Resilience management guidelines and Operationalization applied to Urban Transport Environment

RESOLUTE ERMG

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Co-ordinated by

UNIVERSITÀ DEGLI STUDI FIRENZE

About RESOLUTE

- **Start**: May 2015
- **End**: April 2018
- **Coordinator**: UNIFI/DISIT

RESOLUTE Consortium

The final goal of RESOLUTE is to identify, and enable adoption and adaptation of concepts and methods for developing and evaluating guidelines on resilience for the Critical Infrastructure of the Urban Transport System (UTS)

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Resilience as an Ability

A system's resilience resides 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 [Hollnagel]

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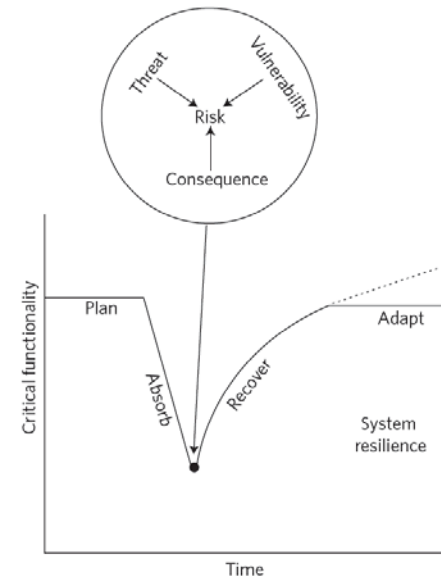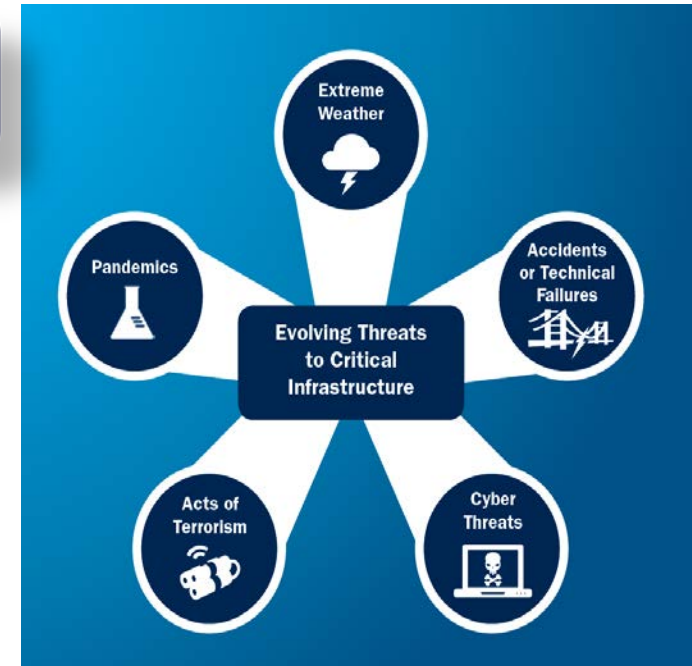
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European Resilience Management Guidelines for Critical Infrastructure

The need

- Guidance to Critical Infrastructure owners/managers to effectively and standardised **organize** and **strengthen** their **facilities**, **personnel** and any other kind of **assets**, in order to confront the needs for resilience against any kind of **risks**.

