



30th
International
Cartographic
Conference

Florence, Italy

23
Giugno



Regione Toscana



UNIVERSITÀ
DEGLI STUDI
FIRENZE



Verso la Conferenza Internazionale di Cartografia Firenze ICC2021

3° Workshop

Geo Open Data: opportunità e nuove sfide per i professionisti, le aziende e la Pubblica Amministrazione

Università degli studi di Firenze, DINFO, DISIT Lab, Snap4City

Paolo Nesi

Paolo.nesi@unifi.it

<https://www.snap4city.org>, <https://www.disit.org>



Sommario

- Chi Siamo: **DISIT Lab, Snap4City**
- Cosa facciamo ←
- Le sfide
- Le innovazioni

DISIT Lab ha bandito

- 2 Assegni di ricerca per 2 anni → PhD
- 1 Borsa del dottorato nazionale in AI per 3 anni

<https://www.snap4city.org/581>

Cosa Facciamo

Smart City: Urban Platform

- Which should not be confused with Open Data Platform

Industry 4.0

Tools for rapid implementation of

- Sustainable Smart Solutions
 - Decision Support Systems
- as a no-coding, low-coding



any data, format
any channel, protocol
any AI/ML
any place
online development
multi-tenant
Secure, PENTest
GDPR, privacy
→ **low costs**
→ **easy to evolve**

Powered by
FIWARE

SNAP4
Appliances and Dockers
Installations

**FREE
TRIAL**

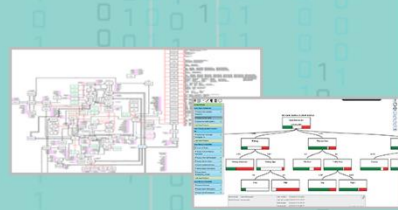
 **PEN Test
Passed**

 **EU GDPR
COMPLIANT**

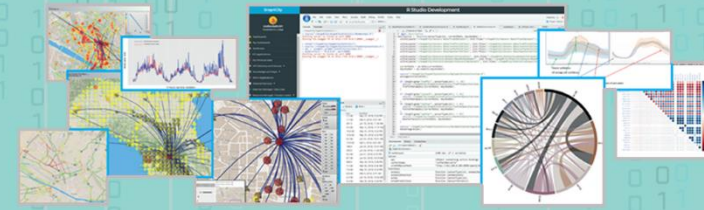
 **100%
OPEN
SOURCE**



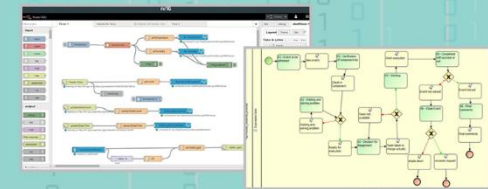
DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS



**EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE**



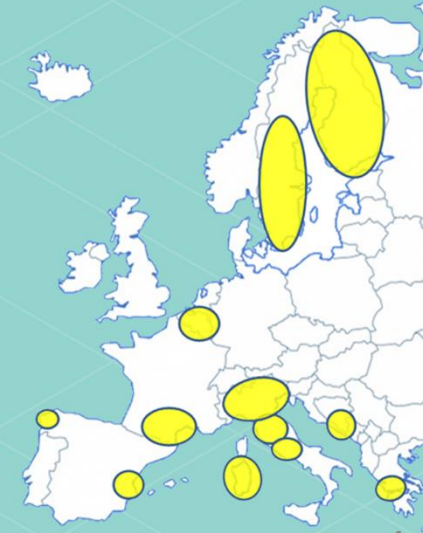
**BIG DATA ANALYTICS
ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING**



**DATA FLOWS, WORKFLOWS
MICROSERVICES
MANAGEMENT**

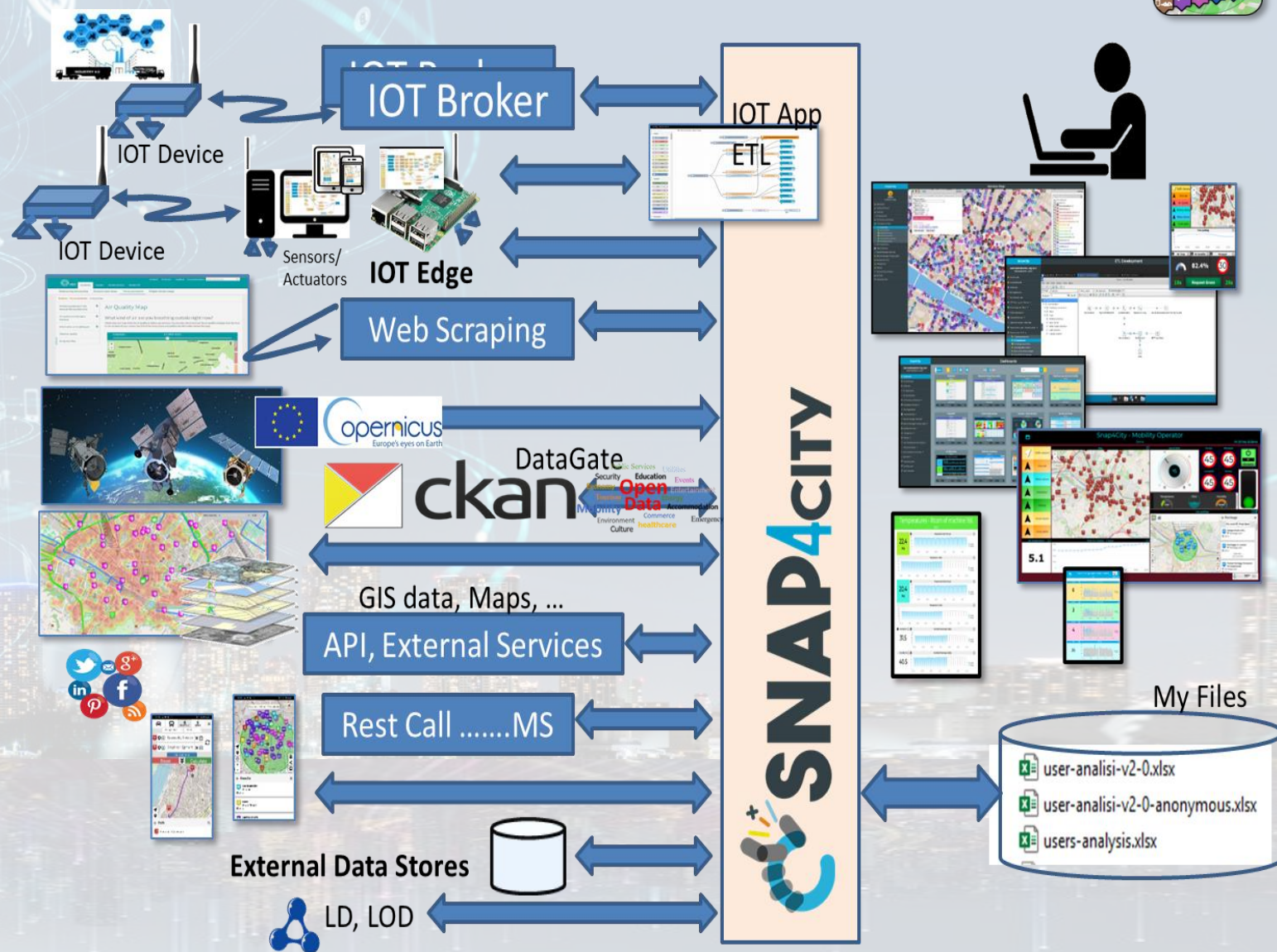


**METHODOLOGIES
COURSES AND COMMUNITY
LIVING LABS
DEVELOPMENT TOOLS**



Ingestion, agg. → exploitation

- **Snap4City** efficient tools for
 - Bidirectional data channels
 - Any format, any channel, any data, any broker, any protocol, ...
- **Km4City** Knowledge base Ontology reasoning on geo, space, time, relationships

