

Resilience management guidelines and Operationalization applied to Urban Transport Environment

European Resilience Management Guidelines

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RESOLUTE 2nd Workshop

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Co-ordinated by



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Objectives

- To define the **methodology** for the production of European Resilience Management Guidelines
- To develop **European Resilience Management Guidelines** through an iterative and multi-actor process
- To adapt the ERMG for the case of the **Urban Transport System**, in order for them to be tested and validated in the RESOLUTE pilots



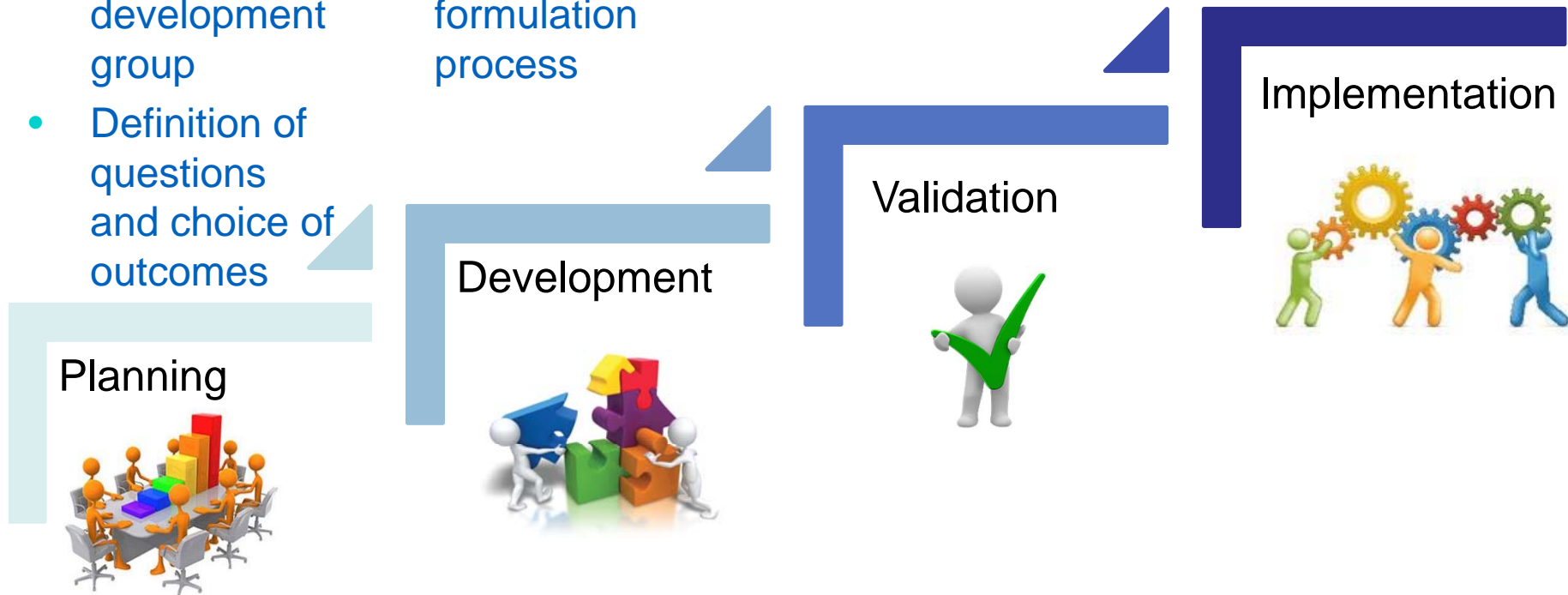
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ERMG Methodology – A step-wise approach

- Defining the scope of the Guideline
- Guideline development group
- Definition of questions and choice of outcomes
- Information collection and literature review
- Guidelines formulation process
- Review of guidelines
- Validation
- Adaptation to UTS
- Pilots
- Impact evaluation



