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VLERICK BUSINESS SCHOOL

University of Antwerp
Faculty of Business and Economics

The business model for federated data spaces to facilitate synchromodal logistics

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Connecting Data Space, Synchromodality and Physical Internet

Physical Internet	Synchromodality	Data Space
• Seamless integration • Communication protocols	• Use of various transport modes interchangeably	• Common Vocabulary • Secure Exchange Interoperability
• Real-time Information Flow • Synchronisation Physical-Digital	• Dynamic Decision-making • Real-time Switching	• Real-time Data Sharing • Enhanced Visibility Timely and Real-time Data
• Efficient Routing • Transport Resource Optimization	• Optimised Transport Modes • Environmental Impact Reduction	• Data-driven Optimization Efficiency and Sustainability
• Standard Data Formats • Common Guidelines	• Multi-modal Integration	• Standardized Data Handling • Data-Sharing Protocols. Standardization

Data Space: What is a Data Space?

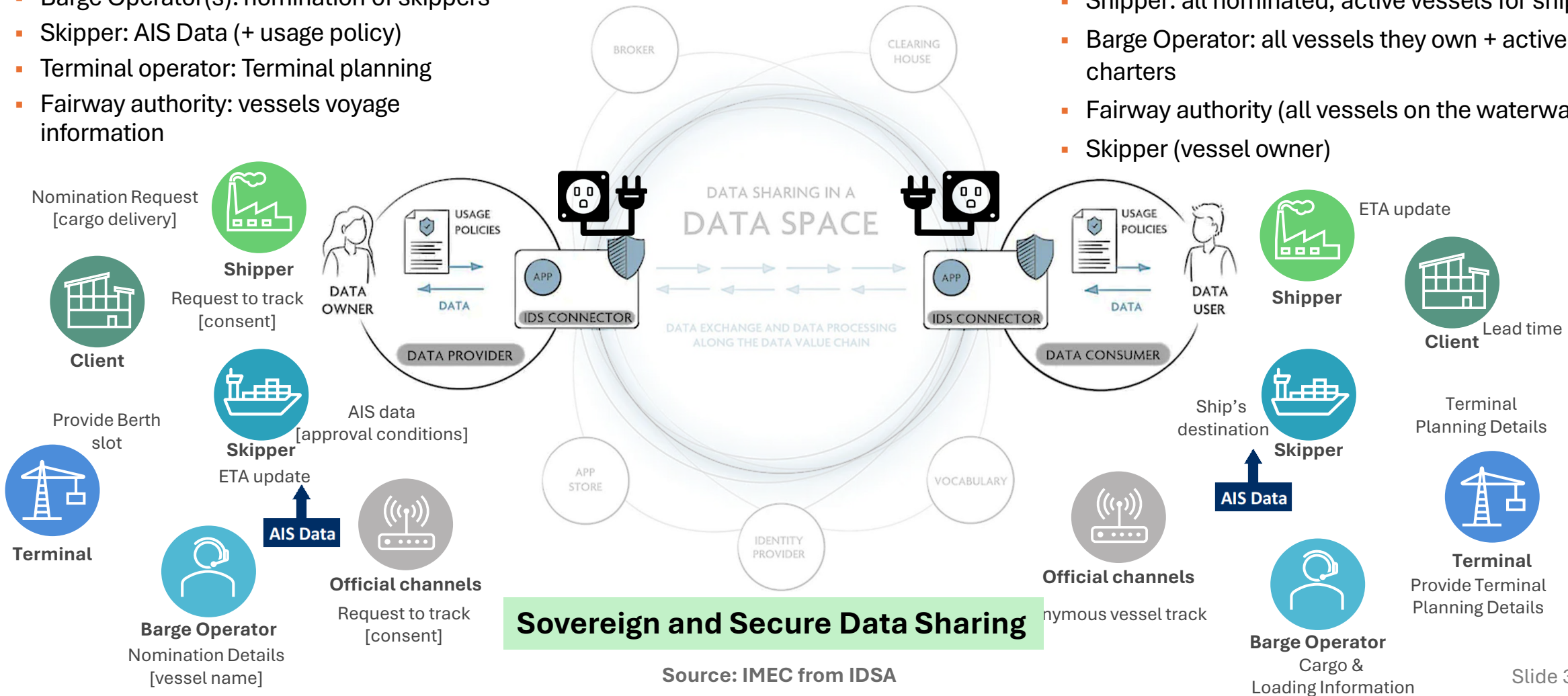
Federated data space is a network of multiple platforms and a peer-to-peer solution utilized by the involved parties.

Data Owners:

- Barge Operator(s): nomination of skippers
- Skipper: AIS Data (+ usage policy)
- Terminal operator: Terminal planning
- Fairway authority: vessels voyage information

Data consumers:

- Shipper: all nominated, active vessels for shipper
- Barge Operator: all vessels they own + active charters
- Fairway authority (all vessels on the waterways)
- Skipper (vessel owner)