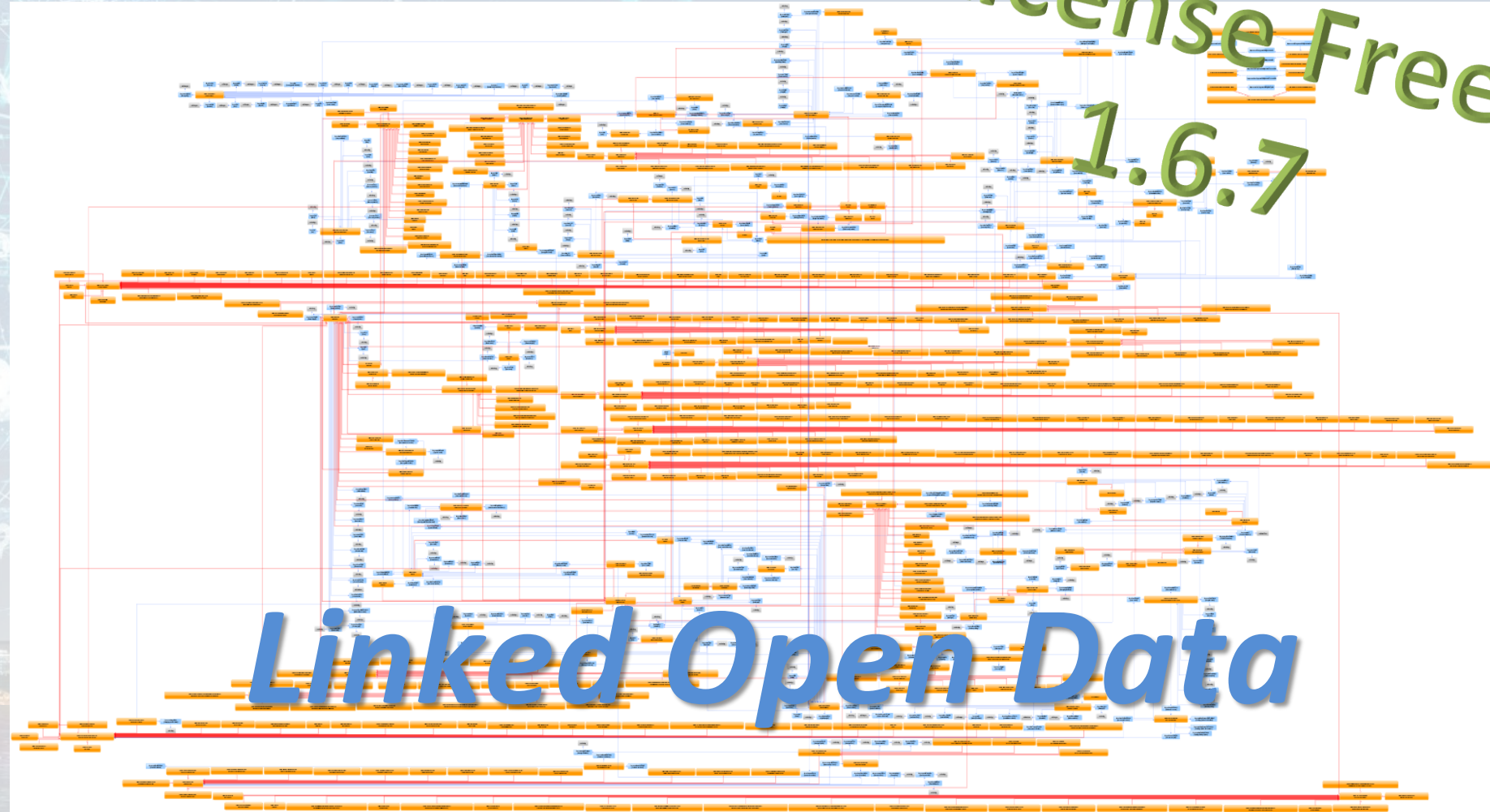


Expert System semantic queries




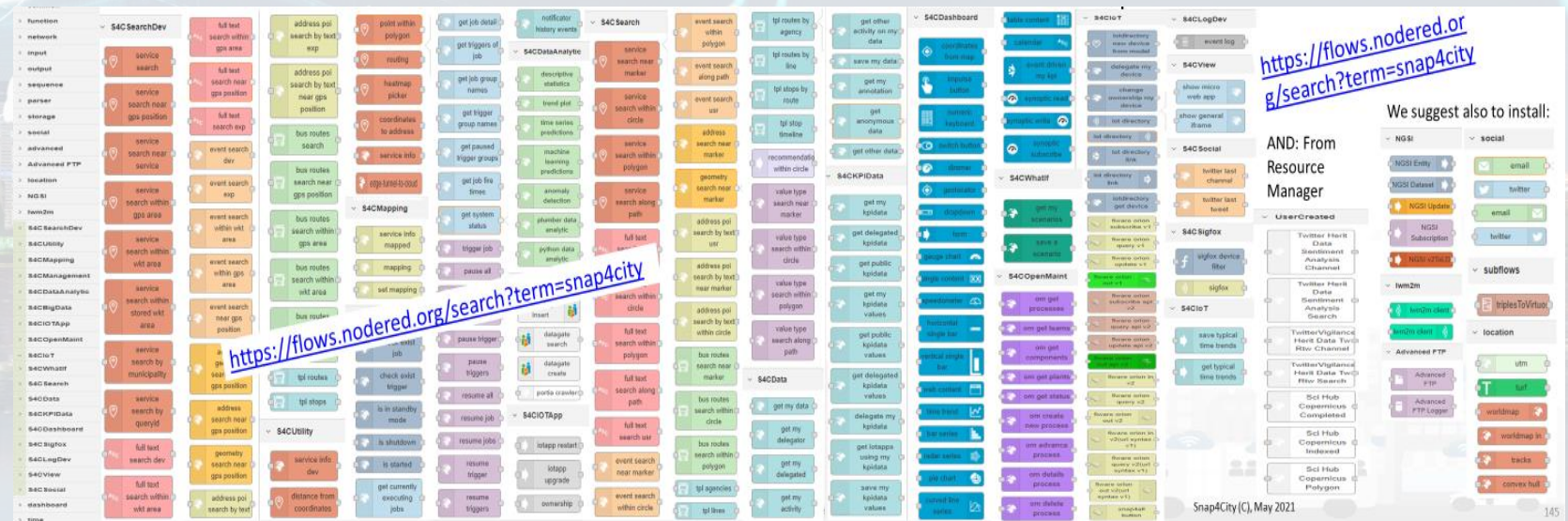
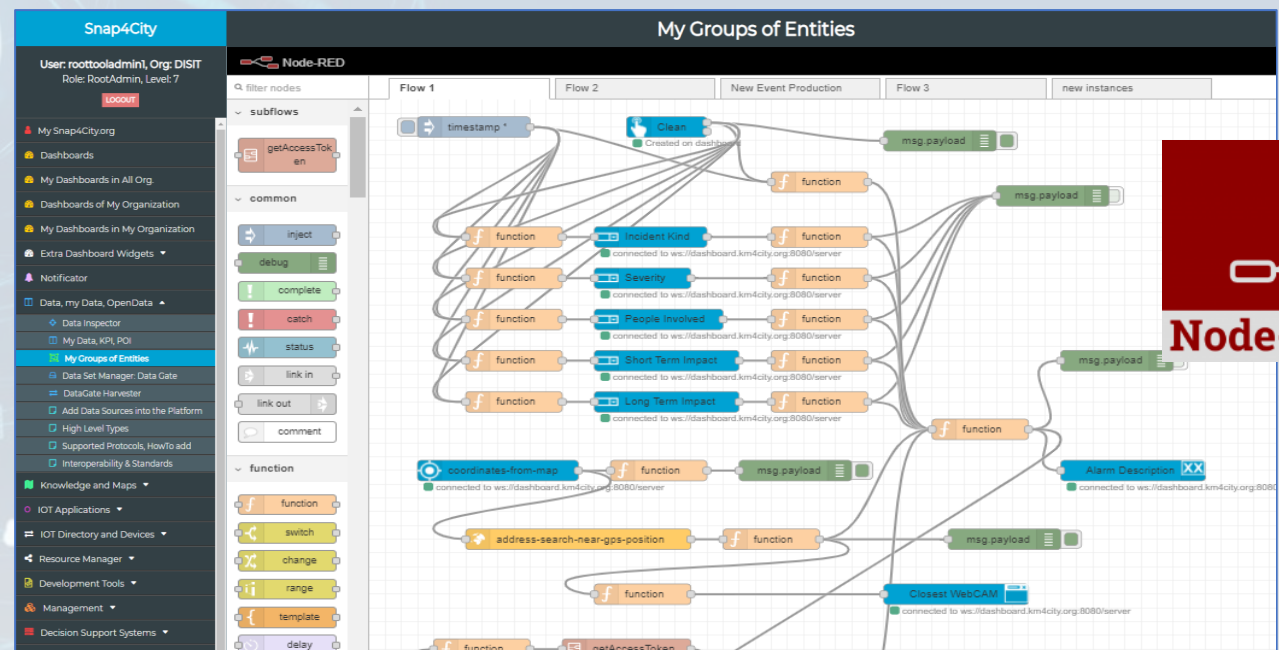
- **via:**
- **Smart City API**
for
Apps and third
party
- **MicroServices**
data driven
develop via
visual language
Node-RED

License Free
1.6.7



<https://www.snap4city.org/19>

- 
- Node-RED**





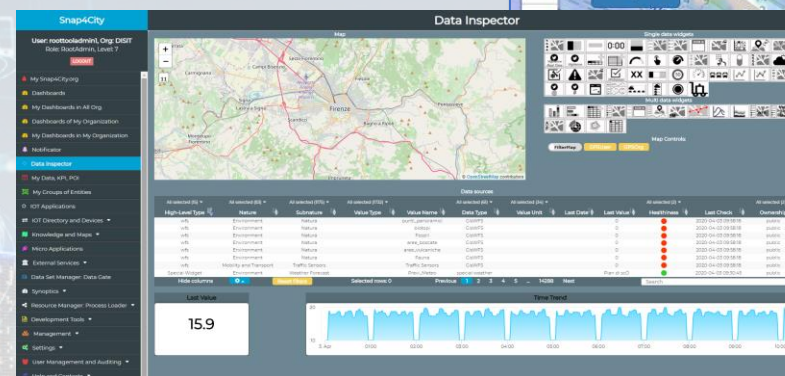
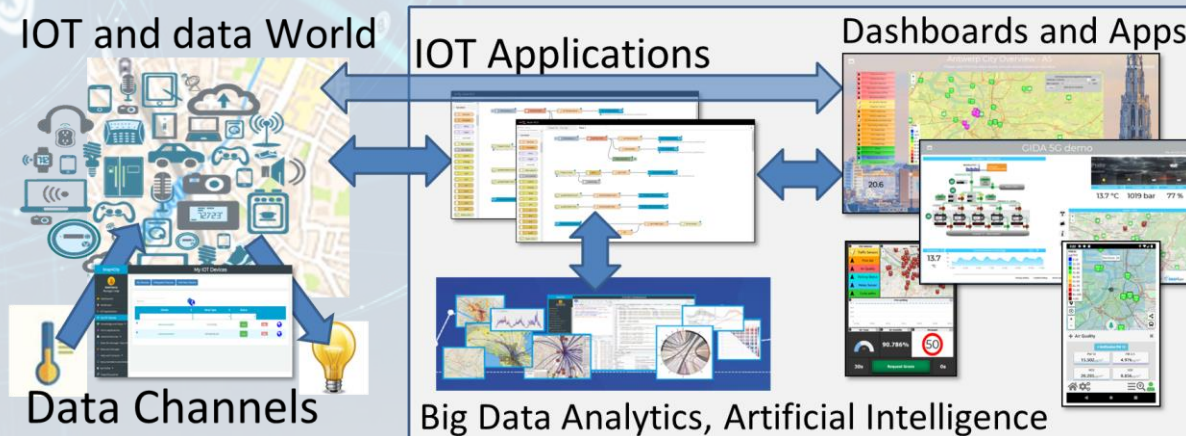
Solutions: reliable, secure and fast to realize

• Via Snap4City tools

- Dashboard Wizard
- Dashboard Builder
- Data/Visual Analytic

• Smart Solutions results to be

- Real time data drive
- Secure end-to-end
- GDPR compliant
- Reliable, interoperable
- Auditable, marketable



Big Data Analytics + Artificial Intelligence

- **Short and Long terms predictive models:**
 - traffic, parking, people flow, maintenance,
- **Traffic Flow reconstruction**
- **3D Flow prediction: Pollutant (NOX, NO2, ...)**
- **Constrained Routing**
- **What-IF analysis (simulation + AI + data)**
- ...
- **Based on several computational models:**
 - trajectories, OD matrices, Typical Time Trends, etc.

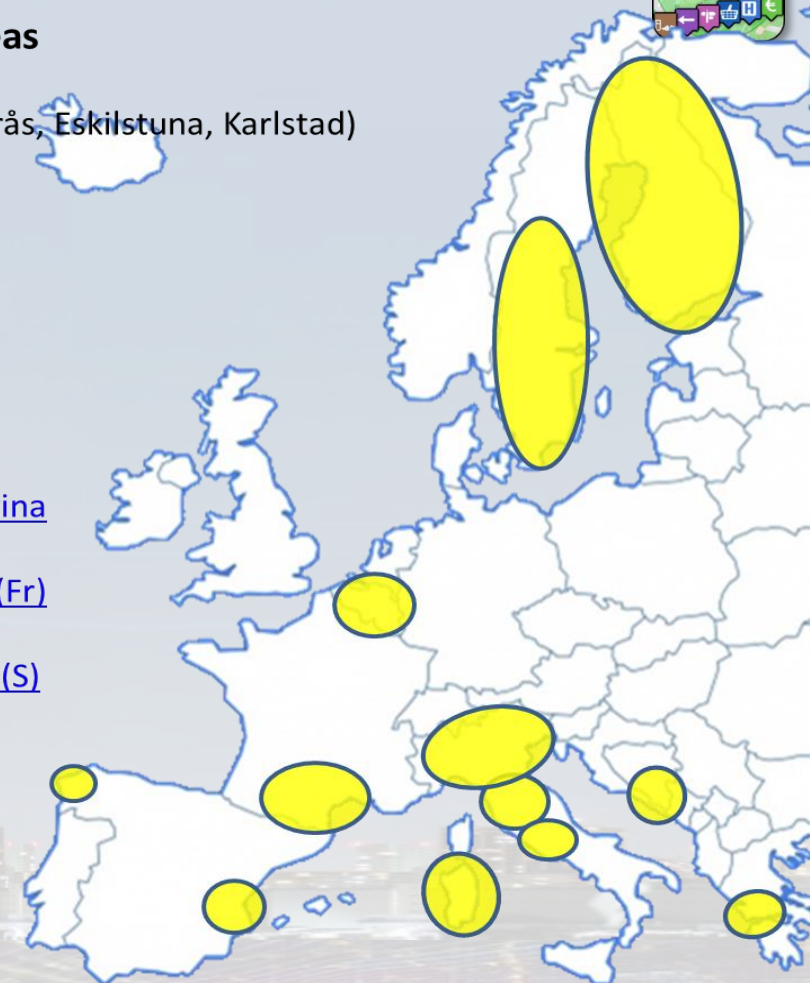


2021: Snap4City Numbers

- > 100 Protocols
- *Mobility, energy, people flow, environment, Industry 4.0, tracking, smartbed, smart ambulance, Tourism, smart light, culture, etc...*
 - 5 running installations
 - 13 projects, 12 pilots on 9 Countries
- **On the largest deploy**
 - 17 Organizations / tenant
 - > 4800 users on <https://www.Snap4City.org>
 - > 1200 Dashboards
 - > 15 mobile Apps
 - > 2 Million of structured data per day
 - > 500 IoT Applications/node-RED / Docker
 - > 680 web pages with training
 - > 40 videos, training videos

Main Organizations/areas

- [Antwerp area \(Be\)](#)
- Capelon (Sweden: Västerås, Eskilstuna, Karlstad)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Helsinki area \(Fin\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Pisa area \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Roma \(I\)](#)
- [Santiago de Compostela \(S\)](#)
- [Sardegna Region \(I\)](#)
- SmartBed (multiple)
- [Toscana Region \(I\), SM](#)
- [Valencia \(S\)](#)
- [Venezia area \(I\)](#)
- [WestGreece area \(Gr\)](#)



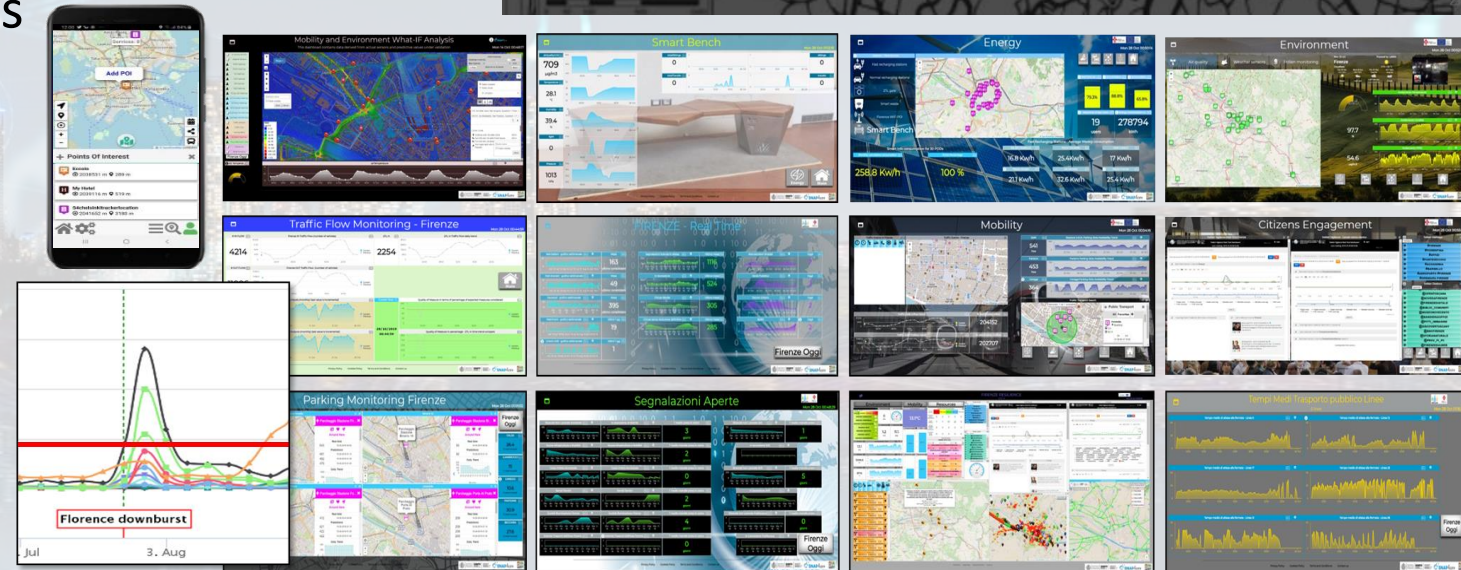
Last minute:

