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Agenda

- 1 Introduction
- 2 Maritime Transport Chain
- 3 Potentials
- 4 Conclusion

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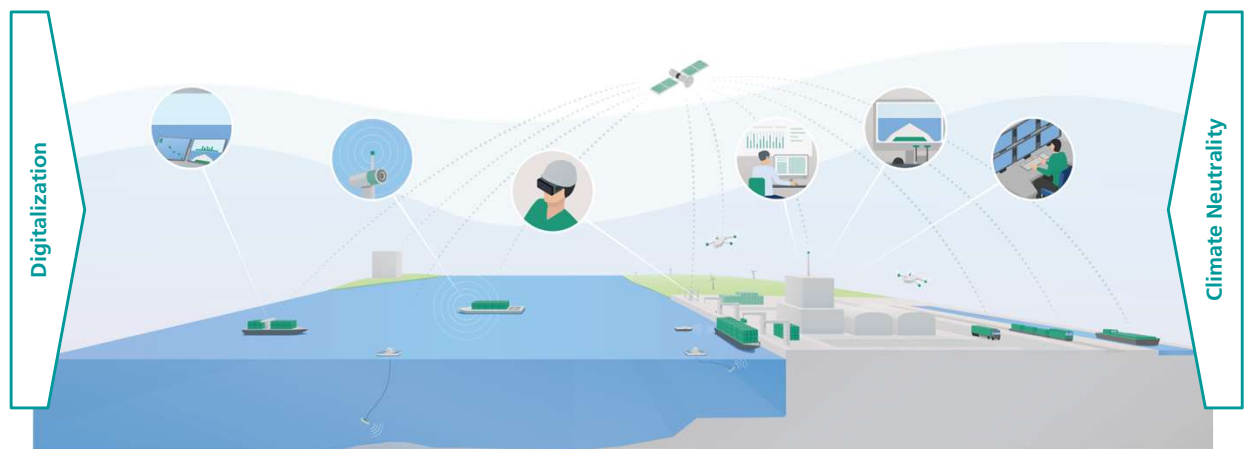
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Fraunhofer CML: Innovating the Maritime Sector

Making shipping, ports and logistics safer, more efficient and more sustainable

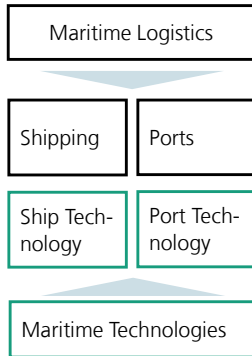


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Fraunhofer CML

Innovating the Maritime Sector

Industry Focus



Interdisciplinarity

- Engineers (mechanical and electrical engineering, shipbuilding)
- Logisticians
- Economists
- Computer scientists
- Mathematicians
- Navigators

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Why is Efficiency of the Transport Chain an Issue?

Efficiency means doing things right.



Working faster or better or



more resource-efficiently.



Effects of Transport Chain Efficiency

- keeping customers satisfied
- faster and reliable delivery
- shorter order processing times
- better inventory management
- better resilience
- **higher profits** (costs reduction 10-30%)

Demand vs Capacities

- growing demand for transport meets limited capacities (transport, infrastructure)

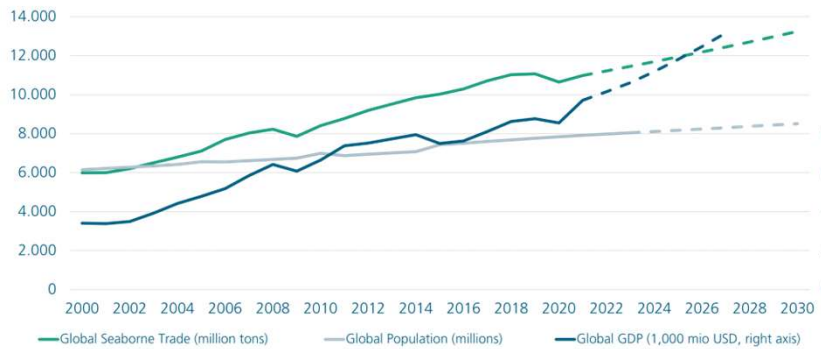
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Global Market Development

Populations, Economies, Trade

Global Framework and determining factors

- Growing populations and economies lead to more global trade and thus seaborne transport
- Expanded demand for transport meets inelastic supply of transport capacity

