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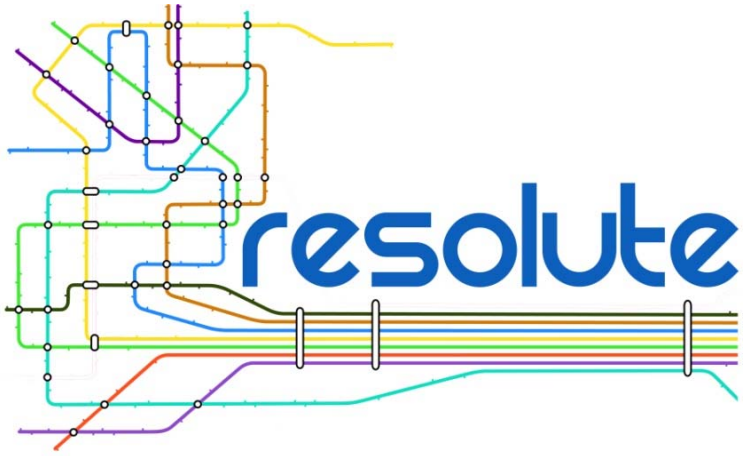

www.resolute-eu.org

Resilience management guidelines and Operationalization applied to Urban Transport Environment

RESOLUTE project presentation

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1st workshop on Resilience
20-22/9/2016 Turin, Italy

Co-ordinated by

UNIVERSITÀ DEGLI STUDI FIRENZE

DISIT

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Problem and issues

- **Critical infrastructures in the city are strongly interdependent:**

  Transport, energy, communication, cyber, health...
- **Critical Infrastructure are hit by** natural and/or human made expected and unexpected events.
- **UTS, Urban Transport System**, is one of the most challenging since UTS is the via by which effects may be propagate but also the path used by solutions and the recovery actions.

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Examples: The Big flooding in Florence 1966

People took local WRONG decision to escape from the hazard…

Water flow direction

- Lack of community preparedeness 90% unaware
- Lack of contextual and real time information
- Lack-wrong official early warnings (15 hours passed from the first event at the source)
- Questionable allocation of the resurces (all were concentrated at downtown)

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Main criticalities

- **Over-specification** of procedures
- **Multi-decision-makers** (civil protection, public administration, infrastructure managers, etc.),
- UTS users (citizens) with their conflicting micro-opportunistic behaviors, different risk perceptions, beliefs, skills, etc.
- **Heterogeneous data sources** with different data delivery rate, quality, reliability and semantics.
- **Fragmented** and sometimes not clearly defined **responsibilities** among UTS actors.
- Needs to optimally manage the **scarcity of resources**
- Needs of a coordinate **multi-channel communication** strategy and a situation-aware communication delivery tools
- Common attitude of the authorities **to neglect the preparing and adapting phases** in favor of the absorbing and reacting phases.
- Weak population preparedness against unusual extreme events and wrong perception about their recurrence probability and potential effects.

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RESOLUTE 5 Objectives

Obj1- Conducting a systematic review and assessment of the state of the art of the Resilience assessment and Management concepts, national guidelines and their implementation strategies in order to develop a conceptual framework for resilience within Urban Transport Systems

Obj2 - Development of **European Resilience Management Guidelines** (ERMG)

Obj3 - Operationalize and validate the ERMG by implementing the RESOLUTE Collaborative **Resilience Assessment and Management Support System (CRAMSS)** for Urban Transport System (UTS) addressing Roads and Rails Infrastructures

Obj4 – Enhancing resilience through **improved support to human decision making processes**, particularly through increased focus on the training of final users (first responders, civil protections, infrastructure managers) and population on ERMG and RESOLUTE system

Obj5 – **ERMG wide dissemination, acceptance and adoption** at EU and Associated Countries level

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Main Outcomes

- **European Resilience Management Guidelines** – (guidelines) – consensus driven approach improve guidelines acceptability at EU level
  - general version, and UTS version
  - http://www.resolute-eu.org/index.php/deliverables
- **CRAMSS** – (tools and algorithms) – ontology based static and dynamic CI data integration, processing and analysing platform
- **Mobile Emergency app** – (tools and procedures) – supporting users in their local decision before (early warnings), during and after an event
- **Game based training app** – (tools and procedures) – improving the current preparedness of the citizen in order to increase the community self-resilience

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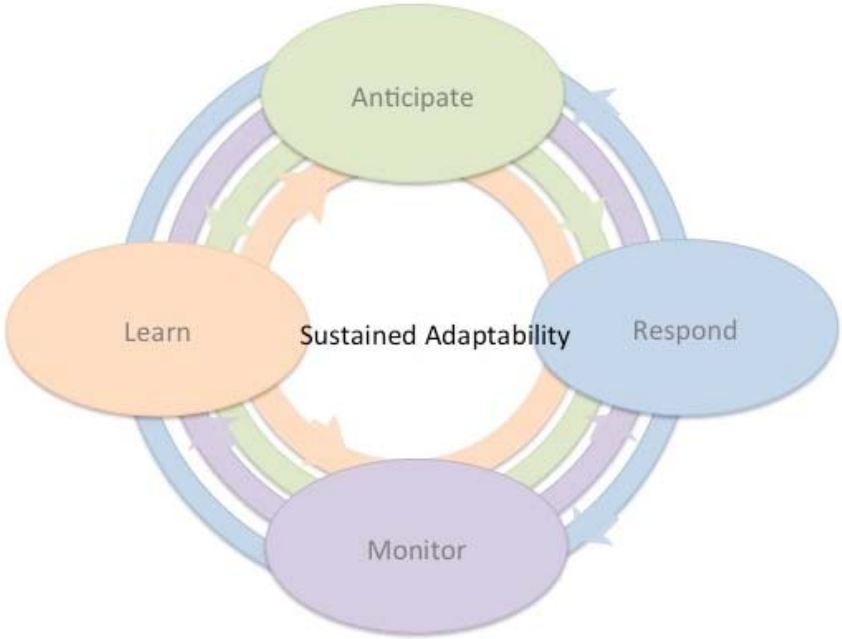
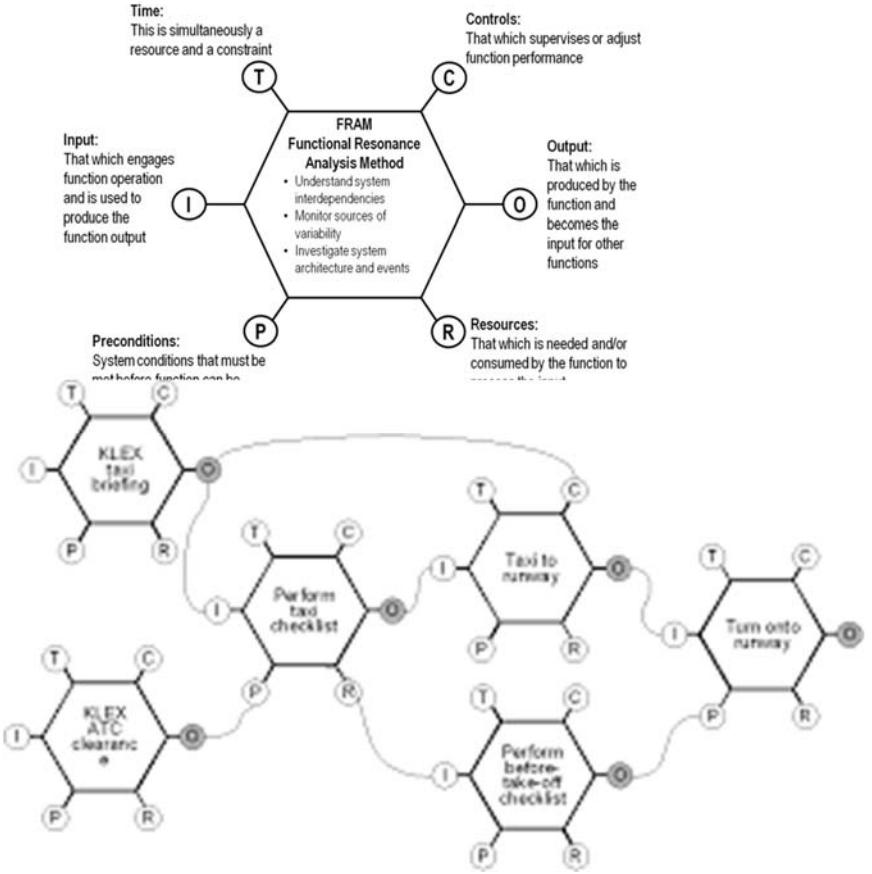
Sustained Adaptability and FRAM

