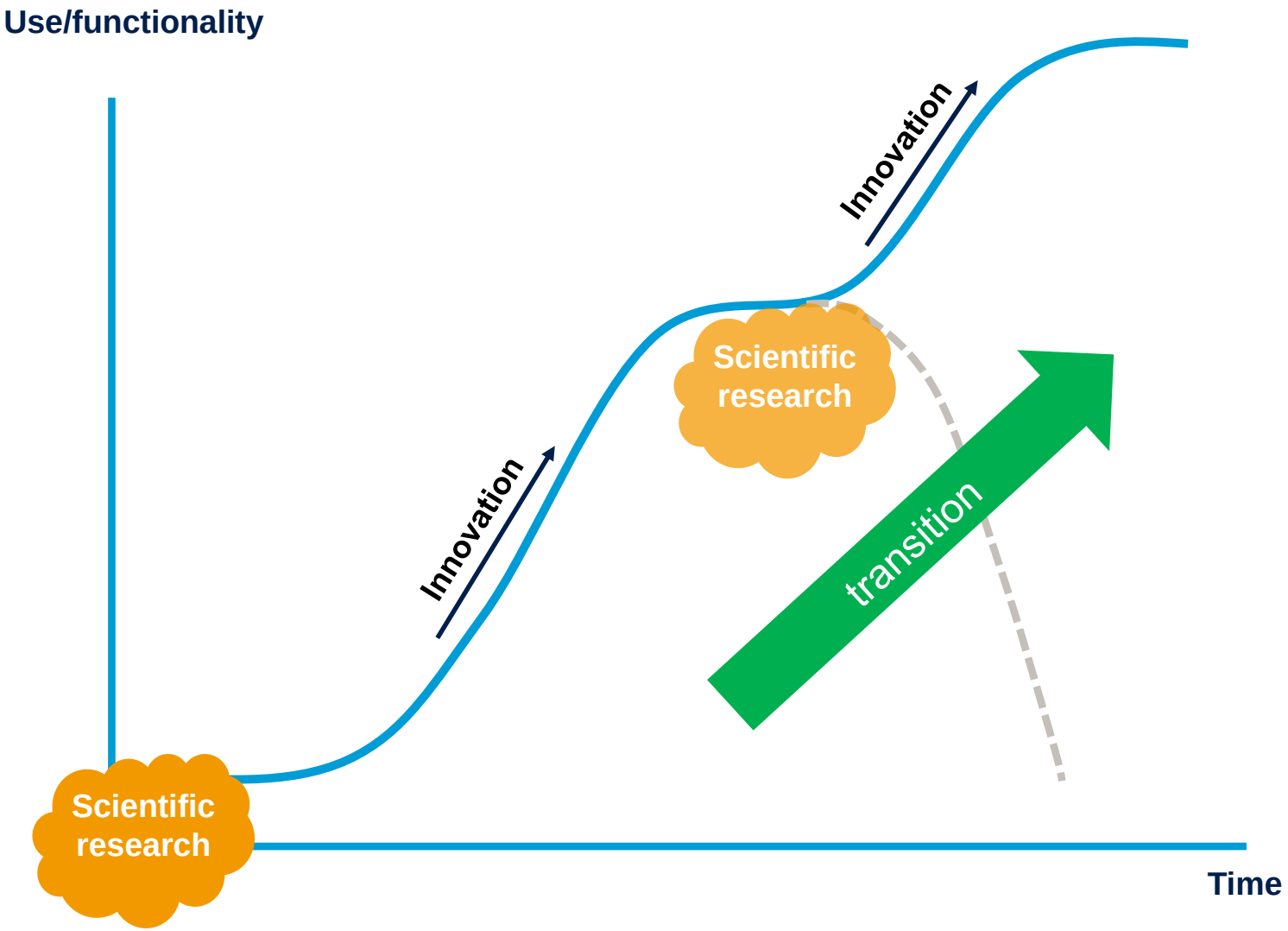
- Smart Energy and Industry (CO_2 reduction, biobased and efficiency)
- Smart Logistics (growth vs optimal use infra)
- Futureproof Port Infrastructure (lifecycle extension, future-proof design)
- World Port City (synergy port and city economies)
- Port Strategies (role and positioning Port Authority)

Transitions have started!