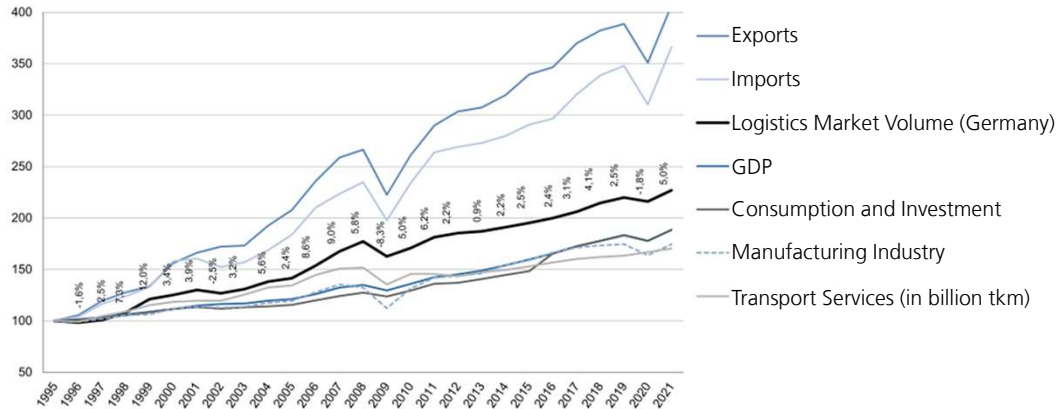


Source: UNCTAD (2022): Review of maritime transport

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Logistics Market Development

Germany



Source: DVV Media Group GmbH (2022): Top 100 der Logistik

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Priorities of CSCOs (Chief Supply Chain Officers)?

52%
Deliver better customer experience



49%
Improve efficiency or profitability



47%
Generate more accurate forecasts



45%
Increase sustainability



45%
Deliver more innovation in business models



Source: IBM (2022) Own your transformation_Data-led innovation for the modern supply chain (ibm.com)