A system resilience side in the ability to understand and monitor resources and the capacities that they provide towards coping with both expected and unexpected amplitudes of performance variability





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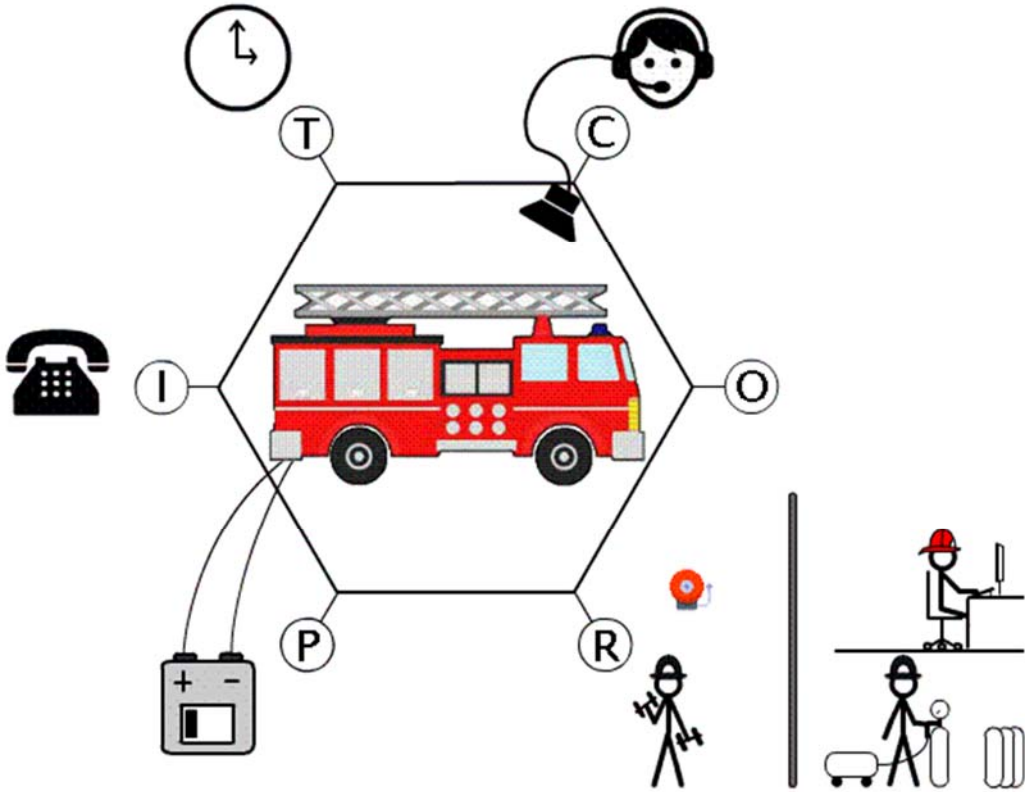
Functional Resonance Analysis Method

- **Success and failure are equivalent** in the sense that they both emerge from performance variability.
- **Variability**, intended as a way for people to adjust tools and procedures to match operating conditions.
- Emergence of either **success or failure** is due to unexpected combination of variability from multiple functions.
- The unexpected "amplified" effects of interactions between different sources of variability are at the origin of the phenomenon described by functional resonance.



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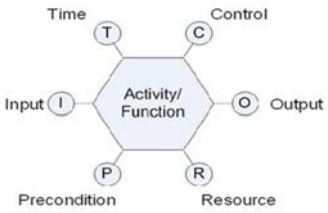
Workflow to produce guidelines

Stakeholder interviews (workshop, F2F, etc.)

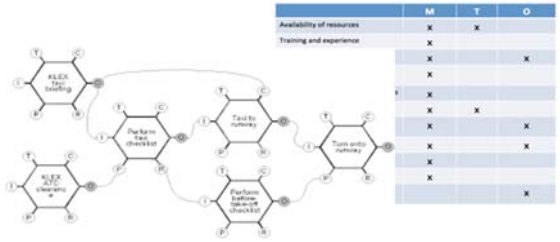
Collect data about how the system work in general (daily operation)

(High Level) Desired System Functions identification And description



Define an high level functions that are present in all kind of CI (Technical, Organizational, Human)

Performance Variability (Coupling & Common Condition)



- Function coupling
- Common Condition

How to dampen performance Variability of the function

Provide advice for sustaining the capability of each Functions to adapt to the variable conditions for each CC and Coupling

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European Resilience Management Guidelines

- **Level I:** comparing "desired functions" defined in ERMG against functions in place through a FRAM analysis of the
  - **Critical Infrastructures addressed.**
- **Level II:** assessing how functions implemented in the CIs are actually aligned with the ERMG recommendations.
- **Level III:** assessing function interdependencies. The ERMG provides a number of desired interdependencies capable to increase system resilience.

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ERMG operationalization

Three main layers

1. **Complex System modeling**: function, processes, resources, time, events, etc..
   - Functional Resonance Analysis Method, FRAM
   - Resilience Analysis Grid, RAG
   - -Network science
2. **Decision Support System**, DSS
   - E.g.: System Thinking, Goal Models
3. **Data, big data access and** exploitation
   - Data Analytics
   - Internet of Things, sensors, flows

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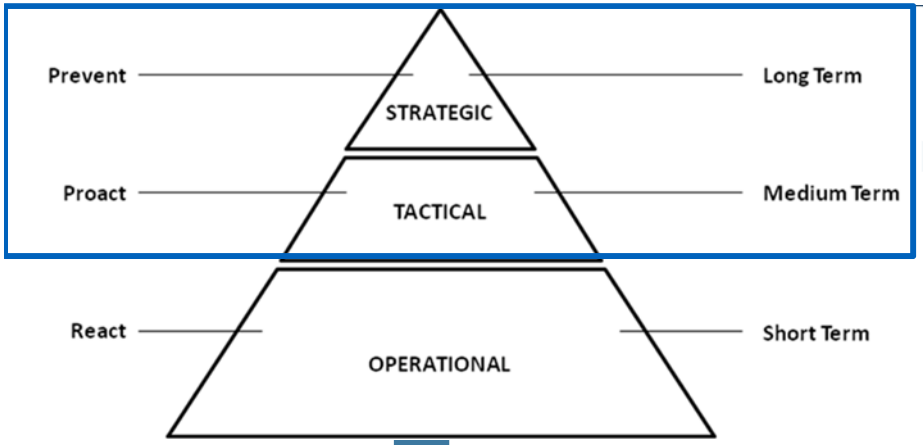
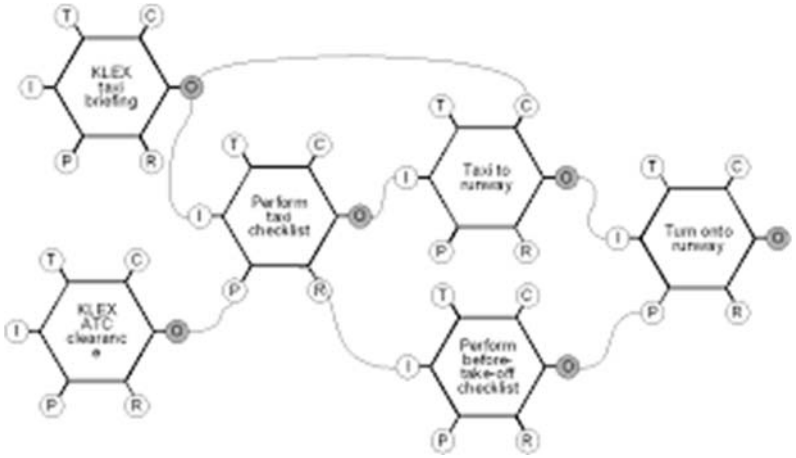
Big KID (Knowledge. Information, Data) Approach



Descriptive



Connecting (Big) Data to the model

Decision Support System for Decision Makers and CI managers

- Data driven Resilience Assessment
- Prediction-simulation
- Real time emergency management
- (trade off costs-time to recovery)
- Training and preparedness assessment
- …..