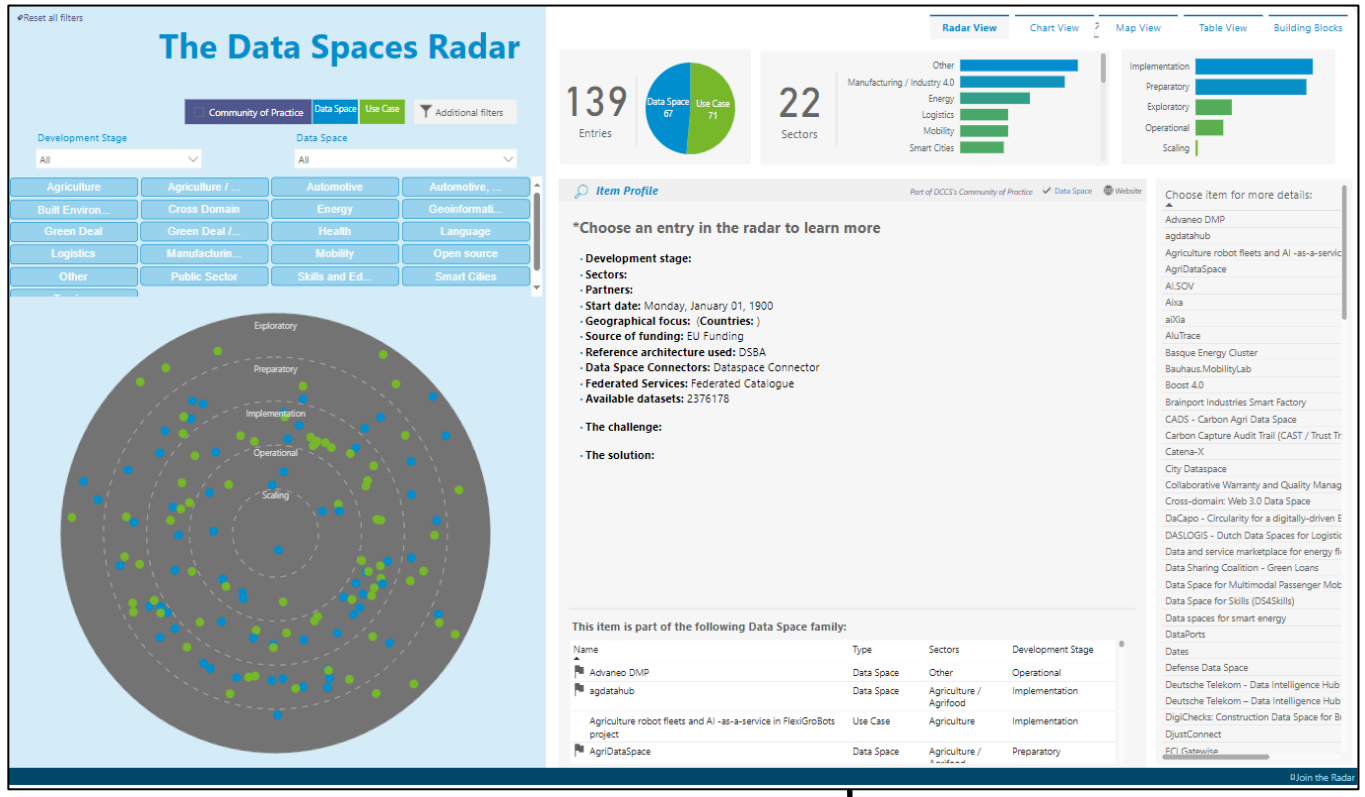


Sovereign and Secure Data Sharing

Source: IMEC from IDSA

What did we do?

1. Data Space radar



Source: https://www.dataspaces-radar.org/

2. Literature on Business Models

Big Data

(Katrakazas et al., 2019; Kim et al., 2016)

Centralized platforms

(Abrahamsson et al., 2003)

Multi-sided platforms

(Hoch & Brad, 2021)

Decentralized business ecosystems

(Lage et al., 2022; Radonjic-Simic et al., 2017; Radonjic-Simic & Pfisterer, 2019; Tumasjan & Beutel, 2019; Wang et al., 2019)

Open data ecosystems

(Immonen et al., 2014; Kitsios et al., 2017)

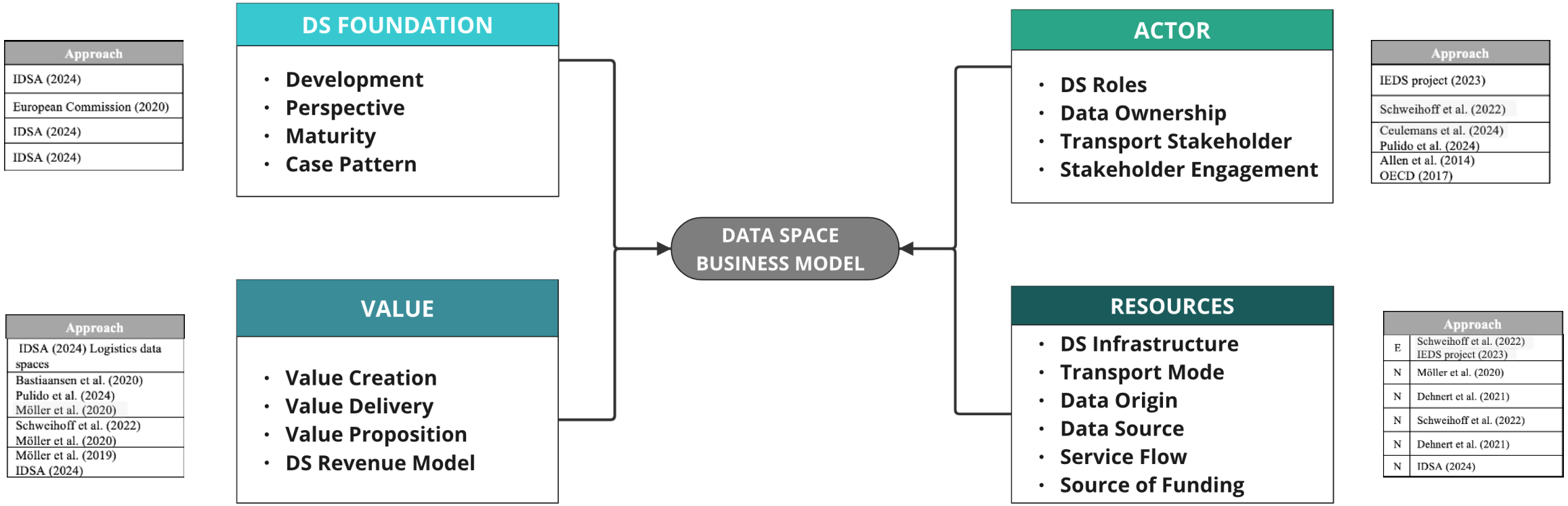
analyse

Data Space Business Model Taxonomy

derive

What we developed: Taxonomy

- We developed a taxonomy following Nickerson et al. (2013).
- Identified various components and characteristics to describe business models for data spaces in the freight transport sector based on a Systematic Literature Review and Data Space applications