- Change of era, not an era of change
- From Biggest to Smartest Port
- Deltaplan Energy Infrastructure (CO_2, LNG, steam, residual heat)
- Fully automated container terminals
- Largest container vessel berthed
- Tech start-ups
- Some companies become footloose

Increased speed of change and complexity require collaboration and integral approach

Research and Innovation are key



Ambition

- value creation for the port community
- central hub for knowledge development, dissemination and application
- concentrate all investments and leverage via SmartPort
- demand-driven by the issue-owners, not being contract research
- shared roadmaps per challenge as leading principle
- community building and knowledge transfer
- be embedded in Port's innovation ecosystem
- 100 projects, 40 M€ project volume

"A World Class Port needs a world class knowledge infrastructure in the region"

Port automation and optimisation

Predictions based on historical data

(real time) Situational awareness (IoT)

Predictive analytics

Self organisation

- More data, real time and decentralised generation and application
- Examples:
  - Truck platoon matching (and barge/sea vessel platooning)
  - Self organising synchromodality
  - Physical internet
  - Swarm Port (port call optimisation)

Highly automated terminals (RWG, ECT, APMT)

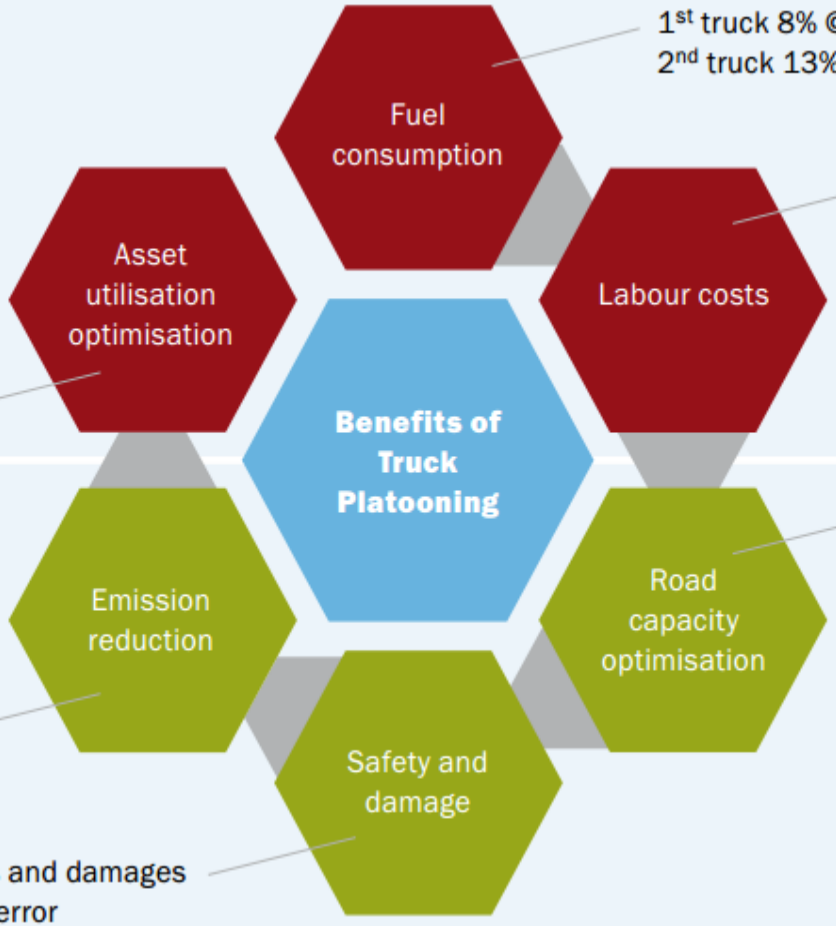
2.350.000 TEU/year
20 m water depth
1150 m quay wall
11 deep sea quay cranes
3 barge feeder cranes
2 rail cranes
50 automatic stacking cranes
59 automated guided vehicles

Truck platooning

Virtually-linked automated driving at min 0.3 s time gap with automated braking, throttle (and steering), enabled by C-ACC, wireless communication, GPS

Why Truck Platooning?

BUSINESS VALUE



1st truck 8% @ 0.3s/~2.0 L/100 km
2nd truck 13% @ 0.3s/~3.3 L/100 km

Driver efficiency optimisation
driving/resting times

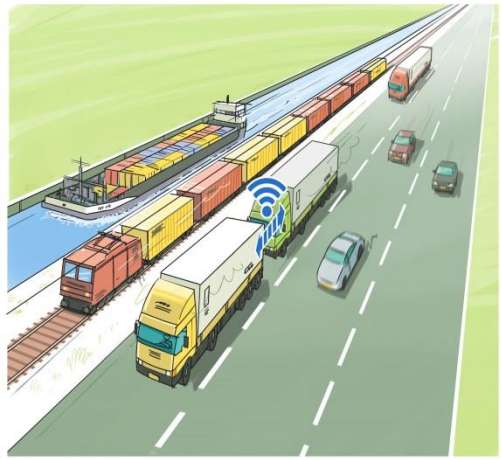
Reduced truck idle time;
enhanced efficiency