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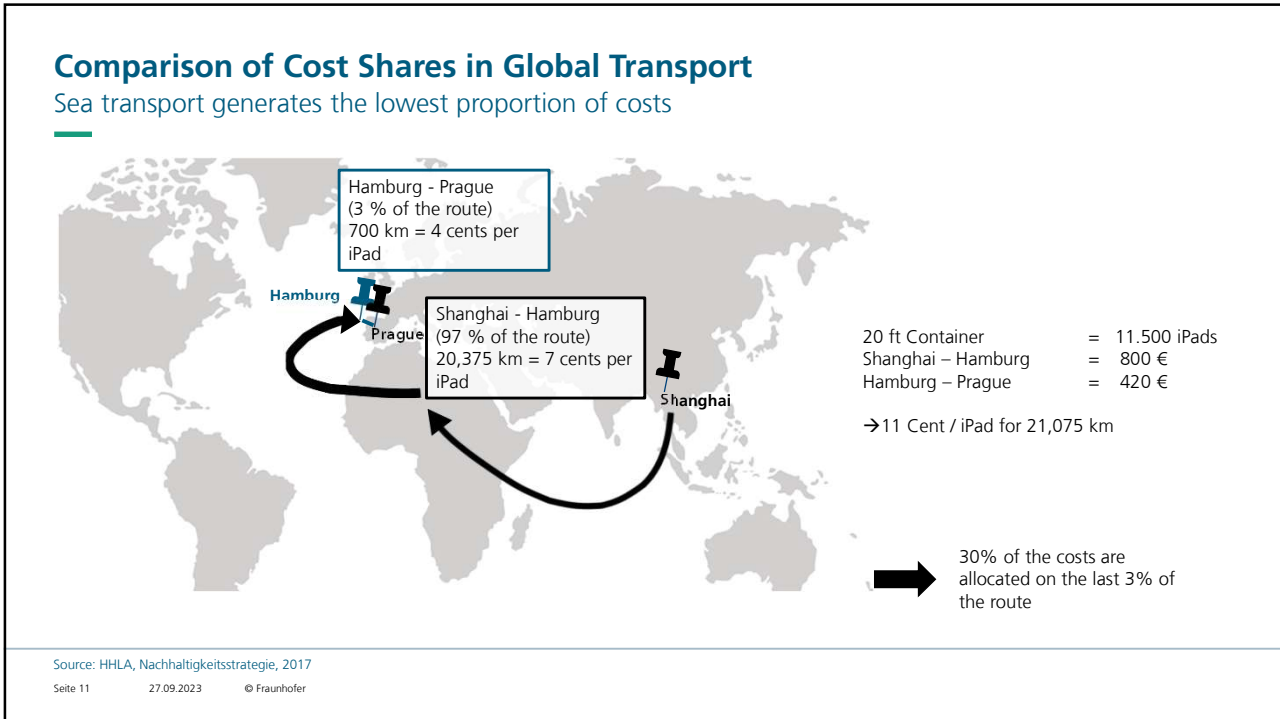
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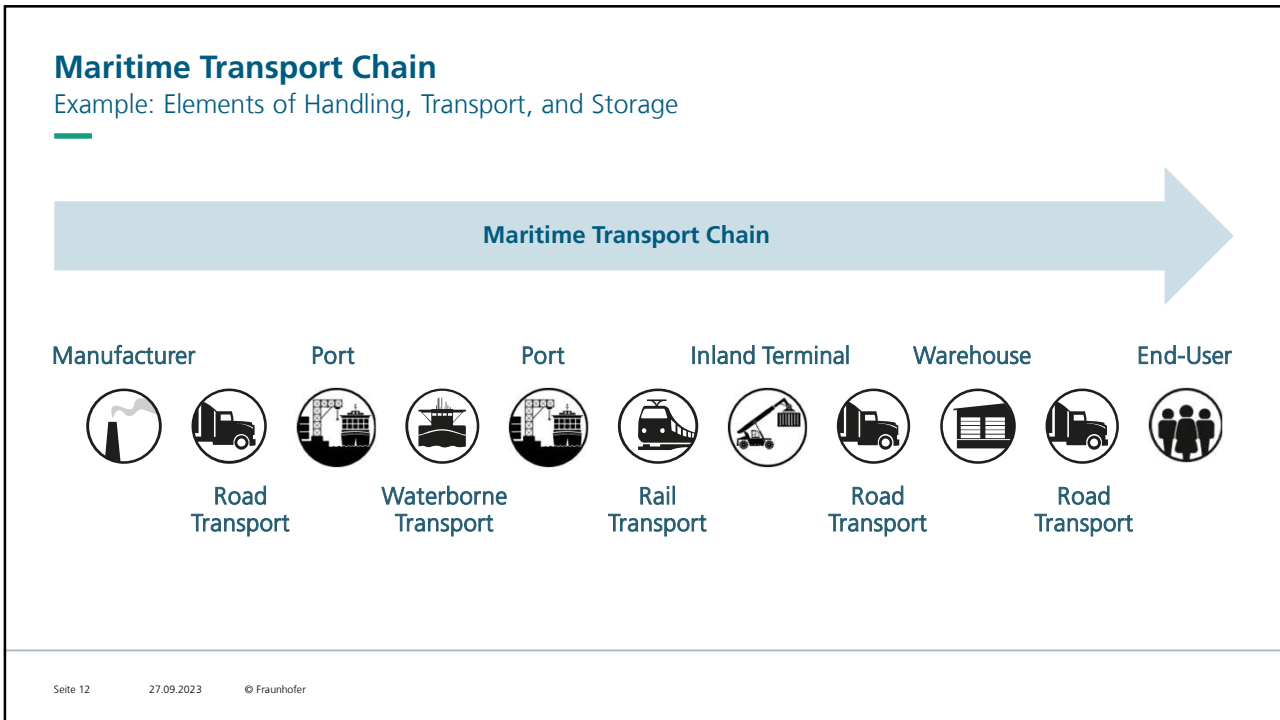
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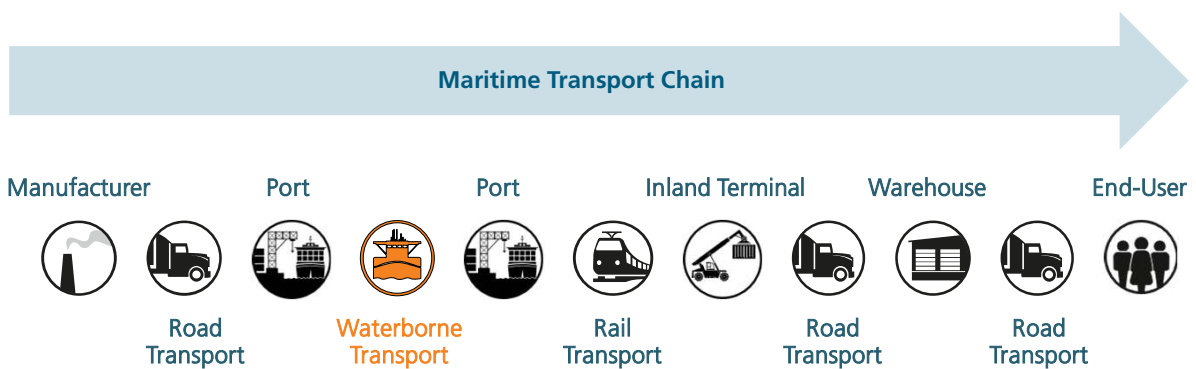
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Maritime Transport Chain

Efficiency Potentials in Waterborne Transport



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Ship Efficiency Potentials

Efficiency potential of the seagoing vessel is determined, ~10 years ago

Operational

Weather routing **1-4%**
Autopilot upgrade **1-3%**
Speed reduction **10-30%**

Auxiliary power

Efficient pumps, fans **0-1%**
High efficiency lighting **0-1%**
Solar panel **0-3%**