Synchromodal Data Space Business Model Taxonomy Overview
Building Blocks

Development of the Taxonomy

	Dimension	Characteristics								E/N	Approach
DS Foundation	***Development***	*Data space*	*Use Case*							E	IDSA (2024)
	Perspective	*Private*	*Public*	*Mixed*						N	European Commission (2020)
	Maturity	*Exploratory*	*Preparatory*	*Implementation*	*Operational*	*Scaling*				E	IDSA (2024)
	Case Pattern	*Shared Cost*	*Joint Innovation*	*Shared Marketplace*	*Grater Community Good*					N	IDSA (2024)
Actor	***DS Roles***	*Service Provider*	*Data Trustee*	*Data-infrastructure provider*	*App-Store Provider*	*Data Provider*	*Data Consumer*	*Ecosystem Orchestrator*	*Marketplace Operator*	N	IEDS project (2023)
	Data Ownership	*Own Data*	*Derived data, ownership uncertain*	*Data owned by another entity*						E	Schweihoff et al. (2022)
	Transport Stakeholder	*Shipper*	*Carrier*	*Infrastructure Management*	*LSP*	*Authority*	*Terminal Operator*	*Orchestrator*	*Software and Technology*	N	Ceulemans et al. (2024) Pulido et al. (2024)
	Stakeholder engagement	*Data Sharing Agreements*	*Partnership Models*	*Consortiums*	*Independent Operations*					N	Allen et al. (2014) OECD (2017)
Value	***Value Creation***	*Data Sovereignty*	*Secure Data Sharing*	*SC. Efficiency*	*SC. Responsiveness*	*SC. Visibility*	*Sustainability Goals*	*Collaboration and Networking*	*Digital Automation*	N	IDSA (2024) Logistics data spaces
	Value Delivery	*Provider & consumer matching*	*Shared Digital Twins*	*Process Optimization*	*(Big) Data analytics/enrichment*	*Real-time visibility*	*(Smart) Contracts management*			N	Bastiaansen et al. (2020) Pulido et al. (2024) Möller et al. (2020)
	Value Proposition	*Selling data-based services*	*Optimization Services*	*Selling data*	*Selling analysis*	*Data-driven improvements*	*Data-enriched products & services*	*Data-driven services*		N	Schweihoff et al. (2022) Möller et al. (2020)
	DS Revenue Model	*Fees*	*Pay-per-Use*	*Licensing*	*Commission*	*Subscription plan*	*Customized*			N	Möller et al. (2019) IDSA (2024)
Resources	***DS Infrastructure***	*Data Ecosystem*	*Marketplace*	*Hybrid*						E	Schweihoff et al. (2022) IEDS project (2023)
	Transport Mode	*Truck*	*Rail*	*Ship/IWT*	*Air*					N	Möller et al. (2020)
	Data Origin	*Internal*	*External*							N	Dehnert et al. (2021)
	Data Source	*Self-generated data*	*Existing data*	*Restricted data*	*Freely available*	*Provided by customer*	*Acquired data*			N	Schweihoff et al. (2022)
	Service Flow	*Manually driven*	*Predefined time steps*	*Event driven*	*Data stream*					N	Dehnert et al. (2021)
	Source of Funding	*EU*	*Government*	*Private*	*Other*					N	IDSA (2024)

E: Exclusive Dimension, N: Non-Exclusive Dimension

SYTADEL

IPIC 2024

- Project recap - Milestones.

Applying the state-of-the-art on <u>data spaces</u> to the context of logistics <u>synchromodal</u> planning…

➢To setup a successful real life experiment in a LivingLab with a working demonstrator

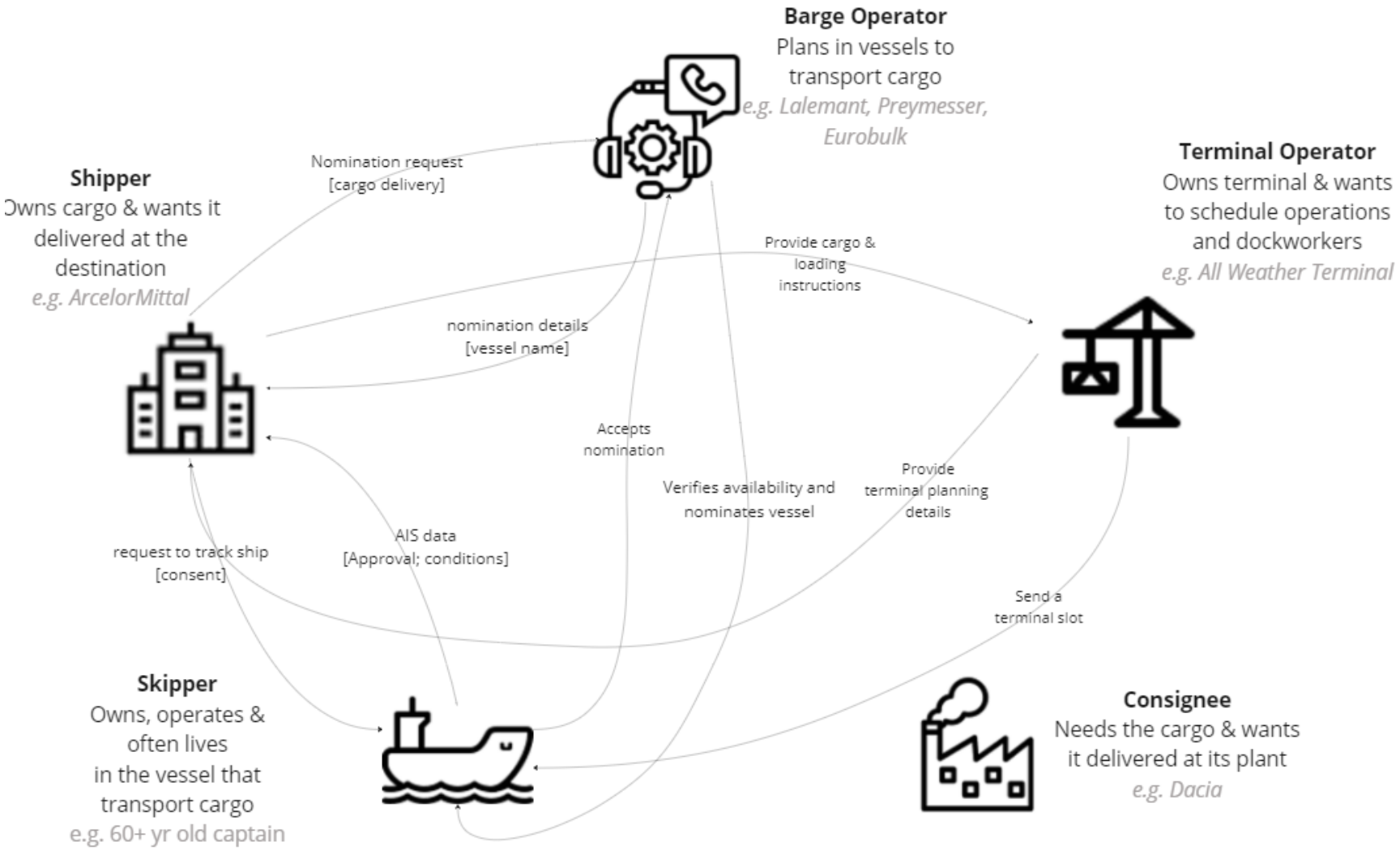
➢To Share data within the logistics supply chain in a trustworthy & value added way

