Kriittisen infrastruktuurin kestävyyden mittaamisen metodologia

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Myönnetty rahoitus: 83 750 €
Toteuttaja: Chan Puma House Oy
Hankejohtaja: Prof. Christer Pursiainen

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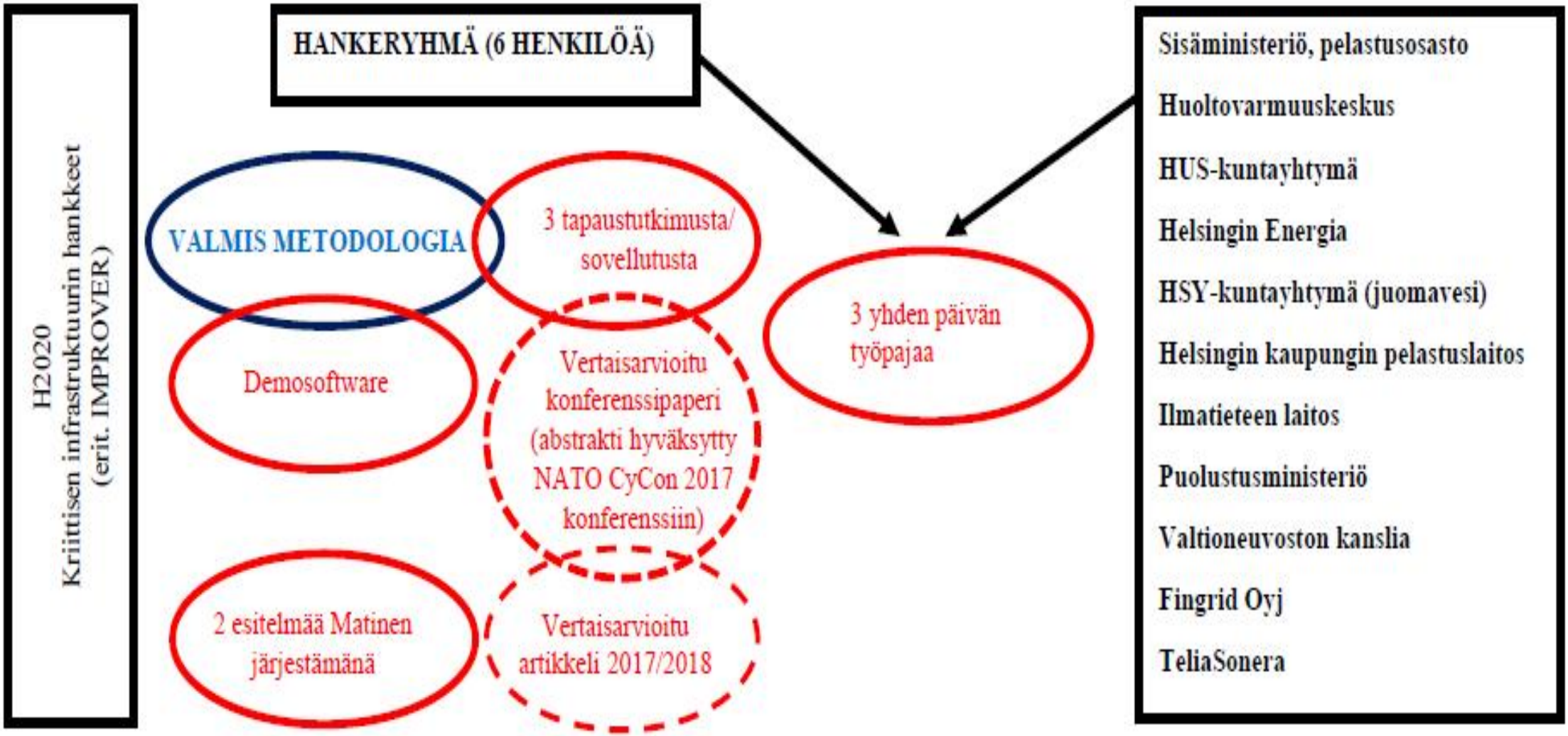
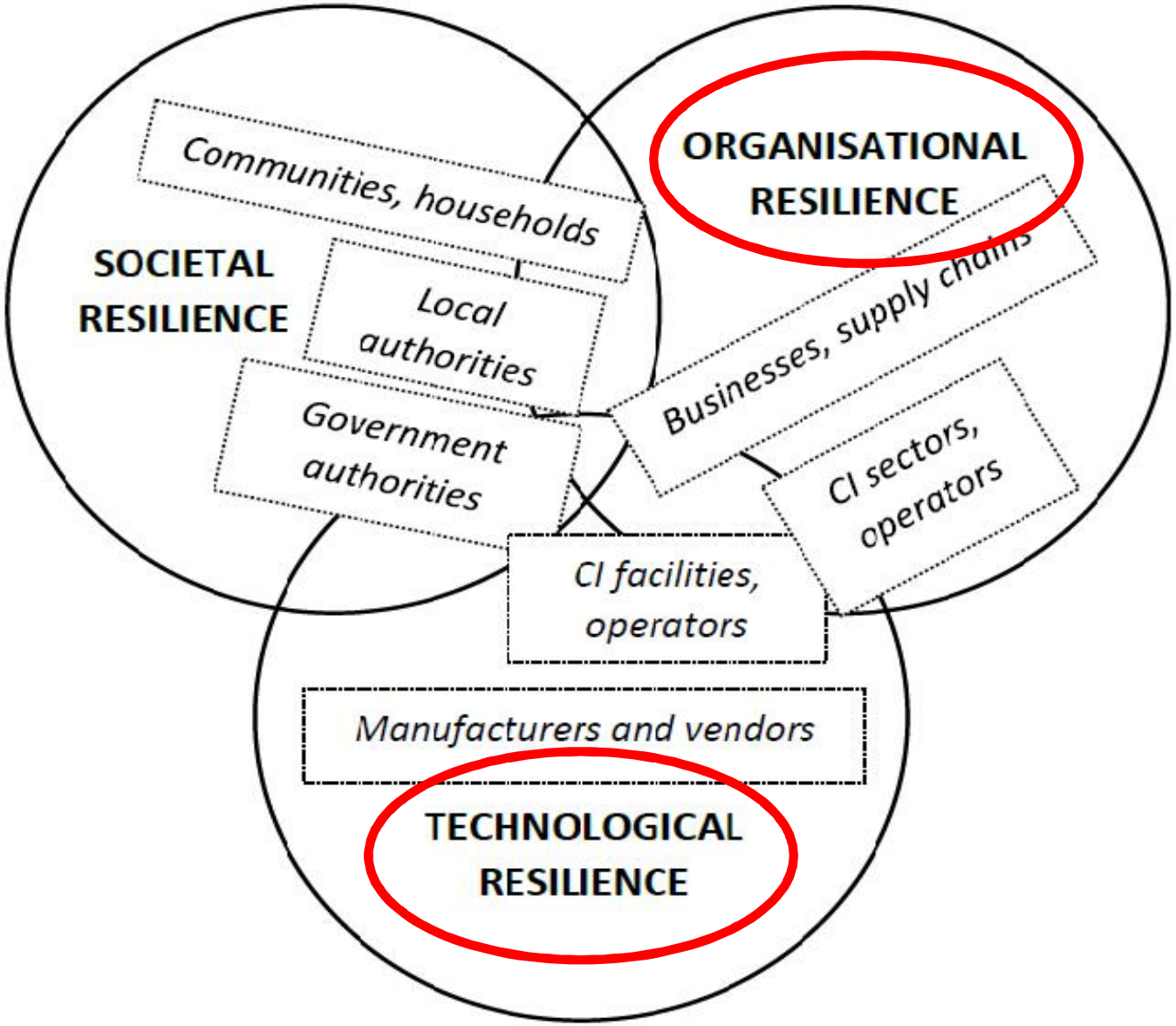
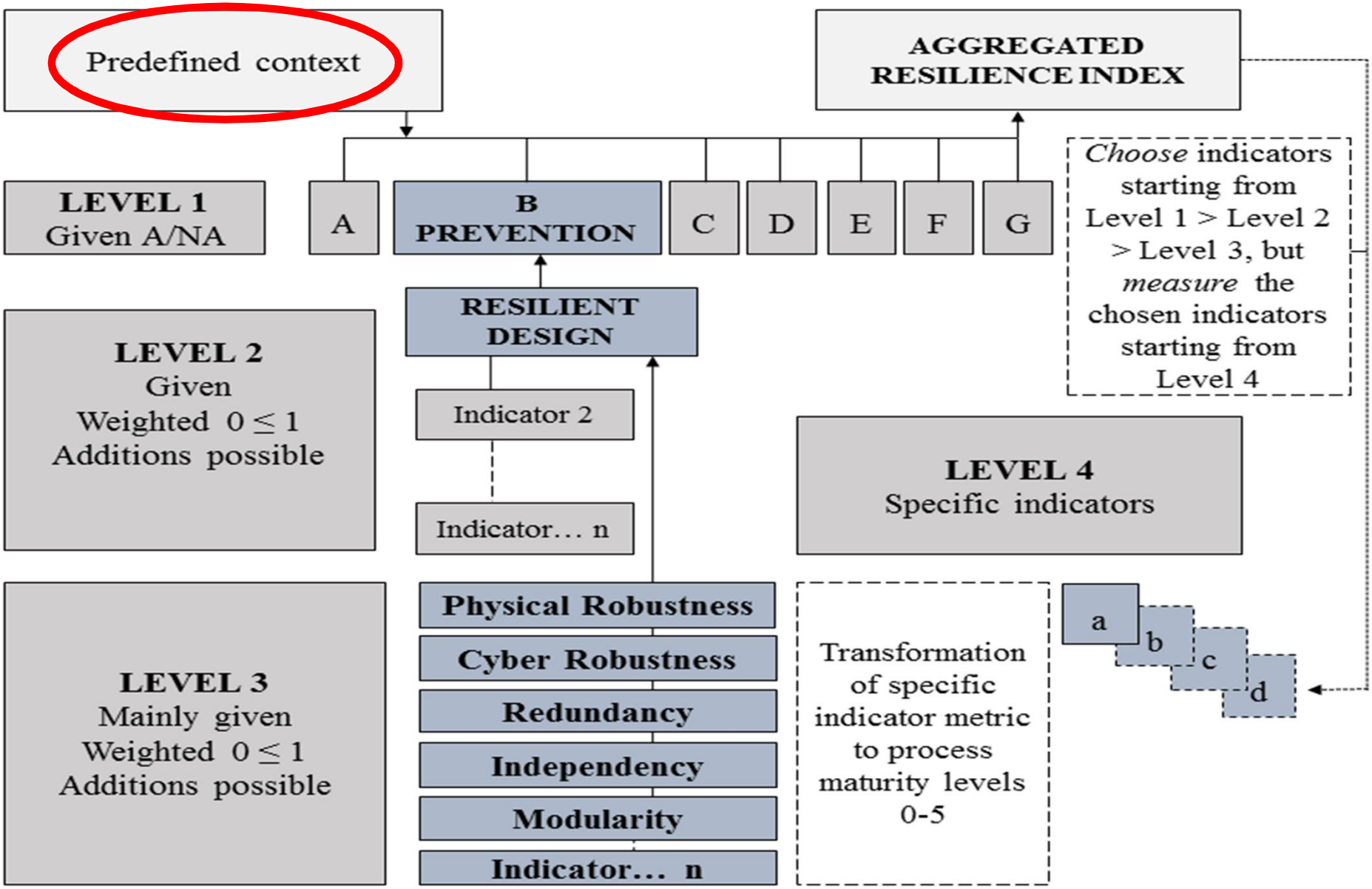

