Smarter Ports with Digital Twins

Use Case: APICA

NAVES

Port of Antwerp Bruges

Who we are

NAVES

Port of Antwerp Bruges

NAVES

A global port in the heart of Europe

One port
Two sites

Port of
Antwerp
Bruges

2nd largest port in Europe

Port of Antwerp Bruges

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Number one **export** port in Europe

Largest **car handling** port in Europe
3,507,461 million cars/year

Total throughput
287 mio tons/year

20,675
Seagoing vessels/year

Important **cruise** port in Benelux
547,374 passenger movements

Largest **chemical** hub in Europe

15% of EU **gas** market

Belgium's most important economic driver

14,322
Hectares

1,400
Companies

€ 20,8 billion
Added value

4.5%
GDP

164,000 **jobs**
Direct and indirect

Energy transition
frontrunner

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Digital Twins

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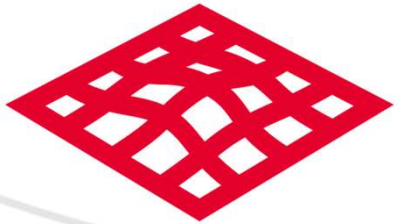
HUMAN SENSES
Touch
Vision
Hearing
Smell
Taste
DIGITAL SENSORS
UI & IoT
Cameras
VHF
iNoses
Sensors

Digital nervous system

Digital nervous system

- **for efficient, safe and sustainable operations**

Digital twin

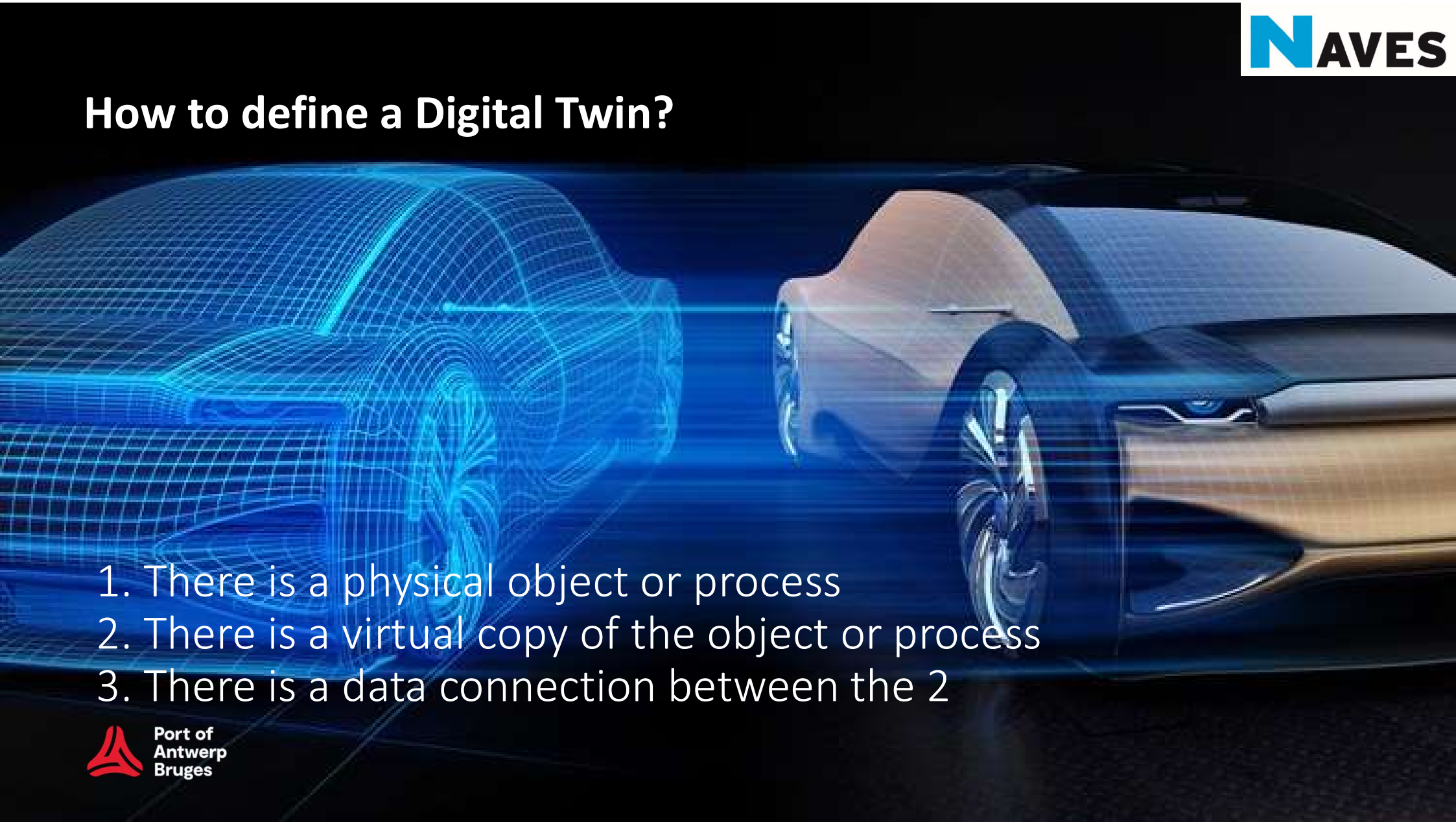


Sensors

Drones

5G

How to define a Digital Twin?



1. There is a physical object or process
2. There is a virtual copy of the object or process
3. There is a data connection between the 2

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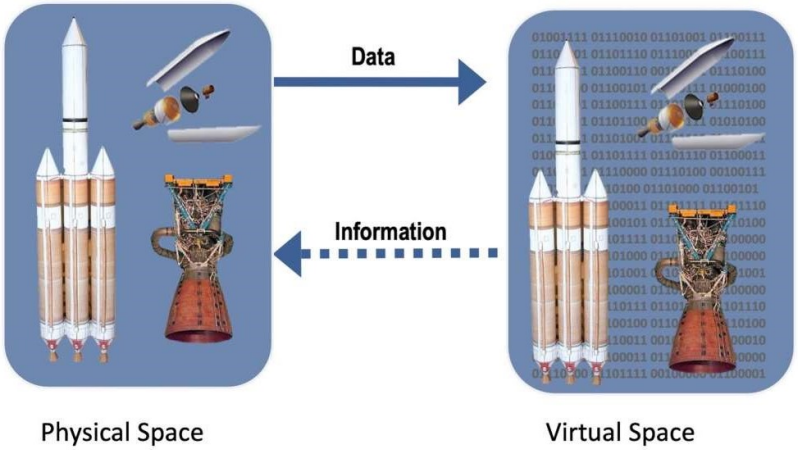
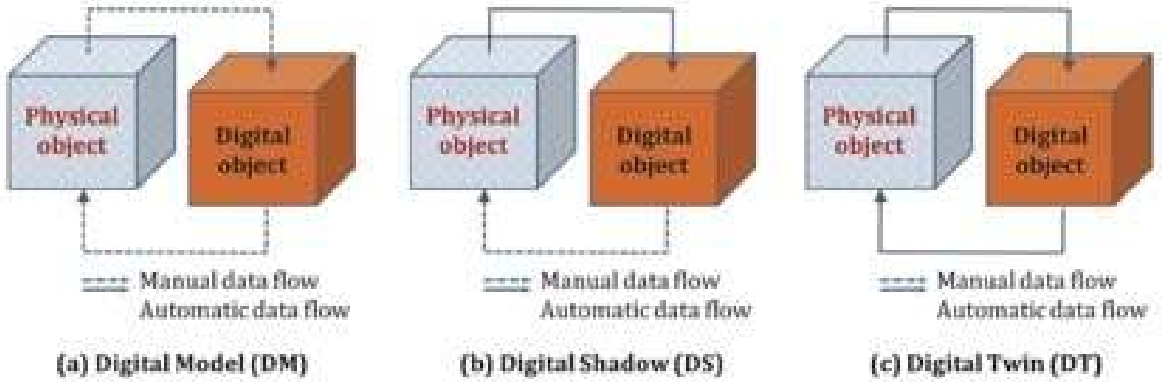
There is an academical literature