➢Enabling a realtime 'synchromodal' application

Partners: imec, University of Antwerp, Vlerick Business School, Empowering Logistics

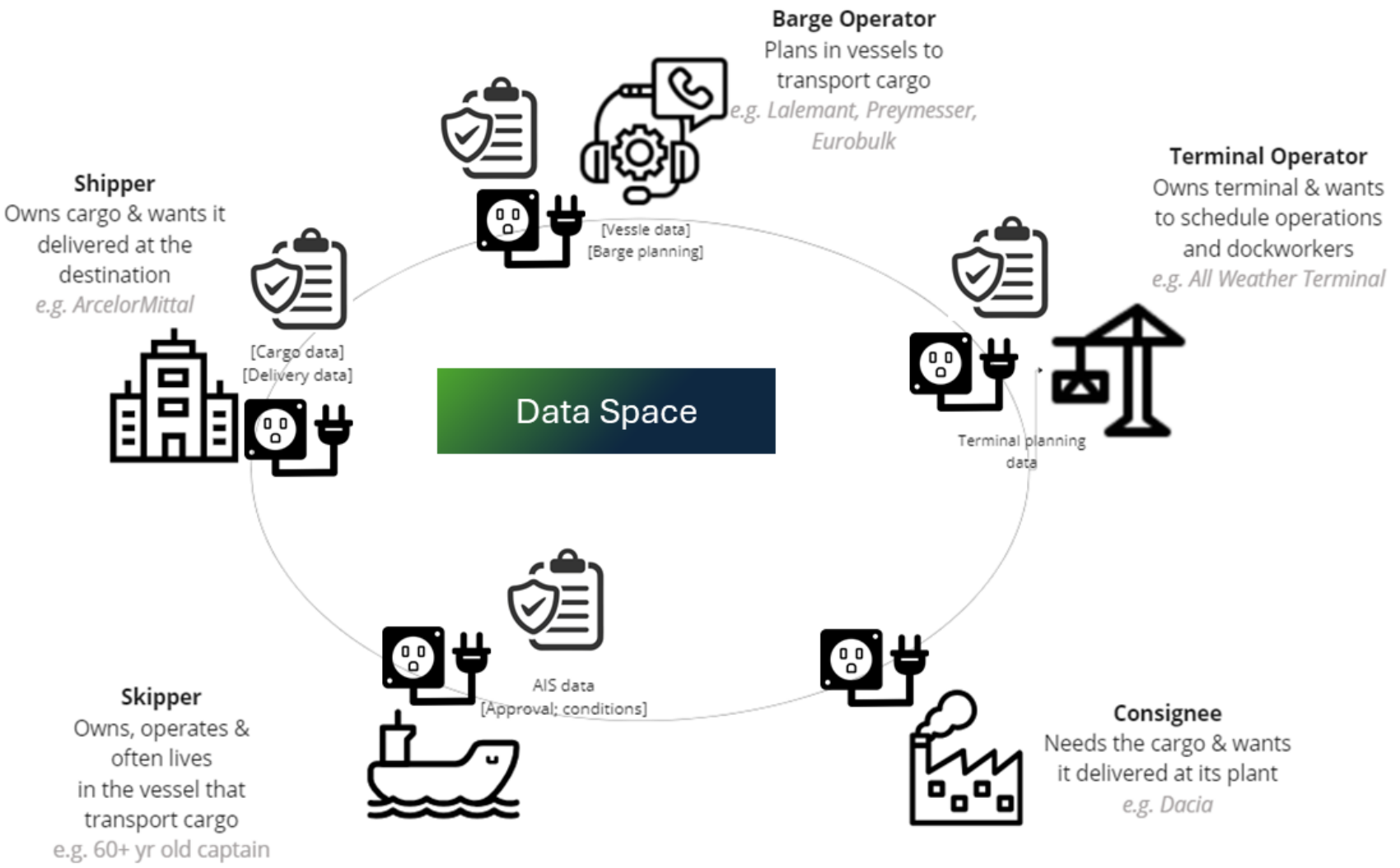
SYTADEL Use Case

COLLABORATIVE PLANNING ECOSYSTEM: information exchange



SYTADEL Use Case

COLLABORATIVE PLANNING ECOSYSTEM: information exchange with Data Space



Use Case

Version 1
Vessel location data sharing within the ArcelorMittal ecosystem

Version 2
Proactive asset monitoring (vessel / in-transit inventory) within the ArcelorMittal ecosystem

