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TECHNOLOGIES LAB



Mobility and Transport Data for City Digital Twin Modeling and Exploitation

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<https://www.snap4city.org>

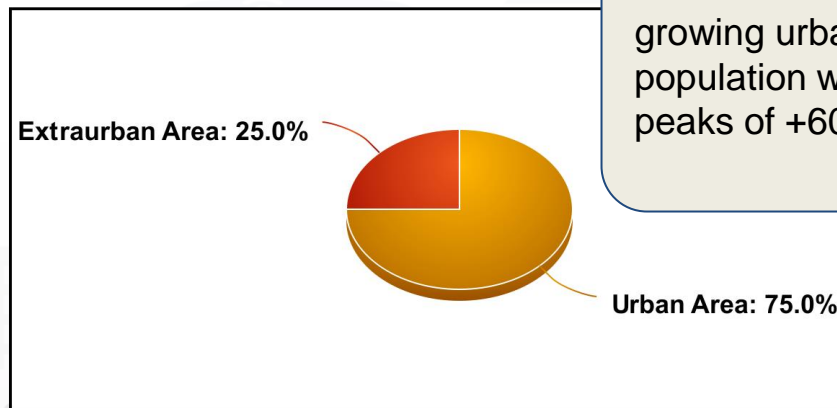
Smart Mobility and Transport

The development of smart and sustainable mobility solutions is nowadays a critical challenge that all cities must face to **improve citizen quality of life**

Decision support tools require **huge amount of data** and **precise representation** in order to be effective



(European JRC)
Worldwide population live in



growing urban population with peaks of +60%

Urban Area Extraurban Area

Smart Cities and Big Data

Government Big Data

Open Data
IoT/IoE sensors



Enabler Technologies
to monitor and analyze
the status of the urban
area



Intelligent Transport Systems ITS

- traffic management
- public transport planning
- detection of critical events

Mobility as a Service (MasS)

- optimal routing support
- what-if-analysis tools

Specialized SW infrastructures are
required to efficiently:
handle and exploit Big Data in terms
of indexing, storing, data retrieval
services, GUI dashboards