H2020
Kriittisen infrastruktuurin hankkeet
(erit. IMPROVER)
HANKERYHMÄ (6 HENKILÖÄ)
VALMIS METODOLOGIA
3 tapaustutkimusta/
sovellutusta
Demosoftware
Vertaisarvioitu
konferenssipaperi
(abstrakti hyväksytty
NATO CyCon 2017
konferenssiin)
3 yhden päivän
työpajaa
2 esitelmää Matinen
järjestämänä
Vertaisarvioitu
artikkeli 2017/2018
Sisäministeriö, pelastusosasto
Huoltovarmuuskeskus
HUS-kuntayhtymä
Helsingin Energia
HSY-kuntayhtymä (juomavesi)
Helsingin kaupungin pelastuslaitos
Ilmatieteen laitos
Puolustusministeriö
Valtioneuvoston kanslia
Fingrid Oyj
TeliaSonera

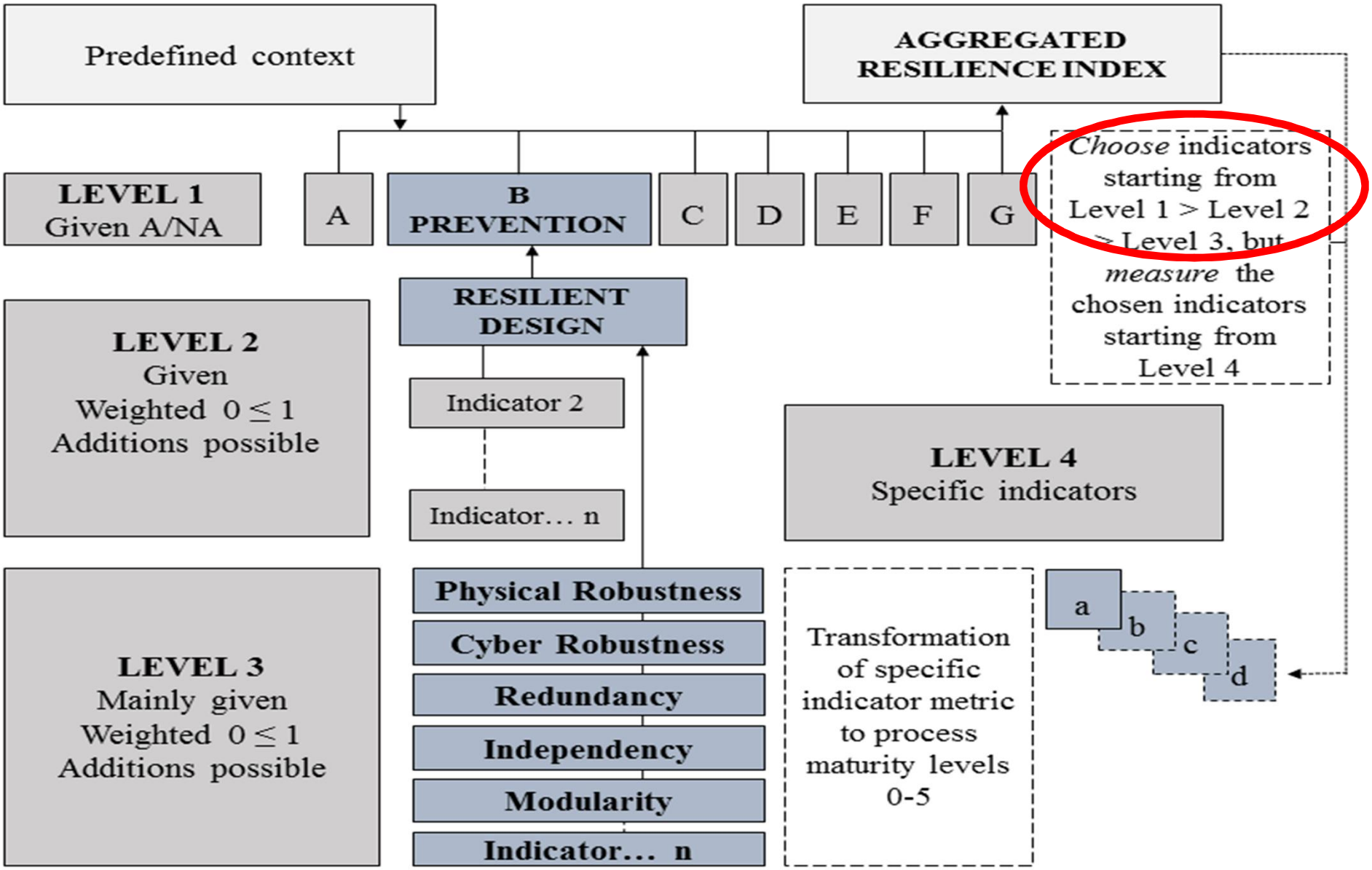
METODOLOGIA


Communities, households
SOCIETAL RESILIENCE
Local authorities
Government authorities
ORGANISATIONAL RESILIENCE
Businesses, supply chains
CI sectors, operators
CI facilities, operators
Manufacturers and vendors
TECHNOLOGICAL RESILIENCE


Preparedness
Monitoring, Early Warning & Warning
Response, Post-event mitigation, Consequence management
Recovery, Restoration, Reconstruction
Learning, Post-crisis evaluation
Risk assessment
Prevention & Pre-crisis mitigation
Targeted resilience measures

Level 1	**Risk assessment**	**Prevention**	**Preparedness**	**Warning**	**Response**	**Recovery**	**Learning**
Level 2	Failure data gathering	Safety and security culture	Preparedness plan and crisis organization	Audits	Situation awareness	Downtime	Evaluation
	Knowledge of the context	Physical and cyber entrance control	Redundancy plan	Monitoring	Decision-making	Reduced service level	Institutional learning
	Risk assessment procedure	Risk treatment plan	Cooperation agreements (external resources)	Early warning and alarm	Coordination (internal and external)	Costs	Implementation of lessons
	Monitoring and review	Risk communication	Capability building		Communication (internal and external)	Unplanned maintenance	Technological upgradability
	Testing and simulation	Resilience plan	Capacity building		Resource deployment	Restart	
		Resilient design	Technical supportability		Absorption/ damage limitation	Autonomy	
		Planned maintenance	Interoperability (internal and external)		Externalised redundancy	Insurance	
		Information sharing	Stakeholder management				


