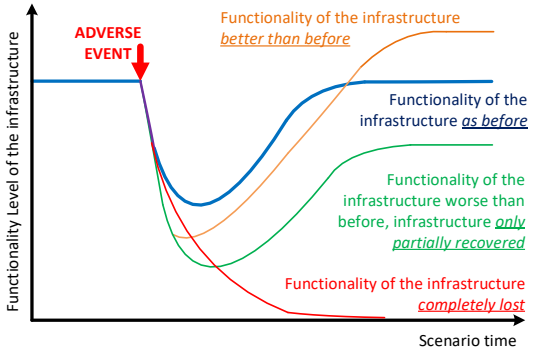
European Virtual Institute for Integrated Risk Management

The quintessence of the Resilience Assessment Methodology in the SmartResilience project

The SmartResilience project provides a new methodology for assessing and managing resilience of critical infrastructures, such as energy and water supply, transportation networks and similar. The term "resilience" of an infrastructure, describes its ability to cope with possible adverse scenarios/events that can potentially lead to significant disruptions in its operation/functionality. Examples of scenarios are, for instance, terrorist attacks stopping airport operation or cyber-attacks destroying the financial systems. Coping with these scenarios means preparing for them, being able to absorb/withstand their impacts, recovering optimally from their impacts and adapting to the continuously changing conditions. In practice, an end-user essentially wants to know answers to the questions below, flowing the resilience assessment workflow

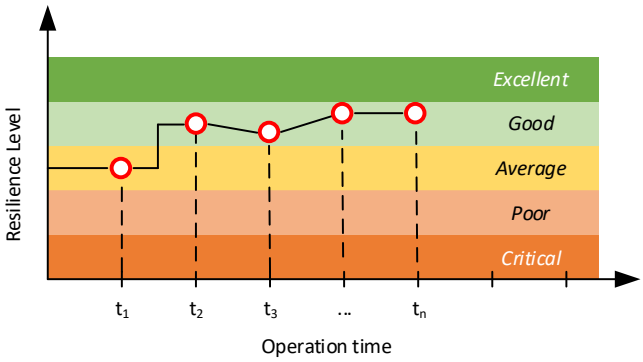
OUTCOME OF A POSSIBLE/ASSUMED DISRUPTIVE EVENT: What could be the possible outcome of such an event/scenario?

SmartResilience looks primarily at functionality of the infrastructure, e.g. does the energy plant produces electricity, can passengers be transported, etc. SmartResilience looks at various aspects ("elements") of functionality and calculates them based on resilience indicators in order to qualitatively assess the functionality level during the course of a disruptive event ("scenario time"). The result is a prediction of the functionality of the infrastructure after the event (e.g., "fully recovered").



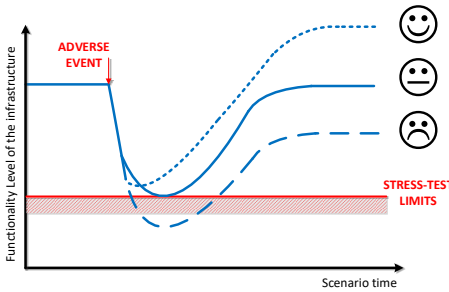
RESILIENCE OF AN INFRASTRUCTURE: How can one check if a critical infrastructure is "resilient"?

SmartResilience looks at resilience indicators to show how an infrastructure is prepared for an adverse event, how can it withstand it and then recover, possibly adapting afterwards. The assessment result is the "Resilience Level" (a number) that allows to compare one infrastructure with other infrastructures (do the "benchmarking") and/or to monitor changes in resilience over the operation time.



BEHAVIOR OF THE INFRASTRUCTURE WITHIN PRESCRIBED LIMITS: Will the functionality remain in the prescribed limits?

SmartResilience assesses the safety margins of an infrastructure in case of a disruptive event. E.g., evaluation of the infrastructure response when facing a set of adverse events (following the European Nuclear Safety Regulators Group stress-test definition).

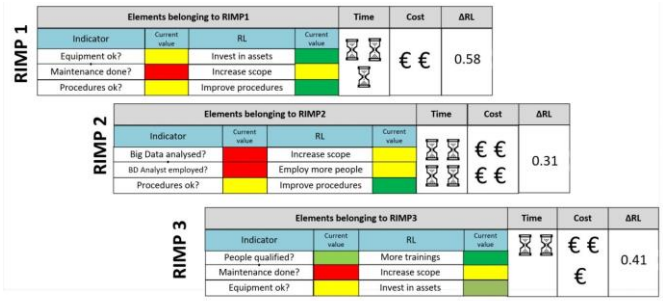


☺ test passed
😐 test barely passed
☹ test failed

INVESTMENT IN RESILIENCE OPTIMIZATION: How to get the best value for the money invested?