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Resilience Management Framework
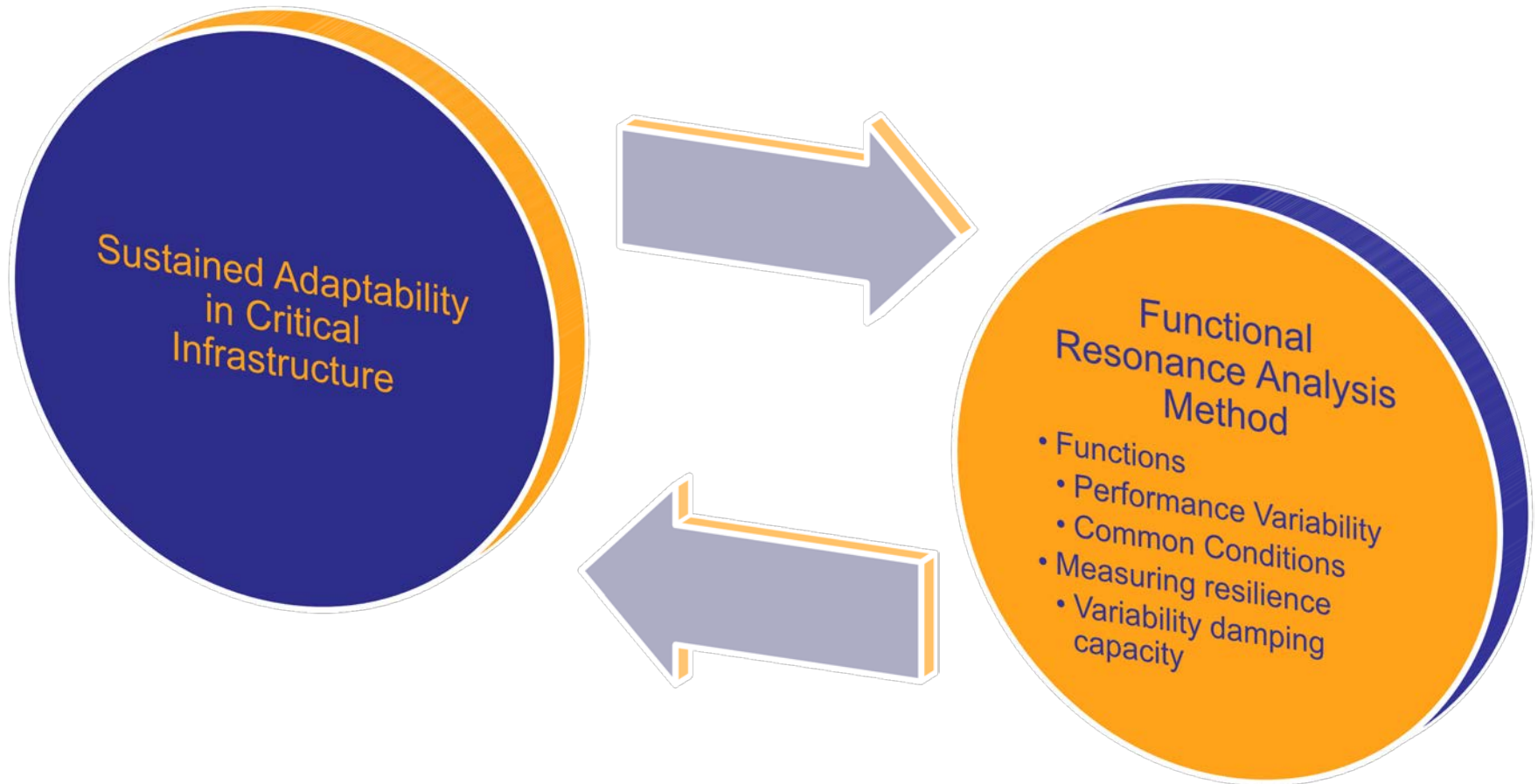
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From work as done to work as desired

From "Work as Imagined" to "Work as Done" (FRAM paradigm shift)

From "Work as Done" to "Work as Desired" (RESOLUTE extension)

- **"Work-As-Imagined"** describes what should happen under nominal working conditions.
- **"Work- As-Done"**, on the other hand, describes what actually happens, how work unfolds over time in a concrete situation

- The interesting thing from the guidelines perspective is to identify **which functions are needed** and how their **interdependencies** and **variability** should be managed to enhance resilience; and this requires going beyond the "Work-As-Done" level

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ERMG production methodology

Stakeholder interviews (workshop, F2F, etc.)

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

Work as done

(High Level) System Functions identification and description

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

Performance Variability (Coupling & Common Condition)

Function coupling
- Common Conditions

Work as desired

Questions definition For each CC of a function

How to dampen performance Variability of the function?

Answer the questions (Guidelines)

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

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System Functions definition

Abstract **Questions**

Resources **Examples**

Anticipate

- **Develop Strategic Plan**
- **Manage financial affairs**
- **Perform Risk Assessment**
- **Coordinate Service delivery**
- **Manage awareness & user behaviour**
- **Develop/update procedures**
- **Manage human resources**
- **Training staff**
- **Manage ICT resources**
- **Maintain physical/cyber infrastructure**

Monitor

- **Monitor Safety and Security**
- **Monitor Operations**
- **Monitor Resource availability**
- **Monitor user generated feedback**

Respond

- **Coordinate emergency actions**
- **Restore/Repair operations**

Learn

- **Provide adaptation & improvement insights**
- **Collect event information**

Function description

Input	**What should start the function? What should the function act on or change?**
Output	**What should be the output or results of the function?**
Precondition	**What should be in place so that you can complete the function normally?**
Resource	**What resources do you need to perform the function, such as people, equipment, IT, power, buildings, etc.?**
Control	**Should there be any formal procedures or instructions or people, such as supervisors controlling the function? Should there be there any priorities or specific constraints?**
Time	**Should be there any time related to the function or a certain time where you have to perform the function?**