SOCIETAL VALUE

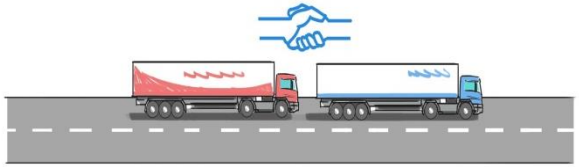
Less congestion
Increased traffic efficiency

Through mileage
improvements
2.6 kg CO_2/L diesel

>90% of accidents and damages
caused by human error



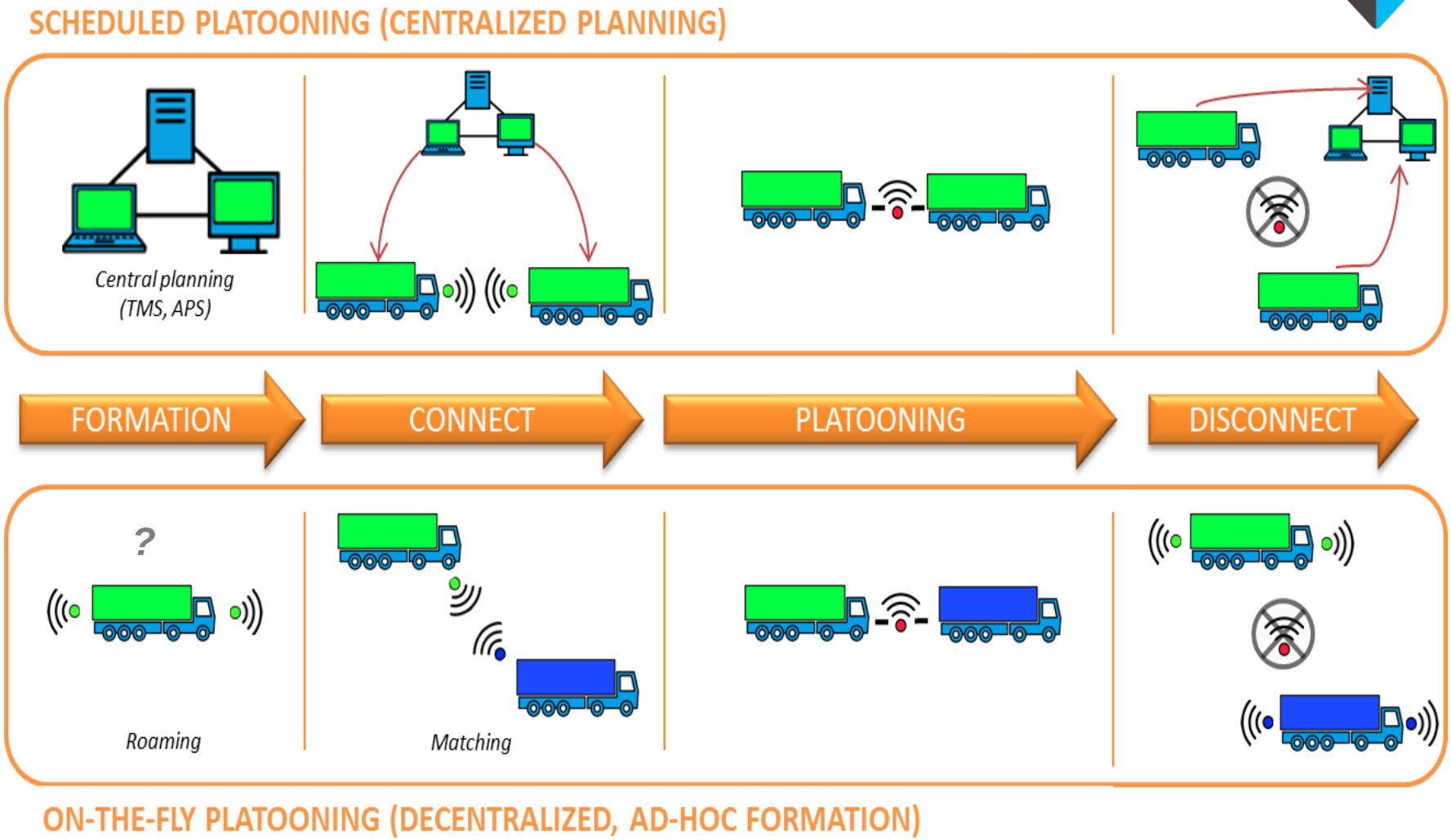
Aspects of truck platooning



TRUCK PLATOONING DEVELOPMENT PATHS

- **INFRASTRUCTURE USAGE**
  - **National** Closed private areas
  - **National** Public main roads
  - **Cross-border** Public main roads
- **PLATOON FORMATION**
  - **Self-organised** Scheduled
  - **Self-organised** Ad-hoc, On-the-fly
  - **Orchestrated** Platooning Service Provider
- **LEVEL OF AUTOMATION**
  - **All drivers drive** ("guarded platoon")
  - **1 driver, others resting** ("follower resting")
  - **1 driver** ("single driver platoon")

