

## **The Road(map) Not Taken**

Navigating Sustainable Shipping Transitions

Spaniol, Matthew J.

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## Road(map) not taken

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## Expertise:

- Strategic foresight
- Sociology of science and technology (STS)
- Maritime & ocean economies
- Scenario-based strategizing
- Open innovation
- Business model innovation

## Roskilde University

Assistant Professor & Fellow

## Aarhus BSS, Aarhus University

Post-Doctoral Fellow

## Danske Maritime

ePhD Fellow

## PERISCOPE

Project Manager

## CIFS

Foresight Analyst



# STS & Science Studies



Robert K. Merton

The provision of  
certified knowledge

Ontological multiplicity



Thomas Kuhn

Paradigm shift



Bruno Latour

Science is culture

Controversy &  
closure



Sergio Sismondo



Annamarie Mol

Logical  
constructivism



Jens Bartelson

**RUC**

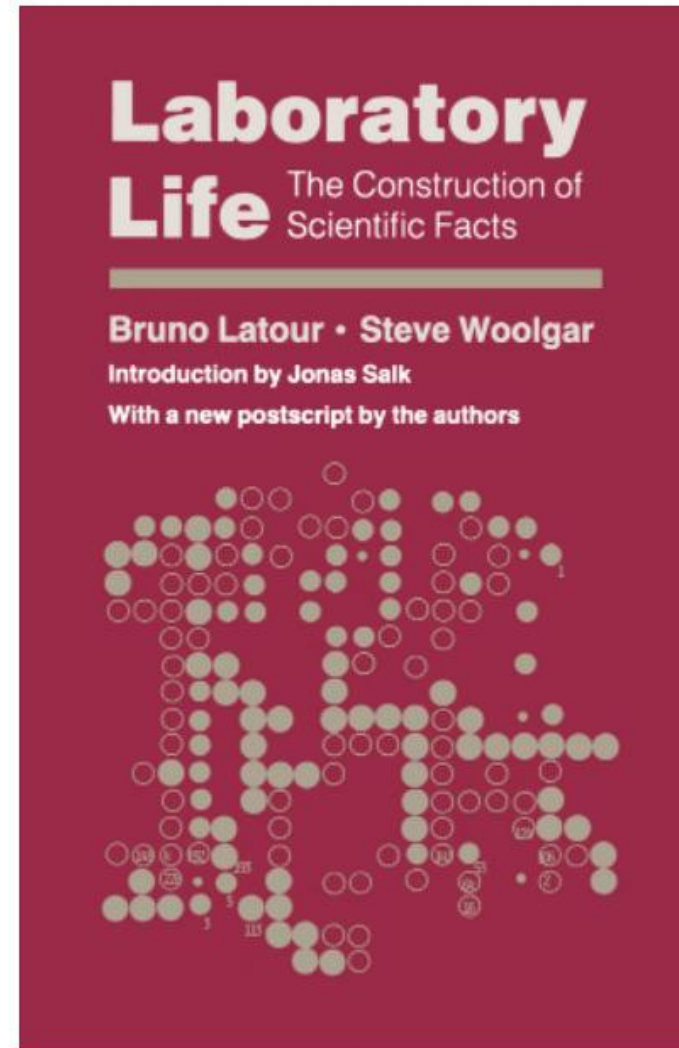


# Laboratory Studies

## Ethnography



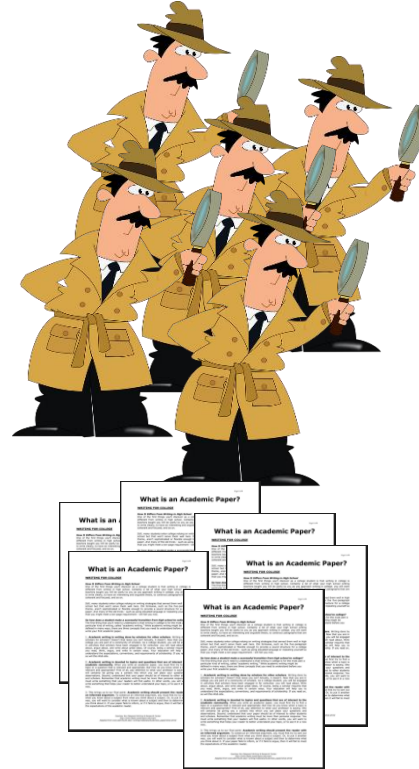
Bruno Latour



# STS



Scholarly community of  
futures and foresight  
researchers



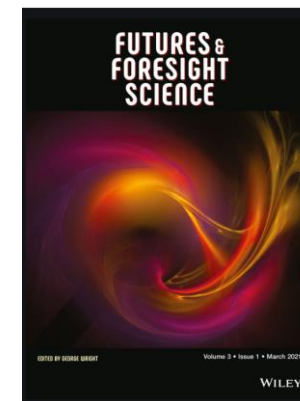
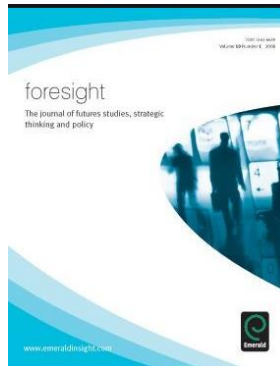
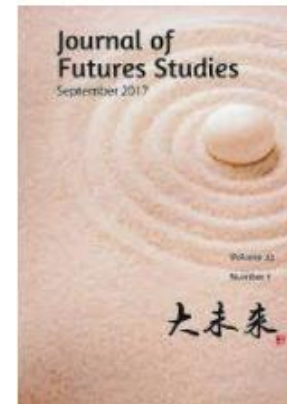
Groups create futures in the  
present to plan

Groups construct fictitious  
"personas" who interpret and  
act in futures



# RUC

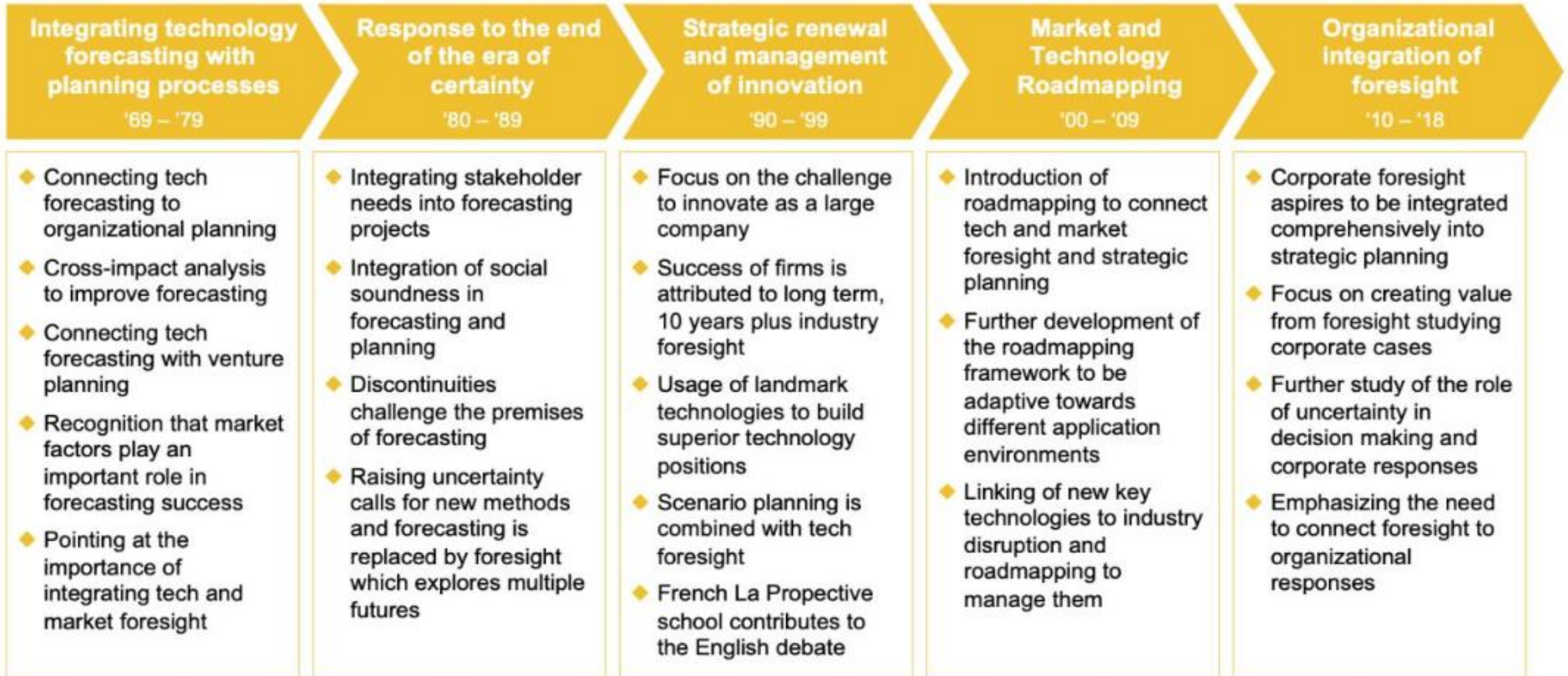
# *Futures & foresight science as an scholarly dicipline*





