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CERIS 2021
Resilience Management Guidelines and Operationalization applied to Urban Transport System

- **Started**: 1st May 2015, **duration** 36 months
- **Pilots**: Florence and Athens
  - End Users: City of Florence, Attiko Metro
Motivations

Enhancing resilience in Urban Transport Systems is considered imperative for two main reasons:

1) Such systems provide critical support to every socio-economic activity and are currently themselves one of the most important economic sectors in Europe.

2) The paths that convey people, goods and information, are the same through which risks are propagated. Transport systems have thus developed a prominent safety and business critical nature, in view of which current management practices have shown evidence of important limitations.
Project 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

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

- **European Resilience Management Guidelines** – (guidelines) – consensus driven approach improve guidelines acceptability at EU level
  - general version, and UTS version

- **CRAMSS** – (tools and algorithms) – ontology based static and dynamic Critical Infrastructure (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
Impact – End users perspective

Increased system resilience through implementing resilience guidelines
• Increase resilience cost- and time-efficiently
• Make the resilience management process easier and effective
• Establish **coordination** among all stakeholders (including first responders) involved in UTS resilience management
• Enable co-creation, re-design, and enhancement of resilience oriented services
• Easily integrate new public services

Increased efficiency of action in emergency situations
• Reduce the time for taking informed decisions
• Allocate resources efficiently to cope with emergency
• Reduce knowledge gap monitoring system (city) status
• Improve communication with citizens and authority
• Make emergency services more user-friendly and widely accessible
RESOLUTE resilience perspective

Resilience as an emergent property of a synergistic dual system

Resolute focus

Building
Adaptive Capacity

Requiring
Coping Ability

Enabling
Potenti ality

Performing
Actuality

Anticipate

Building Adaptive Capacity

Learn

Respond

Monitor

Prepare Absorb Recover Adapt

Performance

Time

t0 t1 t2 t2b


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1. UTS Reference Model

2. Europen Resilience Management Guidelines

3a. Big Data driven CRAMSS

3b. Function variability indicators definition

4. Indicators composition To System Resilience Index

5. Assessment
Collaborative Resilience Assessment and management support system (CRAMSS) -

Collaboration among operators + empowering citizens to self resilient behaviors

ESSMA Users

Informed decisions on mobility
Create / send evacuation routes to ESSMA
Informed decisions on other UTS functions

Co-funded by the European Union under H2020 DRS' 07-2014
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 people 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,
• Real 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…
New datasets

- **Wi-Fi Data (provided by City of Florence)** collection and analysis (provided by DISIT lab), and corresponding data analytics for heat maps, trajectories, origin destination map, clustering of human behaviour, etc.; An extension of the Wifi network is also foreseen provided from the CMfirenze and Thales on the tramline of Florence.

- **Social media data in real time as Twitter Vigilance** real time (Extension of the DISIT Twitter Vigilance tool developed by DISIT lab) with corresponding data analytics: NLP and SA;

- **Real time number of available** beds in the emergency room data (provided by the hospitals in Florence), implemented by DISIT lab.

- **Specific sensors data**, as e.g., underpasses, not yet implemented as data ingestion process;

- **Specific areas of the city as**: Standing areas for population, recovery buildings, meeting points of rescuers and resources, assistance areas for population with the capability of extracting POI and other issues in the area as transport system facilities, etc.
  - Aree di Ammassamento Soccorritori e Risorse [http://opendata.comune.fi.it/statistica_territorio/dataset_0308.html](http://opendata.comune.fi.it/statistica_territorio/dataset_0308.html)
  - Aree di attesa della popolazione [http://opendata.comune.fi.it/statistica_territorio/dataset_0307.html](http://opendata.comune.fi.it/statistica_territorio/dataset_0307.html)

- **Flooding susceptibility** areas

- **Generic weather database**

- **Twitter base dataset for EvacuationDSS**
RESOLUTE outcomes

- Bus routes
- Network analysis
- UTS events
- Resilience dashboard
- ESSMA
- EvacuationDSS

www.resolute-eu.org #RESOLUTE
Some data examples
Twitter vigilance, Sentiment analysis

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.
Firenze Smart City: UTS + ....

- UTS CI POIs
- Bus Lines
- Sensors
- Geo Located Services
- Events in the city

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User Behaviour Analysis

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Km4City Ontology

>84 Classes
>100 ObjectProperties
>100 DataProperties

- Temporal reasoning
- Metadata on the data
- Statistics
- Risk and Resilience
- Licensing
- Open and Private Data
- Static and Real time

- to cover different aspects:
  - Administration
  - Street-Guide
  - Points of interest
  - Citations from strings
  - Mobility and transport
  - Energy
  - Sensors...

