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Resilience management guidelines and Operationalization applied to Urban Transport Environment

www.resolute-eu.org

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Co-ordinated by
UNIVERSITÀ DEGLI STUDI FIRENZE

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.

Main criticalities in a (smart) City

- **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

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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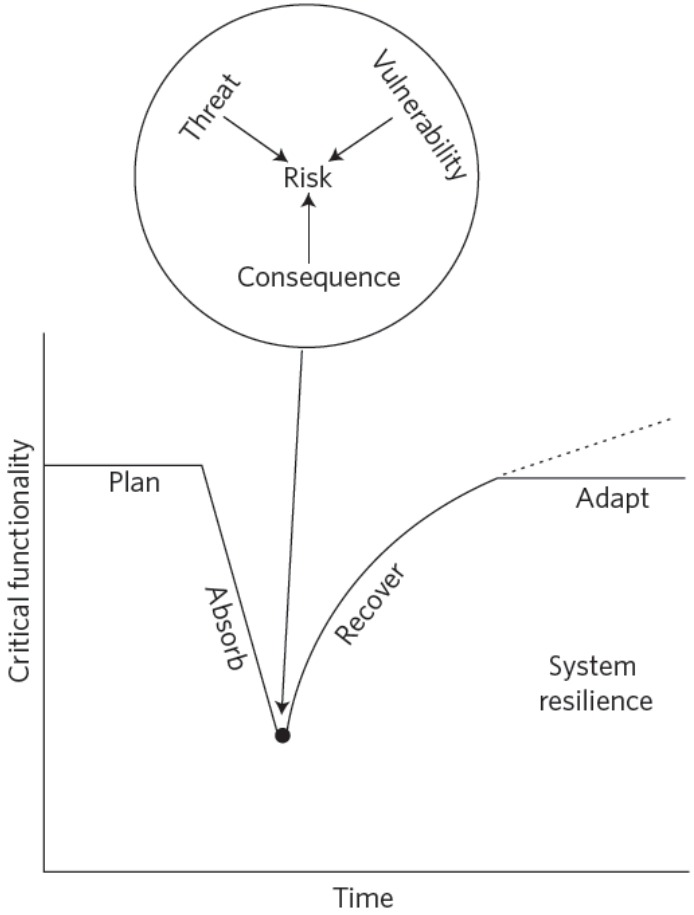
RESILIENCE as Ability



Resilience is the **ability** to prepare and plan for, absorb, recover from, and more successfully adapt to adverse event [NAS]

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Resilience as adaptive capacity

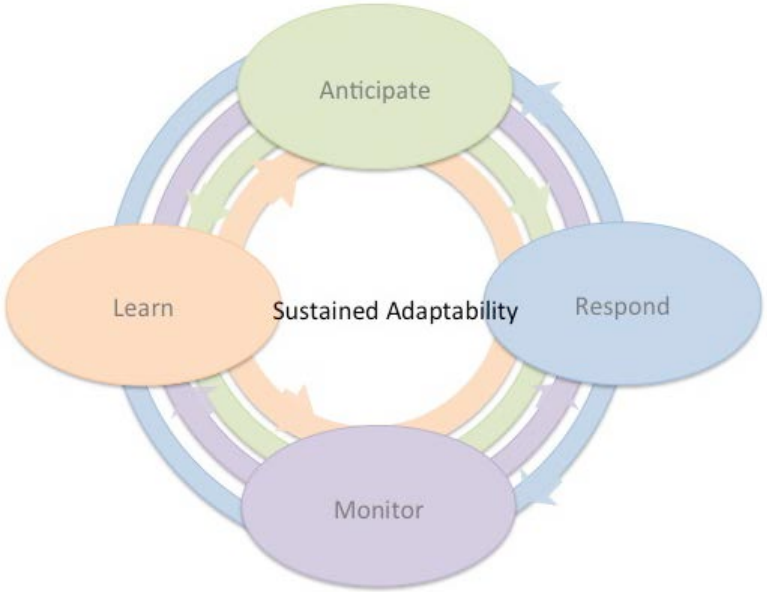
Adaptive capacity:

1) Knowing what to do -> ability to address the "actual" and **respond** to regular or irregular disruptions by adjusting function to existing conditions.