- Installation in Israel
- Training in Japan in July
- Coverage of all Greece is coming



- The screenshot displays a comprehensive SmartCity dashboard for Firenze. The top section includes a date and time indicator (Fri 25 Oct 23:29:38) and a language selector (English). The main dashboard is divided into several sections:

 - Summary Metrics:**
 - 43666 Totale utenti WiFi
 - 176 COLONNINE RICARICA (100%)
 - 71 % ATTIVE
 - 5.1 % IN USO
 - RISCHIO METEO:**
 - MINIMO: BASSO, MEDIO: ALTO
 - RISCHIO IDRAULICO
 - RISCHIO TEMPORALI
 - RISCHIO IDROGEOLOGICO
 - RISCHIO NEVE
 - RISCHIO GHIACCIO
 - RISCHIO VENTO
 - SITUAZIONE VIABILITÀ:**
 - 0 INCIDENTI
 - 0 CHIUSURE AL TRAFFICO (TOT)
 - 0 CHIUSURE PER CANTIERI
 - 0 PROGR. / 0 NON PROG.
 - 0 LIMITAZIONI AL TRAFFICO (TOT)
 - 0 LIMITAZIONI PER CANTIERI
 - 0 NON PROG. / 0 PROGR.
 - 0 TOT. EVENTI SULLA RETE
 - TRAFFICO:**
 - SAV: 287 (occupati su 607 posti)
 - LEOPOLDA: 36 (occupati su 300 posti)
 - PARTIERRE: 34 (occupati su 656 posti)
 - BINAROW: 552 (occupati su 965 posti)
 - CALZA: 703 (occupati su 144)
 - CARLOCCI: 24.9 (occupati su 406 posti)
 - FORTEZZA: 278 (occupati su 521 posti)
 - SAMBROGIO: 99.7 (occupati su 378 posti)
 - BECCARIA: 98.1 (occupati su 210 posti)
 - Attesa media alla fermata:**
 - Linea 9: 3 min
 - Linea 13: 13 min
 - Linea 17: 4 min
 - Linea 20: 5 min
 - Linea 36: 19 min
 - Linea 38: 2 min
 - Other Metrics:**
 - FLUSSO INGRESSO CITTA: 284094 VEICOLI
 - FLUSSO INGRESSO ZTL: 57499 VEICOLI
 - Segnalatori rilevati in attesa: 1116
 - In Lavorazione: 524
 - Risolve: 305
 - Chiusa senza riduzione: 285
 - Manutenzione Scabelli: 54 oggi
 - Verde Pubbli: 4
 - Decoro Urbano: 6
 - Twisti: 3

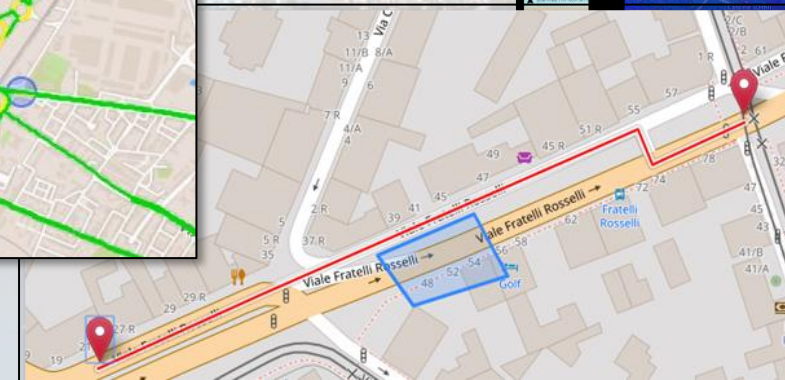
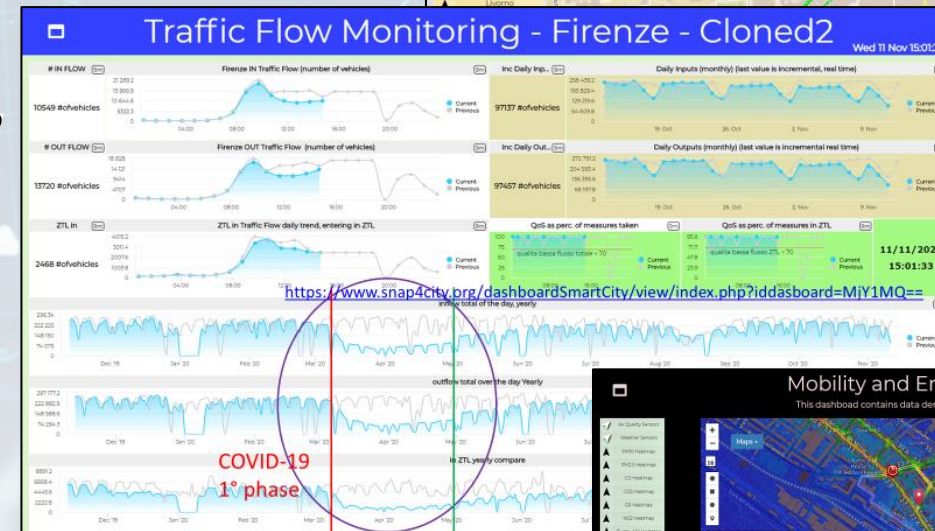


Mobility and Transport Traffic Flow Analysis

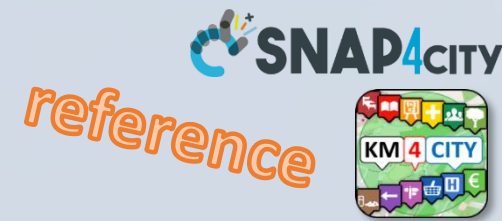
Cities: Firenze, Pisa,
Livorno, Modena,
Santiago di Compostela



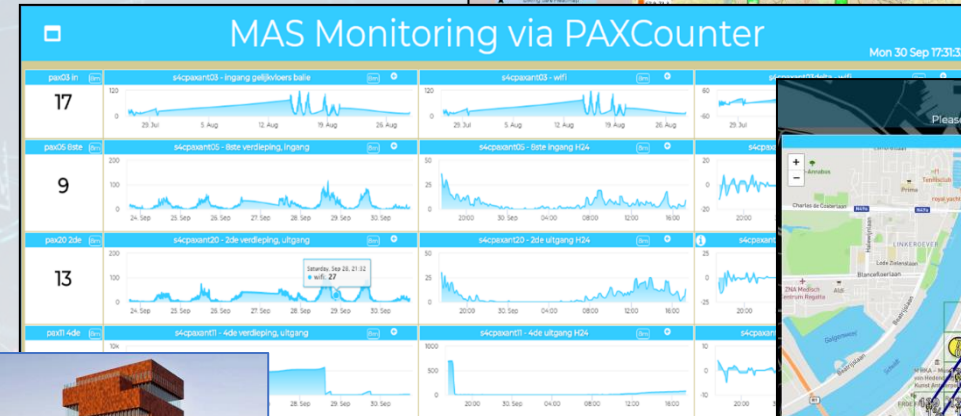
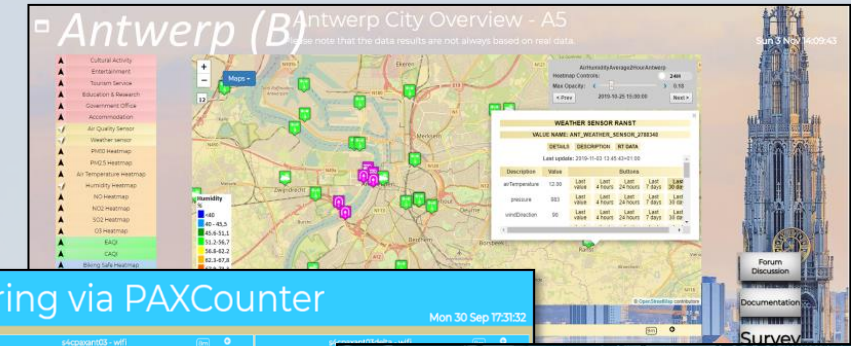
- **Multiple Domain Data**
 - Traffic Flow sensors, city structure, weather
- **Decision Makers Multiple Locations**
 - Real time Monitoring, predictions
 - Traffic Flow Predictions,
 - Traffic Reconstructions, routing
 - Dashboards, What-IF analysis
 - Mobile App, people flows
- **Historical and Real Time data**
- **Services Exploited on:**
 - Dashboards, Mobile App
- **Since 2017, 2019**



People Monitoring on Pub Services DIGIPOLIS Antwerp



- **Multiple Domain Data**
 - PAX Counters: museum, pub services, COVID-19
- **Multiple Levels & Decision Makers**
 - Business Intelligence Dashboards
 - People flow, OD flows
 - Detection of critical conditions
- **Historical and Real Time data**
 - 20 fixed PaxCounters
 - 2 Mobile PaxCounters
- **Services Exploited on:**
 - Dashboards, Mobile Apps, API/data
 - Fully Controlled Devices by Digipolis
- **Since 2019**



Impact of COVID-19

• Multiple Domains Data

- Traffic, environment, People, parking, stock options, Twitter, tc.

• Decision Makers Multiple Locations

- NO2 long term predictions
- Twitter analysis

• Historical and Real Time data

• Services Exploited on:

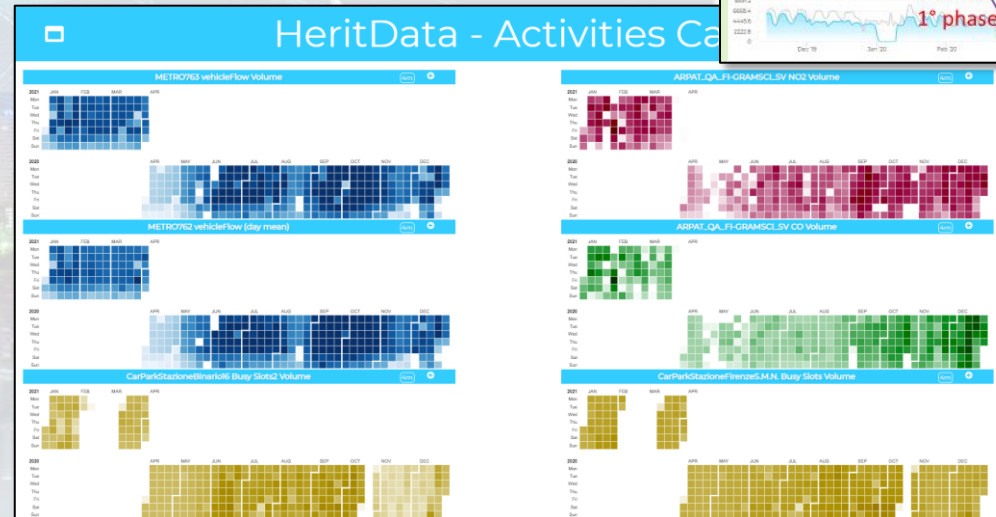
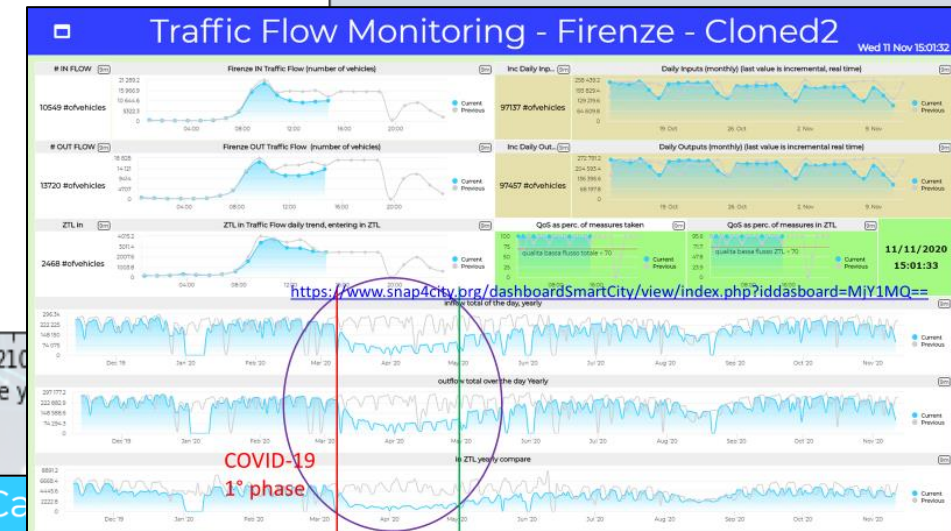
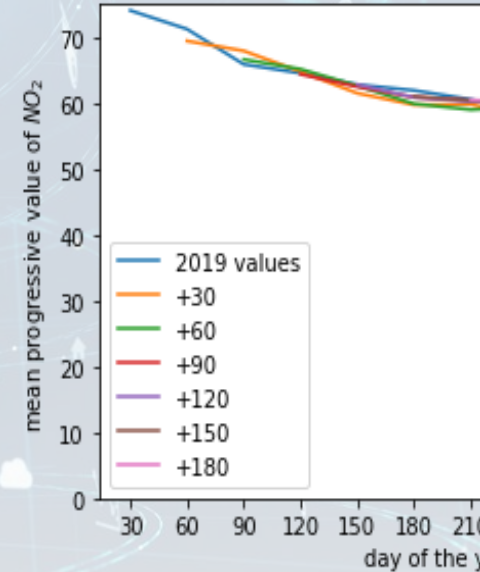
- Dashboards
- Social media,
- Sentiment Analysis

• Since 2019, 2020

Cities: Firenze, Pisa, Livorno, Toscana



mean porgressive NO₂ of 2019



metric	model30	model60	model90	model120	model150	model180
MAE	1.21	1.31	1.52	2.04	2.31	2.37
RMSE	2.16	2.61	4.18	6.77	7.83	7.93
MAPE	1.99	2.20	2.65	3.57	4.07	4.18
R2	0.91	0.83	0.80	0.54	0.45	0.14

Table 4. Assessment of the predictive models with respect to the actual values of the 2019.