Digital Twin Model

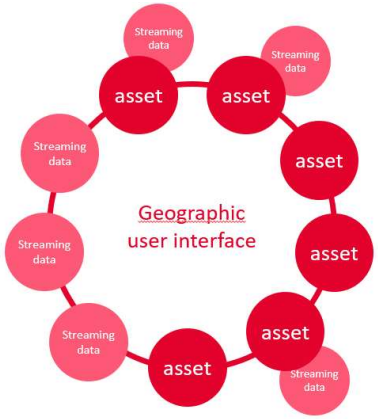


Source: Grieves, M., *Virtually Intelligent Product Systems: Digital and Physical Twins*, in *Complex Systems Engineering: Theory and Practice*, 2019, AIAA



Tijdsaspect

Verleden NU Toekomst



Digital Twin as a vision
Not a single application

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Advanced Port Information & Control Assistant

Digital Twin is the capstone project

SENSORS

CAMERA

LoRa

FIBER

RADAR

DRONE

NETWORK DATA STREAMS

5G

ENTERPRISE ASSET MANAGEMENT

NAUTICAL PLANNING

GEOSPATIAL

DATA PLATFORM

TIMESERIES

OWN DATA

THIRD PARTY DATA

AI

COMBINED DATA

MACHINE VISION

REAL TIME

USER EXPERIENCE

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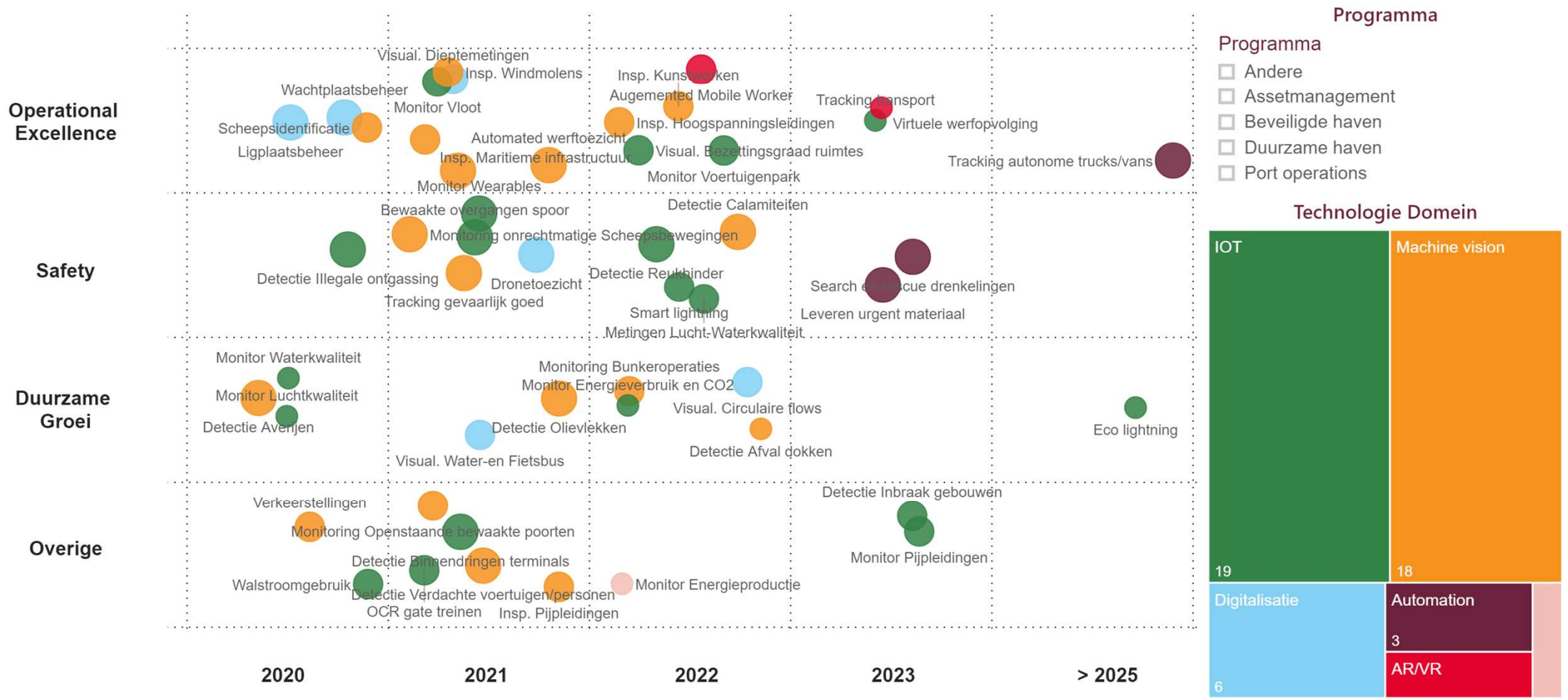
Cherry on the cake – bringing all effort together

[Digital Twin Roadmap]

Digital Twin Roadmap



How to define your Digital Twin?

