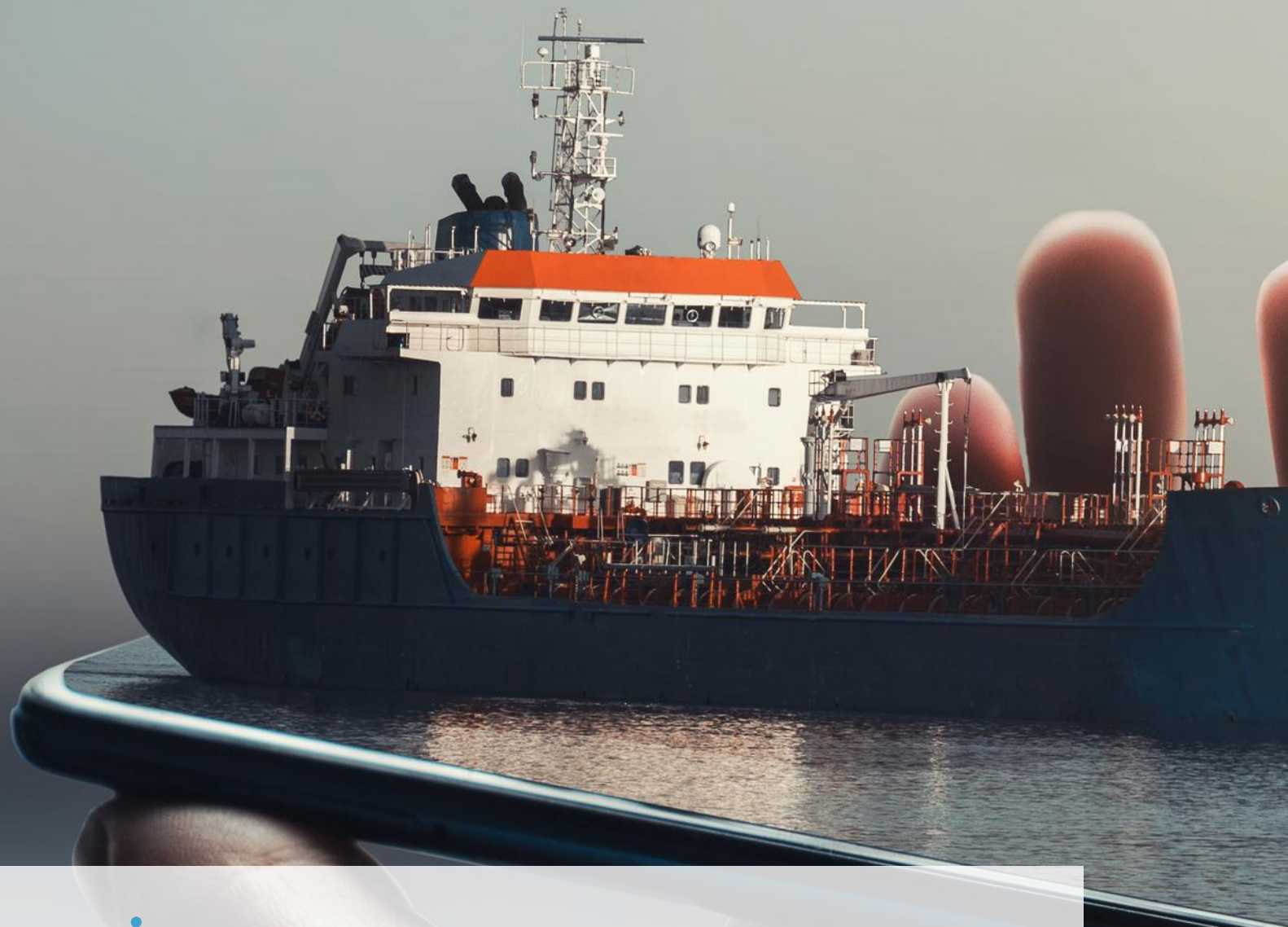




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Cristal project

**Operational decision support system for
navigability**

Orestis Tsolakis and Edwin van Hassel

10 April 2025

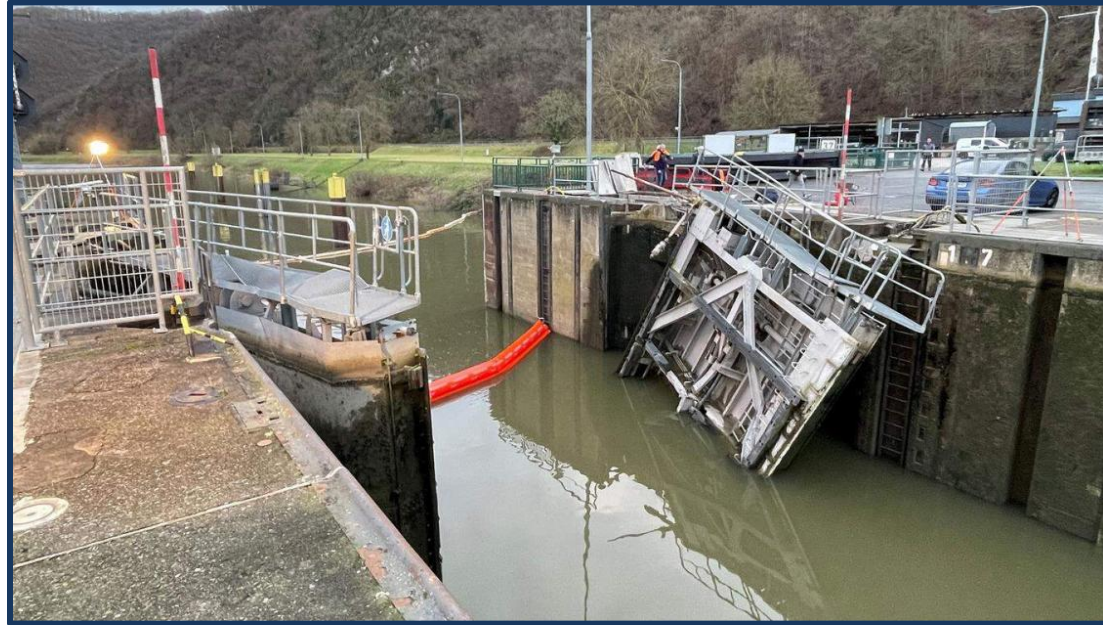
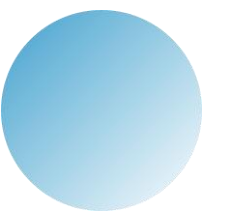


CRISTAL

CLIMATE RESILIENT AND ENVIRONMENTALLY
SUSTAINABLE TRANSPORT INFRASTRUCTURE,
WITH A FOCUS ON INLAND WATERWAYS

www.Cristal-project.eu

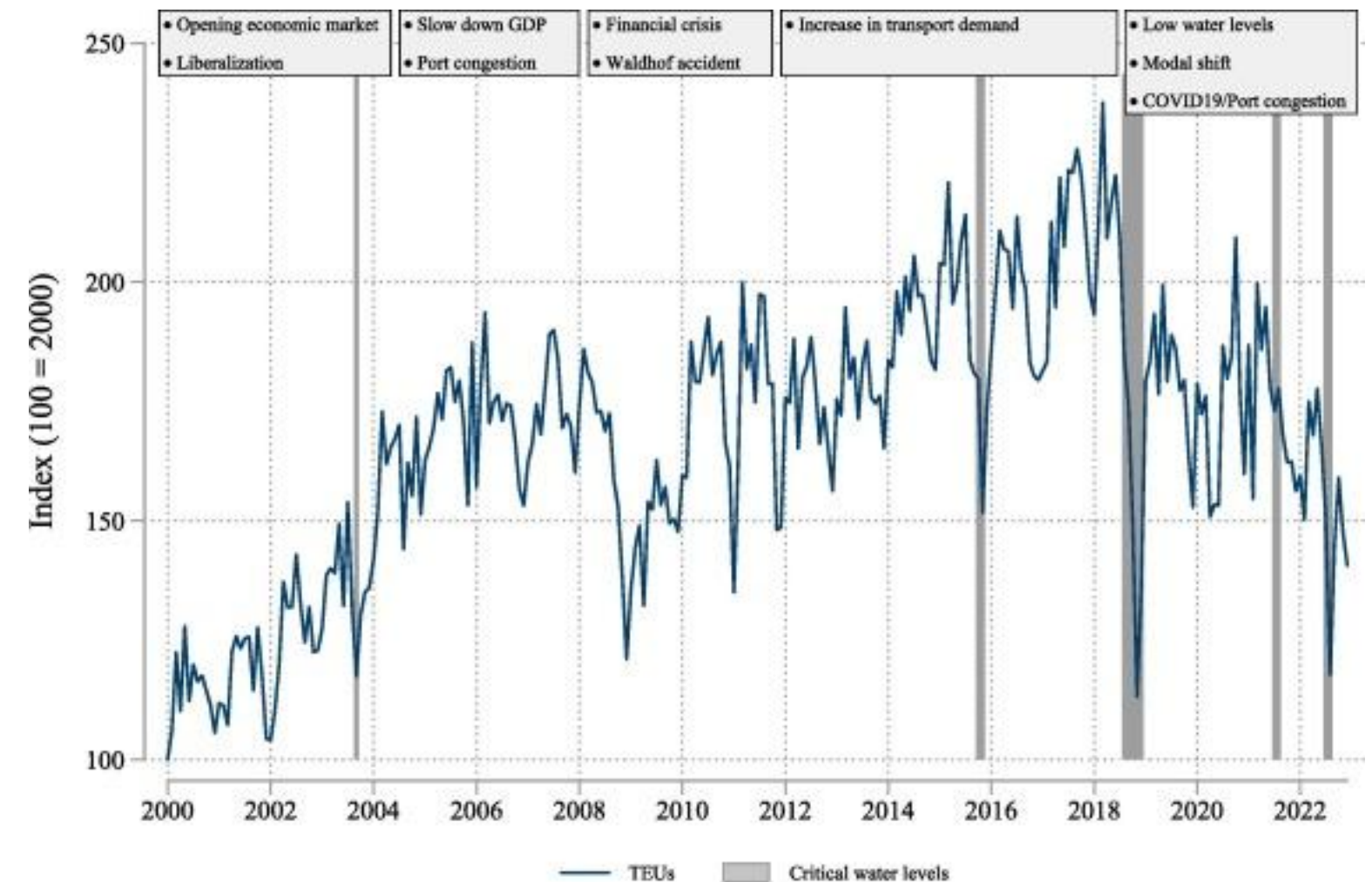
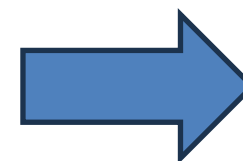
Introduction (1): Challenges