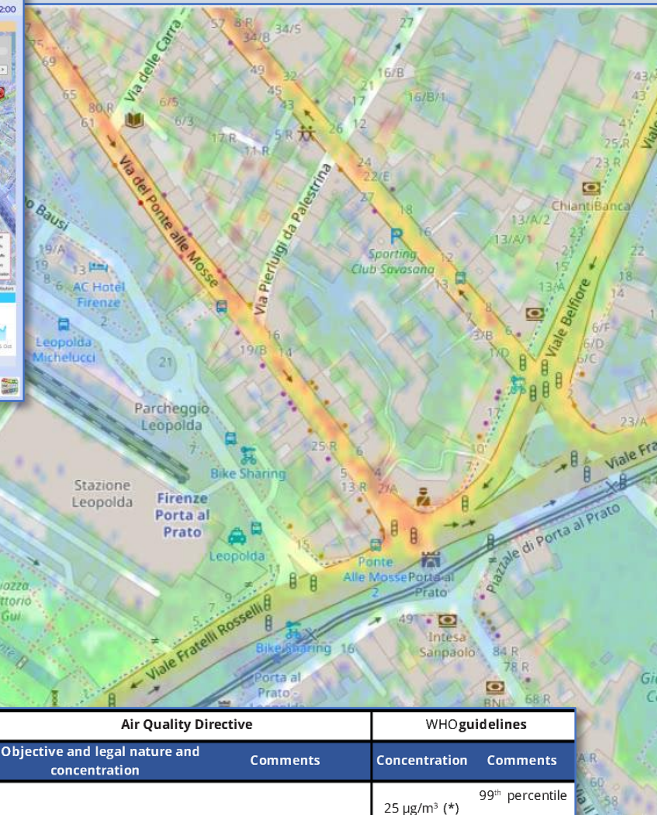
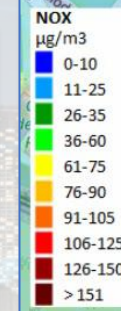
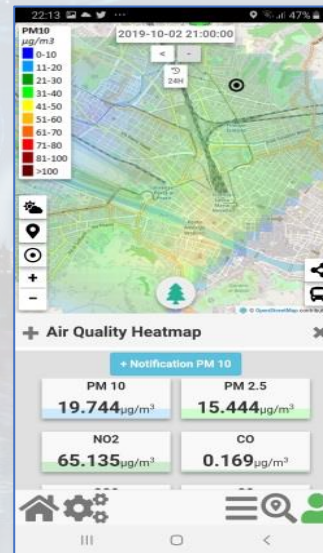
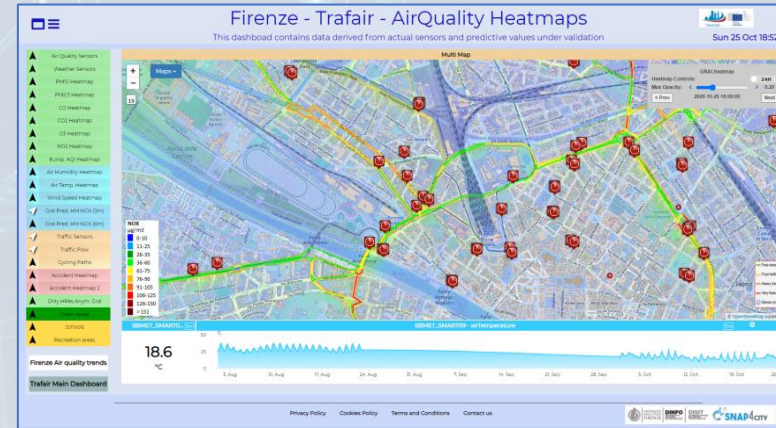
Environment and Quality of Life

Air Quality Predictions

Cities of:
Firenze, Pisa, Livorno



- **Multiple Domain Data**
 - Traffic Flow data, Pollutant: NOX, CO2, PM10, PM2.5, O3,
 - 3D City structure, weather, ...
- **Multiple Decision Makers**
 - Pollutant Predictions: NOX, NO2, ..
 - City officers, energy industries
 - Dashboards, What-IF analysis
 - Traffic Flow Reconstruction
- **Historical and Real Time data**
 - Billions of Data
- **Services Exploited on:**
 - Dashboards, Mobile App
- **Since 2020**



Air Quality Directive				WHO guidelines	
Pollutant	Averaging period	Objective and legal nature and concentration	Comments	Concentration	Comments
PM _{2.5}	One day			25 µg/m³ (*)	99 th percentile (3 days/year)
PM _{2.5}	Calendar year	Target value, 25 µg/m³	The target value has become a limit value since 1 January 2015	10 µg/m³	
PM ₁₀	One day	Limit value, 50 µg/m³	Not to be exceeded on more than 35 days per year.	50 µg/m³ (*)	99 th percentile (3 days/year)
PM ₁₀	Calendar year	Limit value, 40 µg/m³ (*)		20 µg/m³	
O ₃	Maximum daily 8-hour mean	Target value, 120 µg/m³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m³	
NO ₂	One hour	Limit value, 200 µg/m³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m³ (*)	
NO ₂	Calendar year	Limit value, 40 µg/m³		40 µg/m³	

Smart City / Smart Parking + Environment Reverberi, Lonato del Garda



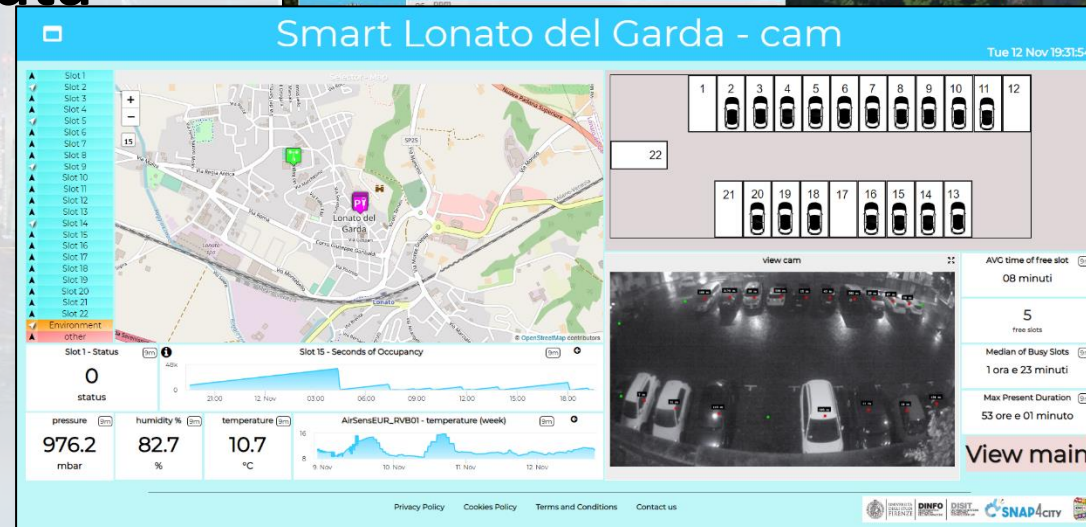
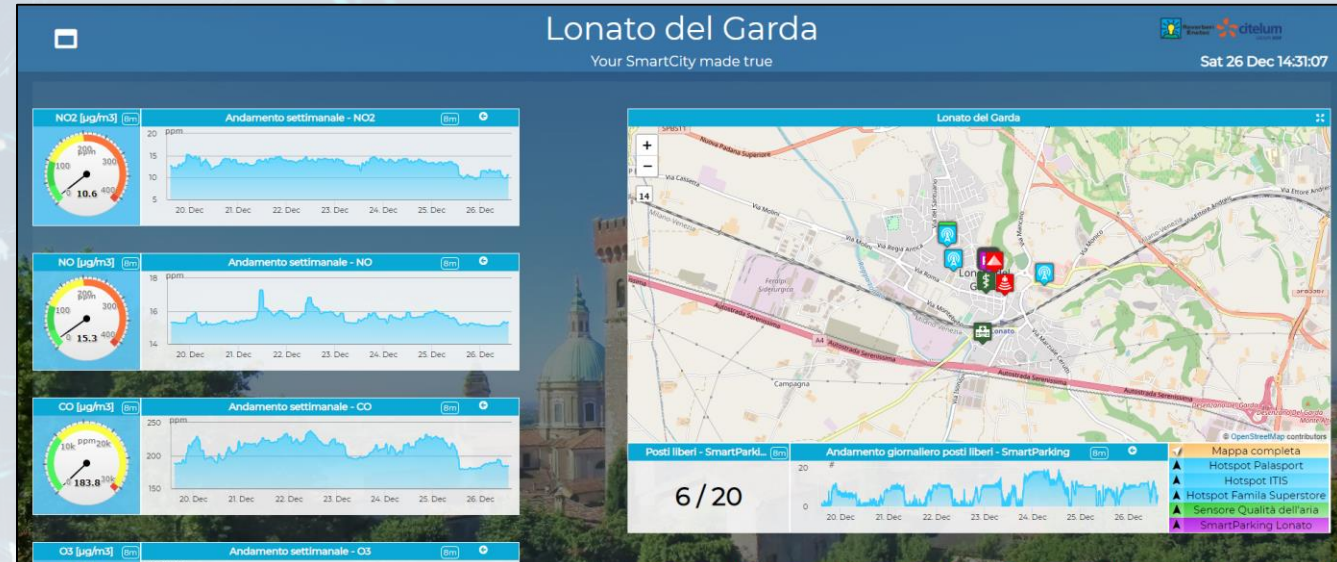
Reverberi
Enetec



citelum
GROUPE EDF

reference

- **Multiple Domain Data**
 - Smart Parking, Environment, Wi-Fi
- **Multiple Decision Makers**
 - City Officer, operators
 - Data monitoring, alerting
 - analytics
- **Historical and Real Time data**
 - Dashboards
- **Services Exploited on:**
 - Dashboards, API
- **Since 2019**



reference

-
- The collage features several key components of a smart lighting system:
- Capelon Test Lights - Cloned - Cloned2 Dashboard:** This dashboard provides a comprehensive overview of the lighting system. It includes a map showing the locations of various light fixtures, a bar chart displaying luminance levels for different fixtures, and a line graph showing the temperature of a specific fixture (DOCSEFFFEBA90D) over time. The dashboard also includes a selector for different light fixtures and a bar series chart showing the active power speed of the fixtures.
 - Light Control Interface:** This interface allows for manual control of the lighting system. It features a city skyline background and a central control panel with buttons for 'Light Control', 'Luminance Control', and 'Temperature Control'. Below the control panel is a list of IoT applications and a 'Test Breakdown by Component and' section.
 - Node-RED Flow Diagram:** This diagram illustrates the logic for controlling the lights. It shows a flow from a 'Start' node to a 'Select' node, which then branches into different actions based on the selected light fixture. The actions include 'Set the light to on', 'Set the light to off', 'Set the light to dim', and 'Set the light to bright'. The diagram also shows how the system can be triggered by a 'Webhook' or a 'Timer'.