- **And be prepared for the road ahead.**

Mission

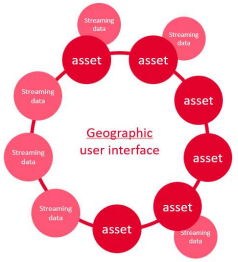
Scope

Target Group

Goal

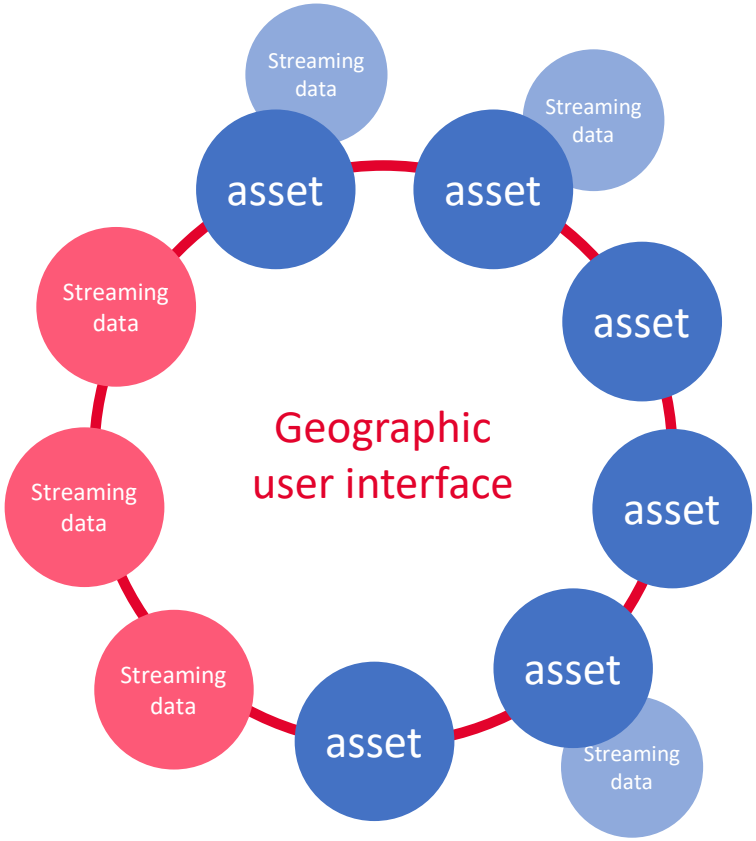
Fluent traffic
in a safe and sustainable Port.

(More) fluent traffic in a safe(r) and (more) sustainable Port, within the same territory.



Situational awareness
Digital Twin of a territory

Which is (or was) the target group?



Situational awareness
Digital Twin of a territory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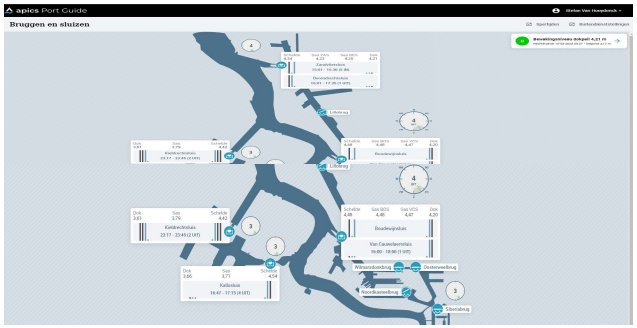
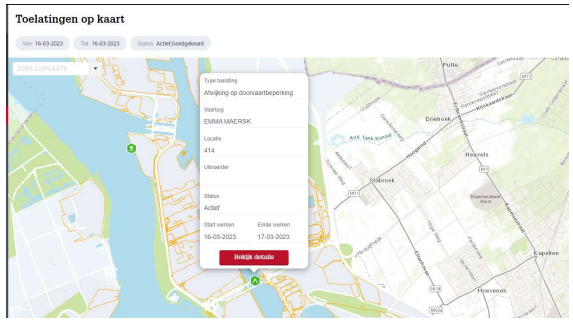
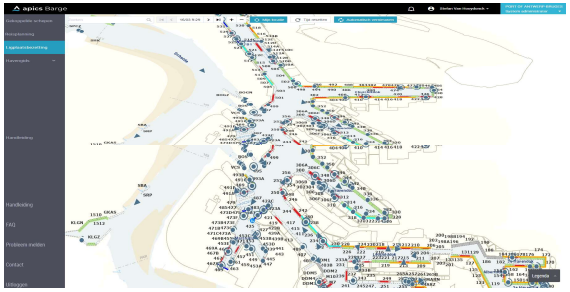
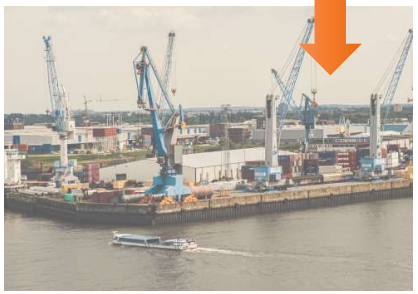
The control room of the Future
Port of
Antwerp
Bruges

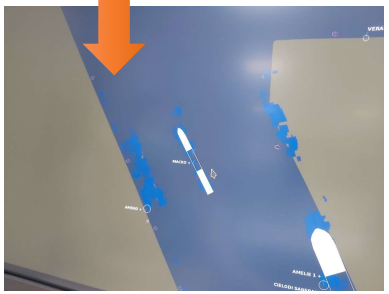
Next level – driven by data intelligence