Aerodynamics

Air lubrication **5-15%**
Wind engine **3-12%**
Kite **2-10%**



Thrust efficiency

Propeller polishing **3-8%**
Propeller upgrade **1-3%**
Prop/rudder retrofit **2-6%**

Engine efficiency

Waste heat recovery **6-8%**
Engine controls **0-1%**
Engine common rail **0-1%**
Engine speed de-rating **10-30%**

Hydrodynamics

Hull cleaning **1-10%**
Hull coating **1-5%**
Water flow optimization **1-4%**

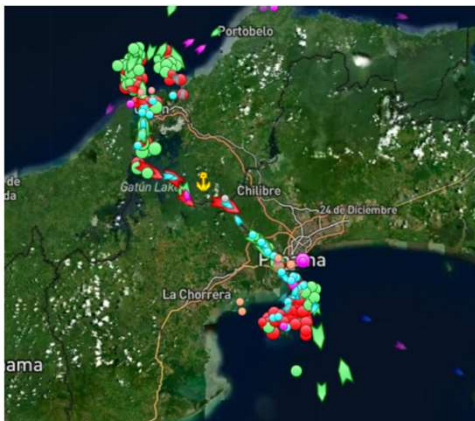
Source: International Council on Clean Transportation ICCT, 2013

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Waiting Ships

Panama canal: more than 100 ships wait for the passage



Source: Marinetráfico.com, 19.09.2023

WAITING TIMES UPDATES

Tuesday, September 19th, 2023

VESSELS IN QUEUE FOR TRANSIT IN THE PANAMA CANAL		
LOCKS	BOOKED	NON-BOOKED
NeoPanamax	7	8
Panamax	36	59
Vessels in Queue for Transit	43	67

WAITING TIME FORECAST		
VESSEL TYPE	NORTH BOUND	SOUTH BOUND
NeoPanamax	1-2 Days	7-8 Days
Panamax Plus	1-2 Days	7-8 Days
Super	13-14 Days	14-15 Days
Regulars	13-14 Days	1-2 Days

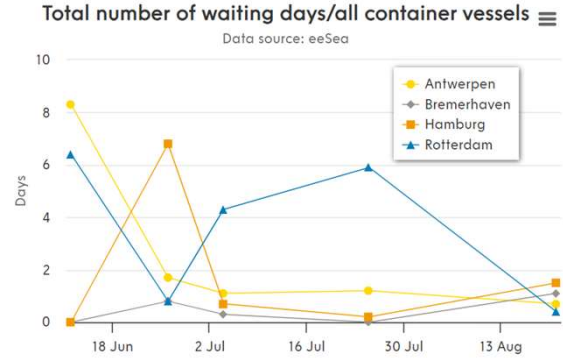
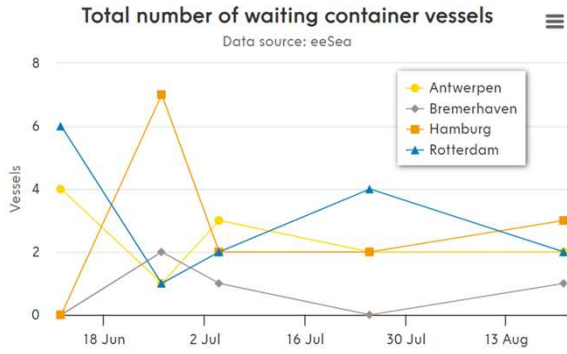
Source: <https://www.waterfront-rs.com/> (Sept 19, 2023) panama-canal-waiting-times/

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Waiting Ships

Norange Ports

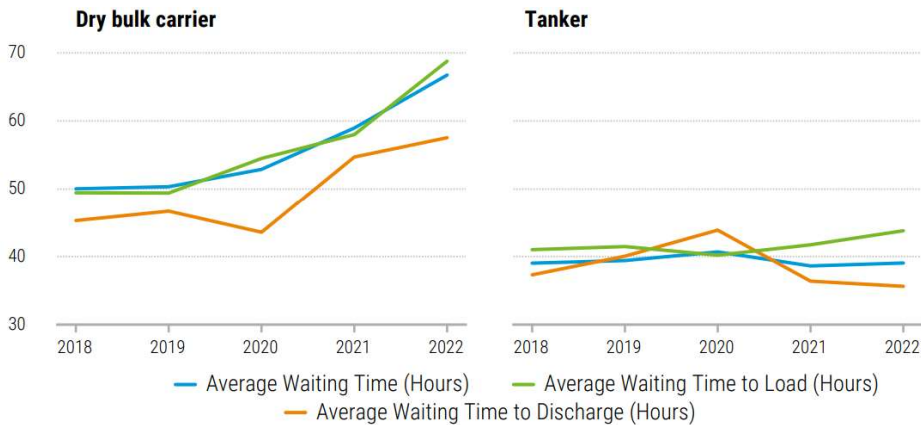


Source: <https://www.portofrotterdam.com/en/logistics/port-performance> (2023)
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Waiting Ships