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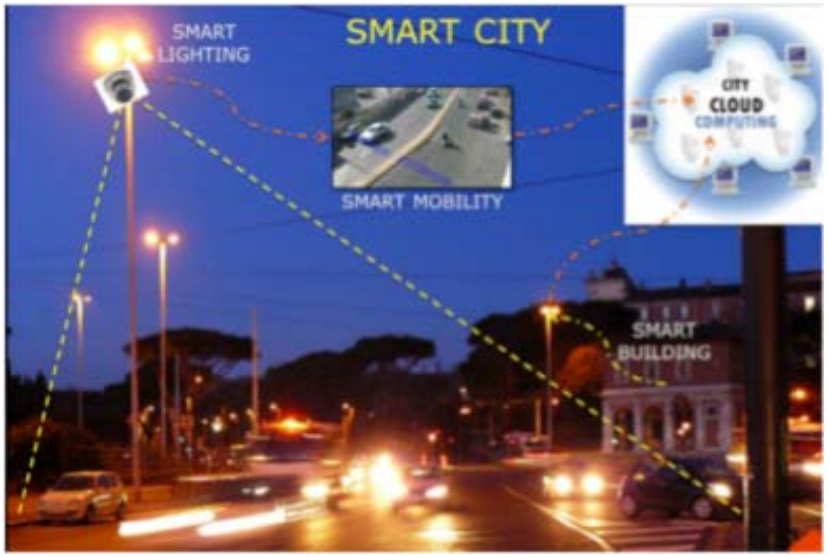
UTS and Big Data

Huge amount of data are produced from: Open Data, Linked Data, Real Time sensors, Twitter, WiFi, etc.
(**Big Data: velocity, variety, volume, veracity, …**)



Data available and collected through km4cty platform
http://www.disit.org/km4city

- Traffic data flows
- Public mobility services real time positions (e.g. bus, metro)
- Open Data (close to 1K available datasets including
- Hidrogeological risk maps)
- City free Wifi covers the 80% of the city (traking peoole flows and movement)
- Social networks (twitters)
- IoT (real time data from environmental sensors e.g. level of the river)
- Real time Parking availability
- City services (business,
- Reat time status of the city hospitals-beds availability
- Meteo data
- Cadastre data
- **….but more data are needed.**

ISSUES
Multiple data owners-producers,
Different delivery rate,
Different formats,
Different data quality,
Different licence for data reuse,
etc…