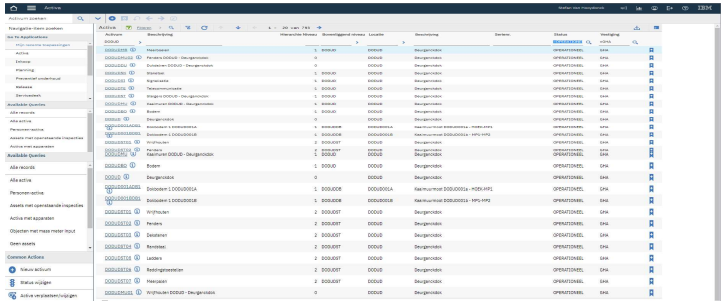


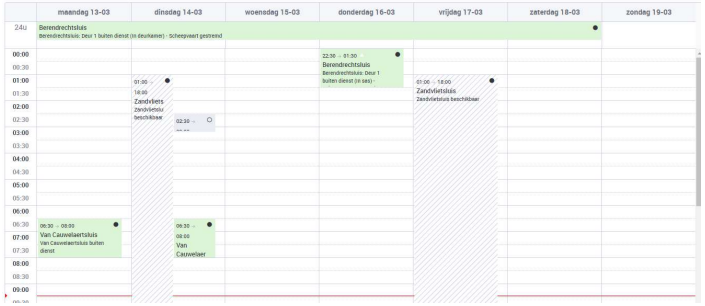


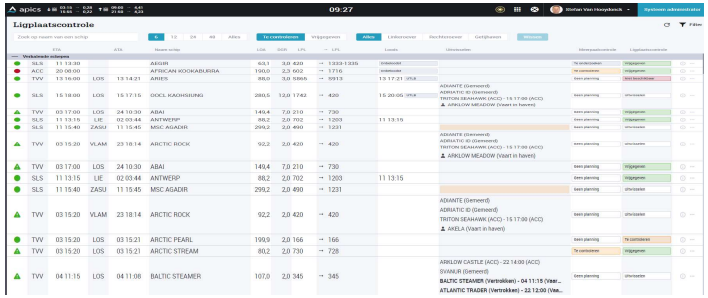












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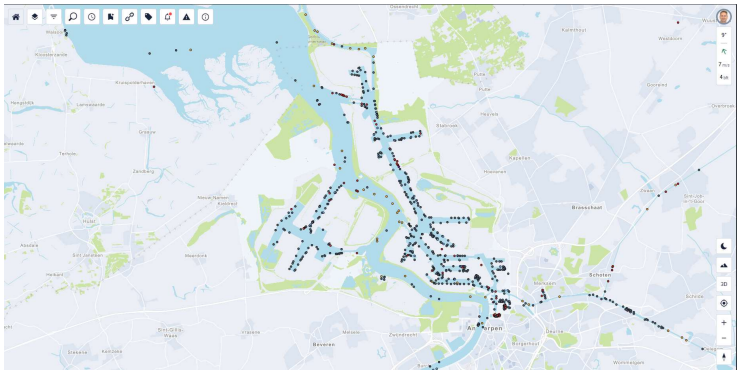
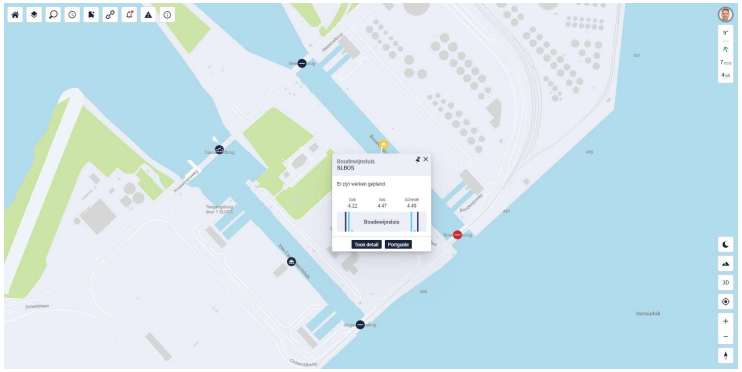
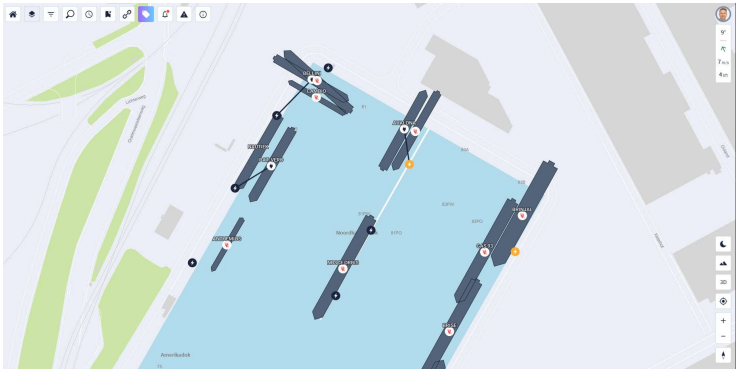
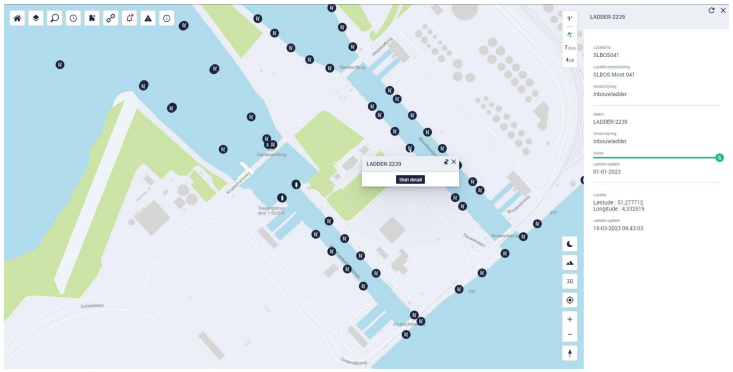
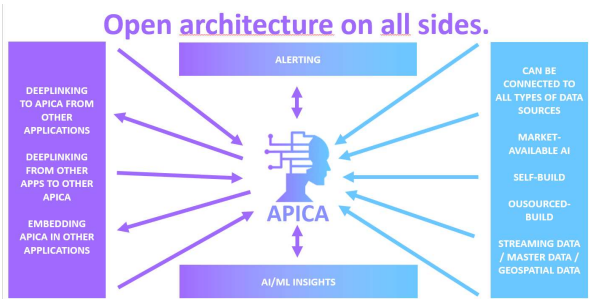
And Many More...