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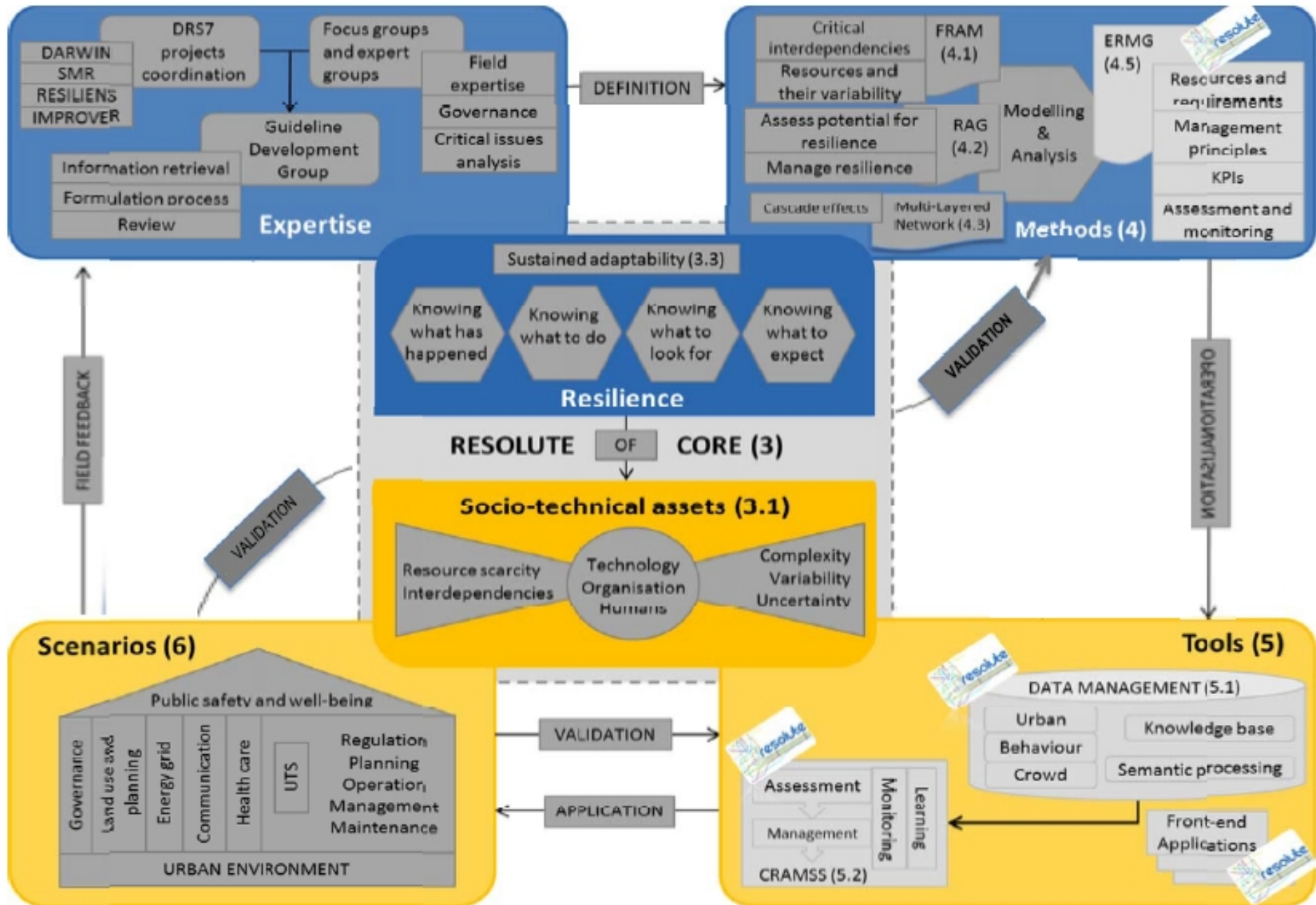




Resilience Management Framework



RESOLUTE conceptual framework





ERMG production methodology

From Work as done (FRAM-based) to work as desired

Identification of a complex system of reference based on desired functions and interdependencies that should be present in a CI in order to be resilient.

Answer to question: « How to dampen functional variability generated by... »

Internal causes: Common Conditions

External causes:
Interdependencies



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From work as done to work as desired

From “Work as Imagined”
to “Work as Done”
(FRAM paradigm shift)



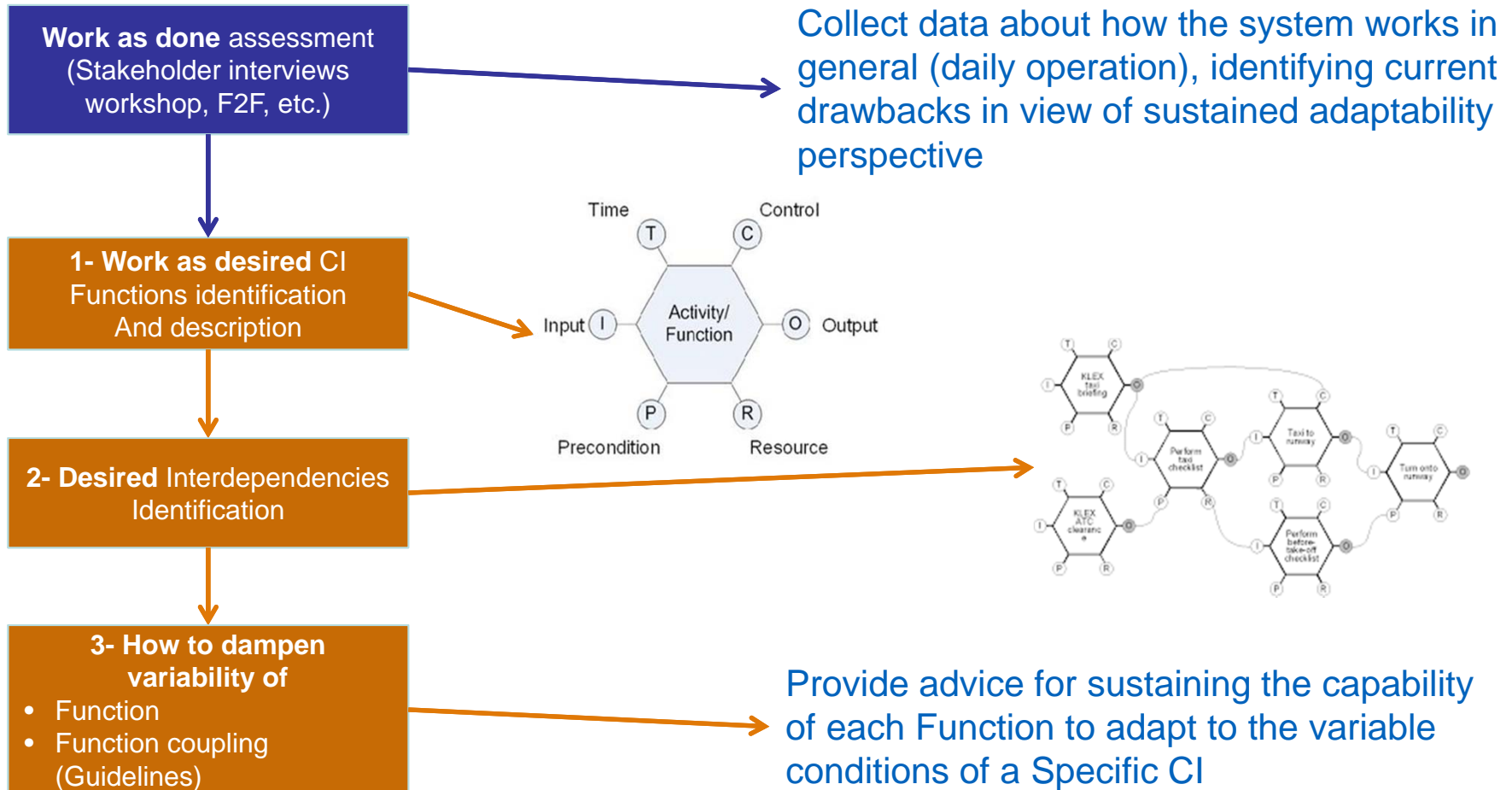
From “Work as Done”
to “Work as Desired”
(RESOLUTE extension)