Transport systems
Mobility, parking

Public Service
Govern,

Sensors,
IOT

Environment,
Water, energy

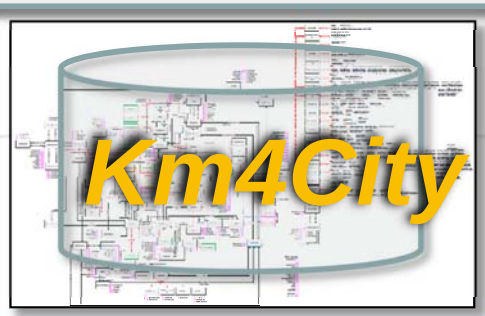
Shops,
services,
operators

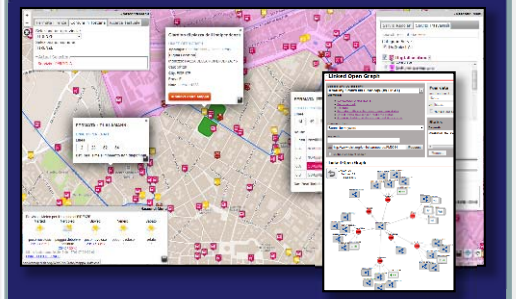
Social Media
WiFi, network

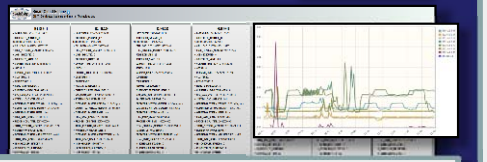
Static, Slow and Real Time data flows

DISCES -- Distributed and parallel architecture on Cloud

Km4City Smart City Engine

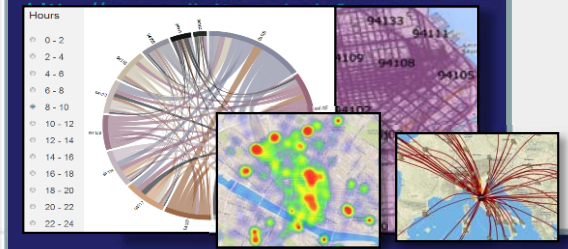






User Profiling and Suggestion Engine

Flow and Origin Destination Matrix

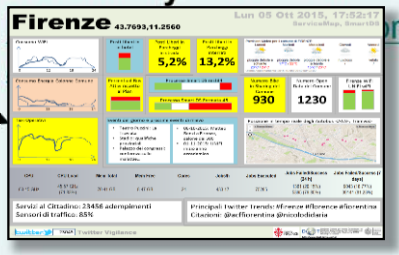


Km4City Tools for Developers

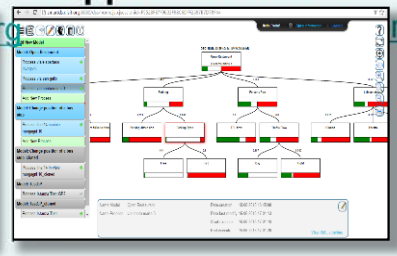
Km4City Smart City API

Tools for City Operators and Decision Makers

Smart City Dashboard

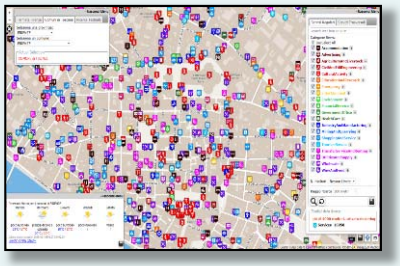


Smart Decision Support

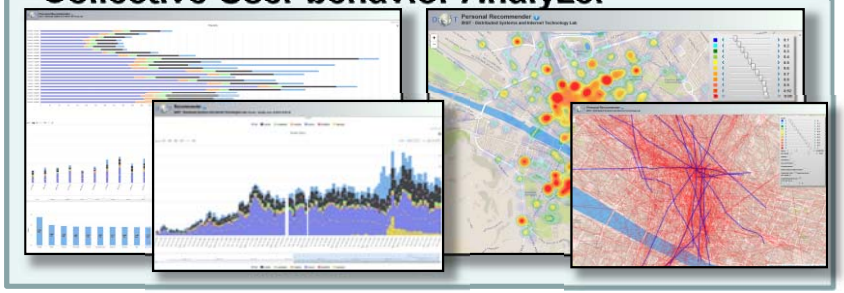


Service map browser
Http://servicemap.km4city.org

Twitter Vigilance
Http://www.disit.org/tv



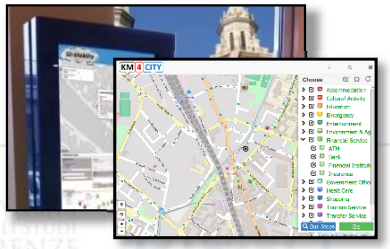
Collective User behavior Analyzer



Tools for Final Users

Mobile e Web Apps

Http://www.km4city.org



Http://www.km4city.org/app

www.km4city.org

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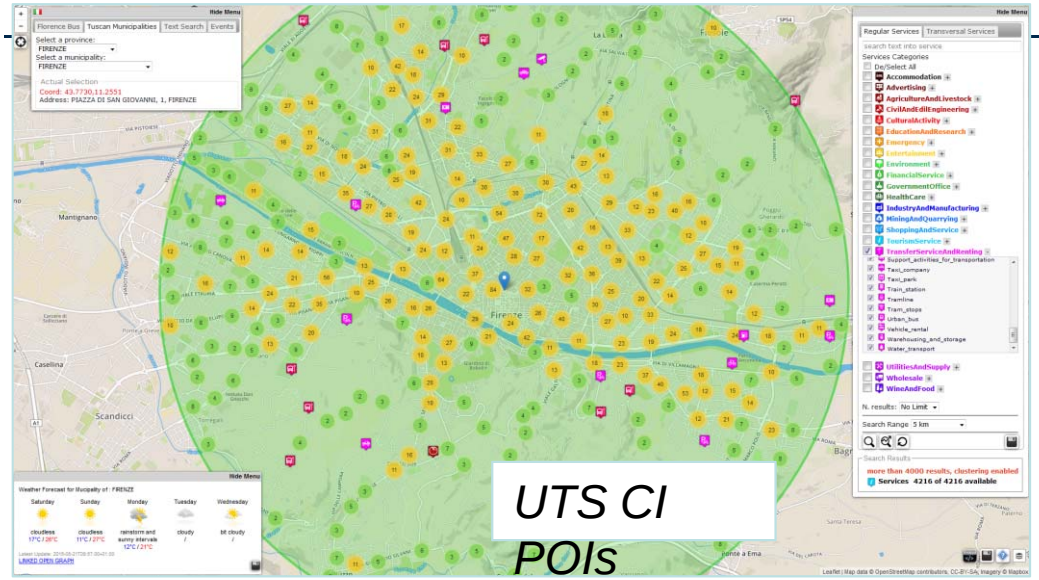
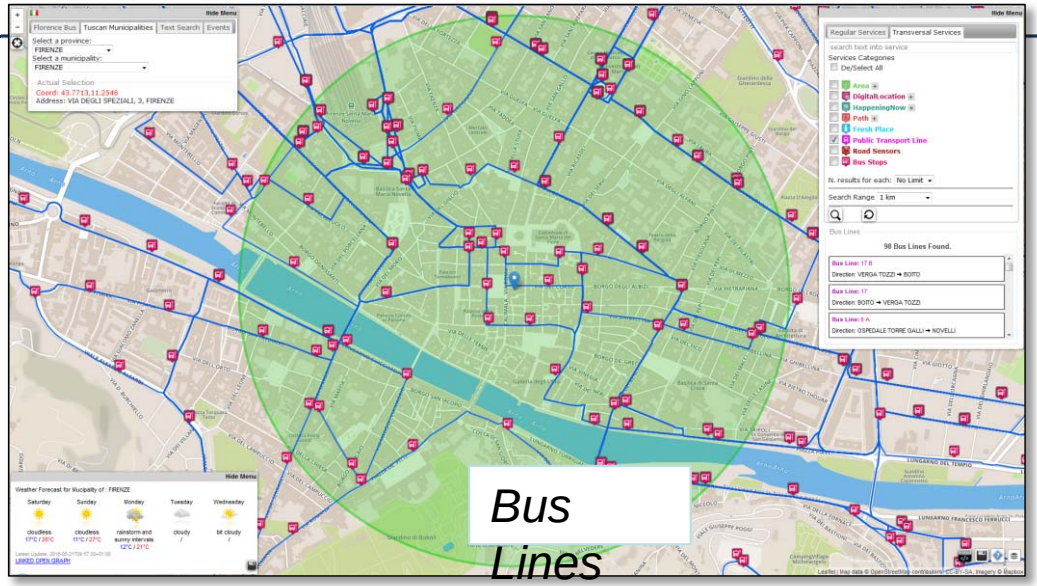
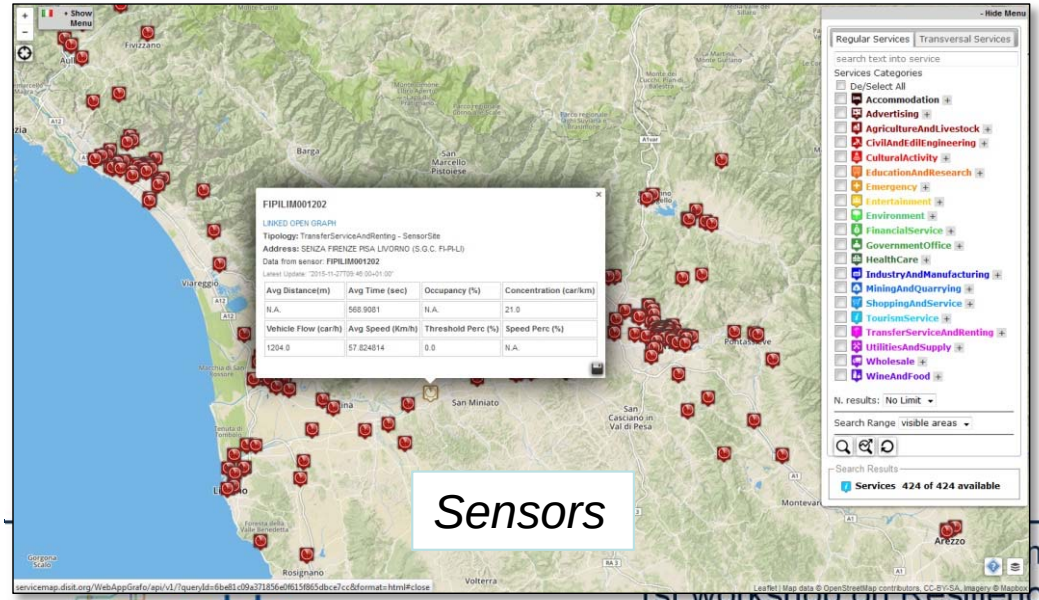
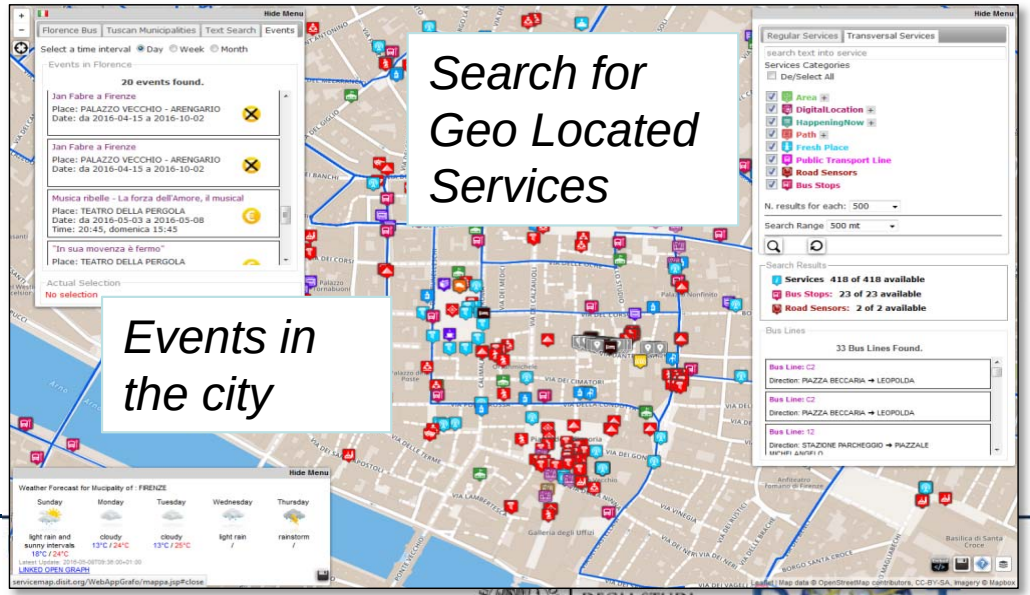
Firenze Smart City: UTS + ...