Dubrovnik

- **Tourism Domain**

- Counting People
- TV Cameras and Wi-Fi
- Social Media

- **Dashboards**

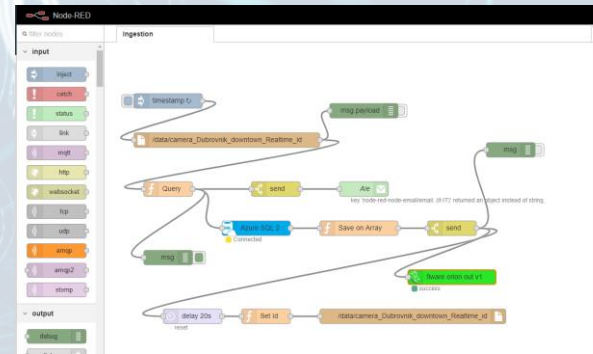
- Monitoring and real time control
- People flow
- Twitter Vigilance

- **Historical and Real Time data**

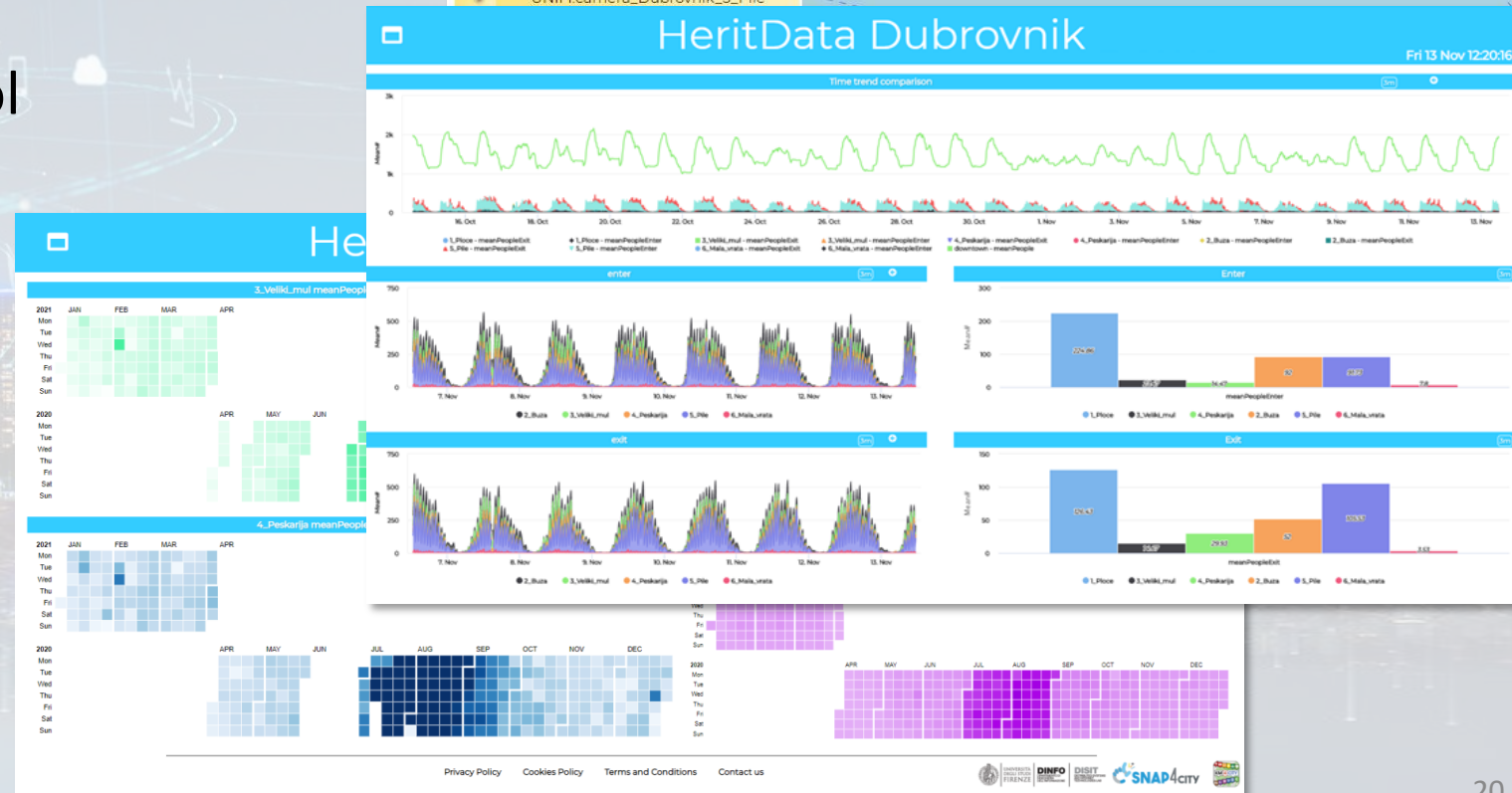
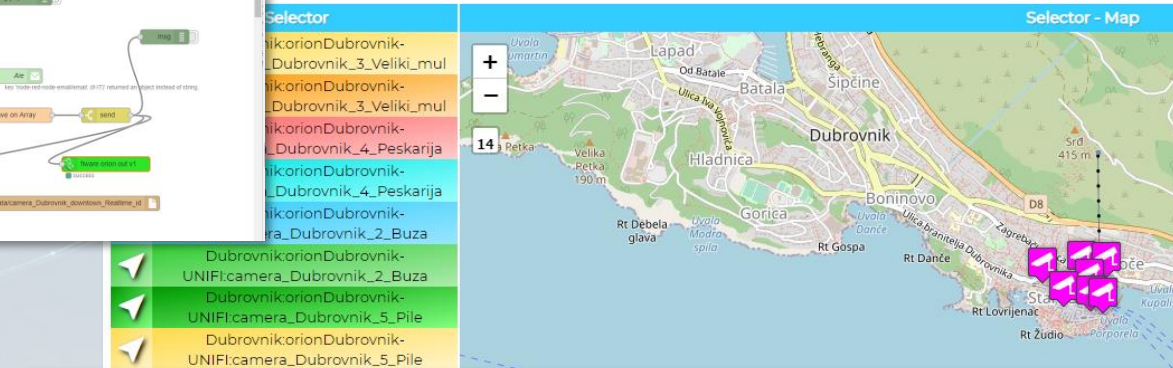
- **Services Exploited on:**

- Dashboards

- **Since 2020**



- ▶ DubrovnikorionDubrovnik-UNIFIcamera_Dubrovnik_2_Buza
- ▶ DubrovnikorionDubrovnik-UNIFIcamera_Dubrovnik_5_Pile
- ▶ DubrovnikorionDubrovnik-UNIFIcamera_Dubrovnik_5_Pile



Snap4Altair Decision Support supervision and control, Industry 4.0



reference

• Multiple Domain Data

- Distributed Control System: energy, flows, storage, chemical data, settings, ..
- Cost of energy, Orders,
- Production Parameters
- Maintenance data

• Multiple Levels & Decision Makers

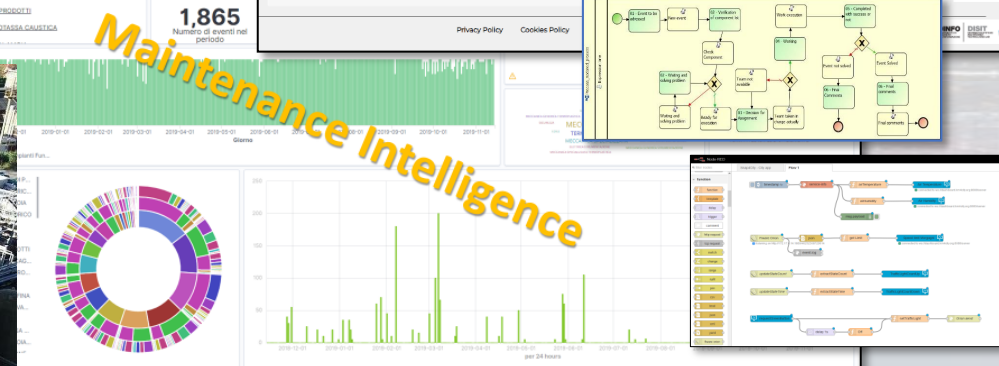
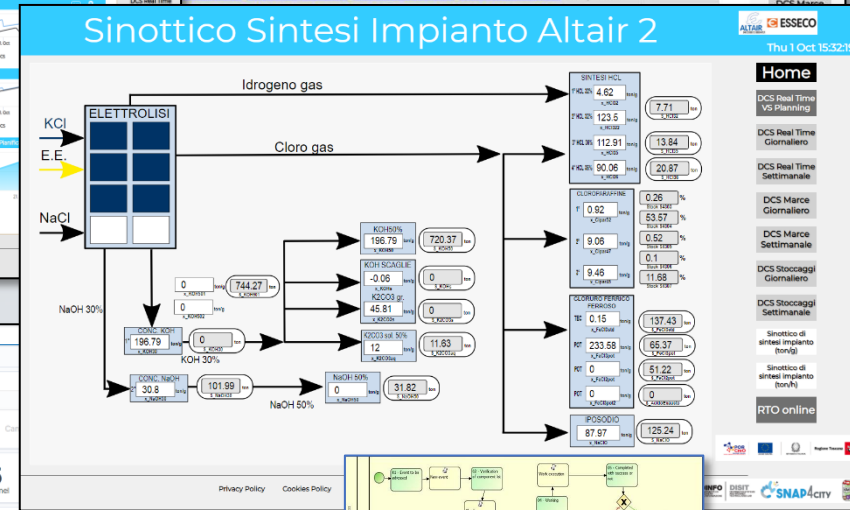
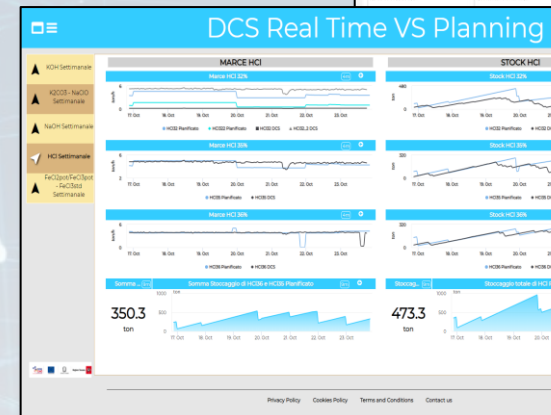
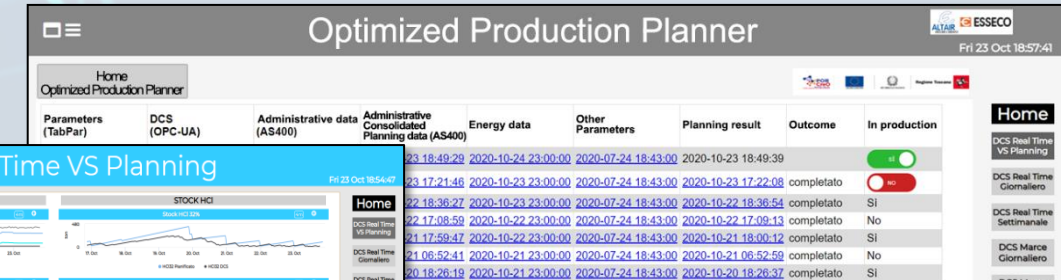
- Optimized planning on chemical model
- Business Intelligence on Maintenance data

• Historical and Real Time data

- Billions of Data

• Services Exploited on:

- Multiple Levels, Mobile Apps, API





Sommario

- Chi Siamo
- Cosa facciamo
- Le sfide
- Le innovazioni



Le sfide si superano ogni giorno

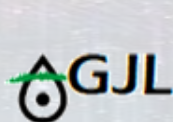
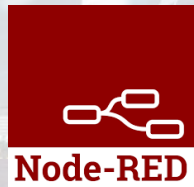
- *Interoperabilità*
 - Moltitudine di protocolli e formati, new standards
 - Integrazione con sistemi legacy di ogni tipo
- *Gestione di innumerevoli tipi di dati diversi oltre il GIS*
- *Automating the data ingestion*
- Sicurezza → PEN Test
- Privacy → GDPR
- Scalabilità ...
- Modularità ...
- ...

Standards and Interoperability (2021)



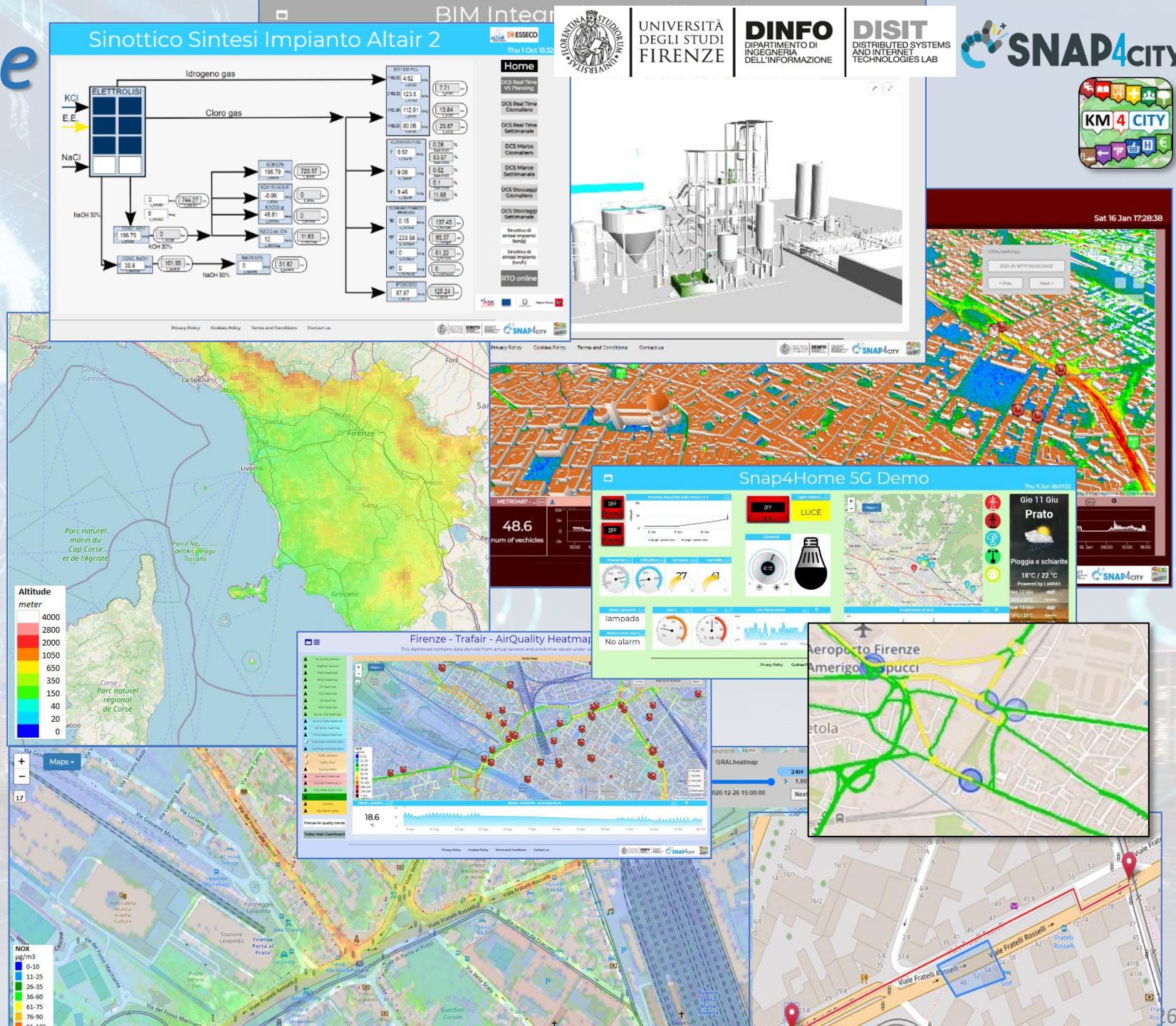
Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC/OPC-UA, GML, RS485, RS232, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET/IBE, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, KNX, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Copernicus, Protocol Buffer, IFC, XPDL, etc.