Situation in bulk and tanker transport



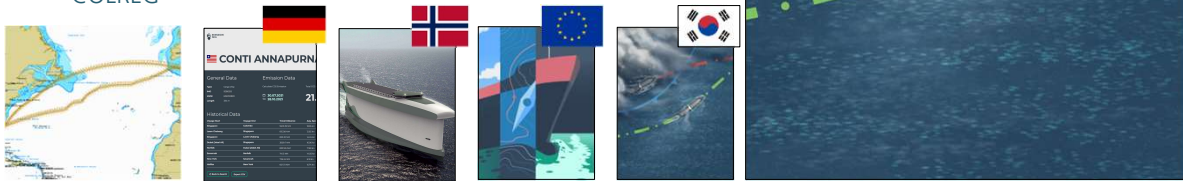
Source: https://unctad.org/system/files/official-document/rmt2022_en.pdf --> S.87
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Project Example(s) 1: Route Optimization

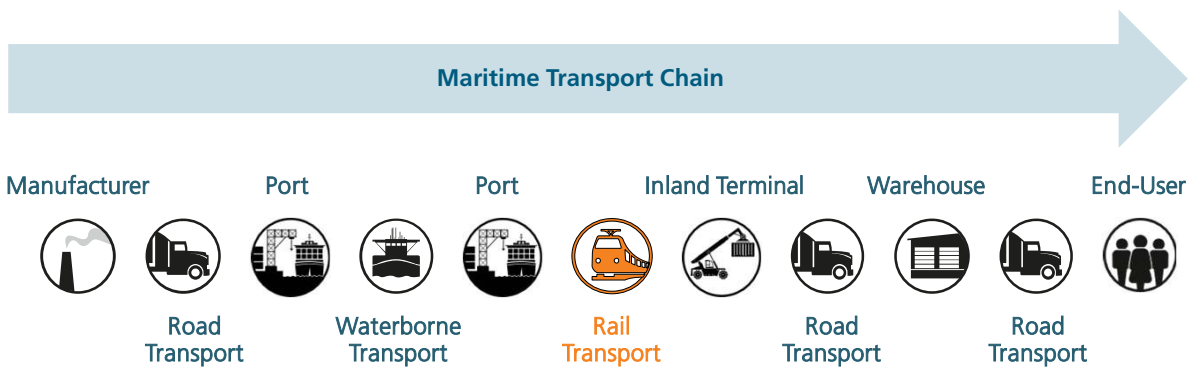
Big Data and AI

- Route optimization taking into account big data and artificial intelligence
 - Weather Data
 - Ship Data
 - Logistics Data
 - Ship Traffic Data
 - COLREG



Maritime Transport Chain

Efficiency Potentials in Railroad Transport

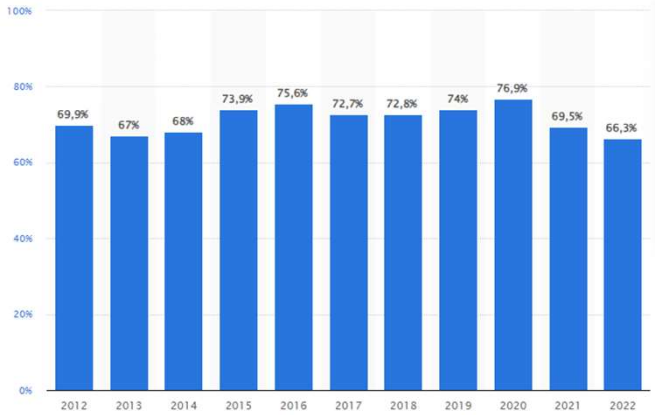


Efficiency Potentials in Railroad Transport

Bottlenecks and lack of punctuality



Share of punctual trains (DB Cargo)