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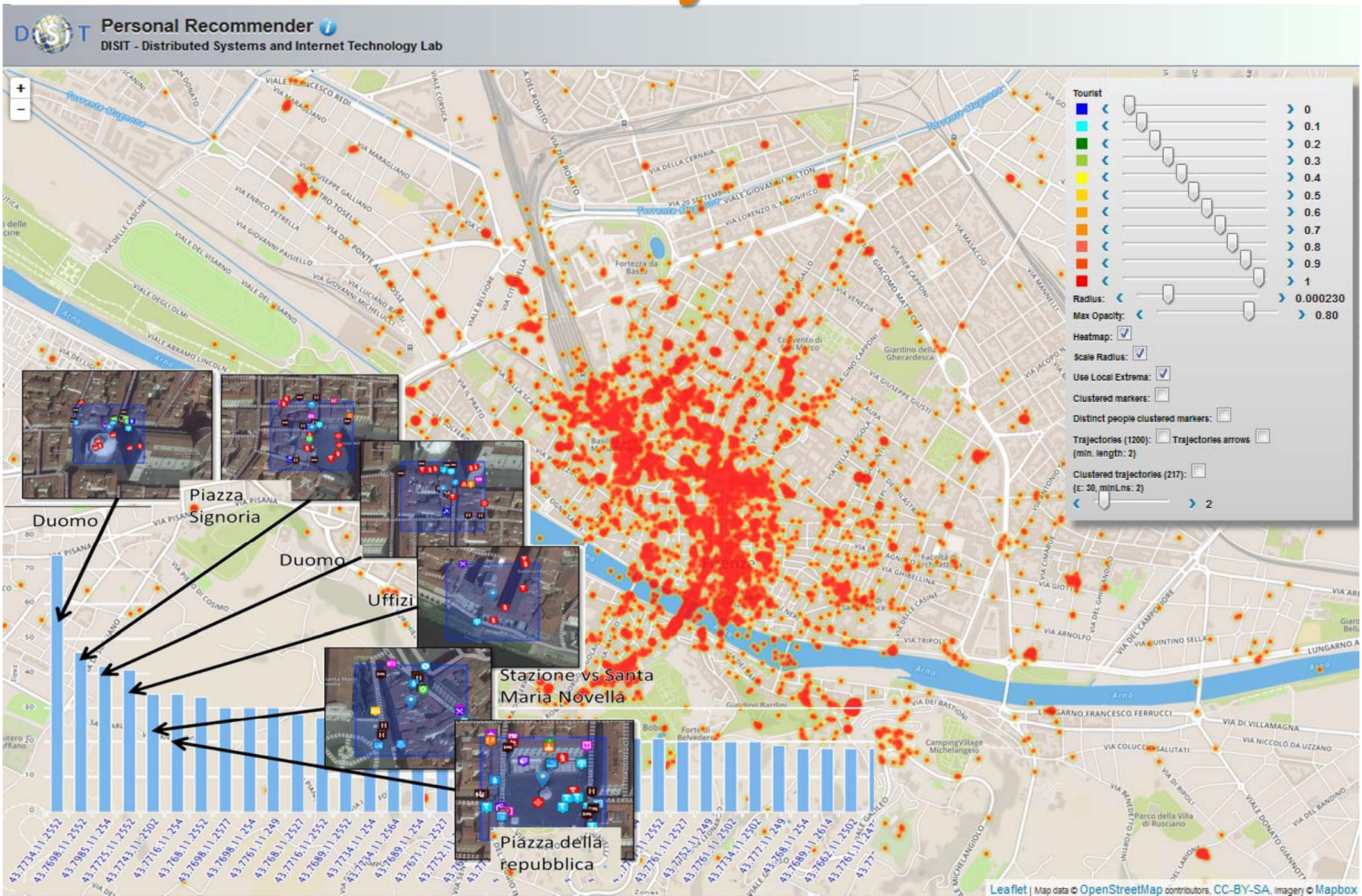
User Behavior Analyzer



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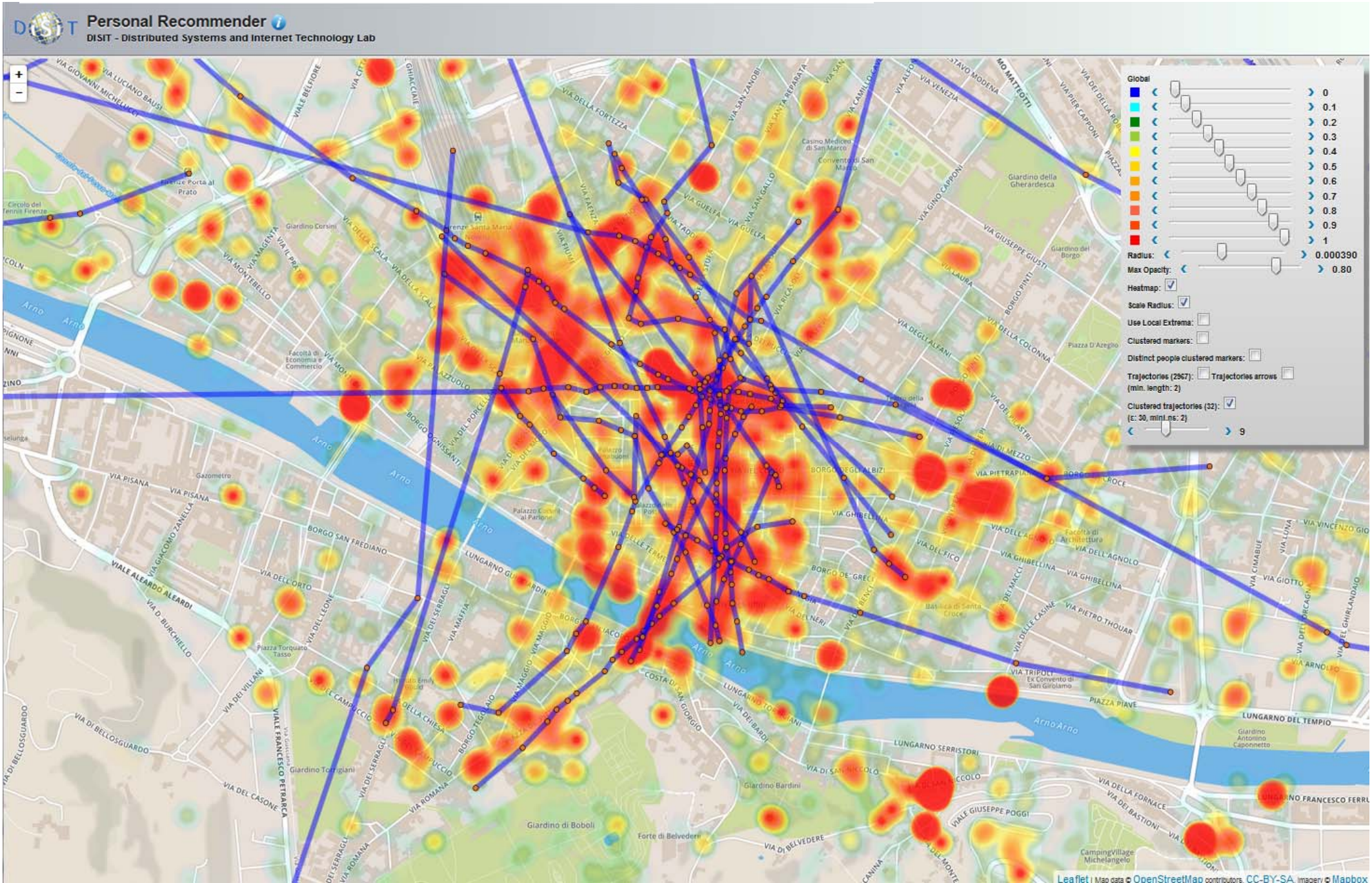