- “**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



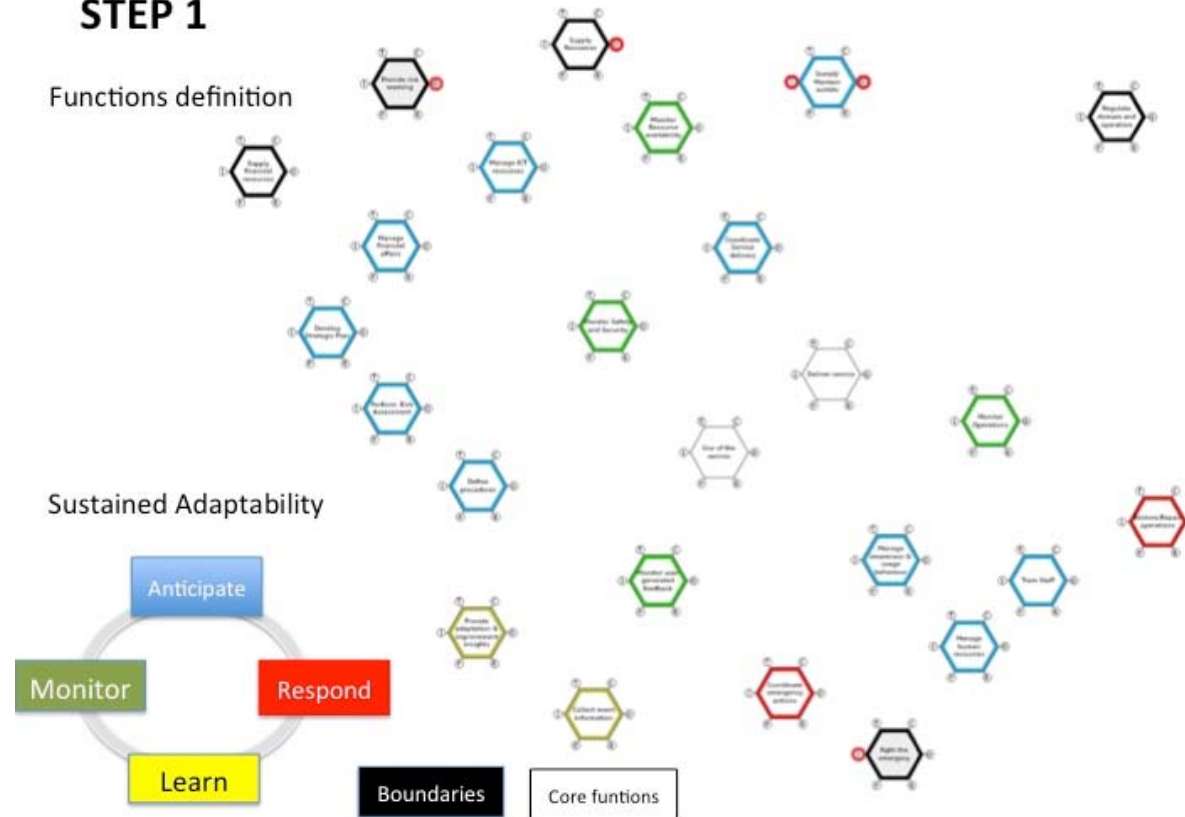
ERMG definition methodology





Desired functions and mapping against sustained adaptability concepts

STEP 1



Key decisions for modeling

- Level of granularity
- System boundaries
- Core functions

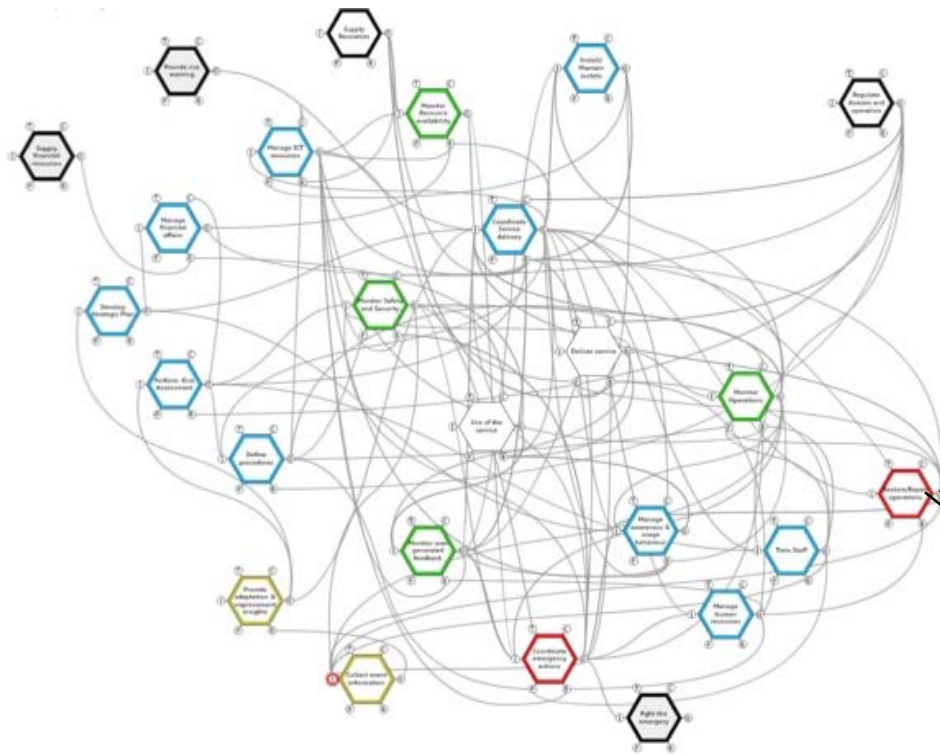


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How to dampen variability



Common Conditions

- Availability of resources
- Training and experience