Platoon formation: planned or ad-hoc formed “on-the-fly”



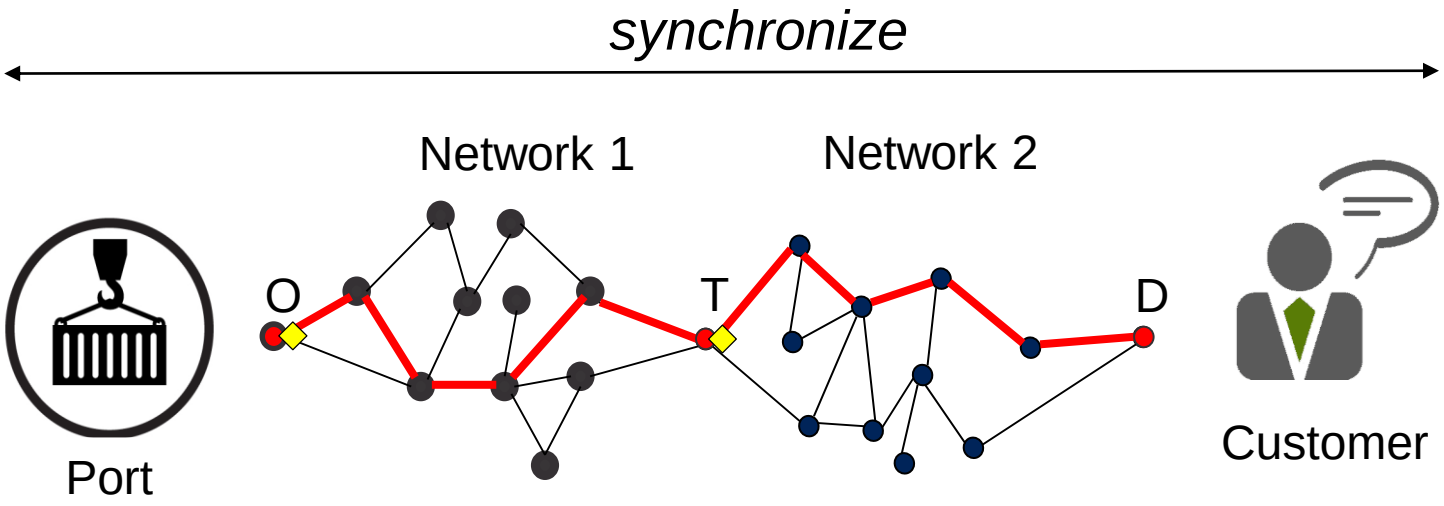
Smart Data for Logistics

74 % of all inefficiency in the container supply chain is due to information that is incomplete or not on time at the right place *).

Examples:

- A container shipped from Singapore to Duisburg is not moving during 400 of the 900 transport hours*).
- The average transport occupancy (average all modalities) is 50% (NL)