Disruptions on the IWT network:

1. Damaged infrastructure
2. Low water

Results, among other causes, in a decrease in IWT containers



Introduction (2): Solution

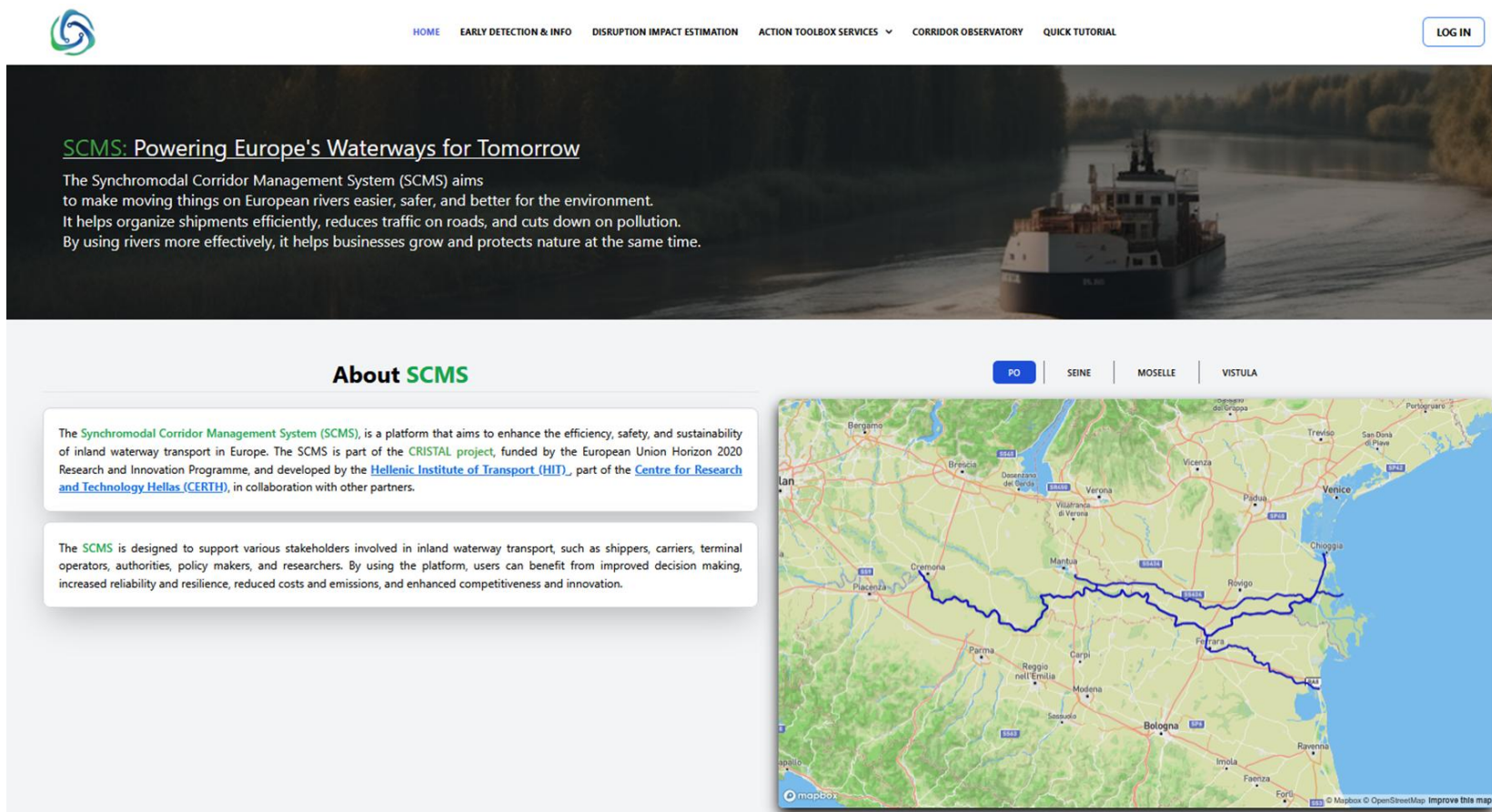
Therefore, more insights are required to be “resilient” by:

1. Proposing alternatives in case a long disruption (blockage of a waterway)
2. Forecasting certain events:
 - water levels
 - Infrastructure maintenance

How to do this?

→ The **Synchromodal Corridor Management System (SCMS)** & **Digital Twins**

Cristal SCMS



SCMS: Powering Europe's Waterways for Tomorrow

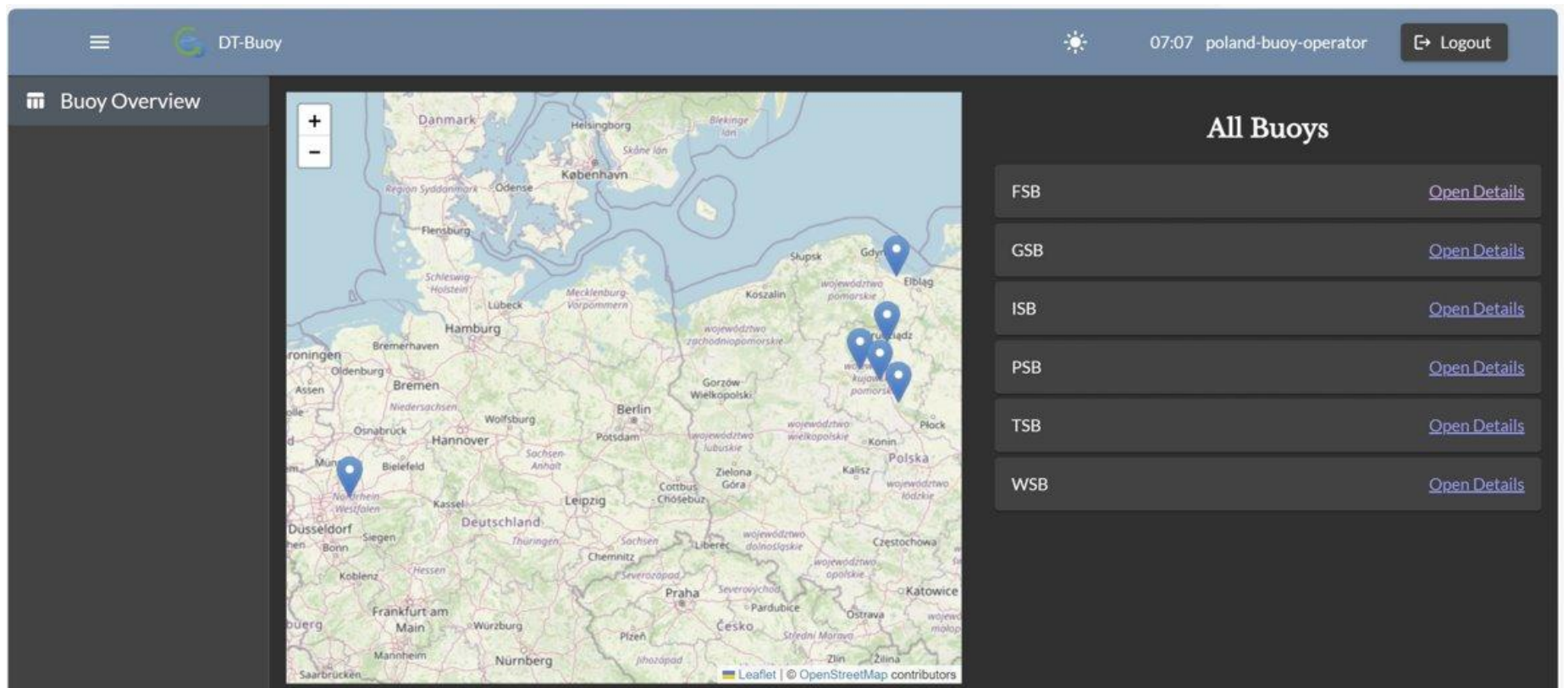
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About SCMS

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Cristal DT



Buoy Overview

All Buoys

FSB	Open Details
GSB	Open Details
ISB	Open Details
PSB	Open Details
TSB	Open Details
WSB	Open Details

The CRISTAL project in a nutshell

❖ *Who creates the project?*

The project is co-created by **15 partners** from **9 countries**: Poland, Germany, Italy, Belgium, the Czech Republic, Hungary, Greece, France and UK.

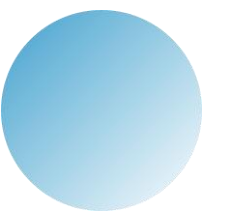
Three river pilots are developed:

- Poland (Vistula and Odra),
- Italy (Po),
- France (Moselle, Seine).

- ❖ a project funded by the Horizon Europe Programme (Innovation Actions)
- ❖ Duration: Sep. 2022 to Sep. 2025 (36 months)
- ❖ Coordination: LUKASIEWICZ - POZNANSKI INSTYTUT TECHNOLOGICZNY (Poland)