- Quality of communication
- Human Computer Interaction and operational support
- Availability of procedures and plans
- Conditions of work
- Number of goals and conflict resolution
- Available time and time pressure
- Circadian rhythm and stress
- Team collaboration quality
- Quality and support of the organization

Interdependencies Function1

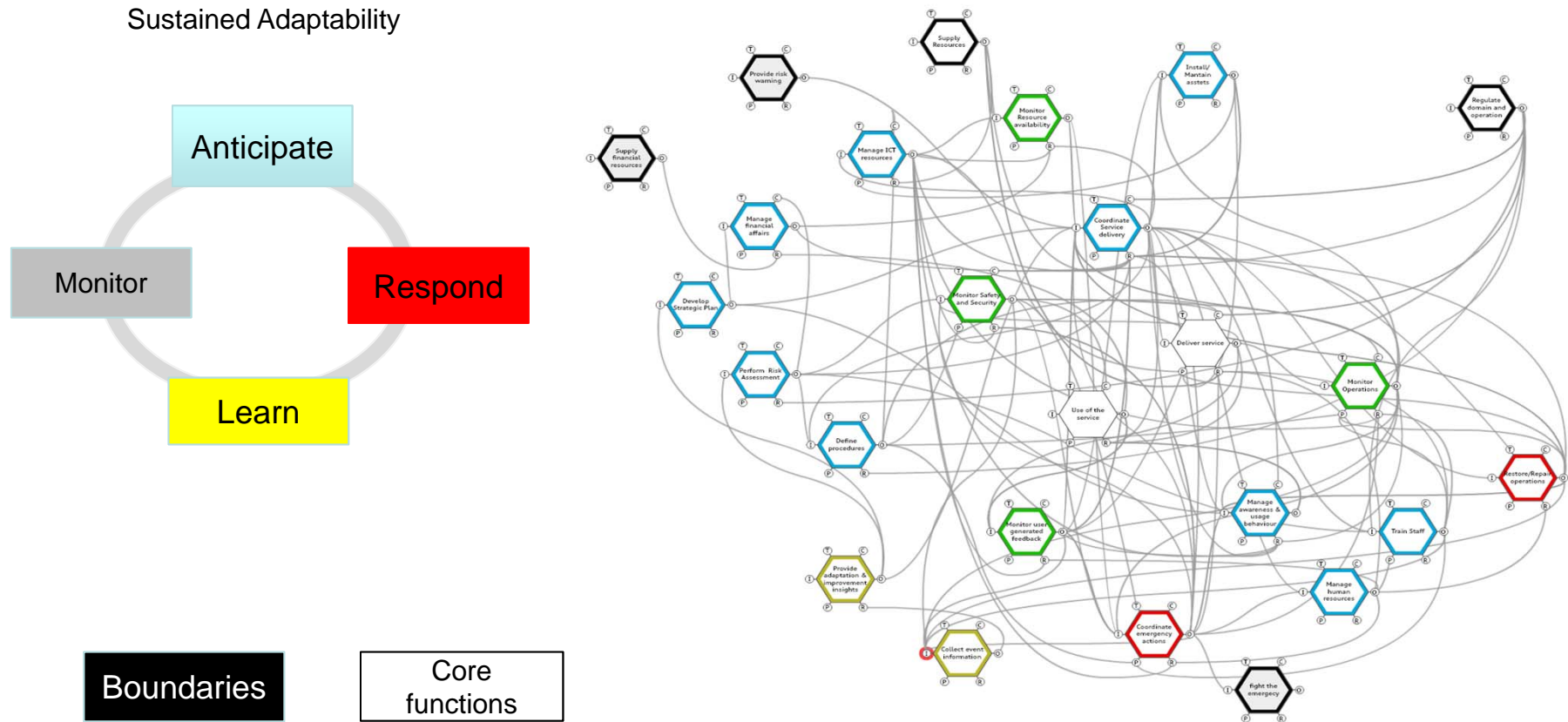


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Modeling CI and mapping against Sustained Adaptability Concepts