Twitter Vigilance, Sentiment Analysis, Monitoring and prediction

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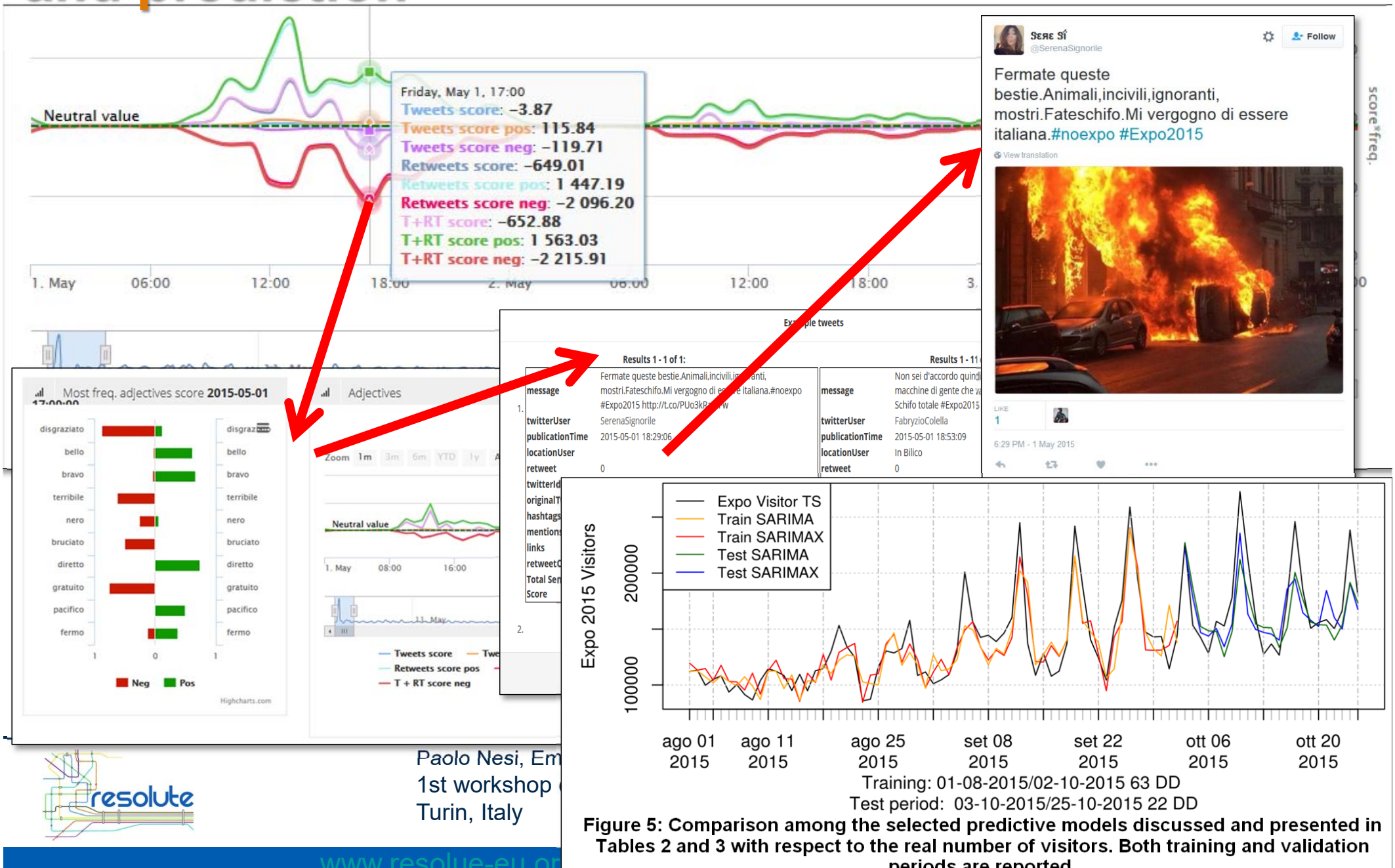

Figure 5: Comparison among the selected predictive models discussed and presented in Tables 2 and 3 with respect to the real number of visitors. Both training and validation periods are reported.

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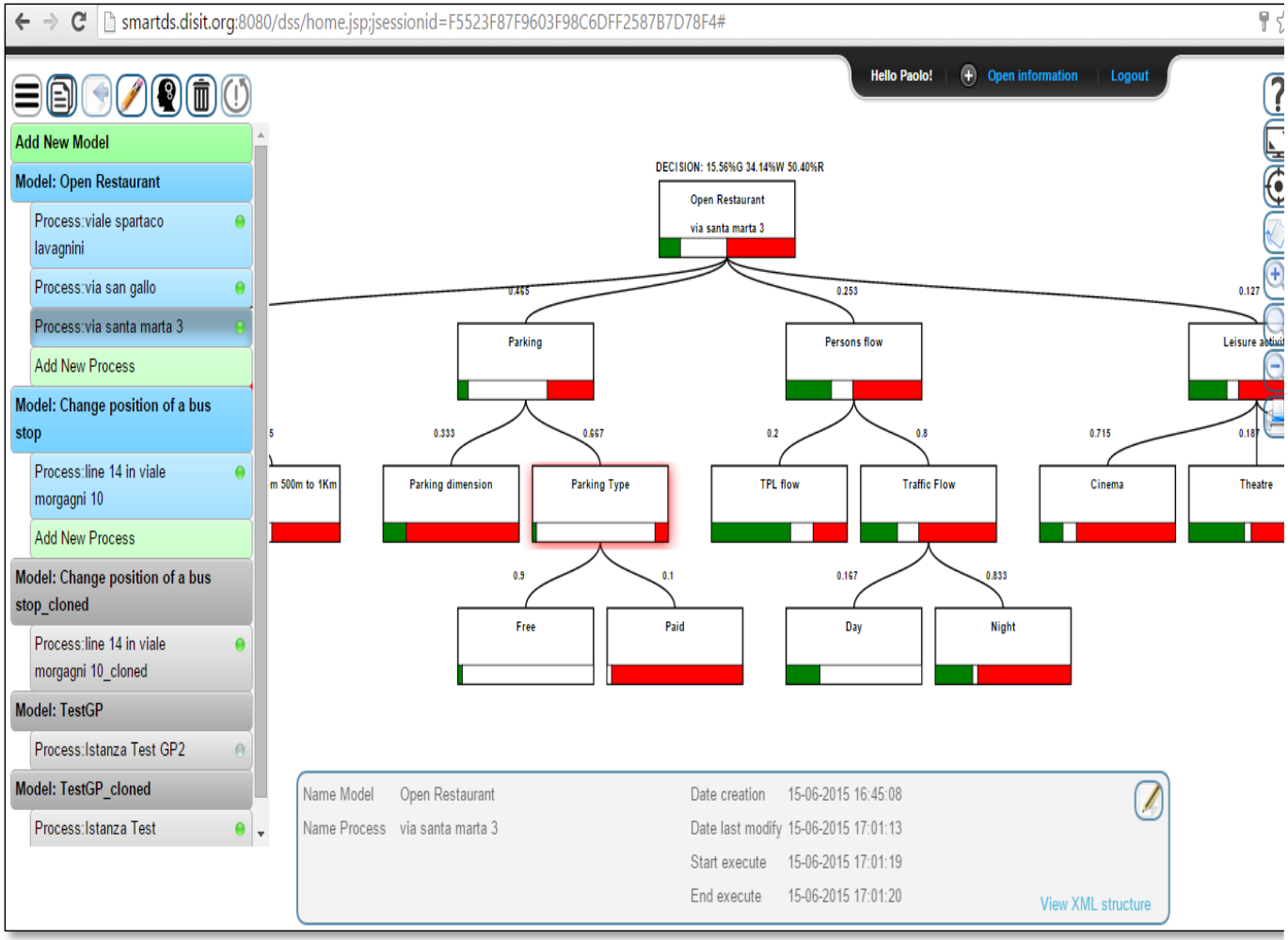
Smart Decision Support

- ***Smart Decision Support System*** *based on System Thinking plus*
- Actions to city reaction, resilience, smartness..