Project goals

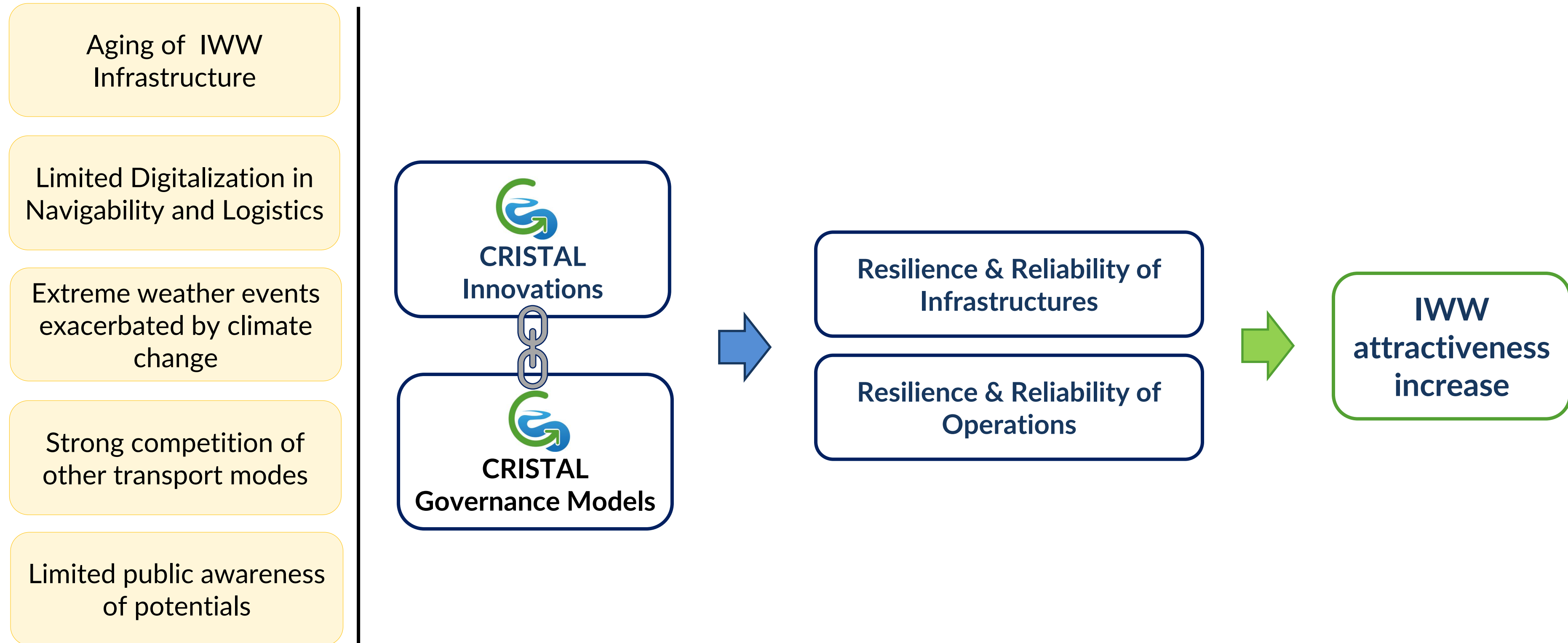
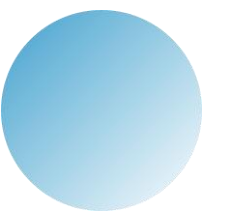


CRISTAL aims to contribute to the following:

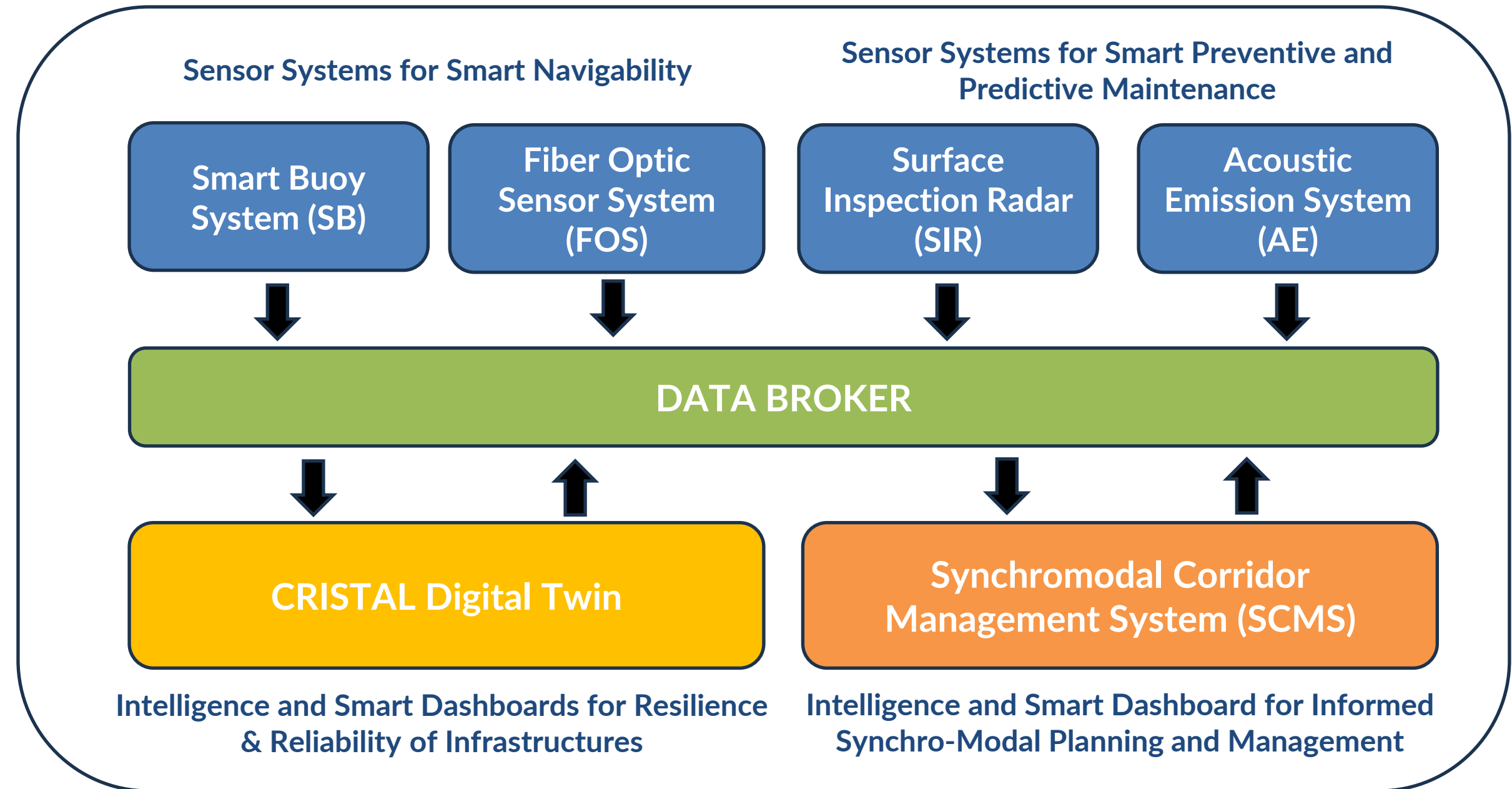
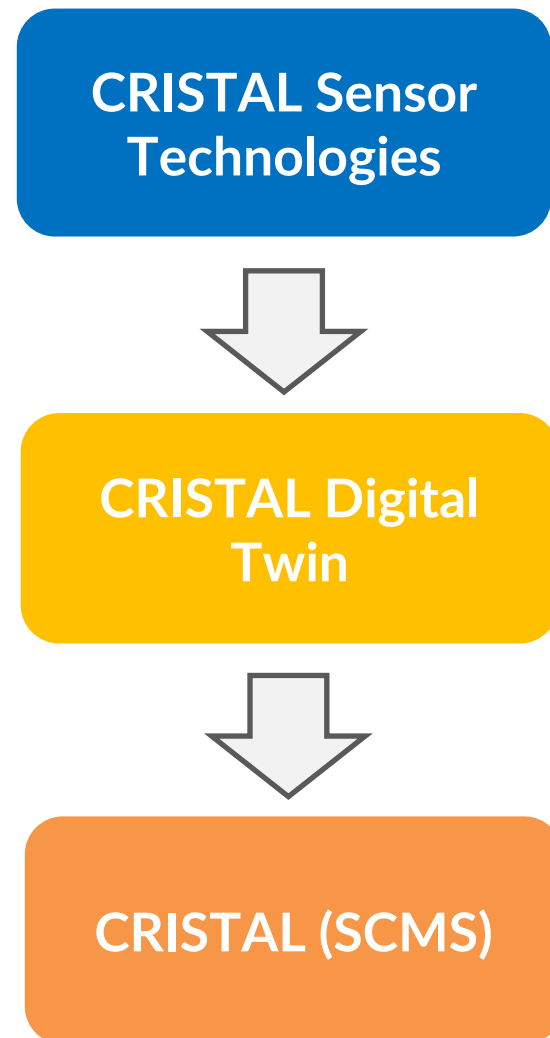
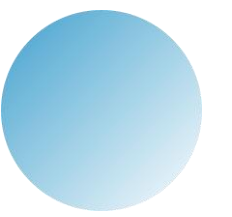
- Shifting 20% of freight traffic to inland waterways.
- Increase the reliability of transport by 80% at network level with the use of synchromodality and the integration of IWT to multimodal supply chains.
- Increasing the operability and resilience of infrastructure assuring 50% operation capacity during extreme weather events.
- Developing new governance models enabling cooperation across institutional, modal and national boundaries.



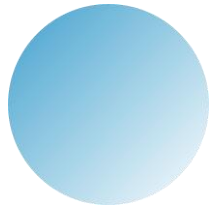
The CRISTAL project approach



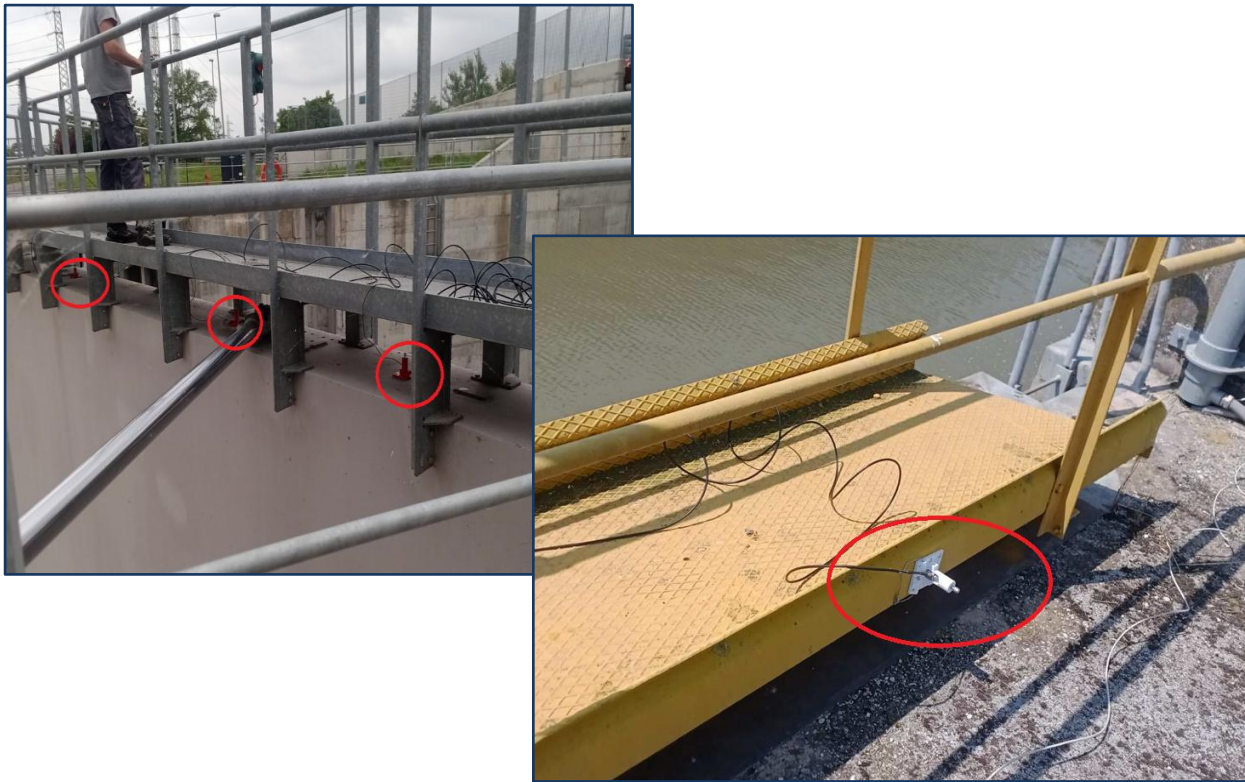
CRISTAL Innovations: Pillars and Architecture



