TUSCANY X.0

Dalla modellazione dati alla Business Intelligence

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Martedì 7 Ottobre 2025 | ore 15.00

Firenze, 07 Ottobre 2025,
DISIT lab

1

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

SNAP4CITY

TUSCANY X.0

EDIH | European Digital Innovation Hubs Network

Finanziato dall'Unione europea
NextGenerationEU

Agenda

- Data Modeling, formats

- Public/private data, real time data, Structured and non structured data

- Data Privacy, GDPR, Data Spaces

- Data Selection and caratterization: value type, value unit, data type

- Smart Industrial Applications of data

- Data Visualization, Visual Analytics, Business Intelligence, Dashboards

- Esercitazione on defining data models vs data representation

- Test

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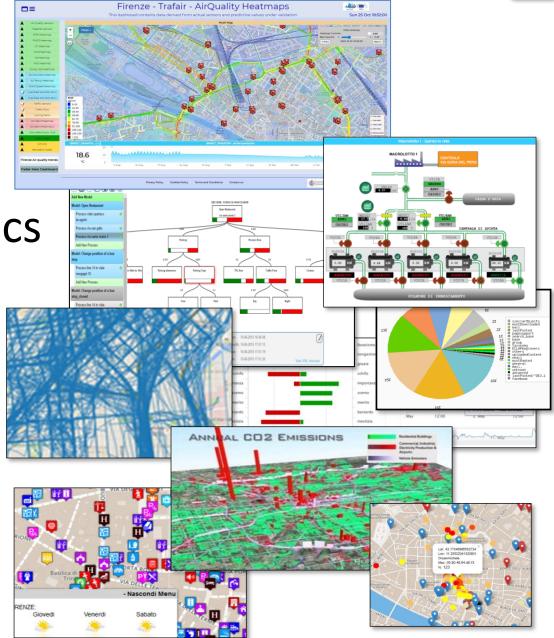
Data Driven Decision Support

- Decision Support system
- Assessment / Strategies
- Data Rendering, visual analytics
  - Business Intelligence
- Data Processing
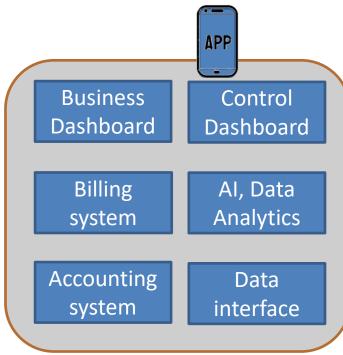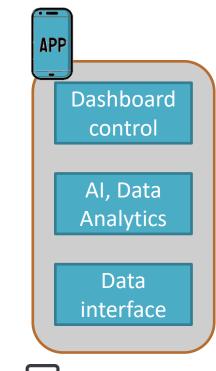- Data aggregation, Storage, indexing
- Data Ingestion
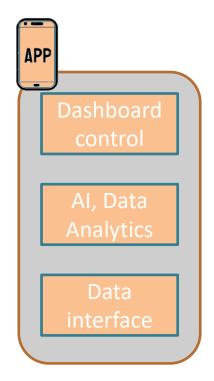
Avoiding to have a collection of verticals

Business Dashboard	Control Dashboard
Billing system	AI, Data Analytics
Accounting system	Data interface

Dashboard control
AI, Data Analytics
Data interface

. . . .

Dashboard control
AI, Data Analytics
Data interface

. . . .

Dashboard control
AI, Data Analytics
Data interface

Simplifying the development and integration of verticals

Integrated Data Platform

- **Produce value from data**
  - Stimulate virtuous behavior, influence Users!
  - put in action Strategies
- **Data Exploitation performing**
  - predictions, reasoning, business intelligence, ..
  - users behavior analysis, decision support system, ..
  - Control Room, Real Time Monitoring tools, ….
- **Aggregate & integrate data**
  - Multiple protocols from operators, ….
  - open data, IOT, sensors, internet of everything, cloud, mobile devices, Wi-Fi, social media, …

Private and static

- Fiscal Code, SSN
- Non shared pictures
- Level aspects
- Patient health record
- Commercial aspects
- ..

Personal movements
GPS traces
Relationships among people
Trading, sales
User Behaviour
social media
Contributions
Consumption of energy, gas
banking

Static Public (open data)

statistics: accidents, census, votations

- # Accesses to RTZ ZTL
- Data from Public GOV

Position of commercial activities, POI

- Museums
- City services data, almost
- Active services

TV cameras

- Info traffico
- video camere
- Info weather
- Info environment
- Status of the queue at Museums
- earthquake data
- parking

Stato accessi alla ZTL
Stato dei servizi

Real time private

- Personal traffic
- Position of cars
- Position of taxi
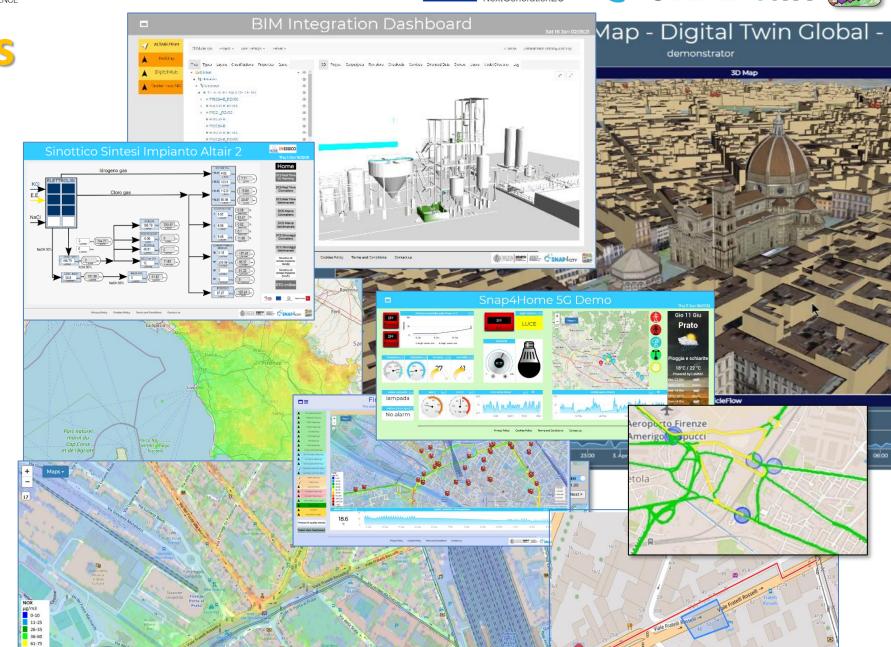- Position of CarSharing …

Real time public (open data)

High Level Types

- POI, IOT Devices, shapes,..
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of several kinds, ..
- Dynamic icons/pins, ..
- Synoptics, animations, ..
- KPI, personal KPI,..
- social media data, TV Stream,
- routing, multimodal, constraints, ..
- decision scenarios, ….
- User profiles, sales, paiments, ….
- etc.

Standards and Interoperability (10/2024)

Compliant with:

- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **General**: HTTP, HTTPS, TLS, Rest Call, SNMP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP, VMS Milestone, TIM, HERE, ….
- **Formats**: JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, Lidar, glTF, GLB, DTM, GDAL, Satellite, D3 JSON, …
- **Database**: Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, PostGres, MS Azure, ..
- **Industry**: OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility**: DATEX, GTFS, Transmodel, ETSI, NeTEx, ..
- **Social**:Twitter, FaceBook, Telegram, ..
- **Events**: SMS, EMAIL, CAP, RSS Feed, ..
- **OS**: Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.
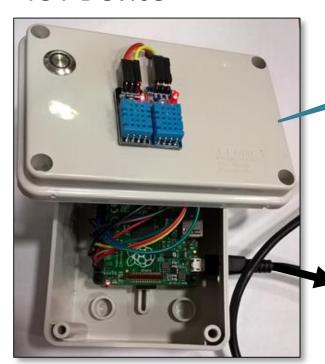
https://www.snap4city.org/65

What About a Time Series

IOT Device

Entity: IOT Device

Sends a message

Message (
timestamp: 02-04-2020 at 10:30,
Temperature: 29.34,
Humidity: 35
)

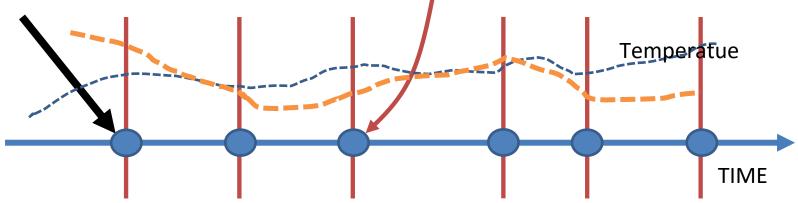| dateObserved	Temp	Humidity
02-04-2020 10:30	34.5	23
02-04-2020 10:40	36.5	24
02-04-2020 10:50	36.0	22.5

- A set of data coming from an Entity (may be a device, an action, etc.) with multiple values become a time series of values for the Entity.
  - For example: taking a new measure every 10 minutes (Red Lines)
  - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «dateObserved», which has to be **Unique.**
  - **Only one message per dateObserved is allowed**

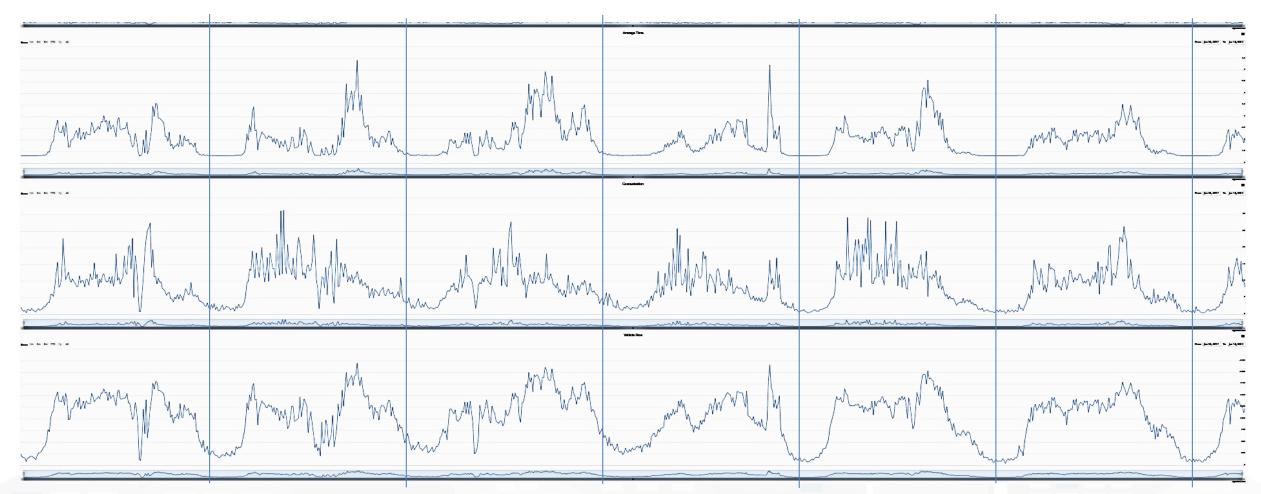Temperatue

TIME

Traffic Flow data

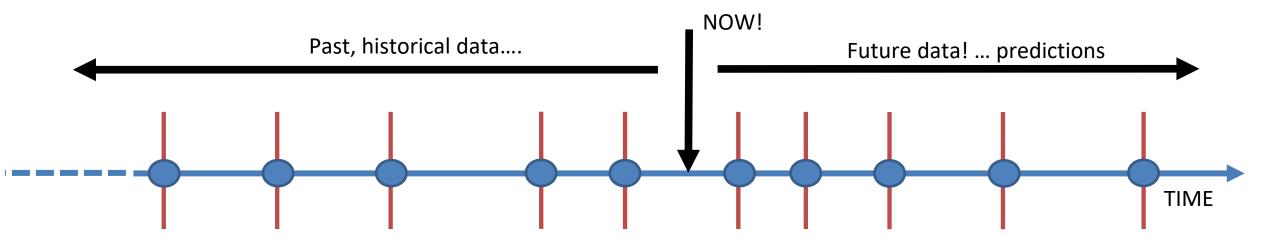- Day by day traffic flow, on the week data from 3 sensors

Time Series: they are data streams

- As soon as you have a variable changing over time → time series
  - You are ready to get Future data, may be arriving in PUSH
  - Recall and store historical data as well, but they have to be
    - recalled in PULL with some process taking from API, database,..

NOW!

Past, historical data….

Future data! … predictions

TIME

A time series

The messages posted on Entity Instances / IoT Devices can produce different effects on time series.

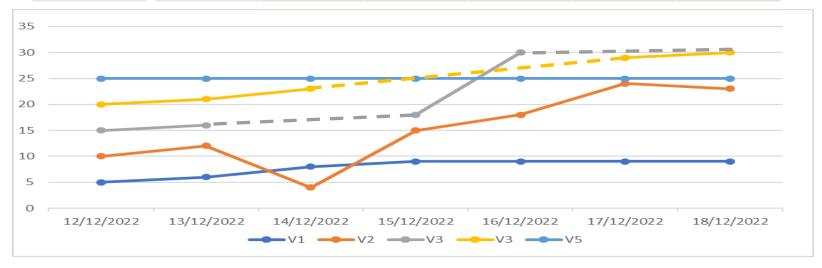**Omitting** the message would allow the broker to reuse the last data to fill it, as for V5, which appear
- valid in all messages on graphs
- With holes in tables

Putting null values (as in V3) would produce a missing data and thus would lead to create:
- interpolate line on graphs: dashed are actually continuous lines in Dashboards
- Empty values in the tables

device42 Entity Messages over time

Color for missed

12-12-2022	13-12-22	14-12-22	15-12-22	16-12-22	17-12-22	18-12-22
V1: 5	5	6	8	9	9	9
V2: 10	10	12	4	15	18	24
V3: 16	15	16	null	18	30	null
V4: 20	20	21	23	null	null	29
V5: 25	25	25	25	25	25	25

Data Indexing & Semantic Data Indexing

- **Structured:** JSON, XML, database, CSV, excel, etc.
- **Non structural Textual**, multilingual, NLP (Natural Language Processing)
  - For social media data, but also for metadata, descriptions
- **With:**
  - **Temporal** → Historical data, real time data, predictions
  - **Semantic:** relationships among entities.
  - **Spatial**, **geographical**, geo-reversing → Knowledge Base
    - Around a point, along a line/path, near a path, into a polyline, etc.
  - **Data Values** different data type (Data Lake/normalization), data unit, etc. → the so called IOT shadowing of Azure, AWS
    - Relating to Knowledge Base reciprocally

Data Collection, ingestion (processes)

- **Data**
  - Open and private: Open Data: CKAN
    - licensing, private, GDPR
  - Static vs Real time
  - Any protocol, any standard: Push and Pull
  - Any format
- From **observations and milestones**:
  - sensors, database, KPI, etc.
- From **legacy services** of in-place operators, API, WS, FaaS, ..
  - External Services: call of any kind
  - MicroServices, MicroApplications
  - Local databases
- From **users, customers, ..**:
  - participated processes, feedback, Apps, etc.
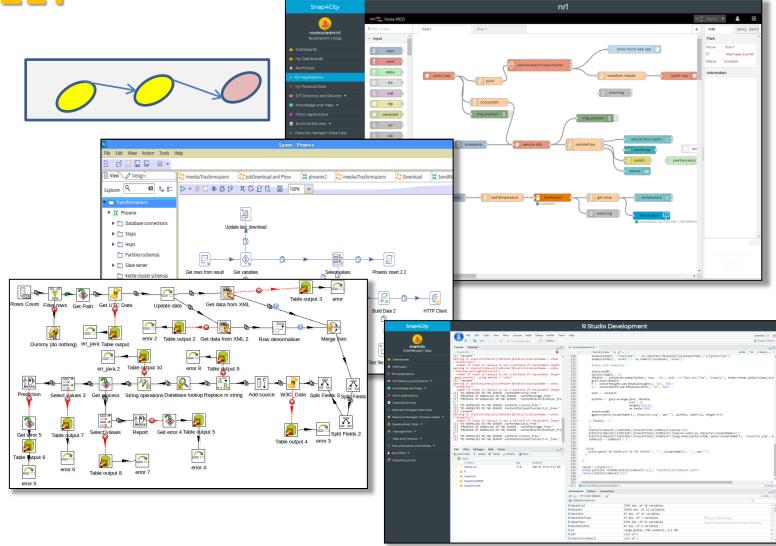 - Crawling web pages, etc.

IOT Device

Data processing: ETL/ELT

- **Data analytics**
  - Periodic or event driven
    - On demand
  - Data transformation
    - ETL: extract transform load
    - ELT: extract load transform
  - Control Flow, data transform
    - Node-RED: Node.JS
- **For example**:
  - Assessment/monitoring
  - Predictions
  - Anomaly detection
  - Simulations
  - Etc.

Km4City: Knowledge Base

- **Multiple DOMAINS**
- Geospatial reasoning
- Temporal reasoning
- Metadata
- Statistics
- Risk and Resilience
- Licensing
- Open and Private Data
- Static and Real time
- IOT/IOE

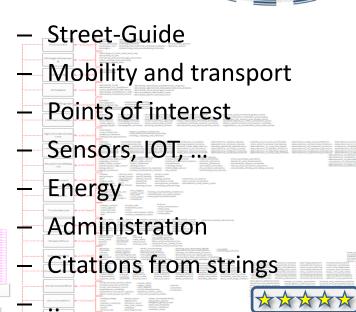**Ontology Documentation:**
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

- Street-Guide
- Mobility and transport
- Points of interest
- Sensors, IOT, ...
- Energy
- Administration
- Citations from strings
- ..

Big Data Tools

LOD and reasoners

Schema: http://www.disit.org/km4city/schema
RDF version: http://www.disit.org/km4city.rdf

RDF stores as NoSQL database

- All in terms of Triples
  - <Subject><Predicate><Object>
  - «cat» «is a specialization of» «animal» // generic definition for the ontology
  - // instances of the knowledge base
    - «micu» «is an instance of» «cat»
    - «leg1» «is part of the» «table»
    - «carl» «is belong to class» «5c»
    - «carl» «is child of» «frank»
    - «frank» «is father of» «carl»
  - Etc....