Conceptual flow diagram

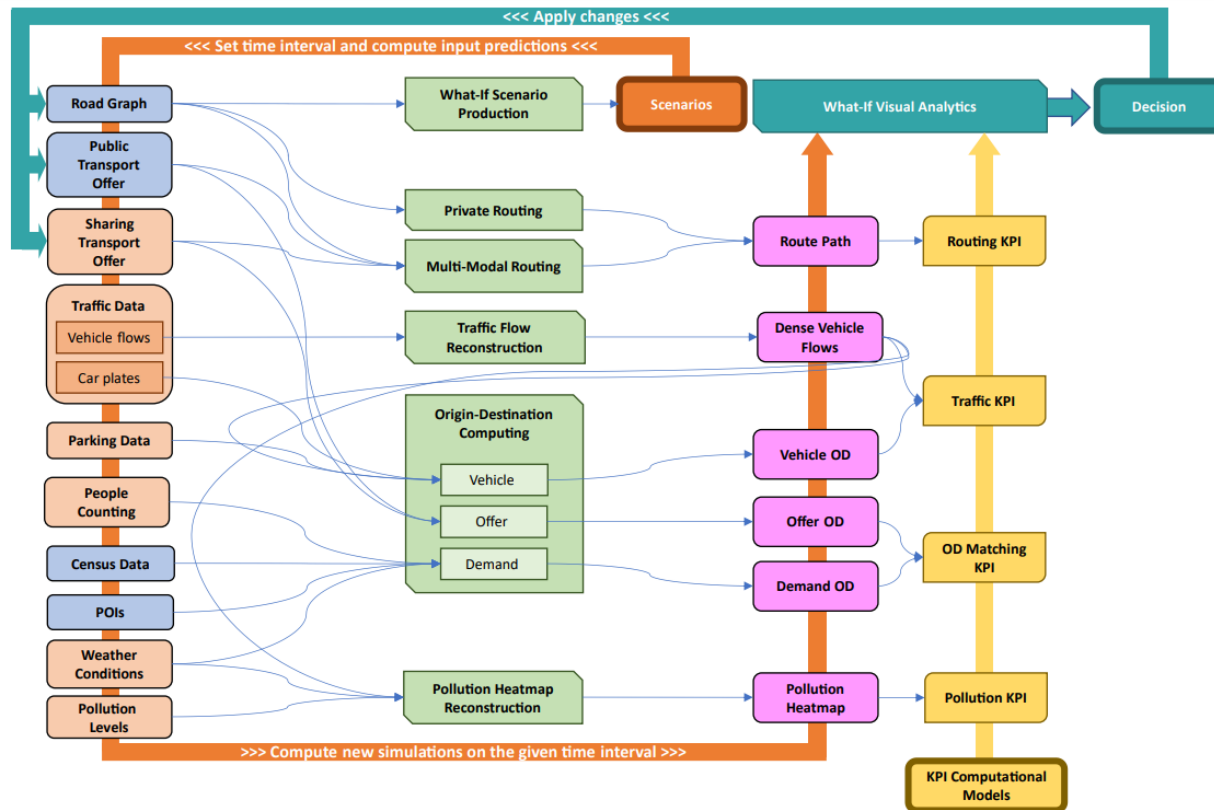
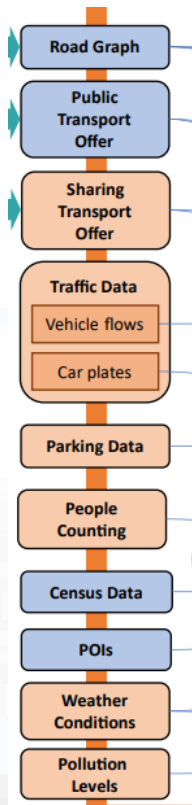


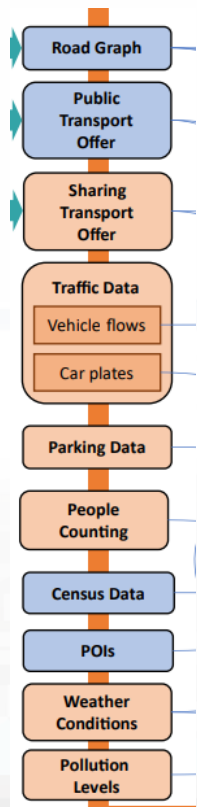
Figure 1: Conceptual Flow Diagram for a What-If analysis platform for mobility and transport with data, processes, simulations, outputs, and KPI.

Mobility Data Kinds



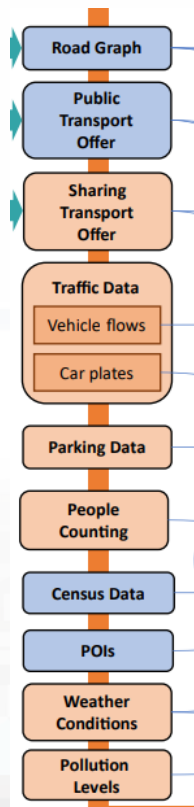
- often required given the fundamental information
 - road intersections
 - road lengths
 - number of lanes
 - speed limits
 - lanes' descriptors
 - road classification (primary, second..., motorway)
 - obstacles [rivers, fences highways]
 - restrictions e.g bridge load
- Can be retrieved from
 - Open Street Map (OSM)
 - local public agencies PBF - XML

Mobility Data Kinds



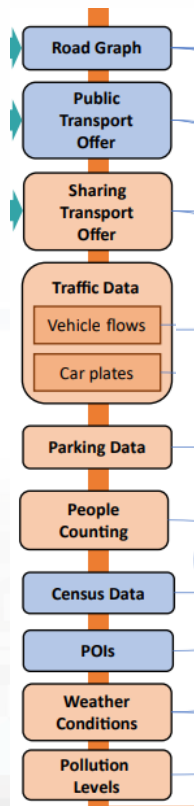
- useful specific information on:
 - busses' lines
 - busses' stops
 - time scheduling
- Data formats
 - GTFS
 - Transmodel
 - Netex
 - ETSI stds