Version 3
Synchromodal rerouting in case of disruption in OR outside the ArcelorMittal ecosystem

The Setup in Practice (Version 2)

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Sytadel

ArcelorMittal

Map Settings

Corridors of Interest:

Name:

MMSI:

Latest timestamp: Monday, November 27, 2023 8:41 AM (11 minutes ago)
Destination port: CTS DUISB (Nomination)
Status: N/A
Tonnage: 1914.409912T
Coils: 133
Course: 50.299999°
Speed: 0kn
Position accuracy: Low (> 10m)
PTA: Thursday, November 23, 2023 12:00 AM (4 days ago)
ETA: Saturday, November 25, 2023 6:32 AM (2 days ago)
Euris ETA: Monday, November 27, 2023 5:09 PM (in 8 hours)
Data provider: Spire Terrestrial

DoNotReply@0dce344c-01c1-4778-ac0b-99120e0e404c[redacted]net via email 11/20 10:49 PM
To: 2be1ffcb.[redacted].com

[SYTADEL] ETA Alert

SYTADEL - ETA Alert Notification
Alert Details:

Date/Time: Mon Nov 20 2023 21:49:19 GMT+0000 (Coordinated Universal Time)
Alert Type: Warning
Affected Voyage: 123 to test
Description: Vessel test (123) might reach its destination later than planned 1700516955525 - 123
Action Required:
[Transshipment Options]

View original email

HISTORICAL CURRENT

Last updated: Monday, November 27, 2023 8:52 AM

Utrecht Zeist Nieuwegein Veenendaal Ede Netherlands Arnhem Culemborg Tiel Nijmegen Doetinchem Winterswijk Vreden Ahaus Emmerich am Rhein Bocholt Borken Kleve Oss Gorinchem Dordrecht De Biesbosch National Park Hamminkeln Goch Xanten Wesel Dorsten Marl Datteln Werne Recklinghausen Kevelaer Geldern Herne Gelsenkirchen Dortmund Bochum Oberhausen Essen Duisburg Port Venlo Krefeld Nettetal Hagen Hemer Mend Wupp Dusseldorf Weert Lommel Pelt

© Mapbox © OpenStreetMap Improve this map

Application & Results

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	Dimension	Characteristics								E/N	Approach
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	Source of Funding	*EU*	*Government* 1	*Private* 2 3	*Other*					N	IDSA (2024)