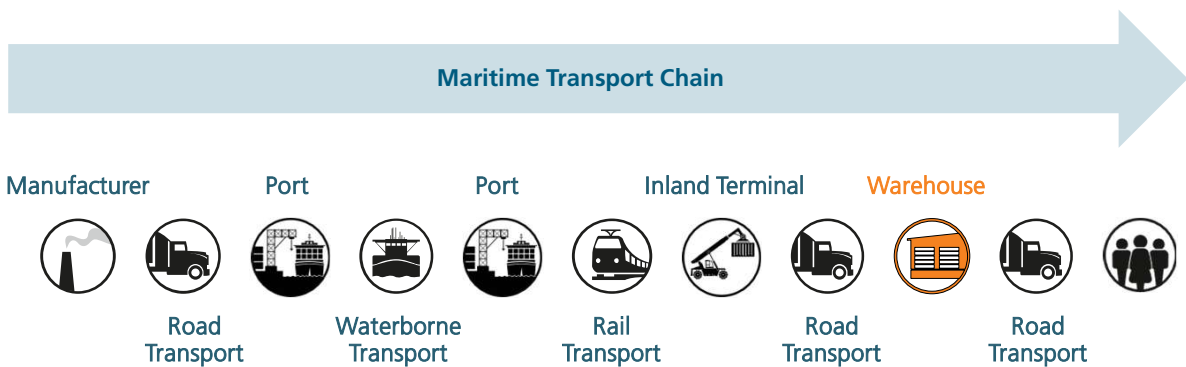
Source: <https://www.allianz-pro-schiene.de/themen/gueterverkehr/>

<https://de.statista.com/statistik/daten/studie/1396603/umfrage/puenktlichkeitsquote-der-db-cargo/>

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Maritime Transport Chain

Efficiency Potentials in Inventory



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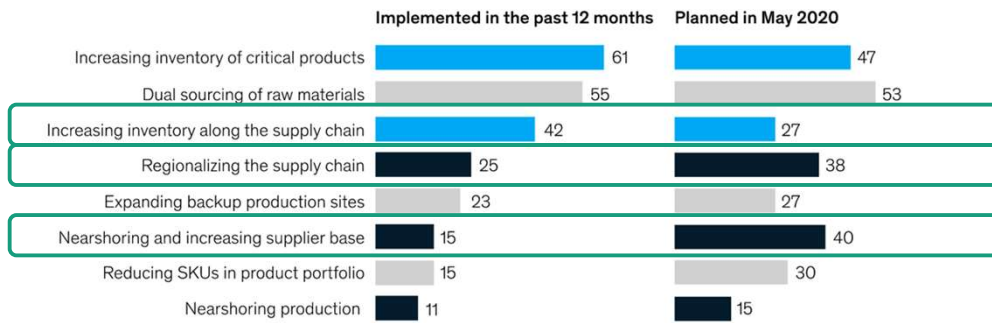
Efficiency Potential in Inventory

Increasing Inventory and Globalized Supply Chains

Companies originally planned to increase nearshoring of suppliers to boost supply-chain resilience—but wound up increasing inventory.

Planned and implemented actions, % of respondents

■ Actions related to nearshoring ■ Actions related to inventory ■ Other



Source: PwC / smart moves supply chain (2022)

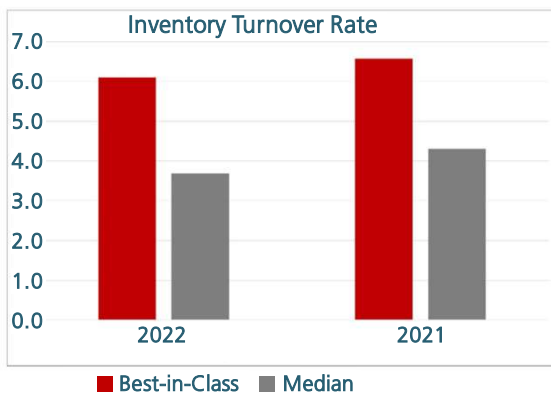
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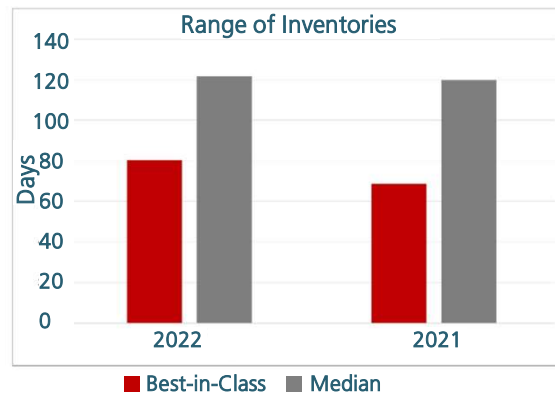
Efficiency Potential in Inventory