2) **Knowing what to look for** -> ability to address the "critical" by **monitoring** both the system and the Environment

3) **Knowing what to expect** -> ability to address the "potential" longer term threats, **anticipate** opportunities for changes in the system

4) **Knowing what has happened** -> ability to address the "factual" by **learning** from experiences of both successes and failures



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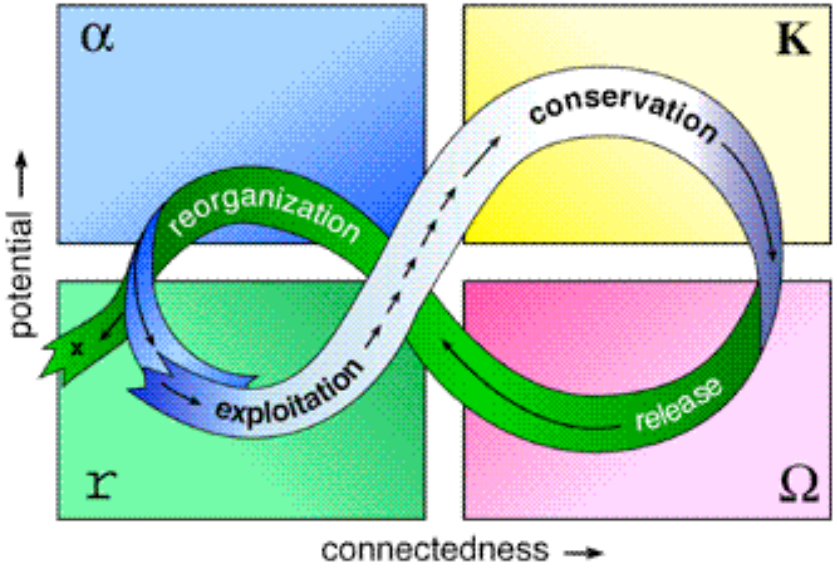
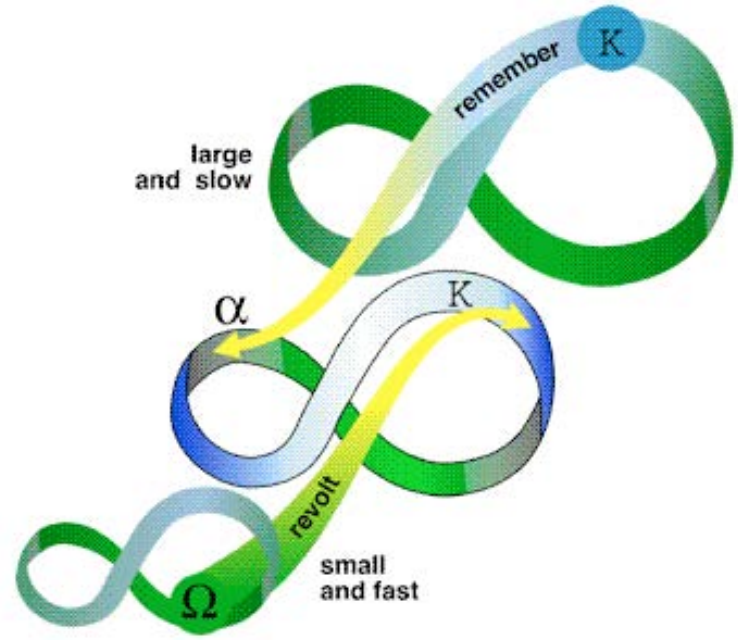
Towards Smart Panarchic City





Developing and mobilizing
Urban adaptive capacities
into a multi-scale time framed cycle