1 IMEC
2 Arcelor Mittal
3 Lalemant, Preymesser Eurobulk

1 Data Space Developer
2 Shipper
3 Barge Operator

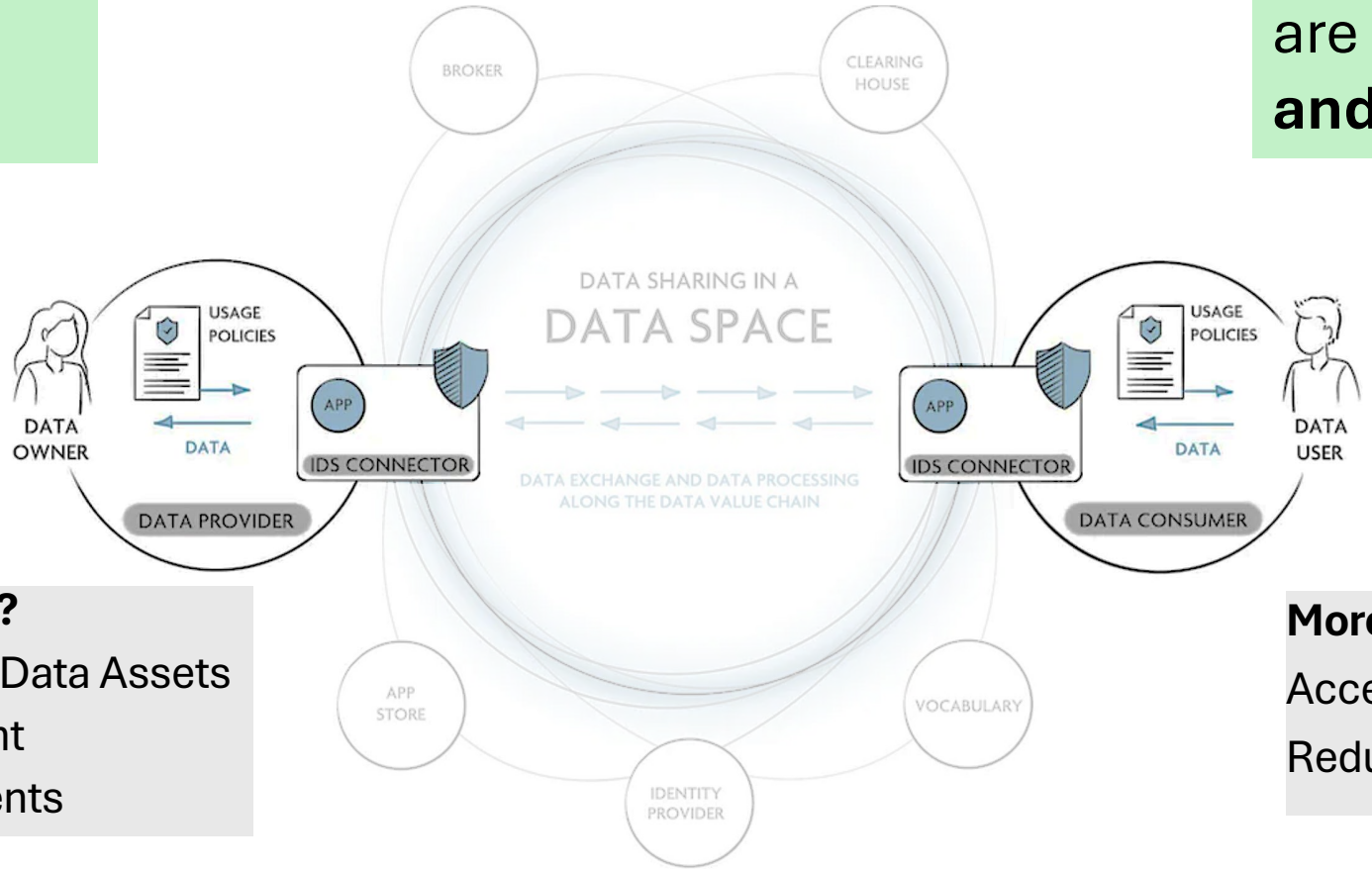
Conclusion

Data Space behave as a **Multi-Sided Platform**

Adoption by Demand

Data Space Business Models are **Collaborative and Evolving**

Add More Data Providers



Add More Data Consumers

More Cost/Investment?

Losing Control Over the Data Assets

Infrastructure Investment

Data Quality Improvements

More Benefits?

Access to More Data

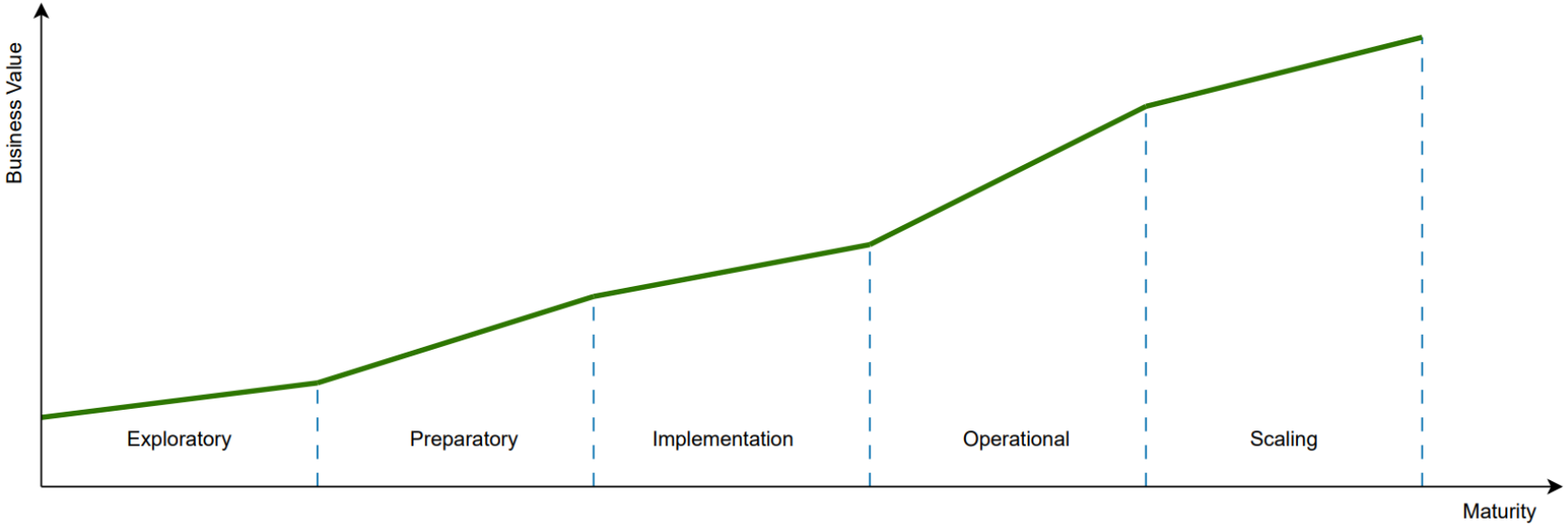
Reduced Cost

Adding Multi-Role Actors

Source: IMEC from IDSA

Conclusion

Where to Start?



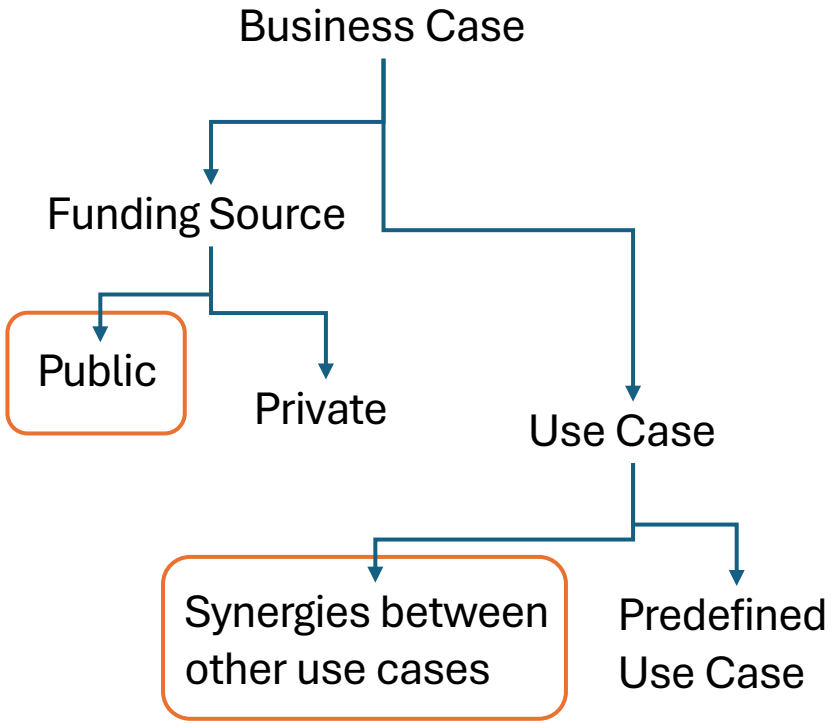
- EdgeDS
- GATE Urban
- H2 Metaverse
- Potato-X
- PwC Data Ecosystem
- Software Dataspace
- Vehicle Charging
- Green Data Hub
- Manufacturing DS
- Skills Data Space
- MDS

- AgriDataSpace
- aiXa
- Basque Energy Cluster
- Data Cellar
- Data Space 4.0
- Eddie
- ENERSHARE
- FAIR Data Spaces
- IDEAL,
- HEALTH-X dataLOFT

- energy data-X
- FutureForest
- Gaia-X4KI
- GDI
- iGreenPort
- INESData Incubator
- Maritime Data Space
- O-Cloud

- Advaneo DMP
- Catena-X
- Huawei Data Space
- Mobilithek
- SCSN

- Global Data Service Organisation



Public or government funding is a prudent choice for initiating collaboration among stakeholders to develop a Data Space **Technical Setup and Data Collaboration**, which can later be commercialised.