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Critical Infrastructure - The EU perspective

2006

- European Programme for Critical Infrastructure protection (EPCIP)

2008

- Directive on European Critical Infrastructure - ECI (2008/114/EC)

2008

- Critical Infrastructure Warning Information Network (CIWIN)

2010

- Risk Assessment and Mapping Guidelines for Disaster Management – Commission Staff Working Document

2012

- Review of the EPCIP – Commission Staff Working document

2013

- A new approach to the EPCIP- Making ECI more secure - Commission Staff Working document

- Critical Infrastructure is an asset or system which is essential for the maintenance of vital societal functions.
- The damage to a critical infrastructure, its destruction or disruption by natural disasters, terrorism, criminal activity or malicious behaviour, may have a significant negative impacts for the security of the EU and the well-being of its citizens



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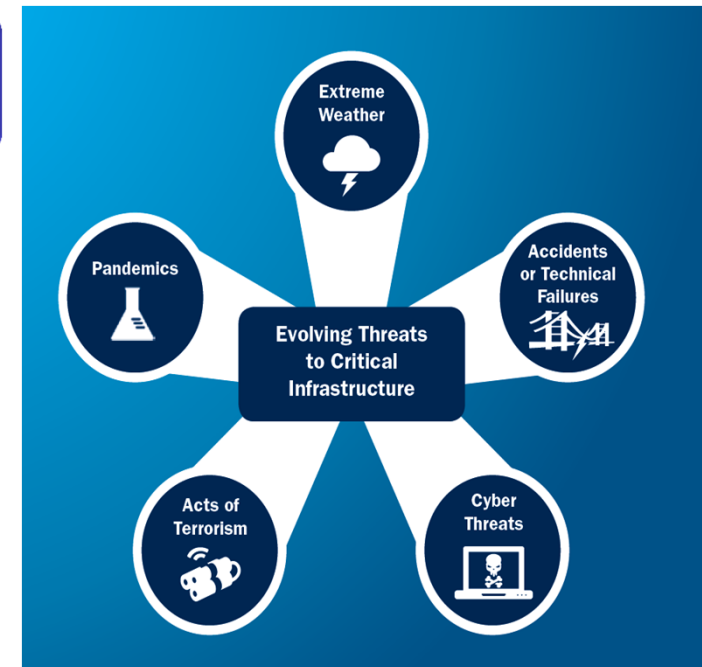




European Resilience Management Guidelines for Critical Infrastructure

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**.





How to use the 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.





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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Additional Material - Boxes

A distilled summary of the guidelines is provided in order to quickly orient the reader

Abstract

Questions

The questions aim at supporting the reader in assessing his/her own function. They are questions that CI managers/decision makers should ask themselves to verify the level of implementation of the guidelines in their own organization

Articles, standards, directives, etc. which have been used to justify the provided recommendations and for further technical and scientific investigations of the reader

Resources

Examples

A number of good practices related to each function to improve understandability of the guidelines



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EU level Recommendations



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Functions

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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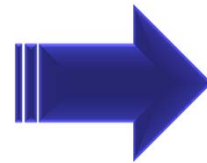
Recommendations provided based on...

Common Conditions

- Availability of resources
- Training and experience
- Quality of communication
- Human Computer Interaction and operational support
- Availability of procedures and plans
- Conditions of work
- Number of goals and conflict resolution
- Available time and time pressure
- Circadian rhythm and stress
- Team collaboration quality
- Quality and support of the organization

Interdependencies

- Function 1
- Function 2



Collection and Integration of...

- Existing best practices in the corresponding field of the function
- Existing standards in the corresponding field of the function
- Recommendation from experts
- New recommendations coming from theory and last findings
- New recommendations coming from last technological developments and trends (e.g. IoT, Big Data, etc.)

...in a unique holistic perspective





Cross-sector variability

- The performance conditions should be described in terms of their variability and potential impacts on uncertainty.
- The guidelines built around the functional system perspective are related to this through the performance conditions.
- The purpose is to address guidelines to provide support in coping with the identified variability and potential uncertainty.