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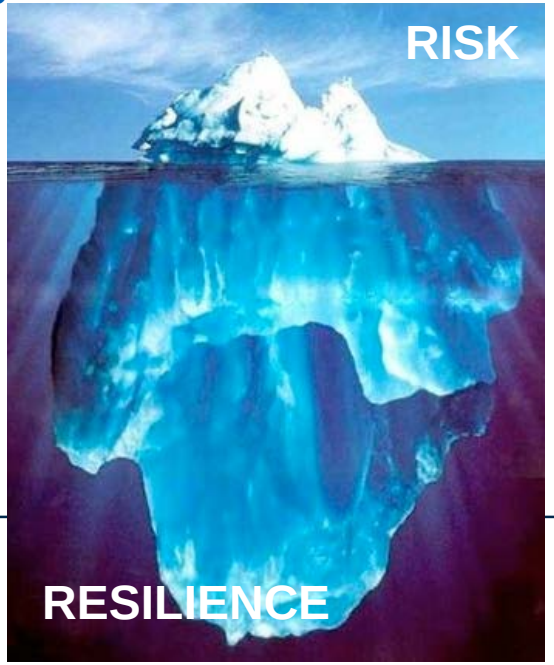
From Risk to Resilience

1) Enforcing Stability	->	Accept/dump variability
2) Resist	->	Adapt
3) Expect knowns	->	Expect unknowns
4) Breakdown at boundaries	->	Tolerance, graceful degradation
5) Centralization	->	Decentralization, local knowledge
6) Central C&C	->	Directed opportunism (mission command)
7) Reducing local DoF	->	Increasing local DoF (margin of maneuver)
8) Compliance to roles	->	Problem solving, flexibility
9) Minimising uncertainty	->	Cope with uncertainty
10) Bounce back	->	Bounce forward (better)



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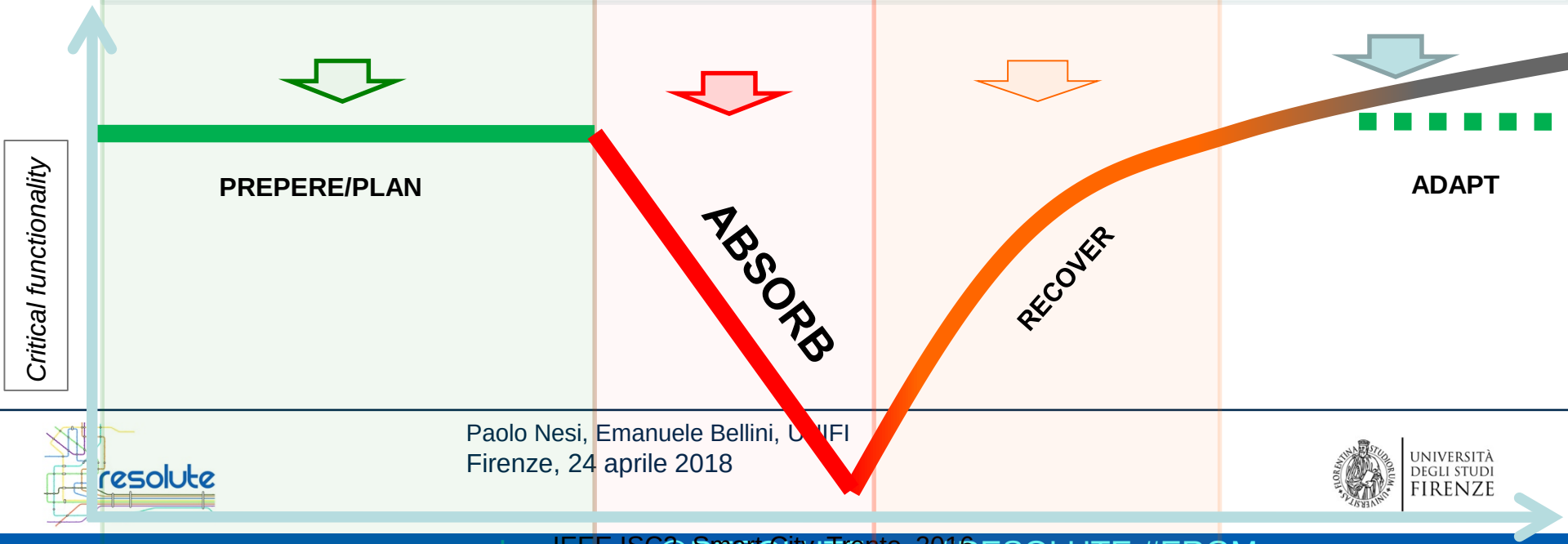
Resilience objective in RESOLUTE