<https://www.snap4city.org/65>



Data Type Coverage

- POI, IOT, shapes,...
- maps, orthomaps, GTFS, GIS WFS/WMS, GeoTiff, ..
- calibrated heatmaps, ..
- traffic flow, typical trends, ..
- trajectories, events, ..
- 3D, BIM, Workflow, ..
- Dynamic icons/pins, ..
- OD Matrices, scenarios, ..
- prediction models,
- decision support,
- Synoptics, animations, ..
- social media, Routing, ..
- Satellite data, ..
- KPI, personal KPI,...
- etc.





Sommario

- Chi Siamo
- Cosa facciamo
- Le sfide
- Le innovazioni

DISIT Lab ha bandito

- 2 Assegni di ricerca per 2 anni → PhD
- 1 Borsa del dottorato nazionale in AI per 3 anni

<https://www.snap4city.org/581>

15MinCityIndex

What would support my neighborhood to become a 15-Minute City?

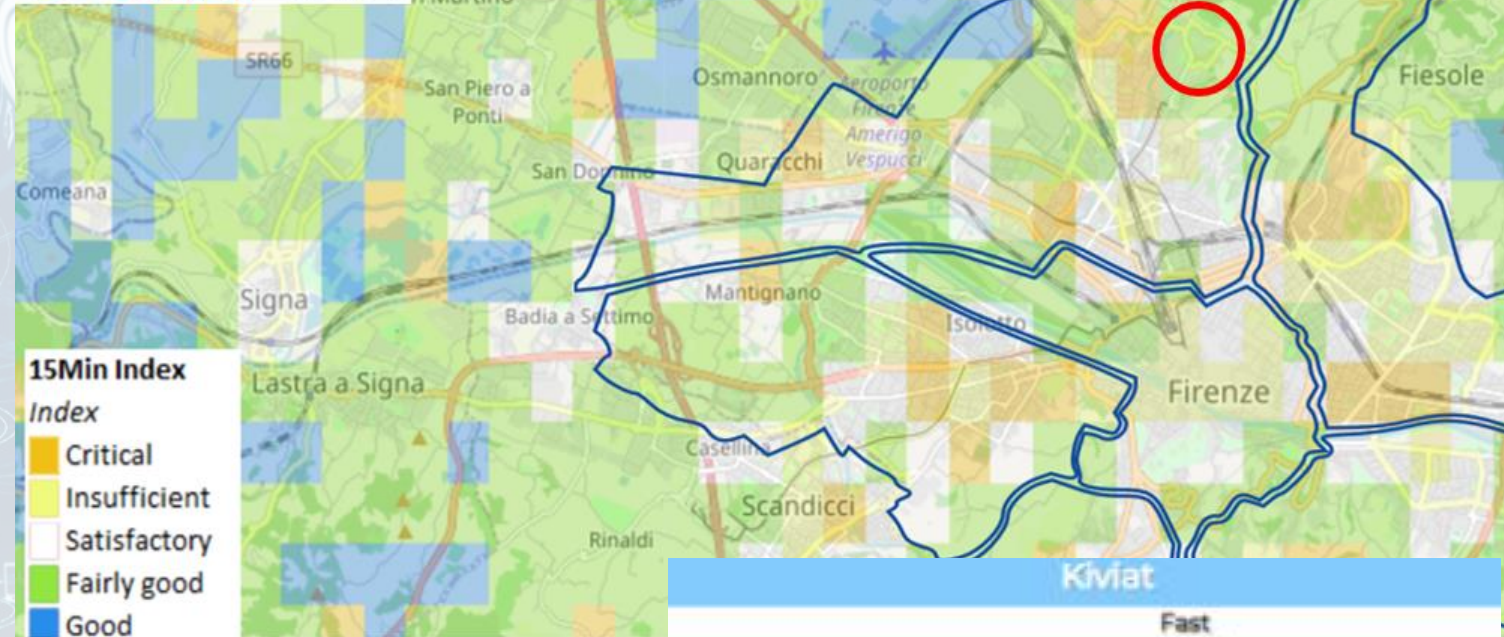
Using the Open Data:

We developed a data analytic tool based on municipal and national open data to assess services adequacy for people living in each 15 minutes areas of the city.

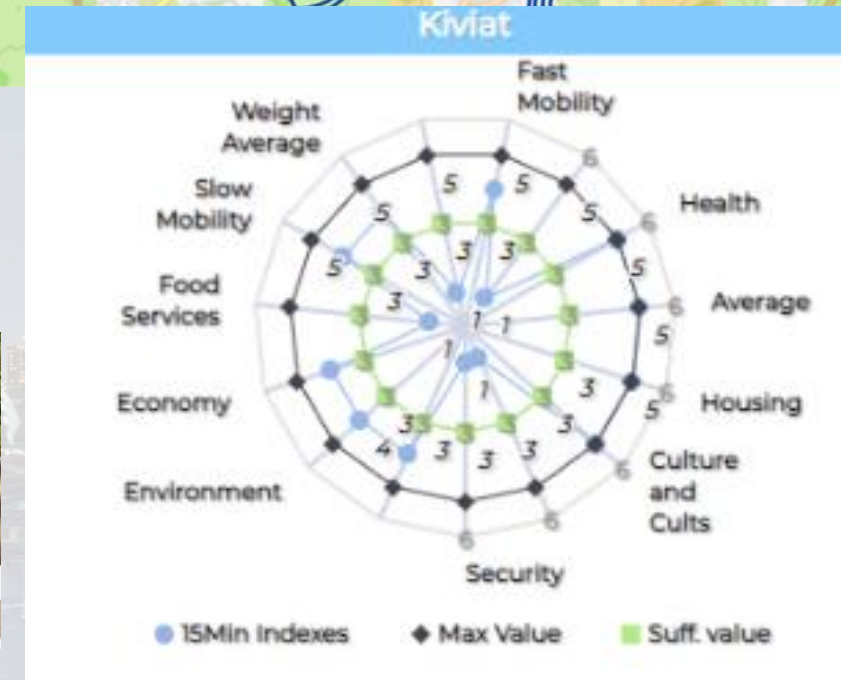
Good public transport services: bus, new tram line, train stations, cycle paths.



Careggi/Rifredi is a relevant district in Florence because of hosting the main Florence/Tuscany hospitals Careggi and Meyer, but also university headquarters and many other workplaces.



The tool supports the becoming of a 15-Minute city evaluating the service level in various domains.

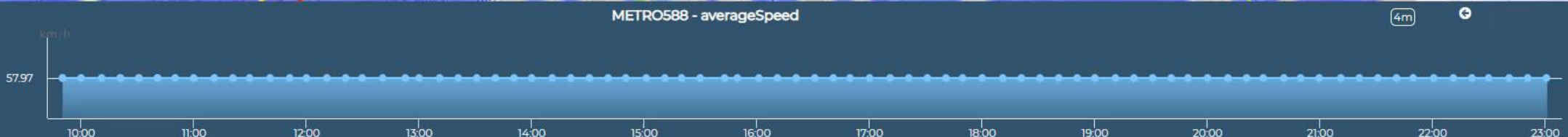
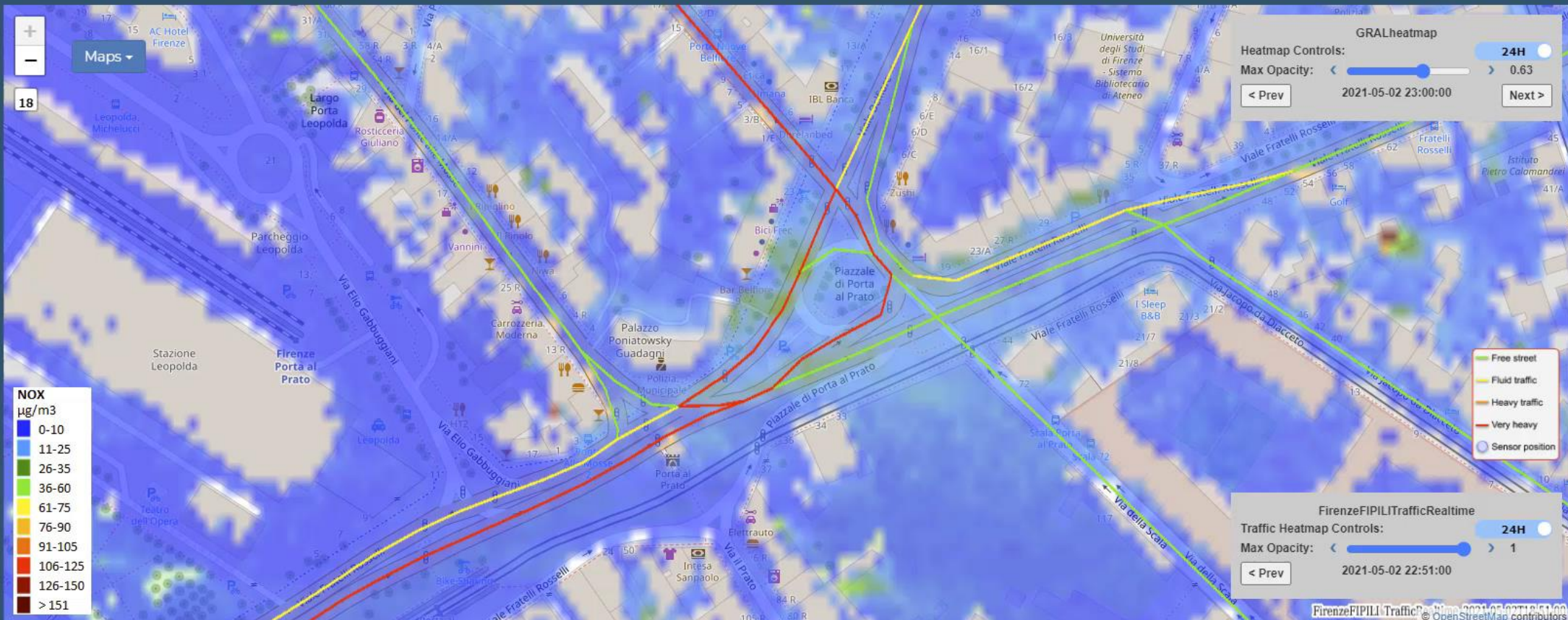




Traffic Flow Manager on multiple cities

Sun 2 May 23:16:31

- Traffic Sensors
- Weather_sensor
- AirTemperatureAverage2HourFirenze
- PM2.5 Heatmap
- GRAL Heatmap
- Gral HRES
- Accident Heatmap
- Traffic Flow
- TFM FIRENZE Real Time
- TFM FIPILI Real Time
- TFM Pisa Real Time
- TFM Livorno Real Time
- TFM Modena Real Time
- TFM Santiago Real Time
- prova hres fipili 2k
- prova hres fipili 4k
- prova hres fipili 8k
- Scenario
- What-if



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<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==>

