• A complex multi-module software platform which operates on the basis of innovative paradigms such as the Internet of Things and Big Data.

• A system to support decision-making, leading to the creation of sophisticated models for predicting the impact of human activities on environmental and business scenarios.

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The system consists of a distributed and heterogeneous environmental sensors network

### Air Sensors
- PM10, e PM2.5
- SO2
- NO
- NO2
- CO
- O3

### Water Sensors
- Temperature
- Conductivity
- pH
- Pot. Redox
- Dissolved Oxygen
- Turbidity

### Meteo Sensors
- Temperature
- Humidity
- Atm. Pressure
- Wind direction
- Wind strength
- Rain quantity

### Traffic Sensors
- Num. incoming vehicles
- Num. outgoing vehicles
- Type of incoming vehicle
- Type of outgoing vehicle
Sensors positioning in Port of Bari

TYPE OF SENSORS

n.3+4 AIR
n.2 WATER
n.3 METEO
n.1 TRAFFIC
Metadata are information related to the port’s business processes that allow to contextualize «raw» data measured by sensors.

**Port Information System**
- Vessel identification
- Time of Arrival / Departure
- Berth
- Vessel details (type of motor, age, fuel consumption)
- Coordination vessel vs ports operation (AIS)
- Vessel announcement roster vessel departure/Arrivals next day
- N. uploaded/downloaded vehicles (ferries)
- Type of vehicles handled by ferries (car, bus, truck, motorbike, ...)
- Fuel consumptions
- Daily hours of usage
- Type of motor

**Historical data series**
- Dust/gas (from env. Agency)
- Meteo (from env. Agency)
- Crane movements
- Historical metadata form port management system

**External data series**
- Meteo forecasts
- Road Viability status
- Road Viability forecasts
The Platform consists of two main elements:

**Hardware**

- Servers with high parallel computing power
  - High storage capacity and data volumes handling capability
  - Billions of operations per second
  - Ultra high speed fibre optic cable connections to transmit data over long distances

**Software**

- Data elaboration Software platform
  - Able to solve the “classic” equations describing dispersion/transport/diffusion of pollutants
  - Implements Artificial Intelligence, machine learning, deep learning algorithms

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Software platform based on **machine learning techniques** able to:

- **Monitor** in real time «Water» and «Air» environmental matrixes
- **Predict** scenarios of potential **environmentally critical** situations
- **Support** the business decision process with "what-if" simulation scenarios
| 1 | **"3D PORT MODEL"** \(\Rightarrow\) DIGITAL TWIN  
  - CCTV and Virtual Views to monitor sensors and port activities  
  - Gate access control, historical data on vessel |
| 2 | AIR POLLUTANTS IMPACT PREDICTION |
| 3 | TURBIDITY PREDICTION INSIDE PORT BASIN |
| 4 | DSS AND "WHAT-IF" SCENARIOS SIMULATIONS  
  - e.g. variation to vessel calls planning to reduce PM10 particle levels |
| 5 | SAND MOVEMENT AND DRAFT VARIATIONS PREDICTION |
• Real time monitoring of environmental issues

• Historical data management and retrieval

• Decision making support in human operations affecting business scenarios

• Dangerous conditions prevention via alerts and forecasts
Digital Twin

- 3D reconstruction of the scenario related to the port area
- Visualization through different points of view in order to emulate CCTV cameras on-site, bird's eye view, etc..
- "Ship catalog" integration from external information sources (updated technical data)
• Naval traffic monitoring near real-time and «Historical ships» of the days stored in the system

• Access control with biometric recognition

• Monitoring of environmental parameters through data feeds from installed sensors
• Decision support system (DSS) based on the daily schedule of the port

• User-friendly schedule change interface, which uses the drag'n'drop of the ships on the docks and on the timeline of the day

• Creation of "What-If" scenarios (user defined) calculated in batch datacenter, on the basis of the port conditions for the following 24 hours and of the new schedule modified by the user
• Forecasting simulations of pollutants detected by environmental sensors installed on-site

• Creation of "What-If" scenarios, based on the port conditions for the next 24 hours and the new schedule modified by the user

• Hourly display of the polluting maps provided for in the forecast scenario and in the context of the one created by the user (what-if)
• Forecasting simulations of turbidity within the port

• Visualization of the progress and decay of the plum based on the movement of the scheduled ships

• Display of predicted turbidity according to what-if scenarios built by the operator
• Forecasting the levels of CF produced by port activities

• Visualization of the different sources of Equivalent CO2 production

• Total daily indication of the Carbon Footprint produced by human activities
Sand Movement

- Representation and monitoring of the seabed in the air adjacent to the port
- Simulation of sediment movement and bathymetric level at the port entrance
- Forecast of the cover-up levels for the next 48-72 hours
- Management and sending of alerts related to critical events

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MONITORING AND CONTROL OF ASSETS

- Representation and monitoring of assets in critical buildings
- Desktop and VR 3D navigation, through smartphone APP with stereoscopic vision supported by wearable helmet
- Planning and monitoring of scheduled maintenance
- Various types of manageable assets
- System and operator alerts due to unexpected critical events

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This is no small project.

That’s why we’re doing it.

WE’RE READY FOR YOUR PROJECT

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