Lecture 11 - Twin Transition in Shipping_Infrastructure Evolution & Sustainability

Twin Transition in Shipping: Infrastructure Evolution & Sustainability

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🌍 Context: The Twin Transition

The **twin transition** refers to the **combined digital and green (sustainability) transition** of an industry.

In the **maritime shipping industry**, this involves:

1. **Sustainability transition**: Reducing greenhouse gas (GHG) emissions.
2. **Digital transformation**: Creating and evolving global infrastructures and digital platforms to support this transition.

⚖️ Regulatory Drivers

GHG Emissions Taxation

- Enforced by:
  - **IMO** (International Maritime Organization)
  - **EU** (European Union)
- **Carbon Intensity Indicator (CII)** ratings (A–F)
- Shipping companies must:
  - Report emissions
  - Develop GHG reduction plans
  - Get verified by third parties

Financial Impacts:

- **Banks/Insurers** consider emission scores when offering services
- CII score affects **loan portfolio risk** and **insurance policies**

🔧 Strategies for GHG Reduction

Short- and Medium-Term Efforts:

- **Operational Efficiency**
  - Route optimization (speed, trajectory)
  - Port and logistics coordination (reducing idle time)
- **Tuning Machinery**
  - Sensors & predictive maintenance
  - Trim adjustments, hull cleaning (e.g. HullSkater)

Logistics

- Increase capacity utilization: from 70% to 100%
- Match charterer-shipowner deals efficiently
- Improve harbor time management

🖧 Infrastructure for Digital Innovation

What Drives It?

- Regulations + Market (Cost, Performance)
- AI and machine learning
- Integration of diverse data sources

Core Components:

- **Internet & Satellite Infrastructure**
- **AIS (Automatic Identification System)**
- **Weather, ocean streams, ice condition data**
- **Ship registers**
- **Digital twins**: Represent ships virtually for analytics and simulation
- **Emission reporting infrastructure**

🔁 Data Sharing & Ecosystem Platforms

Examples of Existing/Used Data Sources:

- AIS, weather observations, wave/ocean data
- Ship registry data
- Digital twin platforms
- Arctic data (ice flow, concentration)

Layers:

- Basic: Internet, satellites
- Specialized: Ship condition, emissions, navigational hazards

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📱 Vessel Infrastructure as Platform

- **APIs to onboard sensors**
- **Cloud-based digital twins**
- Machinery control apps
- Predictive maintenance systems
- Interfaces for collaboration:
  - **Crew ↔ Ship management ↔ Equipment manufacturers**

🧠 Examples of Data-Driven Innovation

1. Route Recommendation

- Inputs: weather, currents, ice, ship condition
- Outputs: optimal speed, path
- Real-time updates (every 4 hours)
- Integrated with trim and engine systems

2. Emission Prediction

- Based on verified emissions data
- Factors: vessel, load, location, historical data
- Users:
  - Brokers
  - Port authorities
  - Municipalities
  - Charterers

📈 Infrastructure Lessons

- Infrastructure innovation is **regulation-driven** and **market-enabled**
- EU & IMO are **forcing standards**

- **AI/ML** applied on top of shared data ecosystems
- Core challenges:
  - Lack of standards → Coordination issues
  - Emergence of **dominant platforms and hubs**

🧩 Governance Questions

- **Governance by infrastructure**: Are platforms shaping industry rules?
- **Infrastructure governance**: Who manages shared infrastructures?
- Do platform owners control **architectural bottlenecks**?
- Is progress being **blocked by fragmentation** and lack of coordination?

🔚 Summary

- The **twin transition** in shipping combines environmental and digital innovation.
- Core enablers include:
  - **Data sharing platforms**
  - **AI/ML for prediction and optimization**
  - **Global, layered infrastructures**
- Industry success relies on collaboration across stakeholders, technological standardization, and effective governance of digital infrastructures.