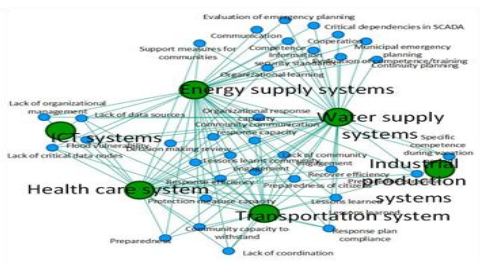
In SmartResilience, various "resilience improvement measure portfolios" (the "RIMPs" below!), i.e. portfolio of measures improving the resilience level (ΔRL) of an infrastructure, e.g. educating people, improving communication, investing in new equipment, etc..

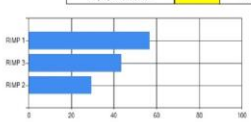
Different criteria can be taken into account and the optimal portfolio singled-out.



INFLUENCE OF INTERCONNECTEDNESS: How the operation of an infrastructure impacts the others?

SmartResilience looks at interdependencies between infrastructures to understand how, in a case of a problem on one of them, the functionality of others can be impacted. In other words, how one can assess the influence of interconnectedness.





Coordinator: *EU-VRi, A. Jovanović jovanovic@eu-vri.eu* | | SmartResilience-CORE@eu-vri.eu
www.smartresilience.eu-vri.eu

WORK-FLOW:

"Infrastructure of Critical Infrastructures" (e.g. a Smart City)

Scenario: Infrastructure(s) → Threat(s)

Analysis: Phases → Issues → Indicators

SMART RESILIENCE

OUTCOME OF A DISRUPTIVE EVENT?
Functionality level

time$_{scenario}$

Critical Infrastructure(s) → Threat(s) → Elements → Indicators

Functionality

1. Production performance; ID-1234

1.1. G4-4: Domestic gas production (million m3/day); ID-1236
1.2. G4-4: Domestic oil production (thousand tons/day); ID-2302
1.3. Overall Equipment Effectiveness (OEE); ID-2308

2. HSE:Health, Safety and Environment performance; ID-1247

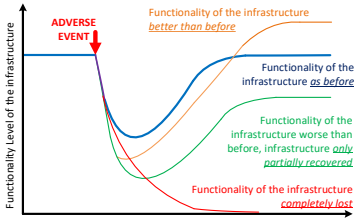
2.1. G4 EN3: Energy consumption within the organization (GJ/day); ID-1249
2.2. G4 EN21: Amount of air pollutant i.e. SO2 emitted (tons/day); ID-1255
2.3. G4 LA6: Number of lost days/year; ID-1263
2.4. Number of HSE training/year; ID-2305

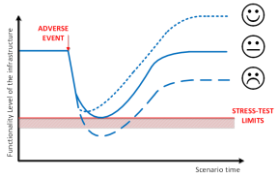
3. Global/ international/ interconnectedness; ID-1271

3.1. Economic inoperability between the NIS serbia and Angola (€/day); ID-1272
3.2. Exports (thousand tons/day); ID-2306

4. SOCIAL/SOCIETAL performance; ID-1281

4.1. Percentage of employees present per shift; ID-2309





RESILIENCE OF AN INFRASTRUCTURE?
Resilience level

time$_{operation}$

Critical Infrastructure(s) → Threat(s) → Phases → Issues → Indicators

I. Understand risks

I.1. Register of accidents/incidents; ID-2071

I.1.1. The existence of a register of accidents/incidents; ID-2072
I.1.2. Frequency of communication with units about an occured incidents;

I.2. Safety risk registry ; ID-2060

I.2.1. Does the Safety Risk registry exist? ; ID-2061
I.2.2. Using of Safety Risk registry in decision making; ID-2062
I.2.3. Frequency of revision of Safety Risk registry defined ?; ID-2063

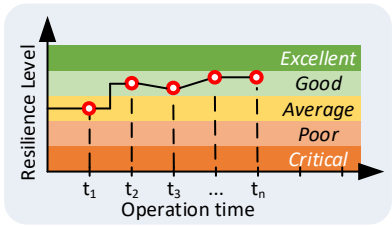
I.3. Management of change - MoC; ID-2064

I.3.1. Is Procedure for Management of change established ?; ID-2065

II. Anticipate/prepare

II.1. Measures ordere through Inspection visits; ID-2093

II.1.1. Are inspection visits measures documented?; ID-2094
II.1.2. Are inspection visits measures realized?; ID-2095