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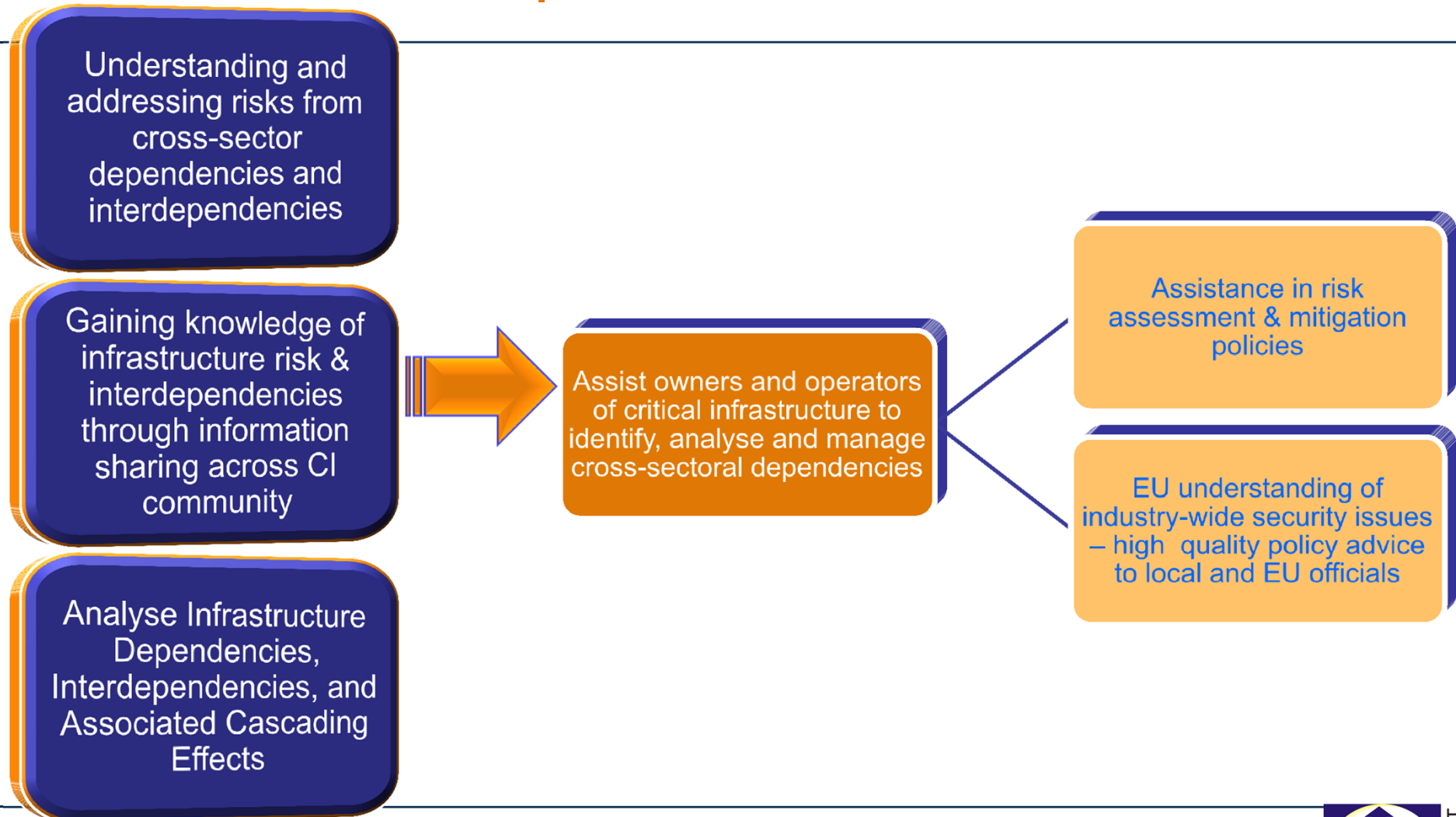
Cross-sector variability

- A matrix was built to facilitate the relation between the functional system description and the human, technical and organisational features that may give shape to CI, relating each of the CI sectors to the set of eleven performance conditions has been built.
 - The Y axis represents the critical sectors as identified in the EU Directive in order to ground the guideline approach on concrete human, technical and organisational aspects;
 - the X axis represents the 11 common performance conditions (defined by Hollnagel) linking each of the contexts to the contents of each function, thus relating to the system functional perspective on which the guidelines were produced.