Predefined context
AGGREGATED RESILIENCE INDEX
LEVEL 1
Given A/NA
A
B PREVENTION
C
D
E
F
G
Choose indicators starting from Level 1 > Level 2 > Level 3, but measure the chosen indicators starting from Level 4
RESILIENT DESIGN
LEVEL 2
Given
Weighted 0 ≤ 1
Additions possible
Indicator 2
Indicator… n
LEVEL 4
Specific indicators
LEVEL 3
Mainly given
Weighted 0 ≤ 1
Additions possible
Physical Robustness
Cyber Robustness
Redundancy
Independency
Modularity
Indicator… n
Transformation of specific indicator metric to process maturity levels 0-5
a
b
c
d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Transformation of specific indicator metric to process maturity levels 0-5
a
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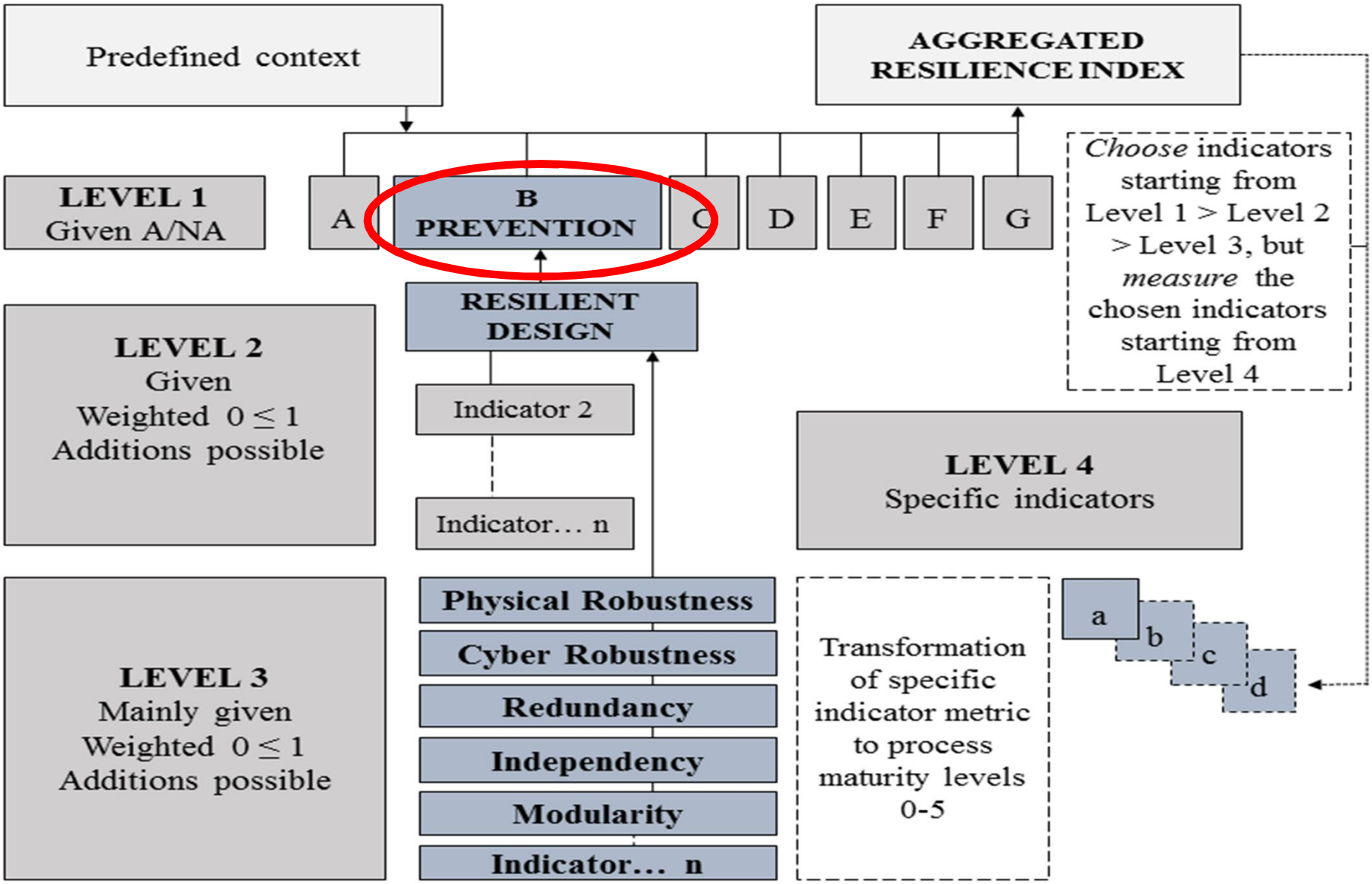
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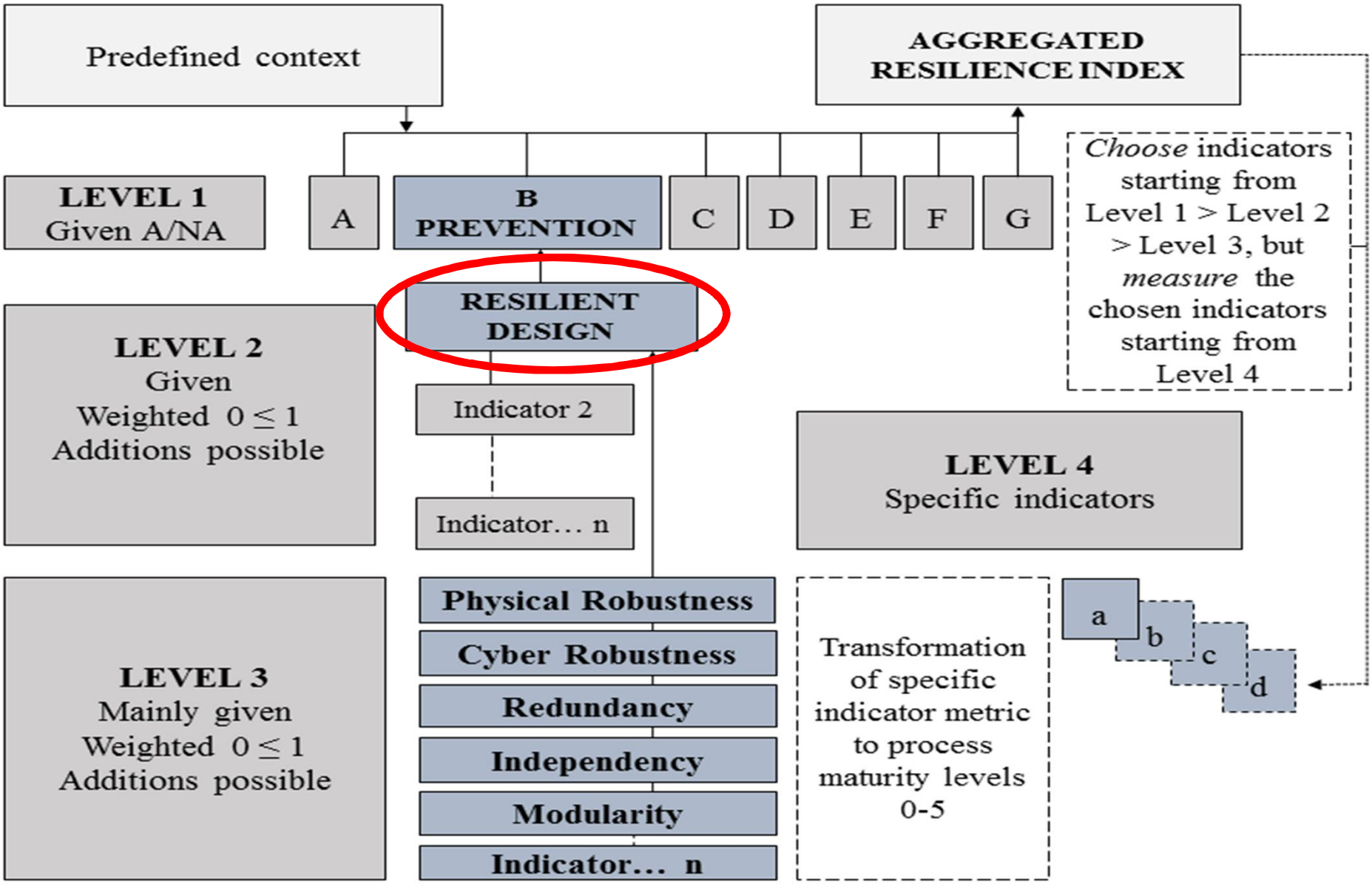
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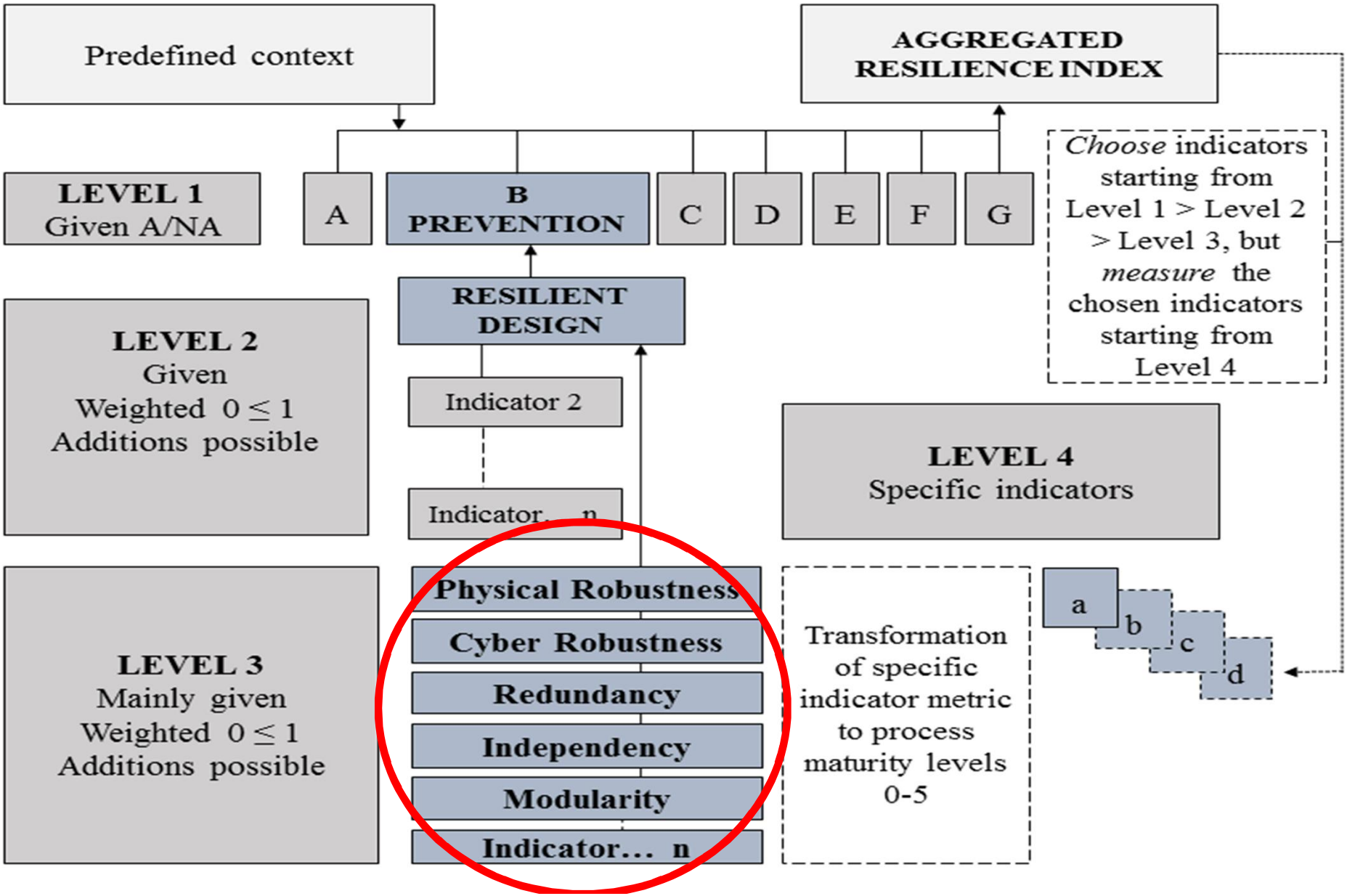