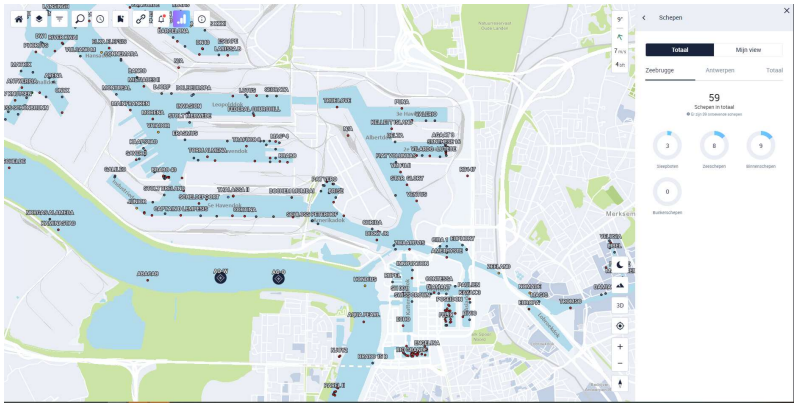


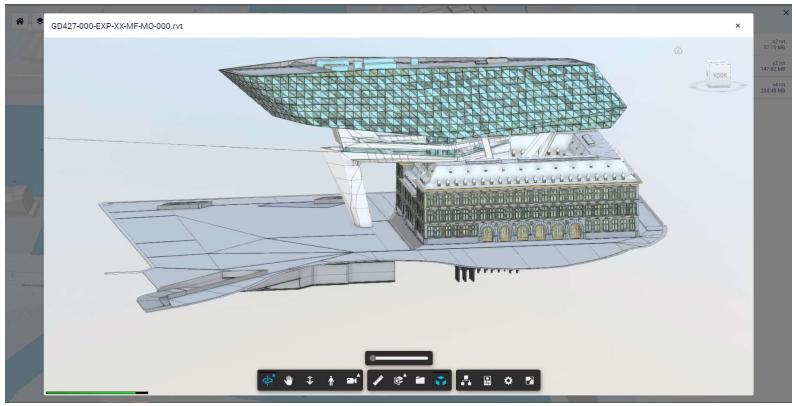


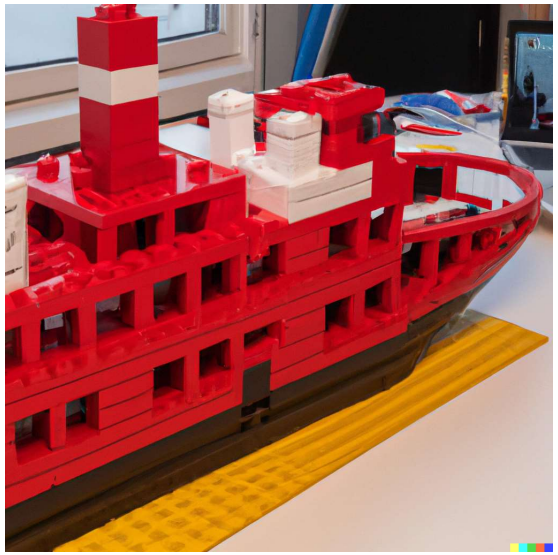


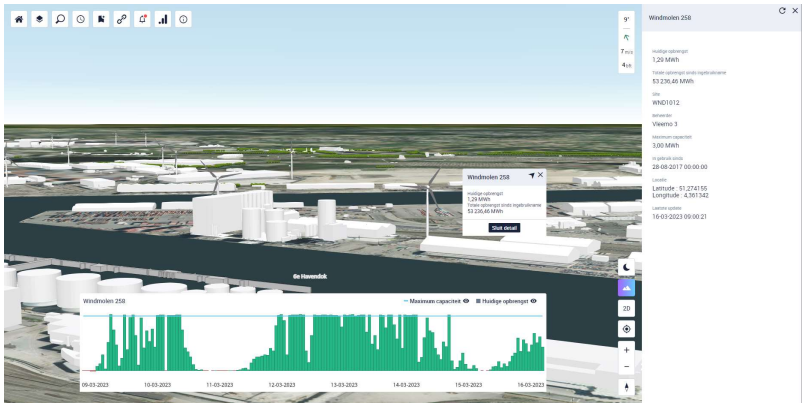


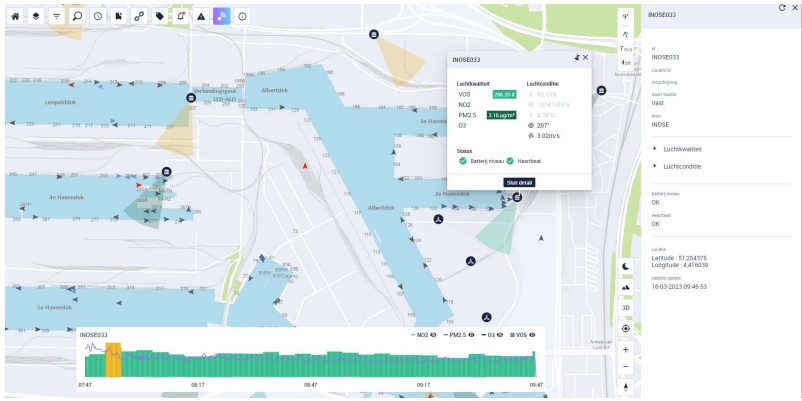
Building the skeleton…











“Evolution by inspiration and iteration”

Situational awareness through the Digital Twin “APICA”

Port of Antwerp Bruges

NAVES

ANNETTE E

NAVES

MMSI nummer
255806303

Snelheid
0 m/s

Heading
308.996124°

Berekende heading
308°

Koers over de grond
0,1°

Bestemming
227

Haven van herkomst
Porvoo (Borga)

Haven eindbestemming
Naantali (Nadendal)