Km4City Ontology elements 1.6.8

- **DCTERMS**: for metadata Dublin Core Metadata Initiative
- **FOAF**: friends of a friends
- **Good Relation**: entities relationships
- **iot-lite**: IOT Vocabuary
- **OTN**: Ontology of Transportation Networks
- **OWL-Time**: time reasoning
- **SAREF** Smart Appliances REFerence extension for building devices available at https://saref.etsi.org/saref4bldg/
- **Schema.org** for people and organizations
- **SSN**: Semantic Sensor Network Ontology (see https://www.w3.org/TR/vocab-ssn/
- **WGS84** Datum of Geo-Objects
- **GTFS**, General Transit Feed Specification, and **Transmodel**, for public transport infrastructures: lines/rides time schedules, real-time records, paths, etc.;
- **BOT**: Building Topology Ontology. https://w3c-lbd-cg.github.io/bot/
- **S4CITY**: SAREF extension for Smart City. https://saref.etsi.org/saref4city/v1.1.2/

Smart-city Ontology km4city

Knowledge Base Semantic Reasoners

100% OPEN SOURCE

License Free 1.6.8 Since 2024

Also covers Sigital Twin, Industry 4.0 structures, HLTypes
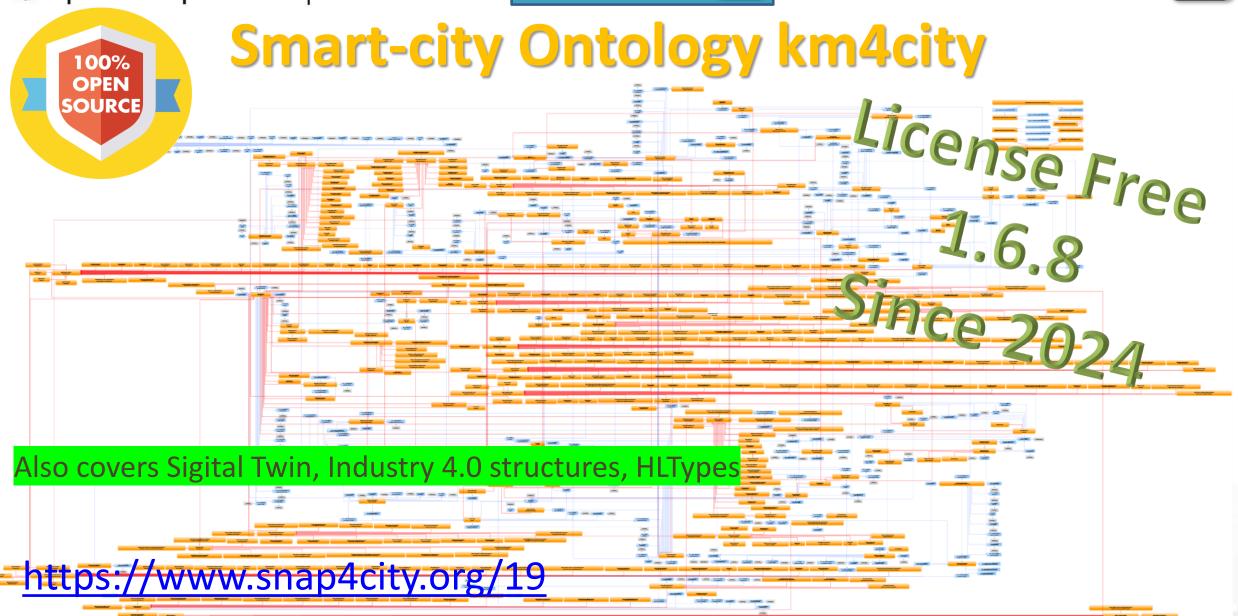
https://www.snap4city.org/19

Non structured data

- **Textual Data coming from:**
  - Social media posts
  - Dialogue with users, posts, blob, complains, emails
  - Documents, manuals, slides, web pages
  - Media: images, video, audio, drawings, etc.
- **Non structured can be processed by**
  - AI NLP solutions, BERT, LLM, LLM RAG, etc.
    - *See webinar of the 14 October 2025, 15:00*

Datawarehouse

Data Sources
Static Data

Scheduling and preproc

Batch

Storage

Big Data Cluster	Indexing	Search and Query	Rendering acting
HDFS, noSQL	SOLR, Elastic search	Facet, cluster	User interface, Dashboard Drill down

Unified aggregation and regularization

Data Transformation	Data Analytics	Visual Analytics	
ETL, NIFI	R, TF, …	Spec dash	

Data Sources
Data Driven

Broker, Stream processing

Stream

Knowledge base

Optionally

Data Lake

Batch

Stream
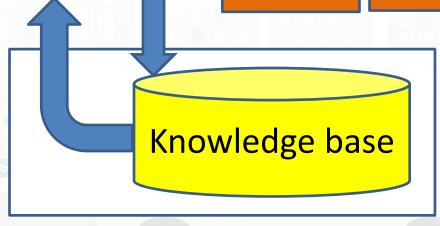
| Data Sources Static Data | Scheduling and preproc | Big Data Cluster With some raw index noSQL Storage | Search and Query / Data Transformation | Data Analytics / Visual Analytics | Temporary data storage Storage Storage Storage | Rendering acting User interface, Dashboard |
| Data Sources Data Driven | Broker, Stream processing | | | | | |
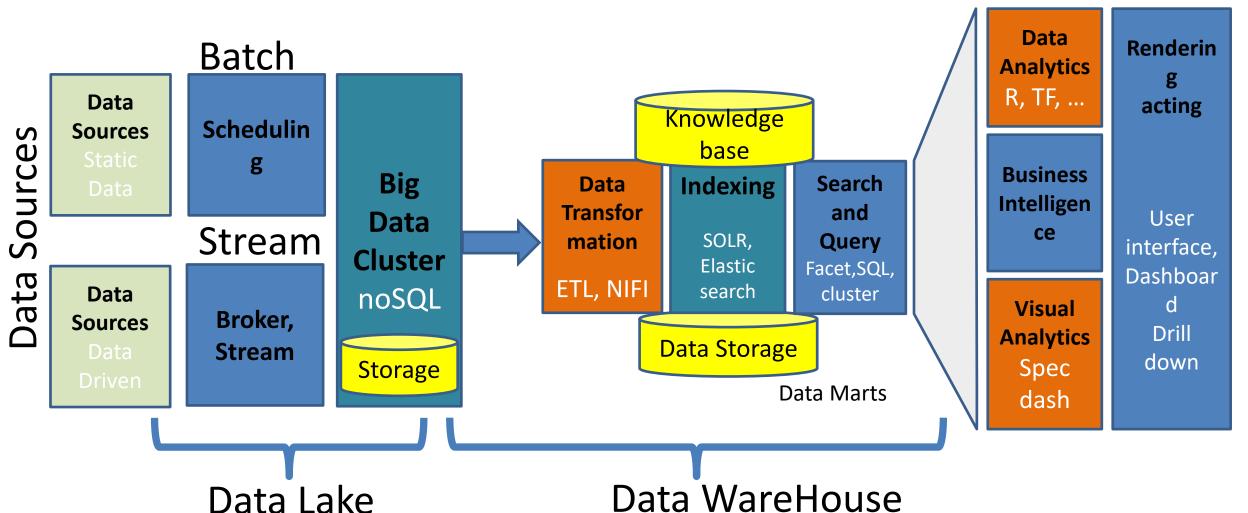
Combined Solutions: DWH/DL
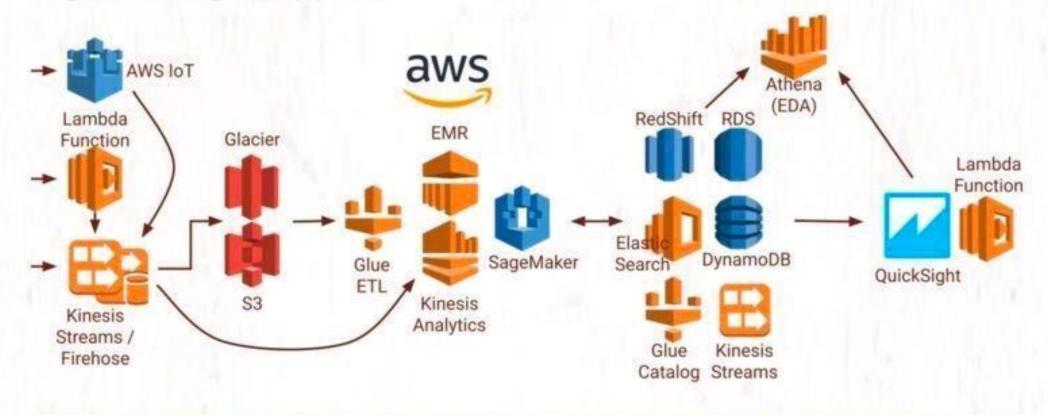
Big Data Pipelines on AWS, Microsoft Azure, and GCP

Hypercube

Longitude

Latitude

Values

Sensors of Devices, KPI, etc.

time

OBD2 - Engine RPM - pid_val_12@WF0LXXTACLKY65816
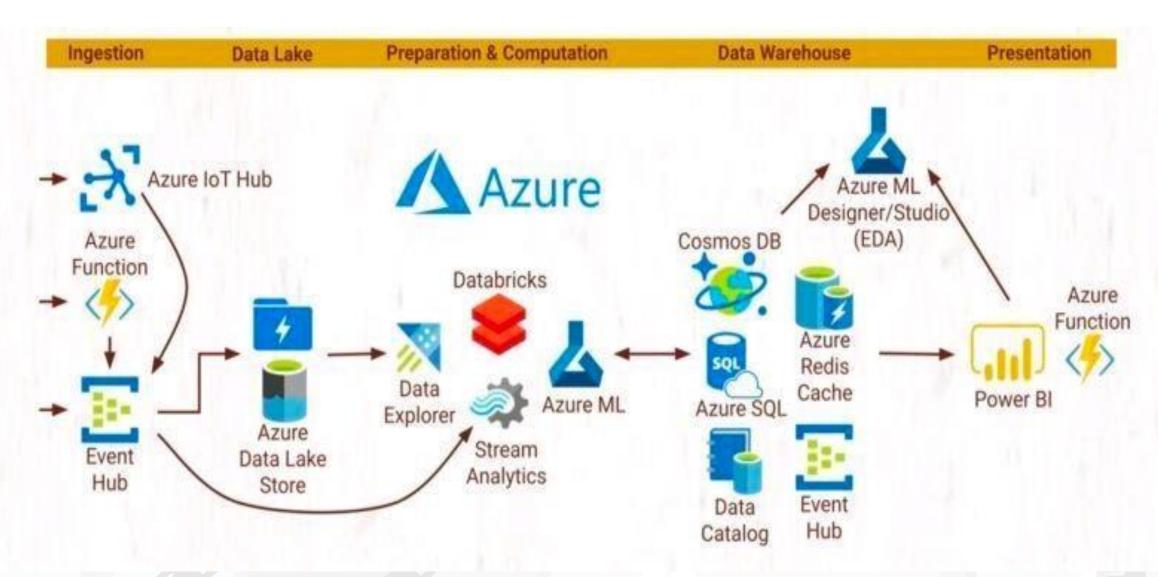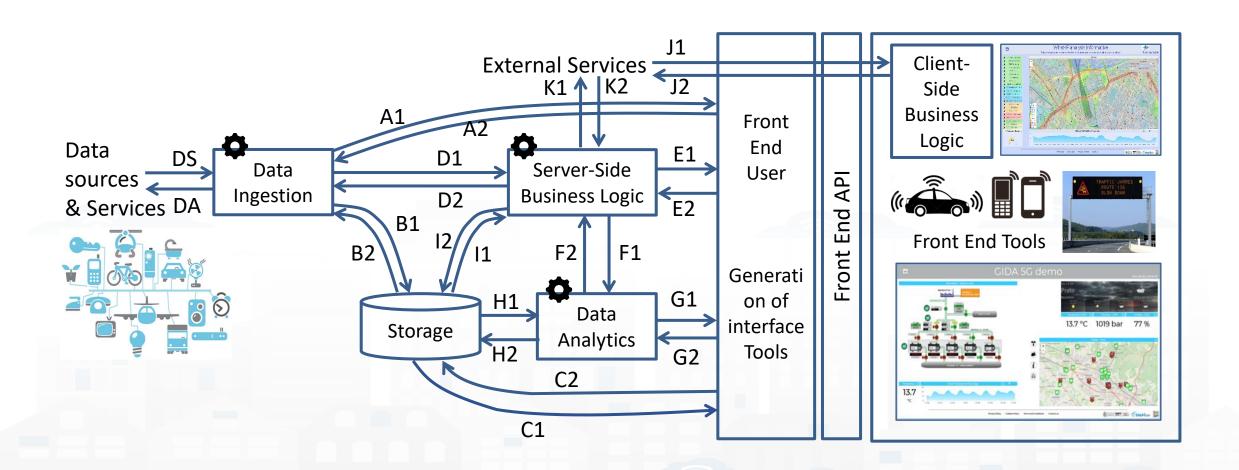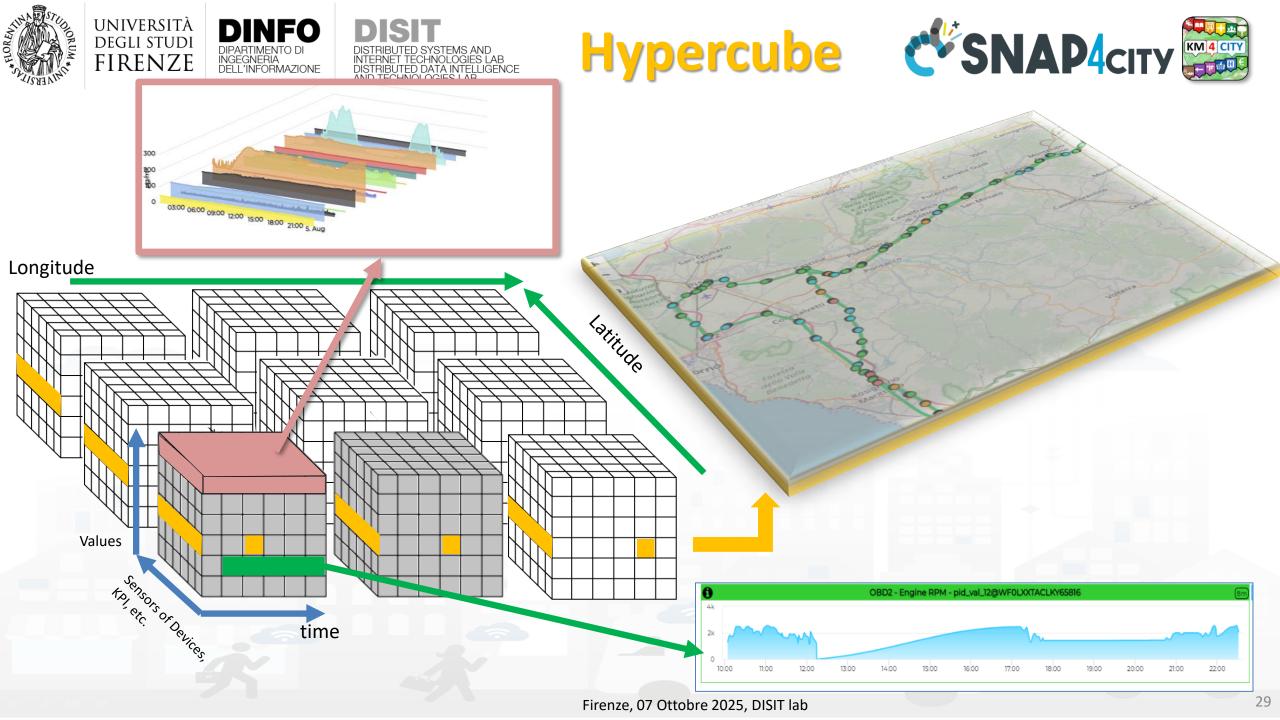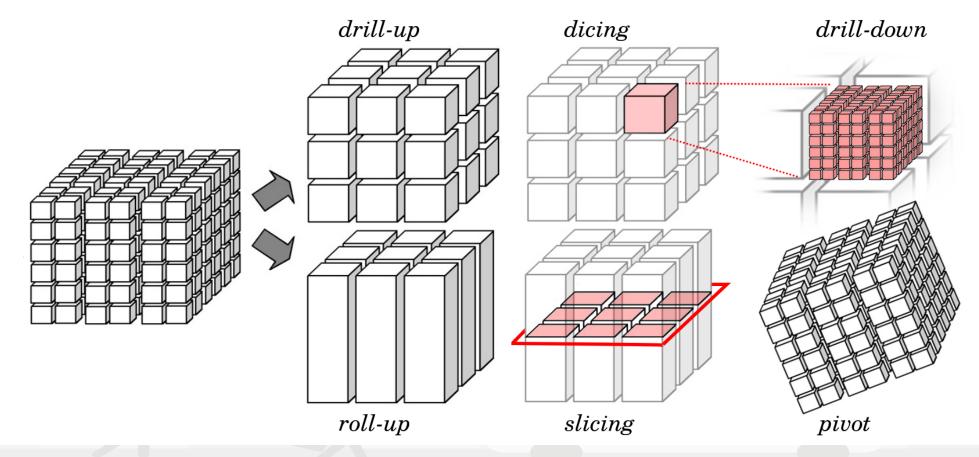
The data cubes

- Using Dashboard Wizard with Widgets all the different transformations may be possible with different representations.
- The IoT App allows to make them Dynamic

Data Rendering vs Control Room Dashboards

- **Business intelligence** mainly focused on making statistics from tabular: no layer, hard relationships, ... Exploit Data Analytic, ETL

- **Visual Analytics**, data understanding
  - Rendering and drill down/up, slicing
  - Faceting/grouping (Elastic Search/SOLR)
    - Cross filtering
  - Interactive, Cross Widgeting

- **Control Room Dashboards:**
  - Need: Visual Analytics, Data Analytic, geospatial reasoning, data driven processing
  - H24, alerting, Flexible rendering, custom widgets, interactive dashboards

Decision Support, Act!
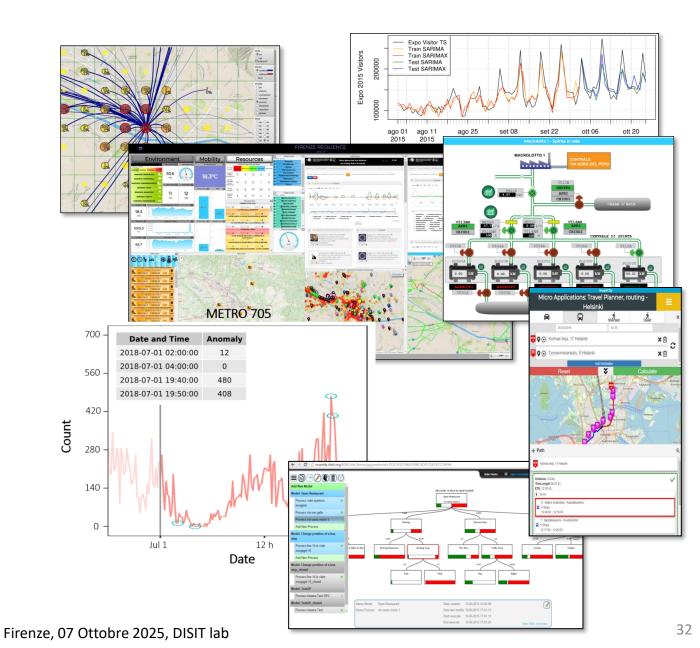
Control Room

- Not only a collection of verticals

- **Exploiting analytics**: prediction, simulations, anomaly detection. ..