Synchromodal transport

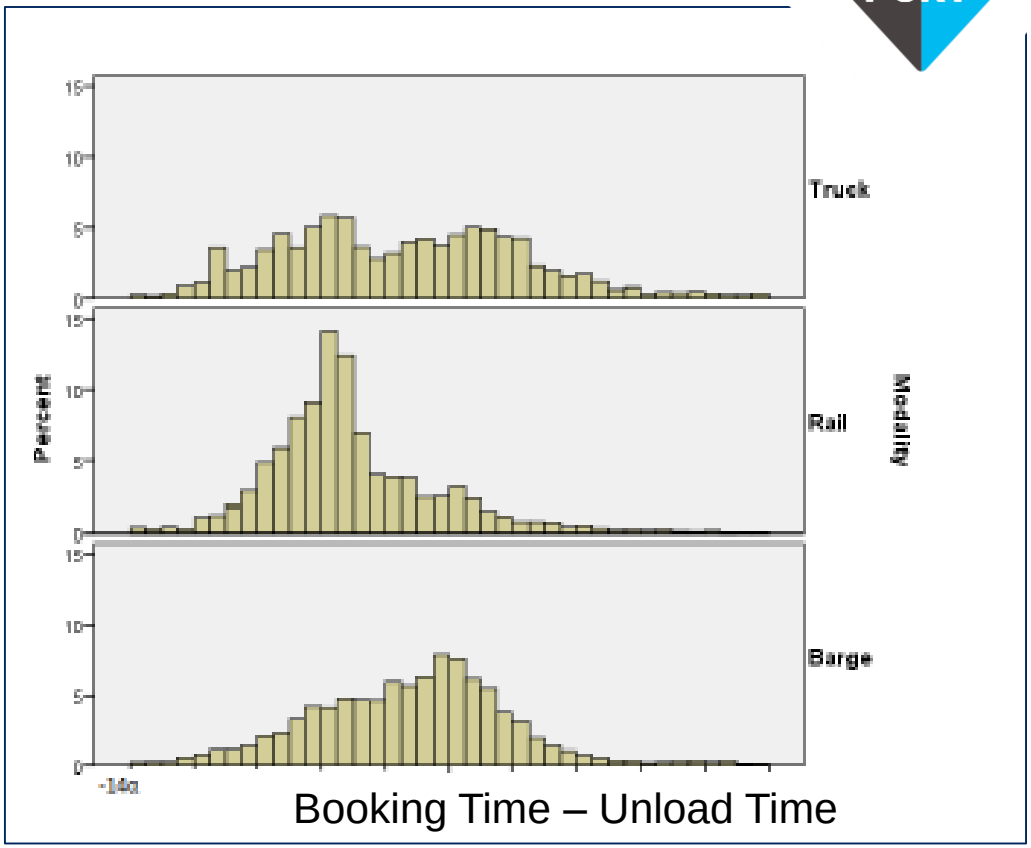


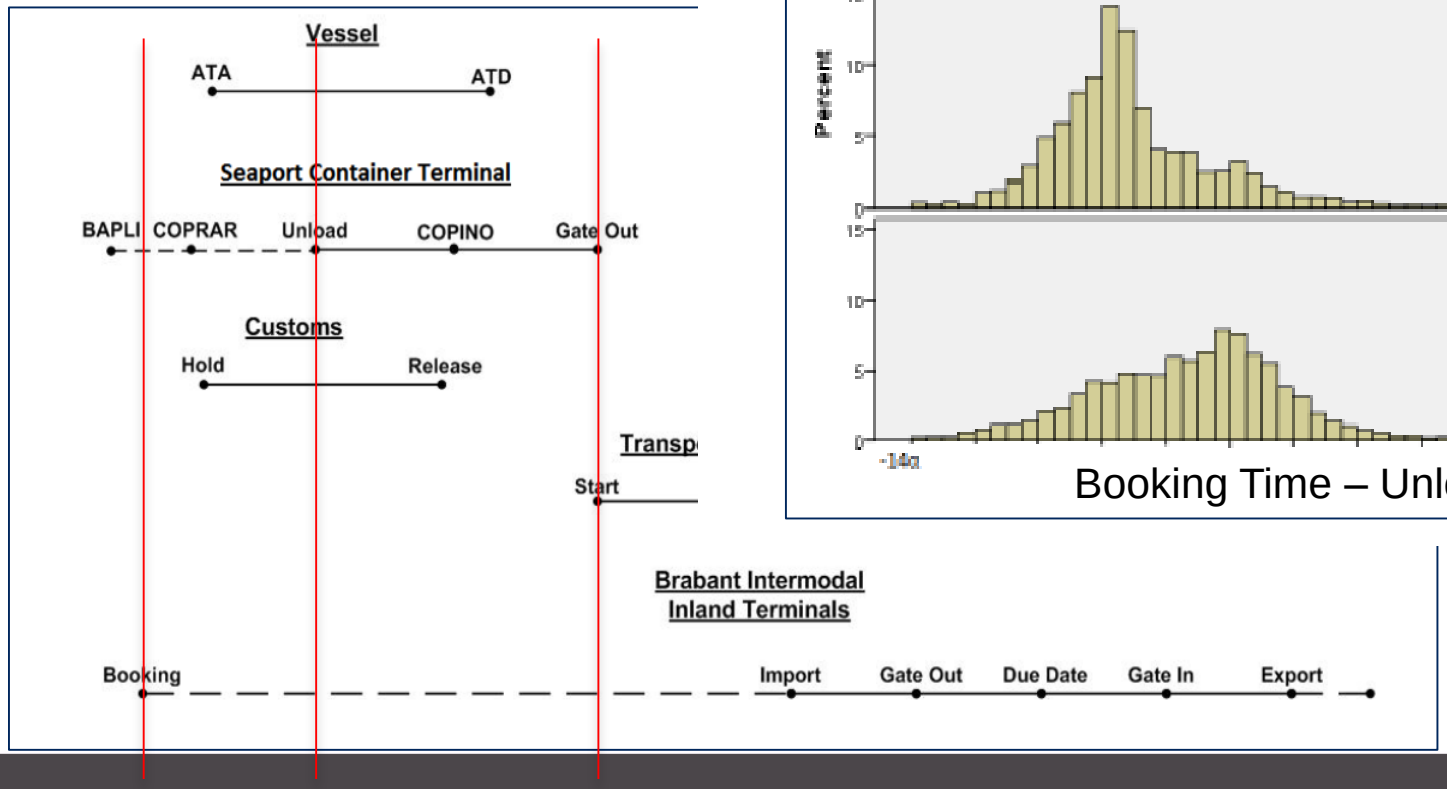
- node
- link
- link on selected route
- mode and route choice