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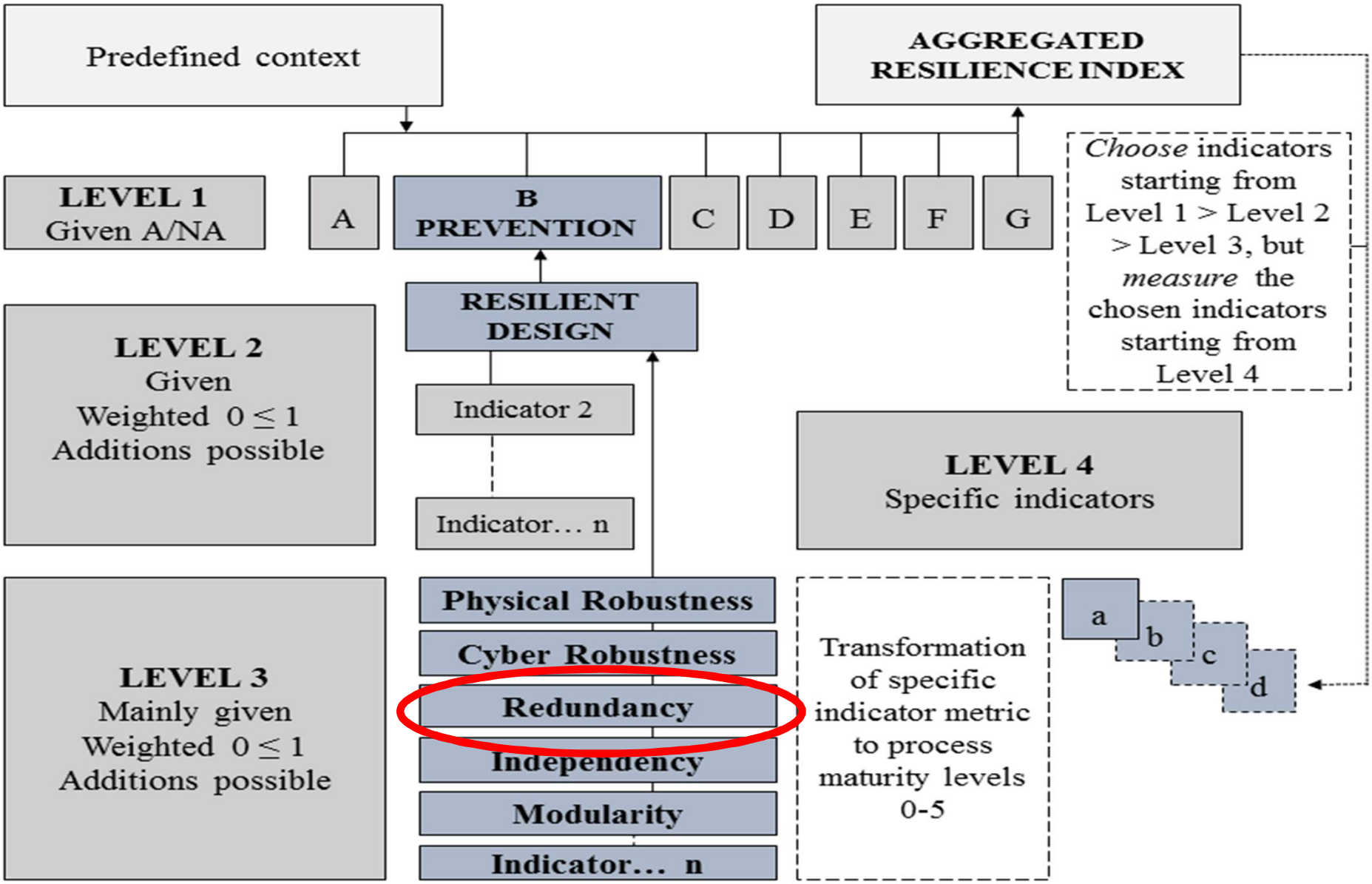
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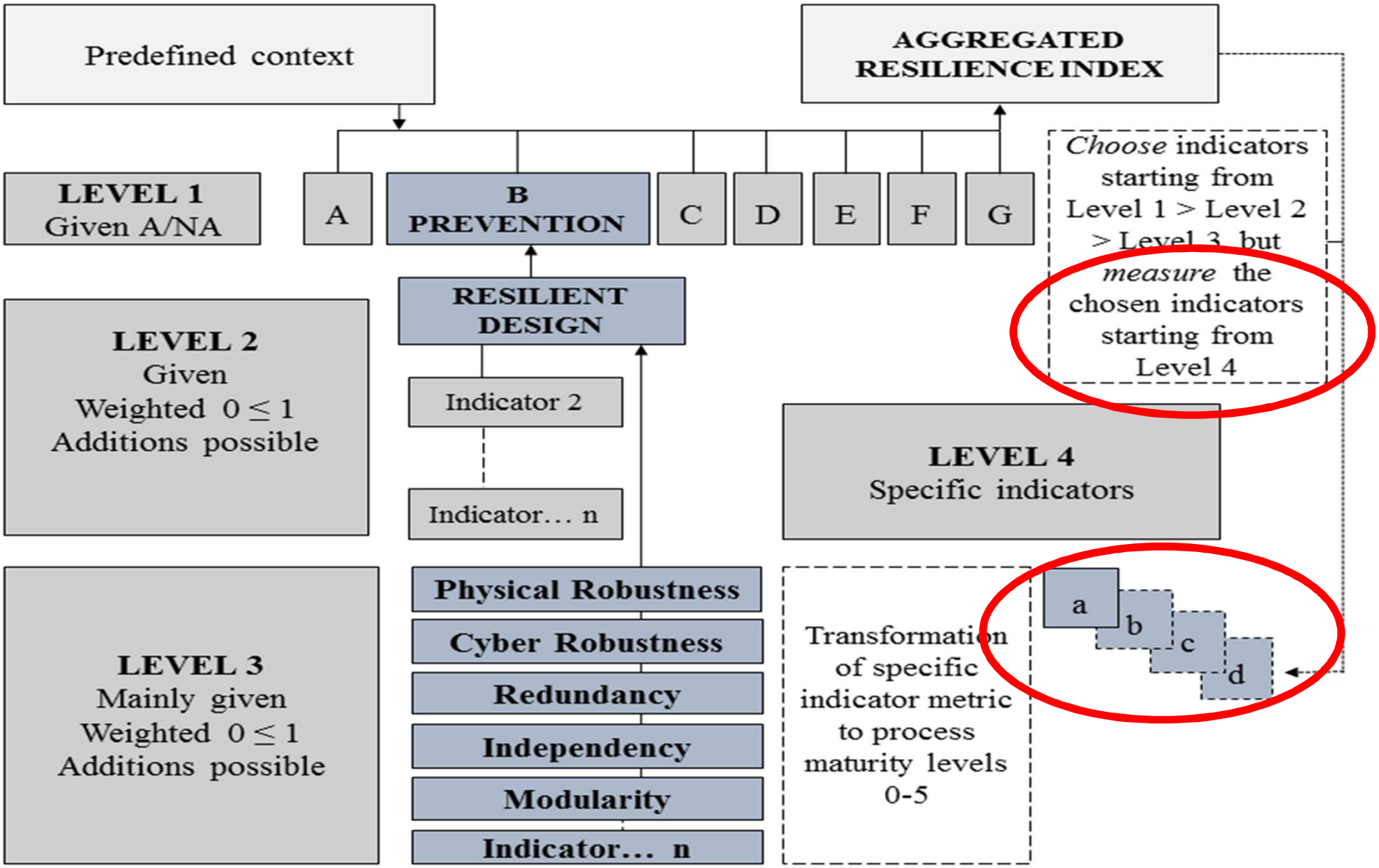
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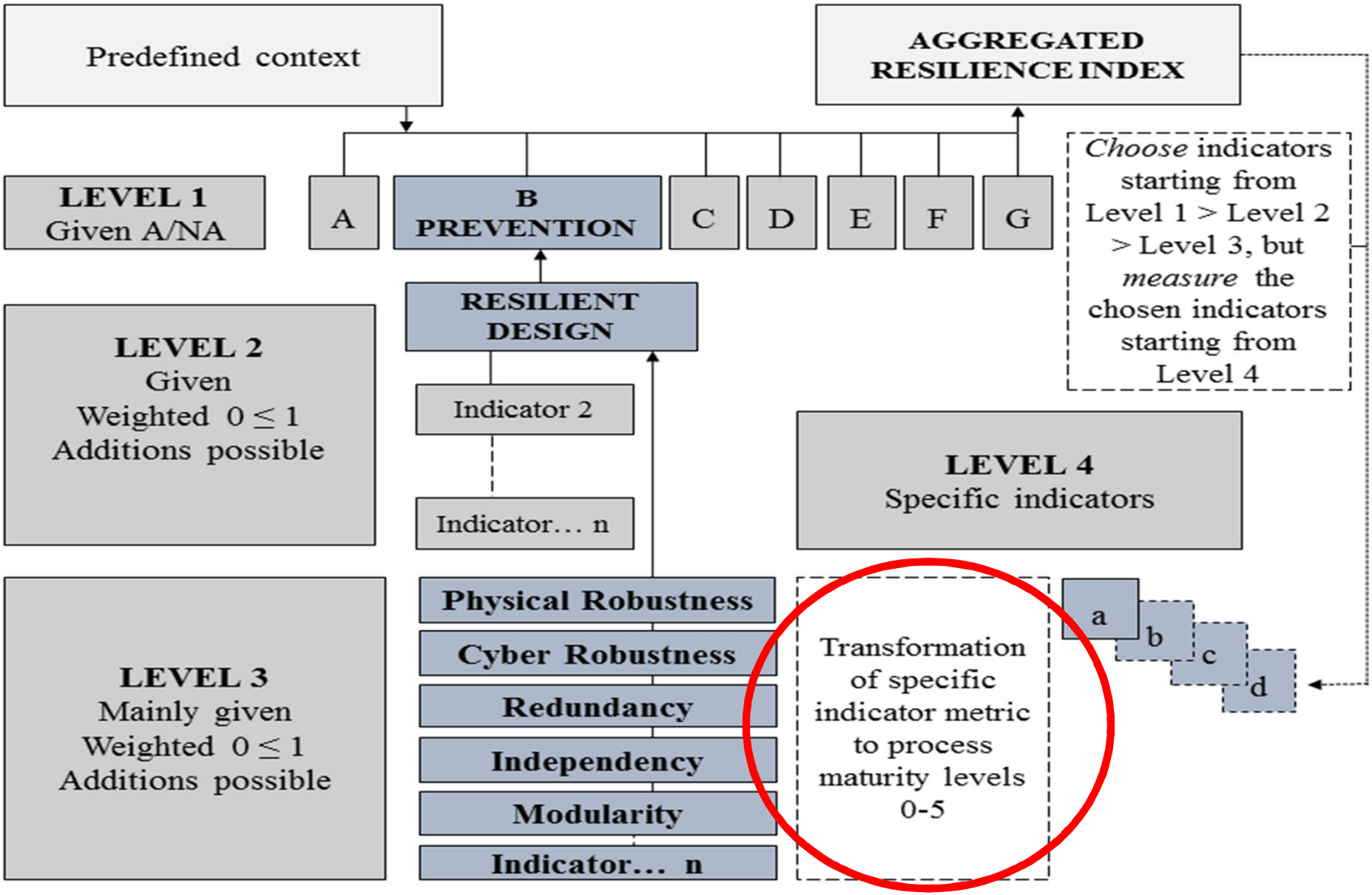
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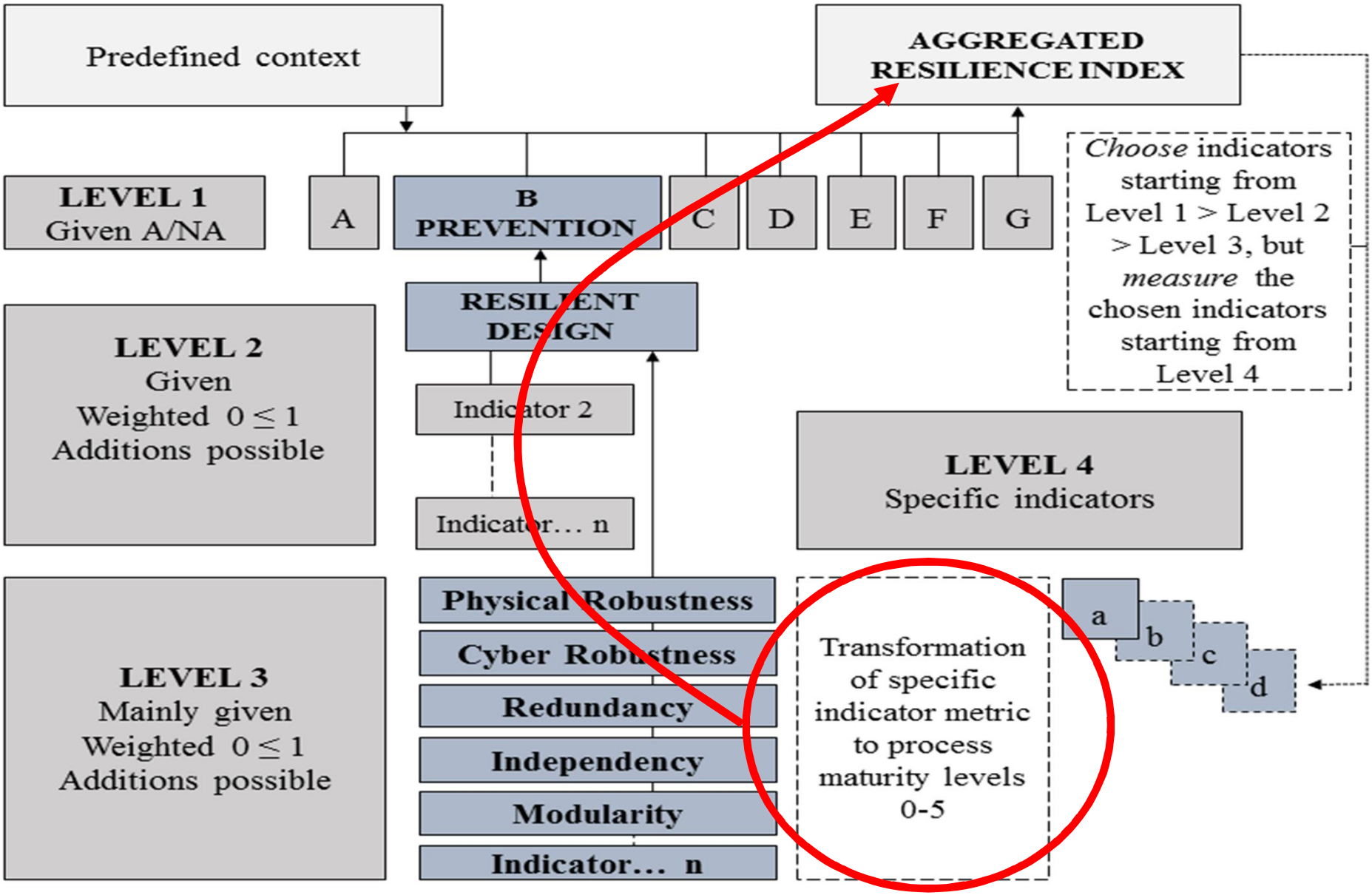
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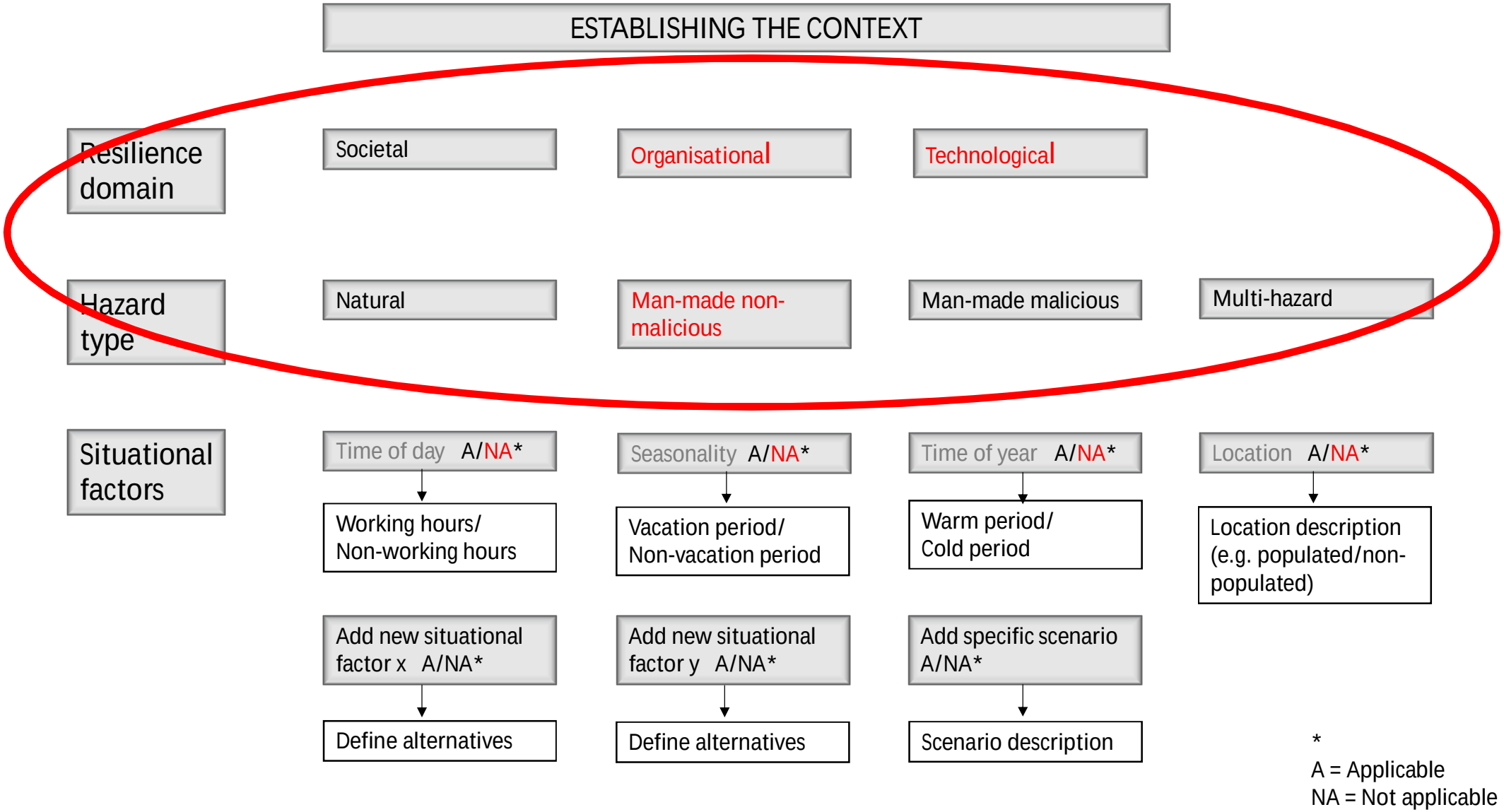
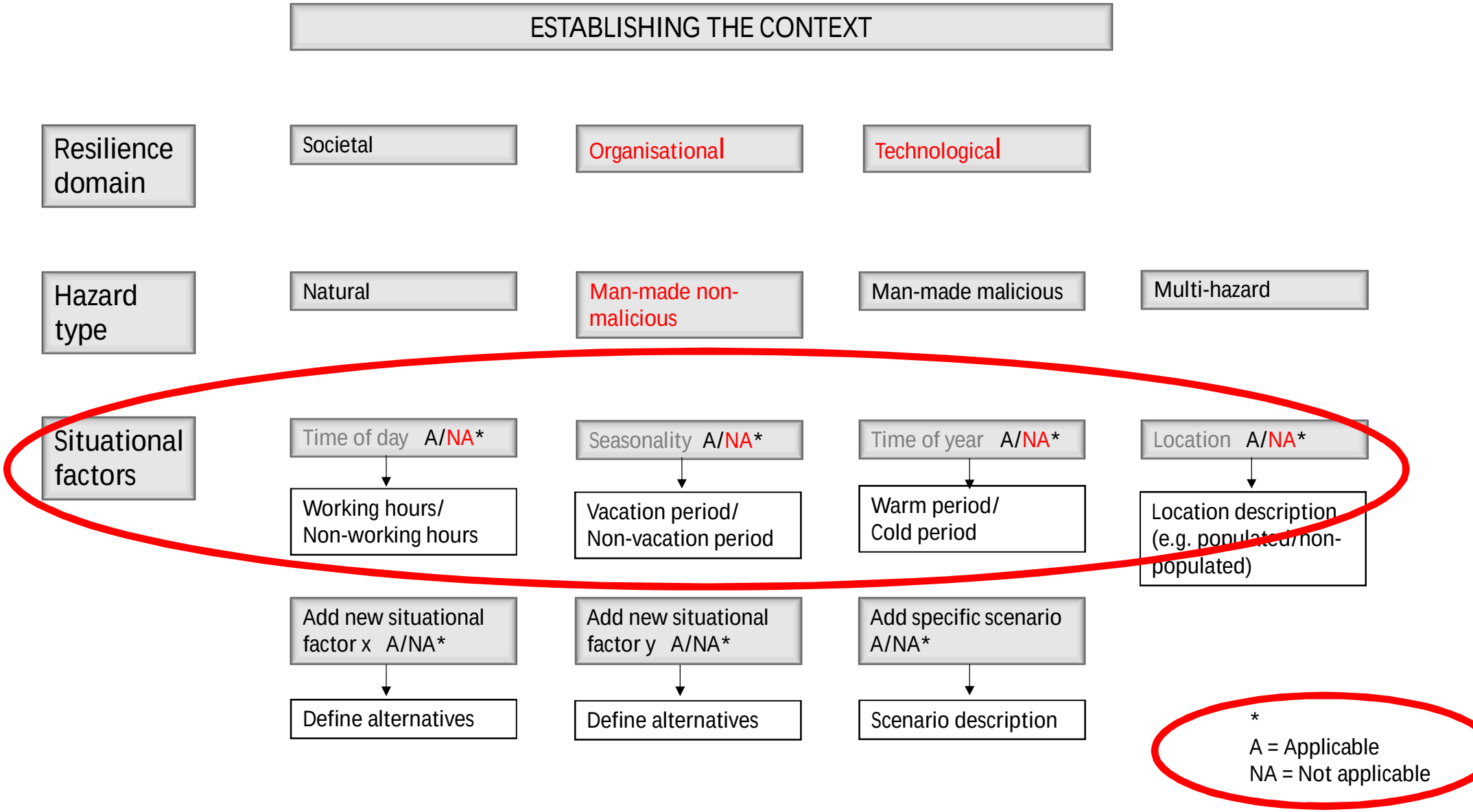
d