Ontology Documentation:
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461
Snap4City Functional Architecture

Data Sources, External Services

PULL Data

Data Ingestion, aggregation, regularisation, reconcile:
ION Directory, NIFI, special tools

Knowledge base
Semantic Reasoners

Indexing and aggregating
Elastic Search

Data Analytics, Simulations, Special Tools

R Studio, Tensor Flow, Python, ...

IOT Applications, Business Logic
Node-RED + Snap4City MicroServices

Authentication, Authorization, Platform & Processes Management, Data Inspector, Digital Twin, ...

Front-End

Rendering
Acting, Widgets, Synoptics, MicroApps
User interface, Drill down, maps, heatmaps

Back-End

Federation
Search and Query,
Smart City API,
Web Socket Server,
GIS, Facet, semantic

Social Media
Crawler and Manager

Transport systems,
Mobility, parking

Public Services,
Govern, events...

Sensors, IOT Cameras,
Wi-Fi

Environment, Water,
energy

Shops, services,
operators

Social Media
Crawler and Manager

Appliances and Docks
Installations

SNAP4City on
EUROPEAN OPEN
SCIENCE CLOUD
MARKETPLACE

PEN Test
Passed

EU GDPR
COMPLIANT

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Snap4City (C), February 2021

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What-IF analysis

Mobility and Environment What-IF Analysis
This dashboard contains data derived from actual sensors and predictive values under validation

Alert Registration

Alerting Generation
This dashboard contains data derived from actual sensors and predictive values under validation.

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Dashboards

Alerting Generation
This dashboard contains data derived from actual sensors and predictive values under validation.

Snap4Home 5G Demo
Luce

3D Map beta Testing

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### On Line Training Material (free of charge)

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https://www.snap4city.org/577

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UTS Pilot execution Florence Scenarios

Scenario 1 – Evacuation optimization:
- 2 groups of people suffering from partial / holistic disability to be evacuated to the closest Safe point with higher priority
- 8 groups people to be evacuated Normal route already blocked due to public works
- DSS to view this route as blocked and offer alternative
- DSS sends to the APPs the information

Scenario 2 – User in need: collaborative assistance & rescue
- Citizens (one Safe Point) declares injury / need / inability to evacuate on their own
- System identifies voluntary rescuers based on declared availability System identifies proximity of potential rescuers to citizen / user in need based on the location of user in need
- System informs selected rescuer to attend to user in need

Scenario 3: Parametric analysis
- Operator examines systems ability to respond effectively for a range of virtual scenarios
- Operator to check ability to collaborate with first responders
- NO physical participation of volunteers

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Florence pilot

- Florence pilot scenario identified:
  - river flooding
  - water bomb
- 4 use-case defined: 3 for river flooding, 1 for water bomb.
- All CRAMSS component used to validate the scenarios

River Flooding use-case:
- Arno/Greve
- Mugnone
- Ema
**Athens pilot**

- Athens pilot scenario identified:
  - Bomb attack
- Based on modelling/simulations and stated choice questionnaires on risk cost perception.

- Extension: testing eDSS and ESSMA
RESOLUTE team in Florence

IT Dept
Responsible for the Municipality Data (Open, GIS)
Dashboard w Unifi
Dissemination on technical contents

City Manager Dept
EuroProjects Office
Coordination with H2020 REPLICATE (SCC1)
Dissemination & monitoring

Local Police
Data/incidents/street events
Dashboard evaluation

Office of the Mayor
Civil Protection (16 association activated)
Processes & procedures
Mapping communication channels

Mobility & Metropolitan City
Mobility Scenarios Analysis
Mobility Manager
Traffic re-adaptation
Traffic Supervisor

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Not only digital technologies....

Goose in the Riskland Game for kids

+1,200 kids, students, teachers, families meeting RESOLUTE
RESOLUTE and Community of User

- **CoU** event in Brussels on 13 & 14 September 2017. https://youtu.be/BC1_d2Z_RUo

- Aligning the resilience-related research efforts in the EU-DRS projects 12 September 2017, Brussels, Belgium

- In conjunction with **CoU** event & with DRS projects
  - Presenting new approached to the resilience assessment and management methods, new guidelines and new tools are being developed in many current EU projects.

Aleksandar Jovanovic, Emanuele Bellini (Eds.)
ISBN 978-3-95663-143-6 2017
Critical Infrastructure Resilience 2018 (DRS-7 joint conference)
RESOLUTE End User engagement results

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Thank you