Mobility Data Kinds

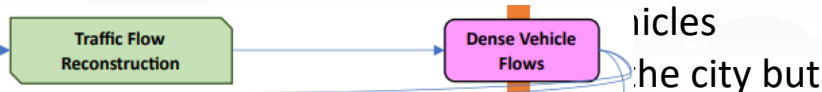


- Sharing Transport data offered by private companies
 - car
 - bike
 - scooter
- Data often includes
 - stop positions
 - occupancy
 - gps route of the ride
 - docking systems total number of free slots

Mobility Data Kinds



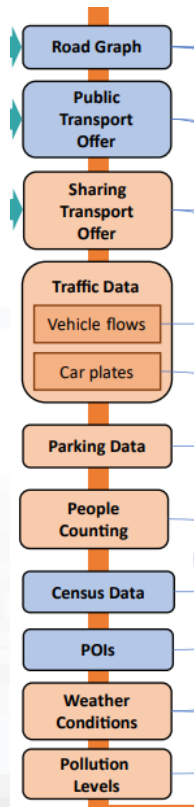
- Geolocated IoT sensors
 - Lorawan, NGSI, OneM2M, MQTT, ...
 - Real-Time XML, JSON, HEX formats
 - disaggregated per vehicle type (car, motorbikes, truck, busses)



- dense vehicle flow reconstruction via partial differential equations of fluid-dynamic algorithms or smart AI agent simulation

- Cameras able to read plates
 - more traffic informations about vehicle kind
 - travel origin-destination flow

Mobility Data Kinds

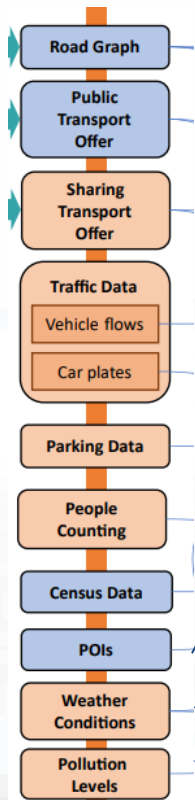


- Parking data
 - parking locations
 - occupancies
 - e-charging stations

- People Counting / Flow
 - number of presences at specific locations
 - bus stops / malls / city center
 - Acquired by iot sensors, wifi connections, mobile apps, video surveillance cameras, manual counting.

Census Data: Open Data insights geographical distribution of people useful for identifying O-D matrices for recurrently travels eg- work/school

Mobility Data Kinds



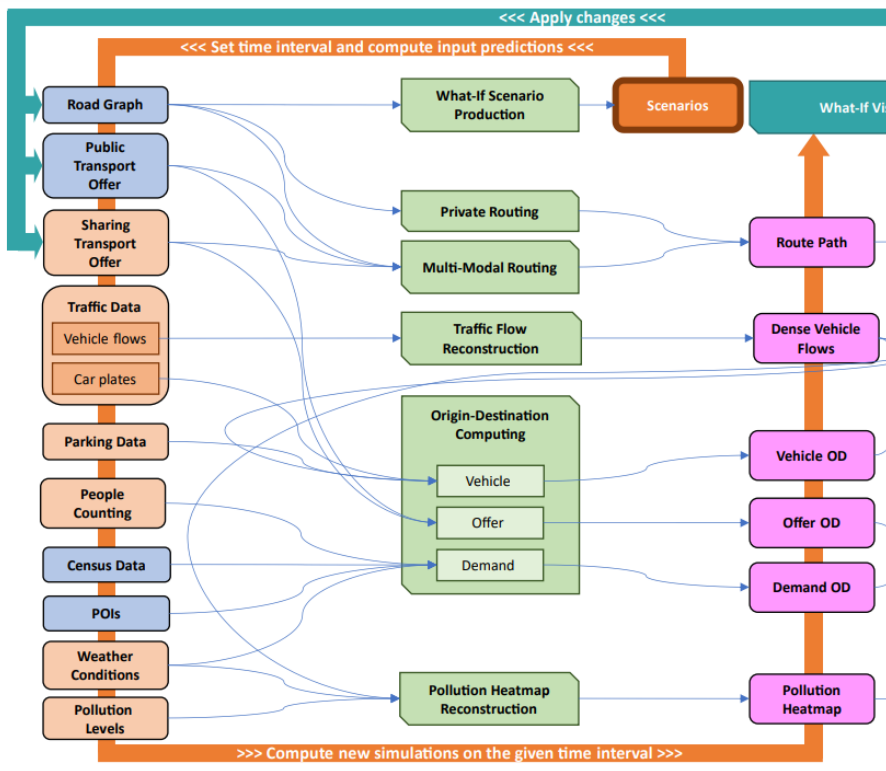
- Point of interest
 - representation of geolocalized services
 - Schools / Hospitals / libraries / stations
 - insights about possible point of attraction