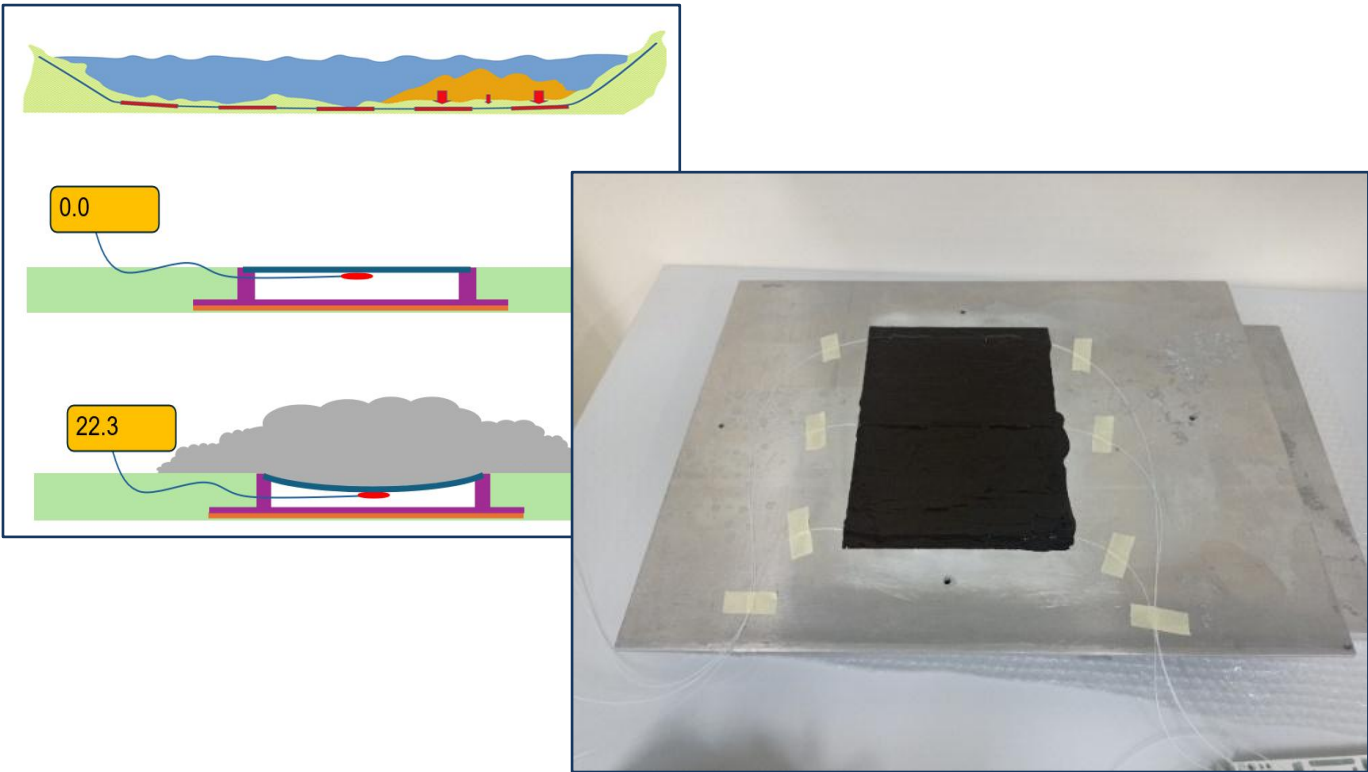
CRISTAL sensor technologies



Acoustic Emissions (AE)



Fiber Optics Sensors (FOS)



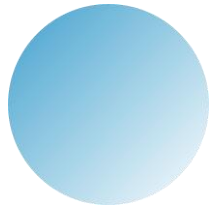
Surface Inspection Radar (SIR)



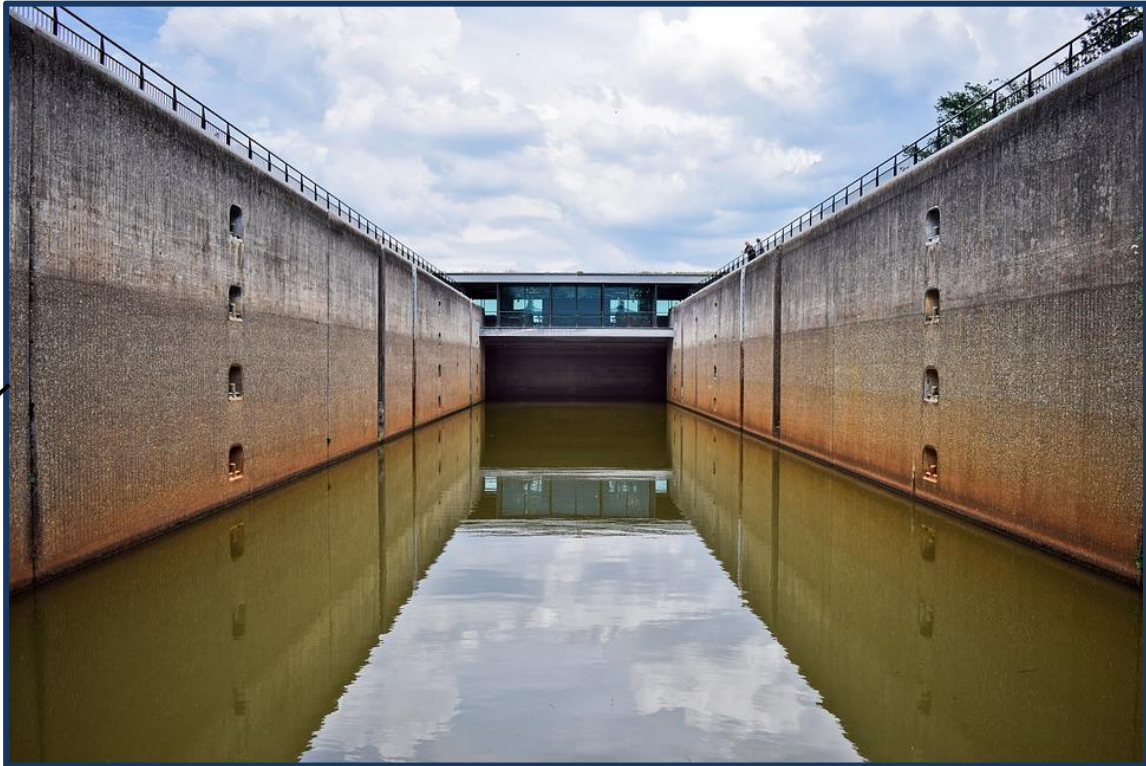
Smart Buoys (SB)



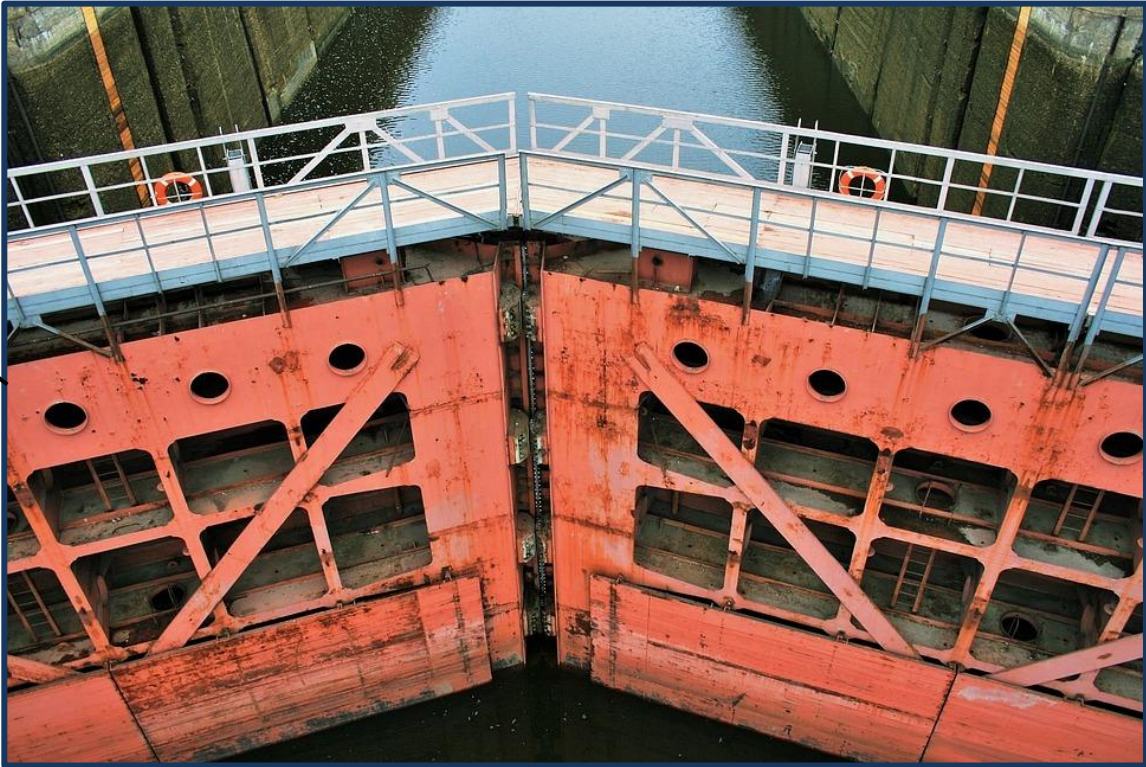
CRISTAL Digital Twins



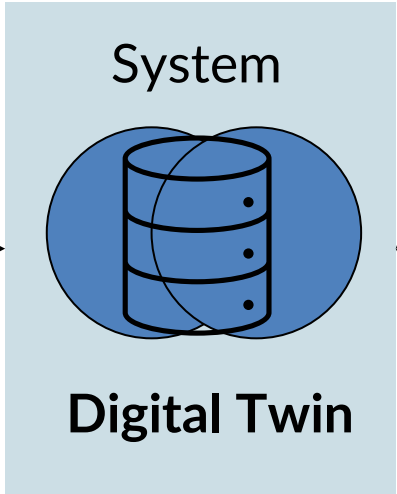
Buoys measuring barge count, river depths, temperature, ice cover, etc.