Inventories in Mechanical Engineering

The inventory turnover rate deteriorated at Best-in-Class and Median



The overall range of inventories deteriorated



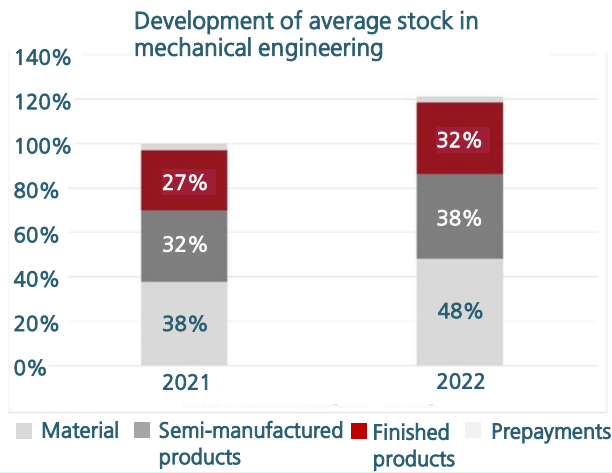
Source: <https://logistik-heute.de/news/studie-lagerbestaende-im-maschinenbau-2022-deutlich-gestiegen-40962.html>

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Efficiency Potential in Inventory

Total inventory increased by one fifth and shifts to higher value-added levels



<https://logistik-heute.de/news/studie-lagerbestaende-im-maschinenbau-2022-deutlich-gestiegen-40962.html>

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Project Example 2: Detection of Container Damage

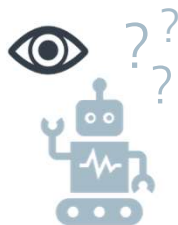
Computer Vision and Artificial Intelligence

Geleitet durch:

 auf Grund eines Beschlusses
 des Deutschen Bundestages

HHLA HCCR

Automatic container inspection



Repair



Originally intended Use

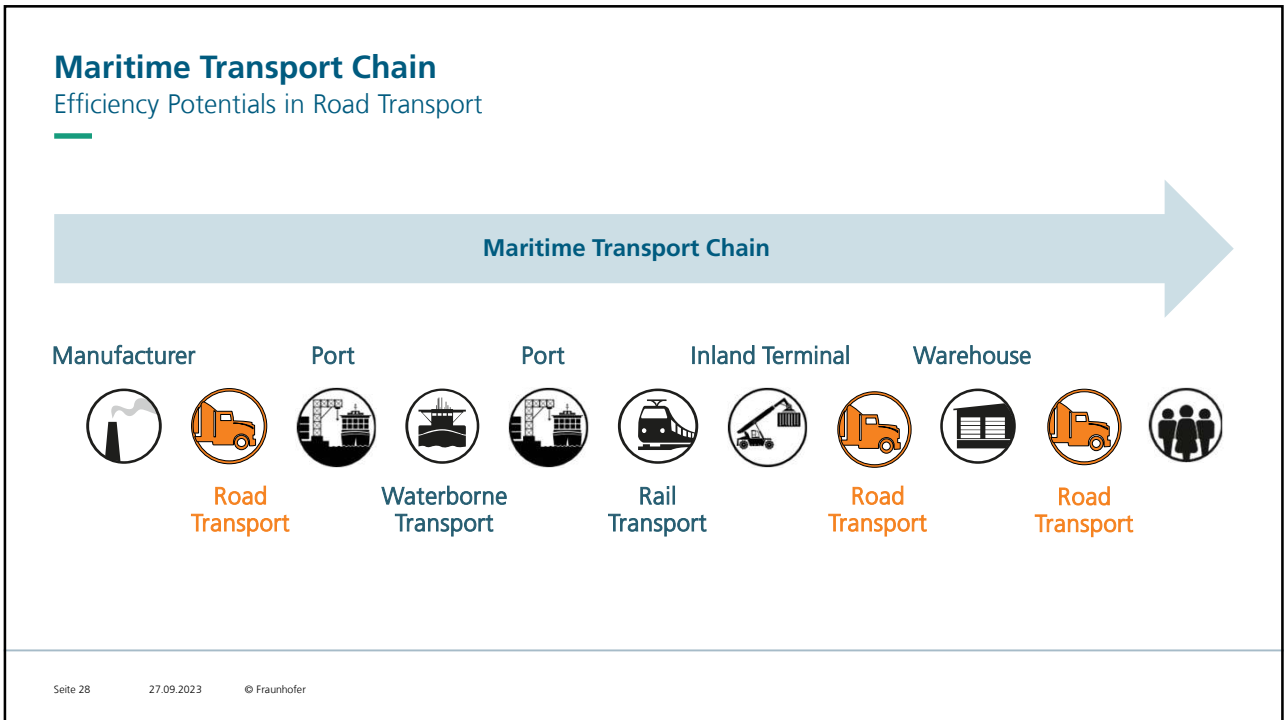


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Efficiency Potentials in Road Transport

Road Congestion, Empty Trips, Waiting Times



Ranking 2022	City	Time loss in traffic jams (hours per year)
1	München	74
2	Berlin	71
3	Hamburg	56
4	Potsdam	55
5	Darmstadt	47
6	Leipzig	46
7	Freiburg	43
8	Lübeck	41
9	Bremen	40
10	Nürnberg	40