- Weather conditions
 - IoT sensors / web services
 - influence users' decisions on transport modalities

- Air Quality
 - where pollutants at ground level are often correlated with traffic data
 - compute heatmap of pollutants dispersion



Processes and simulations

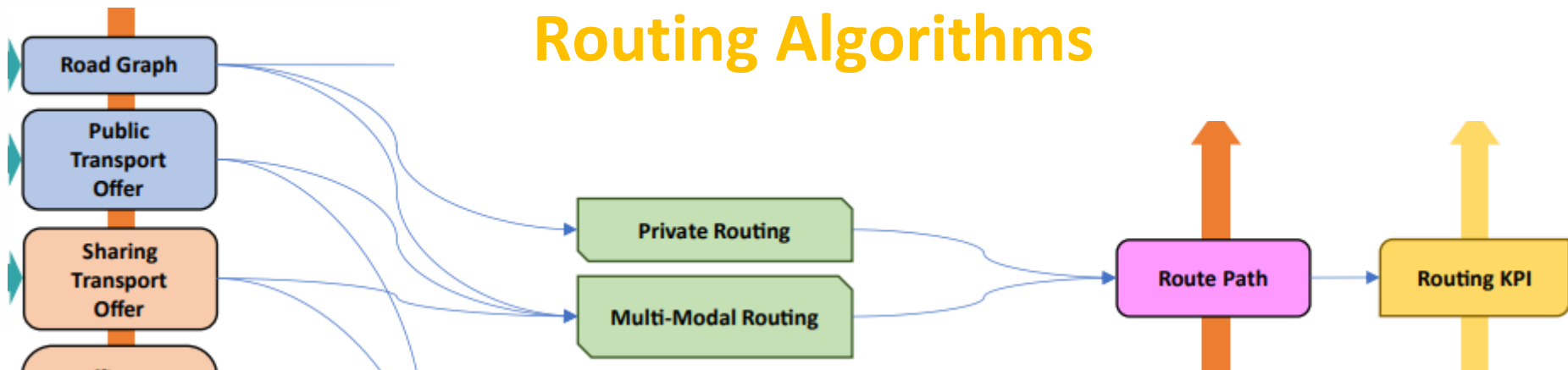


Several processes are used to elaborate the inputs to compute more

advanced information

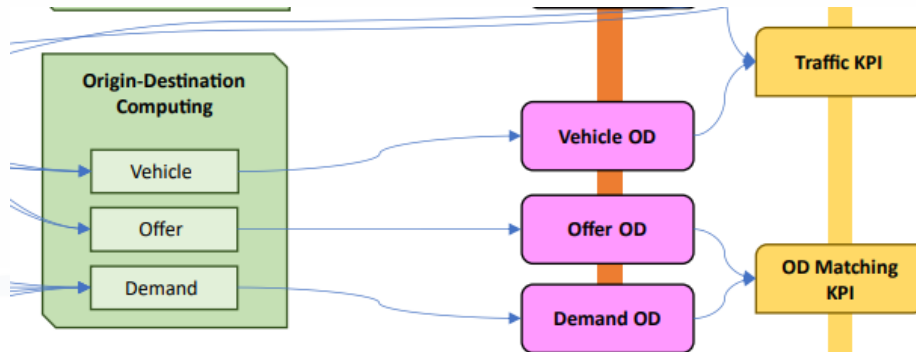
That can be used to determine monitoring Key Performance Indexes (KPIs)