# EVOLUTION OF CORPORATE FORESIGHT

1969 to 2019



**Source:** Gordon, A. V., Ramic, M., Rohrbeck, R., & Spaniol, M. J. (2020). 50 Years of corporate and organizational foresight: Looking back and going forward. Technological Forecasting and Social Change, 154. <https://doi.org/10.1016/j.techfore.2020.119966>



# applied foresight toolbox



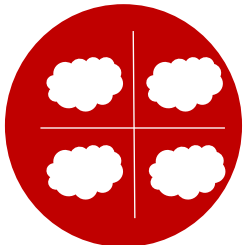
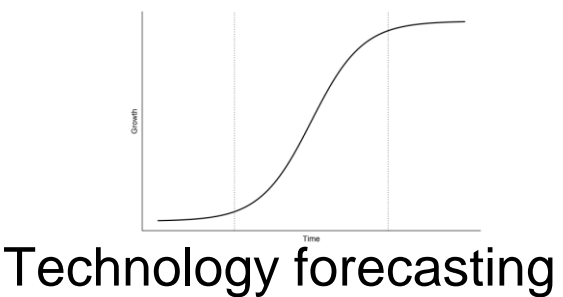
Strategy playboxes

SERVICE SPECTRUM	STRATEGIC PRIORITY	OFFERING TYPE	TARGET SEGMENTS	OPERATING MODEL	CUSTOMER FACING	SECURITY
<b>Full Spectrum</b> The full range of offerings from basic to premium, covering all customer segments.	<b>Strategic Priority</b> The primary focus of the organization, often defined by market position and competitive advantage.	<b>Offering Type</b> The type of offering provided, ranging from basic to premium.	<b>Target Segments</b> The specific customer segments targeted by the organization.	<b>Operating Model</b> The internal processes and structures that support the organization's offerings.	<b>Customer Facing</b> The customer-facing elements of the organization, including branding and user experience.	<b>Security</b> The measures taken to protect the organization's data, systems, and assets.
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Strategy playboxes



Systems analysis

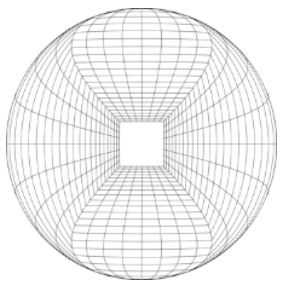


Scenarios

Foresight radars

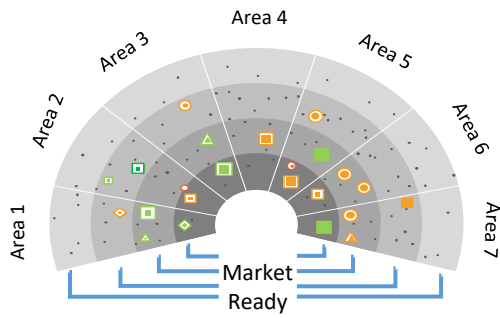
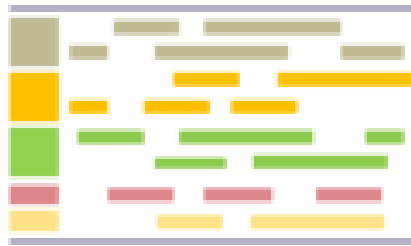