Cross CI interdependencies

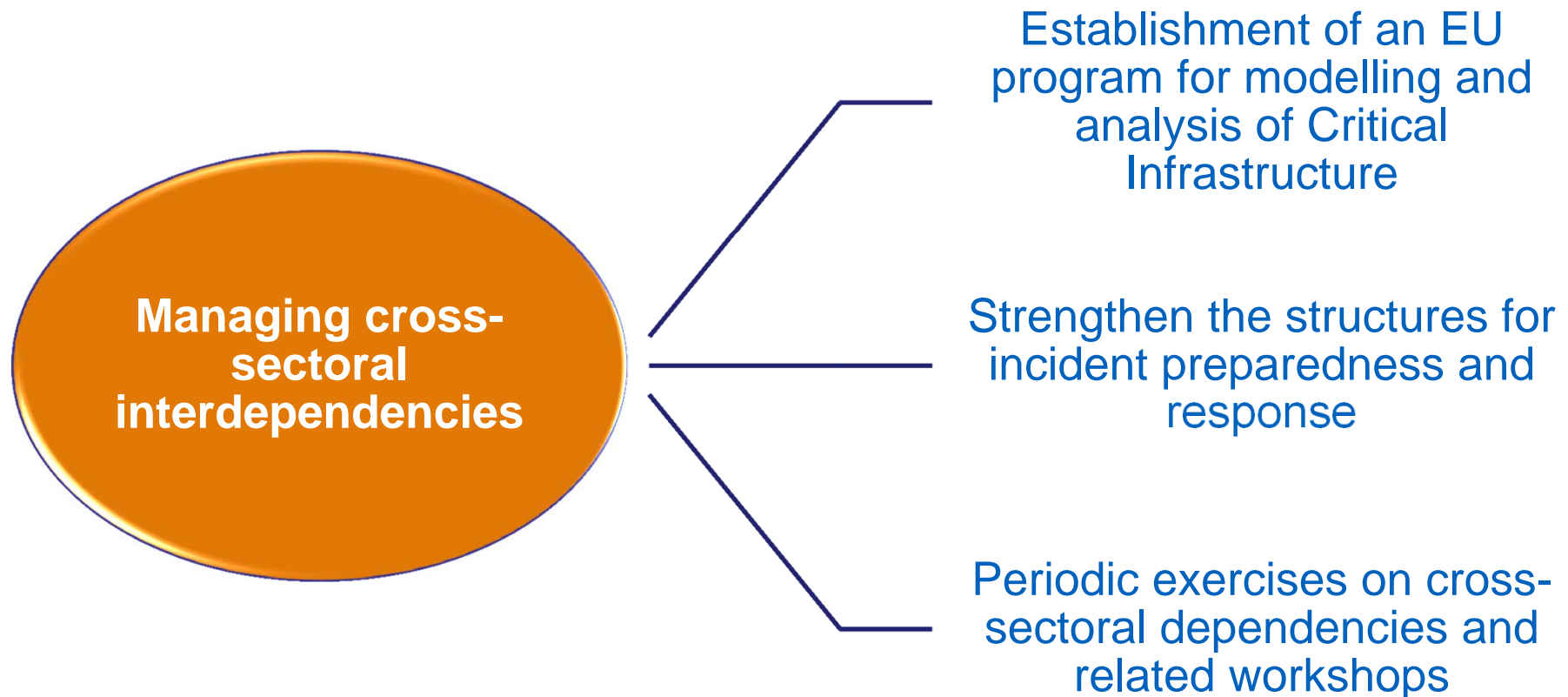


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Cross CI interdependencies





ERMIG Impact



- 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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ERMIG Adaptation to Urban Transport System (UTS)



Co-funded by the European Union under H2020 DRS' 07-2014

Scope

- Adapt the generic ERMIG 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 UTS?

A system of resilience criticality

System complexity

- Large 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

- 1 Prevent incidents within control and responsibility, effectively protect critical assets.
- 2 Respond decisively to events that cannot be prevented, mitigate loss and protect employees, passengers and emergency respondents.
- 3 Support response to events that impact local communities, integrating equipment and capabilities seamlessly into the total effort.
- 4 Recover from major events, taking full advantage of available resources and programs.

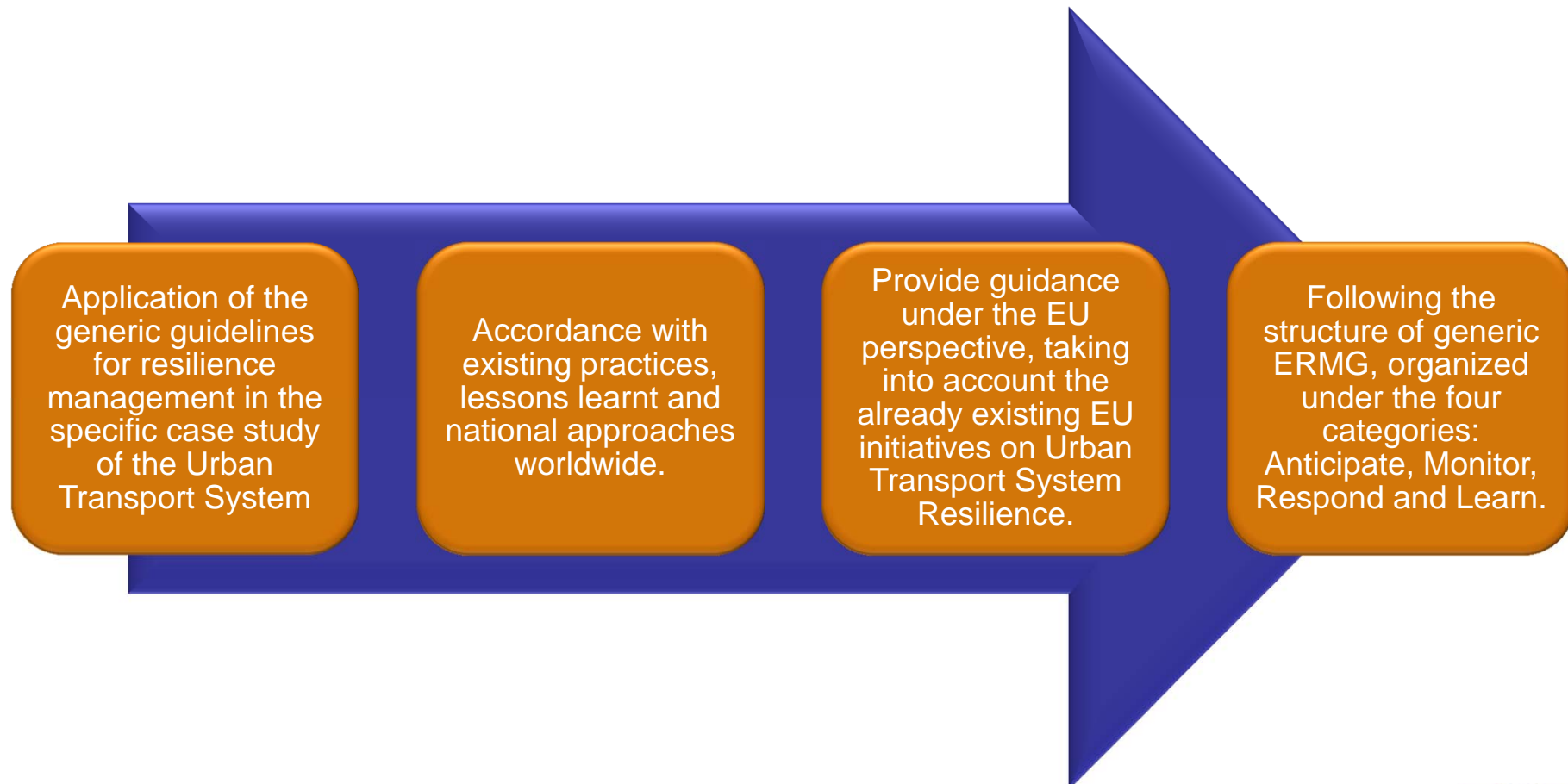


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Guidelines adaptation to UTS



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Cross-sector variability for UTS

- A similar matrix was built to investigate UTS, relating each of its critical sub-sectors to the set of eleven performance conditions.
 - The Y axis represents the critical sub-sectors of UTS (Public Road Transport, Private Road Transport, Heavy rail Transport and Light Rail Transport) in order to ground the guideline approach on concrete human, technical and organisational aspects;
 - the X axis represents the 11 common performance conditions (defined by Hollnagel) linking each of the contexts to the contents of each function, thus relating to the system functional perspective on which the guidelines were produced.