O Origin
T Transshipment point
D Destination

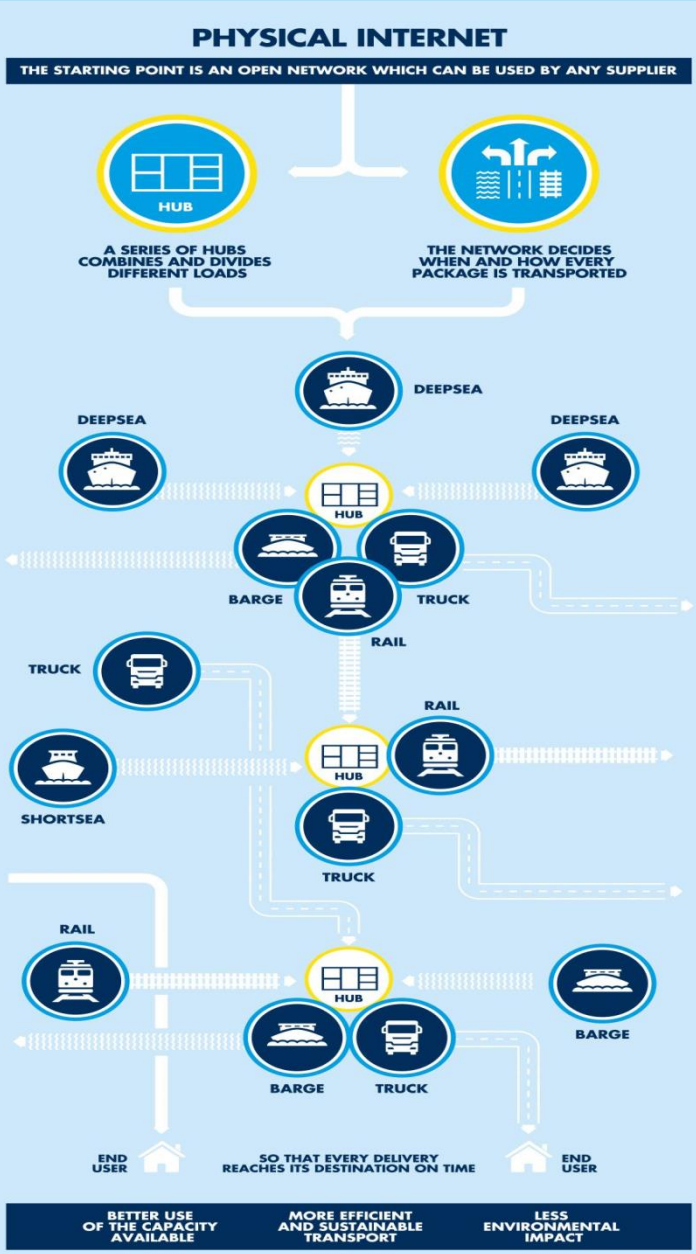
Advance booking

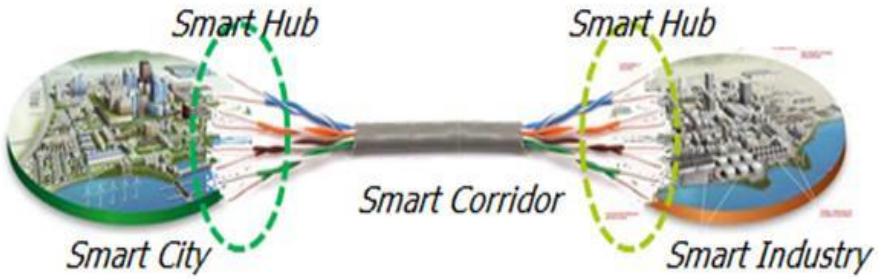
Booking in advance:
mode needs to be selected,
mode switching cumbersome