PREPARE/PLAN:
ERMG
risk map, vulnerability analysis, predictive analytics ,
Resource availability and allocation monitoring,
Game-based training

ABSORB:
Dashboard RT, situational awareness,
event dynamic tracking,
real time operational decision support
Evacuation app

RECOVERY:
Real time damage and function degradation estimation,
resource availability and demand monitoring and estimation

LEARN:
Big Data storage of
events, actions, sensors, etc.,
Big Data mining and intelligence



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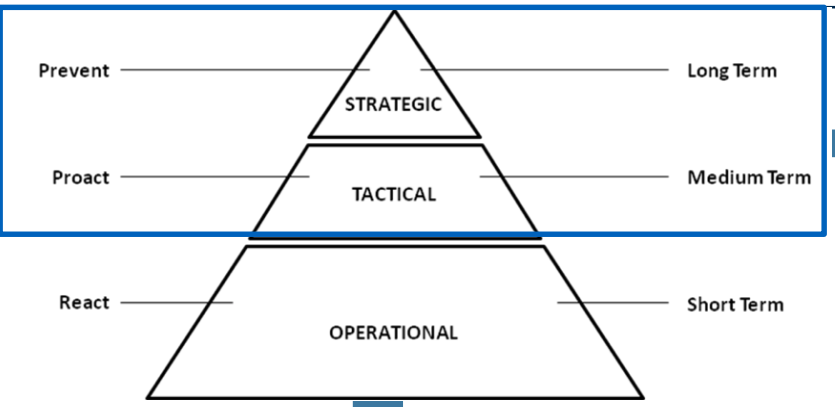
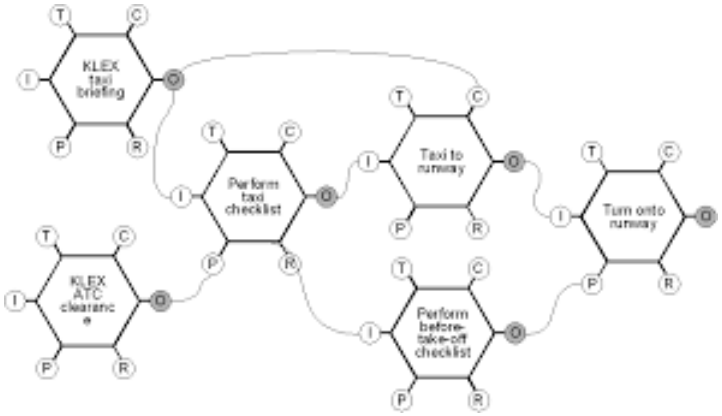
ERMG Operationalization:

Big KID (Knowledge. Information, Data) Approach



Descriptive



KM 4 CITY

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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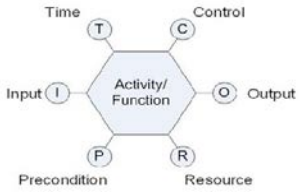
Workflow to produce resilience guidelines

Stakeholder interviews (workshop, F2F, etc.)