Radar technology for detection of microcracks in lock walls



Acoustic Emission system for predictive maintenance of lock doors



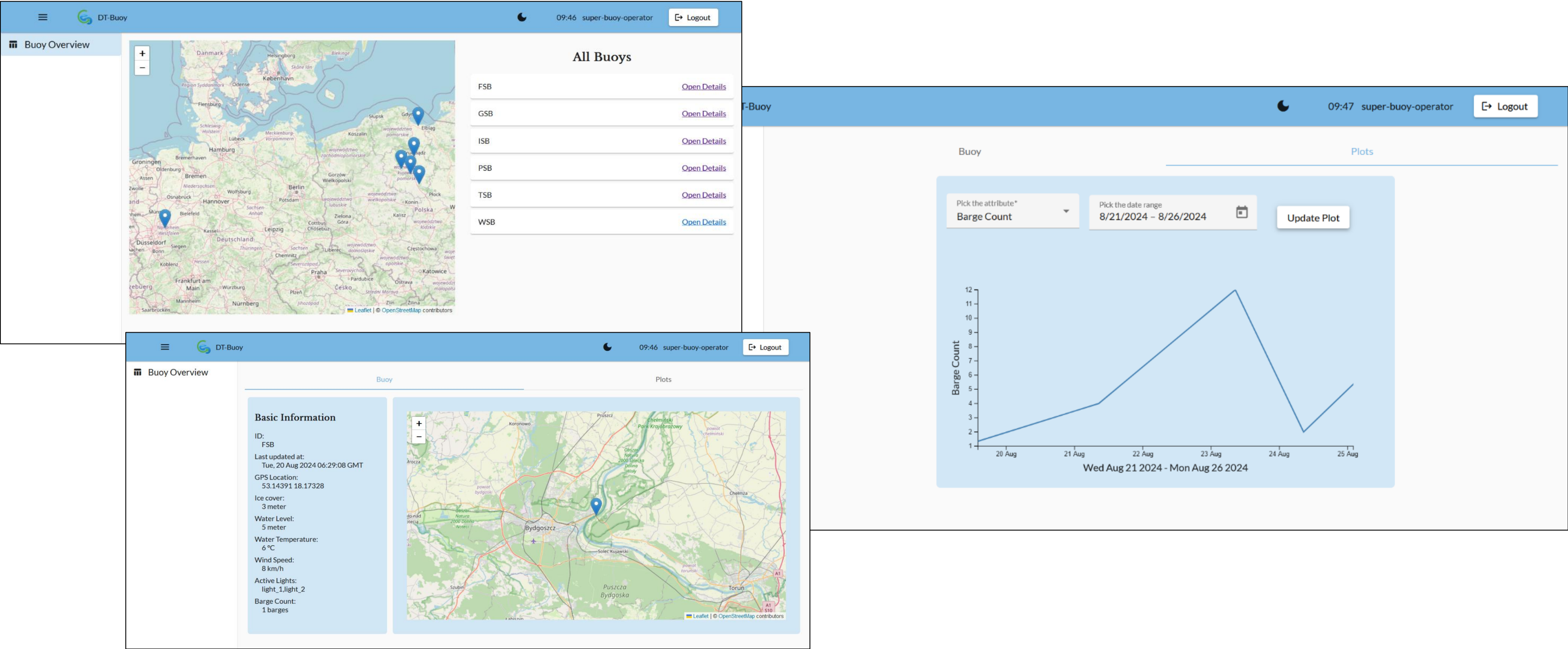
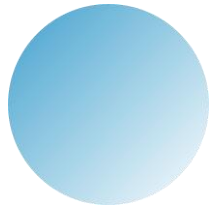
SCMS

DT User Interface



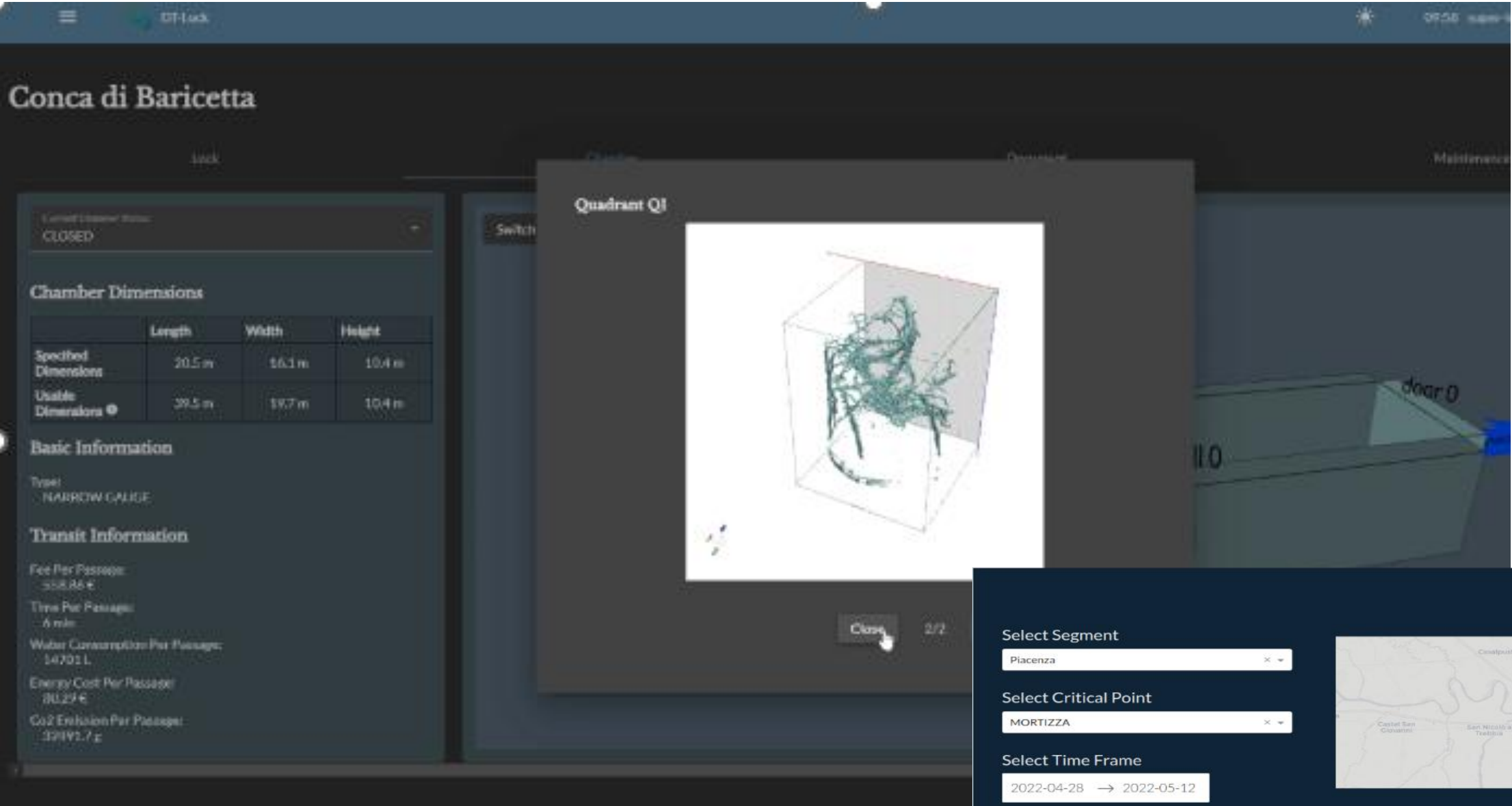
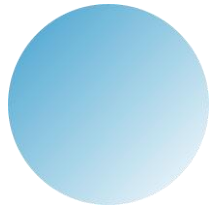
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CRISTAL Digital Twins