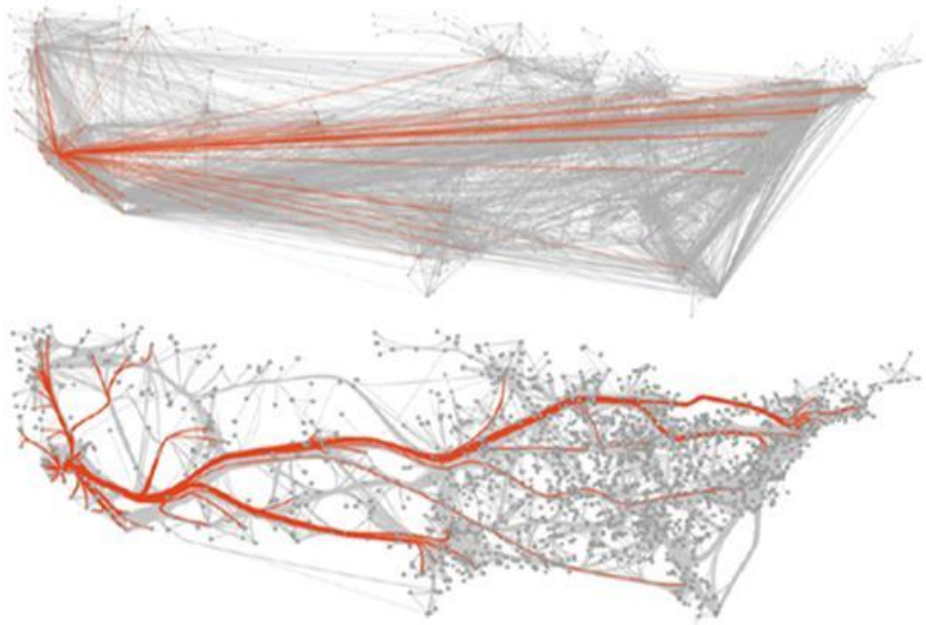




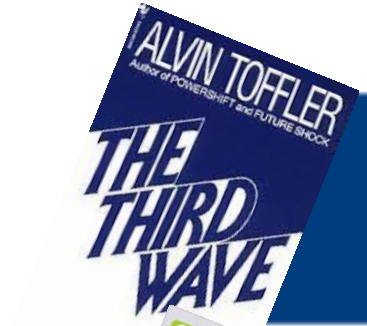
Smart flows, corridors and hubs







Impact of Internet: which one?

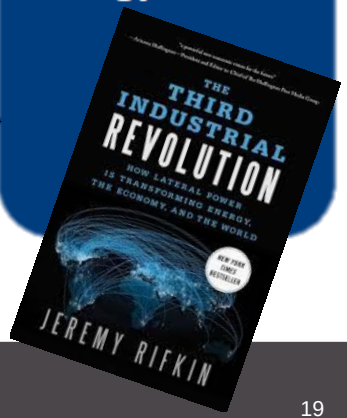


World Wide Web (WWW)
Digital Internet
Digital Information Packets

Connecting Physical Objects through WWW
Internet of Things
Smart Networked Objects