  - Big data approach to Data Analytics

- **Connecting Heterogeneous data** to defined strategies and alerting

- **Connected interactive dashboards** for different kind of decision makers: operators and majors

- **What-if Analysis taking into account multiple data sources, scenarios for hyp., KPI!!!!**

  - **simulation is needed**
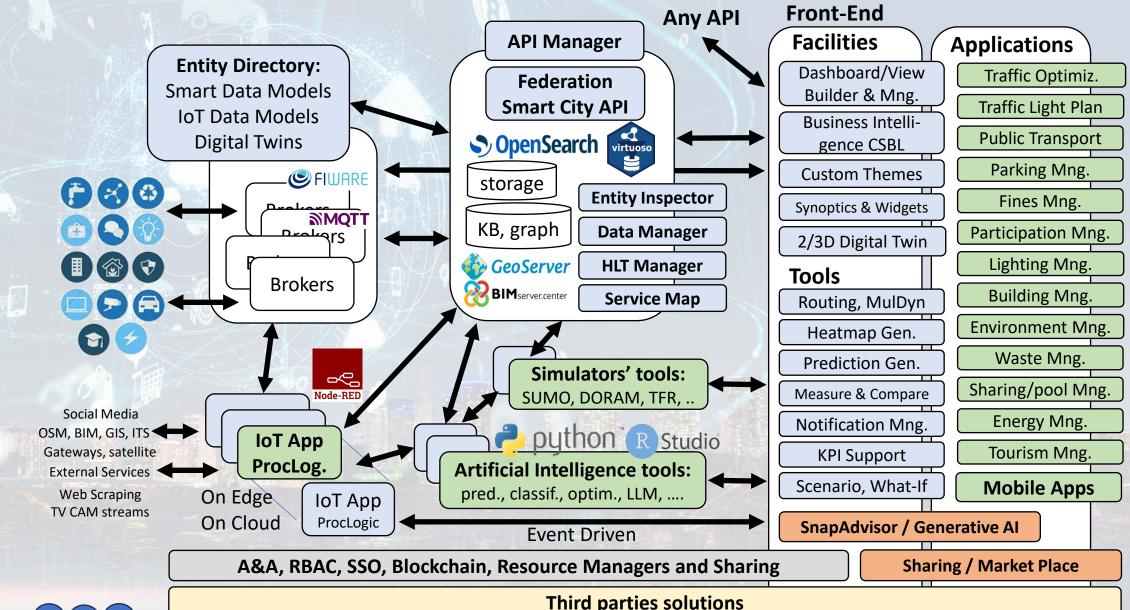
From strategies to Actions

Technical Architecture

Agenda

- Data Modeling, formats
- Public/private data, real time data, Structured and non structured data
- **Data Privacy, GDPR, Data Spaces**
- Data Selection and caratterization: value type, value unit, data type
- Smart Industrial Applications of data
- Data Visualization, Visual Analytics, Business Intelligence, Dashboards
- Esercitazione on defining data models vs data representation
- Test

GDPR: General Data Protection Regulation

Users may decide to:

– provide access to who, for do what, until when consented

– accept terms of use by **signed** consent **for** data management **service**

- Correctness
- Transparency
- Security
- Integrity
- Privacy
- Auditing
- …

From each service, the user is capable to:

– **See** what we collect in terms of Data Type: traces, logs, paths, profiles, accesses, IOT devices, sensors, maps, etc.

– **Download**, **delete**, **inspect** Data

– **Auditing** and **Revoke access** or **grant** access right to each **single Data**

– **Delete all Data in single shot** or singularly (**forget all about me**)

General Data Protection Regulation (2)

- It Substitutes
  - Europe → Directive 95/46/CE
  - Italy → d. lgs. n. 196/2003 (codice per la protezione dei dati personali)

- The following cases are not covered by the regulation:
  - Lawful interception, national security, military, police, justice
  - *Public interest statistical and scientific analysis*
  - Deceased persons (national legislation, consent)
  - Employer-employee (dedicated law, human dignity)
  - Purely personal nature or household activity

Main concepts

The six main principles

1. Lawfulness, fairness and transparency

2. Purpose limitation

3. Data minimisation

4. Accuracy

5. Storage limitation

6. Integrity and confidentiality

Scope (1)

- The regulation applies if the **data controller** (an organization that collects data from EU residents), or **processor** (an organization that processes data on behalf of a data controller – cloud provides), or the **data subject** (person) is based in the EU.

- The regulation also applies to organizations based outside the EU if they collect or process personal data of **individuals located inside the EU**.

- **Data Protection Officer (DPO)** employed in the organization, has responsibilities for advising on GDPR regulation

Scope (2)

- DPO appointment is **mandatory** for
  - Public bodies (excepts courts) and
  - Data controllers and data processors that, as a core activity, monitor individuals *systematically* and on a large scale, or that process *sensitive* data on large scale
- Appointment, position and tasks of DPO are set out in GDPR
  - Expert knowledge of *data protection law* and practice
  - Be involved in *all data protection issues*
  - Report directly to *highest* level of management
  - Operational independence, no conflicts of interest, confidentiality
  - Inform and advice; monitor compliance; point of contact for individuals

Lawful basis for processing (1)

- **Unless** a data subject has provided informed consent to data processing for one or more purposes, personal data may not be processed unless there is at least one legal basis to do so. According to Article 6, the lawful purposes are:
  - If the data subject has **given consent** to the processing of his or her personal data
    - Consent by default is not valid anymore (EXPLICIT consent)
    - Can be removed and controller cannot refuse
  - To fulfill **contractual obligations** with a data subject;
  - To comply with a data controller's **legal obligations**;
  - To protect the **vital interests** of a data subject or another individual;
  - To perform a task in the **public interest** or in **official authority**;
  - For the **legitimate interests of a data controller** or a third party, unless these interests are overridden by interests of the data subject or her or his rights according to the **Charter of Fundamental Rights** (especially in the case of children – 16years old).

Lawful basis for processing (2)

- Public Task: you can process personal data, without consent, to carry out your official functions or a task in the **public interest** - and where you have a **legal basic** for the processing

- **Legitimate Interest**: you can process personal data, without consent, if you have a genuine and legitimate reason to do so

  – Legitimate interest can be for **commercial** benefit

  – GDPR recitals – direct marketing could be a legitimate interest

  – BUT exception if your interests are outweighed by harm to the individual's right and interest (balance it against the individual's interests, rights and freedoms)

Lawful basis for processing (3)

- Consent may be required if you are:
  - Marketing
  - Selling information
  - Transferring data outside EU/EEA
- Consent will NOT be appropriate:
  - Consent is a pre-condition of using the service
  - You would still process personal data using different basis even if consent was withdrawn
- GDPR sets a higher standard for obtaining consent

Responsibility and accountability

- **Compliance** with the GDPR: the *data controller* must implement measures which meet the principles of **data protection by design and by defaul**t.
- Data protection by design and by default (Article 25) require data protection measures to be designed for products and services.
  - i.e. **pseudonymizing** personal data, by the controller, as soon as possible (Recital 78).
  - responsibility of the data controller to implement effective measures and be able to demonstrate the compliance of processing activities even if the processing is carried out by a data processor on behalf of the controller (Recital 74)
  - inform the user about collection
  - **data protection impact assessments** (DPIA, Article 35)
    - identify and minimize the data protection risks of a project

Data protection by design and by default

- (Article 25) requires **data protection to be designed into the development of business processes** for products and services (At the beginning, for the root → easy task for new process, but what about old process?)

- by default: **Privacy settings at a highest level**

- implement mechanisms to ensure that personal data is not processed **unless necessary** for each specific purpose (touch lesser is better)

- encryption and decryption operations must be carried out **locally**, not by remote service (because of keys) and data must remain in the power of the data owner if any privacy is to be achieved.

- outsourced data storage on remote clouds is practical and relatively safe if only the **data owner**, not the cloud service, holds the decryption keys.

DPIA: data protection impact assessments

- **Struttura DPIA:**
  - Executive Summary
  - Obiettivo del Documento e dell'Azione (scambio/accesso/uso dati)
    - Obiettivi, motivazioni
  - Definizioni
  - Contesto Normativo, Normative e Standard di riferimento
  - Perimetro di Applicazione
  - Ruoli e Responsabilità: Conduttore, DPO
  - Durata del trattamento e detenzione dei dati
  - …..vedi next slide….-→

DPIA: aspetti tecnici

- **Segue struttura (aspetti tecnici), draft e non completa**
  - Trattamento dati: Misure di Protezione
  - Trattamento dati relativi a Minori e/o categorie protette
  - Trattamento e Piattaforma dati: descrizione tecnologica
  - Dati Trattati: descrizione
  - Obiettivi perseguiti da chi usa i dati, resa per il fornitore dei dati
  - Modalità di trasmissione dati, da fornitore a utilizzatore
  - Modalità di Utilizzo dei dati
    - Chi accede e come, eventuali liste di accesso, concessioni autorizzazioni, etc.
  - Backup e Continuità del servizio (da ambo le parti, se necessario)
    - Su eventuali ritorni dalle elaborazioni, sui servizi correlati se richiesti dal fornitore, etc..
  - Sicurezza: PENtest, vulnerability, TLS, certification, DB encryption, …
  - Impatto e Rischi: perdita dei dati
  - Accesso e Proporzionalità
  - Firme: DPIA resp, DPO, DPIA reviewer

GDPR verification

GDPR Compliance Verification Feature, partial	Verif.
Signed consent	UI
User profile management and control	UI
Data Type private as default	UI
Rights to access per element	UI
Rights to transfer per element	UI
Rights to erase per element and total	UI
Rights to revoke/change per Data Type	UI
An interface for Right management for Data Type	UI
Clear Terms of Use and Privacy Policy	UI
Auditing Tools for Data Type	UI
Publish as Anonymous	UI
Encrypt personal users' data	Code
Secure Authentication and Authorization	Code
Data protection by Design	Code
Secure connection	Code
Security Control, data breach control, anonymization, etc.	PEN Test

Firenze, 07 Ottobre 2025, DISIT lab

Agenda

- Data Modeling, formats
- Public/private data, real time data, Structured and non structured data
- Data Privacy, GDPR, Data Spaces
- **Data Selection and caratterization: value type, value unit, data type**
- Smart Industrial Applications of data
- Data Visualization, Visual Analytics, Business Intelligence, Dashboards
- Esercitazione on defining data models vs data representation
- Test
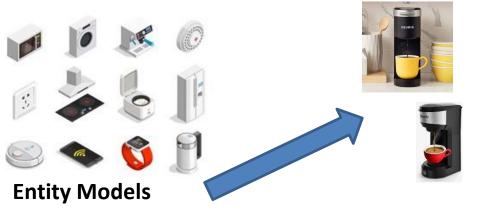
Entities Models and Instances, WoT

Entity Models

Entity Instance
- Name: CM23
- Model: Lavazza
- Position: ....

Entity Variables
- **dateObserved: ....**
- ID: CM23
- Status: ready
- Temperature: 70°
- WaterLevel: 35%
- UsedCapsBox: 30%
- Power: OK
- .....

- Conceptually are entities, IN/IN-OUT

- For Searching and showing on maps and dashboards
  HLT of Entities can be:

  – **Entity Models**, for example: «personal coffee machine»

  – **Entity** name, for example: «mycoffemachine1», «CM23»

  – **Entity Variable**, for example: «Temperature»

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Using the Entity Model notes!!!

- Once performed the Entity Model, a number of Entity Isntances can be produce **using the model as a Template**

  - **NOTE:** the produced Entities are not going to change if the Entity Model is modified.
  - *Your biscuit is not changing if the template is modified after the printout*

Mobile Entities

Mobile Entity Models
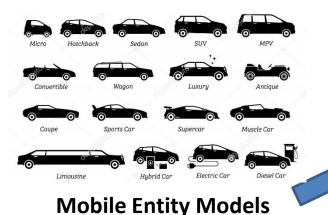
Mobile Entity Instance
- Name: BMWJD7356HD
- Model: BMW 318
- Spec:...

Mobile Entity Variables
- ID: BMWJD7356HD
- **dateObserved: ....**
- Status: ready
- Temperature: 70%
- Gasoline: 35%
- Velocity: 231,3 Km/h
- **Position: 44.3223, 11.3432**
- .....

- They are a special case of devices/entities
  - they are managed as Entities in the system
- For Searching and showing on maps and dashboards, they are different
  HLT of Mobile Entities can be:
  - **Mobile Entity Model**, for example: «sedan»
  - **Mobile Entity Instance** name, for example: «BMW JD7356HD», «Ford KO786KK»
  - **Mobile Entity Variable**, for example: «velocity»

Sensor/Sensor-Actuator

Entity Instance
- Name: CM23
- Model: Lavazza
- Position: …….

data
- **dateObserved: ………..**
- ID: CM23
- Status: ready
- Temperature: 60°
- WaterLevel: 35%
- UsedCapsBox: 30%
- Power: OK
- …..

- For Searching and showing on maps and dashboards
  HLT of Sensors/Sensor-Actuator can be:
  - **Sensor Entity** name, for example: «mycoffemachine1», «CM23»
  - **Sensor/sensor-actuator** is a variable of a Sensor Entity, for example: «Temperature»
- They do not have a model, while, in KB, have a reference process from which their real time data are collected from the field, from gateways, etc..

KPIs, Key Performance Indicators

- **Typically associated with**
  - **City or infrastructure, so that the GPS can be city center**
  - Some date: 2019, march 2019, etc.
- **For example:**
  - Number of Arrivals from France in March 2019
  - Average price for **** hotels in 2019, downtown
  - Net income of the region
  - CO2 saved in the April 2020
  - Total number of vehicles sold in 2020
  - Stock option value of Airport
- **Note that in most cases:**
  - They are time series, change over time, by year
  - they can be managed as *Virtual IoT Devices*

Data from INSETE
Basic Sizes of Incoming Tourism

Regions	Countries Origin	Visits (in thousands)	Receipts (in € million)	Nights (in thousands)	Expenditure / Visit (in €)	Cost / Night (in €)	Average Length of Stay
				Basic Sizes of Incoming Tourism of the Region of Western Greece 2019			
West Hellas	Albania	132.9	26.5	225.8	199.7	117.5	1.7
	United Kingdom	47.7	17.9	345.8	375.2	51.8	7.2
	Germany	70.3	36.4	672.4	517.9	54.1	9.6
	France	55.4	16.5	321.6	298.1	51.4	5.8
	Other	510.7	160.0	2,964.9	313.3	54.0	5.8
	Total	817.0	257.4	4,530.4	315.0	56.8	5.5
	% of the total	2.2%	1.5%	1.9%			

Source: BoG Border Research, INSETE Intelligence Editing

Regions	Countries of Origin	Visits (in thousands)	Receipts (in € million)	Nights (in thousands)	Expenditure / Visit (in €)	Cost / Night (in €)	Average Length of Stay
				Basic Sizes of Incoming Tourism of the Region of Western Greece 2018			
West Greece	Albania	138.7	29.0	222.9	209.2	130.1	1.6
	United Kingdom	42.6	13.5	180.6	317.6	74.9	4.2
	Germany	71.3	26.0	466.5	365.1	55.8	6.5
	France	44.2	13.5	262.9	304.7	51.2	6.0
	Other	402.5	129.8	2,050.7	322.4	63.3	5.1
	Total	699.2	211.8	3,183.5	302.9	66.5	4.6
	% of the total	2.0%	1.4%	1.4%			

Unified Data and Services Model/Classification

Semantic

Nature ← SubNature
SubNature

Technical meaning

Value Type ← Value Unit
Value Unit

- Exists a Dictionary for the 4 categories
- They are related each other and not all values are possible
- **Right setting** leads to right rendering on graphs / dash
- **automated** combinations and processing
- The Dictionary is used by many tools

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For example

Technical meaning

Power
Value Type

Value Unit — mW
Value Unit — KW
Data Type — Integer
Data Type — Float

Link to Friend Sensor as ServiceURI: Value Type

Value Unit — URL
Value Unit — KW
Data Type — String, URL
Data Type — Float

Please note on: Data Type

- Value Types have only a few number of **Data Types** because they represent how the data area treated into the system

- Therefore: main Data Types are:
  - **Float**: numbers with decimals large as you like, etc.

  - **Integer**: numbers, booleans (0/1), etc.

  - **String**: url, links, names, id, descriptions, status code, etc.

  - **Json**: structured data, vector, matrices, etc.

  - …..