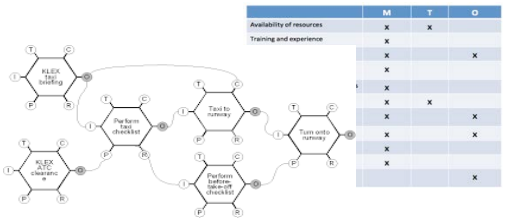
Collect data about how the system work in general (daily operation)

(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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FRAM-based UTS modeling

Functional Variability

Variability propagation through function interdependency

Possible functional Resonance (failing in damping variability)

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RESOLUTE evaluation indicators definition

ERMG functions	Function's output	Preliminary KPI for pilots validation
ANTICIPATE		
Develop Strategic Plan	Strategic Plan	A. Presence of a strategic plan B. Adherence to plan in previous business periods (i.e. performance review) C. External contextual factors accounted in the resilience policy/strategy (ref. Indicator ID 1029 – Smart Resilience) D. Resilience policy defined (ref. Indicator Id 983 – Smart Resilience) E. Frequency of plan revision needs F. Plan delivered with foreseen timeframe (i.e. according to business process)
Manage financial affairs	SLA (Service Level Agreement)	G. Compliance with budget in previous business periods (i.e. performance review)
	Budget	H. Presence of a well-defined (multi) annual budget I. Budget base on Reliability, Availability, Maintainability and Safety (RAMS) aspects. J. Frequency of budget revision

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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…

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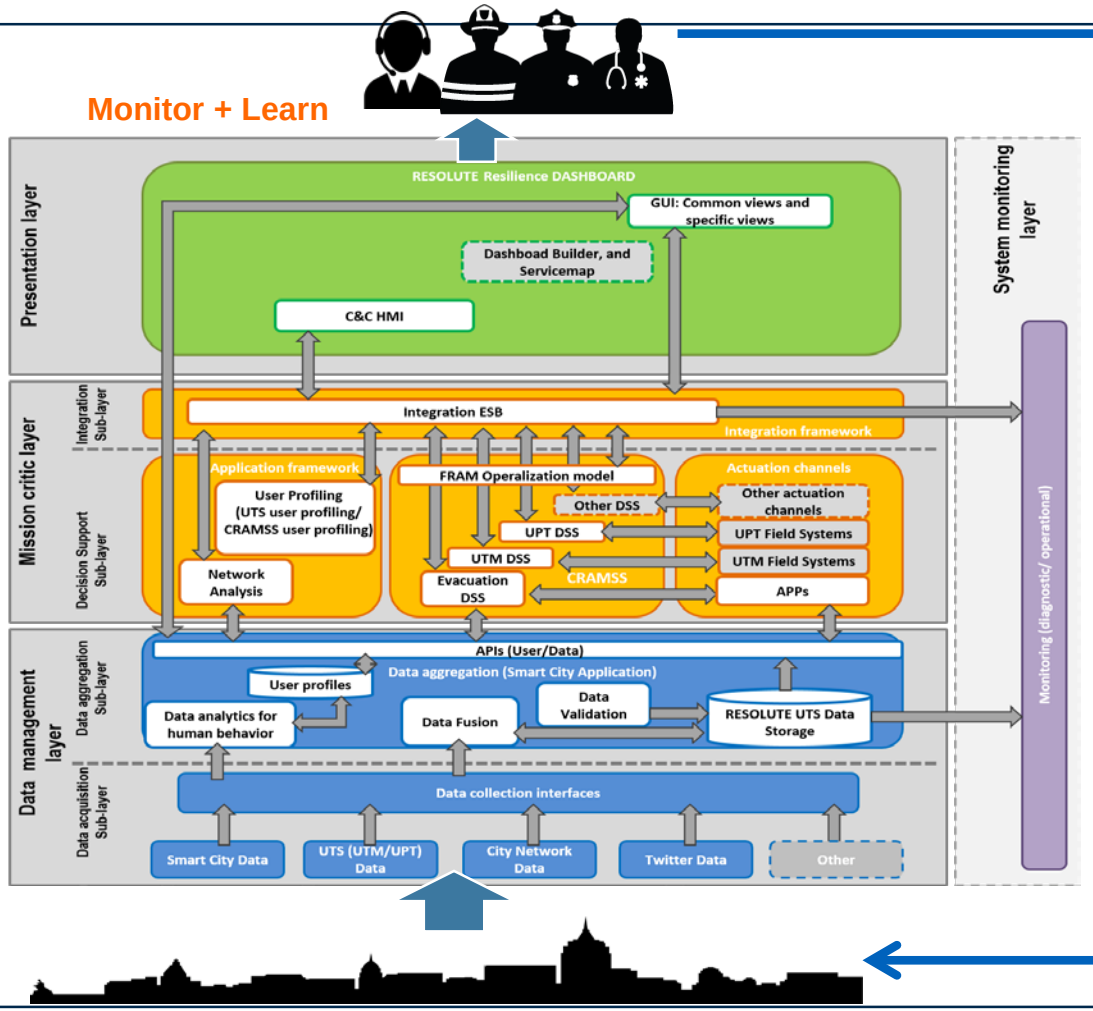
RESOLUTE platform