INFLUENCE OF INTERCONNECTEDNESS?
Interdependencies

time$_{operation\ OR\ scenario}$

Critical Infrastructures → Threat(s) → Phases → Issues → Indicators

Dynamic Checklist - Resilience Level
Water Supply System Contamination

III. Absorb/withstand

III.22. External alert/ communication ; ID-3016

III.22.1. What is the scope of external alert/communication in case of a disturbance?; ID-3069

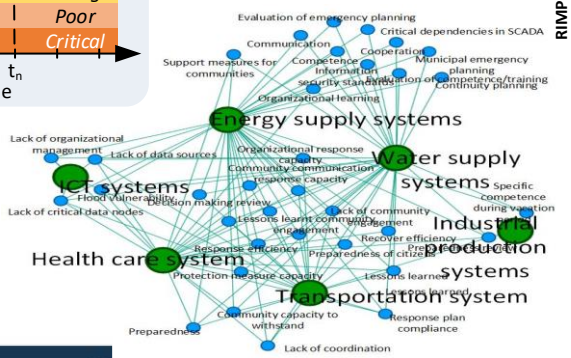
Dynamic Checklist - Resilience Level
Energy supply system in Helsinki affected by fire

II. Anticipate/prepare

II.7. Communication; ID-1046

II.7.1. Are there sufficient guideline for internal and external communication?; ID-2366

II.7.2. Review of communication policy conducted?; ID-919



INVESTMENT IN RESILIENCE OPTIMIZATION?
Decision optimization

time$_{operation\ OR\ implementation}$

Critical Infrastructure(s) → Threat(s) → Dimensions → Issues → Indicators

b. Information/ data & smartness

II.1. Data Analysis; ID-608

II.1.1. How frequent is the Big Data analyst available?; ID-3169
II.1.2. Big Data analysed?; ID-3171

c. Societal/ political

III.1. Operating procedures; ID-2121

III.1.1. Frequency of review of resilience ID-325

d. Societal/ political

IV.1. Training ; ID-988

IV.4.1. What is the frequency of simulator training for operating personnel?; ID-3175

RIMP 1

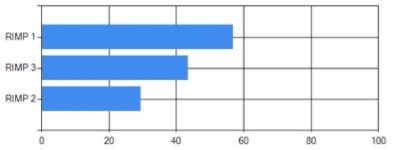
Elements belonging to RIMP1				Time	Cost	ΔRL
Indicator	Current value	RL	Current value			
Equipment ok?		Invest in assets			€ €	0.58
Maintenance done?		Increase scope				
Procedures ok?		Improve procedures				

RIMP 2

Elements belonging to RIMP2				Time	Cost	ΔRL
Indicator	Current value	RL	Current value			
Big Data analysed?		Increase scope			€ €	0.31
BD Analyst employed?		Employ more people			€ €	
Procedures ok?		Improve procedures				

RIMP 3

Elements belonging to RIMP3				Time	Cost	ΔRL
Indicator	Current value	RL	Current value			
People qualified?		More trainings			€ €	0.41
Maintenance done?		Increase scope			€	
Equipment ok?		Invest in assets				



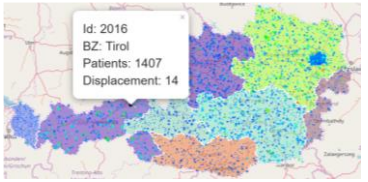
TANGIBLE RESULTS / OUTPUT

time$_{operation\ OR\ scenario}$

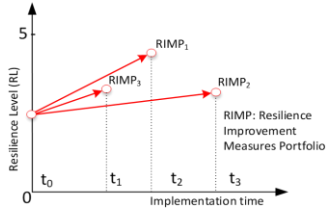
RESILIENCE ASSESSMENT OF A SINGLE INFRASTRUCTURE OR A CITY

Resilience Dimensions	Resilience (cycle) Phases				
	Understand risks	Anticipate / prepare	Absorb / withstand	Respond / recover	Adapt / transform
System / physical	Average	Good	Average	Good	Excellent
Information / smartness	Good	Average	Good	Good	Good
Organization / business	Excellent	Excellent	Poor	Poor	Excellent
Societal / political	Poor	Good	Excellent	Average	Excellent
Cognitive / decision making	Critical	Excellent	Average	Good	Average

RESILIENCE ASSESSMENT OF A COUNTRY OR REGION



INVESTMENT IN RESILIENCE IMPROVEMENT OPTIMAL?



TOOL:

Case Studies → Scenarios → Dynamic Checklists (DCLs) → Assessments