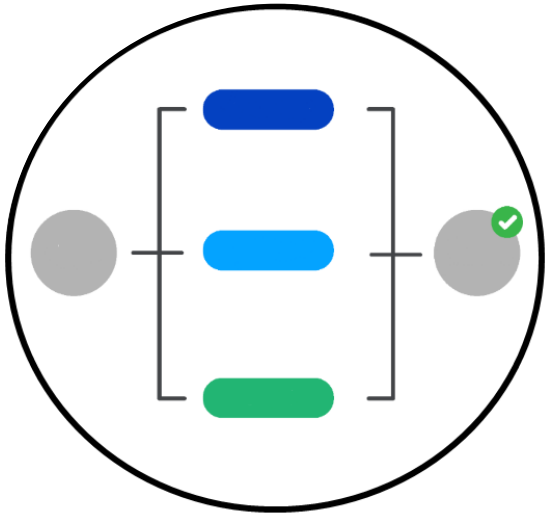
More Examples on: Data Space Radar

Conclusion

Proposed Execution Plan/Roadmap

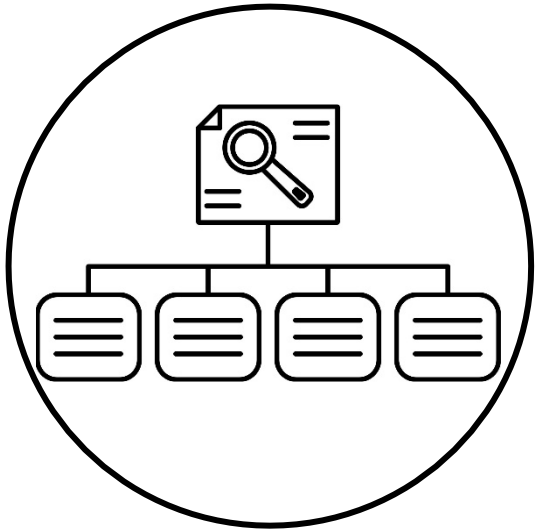
Adapting/Evolving the Business Models

Defining a Case Study



- Identifying Potential Needs/Opportunities
- Common Goals

Mapping on Taxonomy Framework



- Where do Stakeholders see themselves in the Case Study
- Map Collective Values

Perform Economic Viability Analysis

- Willingness to pay for Data/Service
- Quantify the Qualitative Value proposition for Value Creation

Setup Appropriate Business Models

- One who wants to create a Data Space
- One who wants to join the Data Space

Next Steps

Feedback

Thank you

Questions

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valentin.carlan@uantwerpen.be

Back-Up Slides

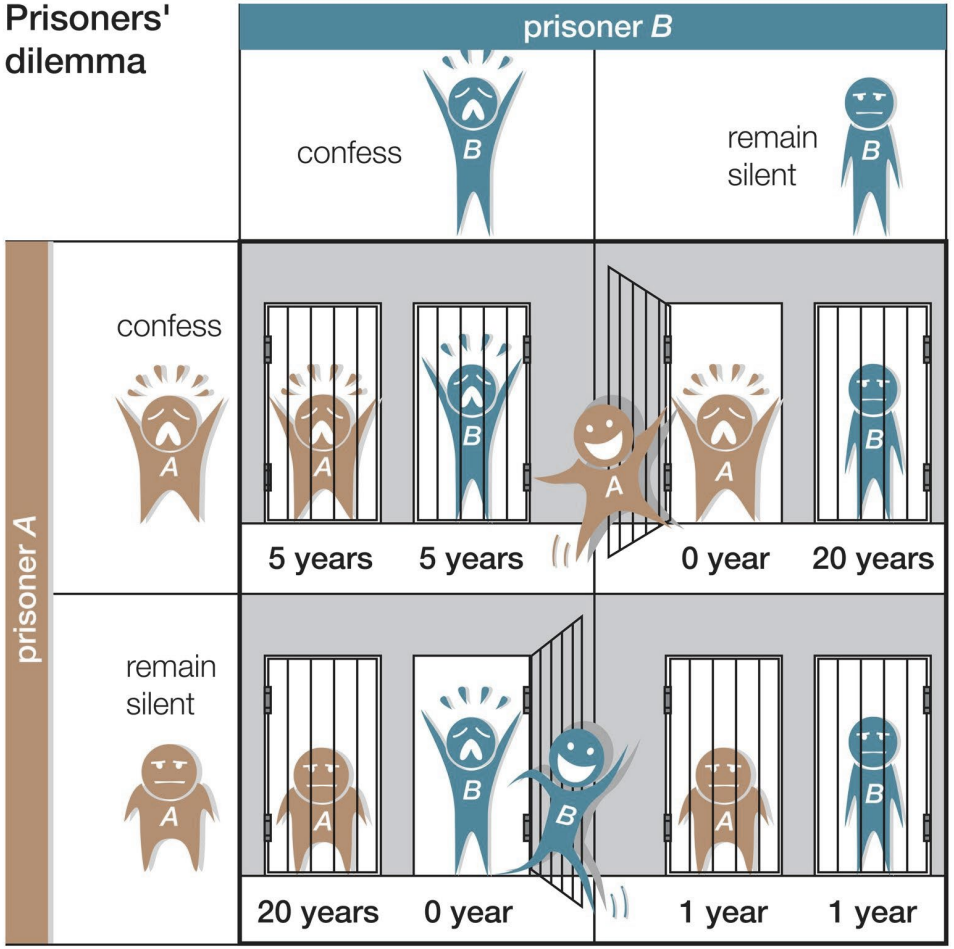
DATA SHARING: THE MODERN PRISONER'S DILEMMA

Many industries **agree that they would benefit** from a more transparent way of working within their industry. In logistics this is especially important, since your supply chain is connected with and impacted by the operations of all stakeholders in it.