Wargaming

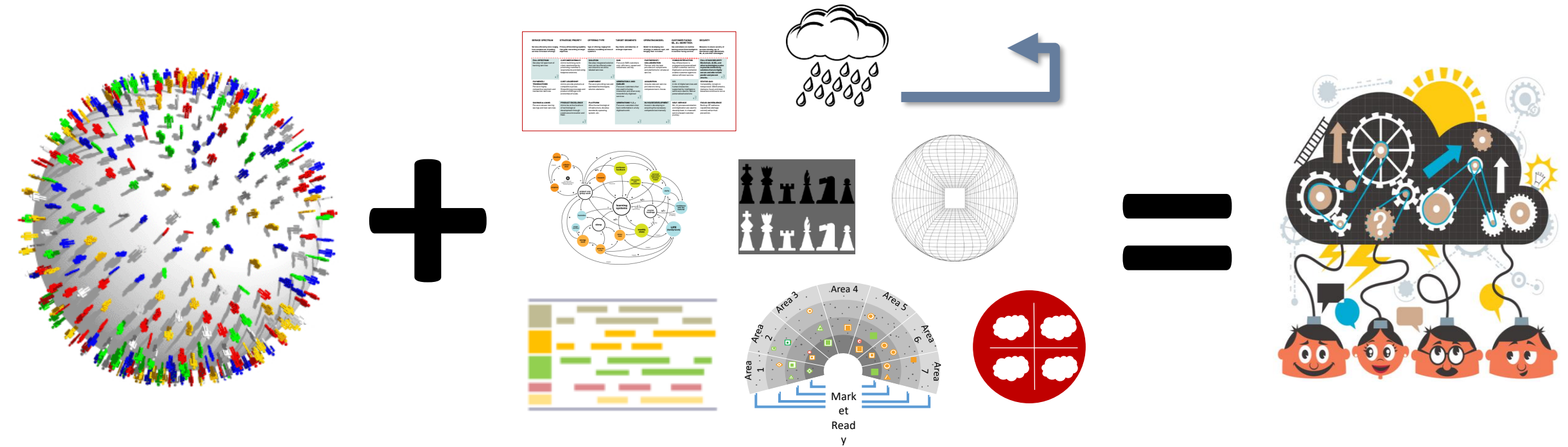


Delphi

Technology roadmapping



# Strategic foresight



Distributed  
Knowledge

Tools for  
Future Thinking

Effective  
Strategizing

# ROADMAP TO SHIPYARD 4.0



EUROPEAN REGIONAL DEVELOPMENT FUND

## Road to Shipyard 4.0:

The state of play, a brief history of maritime developments, and a future roadmap

Focusing on the Baltic Sea and Shipyards





ECOPRODIGI

RESEARCH REPORT

### Shipyard 4.0

An innovation and policy roadmap for digitalising shipyard operations



2023

- 01. Real time planning tools track progress & report problems
- 02. Shipping quality is already mentioned in real time



2024

- 03. AI enhanced documents anticipate, forecast, and warn on events
- 04. Digital database for issue tracking and handover



2025

- 05. AI systems control and manage warehouse inventory
- 06. AI systems control and manage warehouse inventory
- 07. AI systems control and manage warehouse inventory
- 08. 3D Scanning is standardised for ship inspections
- 09. Aerial drones perform incremental 3D scans at yards



2026

- 10. Additive manufacturing of spare and missing parts
- 11. Microgrids equipment power electricity needs



2027

- 12. Autonomous and flexible robots used in hard-to-reach places
- 13. Digital twin files are shared across stakeholders
- 14. Aerial drones perform basic services
- 15. Digital twins are used for virtual delivery inspections



2028

- 16. Unmanned lifting vehicles replace tractor operations
- 17. Digital twins are used in planning requests
- 18. Warehouse operations performed by automated drones



2029

- 19. 3D printers are used to print large blocks



2030

- 20. Composite materials are used for large vessel hulls



www.ecoprodigi.eu



EUROPEAN REGIONAL DEVELOPMENT FUND

# ROADMAP INTEGRATED SHIP OPERATIONS



EUROPEAN REGIONAL DEVELOPMENT FUND

## Maritime in the 21st century:

2000-2030

The state of play, a brief history, a roadmap, and scenarios

Focusing on the Baltic Sea and Ro-Ro Shipping





ECOPRODIGI

RESEARCH REPORT

### The future of Ro-Ro and Ro-Pax shipping:

An innovation and policy roadmap for digitalising integrating ship operations



2022

- 01. AIS data used to coordinate the existing fleet



2023

- 02. Automated steering systems
- 03. Fuel & cargo data used to route vessel performance
- 04. Hull & propeller maintenance supported by AI
- 05. Predictive maintenance tools available for engines & systems
- 06. Onboard sensors & equipment collection via live video
- 07. Crew & staff track real time performance analysis