Geschatte tijd

Berekende tijd

Type schip
Zeeschip

Code
CHTAN

Lengte
126,2m

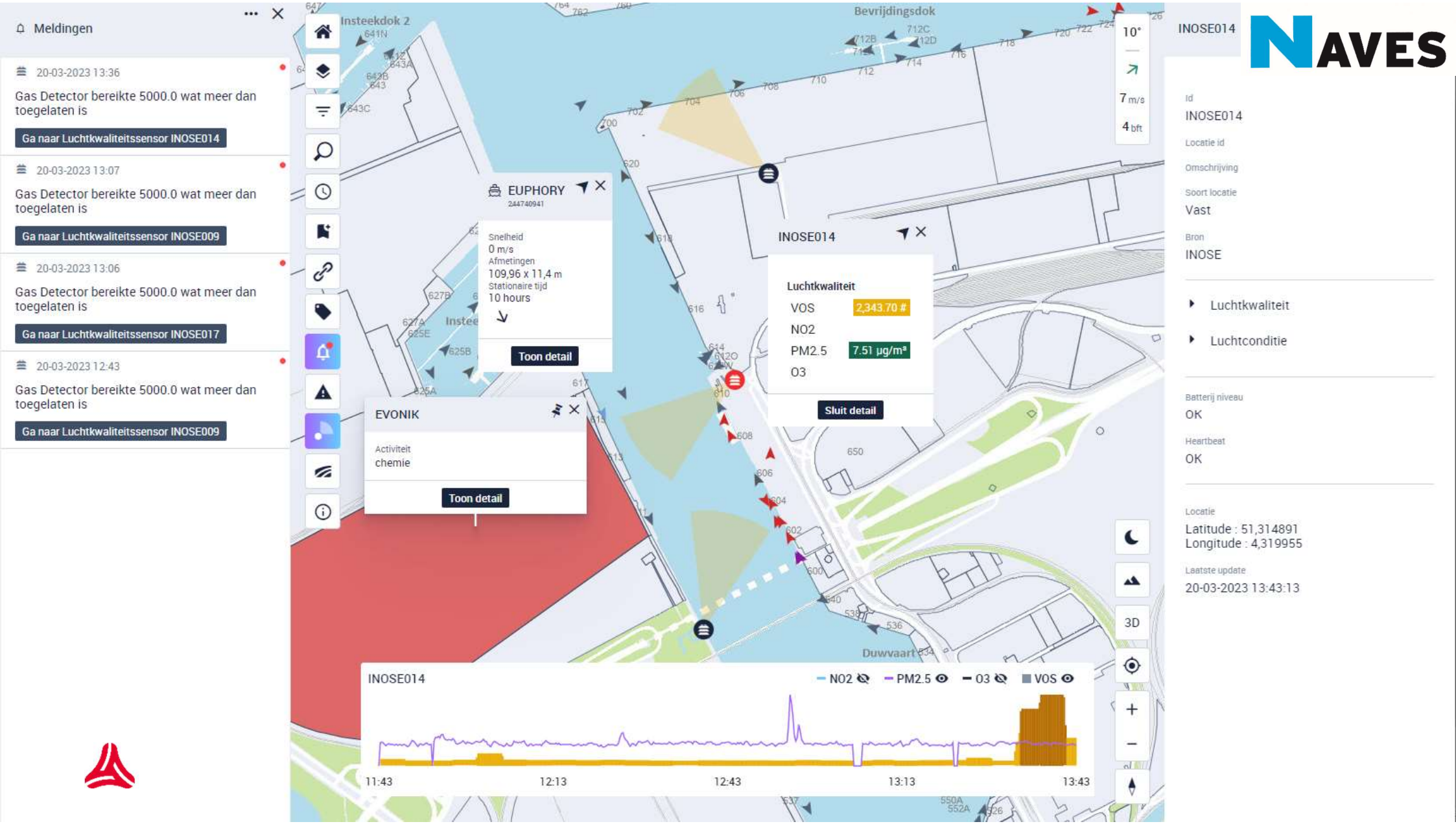
Breedte
19,02m

Diepgang
6,5m

Stationair sinds
20-03-2023 03:41:08

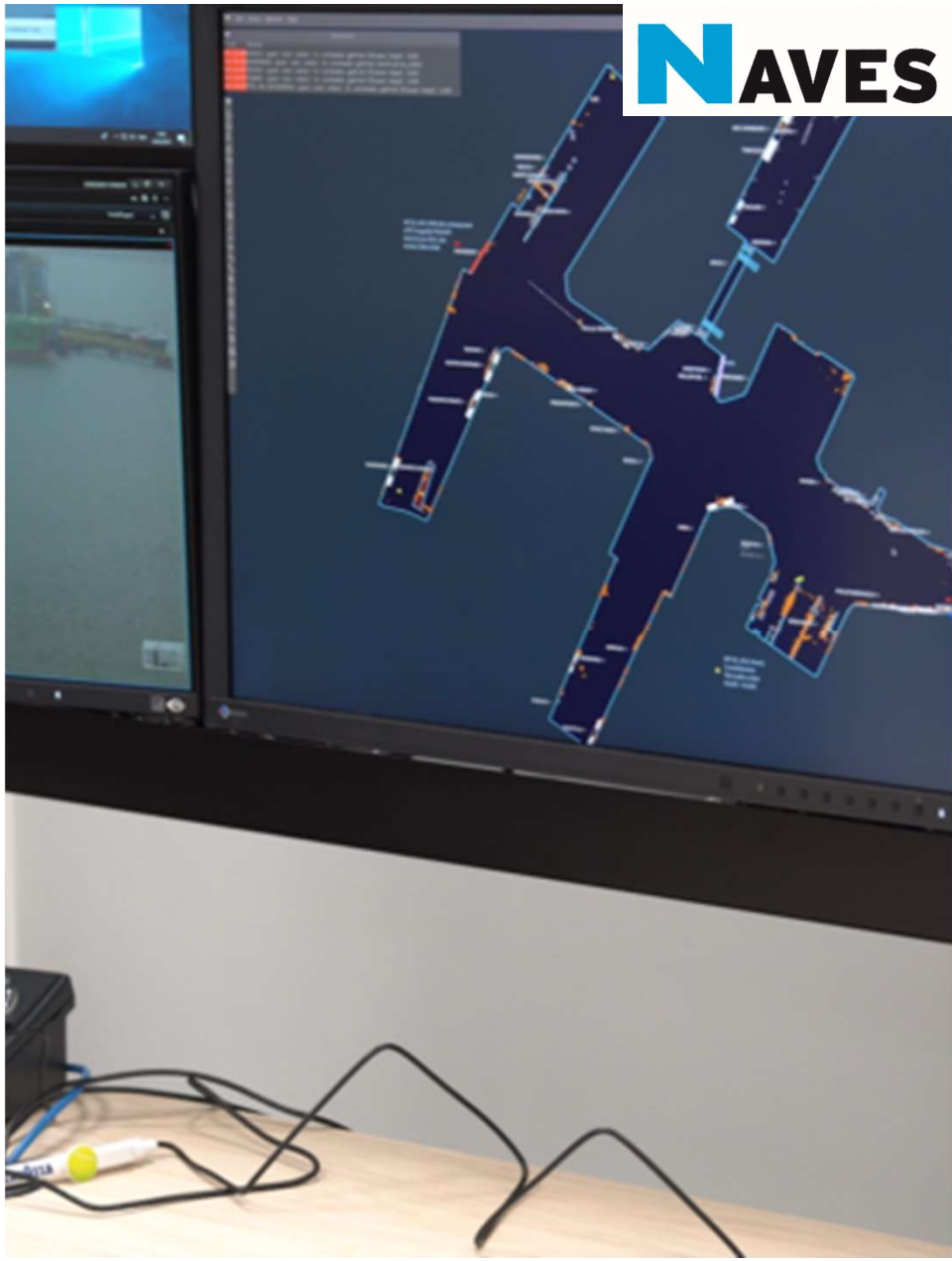
Sensors: an example

iNoses – IoT devices to inspect air condition and air quality. Detection of pollution and air quality issues


Meldingen
20-03-2023 13:36
Gas Detector bereikte 5000.0 wat meer dan toegelaten is
Ga naar Luchtkwaliteitssensor INOSE014
20-03-2023 13:07
Gas Detector bereikte 5000.0 wat meer dan toegelaten is
Ga naar Luchtkwaliteitssensor INOSE009
20-03-2023 13:06
Gas Detector bereikte 5000.0 wat meer dan toegelaten is
Ga naar Luchtkwaliteitssensor INOSE017
20-03-2023 12:43
Gas Detector bereikte 5000.0 wat meer dan toegelaten is
Ga naar Luchtkwaliteitssensor INOSE009
Insteekdok 2
Bevrijdingsdok
EUPHORY
244740941
Snelheid
0 m/s
Afmetingen
109,96 x 11,4 m
Stationaire tijd
10 hours
Toon detail
INOSE014
Luchtkwaliteit
VOS
2,343.70 #
NO2
PM2.5
7.51 µg/m³
O3
Sluit detail
EVONIK
Activiteit
chemie
Toon detail
10°
7 m/s
4 bft
3D
INOSE014
NO2
PM2.5
O3
VOS
11:43
12:13
12:43
13:13
13:43
Duwvaart
INOSE014
Id
INOSE014
Locatie id
Omschrijving
Soort locatie
Vast
Bron
INOSE
Luchtkwaliteit
Luchtconditie
Batterij niveau
OK
Heartbeat
OK
Locatie
Latitude : 51,314891
Longitude : 4,319955
Laatste update
20-03-2023 13:43:13

Benefits for Port Operation Management

- Bringing real time insight into the port situation (nautical, infrastructure, environmental, meteo…)
- Gainging new insights based on (geographical) data connection across different layers
- Possibility to look back in time when investigating
- Augmented awareness by alerting and forecasting