Source: <https://www.faz.net/aktuell/politik/> (2022)

Source: <https://www.tomtom.com/traffic-index/> (2022)

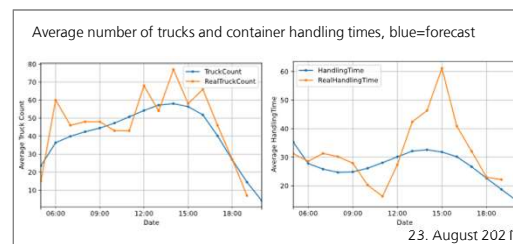
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Project Example 3: Predictions of truck waiting times and arrival rates

Efficient truck dispatch with artificial intelligence

- Startingpoint: strongly fluctuating utilization and waiting times of trucks at logistic nodes.
- Goal: Prediction of truck waiting times and truck arrival rates for the next few days for:
 - More efficient work planning at the terminal
 - More efficient route planning for trucking companies
- Task: Development and implementat of a pilot solution at HCS



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Conclusion

Relevance, Approaches and Drivers of Transport Efficiency

Relevance

- Potential to reduce costs and improve profitability and customer satisfaction
- Increasing transport demand vs limited capacities

Approaches

- Avoiding waiting and idle times in waterborne, rail and road transport through synchronization
- Reducing inventory through reliable demand and supply forecasts
- Eliminating of bottlenecks of waterway, rail and road infrastructure

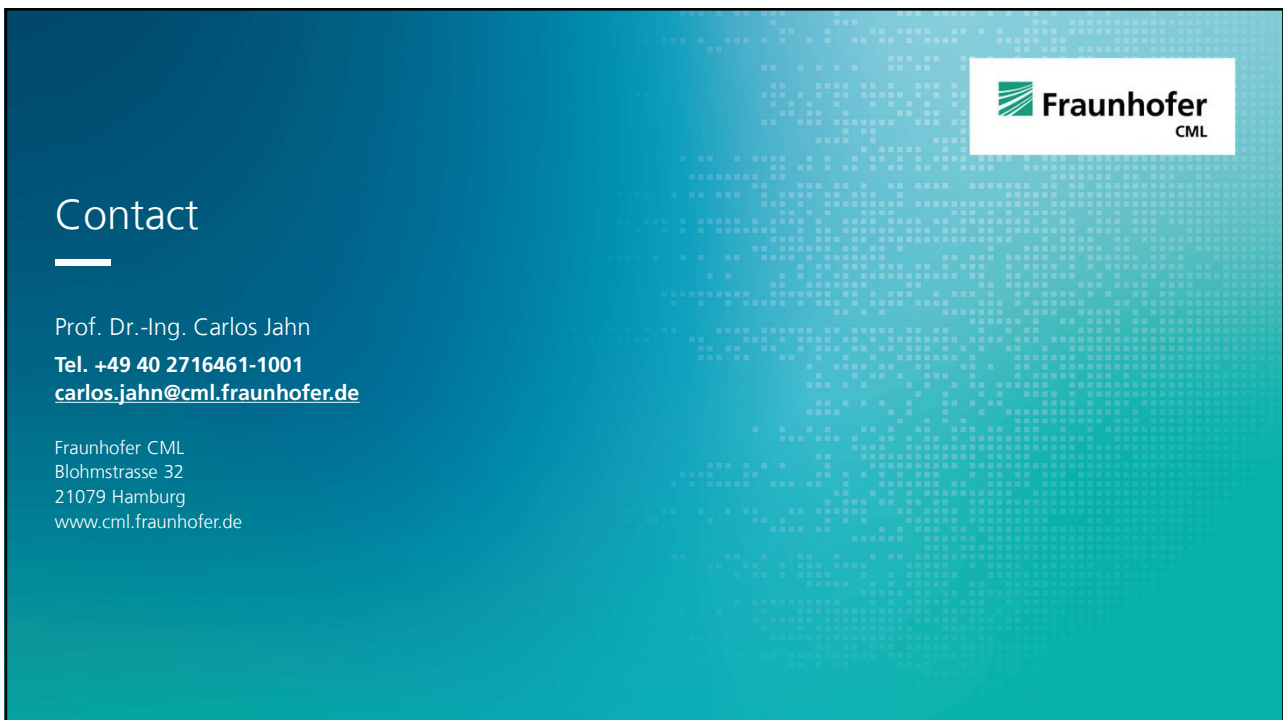
Drivers

- Technology (Digitalization, Connectivity, AI, ...)
- Cooperation (Openness, Trust, Data Sharing, ...)

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