2024

- 08. AI enhanced cameras at terminals & onboard ships
- 09. Stability & trim optimised on data
- 10. Engine & subsystem maintenance supported by AI
- 11. Cargo ETA to terminal tracked & shared
- 12. Voyage planning & execution supported by AI



2025

- 13. Terminal operations & equipment storage system
- 14. Aerial drones assist in real time navigation & loading
- 15. Cargo info shared across network
- 16. Connects parallel into arrival
- 17. Cargo condition data shared across network
- 18. Terminal operations & equipment shared by AI
- 19. Vessels assessed & ranked based on EEDI & MEI
- 20. International standards for maritime cyber security
- 21. Infrastructure shared across ports
- 22. Standards for sharing vessel positions across ports
- 23. IMO mandates cargo weight & dimensions
- 24. IMO mandates cargo weight & dimensions



2026

- 25. International vessel usage codes for the vessels
- 26. Shipments based on their CO2 emissions
- 27. EU mandates cold testing at ports for Ro-Ro vessels
- 28. Remote controlled terminal legs can load cargo



2027

- 29. 3rd generation AIS core solutions
- 30. Border-free transit
- 31. International cold testing at ports for Ro-Ro vessels
- 32. Robotic portside loading operations



2028

- 33. International cold testing at ports for Ro-Ro vessels



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# *The road not taken*

by Robert Frost (1916)



Two roads diverged in a yellow wood,  
And sorry I could not travel both  
And be one traveler, long I stood  
And looked down one as far as I could  
To where it bent in the undergrowth;

Then took the other, as just as fair,  
And having perhaps the better claim,  
Because it was grassy and wanted wear;  
Though as for that the passing there  
Had worn them really about the same,

And both that morning equally lay  
In leaves no step had trodden black.  
Oh, I kept the first for another day!  
Yet knowing how way leads on to way,  
I doubted if I should ever come back.

I shall be telling this with a sigh  
Somewhere ages and ages hence:  
Two roads diverged in a wood, and I—  
I took the one less traveled by,  
And that has made all the difference.

# Purpose of the roadmaps



- anticipation of changes that are forthcoming in the industry
- engaging wider stakeholders from outside the consortium in dialogue and input
- developing materials to help policymakers define and structure policies that will further the regions' ongoing success in the maritime and marine sectors

# Research question: What doesn't get roadmapped and why?

P: Principles

C: Criteria

E: Explanation

Un-forecastable

Out of scope

Bygone technologies

Implausibility

Impossibility

Unstable

Not aesthetically pleasing

Not already here



P: The critical structure of the roadmap is the X axis that depicts “time” or years into the future.

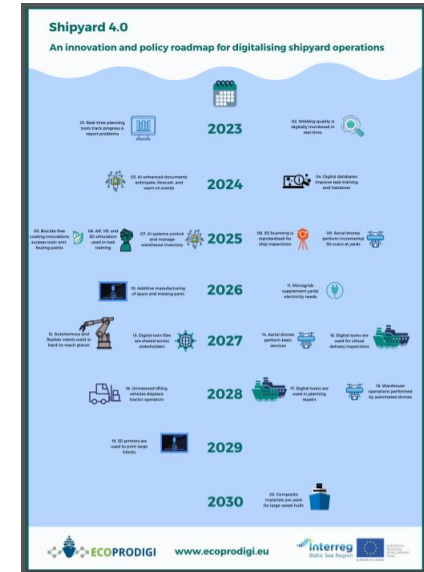


*C: Is the element forecastable?*

E: In order to be forecastable, the element must be a discrete event, and **must be answerable to the question**: When will this become accepted practice or commercially available?

P: Elements must be actionable by the representatives of the project partners

*C: Is the element out of scope?*



E: Because the focus of the project was **primarily concerned** with the upgrading of the *existing fleet of vessels*, there were no project partners that could contribute with sufficient knowledge about electrofuels. Similarly, **subsurface drones** that scan harbors are not included.