IoT Device Model and Devices Data Dictionary: updated at 11/2022

https://www.snap4city.org/818

IoT Device Model and Devices Data Dictionary: updated at 11/2022

View | Edit | Track | Access control | Convert

Any update and addtion to the dictionary of snap4city.org has to be requested to snap4city@disit.org

if you have your own instance of the platform you can define your own dictionary and request a copy of the snap4city.org dictionary

The dictionary is used into the IoT Device Model definition, in mapping smart data models, and in creating full custom devices.

https://www.snap4city.org/drupal/sites/default/files/image_from_word/fil...

value type	Description	possible value Units	Possible Data Types
actuator_canceller	Actuator Canceller		string
actuator_deleted	Actuator Deleted		integer
actuator_deletion_date	Actuator Deletion Date	timestamp	string
air_quality_index	Air quality index		float
altitude	Altitude	m	float,integer
angle	angle	deg	float
annual_C6H6_average	annual_C6H6_average	ppm, mg/m3, µg/m³	float
annual_C6H6_exceedance_count	annual_C6H6_exceedance_count	#	integer,float
annual_CO_average	annual_CO_average	ppm, mg/m3, µg/m³	float
annual_CO_exceedance_count	annual_CO_exceedance_count	#	integer,float
annual_NO2_average	annual_NO2_average	ppm, mg/m3, µg/m³	float
annual_NO2_exceedance_count	annual_NO2_exceedance_count	#	integer,float
annual_O3_average	annual_O3_average	ppm, mg/m3, µg/m³	float

Design: from Data Modelling to Data Ingestion

The Data Models can be simply instantiated from

a) **FIWARE Smart Data Models**, versioning, and harvesting the standard repository

b) **Entity Model / IoT Device Model** which are accessible into the Snap4City environment

c) **Excel files by using Data Table tool**, which extracts the model from the excel table and automatically creates **Entity Model /** IoT Device Model, Entity Instances / IoT Devices and data attached to them

d) Creating a **custom Entity Model / IoT Device Model** in standard Snap4City format via **Entity Directory / IoT Directory**

Connections among Entities

Where	Entity Model (IOT Device Model)	Entity Instance (IOT Device)	Entity Message at 23-12-2019T20:15:00	Entity Message at 23-12-2019T20:30:12
Broker	Broker: **OrionUNIFI**			
Broker	Protocol: **NGSI**			
Info	ID: string	ID: "park45"	park45	park45
Position	GPS: lat, long	GSP: 43.12, 11.34	GSP: 44.1256, 11.1234	GSP: 44.1259, 11.1233
Static attribute	Description: string	Description: "parking massaia"		
Static attribute	MyAddInfoSURI: string	MyAddInfoSURI: "http://…………/InfoPersonal"		
Values	dateObserved: Timestamp		23-12-2019T20:15:00	23-12-2019T20:30:12
Values	FreeSlots: Integer, #		FreeSlots: 345	FreeSlots: 234
Values	TodayCarSURI: string		TodayCarSURI: "http://………/CarNF126GD"	TodayCarSURI: "http://………/CarGF789KK"
Values	Temperature: float, celsius		34	34

Model meaning

- **ID:** is the unique identifier for reconnecting Temporal Instances with registered Entity / Devices
- **Static Attributes:**
  - Are typically associated with instances of the IOT Device.
    E.g.:, You have a set of parking areas, each of them is located in a specific street, and has its one name, etc.
  - Different kinds of attributes can be set for each SubNature. Their definition has to be prepared into the Knowledge Base ☺ for automated indexing.
- **Values**: they are time varying variables (temporal values/instances)
  - They change over time, the timestamp of the time series is conventionally «dateObserved» in Snap4City
  - In new *SensorMobile* HLT, also GPS can be changing over time as in the MyKPI
- **NOTE for:**
  - **names/IDs**: Spaces or strange characters are not allowed in the. Please use simple alfphanumeric strings, it is a limitation of many solutions including Orion Broker and increase interoperability of your data.
  - **Values of attributes and variables**: can be UTF8, but similarly, they do not accept: () <> " ' ; = into values
  - https://fiware-orion.readthedocs.io/en/master/user/forbidden_characters/index.html
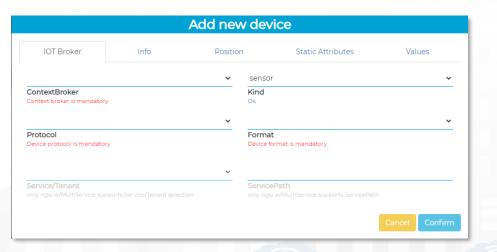
Entity / Device Model (1)
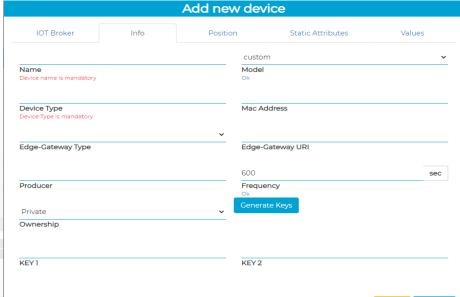
- IOT Broker
  - Name of the Brokers: among those registered
  - Protocol: NGSI, AMQP, MQTT, etc..
  - Format: CSV, JSON, XML.
  - Service/Tenant:………..
  - ServicePath:………

- Info
  - Name (Identifier)
  - Model: Custom or Model ID
  - DeviceType: ..a string..
  - MAC address: …optional…
  - Edge-GW: Raspberry, Android, …
  - Edge-GW: URI
  - Producer
  - Owner
  - Freq: ….. Sec
  - Keys: K1, K2
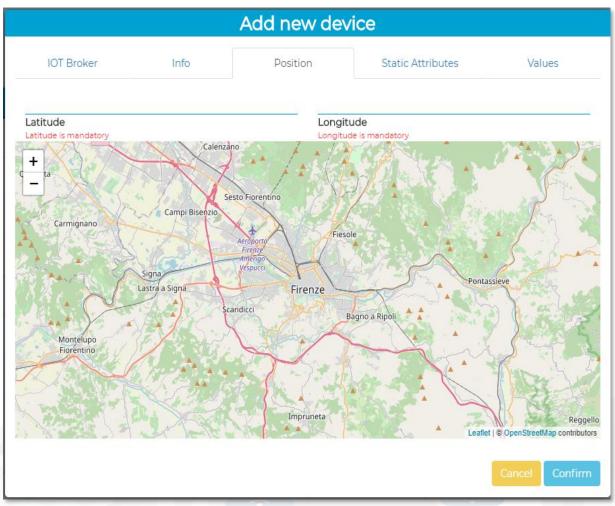
Entity / Device Data Model (2)

Agenda

- Data Modeling, formats
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- Data Privacy, GDPR, Data Spaces
- Data Selection and caratterization: value type, value unit, data type
- **Smart Industrial Applications of data**
- Data Visualization, Visual Analytics, Business Intelligence, Dashboards
- Esercitazione on defining data models vs data representation
- Test

Some Real Cases from DISIT Lab

- **Smart Manufacturing**: PINN per la fluidodinamica, etc.
- **Smart Retail:** raccomandazioni, suggerimenti per il retail,
- **User Behavior:** People Counting and Trajectories, termiche per la sicurezza, il conteggio e la stima di traiettorie, etc.
- **Predictive maintenance**: predizione della manutenzione in impianti a produzione continua
- **Predictions on Time Series**: traffic, pollution, presenze, parcheggi, consumi, costi, etc.; ALSO for **early warning:** accidents, maintenance, e
- **Routing Optimization**: reduction of costs, waste collection optimization, pooling, delivering optimization, optimisation of resources, etc.
- **Traffic Light Optimization**: semafori con RL, infrastrutture (generative A
- **What-if-Analysis and Infrastructure Optimization**.
- **Virtual Assistant:** text analysis e classificazione, predizione della probabilità di mediazione, richieste in linguaggio naturale su testi forniti c LLM
- **Digital Twin**: 3D production and optimized rendering, Virtual Reality, Augmented Reality, etc.

Firenze, 17 Ottobre 2025, DISIT lab

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UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

TUSCANY X.0

EDIH | European Digital Innovation Hubs Network

Finanziato dall'Unione europea NextGenerationEU
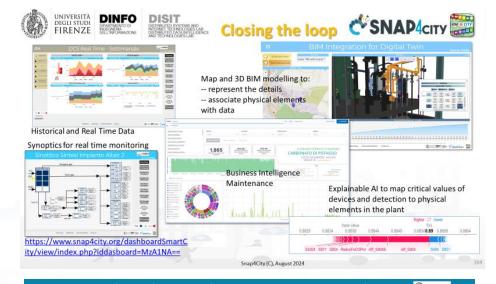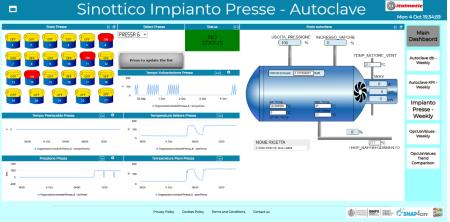
Industry production Domain (2025/5)

- Goals:
  - Cost reduction, increase control on production
  - Production optimisation
  - Quality Level
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring KPI: admin., production, commercial, faults, etc.
  - Early detection/warning, alarm, of critical conditions. Multichannel Event reporting: email, Telegram, mob apps, etc.
  - Managing maintenance operation, predictive maintenance
  - Simulation of Fluid dynamic on Autoclaves (the 9th October)
  - Recommendations for sales (the 9th October)
  - LLM RAG Generative AI assistant (the 9th October)
- Solutions for Planning (optimization and what-if analysis)
  - Generative AI and predictive AI for production plan optimisation
  - Reduction maintenance costs, reduction of critical SLA conditions, improving quality level
- Algorithms and computational solutions

The Power of Artificial Intelligence at the Service of Your Operation and Plan

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB | SNAP4INDUSTRY | KM4CITY

| COMMERCIAL MARKETING AI ADVISOR DSS | ENERGY, eVEHICLES, BUILDING | MOBILITY AND TRANSPORT | CUSTOMER BEHAVIOUR | ENVIRONMENT AND WASTE MANAGEMENT |

DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING

| DASHBOARDS, WIDGETS TEMPLATES | PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC... | API - MICROSERVICES - GIS - BPM VIDEO - REPORTS - MAPS - 3D ... |

ANY: DATA, BROKER, NETWORK AND VERTICAL

EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE

BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING
OPERATIVE RESEARCH, STATISTICS

VISUAL PROGRAMMING, ADAPTERS
DATA FLOWS, WORKFLOWS
PARALLEL DISTRIBUTED PROCESSING
DATA DRIVEN

METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS

CONTROL ROOM — ADMIN — MAINTENANCE — SHOPS — PLC — SERVER — DCS/SCADA — MES — LOGISTICS — MARKET AREAS — WASTE — DRONES — ENERGY — ENVIRONMENT — CO_2
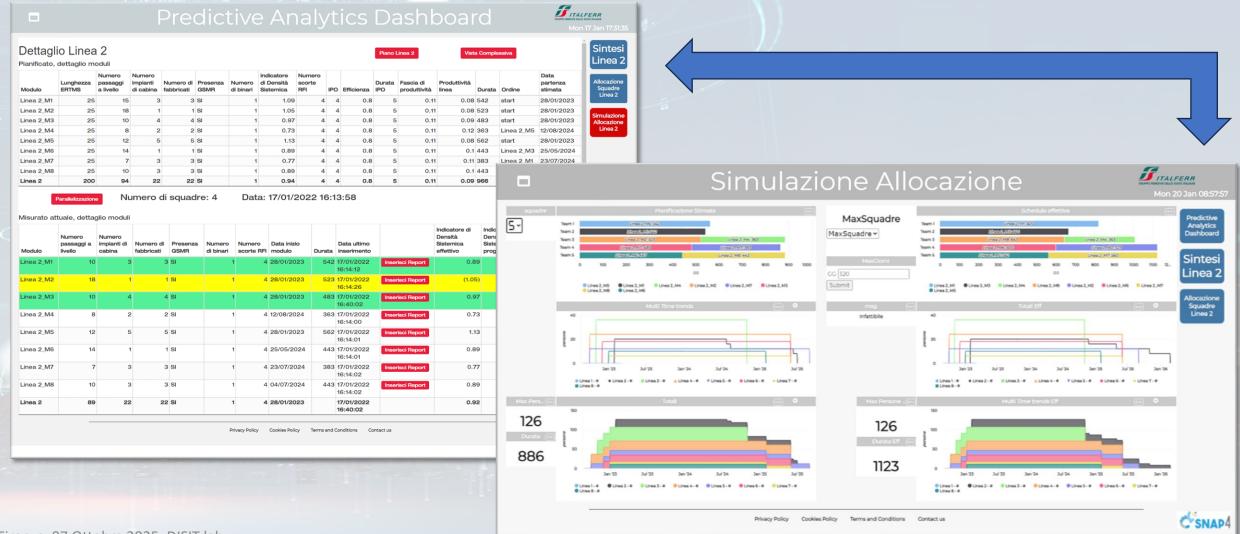
ITALFERR: Application to support decision-making processes to allocate human resources in the work plan
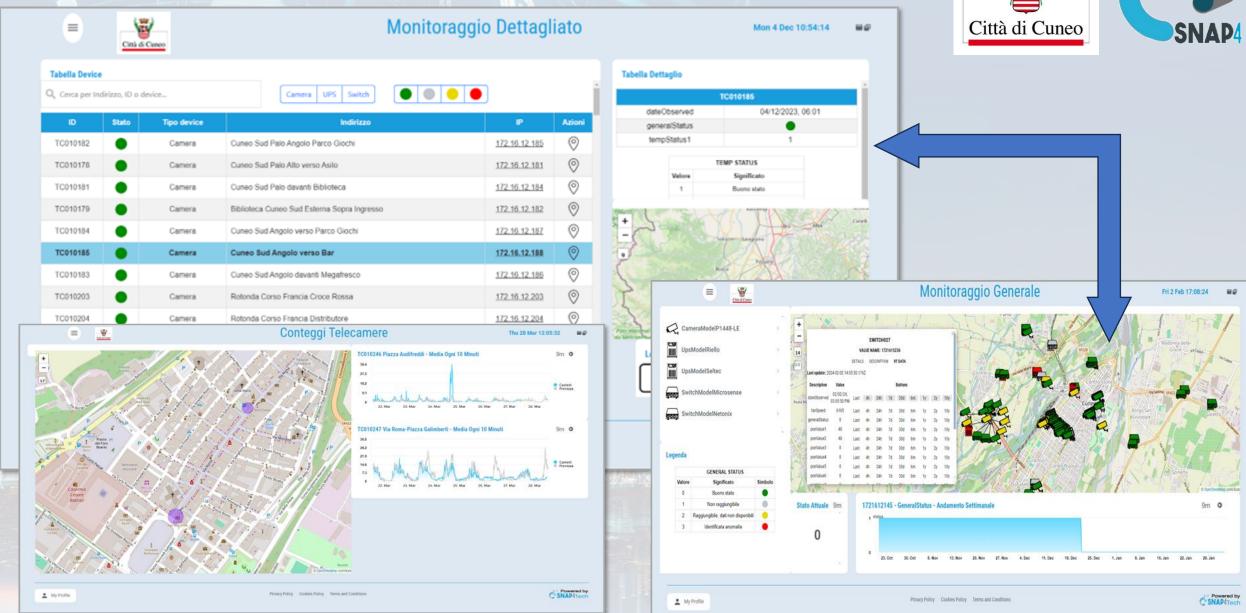
ICT Assets Control: CUNEO Municipality
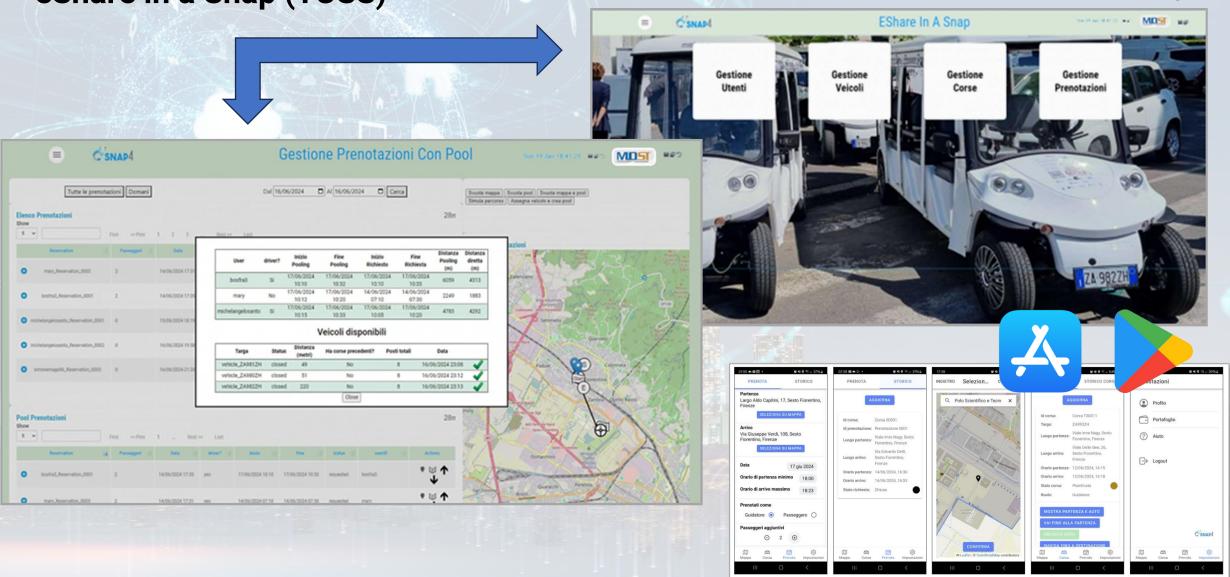
Car Sharing and Polling, Fleet Management