Level 3		Level 4
0	**Non-existent**	Specific metric of any indicator is transformed into processes, procedures, series of actions, series of operations, schemes, methods, or systems, corresponding one of the maturity levels 0-5.
1	(Initial/Ad hoc)	
2	(Repeatable but Intuitive)	
3	(Defined Process)	
4	(Managed and Measurable)	
5	**Optimised**	

*Following COBIT 4.1/5


ESTABLISHING THE CONTEXT
Resilience domain
Societal
Organisational
Technological
Hazard type
Natural
Man-made non-malicious
Man-made malicious
Multi-hazard
Situational factors
Time of day A/NA*
Working hours/ Non-working hours
Seasonality A/NA*
Vacation period/ Non-vacation period
Time of year A/NA*
Warm period/ Cold period
Location A/NA*
Location description (e.g. populated/non-populated)
Add new situational factor x A/NA*
Define alternatives
Add new situational factor y A/NA*
Define alternatives
Add specific scenario A/NA*
Scenario description
*
A = Applicable
NA = Not applicable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Technological
Hazard type
Natural
Man-made non-malicious
Man-made malicious
Multi-hazard
Situational factors
Time of day A/NA*
Seasonality A/NA*
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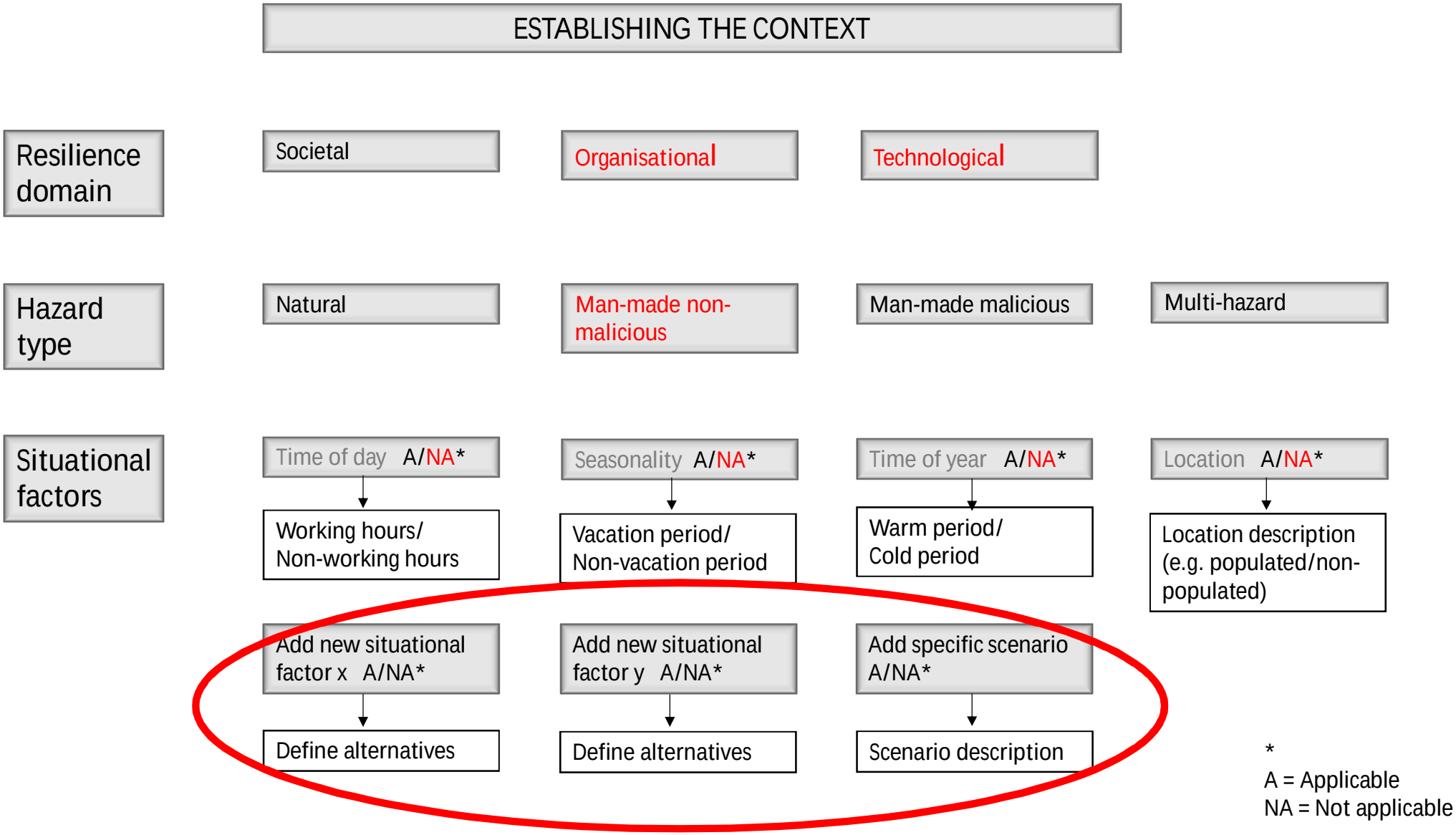
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Technological
Hazard type
Natural
Man-made non-malicious
Man-made malicious
Multi-hazard
Situational factors
Time of day A/NA*
Seasonality A/NA*
Time of year A/NA*
Location A/NA*
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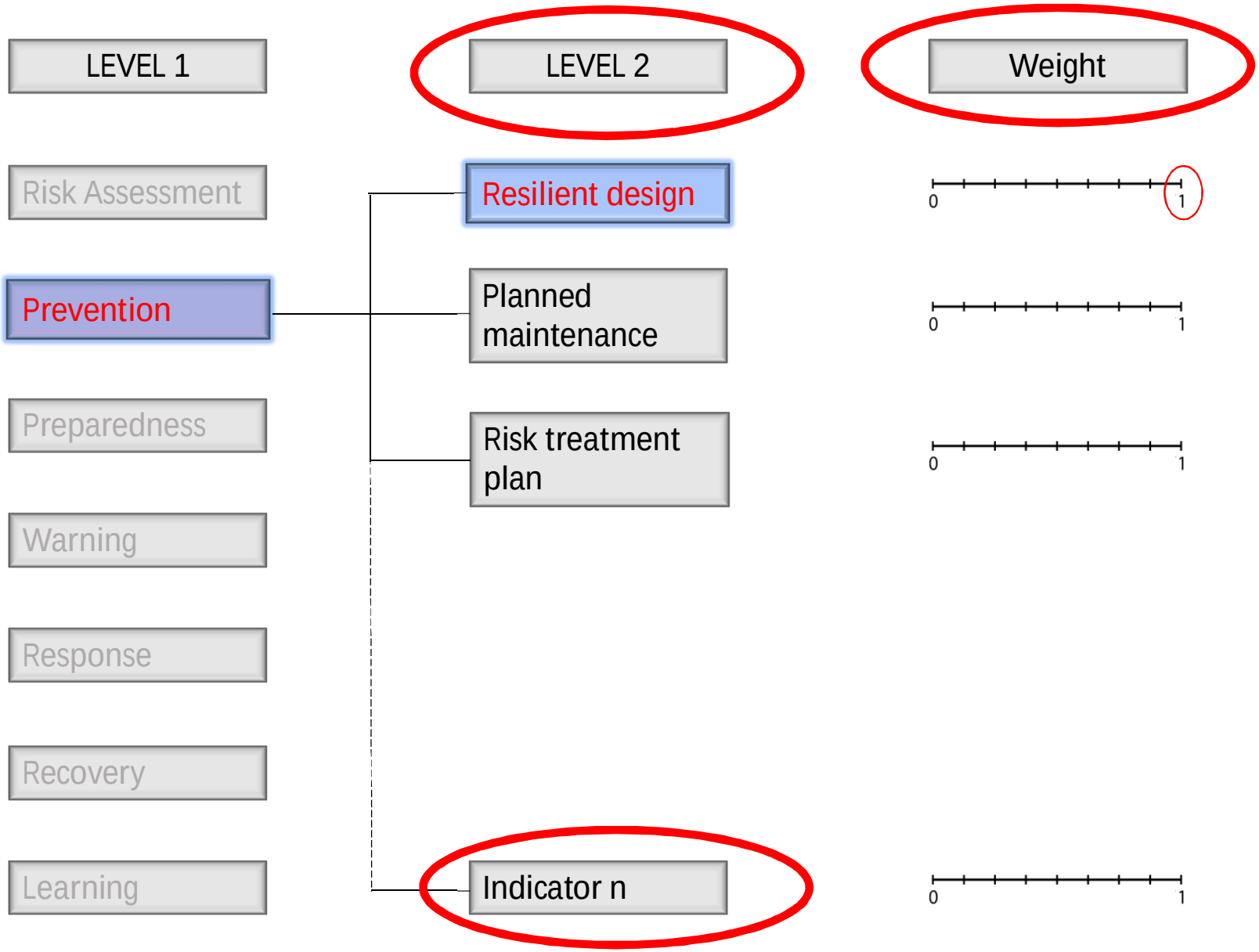
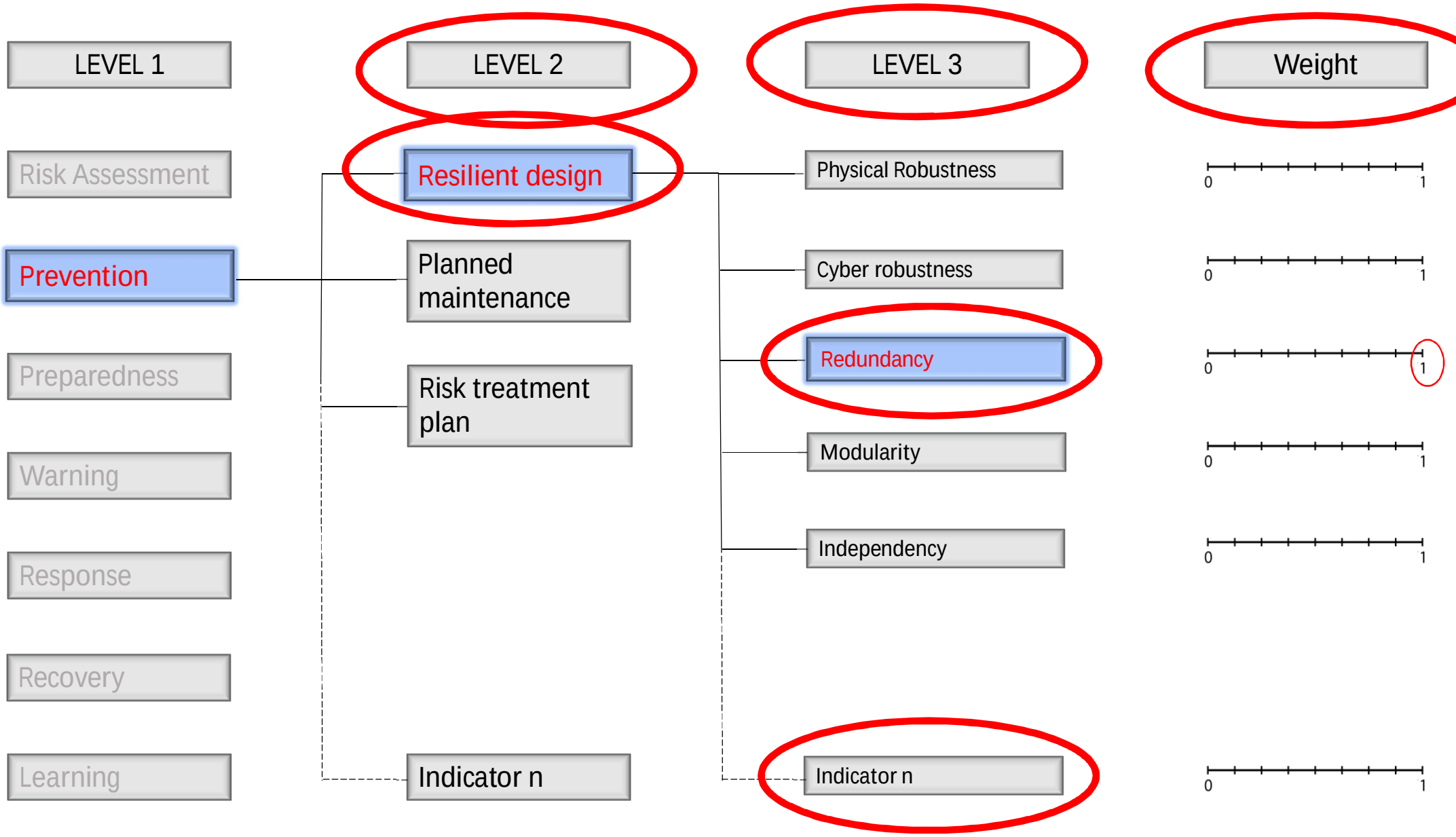
Add new situational factor x A/NA*
Add new situational factor y A/NA*
Add specific scenario A/NA*
Define alternatives
Define alternatives
Scenario description
*
A = Applicable
NA = Not applicable

LEVEL 1	A/NA*
Risk Assessment	A/NA
Prevention	A/NA
Preparedness	A/NA
Warning	A/NA
Response	A/NA
Recovery	A/NA
Learning	A/NA

*
A = Applicable
NA = Not applicable


LEVEL 1
LEVEL 2
Weight
Risk Assessment
Prevention
Preparedness
Warning
Response
Recovery
Learning
Resilient design
Planned maintenance
Risk treatment plan
Indicator n
0
1
0
1
0
1
0
1


LEVEL 1
LEVEL 2
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Risk Assessment
Prevention
Preparedness
Warning
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Resilient design
Planned maintenance
Risk treatment plan
Indicator n
Physical Robustness
Cyber robustness
Redundancy
Modularity
Independency
Indicator n
0
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0
1
0
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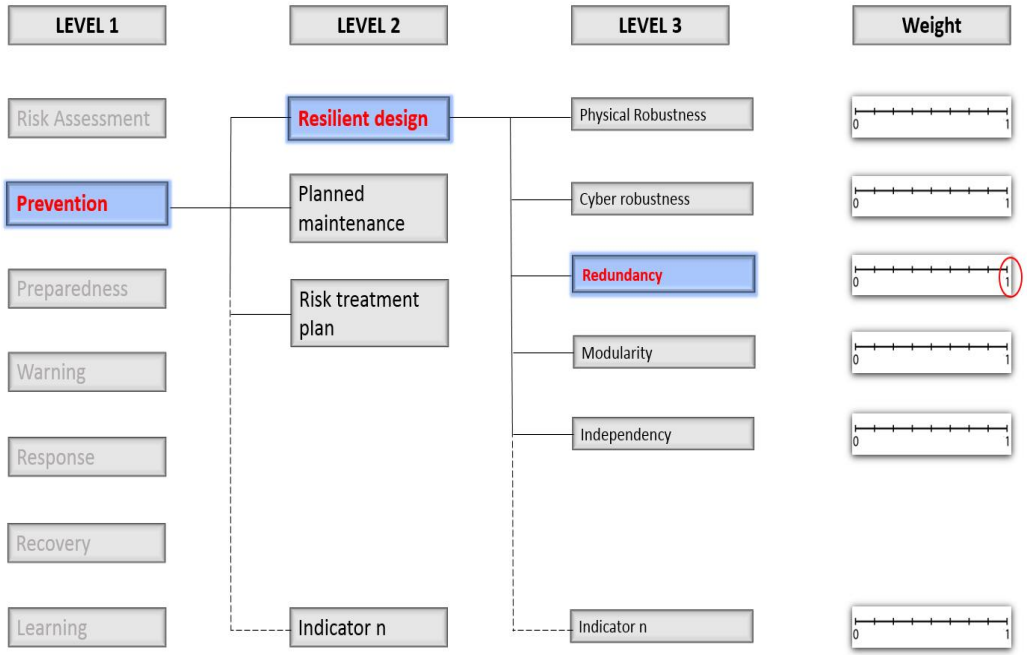
1
0
1
0
1