P: The roadmap has to be novel

*C: Is the element deemed a  
“bygone” technology?*

E: Lightweight containers were considered. However, all though they are not currently used in practice in any significant quantity, they have been around and available for a long time.





P: The roadmap should be taken seriously

*C: Is the element deemed to be implausible?*

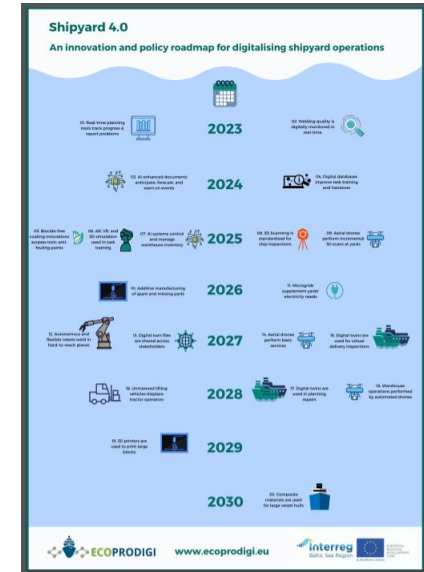


E: Implausible technologies would not be taken seriously by users, for example “game controllers for vessel navigation.” Including it may go against acceptable dialogue, and risk that the other elements – by association – call the entire roadmap into question.

P: The roadmap should be aesthetically pleasing

*C: Is the element deemed to be possible?*

E: Nearly all of the elements had at least one rater thinking that “will never happen.” However, none of them had 100% of raters believing that it will never happen. These were not displayed - there would be no roadmap.



P: The roadmap should support or create opportunities for inter-organizational project development

*C: Is the information stable enough to be deemed an opportunity?*

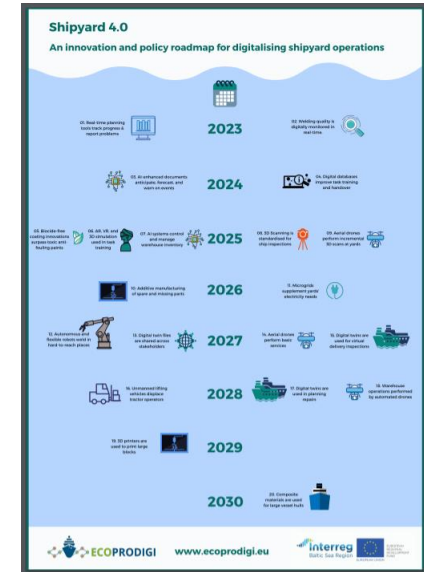


E: The individual ratings, displayed in the violin plots, were discarded in favor of the singular median rating.

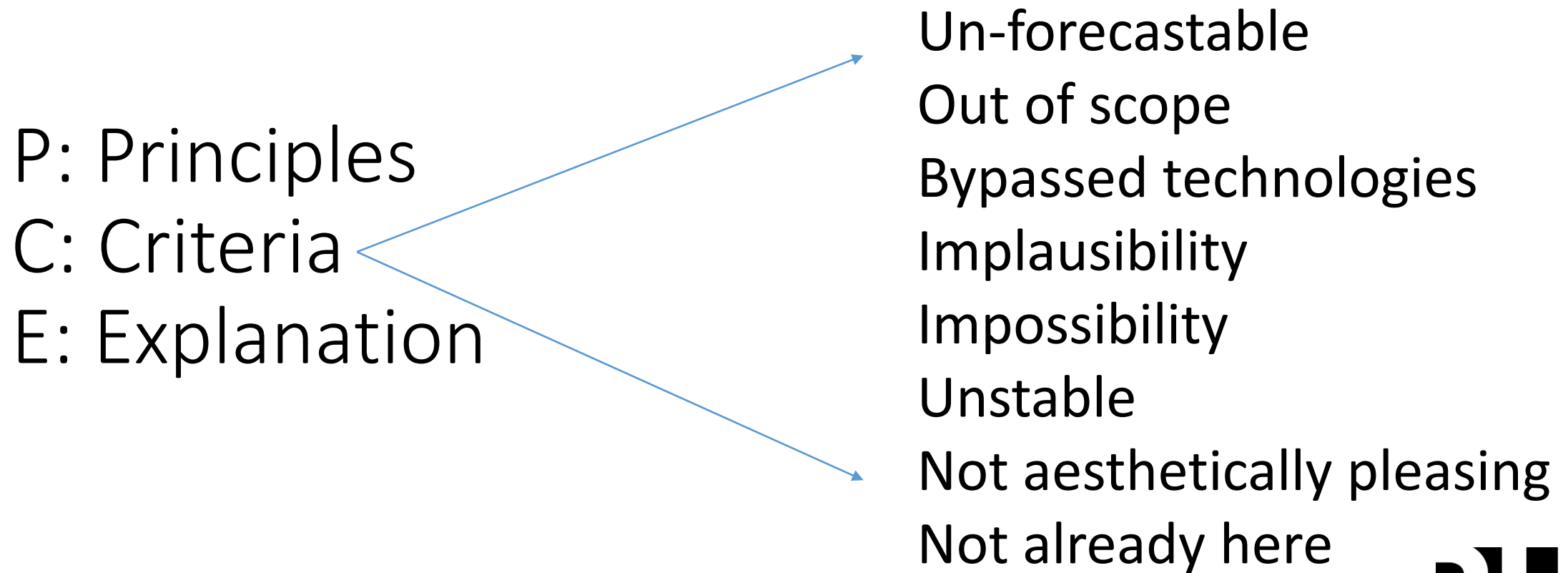
P: The roadmap should be about the future