Digital Twin Local, 3D vs Real Time Data



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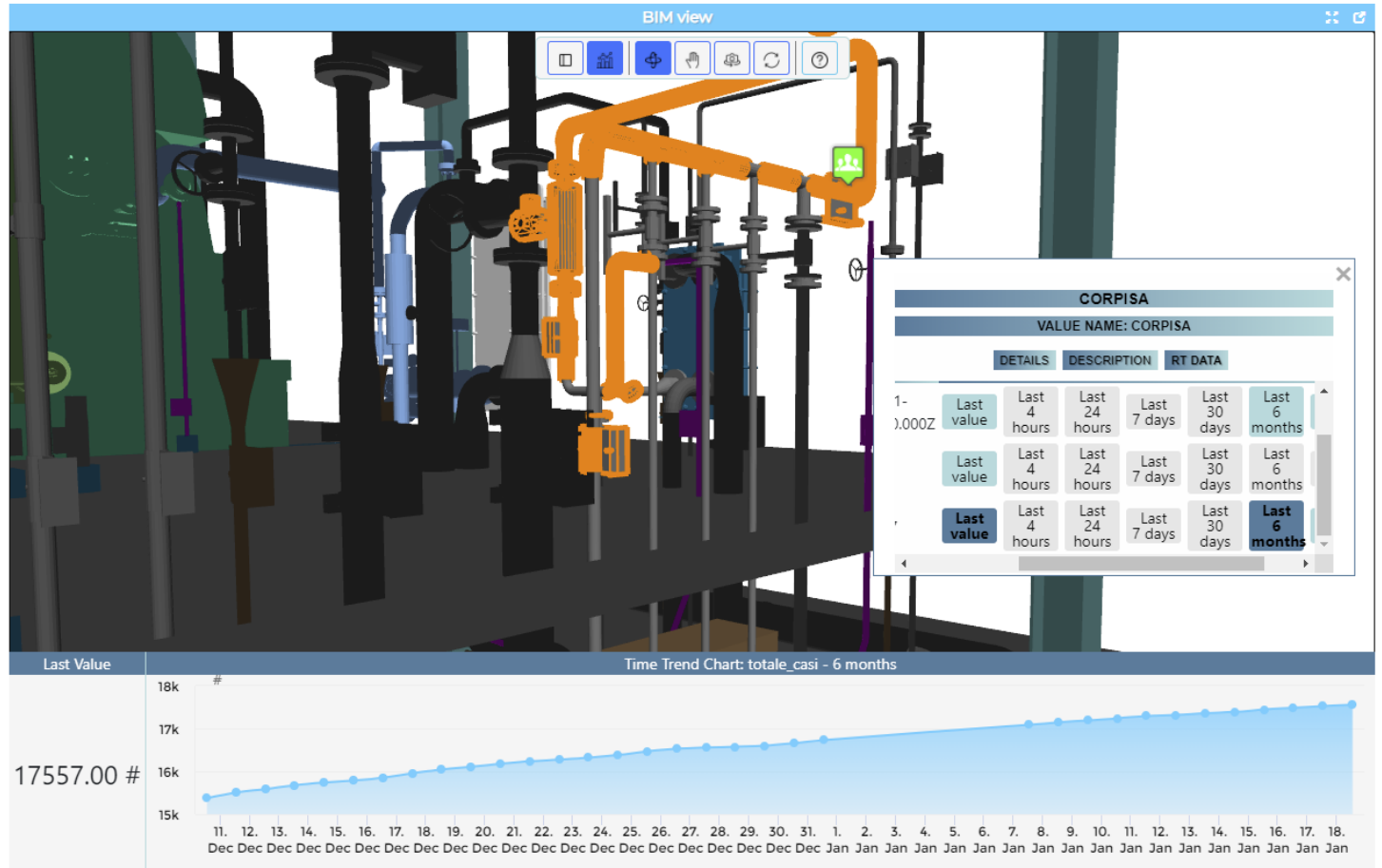
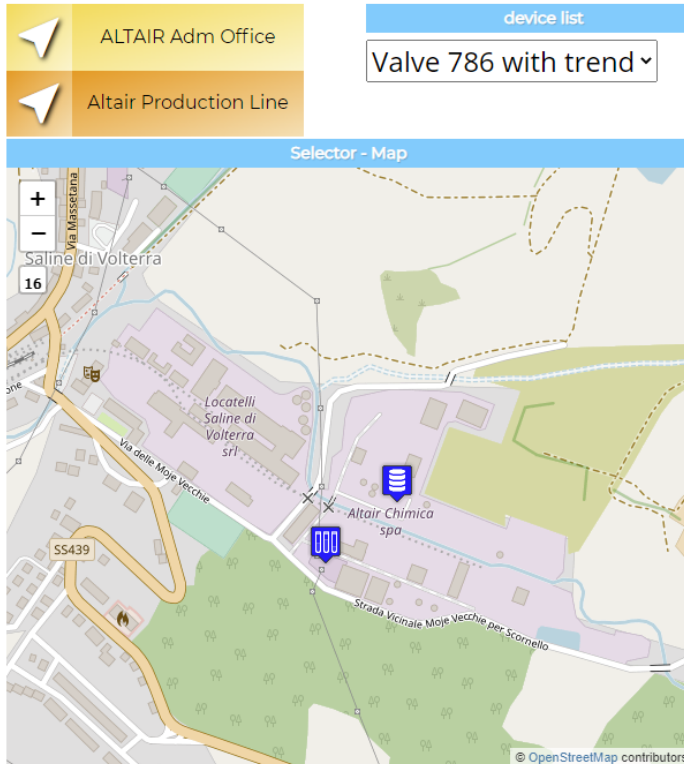
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BIM Integration for Digital Twin

Tue 8 Jun 11:04:55



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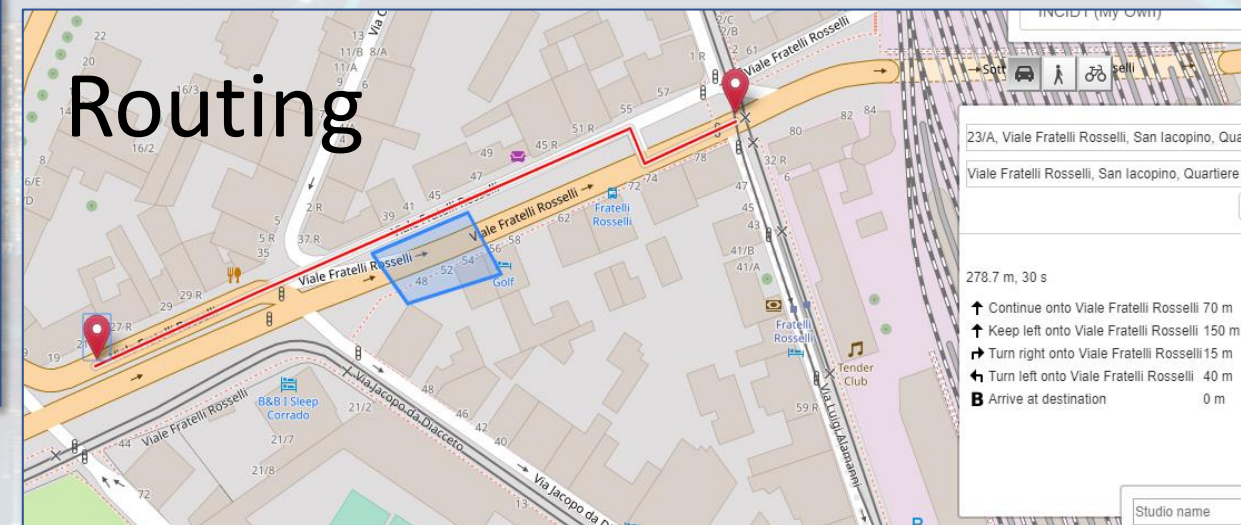
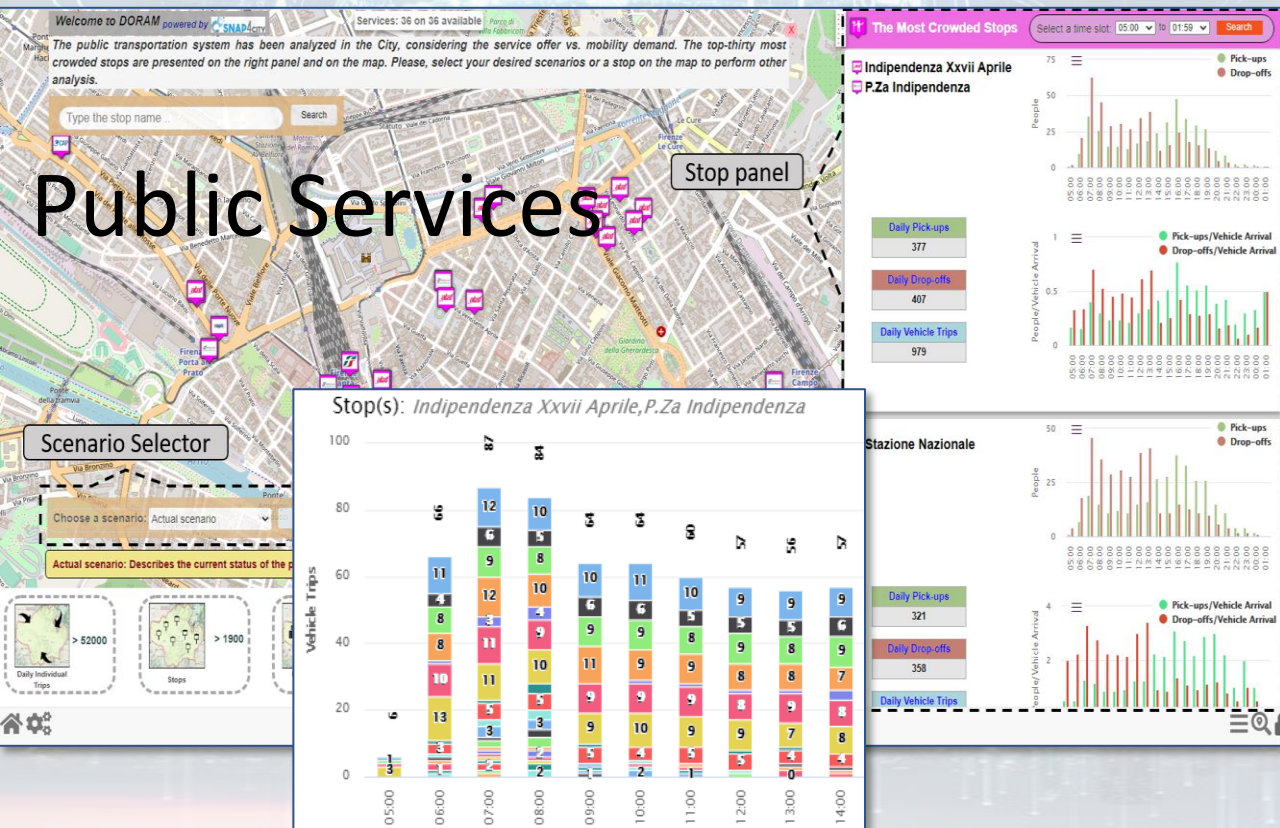
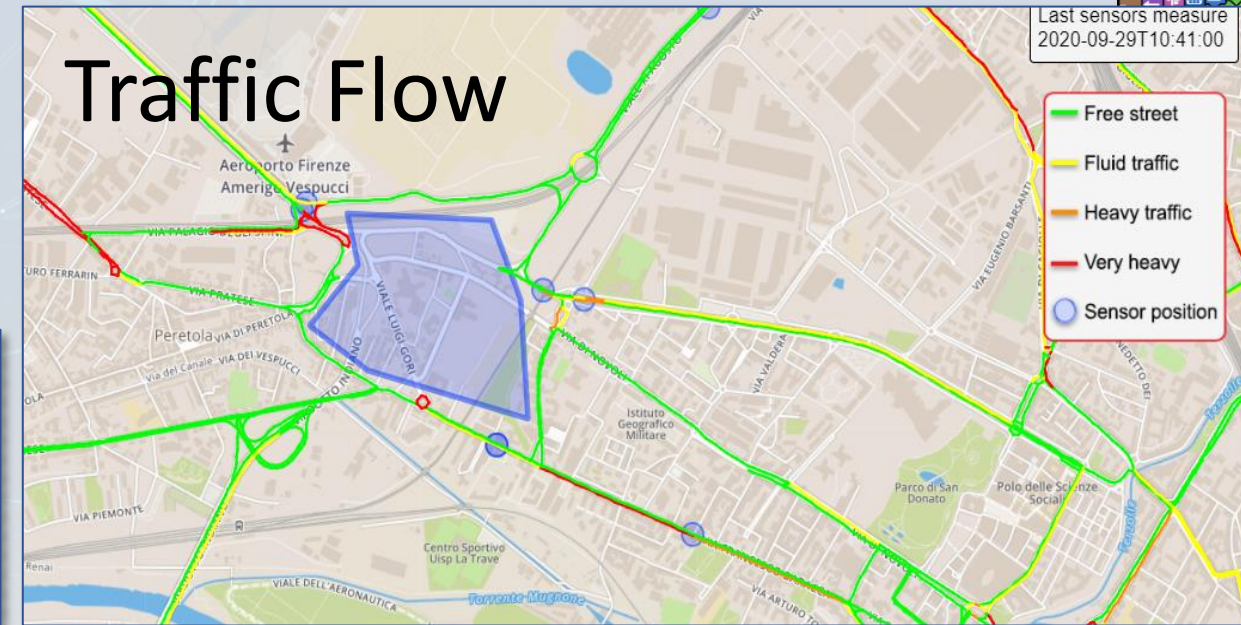
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What-if Analysis