Enforcing

- Mathematical model for propagation of decision confidence..
- Collaborative work…,
- Processes connected to city data: DB, RDF Store, Twitter, etc.
- Production of alerts/alarms
- Data analytics process
- Twitter Processes
- reuse, copy past, …



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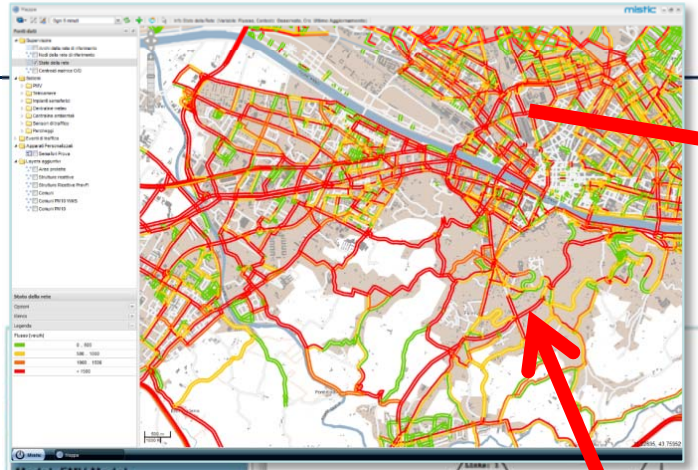
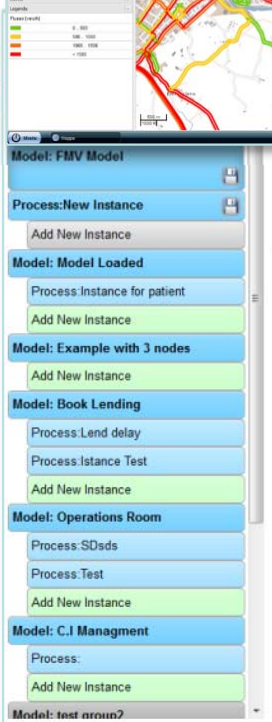
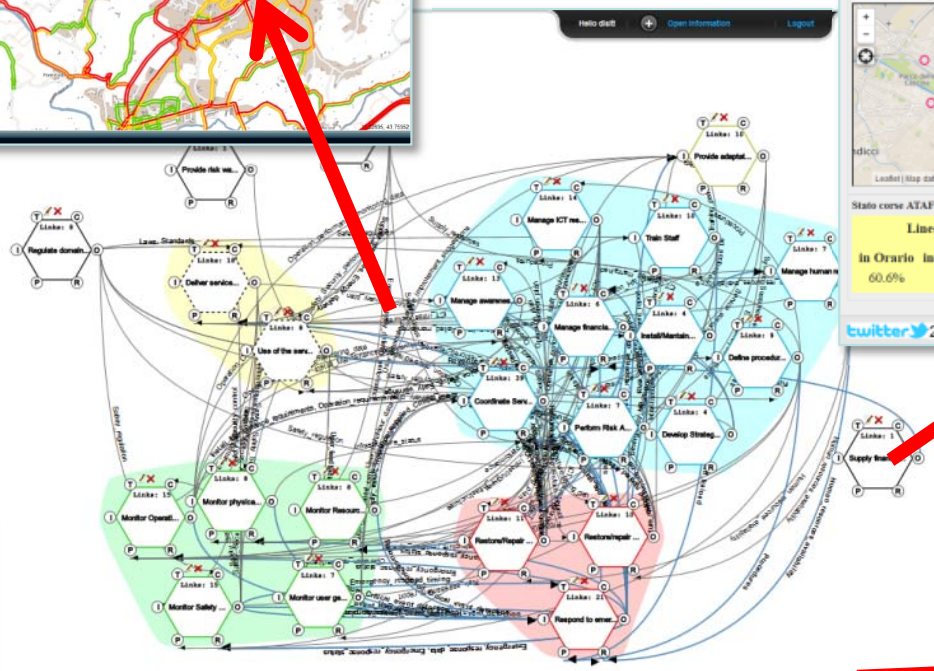
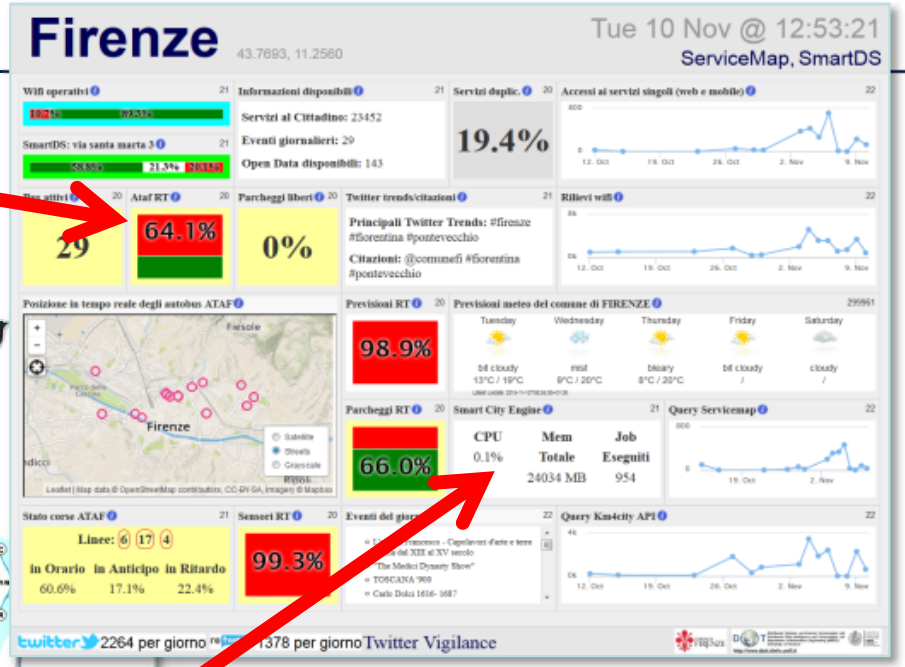
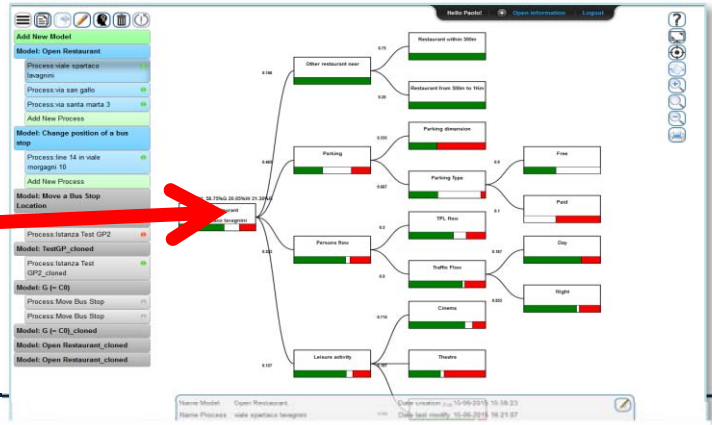
Dashboarding city resilience











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Data and Service Aggregator

Emergency Mobile App

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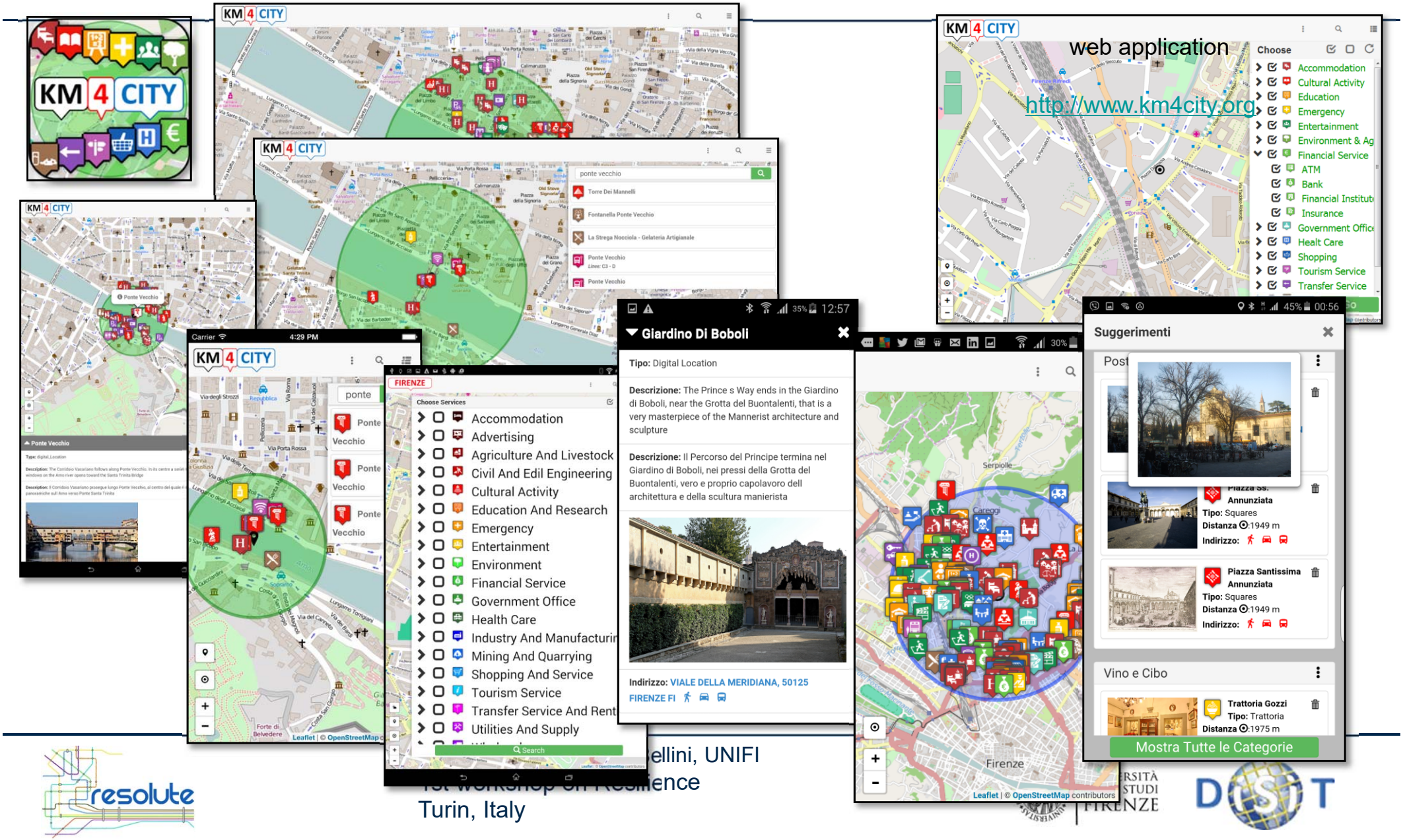