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Desired function interdependencies

STEP 2

Functions coupling

From Work as done to Work as desired

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ERMG Basic structure

Section: Anticipate, Respond, Monitor, Learn	These are the 4 resilience cornerstones. The functions are grouped under the characteristic to which they mainly contribute
<<Name of the Function>>	The name of the system function identified during the FRAM-based system analysis
Background facts	The main rational behind the guidelines, the current issues and roles associated to the function
General recommendations	Recommendations related to the function's "should do" in terms of activities to sustain the system adaptive capacity
Common Conditions recommendations	Recommendations about "how to dampen function performance variability" to continue delivering the desired outcome under unexpected conditions/event
Interdependencies recommendations	Recommendations addressing how a function can manage possible input variability generated by upstream functions within the system

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ERMG Main pillars

- Exploiting all kind of data (IoT/IoE, Social Media, Open Data, Satellite images, static datasets, etc.) to enhance situation awareness and learning capacity

- Considering people (human behavior, belief and preparedness) as an active actors in building system resilience

- Intelligent system resource management

- Sharing data, information, knowledge across the systems (CRAMSS)

- Defining clear responsibilities and procedures across the system

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Addressing Cross CI interdependencies

Understanding and addressing risks from cross-sector dependencies and interdependencies

Gaining knowledge of infrastructure risk & interdependencies through information sharing across CI community

→ Assist owners and operators of critical infrastructure to identify, analyse and manage cross-sectoral dependencies

Assistance in risk assessment & mitigation policies

EU understanding of industry-wide security issues – high quality policy advice to local and EU officials

Analyse Infrastructure Dependencies, Interdependencies, and Associated Cascading Effects

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Cross CI interdependencies

Managing cross-sectoral interdependencies

Establishment of an EU program for modelling and analysis of Critical Infrastructure

Strengthen the structures for incident preparedness and response

Periodic exercises on cross-sectoral dependencies and related workshops

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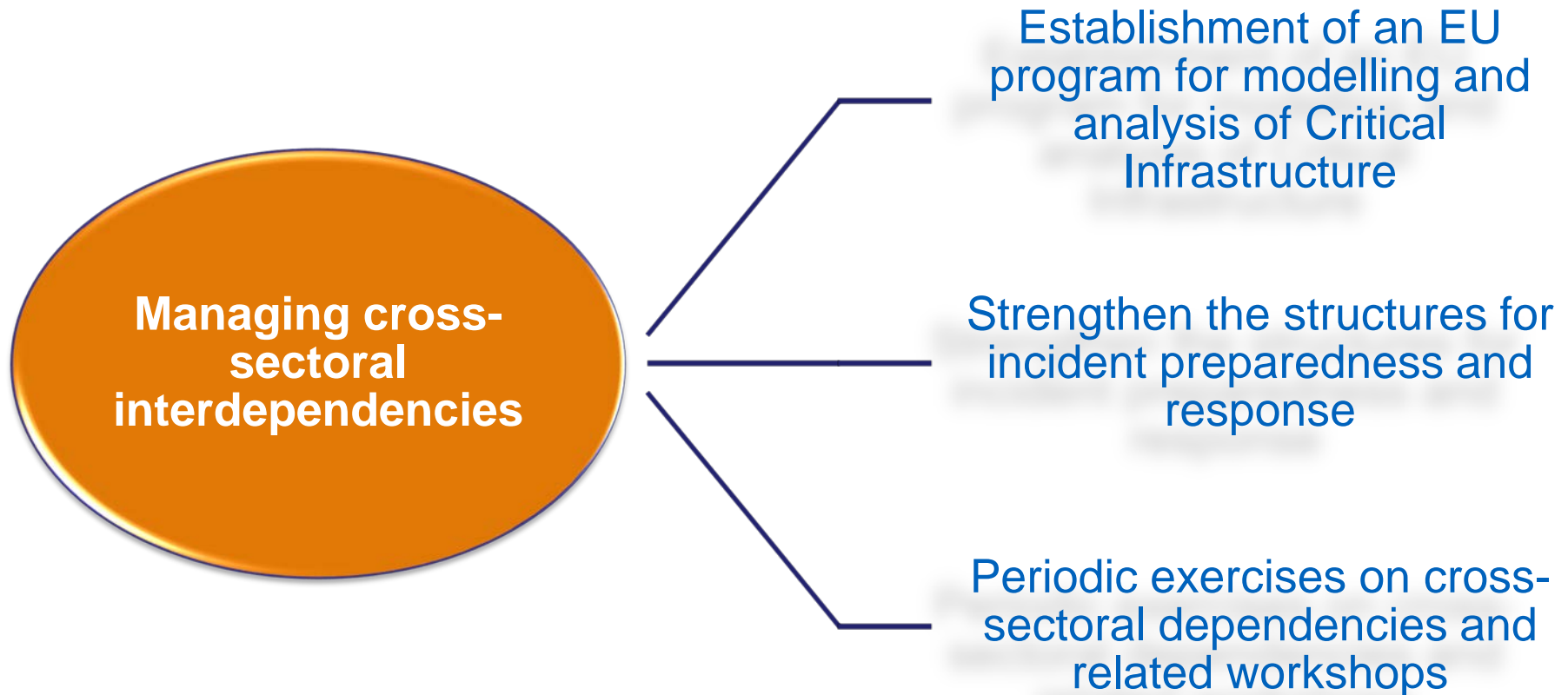**Societies (CoU), Resilience Workshop, Brussels, 13/9/2017**