- **eShare in a Snap (TUSS)**

Snap4Altair Decision Support supervision and control, Industry 4.0

- **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

- **Since 2020**

Industry Plant Supervision and Maintenance
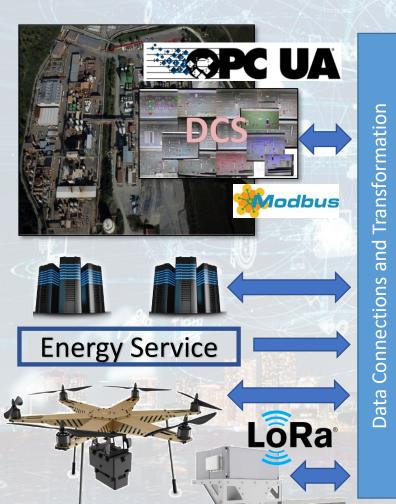
Aims
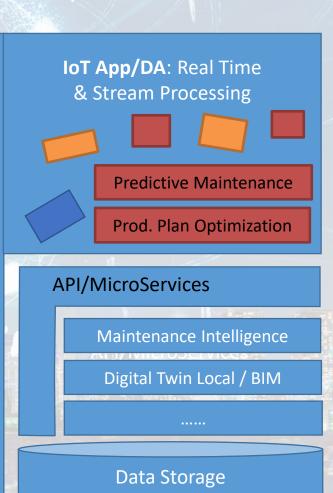
- **Control Room**: Higher level supervision and monitoring (since 2020)
  - Management of Production Plan *Optimization*
  - Control of Perimeter with drone and sensors
- **Maintenance ticketing** (since 2017)
  - *predictive* (in development)
  - 3D Digital Twin (in development)
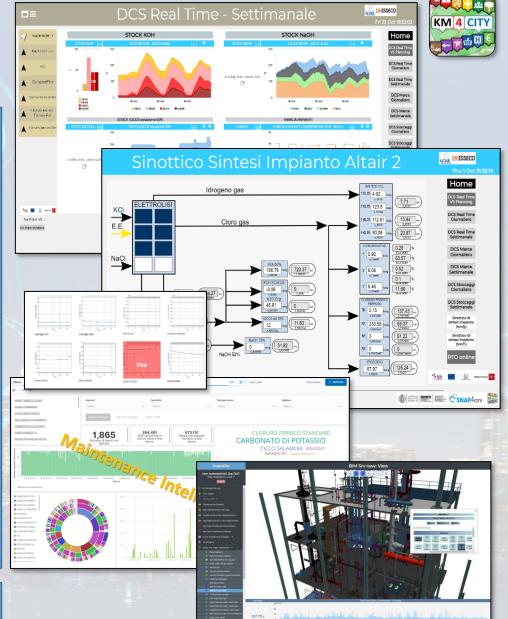
MicroService Architecture

Production vs Planning

Real Time Production Synoptic

Possible Plans

Plant Management
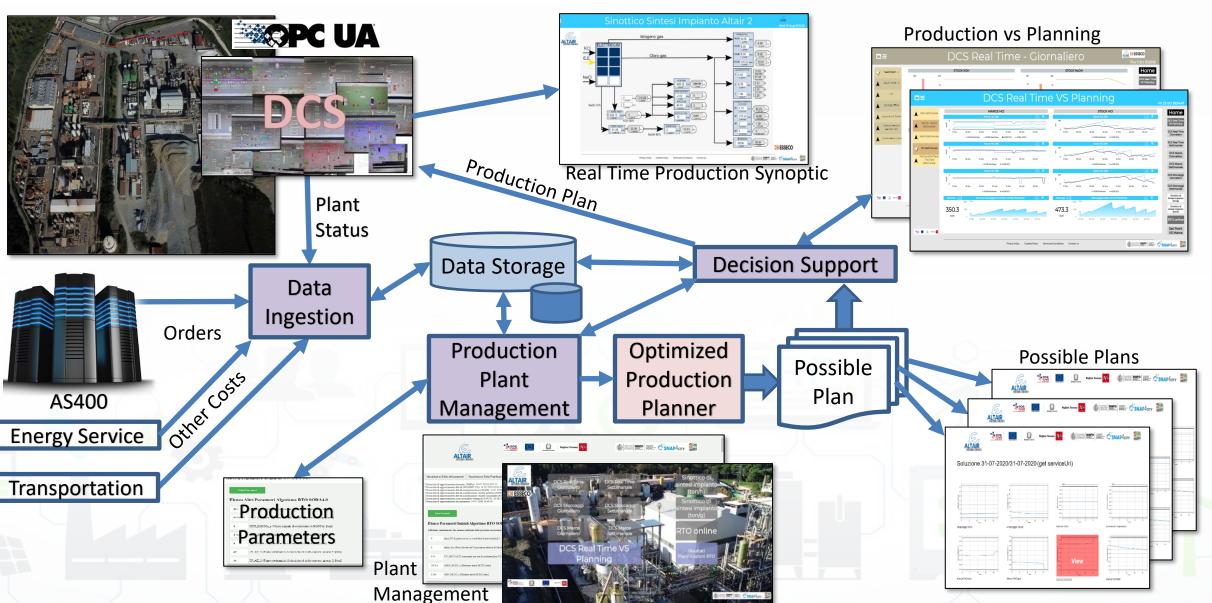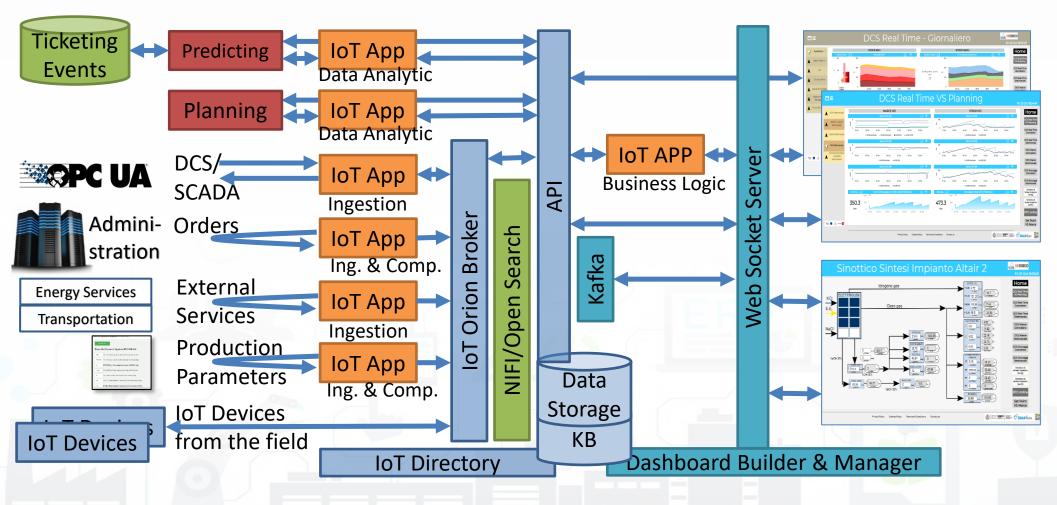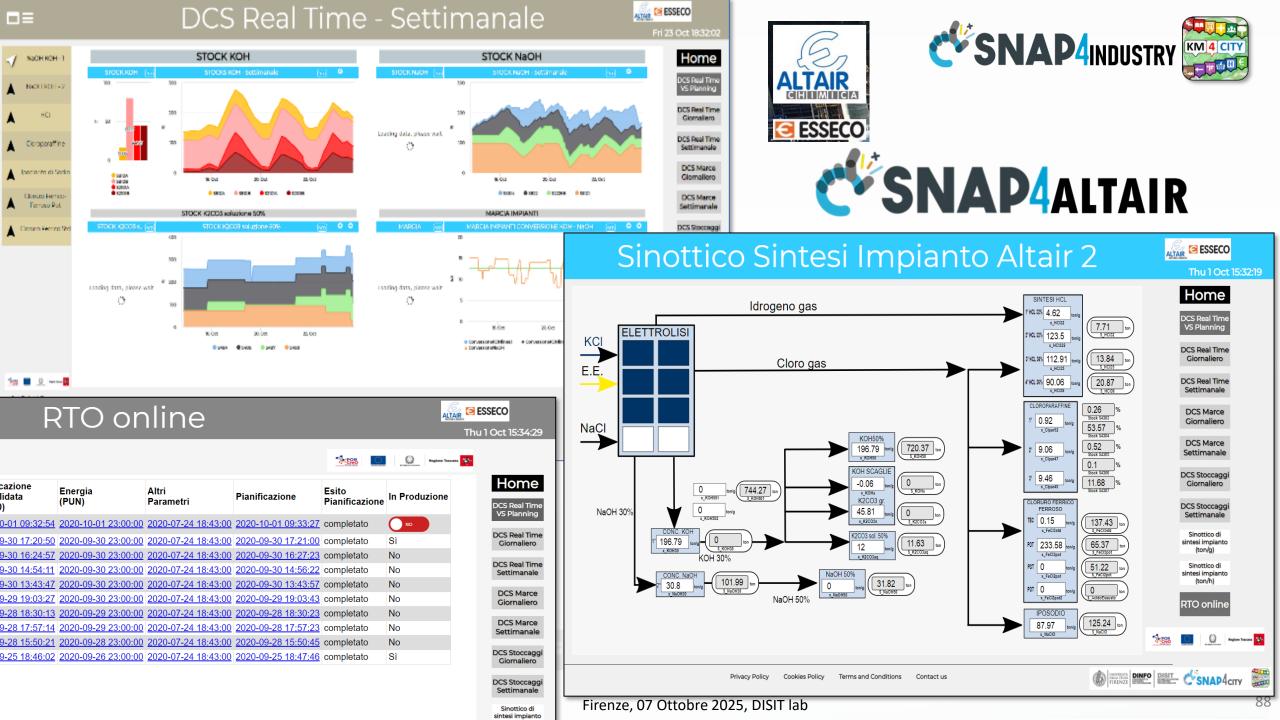
Snap4Industry IOT Architecture

Business Logic
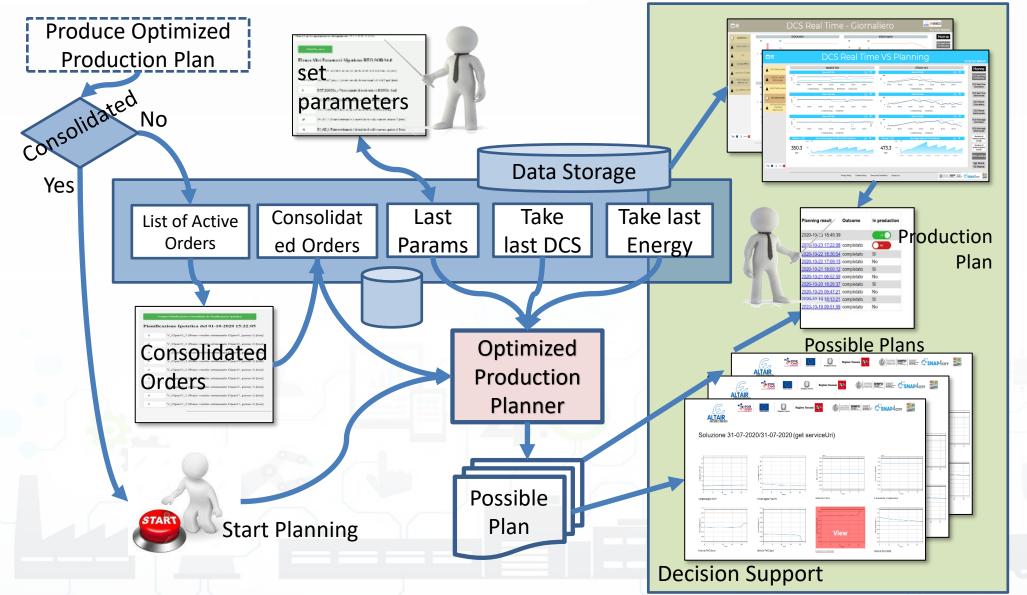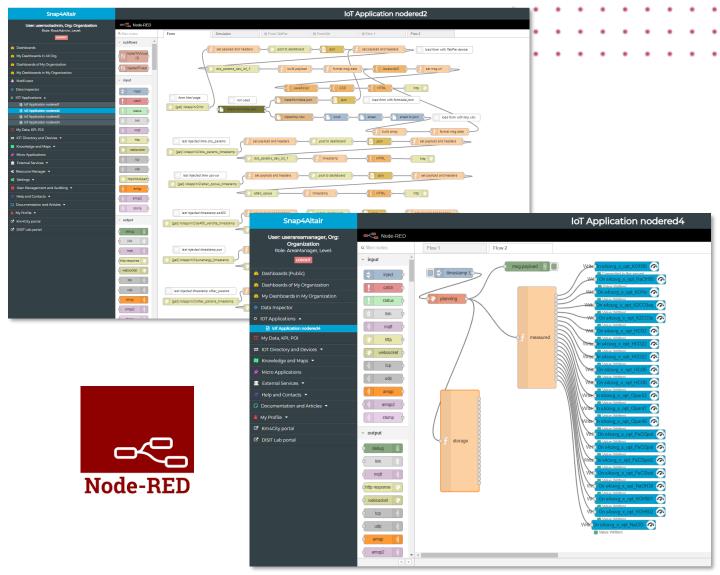
Snap4City/Industry IoT Apps

- Integration
  - Connection with Brokers, GWs, External services
- Data Driven Processing
- Data Analytics Manag.
- Smart City API
  - Search, discovering
  - Routing, Picking
- Dashboard Business logic
- Workflow, Digital Twin
- Management
- Scheduling
- …etc…
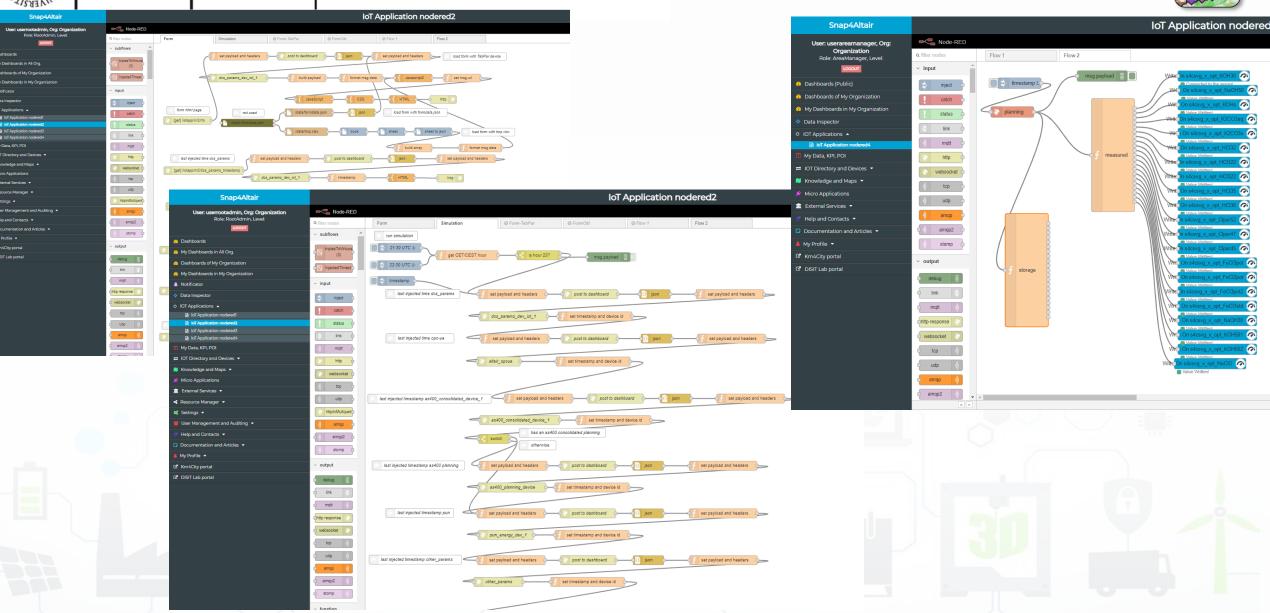
Some Flows
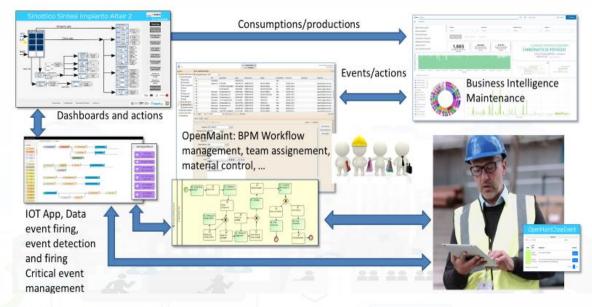
Snap4City Maintenance Solution

- **OpenMaint** open source solution for property & facility management which is a BPM;
  - Inventory of industry assets (movable, logistics, equipment, etc.)
  - Tickets management for corrective maintenance
  - User management with different levels of access
  - BIM Server integrated with OpenMaint
- **Snap4City OpenMaint Extension**
  - **Extended API** developed by Snap4City
    - Create new tickets
    - Manage steps, workflow
    - Collecting feedbacks and results from teams
    - Manage all phases of the workflow on the fields via IOT Apps and logics
    - The integration if via API and MicroServices into IOT App.
  - **MicroServices** integrated with Snap4City via IOT Applications
- **Business Intelligence** which is the **Snap4City tool based on** Elastic Search: which work on top of the database of tickets collected on OpenMaint
- **BIMServer** integration with Snap4City Dashboards;
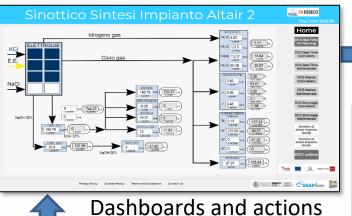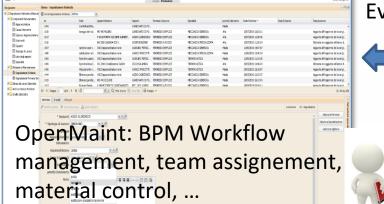
Example of Integrated workflow
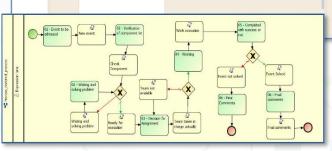
Consumptions/productions