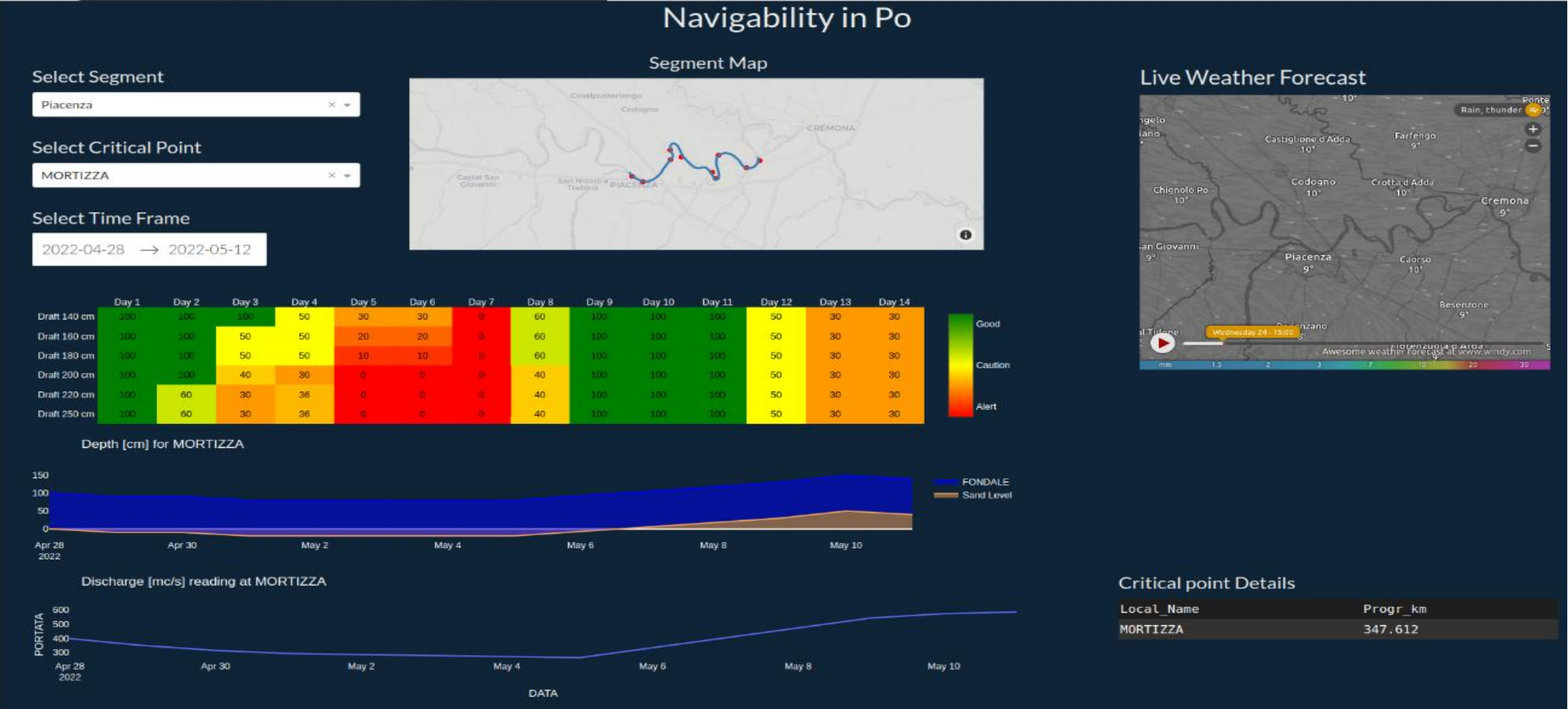
Visualization of DT for Vistula river

CRISTAL Digital Twins



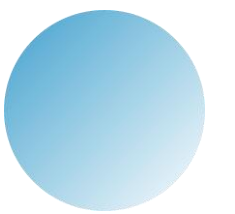
Visualization of DT of Lock Conca di Baricetta


Visualization of DT for navigability in river Po



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The Synchronomodal Corridor Management System





HOME | EARLY DETECTION & INFO | DISRUPTION IMPACT ESTIMATION | ACTION TOOLBOX SERVICES | CORRIDOR OBSERVATORY | QUICK TUTORIAL

LOG IN

SCMS: Powering Europe's Waterways for Tomorrow

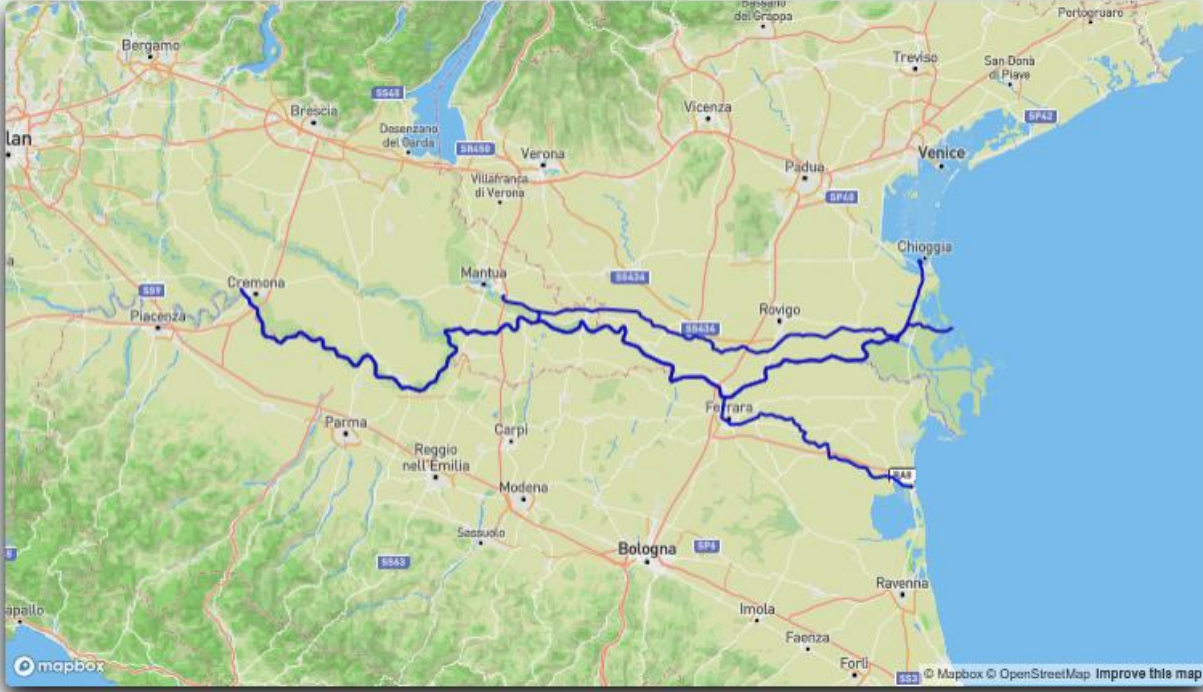
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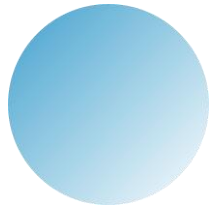
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PQ | SEINE | MOSELLE | VISTULA



SCMS is a system (platform) for collecting and pushing disruptions-related information towards operational stakeholders, using this information also for supporting the planning & re-planning of operations, providing alternatives. It also collects data to support decision and policy-making at regional level.

The Synchronomodal Corridor Management System





HOME EARLY DETECTION & INFO DISRUPTION IMPACT ESTIMATION ACTION TOOLBOX SERVICES CORRIDOR OBSERVATORY QUICK TUTORIAL [LOG IN](#)

SCMS: Powering Europe's Waterways for Tomorrow

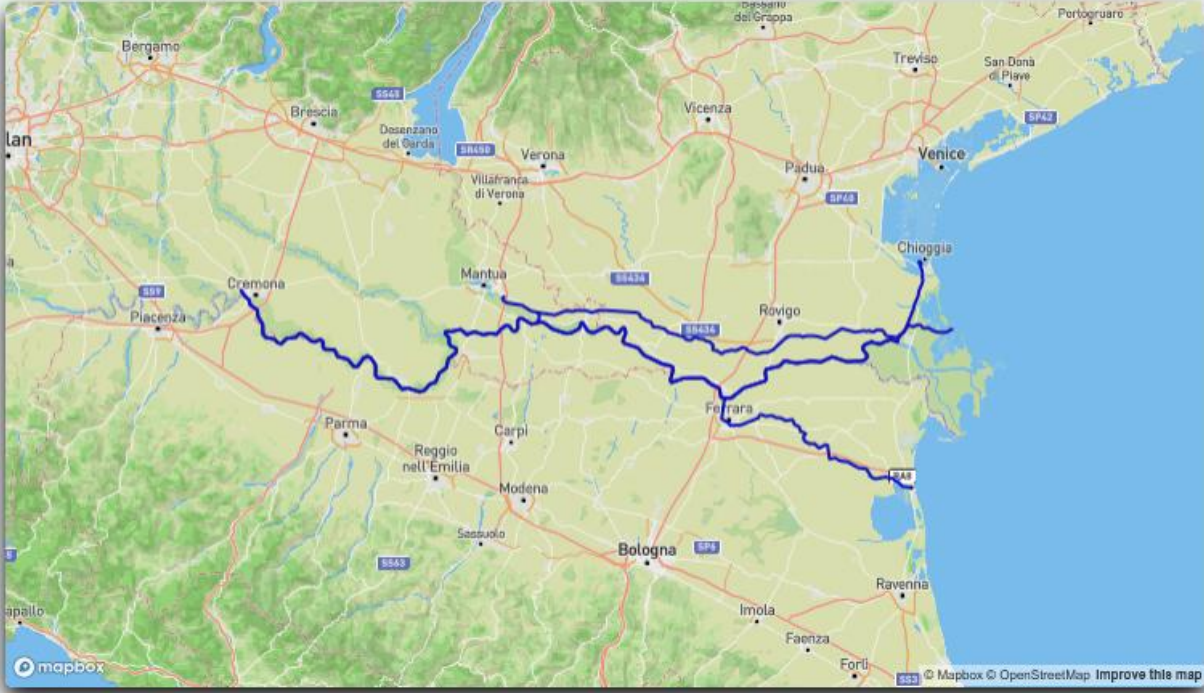
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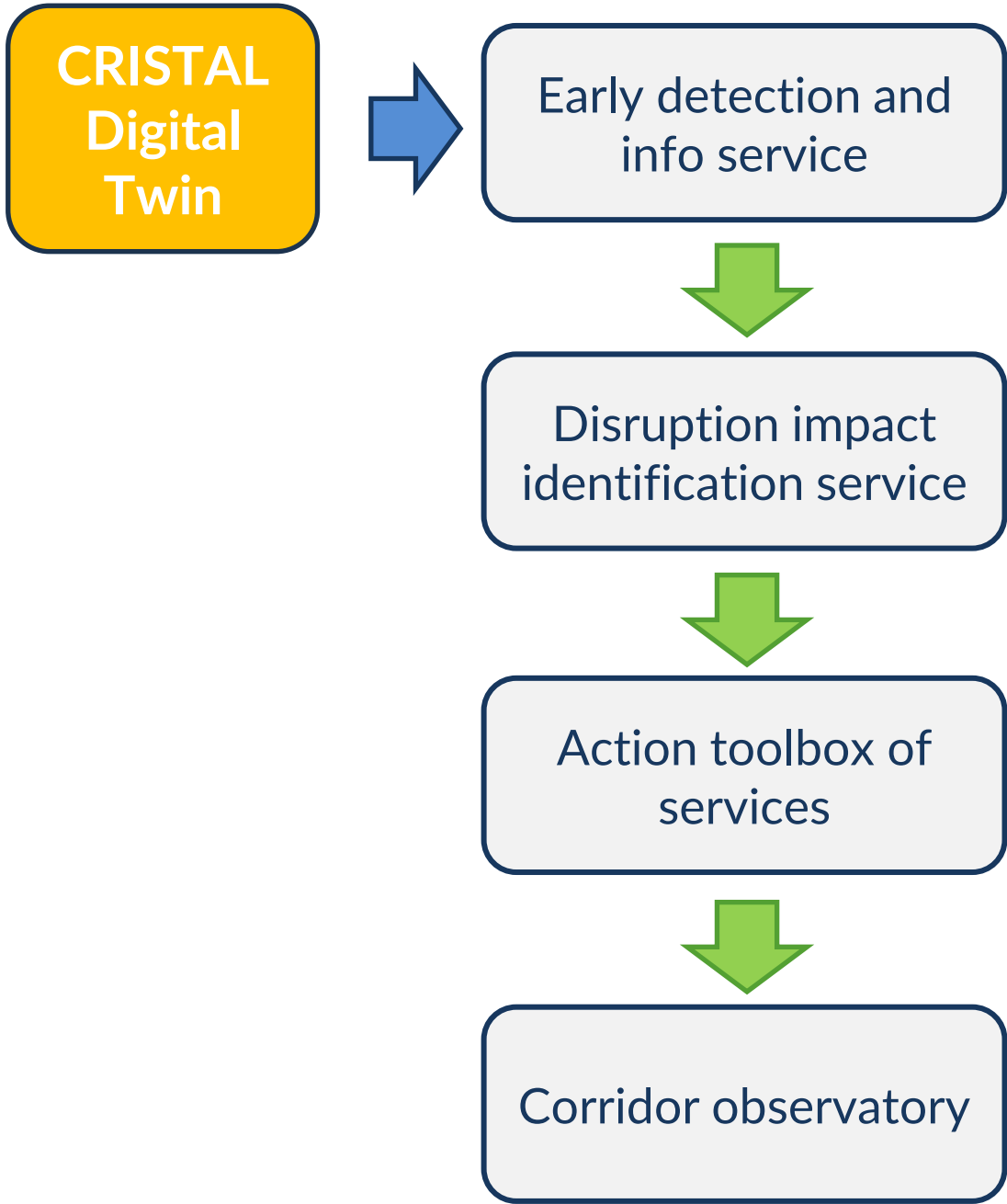
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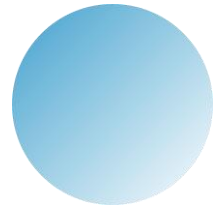
PQ SEINE MOSELLE VISTULA