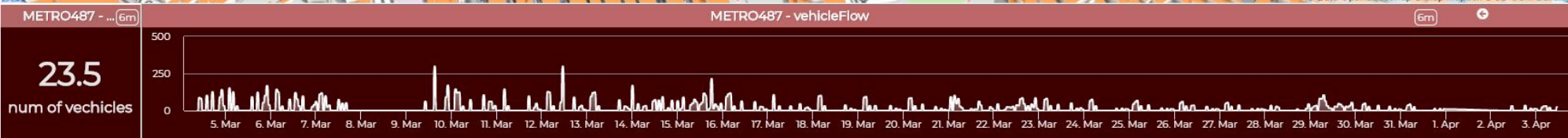
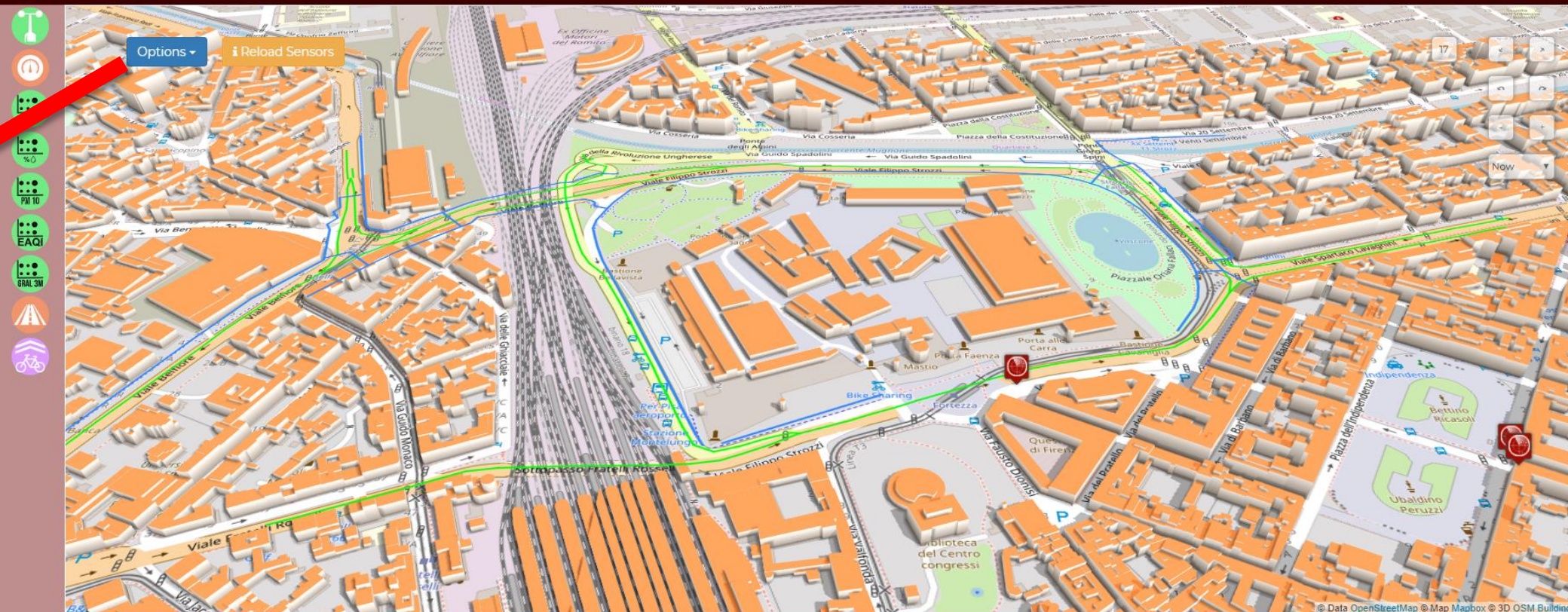
- Definition of scenarios impact on
 - Traffic, Pollutant, parking, public transport, private flows, etc.
 - KPI analysis



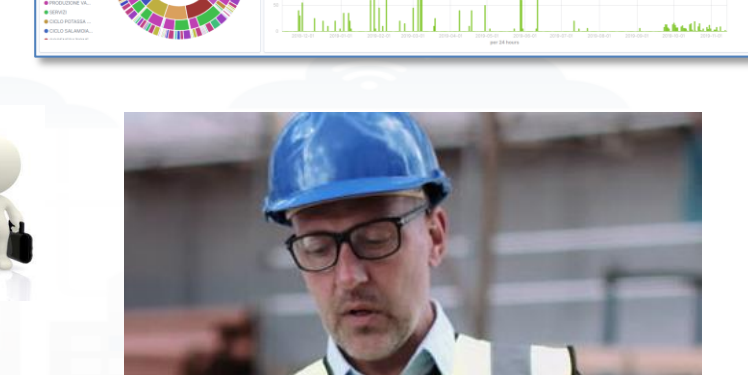
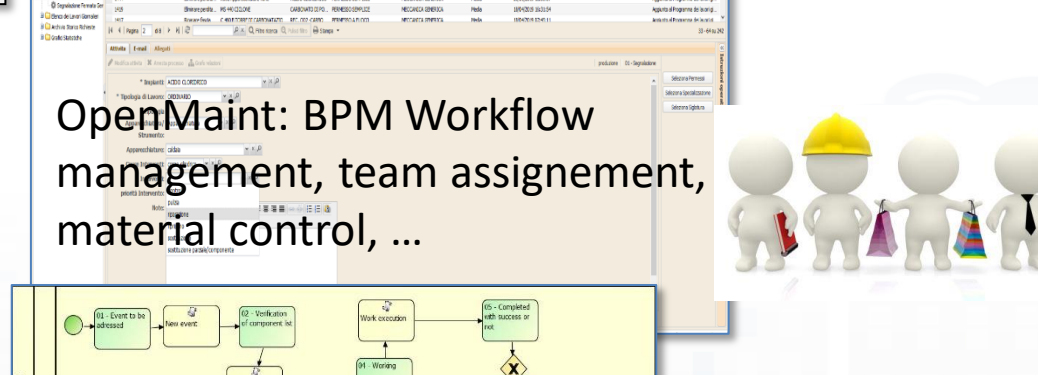
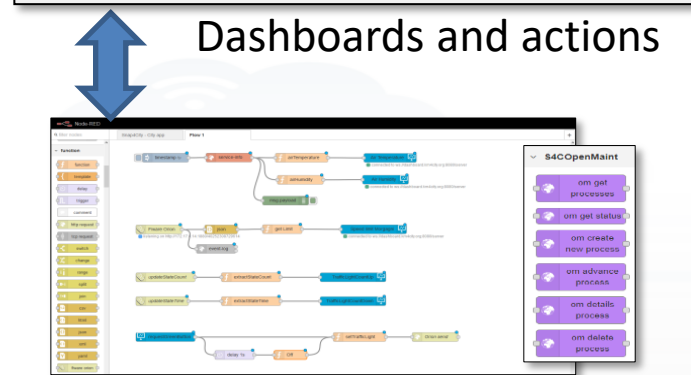
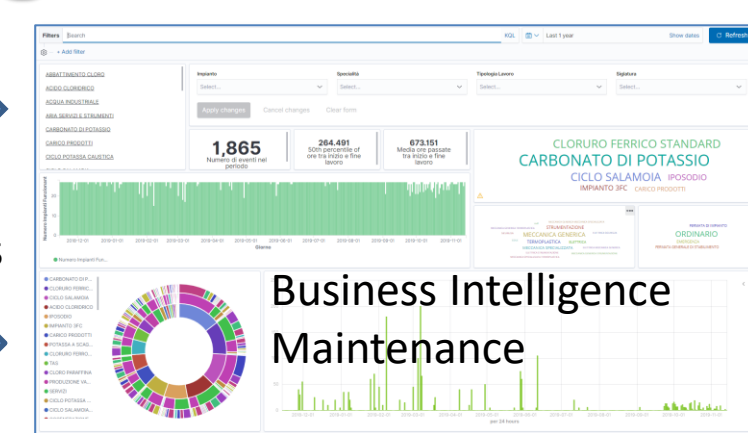
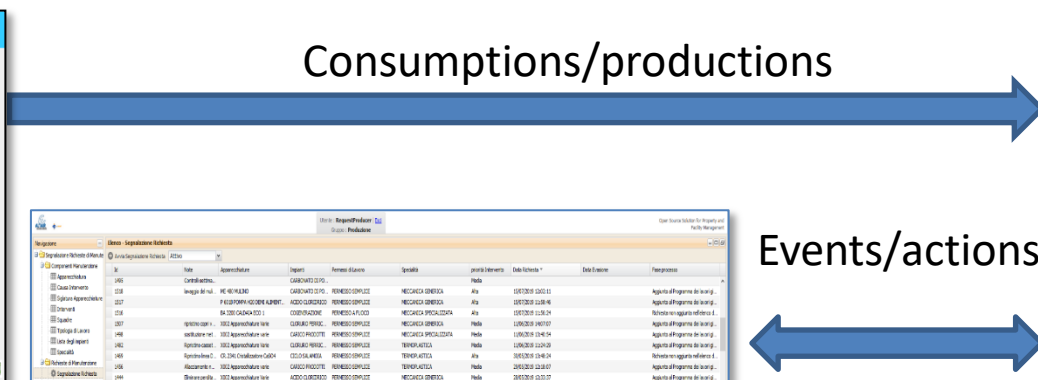
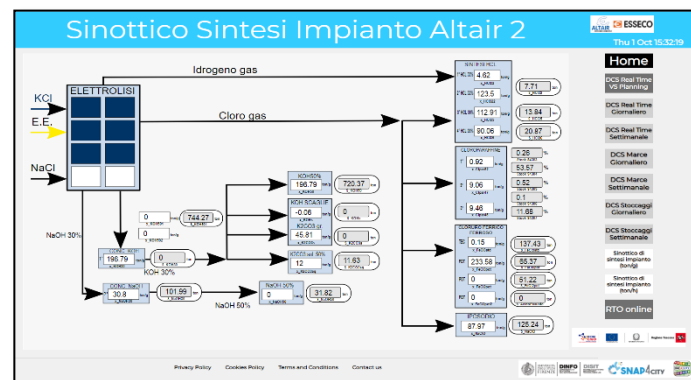


3D Map beta Testing

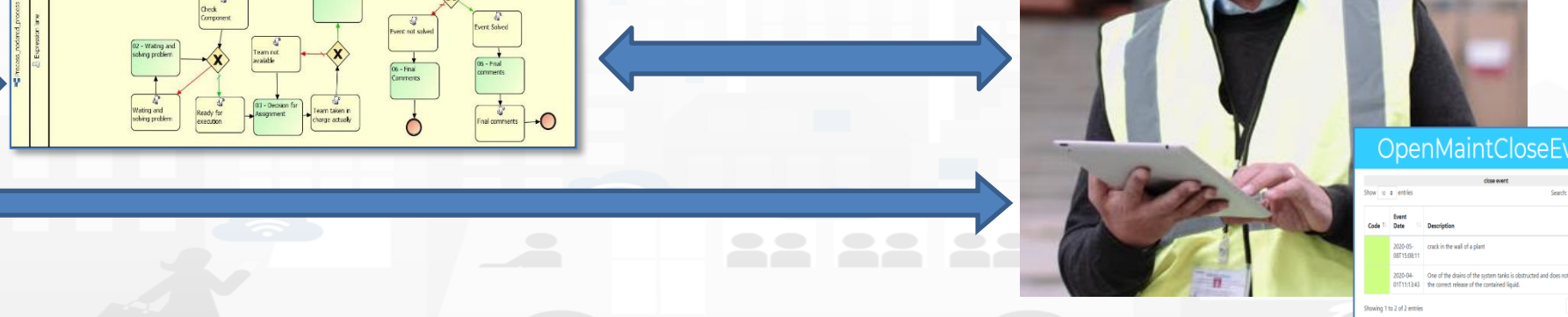
Fri 3 Apr 11:07:55



Workflow for Ticket management



IOT App, Data event firing, event detection and firing Critical event management



On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App
PDF							
Inter active							
Video1							
Video2							
Video3							
Video4				none		none	none
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47

Overview



- <https://fiware-foundation.medium.com/snap4city-fiware-powered-smart-app-builder-for-sentient-cities-acfe24df49d5>
- https://www.snap4city.org/download/sites/default/files/files/FF_ImpactStories_Snap4City.pdf

Snap4City Platform

Technical Overview

From: DINFO dept of University of Florence, with its
DISIT Lab, <https://www.disit.org> with its Snap4City solution

Snap4City:

- Web page: <https://www.snap4city.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>

Contact Person: Paolo Nesi, Paolo.nesi@unifi.it

- o Phone: +39-335-5668674
- o LinkedIn: <https://www.linkedin.com/in/paolo-nesi-849ba51/>
- o Twitter: <https://twitter.com/paolonesi>
- o FaceBook: <https://www.facebook.com/paolo.nesi2>

Access Level: Public.

Date: 05-04-2021

Version: 5.3

- [April 2021](https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview-April-2021-V5-3.pdf)
- <https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview-April-2021-V5-3.pdf>



30th
International
Cartographic
Conference

Florence, Italy

23
Giugno



Regione Toscana



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Verso la Conferenza Internazionale di Cartografia Firenze ICC2021

3° Workshop

Geo Open Data: opportunità e nuove sfide per i professionisti, le aziende e la Pubblica Amministrazione

Università degli studi di Firenze, DISIT Lab, Snap4City

Paolo Nesi

Paolo.nesi@unifi.it, <https://www.snap4city.org>, <https://www.disit.org>