Cross – sector interdependencies

Inter and intra system interdependencies

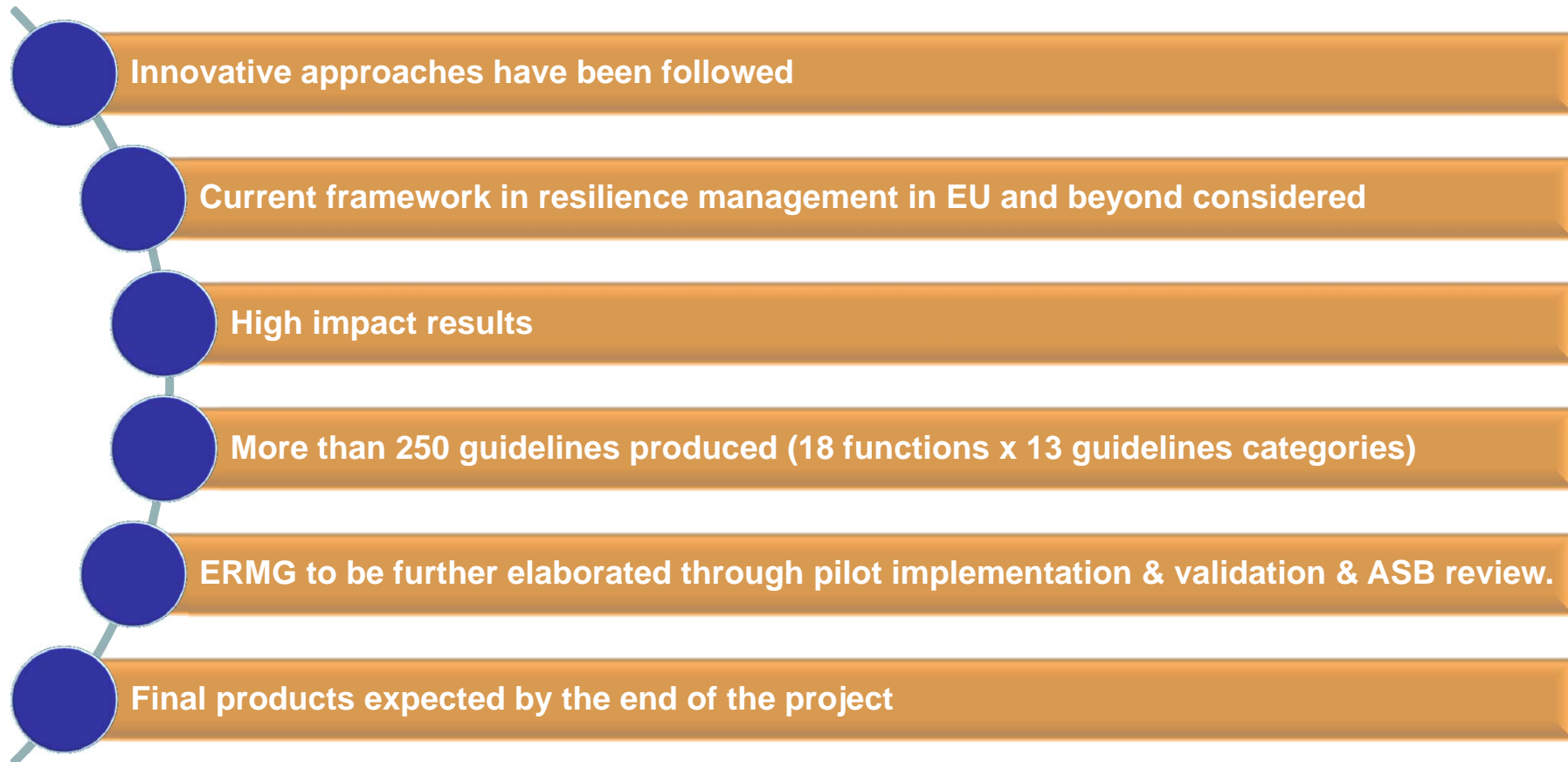
overall monitoring structures



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Conclusions



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May the...Resilience be with you!



RESILIENCE

MORE PEOPLE SHOULD HAVE AS MUCH

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Get your resilience on!

Defenses	
Armor:	999 999
Defense:	500
Dodge:	100.00%
Parry:	100.00%
Block:	100.00%
Resilience:	999 999



Do You Bend or Break?

RESILIENCE

#MyLunchBunch



Resilience

Resilience is the ability to find the inner strength to bounce back from a set-back or challenge.

MAN NEVER MADE ANY MATERIAL AS RESILIENT AS THE HUMAN SPIRIT.



RESILIENCE

Perseverance, no matter what the odds



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