Monitor + Learn

Operationalization

ERMG



Respond

Anticipate + Monitor

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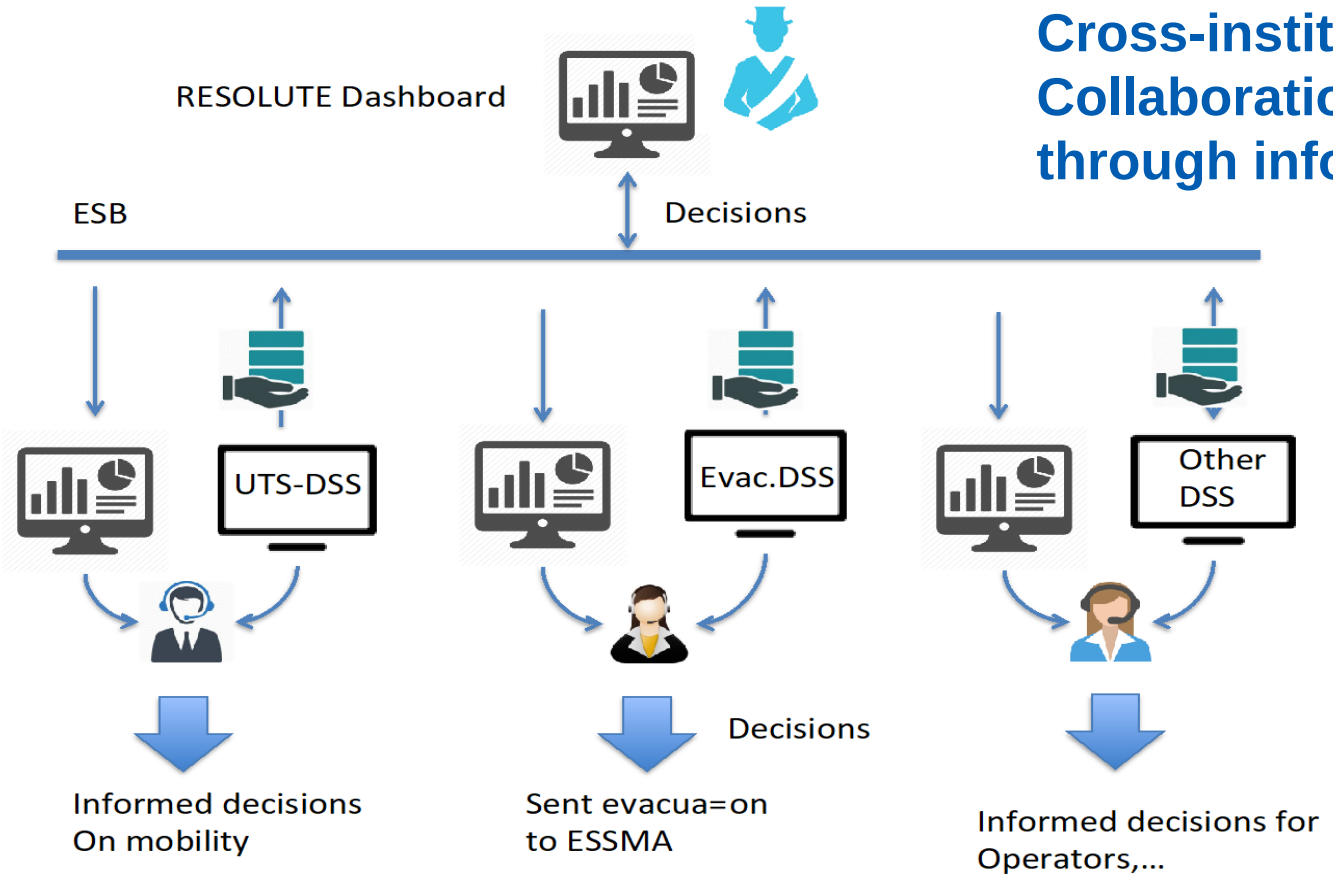
Collaborative Resilience Assessment and Management Support System