Routing Algorithms



- can be used to
 - supply navigation services to users - **Multi-modal solutions**
 - obtain simulated travel paths
- Can be used to evaluate KPI on effectiveness of transport systems, appreciation / TP coverage

O-D matrices



Useful for:

- modelling the mobility demand
- assess the potential capability of the transportation offer

Difficult Data Modeling: privacy issues

- often estimated in different ways
 - Bayesian framework from traffic flow information and road graph
 - Graph neutral networks

Different KPI exploit the O-D:
-> Public Transportation Services

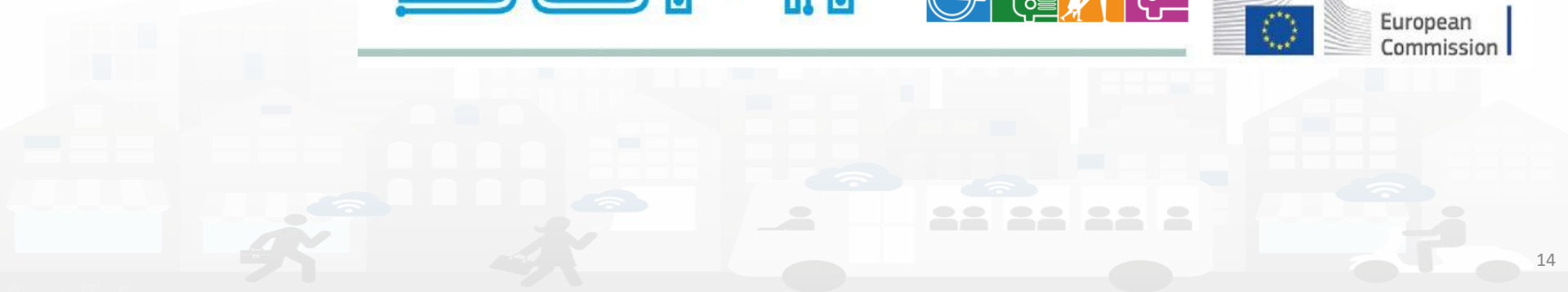
What-if-analysis



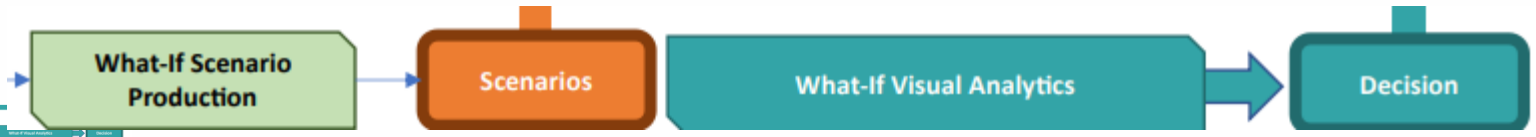
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SUMI

PUMS



What-if-analysis





Powered by
FIWARE

SNAP4
Appliances and Dockers
Installations

**FREE
TRIAL**

**PEN Test
Passed**

**EU GDPR
COMPLIANT**



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**



Smart City Digital Twin (SCDT)

- Are becoming **fundamental tools** for decision makers since they are virtual replicas of real cities in which experiments can be performed.
- SCDT are **augmented via** contextual information by GIS, BIM, IoT sensors data, heatmaps, analytics services, ...
- **Enabling** possibility for urban planning, air pollutant monitoring, mobility and transport management



<https://digitaltwin.snap4city.org/>





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