SCMS functionalities



The Synchromodal Corridor Management System



HOME

EARLY DETECTION & INFO

DISRUPTION IMPACT ESTIMATION

ACTION TOOLBOX SERVICES

CORRIDOR OBSERVATORY

QUICK TUTORIAL

LOG IN

Early Detection & Info Service

This platform provides real-time alerts related to river conditions, tailored to your selected timeframe, ensuring timely and relevant information for decision-making.

1 Select River

PO

SEINE

MOSELLE

VISTULA

2 Select Message Sender

All Senders

River Digital Twin

AIPO

Infrastrutture Venete

3 Select Alert Period

From

03/27/2025

To

04/27/2025

Find Alerts

Maintenance, obstruction, or other incidents were not found for the river in the chosen timeframe.

ALERTS:

ATTENTION

WARNING

DANGER

Early detection and info service

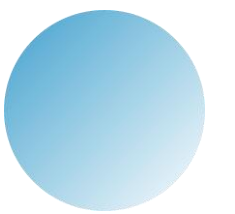
- Collection of forecasted impacts of disruptions on the IWW operation (input from the CRISTAL Digital Twin through defined JSON structure)
- Input from external sources /existing systems providing alerts (e.g. Notices to Skippers from EURIS)
- Push notification mechanism for interested stakeholders based on their preferences

JSONRaw DataHeaders

SaveCopyPretty Print

```
[
  {
    "id": "67380ac2-c0ce-4d87-b297-42054ecb0d84",
    "isrs": "ITFTK000190930100174",
    "name": "Conca di Baricetta",
    "updatedAt": "2024-05-14T11:44:07.179982Z",
    "constructionYear": 1999,
    "lockType": "INCLINED_LIFT",
    "status": "OPENED",
    "address": {
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      "streetName": "Località Pignatta",
      "streetNumber": "1",
      "city": "Adria",
      "postalCode": "45011",
      "federalState": "Veneto",
      "country": "Italy",
      "coordinates": {
        "id": "512a7c8e-ddf3-47ed-b5ef-b5bc351f957a",
        "latitude": "45.054889",
        "longitude": "12.002194",
        "realData": false,
        "new": false
      }
    },
    "waterwayName": "Tartaro-Canalbianco-Po di Levante",
    "locationName": "",
    "hectometerWaterwayPosition": 172.0,
    "realData": false,
    "new": false
  },
  {
    "contact": {
      "id": "ad34db9d-3319-4646-80b8-902abd5cd615".
```


The Synchromodal Corridor Management System



1

Select River

Po

Seine

Moselle

Vistula

2

Origin - Destination

Select Origin-Destination Ports:

☐ Manually

☒ Automatically

Choose Point on Map and Calculate the Departure Port

Porto di Cremona

Destination Port

Porto di Chioggia

3

Vessel

River Class Compatibility

Class III

Not every type of vessel can navigate all parts of the river.

Cargo Type

Container

Cargo in Tons

100

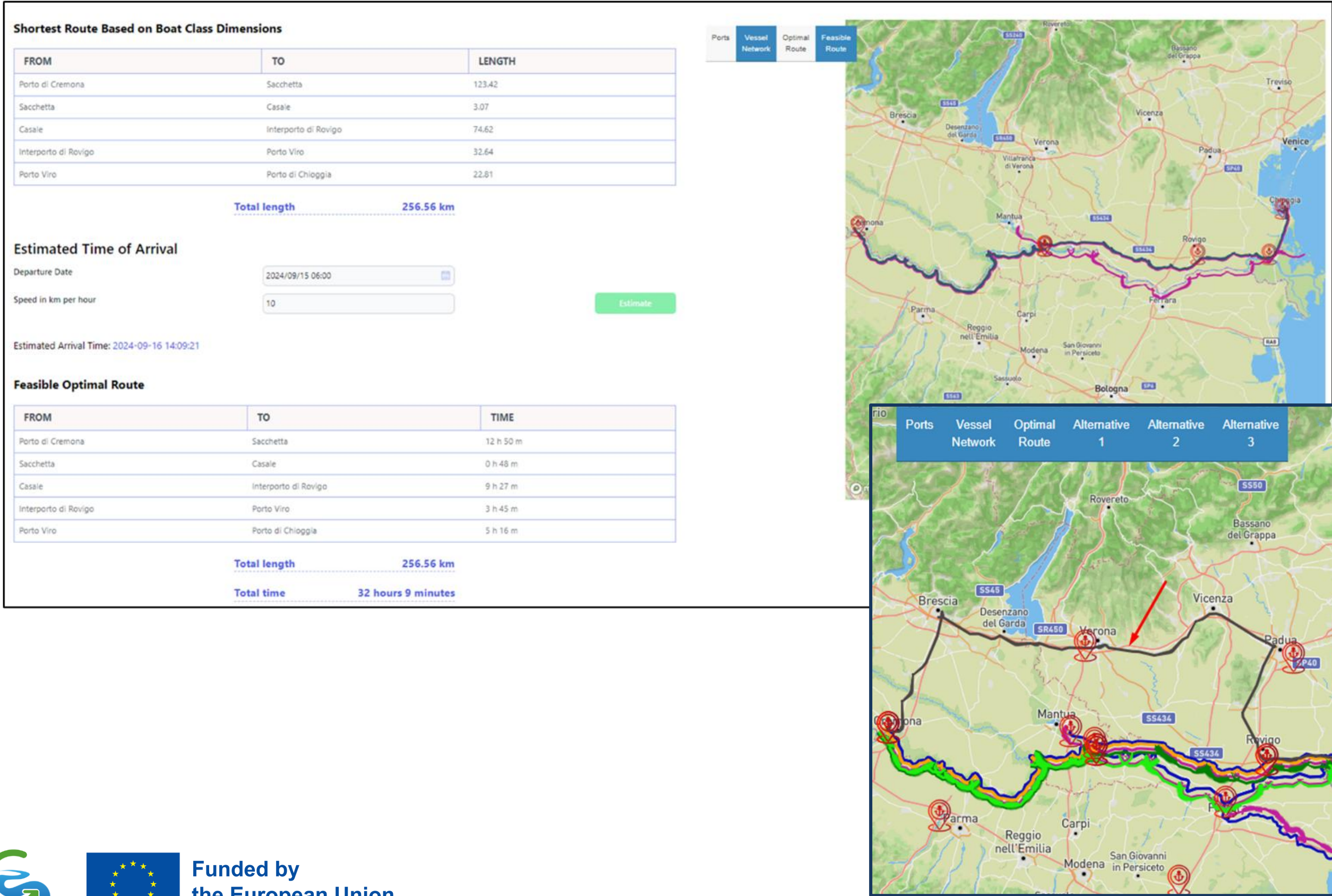
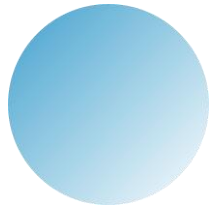
Vessel Network

Show the Shortest Route

Disruption impact
identification service

- Assessment of impacts of disruptions on logistics operations based on existing alerts & forecasted disruptions from the DT
- Specific request from users for assessing the feasibility of planned transportation
- CO₂ & ETA estimation & details on the source of disruptions on planned routes

The Synchromodal Corridor Management System



Action toolbox of services

- Decision support for action (or not) based on calculated alternatives involving the other modes of transport (rail/road) by implementing the principles of the concept of Synchromodality
- Toolbox of additional services customized to the specific river needs (e.g. Track & trace, CO₂ calculator, forecasted river navigability map)

Conclusions

- CRISTAL DT support predictive maintenance of infrastructure and predicting riverways status (water depths) for securing continuity of operations & better river capacity utilization
- use the same information for supporting also operational decisions by reducing the uncertainty related to river navigability
- DT are a must-use tool if we want to increase the share & efficiency of inland navigation