Maturity scale

LEVEL 4

Scale	Description (based on regulations, standards, best practices, expert opinions etc.)
0	Non-existent
1	
2	
3	
4	
5	Optimised

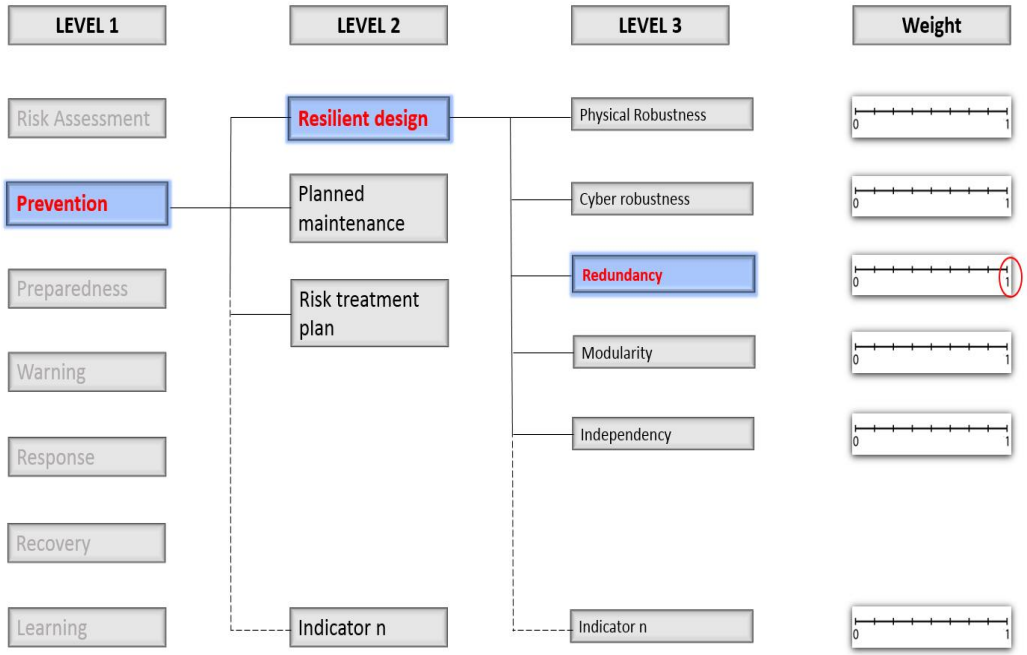
Redundancy indicator 1 measurement
E.g. Reserve power source

Scale	Description (based on regulations, standards, best practices, expert opinions etc.)
0	Non-existent
1	
2	
3	
4	
5	Optimised

Redundancy indicator 2 measurement
E.g. Alternative site

O-5

Redundancy indicator n



$\leftarrow \sum$

Maturity scale

Scale	Description (based on regulations, standards, best practices, expert opinions etc.)
0	Non-existent
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Scale	Description (based on regulations, standards, best practices, expert opinions etc.)
0	Non-existent
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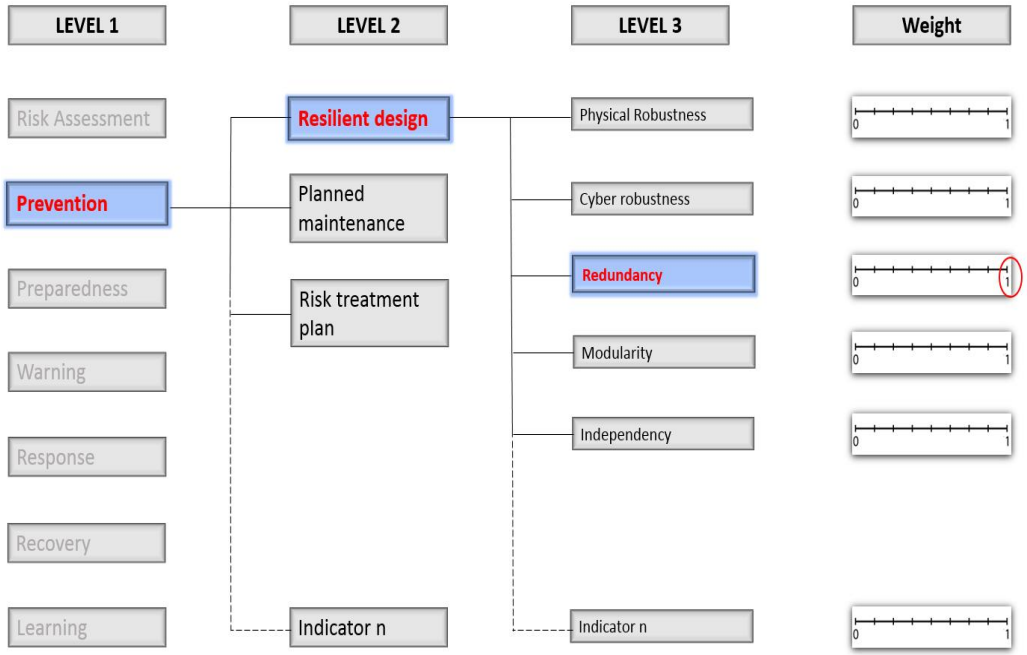
O-5

LEVEL 4

Redundancy indicator 1 measurement
E.g. Reserve power source

Redundancy indicator 2 measurement
E.g. Alternative site

Redundancy indicator n


LEVEL 1
LEVEL 2
LEVEL 3
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Risk Assessment
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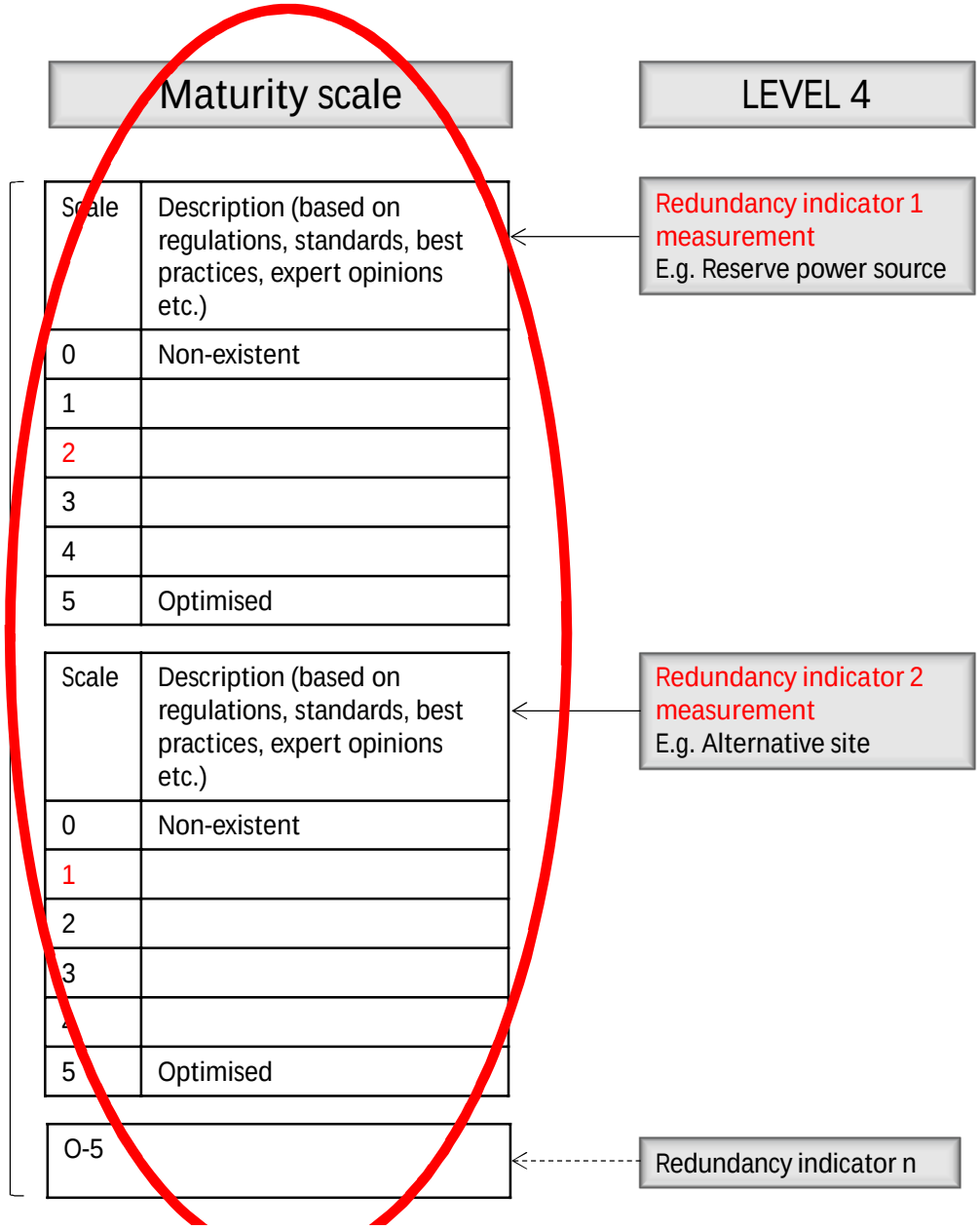
Response
Recovery
Learning
Resilient design
Planned maintenance
Risk treatment plan
Indicator n
Physical Robustness
Cyber robustness
Redundancy
Modularity
Independency
Indicator n
0
1