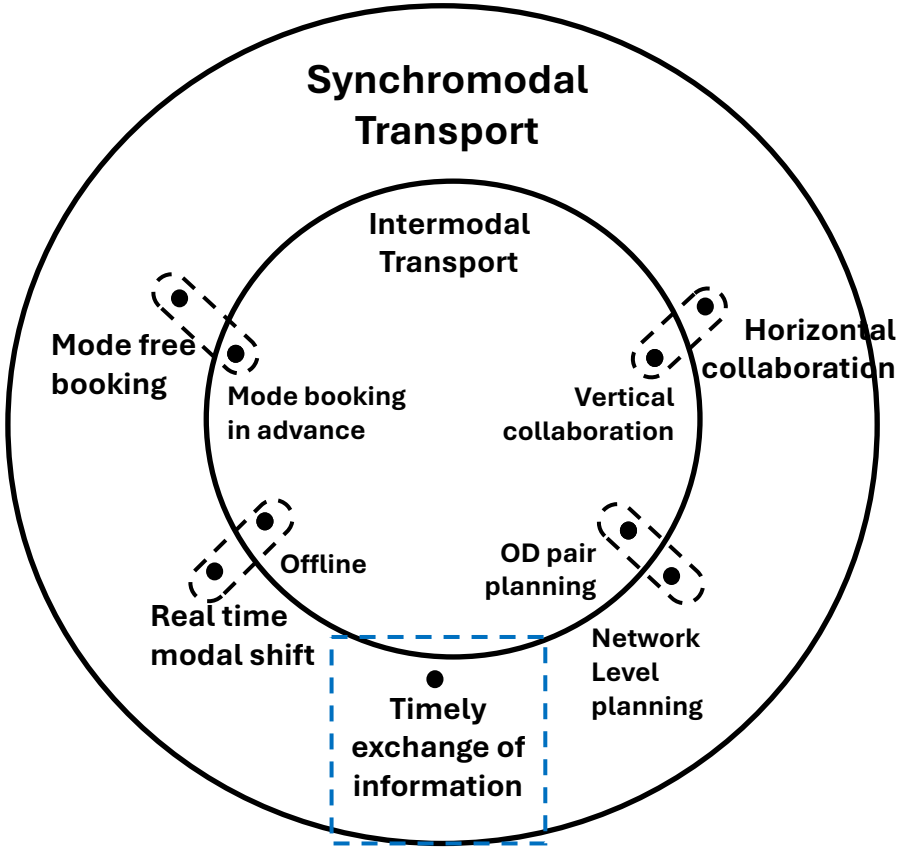
Increasing your collaboration or data sharing across the supply chain can help improve your forecasting, planning optimization or asset utilization. Yet only **few companies are willing to share** their data in order to improve operations.

Understandable of course. What if our competitors would get a hold of our data and use it to outcompete us? Is this GDPR compliant? Who's going to maintain the tech stack & pay for it? Just like in the prisoner's dilemma, we benefit from working together, but refuse out of fear that the other party might misuse our trust and data.

This is why data sharing is expected to be one of the most impactful challenges in logistics of the coming decade. Even more so than AI, since even with an AI you will still need a holistic dataset in the first place!



Transition from Intermodal to Synchromodal Transport



Adapted from: Guo et al. (2017)

- **Moving resources: data from** GPS, AIS, vehicle capacity, ETA.
- **Stationary Resources:** Terminal availability, railways, waterway (levels).
- **Shipper:** Delivery time, inventory, cargo specifics.

Current Practices

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Business Rationale	Business Case	Examples
Cost Sharing	• Data space participants share their data to meet shared requirements (e.g., compliance, process efficiency, transparency). • Every member saves money and time by sharing the burden.	Catena-X; SCSN
Joint Innovation	• A customer innovation can only be realized by ecosystem members working together. • No single ecosystem member has all the necessary data.	Eona-X; Mobility Data Space
Combined Forces	• Ecosystem members team up to prevent monopolies from emerging. • No single ecosystem member has the necessary resources and commitment to do this alone.	EUProGigant
Shared Marketplace	• Ecosystem members team up to provide quality-assured, easy access to data of a domain of common interest (open data, business partner data etc.). • Transaction costs go down for all ecosystem members.	Catena-X; Mobility Data Space
Greater Common Good	• Public and private sector share data for a greater common, societal goal (e.g., climate protection).	Mobility Data Space

Source: Agoria.be , Jelle Hoedemaekers

Automated Usage Policy

[BARGE OPERATOR]

- Registry of offered resource
  [AIS DATA]
- Registry of policy for usage control
  [ONLY AFTER NOMINATION]
- Registry of contract offer for data consumers
  [AIS DATA FOR SHIPPERS]

INITIATION

I have this resource to offer, under these conditions

[BARGE OPERATOR] [SHIPPER]

- Get consumer CB details
  [CB ENDPOINT & TOKEN]
- Check contract agreement
  [TECHNICAL GUID]
- Get all available offers

VERIFICATION

I want your resource, let's agree to share it!

[BARGE OPERATOR] [SHIPPER]

- Initiate batch upload in proxy
- Initiate subscription in proxy
- Receive data
- Front end app

TRANSFER

Let the data flow
(off-band NGSI-LD data plane)