Events/actions

Business Intelligence Maintenance

Dashboards and actions

OpenMaint: BPM Workflow management, team assignement, material control, …
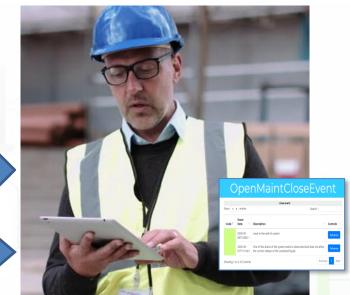
IOT App, Data event firing, event detection and firing Critical event management
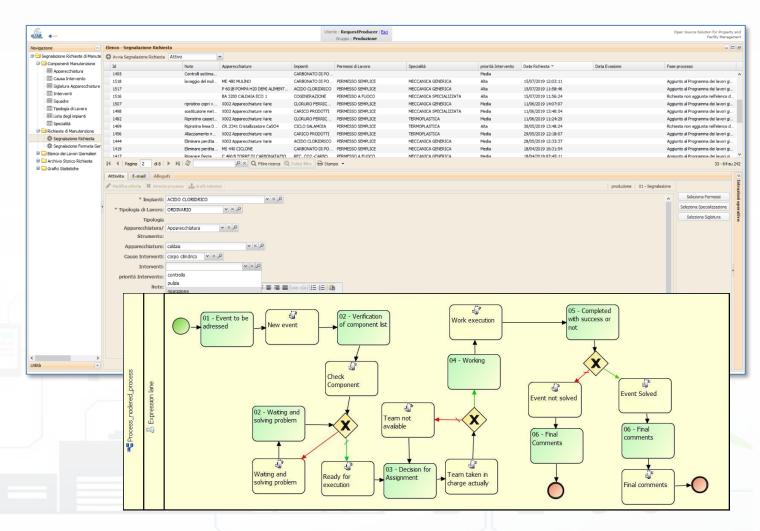
Integration with Ticketing Systems Workflow

- **Snap4City is integrated with OpenMaint Ticketing system. An Open Source solution for ticketing and workflow management, incident management.**

- Any ticketing systems can be integrated with Snap4City, by means of IOT Applications and Dashboards

- https://www.snap4city.org/597
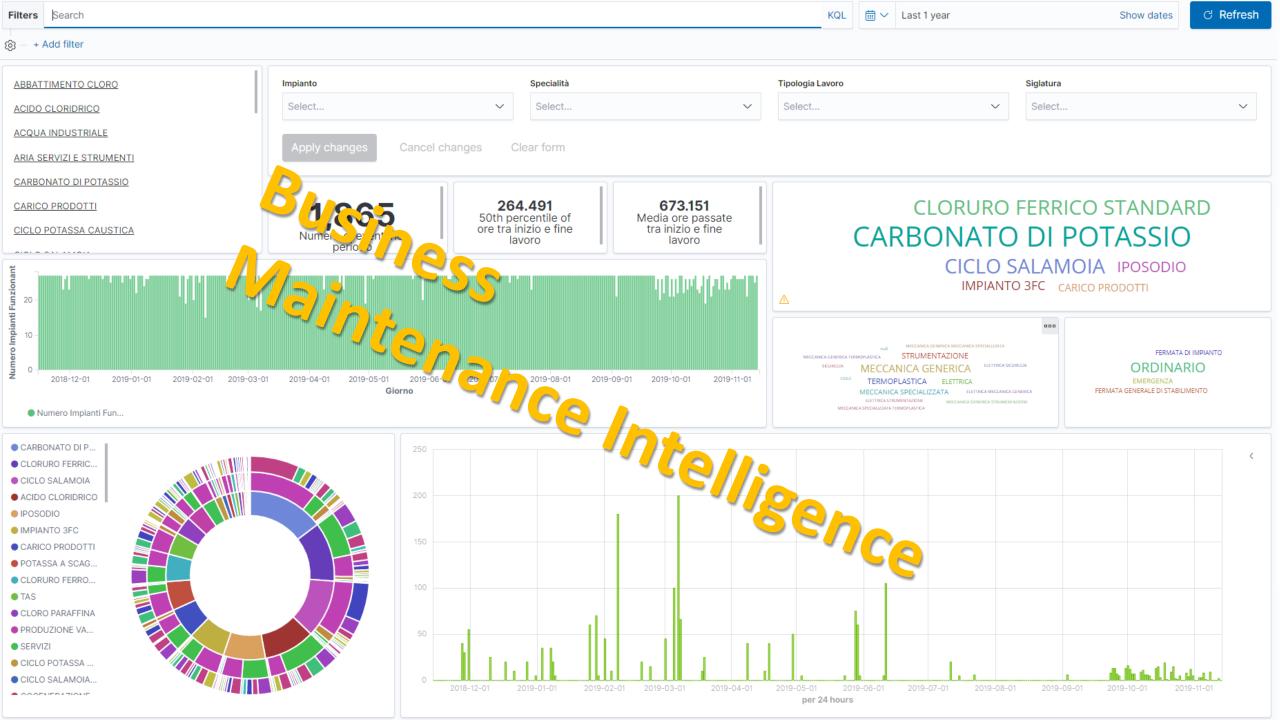
Solution for Asset Management and Maintenance
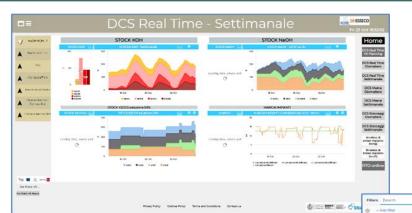
- Inventory of industry assets (movable, logistics, equipments, etc.)

- Tickets management for corrective maintenance

- Reports and Dashboards

- Predictive maintenance and Early Warning support via analytics

- Business Intelligence support

- User management with different levels of access

— + Add filter

ABBATTIMENTO CLORO

ACIDO CLORIDRICO

ACQUA INDUSTRIALE

ARIA SERVIZI E STRUMENTI

CARBONATO DI POTASSIO

CARICO PRODOTTI

CICLO POTASSA CAUSTICA

Impianto
Select...

Specialità
Select...

Tipologia Lavoro
Select...

Siglatura
Select...

Apply changes   Cancel changes   Clear form

264.491
50th percentile of ore tra inizio e fine lavoro

673.151
Media ore passate tra inizio e fine lavoro

CLORURO FERRICO STANDARD
CARBONATO DI POTASSIO
CICLO SALAMOIA   IPOSODIO
IMPIANTO 3FC   CARICO PRODOTTI

Numero Impianti Funzionant (y-axis, values 0, 10, 20)

Giorno (x-axis: 2018-12-01, 2019-01-01, 2019-02-01, 2019-03-01, 2019-04-01, 2019-05-01, 2019-06-01, 2019-07-01, 2019-08-01, 2019-09-01, 2019-10-01, 2019-11-01)

● Numero Impianti Fun...

null
MECCANICA GENERICA MECCANICA SPECIALIZZATA
MECCANICA GENERICA TERMOPLASTICA   STRUMENTAZIONE
SICUREZZA   ELETTRICA SICUREZZA
EDILE   MECCANICA GENERICA
TERMOPLASTICA   ELETTRICA
MECCANICA SPECIALIZZATA
ELETTRICA STRUMENTAZIONE   ELETTRICA MECCANICA GENERICA
MECCANICA GENERICA STRUMENTAZIONE
MECCANICA SPECIALIZZATA TERMOPLASTICA

FERMATA DI IMPIANTO
ORDINARIO
EMERGENZA
FERMATA GENERALE DI STABILIMENTO

● CARBONATO DI P...
● CLORURO FERRIC...
● CICLO SALAMOIA
● ACIDO CLORIDRICO
● IPOSODIO
● IMPIANTO 3FC
● CARICO PRODOTTI
● POTASSA A SCAG...
● CLORURO FERRO...
● TAS
● CLORO PARAFFINA
● PRODUZIONE VA...
● SERVIZI
● CICLO POTASSA ...
● CICLO SALAMOIA...

(x-axis: 2018-12-01, 2019-01-01, 2019-02-01, 2019-03-01, 2019-04-01, 2019-05-01, 2019-06-01, 2019-07-01, 2019-08-01, 2019-09-01, 2019-10-01, 2019-11-01)
(y-axis: 0, 50, 100, 150, 200, 250)

per 24 hours

Business Maintenance Intelligence

Predictive Maintenance

Historical and Real Time Data

Synoptics for real time monitoring

Map and 3D BIM modelling to:
-- represent the details
-- associate physical elements
with data

Business Intelligence
Maintenance
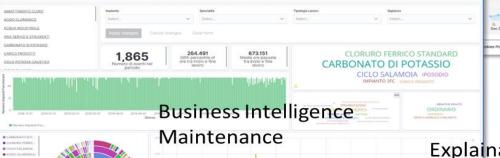
Explainable AI to map critical values of
devices and detection to physical
elements in the plant

https://www.snap4city.org/dashboardSmartC
ity/view/index.php?iddasboard=MzA1NA==

Complex cause-effect relationships

- **Elements:**
  - Machines: A...C
  - Storage: silos...
  - Flows:...
- **Dependencies**
  - Cascade effects
- **Early warning**
  - Reduction of costs
  - Recovering from failure is more expensive than correcting in advance
  - Possible advanced replan and reschedule: secondary solutions
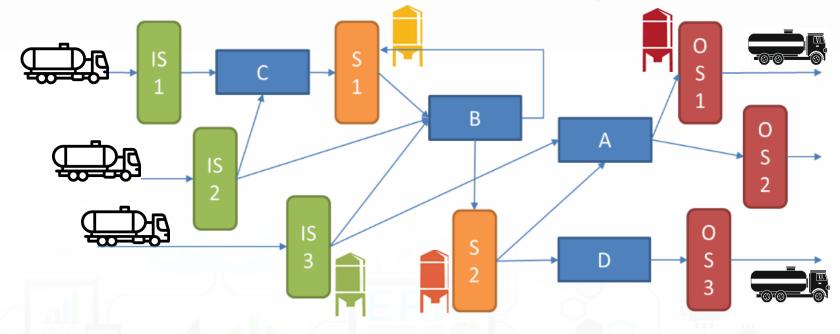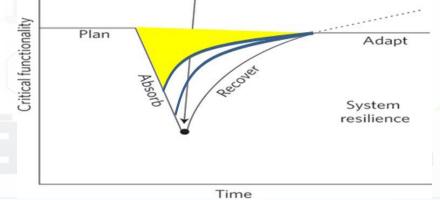
Workflow

Data acquisition Production - Maintenance

Feature selection, Feature engineering

CNN-LSTM Training

Validation AI Model

CNN-LSTM Engine

F/NF

Explainable/XAI (Shap)

{features (t)}

Business Intelligence for Maintenance

Classification Model

integration of workflow management system for maintenance with general control systems and data flow

Structure of the plant

Decision making on more cases

KPI

CNN: Convolutionary NN
LSTM: Long Short-Term Memory
(deep learning model)

Solution

Plant Status

DCS

Real Time Production Synoptic

Dashboard for Production Control

Business Intelligence Maintenance

Control Supervisor

Business Logic
IoT App

OpenMaint

API

Data Storage   Elastic Search

IoT App

IoT App

Business Logic 2

Predictive Maintenance

Predictive Training

Preditive capabilities

- Deep Learning: LSTM, CNN-LSTM approached

- Explainable AI: Identification of possible causes of fault

	Precision %	Recall %	F_1 score %
weighted avg	0.90	0.92	0.90
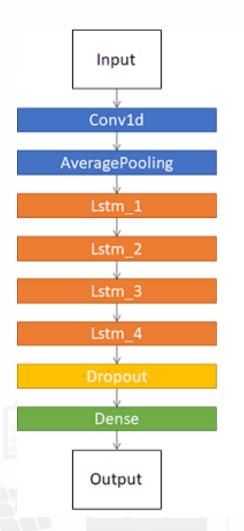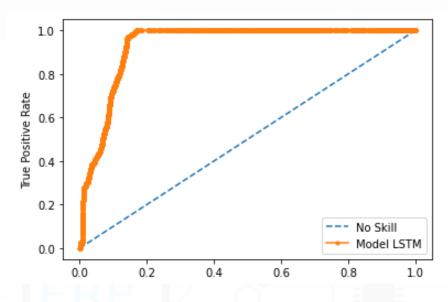
Classification model CNN-LSTM

Layer (type)	Output Shape	Param #
conv1d (Conv1D)	(None, 20, 64)	8320
average_pooling1d (AveragePo	(None, 10, 64)	0
lstm (LSTM)	(None, 10, 200)	212000
lstm_1 (LSTM)	(None, 10, 200)	320800
lstm_2 (LSTM)	(None, 10, 200)	320800
lstm_3 (LSTM)	(None, 10, 200)	320800
lstm_4 (LSTM)	(None, 100)	120400
dropout (Dropout)	(None, 100)	0
dense (Dense)	(None, 1)	101

Total params: 1,303,221
Trainable params: 1,303,221
Non-trainable params: 0
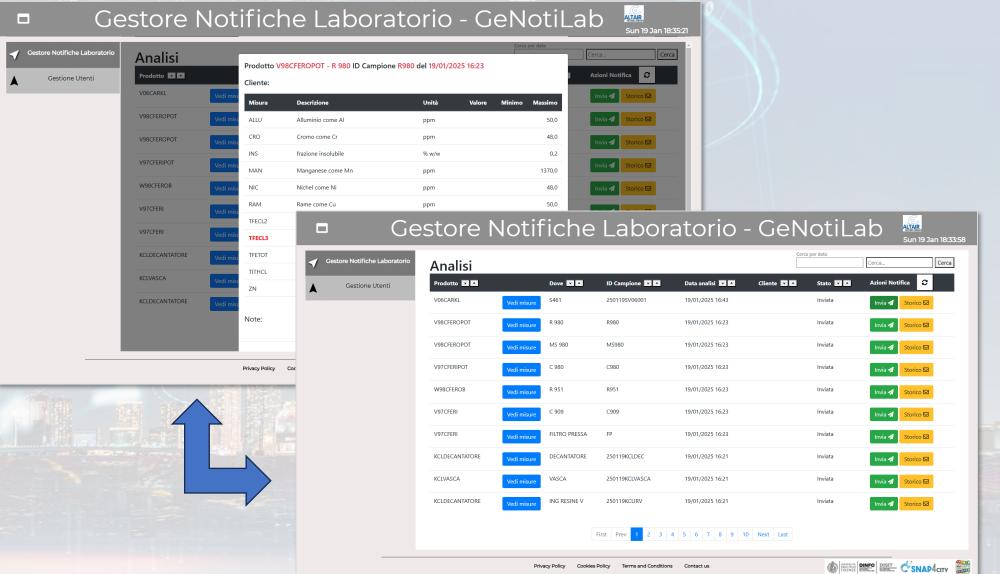
Predicted Class Actual Class	Normality	Fault
Normality	45811	903
Fault	3306	1376

	Precision %	Recall %	F_1 score %
weighted avg	0.90	0.92	0.90

GENOTILAB: Smart production process control

EN.TE.R.PR.I.S.E.

(**EN**hanced **TE**chnological **R**&D of new **PR**oducts and Processes for **I**nnovation, **S**mart factory and green **E**conomy)
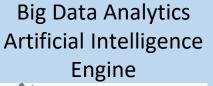
Administrative Data from AS400

Real Time Data, Historical, Events from DCS

Unique National Energy Costs (PUN)

Big Data Analytics Artificial Intelligence Engine

Analytical Data from the product quality Lab (LIMS/SAM)

GeNotiLab

GeNotiLab Architecture for ALTAIR

Analytical Data from the product quality Lab(LIMS/SAM)

AS400

IOT App

Users

Analysis

Notifications

IOT App Analytics

Dashboards

IOT App Management

Tools:
-- List of Chemical Analyses
-- List of Notifications
-- Define notifications
-- Program, send notifications
-- see notification status

IOT App Vs Telegram

Telegram Bot

Sinottico Impianto

Sinottico Impianto Presse - Autoclave

Mon 4 Oct 15:34:59

http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MTk=

Jewel Alarms
AMPERE

BLE

Click on Jewel

NFC

Ampere user list

Fri 15 Apr 11:49:19

Filters

Filter by Age   Filter by Status   Filter by Language

Show 5   Search:

Name	Surname	Ethnicity	Language	Age	Status	DateObserved
Daniele	Bologna	European	Italiano	33	not_active	2022-04-06T14:19:41.050Z

Email: dbologna120@gmail.com

Phone: 3381122333

Controls: See

Hdhdbdb	didjdj		Italiano		not_active	2022-04-10T09:43:45.016Z
Francesco	Vill		Italiano		not_active	2022-04-14T13:47:56.708Z
Mini Long	Mini Long		English	28	not_active	2022-04-14T18:56:49.203Z

First << Prev 1 2 3 Next >> Last

Link to "Ampere User Mana...

Ampere User Management

Fri 15 Apr 12:09:11

Anagraphic data:
- **Name:** Mini Long Mini Long
- **phone number:** 1250666585
- **Day of birth:** 1994-11-11
- **Address:** Fi
- **City:** Fi
- **locality:** Fi
- **Gender:** male
- **Language:** English
- **Ethnicity:**
- **Height:**
- **Weight:**

Healthcare data:
- **Medication:**
- **Vision Impaired:** false
- **Wheel Chair User:** false
- **Allergies:** No

Emergency number:
- **Call 112:** false
- **Call 115:** true
- **Call 118:** true

Contacts:
- **Contact name 1:** Longo Longo
- **Phone number:** 4588665556

User Metadata

Show 5   Search:

	Status	Description	Try
	Called: Longo Longo		
	Called: Longo Longo		
	Called: 118		
	alert		Pin Action

List of user event's

Show 10   Search:

Data Observed	DeviceId	Status	Description	Try
2022-04-11T13:56:29.952Z	Operator	Called: S Sev		
2022-04-11T14:37:52.656Z	APP	alert		Pin Action
2022-04-11T14:38:24.112Z	Operator	Called: 118		
2022-04-12T08:16:46.076Z	APP	alert		Pin Action
2022-04-13T12:07:27.586Z	Operator	Called: 118		
2022-04-13T15:16:45.987Z	Operator	Called: Daniele Bologna	test_description	
2022-04-14T13:00:15.680Z	Operator	Called: 115	new action	
2022-04-14T13:19:18.118Z	Operator	Called: 115	test new action	
2022-4-11T15:18:47.000Z	Operator	Called: M Bol		
2022-4-11T15:21:6.000Z	Operator	Called: 112		

First << Prev 1 2 3 Next >> Last

- **Height:** 170
- **Weight:** 70

Operator Actions   ✕

Call User:
○ Daniele Bologna (3381122333)

Call Contacts:
○ M Bol (057123693966)
○ S Sev (255249146)

ER Numbers:
○ Call 115
○ Call 112
○ Call 118

Description:

Cancel   Confirm

Show 10   Search:

Data Observed			Try
2022-04-11T13:56:29.952Z			
2022-04-11T14:37:52.656Z			Pin Action
2022-04-11T14:38:24.112Z			
2022-04-12T08:16:46.076Z			Pin Action
2022-04-13T12:07:27.586Z			
2022-04-13T15:16:45.987Z			
2022-04-14T13:00:15.680Z			
2022-04-14T13:19:18.118Z			
2022-4-11T15:18:47.000Z			
2022-4-11T15:21:6.000Z	Operator	Called: 112	

Logged in as:
edoardo_tester

👤 Your Profile

Logout

SnapAssistant model:

Llama3.3 ⌄

New Chat

EdoChat1

EdoChat2

EdoChat3

EdoChat4

prova

chatNuova

chatTest1LLAMA

chatTest2LLAMA

testGianniLLAMA

testTastoInvioPreChanges

ChatTestPostPSWINVIO

SnapAdvisor

Current chat: debug0

Visualize references

Personal Advisor LLM

👤 Come creo una dashboard?