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How to use the RESOLUTE ERMG?

- **Level I:** comparison between the "desired functions" defined in ERMG against the functions identified through a FRAM analysis of the CI under assessment.

- **Level II:** assessment about how the functions implemented in the assessed CI are actually aligned with the ERMG recommendations.

- **Level III:** function interdependencies assessment. The missing connections between functions in the CI assessed may suggest that information or resources are not properly supplied or shared, creating vulnerability in the system.

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ERMG expected impact

European Resilience Management Guidelines

| Raise awareness on CI resilience |
| Drive modifications in organisation and functions implementation |
| Focus on resource availability and allocation as key factor for resilience |
| Understanding the importance of (open/big) data generated by the system and "how-to" manage them to support the resilience phases. |
| Develop a culture of safety and of expecting unexpected |
| Build an organizational knowledge of the past events and establish a cyclical learning process |
| Inform and get informed all the stakeholders continuously |
| Being Open to society |
| Being Open to science and technologies |

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ERMG EU level Recommendations

Develop and promote a shared body of knowledge and a common understanding of resilience

Develop & improve guidance materials & tools according to real needs, success/failure cases & technology advancement

Raise awareness and preparedness for different stakeholders through resilience based training programs

Promote a socio – economical "value" perspective of resilience

Undertake specific research on resilience

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ERMG Adaptation to Urban Transport System (UTS)

Scope

- Adapt the generic ERMG within the framework of Urban Transport Systems (UTS)

Means

- Specifying &"translating" the suggested recommendations in terms of the characteristics, the needs and criticalities of UTS.

- Describing indicative operational scenarios,

- Discussing the interdependencies of UTS with other critical infrastructures.

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Why addressing UTS resilience?

A system of resilience criticality

System complexity

Large& interderdependent scale networks

Multiple modes

Multiple industries

Multiple operators – scattered responsibility

Public-private mix

Multiple recipients

Critical to economy

Threats exposure

Climate change – extreme weather events

Man-made threats (e.g. terrorism)

Operational threats (day-to-day mistakes)

Traffic disruptions (congestion, accidents)

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UTS resilience – Main principles

- **Prevent** incidents within control and responsibility, effectively protect critical assets.

- **Respond** decisively to events that cannot be prevented, mitigate loss and protect employees, passengers and emergency respondents.

- **Support** response to events that impact local communities, integrating equipment and capabilities seamlessly into the total effort.

- **Recover** from major events, taking full advantage of available resources and programs.

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ERMG adaptation to UTS

Application of the generic guidelines for resilience management in the specific case study of the Urban Transport System

Accordance with existing practices, lessons learnt and national approaches worldwide.

Provide guidance under the EU perspective, taking into account the already existing EU initiatives on Urban Transport System Resilience.

Following the structure of generic ERMG, organized under the four categories: Anticipate, Monitor, Respond and Learn.

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Conclusions

- Innovative approaches have been followed

- Current framework in resilience management in EU and beyond considered

- High impact results as the ERMG is applicable and adaptable to any CI & discusses cross-CI interdependencies

- More than 250 guidelines produced (18 functions x 13 guidelines categories)

- ERMG to be further elaborated through pilot implementation & validation & ASB review.

- Final products expected by the end of the project

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European Resilience Management guidelines & adaptation to UTS

First Versions available at:

http://www.resolute-eu.org/files/D3.5_European_Resilience_Management_Guidelines.pdf

http://www.resolute-eu.org/files/D3.7_ERMG_adaptation_to_UTS.pdf

Final Versions expected April 2018

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Resilience: expect failure…handle failure!

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