Traffic Management

- **Ongoing use case**

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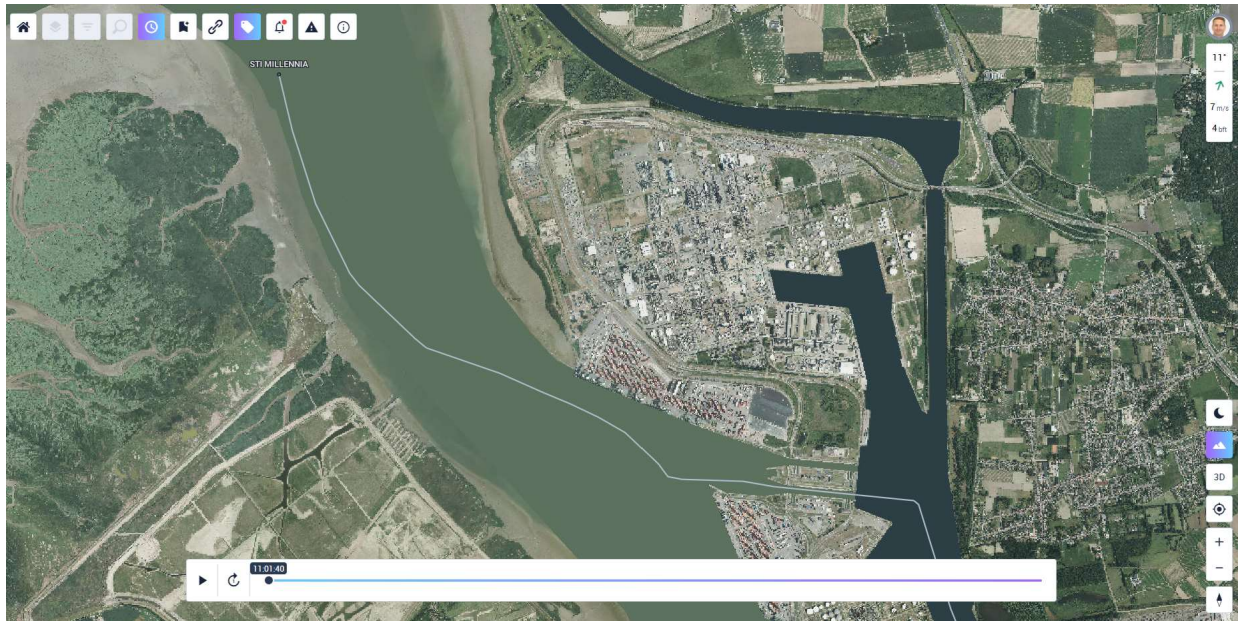
PIONEERS

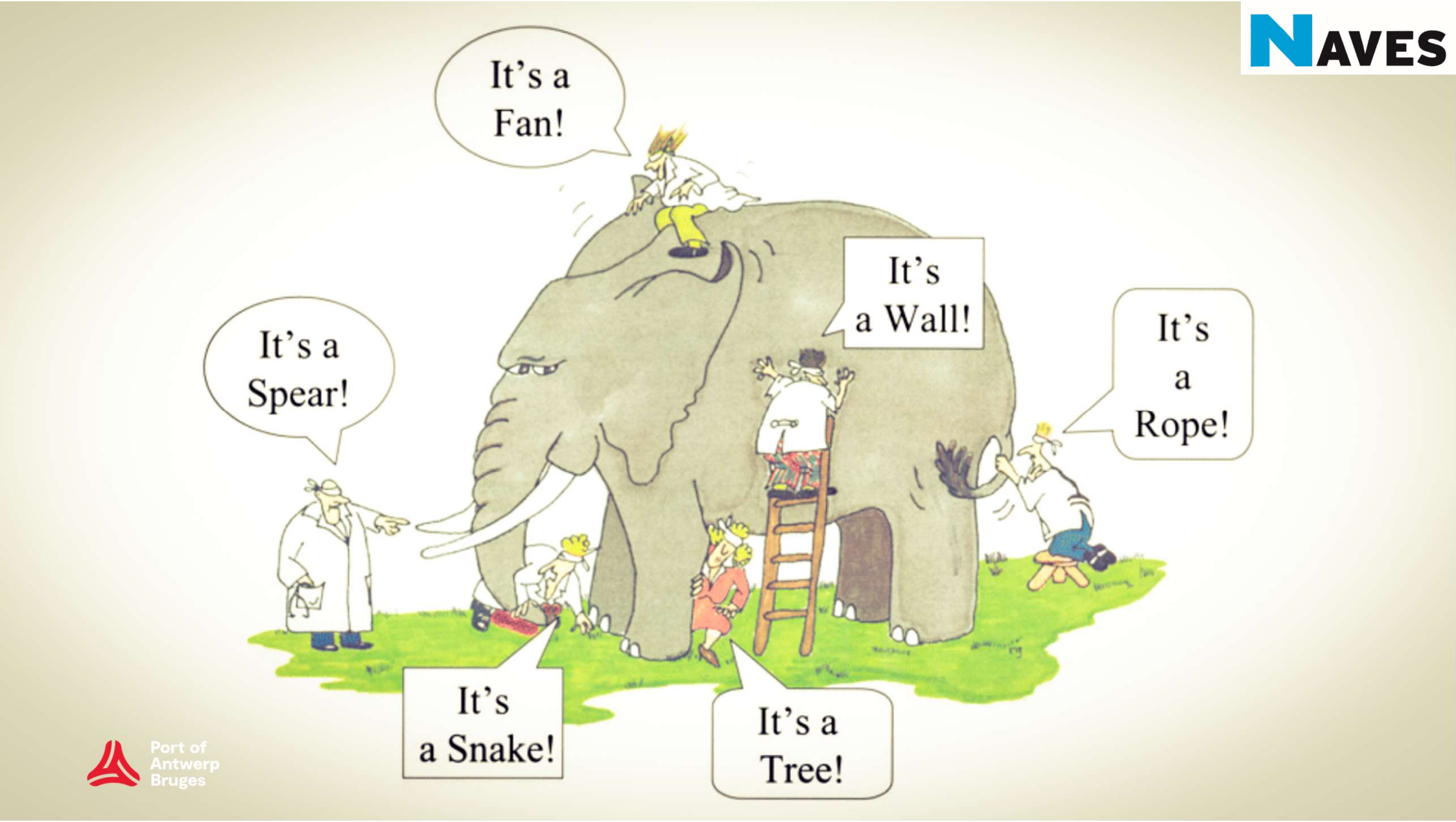
(https://pioneers-ports.eu/)

- Forecast of traffic simulation to 30min
- Based on historic traffic flow, lock planning, tidal windows, current and predicted traffic situation, vessel destinations,..
- Goal: to provide additional insights into predicted situation, possible dangerous situation
- Additionally, provide insights into the emission effect of the simulated situation



MACOMI

Co-funded by the Horizon 2020 programme of the European Union



Open architecture on all sides.