🖥 Per creare una dashboard, puoi utilizzare la piattaforma Snap4City. La dashboard si compone di un insieme di widget grafici che possono essere impostati separatamente assegnando una serie di parametri, come origine dati, dimensioni, colori, forma, font, allarmi, relazioni con altri, ecc. (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Inoltre, la piattaforma offre la possibilità di creare vere e proprie applicazioni interattive, multipagina/multidashboard, e non semplici storie monopagina da scrollare. Puoi anche condividere la dashboard con altri utenti anche fuori dalla Smart City Control Room tramite canali autenticati e protetti in HTTPS, in accordo al GDPR (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Per vedere alcuni esempi di dashboard, puoi visitare il sito https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU0Mg== (SOURCE: Snap4 City 1st Overview v4 8 annot). Tuttavia, non ho trovato informazioni dettagliate sulla procedura di creazione di una dashboard. Se hai bisogno di ulteriore assistenza, ti consiglio di contattare direttamente il team di supporto di Snap4City. Non so dirti altro in merito.

Write a message...

SnapAdvisor: AI based Assistants, DSS

- **Sna4CityAdvisor:**
  - for developers and promoters knowing all Snap4City and DISIT Lab literature, articles, manuals, slides, codes, etc. The SnapAdvisor with this skill is accessible only for selected Snap4City users. It allows users of saving a lot of time by providing answers to facilitate the development of smart solutions, to the exploitation of Snap4City tools, and recently on data and services accessible on the platform, producing offers, etc.

- **Legal Advisor**
  - expert on specific disputes at service of the Legal department of Careggi Hospital of Florence. It allows to save time in recovering precise information from complex legal documents, ordering of events, understanding causes and effects, producing reports, etc.

- **Expert of industrial machines, user manuals, technical manuals, rules,**
  - Answering on technical manuals

- **Complains and Questionnaire analysis**
  - Answering on trends, via questionnaires collected via QR, blobs, emails, etc.

- **Commercial Advisor:**
  - processing orders understanding them and preparing the offer, thus reducing the time to process them.

- **Generative Designs**:
  - Multimodal Generative AI supporting designers in producing innovations

- etc.

Agenda

- Data Modeling, formats
- Public/private data, real time data, Structured and non structured data
- Data Privacy, GDPR, Data Spaces
- Data Selection and caratterization: value type, value unit, data type
- Smart Industrial Applications of data
- **Data Visualization, Visual Analytics, Business Intelligence, Dashboards**
- Esercitazione on defining data models vs data representation
- Test
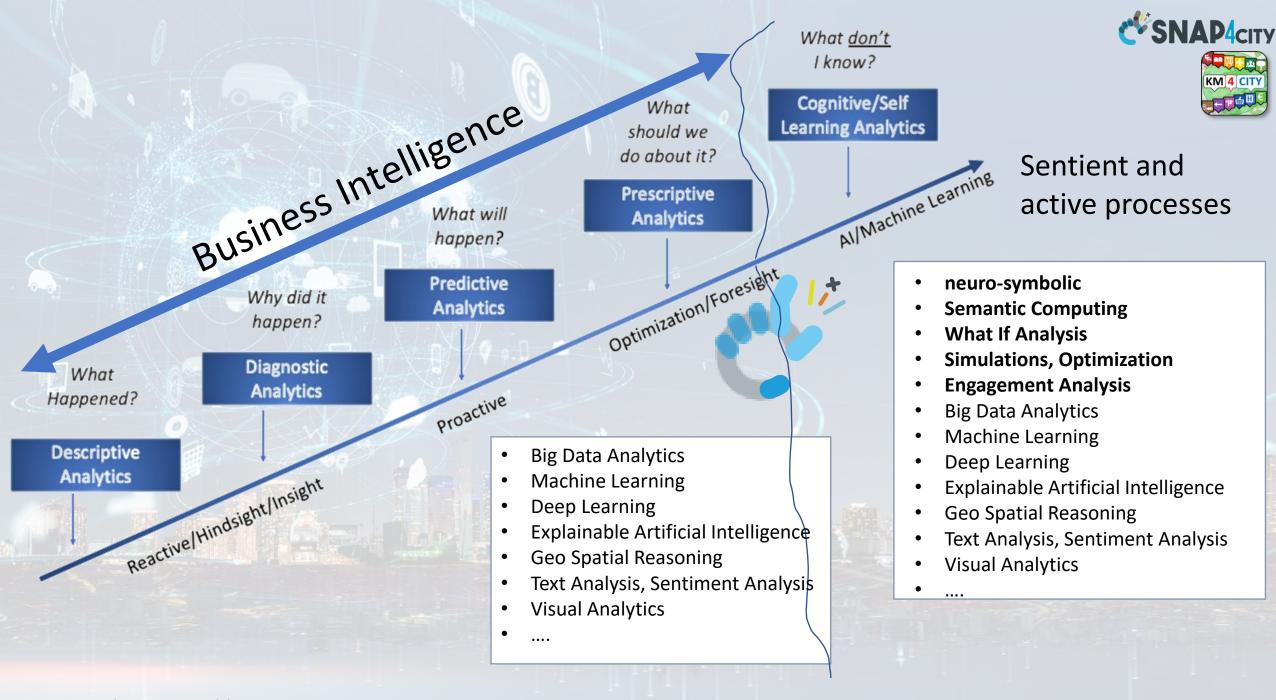
Architettura della BI

- **Data Warehouse**: Cos'è e come funziona (archiviazione centralizzata dei dati storici).

- **ETL (Extract, Transform, Load):** Processo per estrarre, trasformare e caricare i dati.

- **OLAP (Online Analytical Processing)**: Strumenti per l'analisi multidimensionale dei dati.

- **Strumenti di BI**: Esempi (Power BI, Tableau, Qlik, etc.)

Business Intelligence

Sentient and active processes

AI/Machine Learning

What *don't* I know? — **Cognitive/Self Learning Analytics**

What should we do about it? — **Prescriptive Analytics**

What will happen? — **Predictive Analytics**

Why did it happen? — **Diagnostic Analytics**

What Happened? — **Descriptive Analytics**

Optimization/Foresight

Proactive

Reactive/Hindsight/Insight

- Big Data Analytics
- Machine Learning
- Deep Learning
- Explainable Artificial Intelligence
- Geo Spatial Reasoning
- Text Analysis, Sentiment Analysis
- Visual Analytics
- ….

- **neuro-symbolic**
- **Semantic Computing**
- **What If Analysis**
- **Simulations, Optimization**
- **Engagement Analysis**
- Big Data Analytics
- Machine Learning
- Deep Learning
- Explainable Artificial Intelligence
- Geo Spatial Reasoning
- Text Analysis, Sentiment Analysis
- Visual Analytics
- ….

Perche' Business Intelligence

- **Miglioramento del processo decisionale**: Come la BI supporta le decisioni basate sui dati.

- **Aumento dell'efficienza operativa**: Identificazione di aree di miglioramento.

- **Competitività**: la BI aiuta a stare al passo con la concorrenza.

- **Riduzione Costi e tempi**: identificazione dei punti critici, riduzione dei costi e tempi per comprendere i problemi e prendere decisioni

From Data to Visualization

Visual Representations
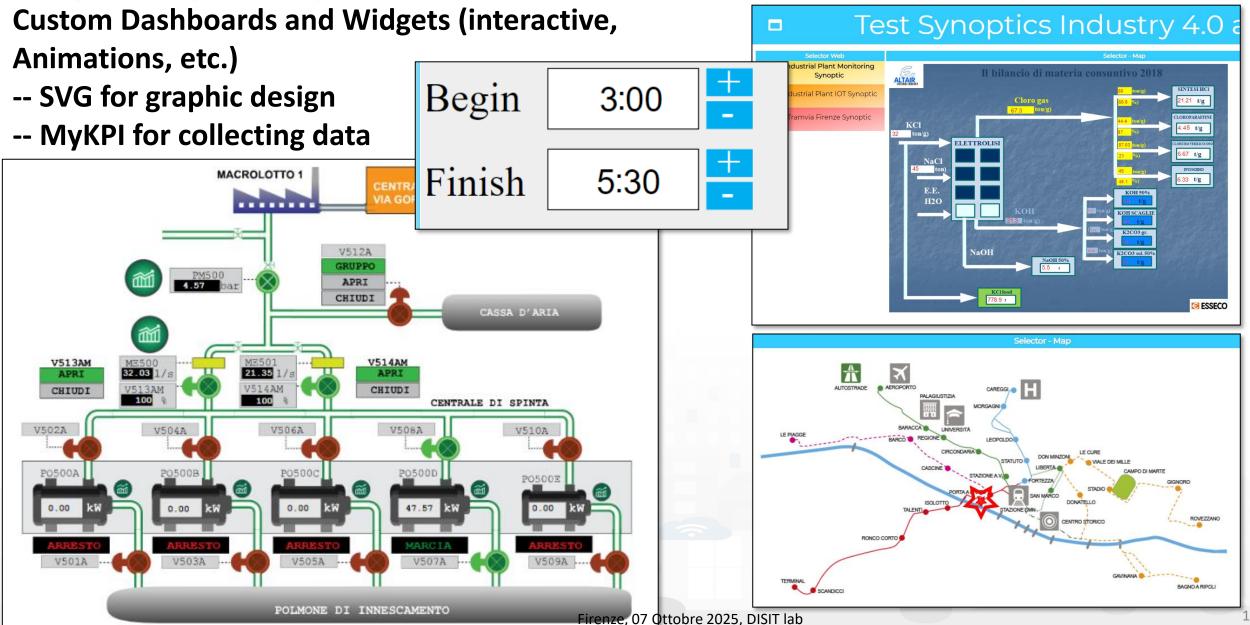
Sliderwith-multiple-steps-for-KPI	sparklines	kpi	histogram	heatmap	flow-maps	geo-maps	donut-chart	Data-grid
chord	Cone	Bubble-matrix-chart	Bullet	Box-plot	staked-area	Stacked-line-chart	Stacked-combinational-Chart	spider-maps
Sequence-Sunburst	Pivot	pie-chart-1	Pareto-chart	radar	Bubble-maps	waterfall	Sunburst	Sankey

Custom Widgets

Custom Dashboards and Widgets (interactive, Animations, etc.)
-- SVG for graphic design
-- MyKPI for collecting data

Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls
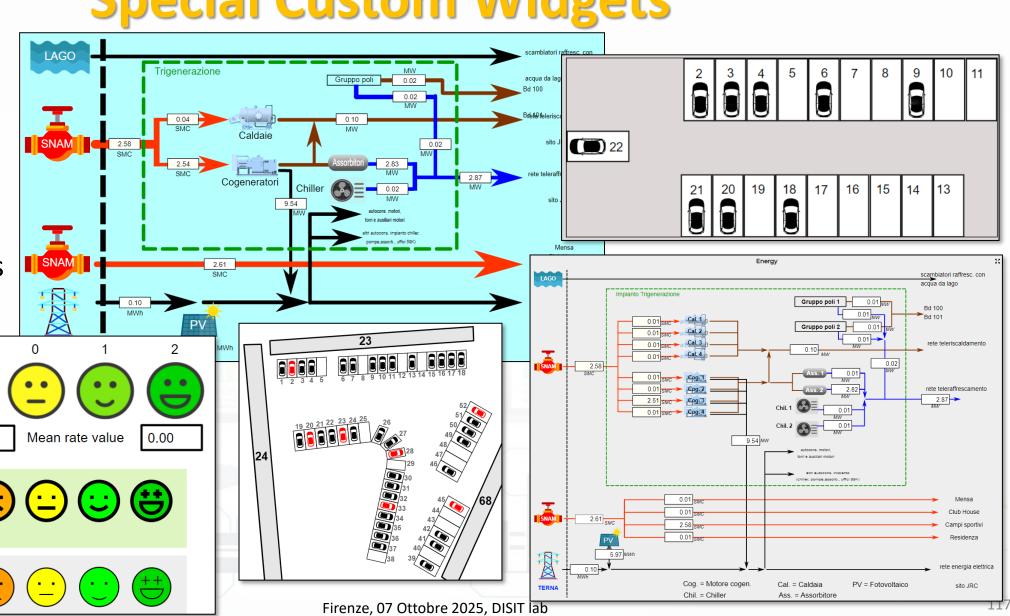
High Level Types

- POI, IOT Devices, shapes,..
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of several kinds, ..
- Dynamic icons/pins, ..
- Synoptics, animations, ..
- KPI, personal KPI,..
- social media data, TV Stream,
- routing, multimodal, constraints, ..
- decision scenarios, ….
- User profiles, sales, paiments, ….
- etc.

New Data Inspector/Wizard

Filtering/Searching for individual fields (even for some fields not displayed as geographic coordinates)

Geographic Filtering

Text Search on all fields

Menu for choosing the fields to display in the table

View on Map(via PREVIEW)

Data and Trend visualization

Opening Digital Twin

Pass to Synoptic mode

Select the graph representation

Main Concepts

- **Time Series**
  - Data sources (sensors / actuators) which provide changes of time. E.g., a sensor of some kind.
- **Geolocated Data on maps (PINs)** can be:
  - Structural info.: roads, building, etc.
  - Maps, orthomaps, Heatmaps (HM)
  - Elements and their positions as
    - Points of Interest
    - Shapes: garden, building, cycling paths, etc.
    - Entities/Devices as Time Series: which may move over time, e.g., tracking a Car
  - Origin Destination Maps, ODM
  - Trajectories, people and traffic flows, etc.
  - etc.
- **Static non GeoLocated Data**:
  - almost nothing since……

A single Data Kind may have multiple representations:
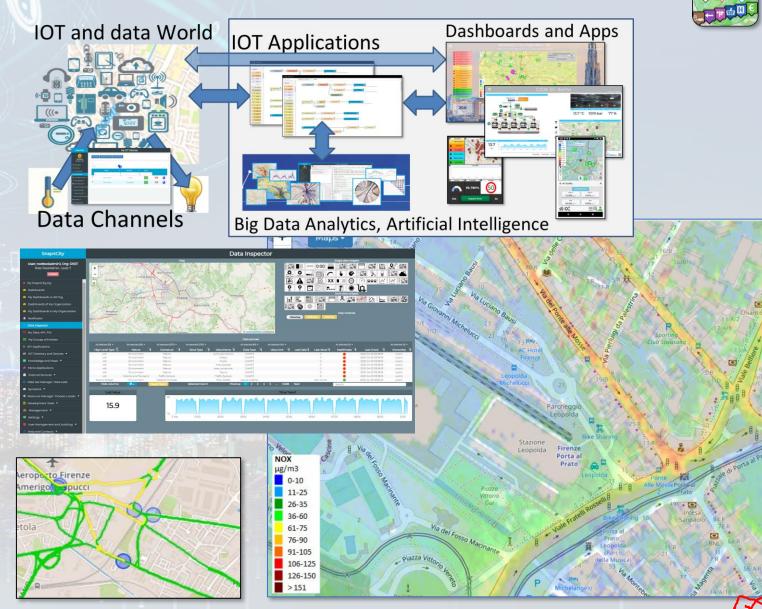
e.g.: the position of the car at 15:30, the trjaectory of yesterday, the ODM with set of travels performed in the last year, the most freq. Visited places as HM