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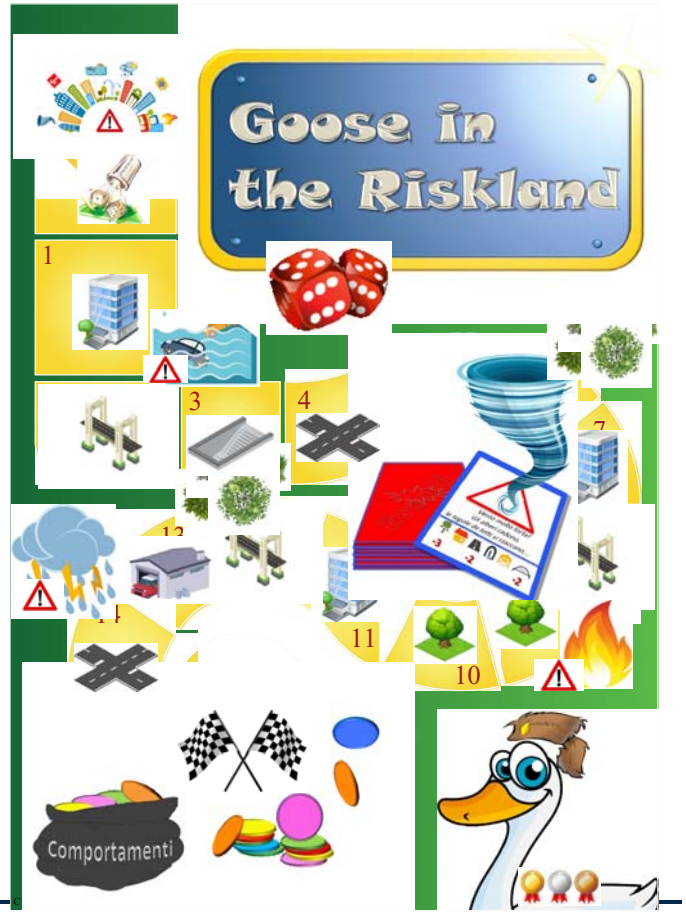
Game based training for preparedness

Game-based training has been associated with greater cognitive effort - an important condition for skill learning and improvements in

- skill execution,
- problem solving and
- decision-making

following game-based training than training involving repetitious technical instruction.

In RESOLUTE we design and develop a game based **meta-application** for Training in order to train different user categories and to improve the community sef resilience



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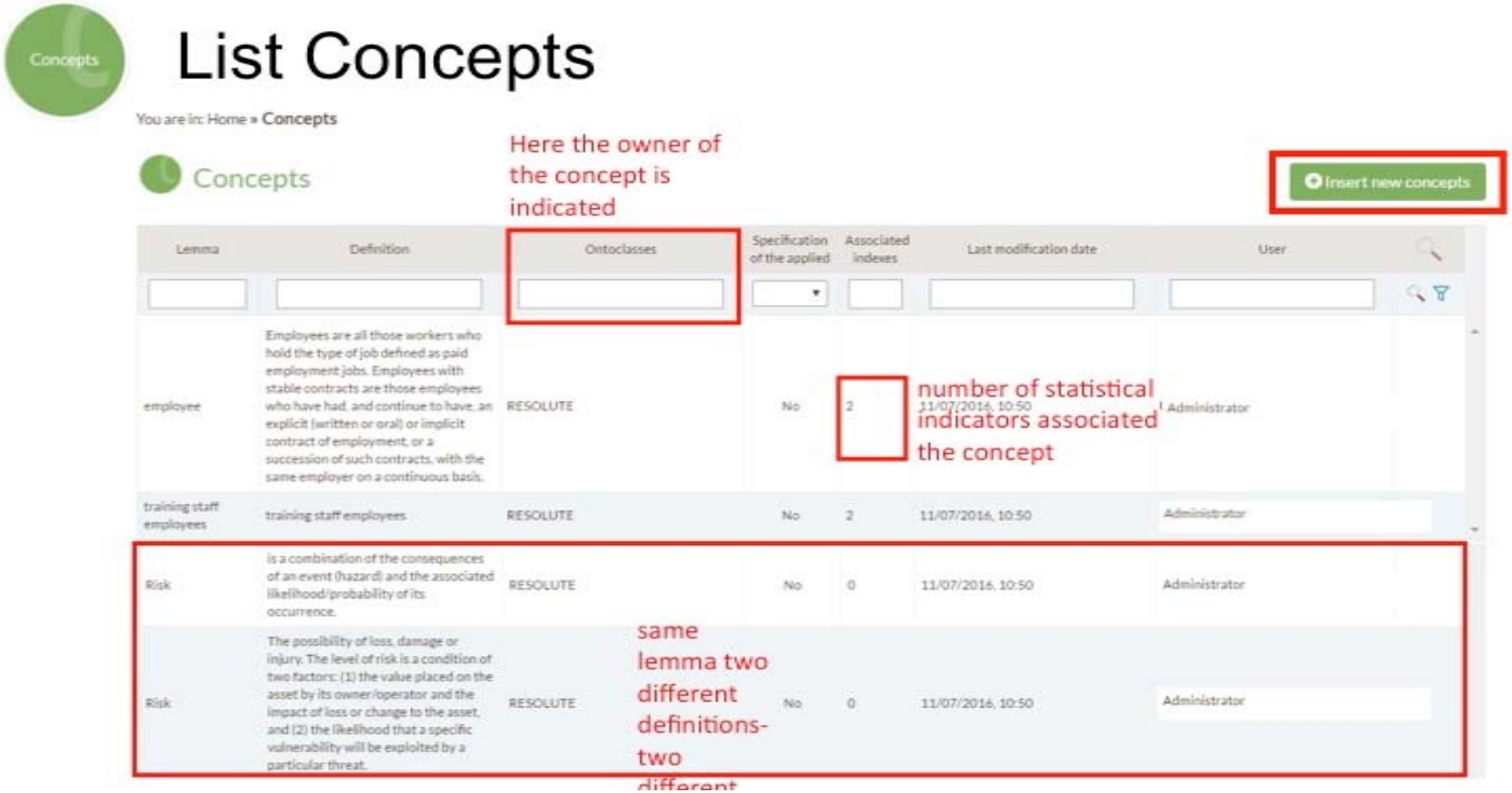
Collaboration with other initiatives (DRS7-14-…)

Building a common language about resilience and related indicators collaboratively



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Thank you

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