*C: Is the element deemed to be already here?*

E: Some events were rated as “already here,” but this could be overcome by reformulating the element by injecting more technological capabilities, such as “powered by AI.”



# Research question: What information isn't on the roadmap?





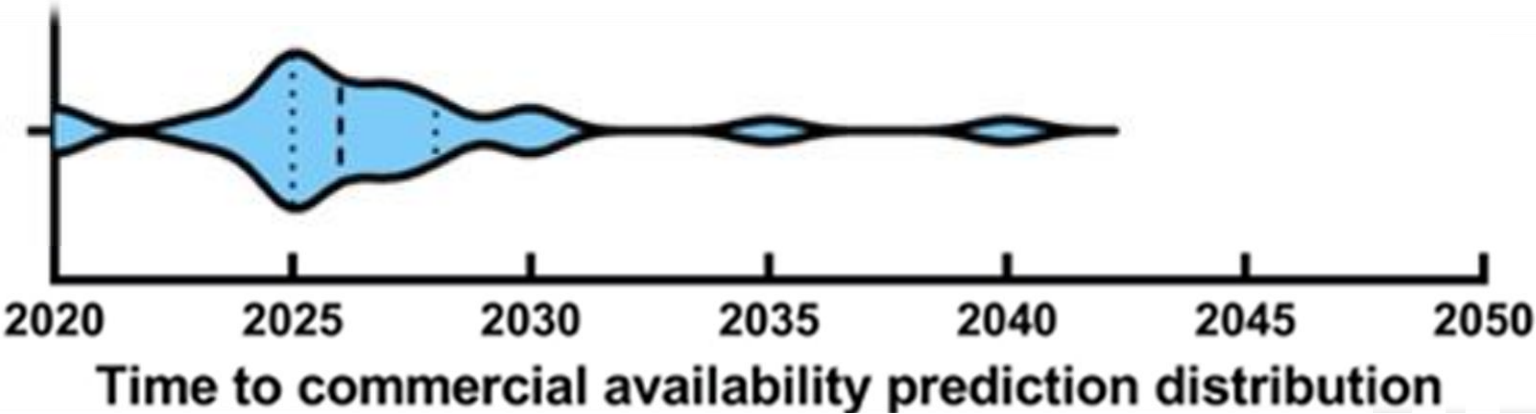


# INTERNATIONAL MRV: CENTRALIZED DATA REPOSITORY FOR FLEET

Maritime transport emits around 940 million tonnes of CO2 annually and is responsible for about 2.5% of global greenhouse gas (GHG) emissions. Establishing a central data warehouse would require a standardization of the digital data file formats that national regulatory bodies can agree to. In turn, this can inform efforts to develop maritime carbon and emission trading schemes.

Median	Mode	Mean	Avg+1std dev.	% already here	% never happen
2026	2025	July/2027	Dec/2031	8%	13%

A central data repository is established to monitor global ship performance data



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# Thank you