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**
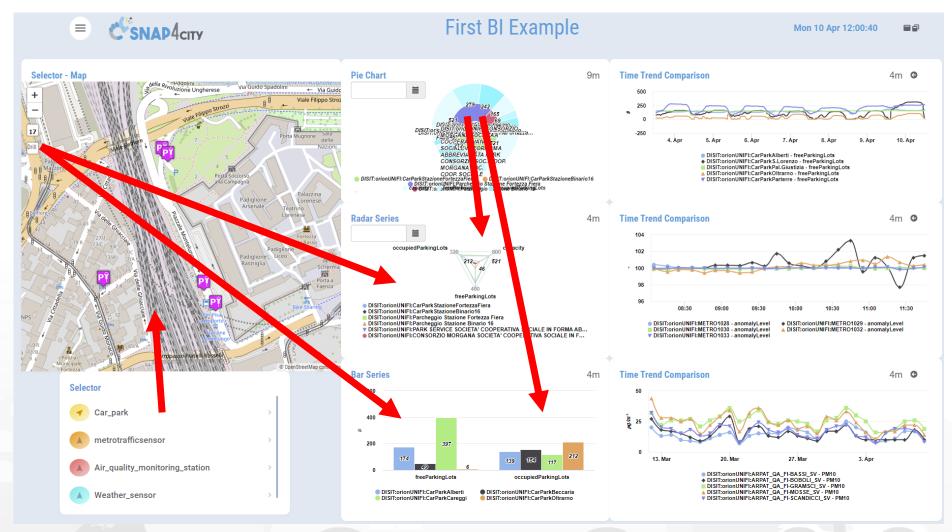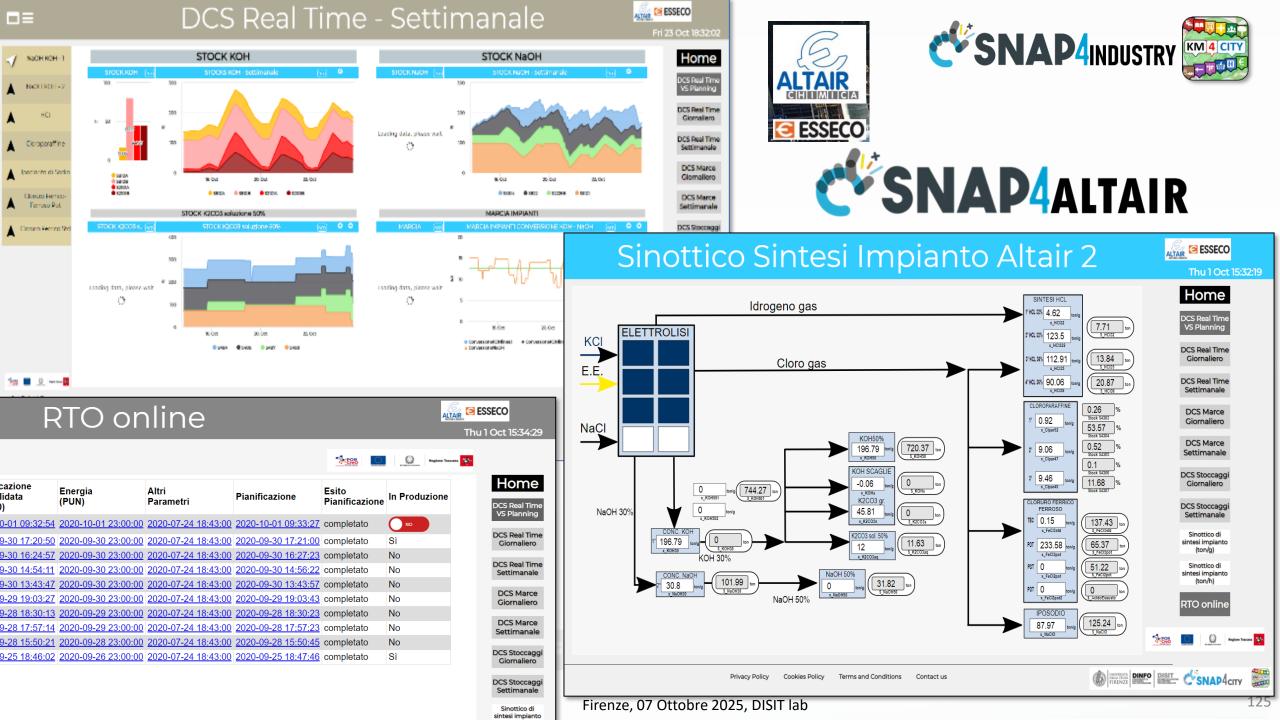
Example: From Map to Graphs (spatial drill down)

1) Select the area of interest on map
2) Select the sensors kind of interest
3) Drill down on map

4) The JavaScript CSBL on Map will send data to the programmed Widgets. In this case, arrowed in RED

ALTAIR ESSECO

Fri 23 Oct 18:32:02

STOCK KOH

STOCK KOH | STOCKS KOH - Settimanale

STOCK NaOH

STOCK NaOH | STOCK NaOH - Settimanale

Loading data, please wait

STOCK K2CO3 soluzione 50%

STOCK K2CO3 s. | STOCK K2CO3 soluzione 50%

MARCIA IMPIANTI

MARCIA | MARCIA IMPIANTI CONVERSIONE KOH - NaOH

Loading data, please wait

Loading data, please wait

SNAP4INDUSTRY KM4CITY

ALTAIR CHIMICA ESSECO

SNAP4ALTAIR

Sinottico Sintesi Impianto Altair 2

ALTAIR ESSECO

Thu 1 Oct 15:32:19

Idrogeno gas

KCl

E.E.

NaCl

ELETTROLISI

Cloro gas

SINTESI HCL
1° HCL 32% 4.62   x_HCl32   7.71 ton   S_HCl32
2° HCL 32% 123.5 x_HCl322
3° HCL 36% 112.91 x_HCl35   13.84 ton S_HCl35
4° HCL 36% 90.06 x_HCl36   20.87 ton S_HCl36

CLOROPARAFFINE
1° 0.92 x_Clpar52   0.26 % Stock S4303
                       53.57 % Stock S4304
2° 9.06 x_Clpar47   0.52 % Stock S4305
                       0.1 % Stock S4306
1° 9.46 x_Clpar45   11.68 % Stock S4307

KOH50% 196.79 x_KOH50   720.37 ton S_KOH50

0 x_KOH501   744.27 ton S_KOH501

KOH SCAGLIE -0.06 x_KOHs   0 S_KOHs

0 x_KOH502   K2CO3 gr. 45.81 x_K2CO3s   0 S_K2CO3s

CONC. KOH 1° 196.79 x_KOH30

0 S_KOH30

KOH 30%

K2CO3 sol. 50% 12 x_K2CO3aq   11.63 ton S_K2CO3aq

CLORURO FERRICO FERROSO
TEC 0.15 x_FeCl3std   137.43 ton S_FeCl3std
POT 233.58 x_FeCl3pot   65.37 ton S_FeCl3pot
POT 0 x_FeCl2pot   51.22 ton S_FeCl2pot
POT 0 x_FeCl2pot2   0 S_AcidoEsausto

NaOH 30%

CONC. NaOH 2° 30.8 x_NaOH30   101.99 ton S_NaOH30

NaOH 50% 0 x_NaOH50   31.82 ton S_NaOH50

NaOH 50%

IPOSODIO 87.97 x_NaClO   125.24 ton S_NaClO

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UNIVERSITA DEGLI STUDI FIRENZE DINFO DISIT SNAP4CITY KM4CITY

RTO online

ALTAIR ESSECO

Thu 1 Oct 15:34:29

POR CreO   Regione Toscana

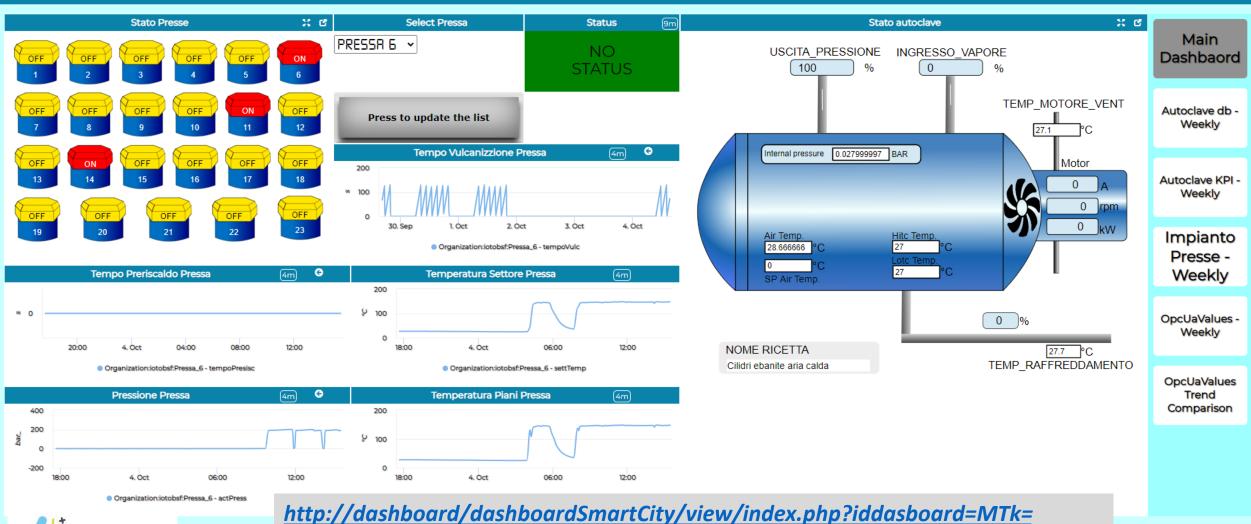| ...cazione ...lidata	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
...0-01 09:32:54	2020-10-01 23:00:00	2020-07-24 18:43:00	2020-10-01 09:33:27	completato	NO
...9-30 17:20:50	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 17:21:00	completato	Sì
...9-30 16:24:57	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 16:27:23	completato	No
...9-30 14:54:11	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 14:56:22	completato	No
...9-30 13:43:47	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 13:43:57	completato	No
...9-29 19:03:27	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-29 19:03:43	completato	No
...9-28 18:30:13	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 18:30:23	completato	No
...9-28 17:57:14	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 17:57:23	completato	No
...9-28 15:50:21	2020-09-28 23:00:00	2020-07-24 18:43:00	2020-09-28 15:50:45	completato	No
...9-25 18:46:02	2020-09-26 23:00:00	2020-07-24 18:43:00	2020-09-25 18:47:46	completato	Sì

Firenze, 07 Ottobre 2025, DISIT lab

Sinottico Impianto

Sinottico Impianto Presse - Autoclave

Mon 4 Oct 15:34:59

http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MTk=

+ Add filter

ABBATTIMENTO CLORO

ACIDO CLORIDRICO

ACQUA INDUSTRIALE

ARIA SERVIZI E STRUMENTI

CARBONATO DI POTASSIO

CARICO PRODOTTI

CICLO POTASSA CAUSTICA

Impianto
Select...

Specialità
Select...

Tipologia Lavoro
Select...

Siglatura
Select...

Apply changes | Cancel changes | Clear form

264.491
50th percentile of ore tra inizio e fine lavoro

673.151
Media ore passate tra inizio e fine lavoro

Numero ... periodo

CLORURO FERRICO STANDARD
CARBONATO DI POTASSIO
CICLO SALAMOIA   IPOSODIO
IMPIANTO 3FC   CARICO PRODOTTI

Business Maintenance Intelligence

Numero Impianti Funzionanti

20

10

0

2018-12-01 | 2019-01-01 | 2019-02-01 | 2019-03-01 | 2019-04-01 | 2019-05-01 | 2019-06-01 | 2019-07-01 | 2019-08-01 | 2019-09-01 | 2019-10-01 | 2019-11-01

Giorno

● Numero Impianti Fun...

null
MECCANICA GENERICA MECCANICA SPECIALIZZATA
MECCANICA GENERICA TERMOPLASTICA   STRUMENTAZIONE
SICUREZZA   ELETTRICA SICUREZZA
MECCANICA GENERICA   ELETTRICA
EDILE
TERMOPLASTICA
MECCANICA SPECIALIZZATA   ELETTRICA MECCANICA GENERICA
ELETTRICA STRUMENTAZIONE   MECCANICA GENERICA STRUMENTAZIONE
MECCANICA SPECIALIZZATA TERMOPLASTICA

FERMATA DI IMPIANTO
ORDINARIO
EMERGENZA
FERMATA GENERALE DI STABILIMENTO

● CARBONATO DI P...
● CLORURO FERRIC...
● CICLO SALAMOIA
● ACIDO CLORIDRICO
● IPOSODIO
● IMPIANTO 3FC
● CARICO PRODOTTI
● POTASSA A SCAG...
● CLORURO FERRO...
● TAS
● CLORO PARAFFINA
● PRODUZIONE VA...
● SERVIZI
● CICLO POTASSA ...
● CICLO SALAMOIA...

250

200

150

100

50

0

2018-12-01 | 2019-01-01 | 2019-02-01 | 2019-03-01 | 2019-04-01 | 2019-05-01 | 2019-06-01 | 2019-07-01 | 2019-08-01 | 2019-09-01 | 2019-10-01 | 2019-11-01

per 24 hours

How the Dashboards / Apps Exchange data (2024/8)

Technical Architecture

Any API

Front-End

Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins

API Manager

Federation Smart City API

OpenSearch virtuoso

FIWARE

Brokers

MQTT

Brokers

Brokers

storage

KB, graph

GeoServer

BIM server.center

Entity Inspector

Data Manager

HLT Manager

Service Map

Facilities

Dashboard/View Builder & Mng.

Business Intelligence CSBL

Custom Themes

Synoptics & Widgets

2/3D Digital Twin

Tools

Routing, MulDyn

Heatmap Gen.

Prediction Gen.

Measure & Compare

Notification Mng.

KPI Support

Scenario, What-If

Applications

Traffic Optimiz.

Traffic Light Plan

Public Transport

Parking Mng.

Fines Mng.

Participation Mng.

Lighting Mng.

Building Mng.

Environment Mng.

Waste Mng.

Sharing/pool Mng.

Energy Mng.

Tourism Mng.

Mobile Apps

Node-RED

Simulators' tools:
SUMO, DORAM, TFR, ..

python R Studio

Artificial Intelligence tools:
pred., classif., optim., LLM, ...

IoT App ProcLog.

Social Media
OSM, BIM, GIS, ITS
Gateways, satellite
External Services
Web Scraping
TV CAM streams

On Edge
On Cloud

IoT App
ProcLogic

Event Driven

SnapAdvisor / Generative AI

**A&A, RBAC, SSO, Blockchain, Resource Managers and Sharing**

Sharing / Market Place

Third parties solutions

Agenda

- Data Modeling, formats
- Public/private data, real time data, Structured and non structured data
- Data Privacy, GDPR, Data Spaces
- Data Selection and caratterization: value type, value unit, data type
- Smart Industrial Applications of data
- Data Visualization, Visual Analytics, Business Intelligence, Dashboards
- **Esercitazione on defining data models vs data representation**
- Test

- *Let us now to suppose that we have to develop a solution for monitoring Industrial **Vehicles** and **Drivers**.*
  - *Each **Vehicle** has a profile description and can be driven by a number of Drivers over time. Each **Vehicle** can experience some maintenance and performs trips.*
  - *__A trip__ has an official start/end and over time is described by its velocity, acceleration, brakes, charging level, or thank level, etc.*
  - *Each **Drive**r has a profile and can use a number of Vehicles to perform trips.*
- *During the trip also the Driver is monitored for its healthiness, attention, etc., and before, during and after the driving, periodically or sporadically may experience some Analysis to certify its capability to drive in that moment and for the next days. The Driver may experience some warning cases for healthiness, some tickets from policeman, some warning for high-speed velocity or generically bad driving, some problems from the vehicle's status, etc.*

legenda
- Entity Instance
- Entity Model
- Entity Messages with dateObserved

Data Model of the Driver
- Name: string
- Surname: string
- Age: number
- Weight: number
- Phone: string
- Email: string
- DriverAnalysisID: ServiceURI
- ......

Register to instantiate →

Driver: user45
- Name: David
- Surname: Smith
- Age: 45
- Weight: 78 Kg
- Phone: +49345096103
- Email: david89@gmail.com
- NikName: Carl
- DriverAnalysis: http://.../user45driveranalysis
- ......

Write SURI to create cross references

DriverAnalysis: user45driveranalysis
- DriverID: http://.../user45
- dateObserved: 12-03-2022T12:00:00
- Status: "none"
- Location: null
- Doctor: null
- Tools: null
- ......

Register to instantiate →

DriverAnalysis: user45driveranalysis
- DriverID: http://.../user45
- dateObserved: 25-04-2022T12:00:00
- Status: "bad"
- Location: truck
- Doctor: null
- Tools: Eyetrack
- ......

New update on user45driveranalysis by sending a message

DriverAnalysis: user45driveranalysis
- DriverID: http://.../user45
- dateObserved: 22-03-2022T12:00:00
- Status: "good"
- Location: room45
- Doctor: https://..............
- Tools: null
- ......

New update on user45driveranalysis by sending a message

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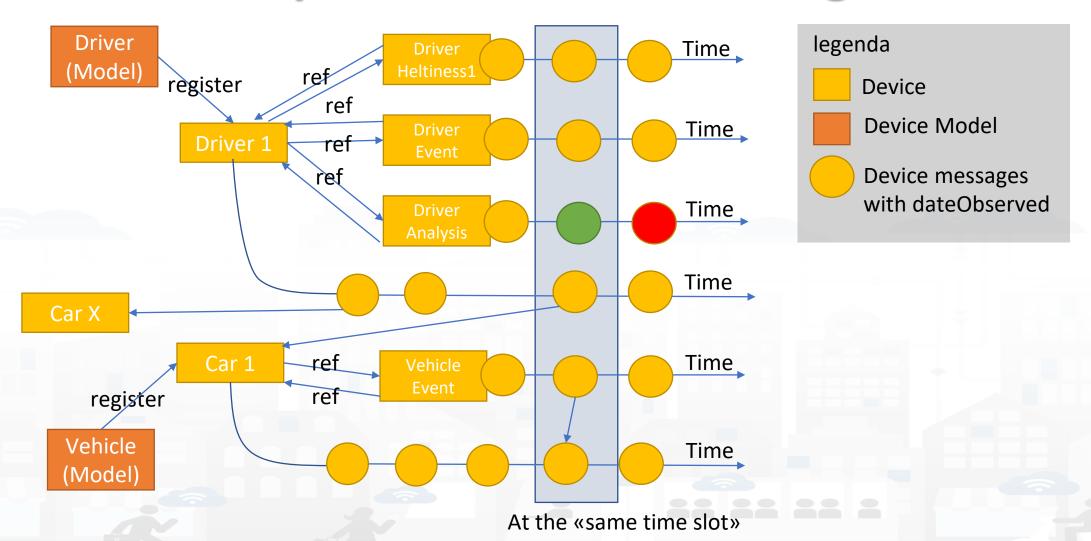
Example of Data Model Diagram

Agenda

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- **Test**

Test

- https://docs.google.com/forms/d/e/1FAIpQLSe0JZ-Im3GTPnHYvMjczg9wmY8ePvtRY3grnXOHncHzWUhd_w/viewform
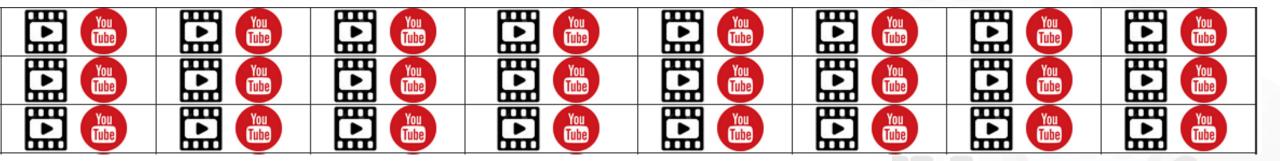
1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions

booklets

- Smart City
- Industry
- Artificial Intelligence

https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf

https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf

https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

Tech. Overview

- **https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf**

Development

https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf

CSBL
Client Side Business Logic

https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf

Grazie per l'attenzione!

? Q&A !

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CONTATTI

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