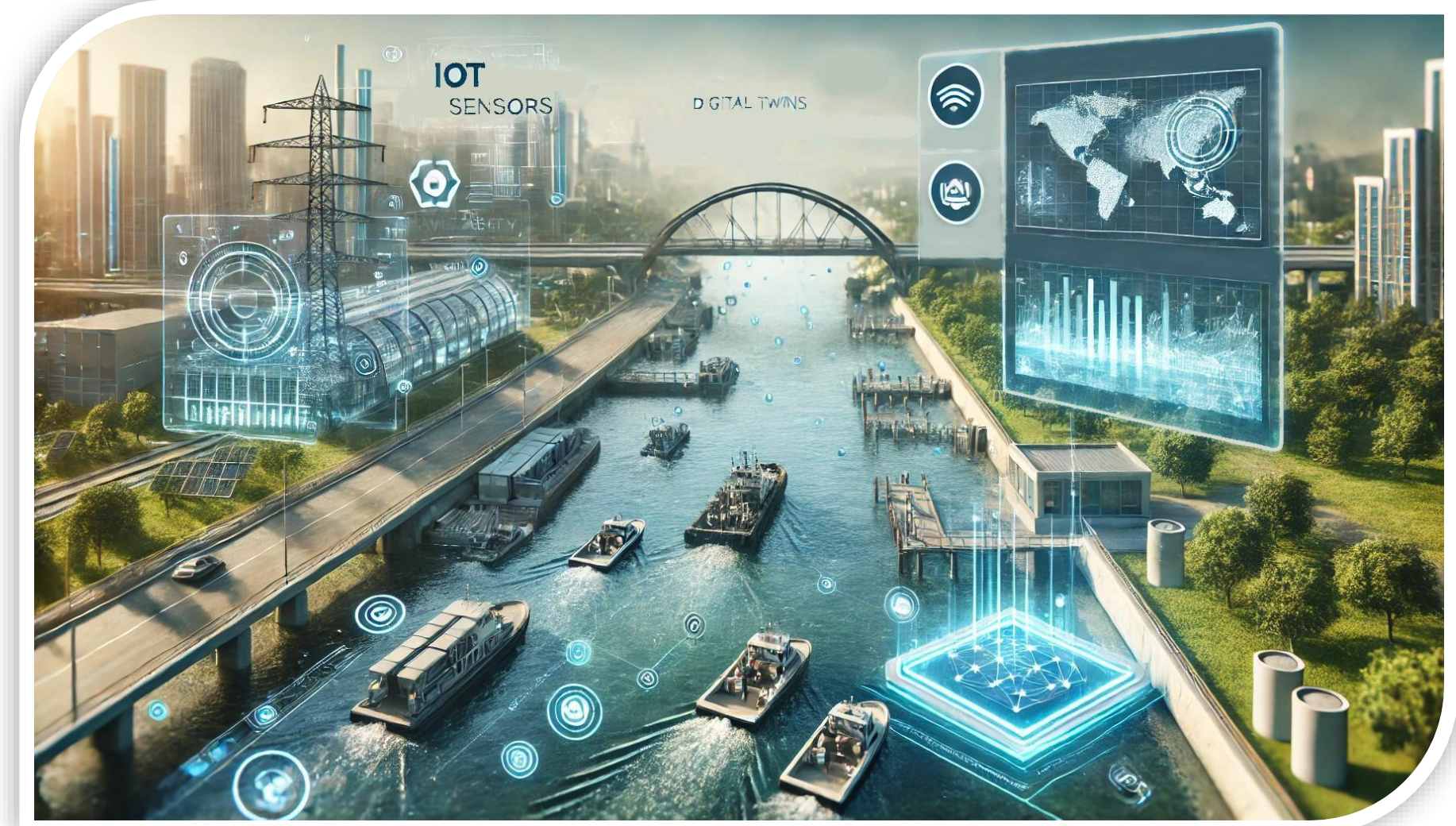
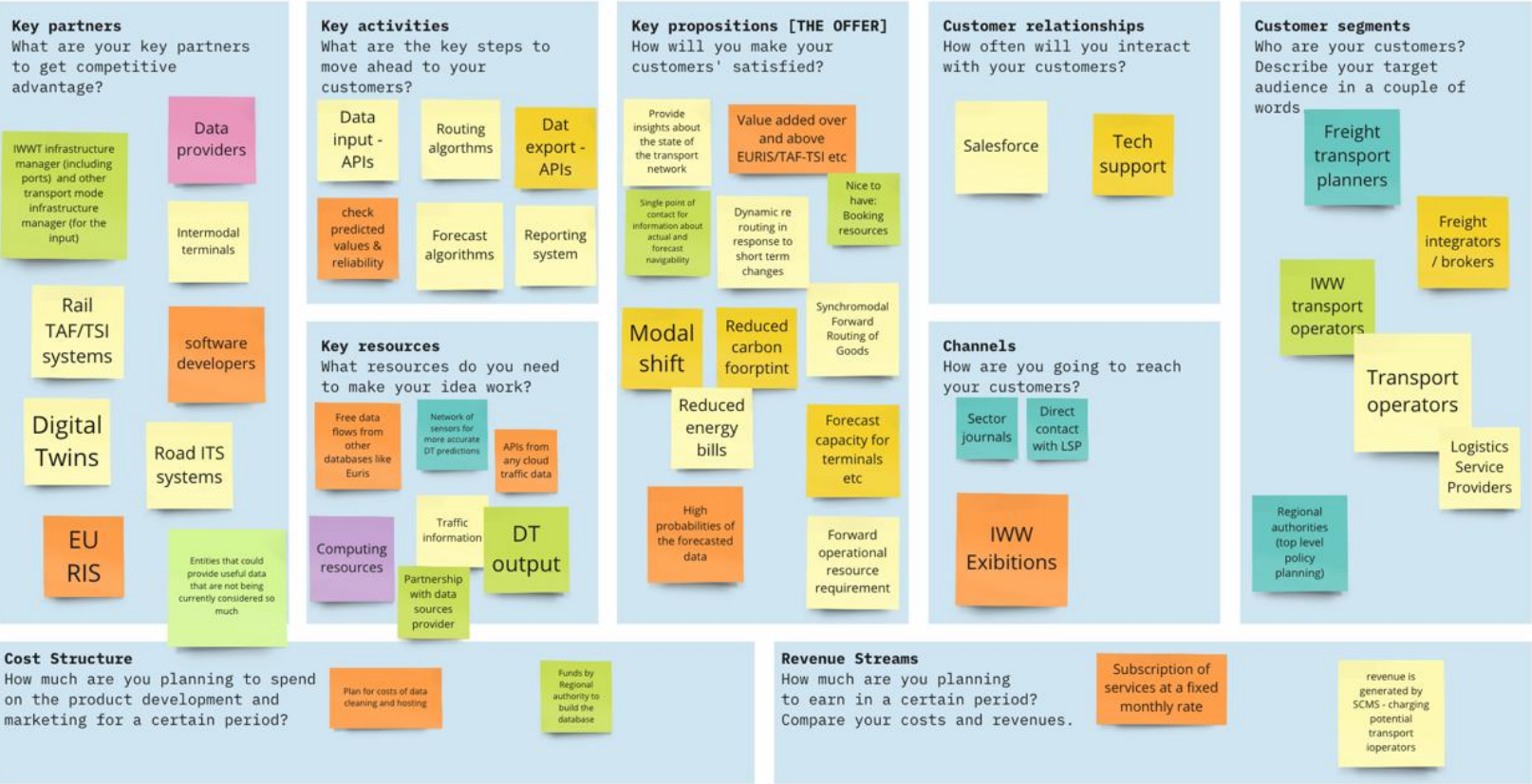


Image generated through ChatGPT

Business model canvas SCMS (1)

Value proposition

The CRISTAL SCMS Business Model Canvas



Benefits	Perceived Value	Realisable Value
Provide insights about the state of the transport network	Y	Y
Value added over and above EURIS/TAF-TSI etc	Y	Y
Nice to have: Booking resources	Y	
Single point of contact for information about actual and forecast navigability	Y	Y
Dynamic re-routing in response to short-term changes	Y	Y
Synchromodal Forward Routing of Goods	Y	Y
Reduced carbon footprint	Y	Y
Modal shift	Y	Y
Reduced energy bills	Y	Y
Forecast capacity for terminals etc	Y	Y
High probabilities of the forecasted data	Y	Y
Forward operational resource requirement	Y	Y

Business model canvas SCMS (2)

Potential benefits

Evaluation model

Road transport									
Cost data	LoadCont	1,5	TEU	DISTANCE		100	[km]	OUT of pocket COST	232,32 [EUR/TEU]
	LoadTonne	24	tonne						11,32 [EUR/tonne]
	CLoadCont	40	[EUR/TEU]	Transport time		1,330	[h]	EXT cost	1 59,13 [EUR/TEU]
	CLoadTonne	0,3	[EUR/tonne]	Handling time		1	[h]		1 2,46 [EUR/tonne]
	Cost per hour	35,4	[eur/h]	Waiting time		1	[h]	GEN. COST	
	Cost per km	0,87	[eur/km]	Variance of transport		20%	[h]	234 538 [EUR/TEU]	11,343 [EUR/tonne]
				Total transport time		4,00	[h]		
TEU	Value of the cargo	50000	[EUR/TEU]						
	VoT	*****	[EUR/TEU/h]						
Tonne	value of the cargo	500	[EUR/tonne]						
	VoT	*****	[EUR/tonne/h]						

IWT TRANSPORT									
CEMT	Cost			Load CAP		Distance IWT	100	[km]	
	Sailing	Waiting	Empty	LoadCont	LoadTonne	Distance Road (pre haulage)	25	[km]	
0	0	0	0	0	0	Class vessel	5		
2	96,10	49,72	85,89	20	400	VltWT	[km/h]	12,5	
3	127,02	66,59	111,32	28	650	Vhandle	[TEU/h]	50	
4	198,97	*****	172,02	70	1250	Occ rate	[%]	80%	
5	438,17	*****	371,84	250	3000				
6	785,66	*****	662,40	950	5200				
	438,172	224,3	371,84	250	3000				

YOUR INPUT

Do you want to share your insights on the potential market adoption of
Digital Twins in the IWT sector?

Your input will be extremely valuable -

THANK YOU SO MUCH

[Qualtrics Survey | Qualtrics Experience Management](#)



Thank you for your attention!

Orestis Tsolakis – CERTH - ortsolakis@certh.gr

Edwin van Hassel –UA -edwin.vanhassel@uantwerpen.be

For more information, please contact:

marta.cudzilo@pit.lukasiewicz.gov.pl

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CRISTAL

CLIMATE RESILIENT AND ENVIRONMENTALLY
SUSTAINABLE TRANSPORT INFRASTRUCTURE,
WITH A FOCUS ON INLAND WATERWAYS

XXXXXXXXXXXXXXXXXXXXXXXXXXXX



THANK YOU FOR YOUR ATTENTION!