Open Logistics Web
Physical Internet
Smart Physical Packets

Smart Grid
Energy Internet
Energy Packets



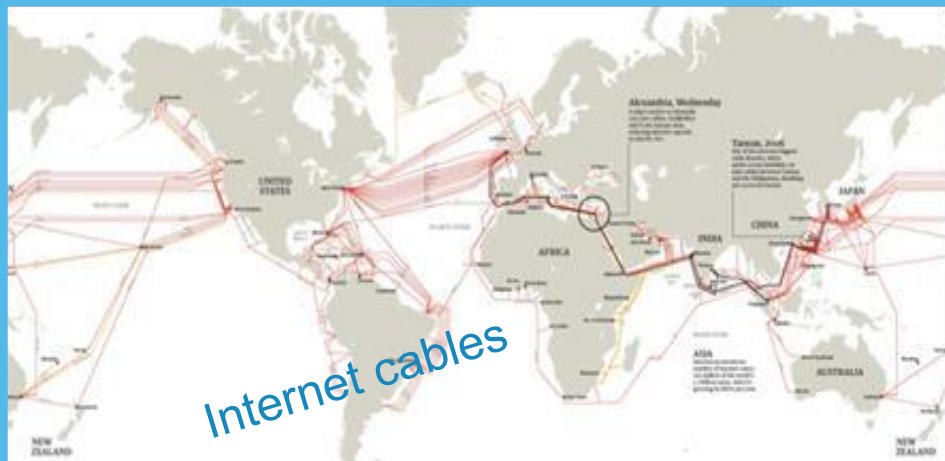

Facebook


flights


energy

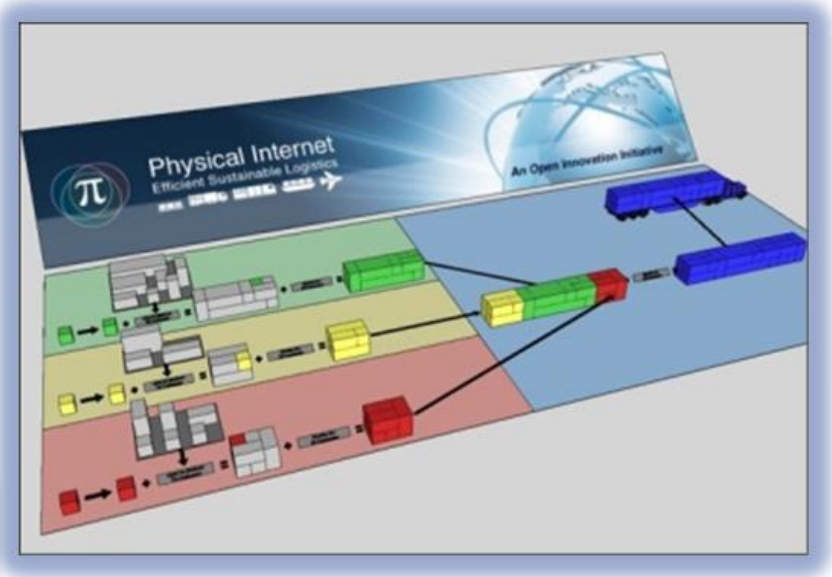

E-mail


cargo


Internet cables

Physical Internet

www.physicalinternetinitiative.org

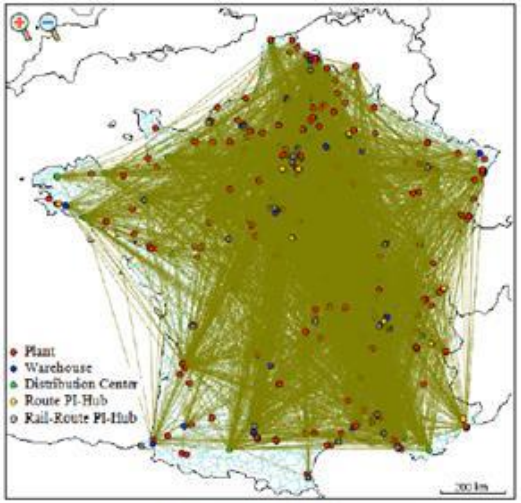


Physical Internet

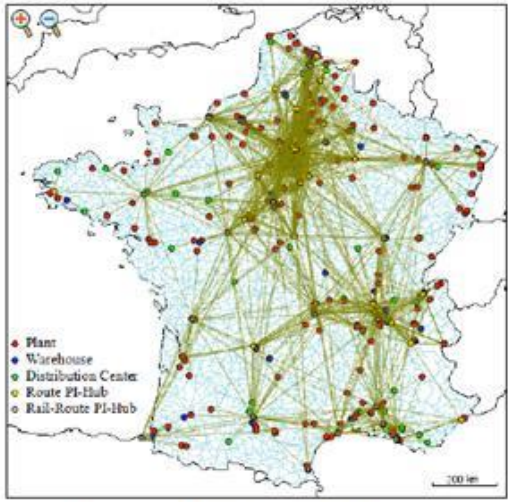
Exploiting a Physical Internet Enabled Bimodal Mobility Web for the Consumer Goods Industry in France

Road and rail transport seamlessly integrated into the PI backbone network

Simulation based on product distribution flow to two top retailers in France, from their 100 top suppliers



Current flows



Physical Internet flows

Physical Internet traffic

Preliminary results using existing infrastructures, facilities, demand patterns and service levels

Economical: From 4% to 26% overall cost saving

Environmental: About 3 times better in terms of greenhouse gas emissions,

by combining road-to-rail modal transfer and more efficient road transport

Ballot É., B. Montreuil, R. Glardon (2012), Simulation de l'Internet Physique: controbution à la mesure des enjeux et à sa définition, PREDIT Research Report, France, June 2012, 96 p.

Conclusions

1. IoT related to transport and logistics generates a lot of vital data
2. Data exchange can improve situational awareness and predictive analytics (information)
3. Automation of both the transportation modes and trans-shipment processes reduces costs and handling time and improves the reliability
4. The complexity of logistics (eco)systems requires self organisation
5. Highly automated processes and data exchange are prerequisites for a system breakthrough: self-organised system or Physical Internet
6. Blockchain technology might be an enabler for digital trust and smart contracts (transactions) in self-organised or PI systems

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