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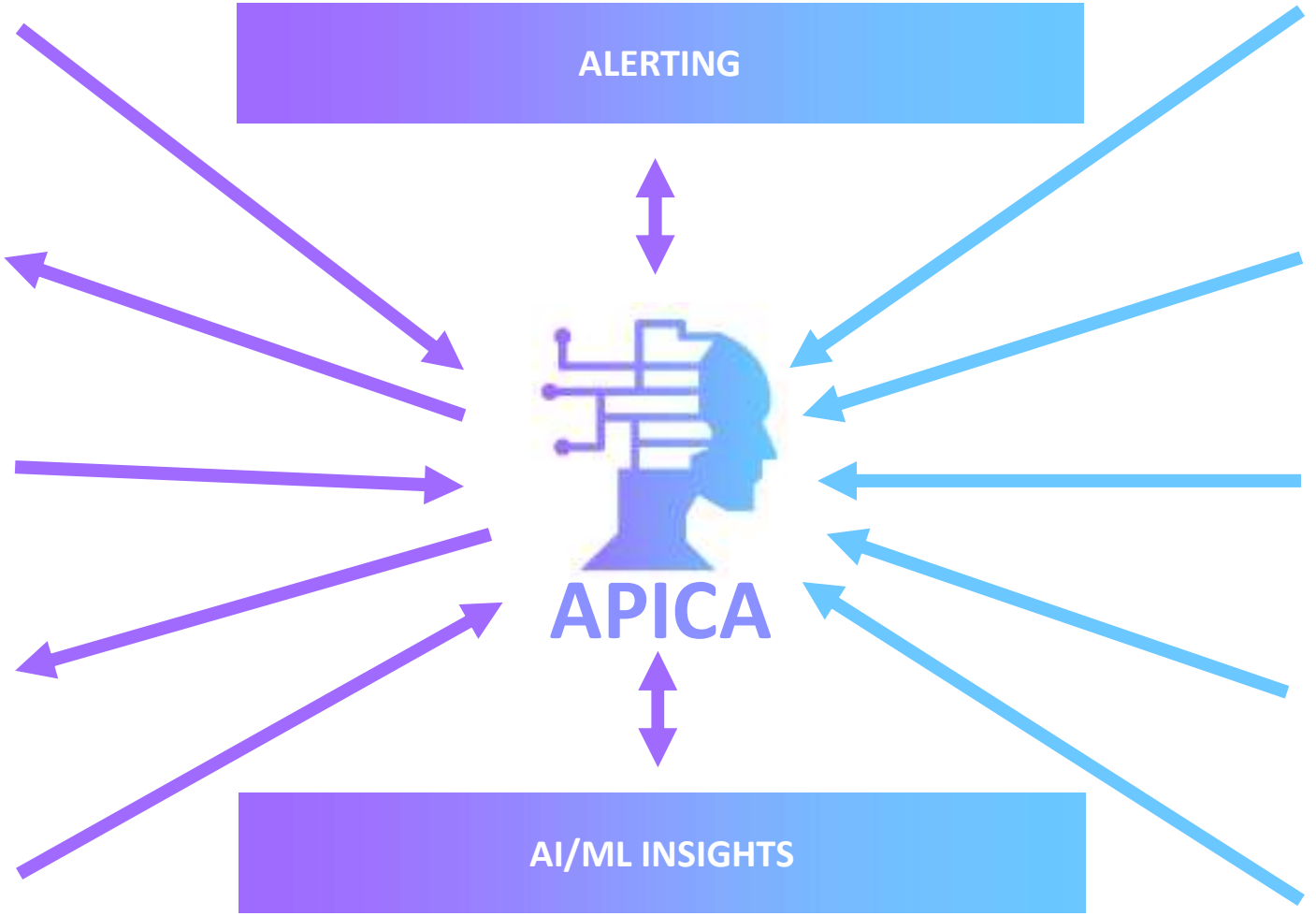
DEEPLINKING TO APICA FROM OTHER APPLICATIONS

DEEPLINKING FROM OTHER APPS TO OTHER APICA

EMBEDDING APICA IN OTHER APPLICATIONS



CAN BE CONNECTED TO ALL TYPES OF DATA SOURCES

MARKET-AVAILABLE AI

SELF-BUILD

OUSOURCED-BUILD

STREAMING DATA / MASTER DATA / GEOSPATIAL DATA

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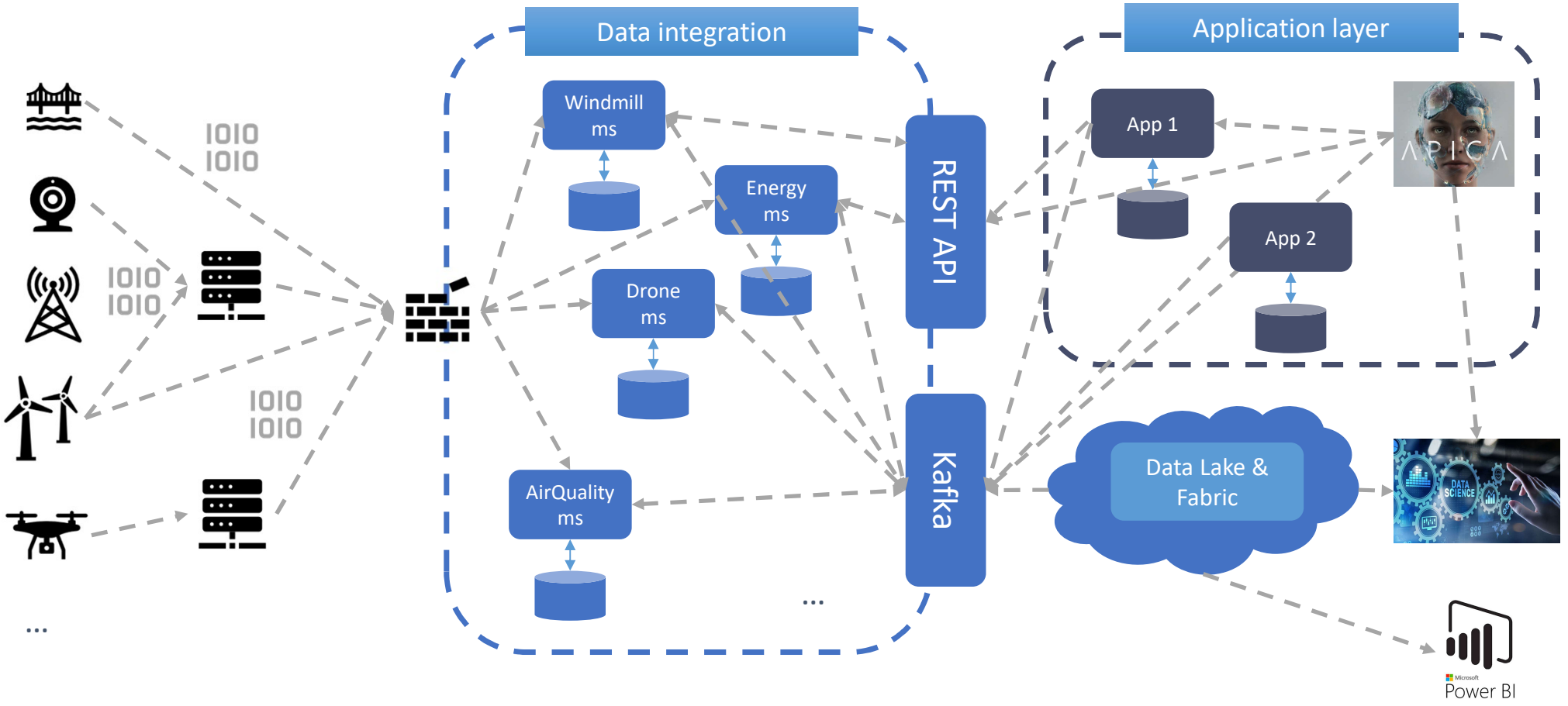
Data Management & Architecture is key



A (Port) Digital Twin

- ✓ Creating a new additional application is NOT the goal, creating a digital twin is a vision
- ✓ Define clear vision, scope, target group(s), goal when starting, BUT… don't be reluctant to change or evolve!
- ✓ Building step by step provides focus and tangibility. By evolution, it inspires and brings new insights
- ✓ Open architecture lowers the integration effort for new use cases
- ✓ Strong data management & integration platform is key