Cross-institution Collaboration through info sharing

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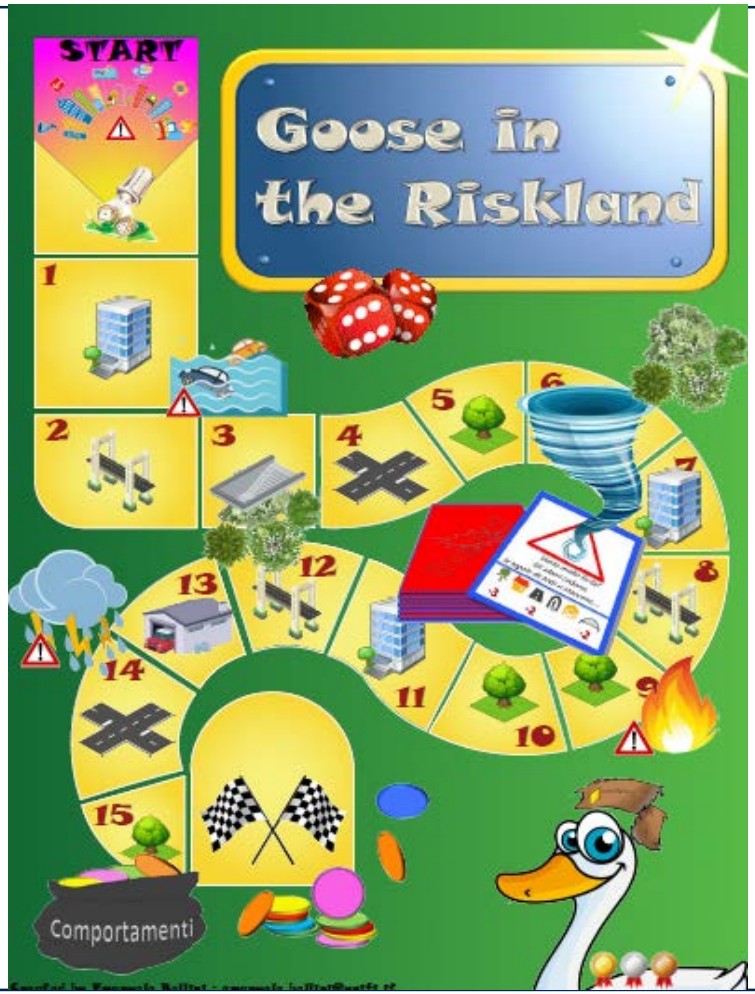
Florence Pilots – empower public awareness

A game to disseminate resilience mindset and good practices.

More then 200 kids has been "trained" at school.



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Impact

- Demonstrate capacity of timing intervention and operator's synchronization defragmenting information sources
- Timely and thorough response.
- Effective information propagation through multiple communication channels (mobile app, city panels, radio, etc.)
- Fast restoration of pre-emergency traffic and UTS conditions.
- A stronger perception of the risk and within the community
- A better help to people living in the suburb, isolated


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