Σ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3
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E.g. Reserve power source
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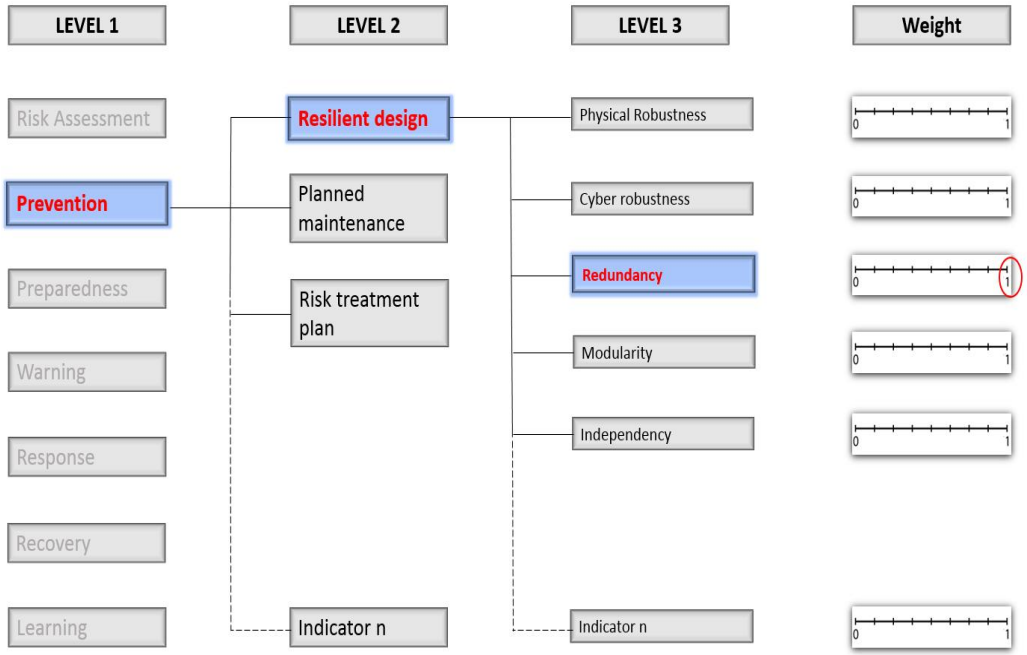
E.g. Alternative site
O-5
Redundancy indicator n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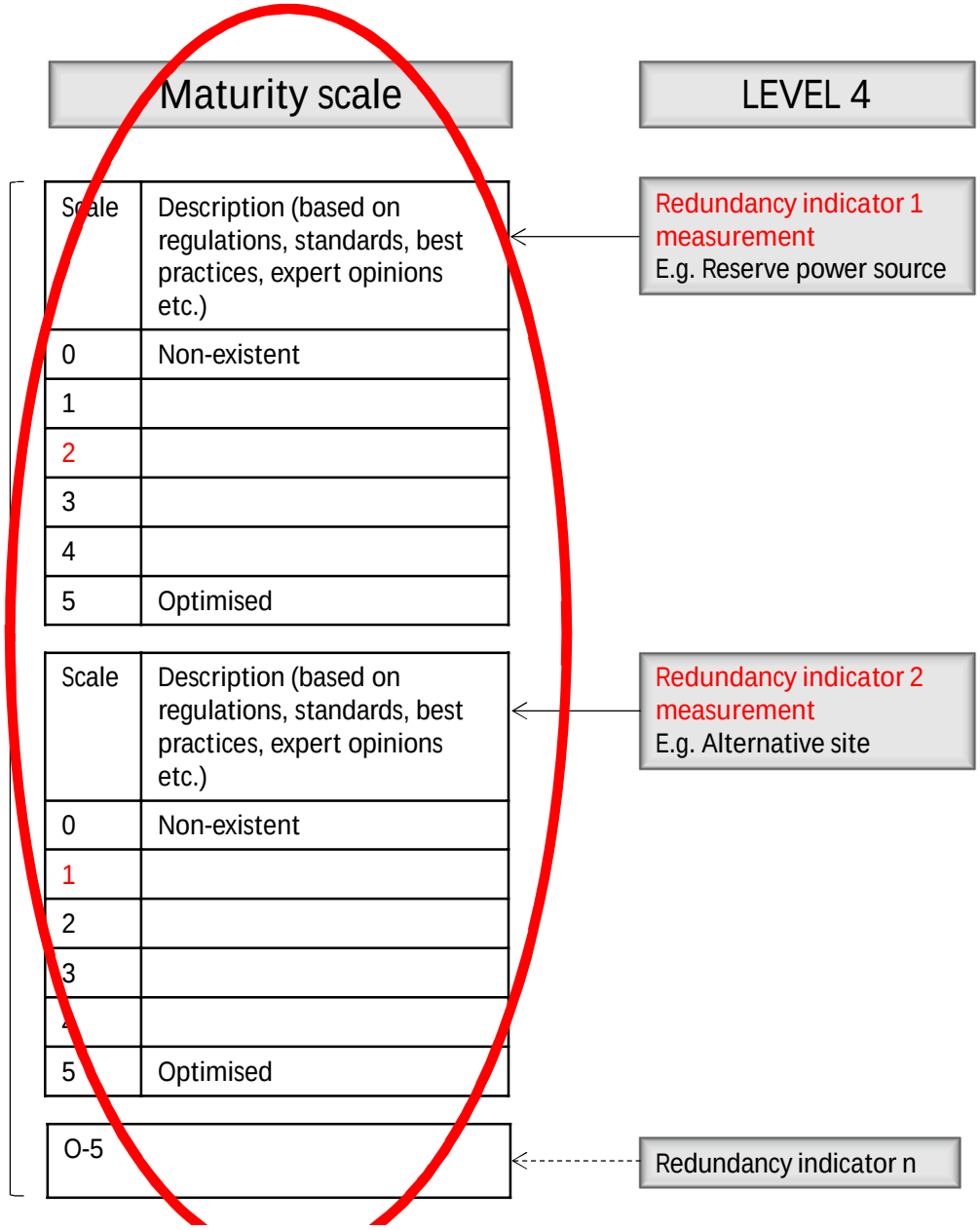
Independency
Indicator n
0
1


Σ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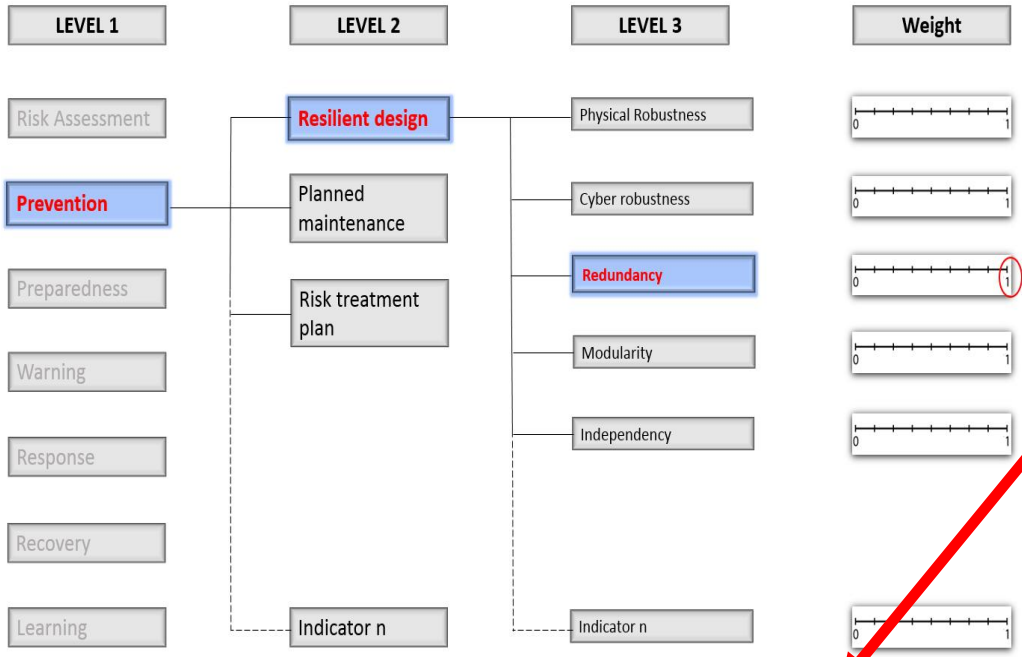
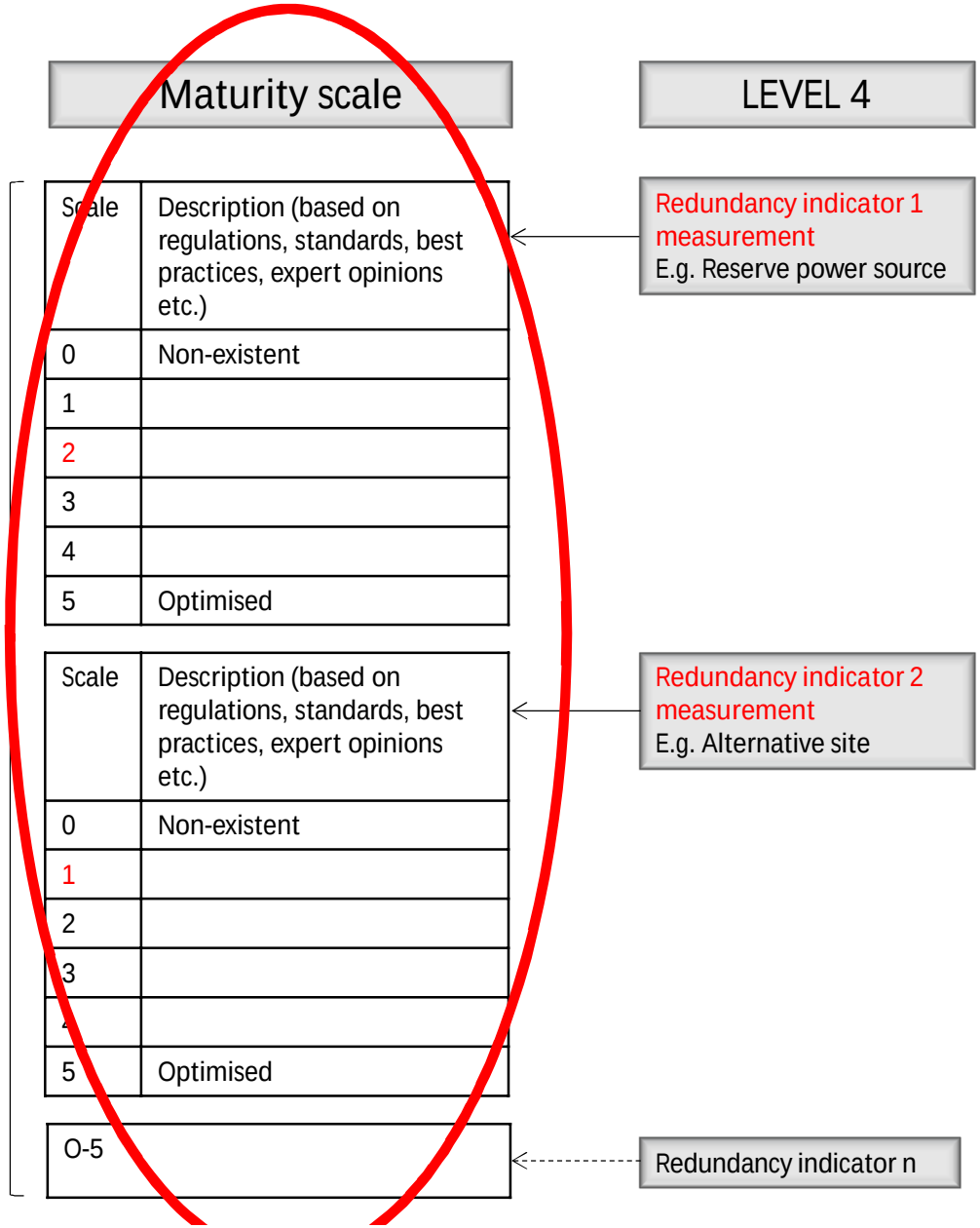
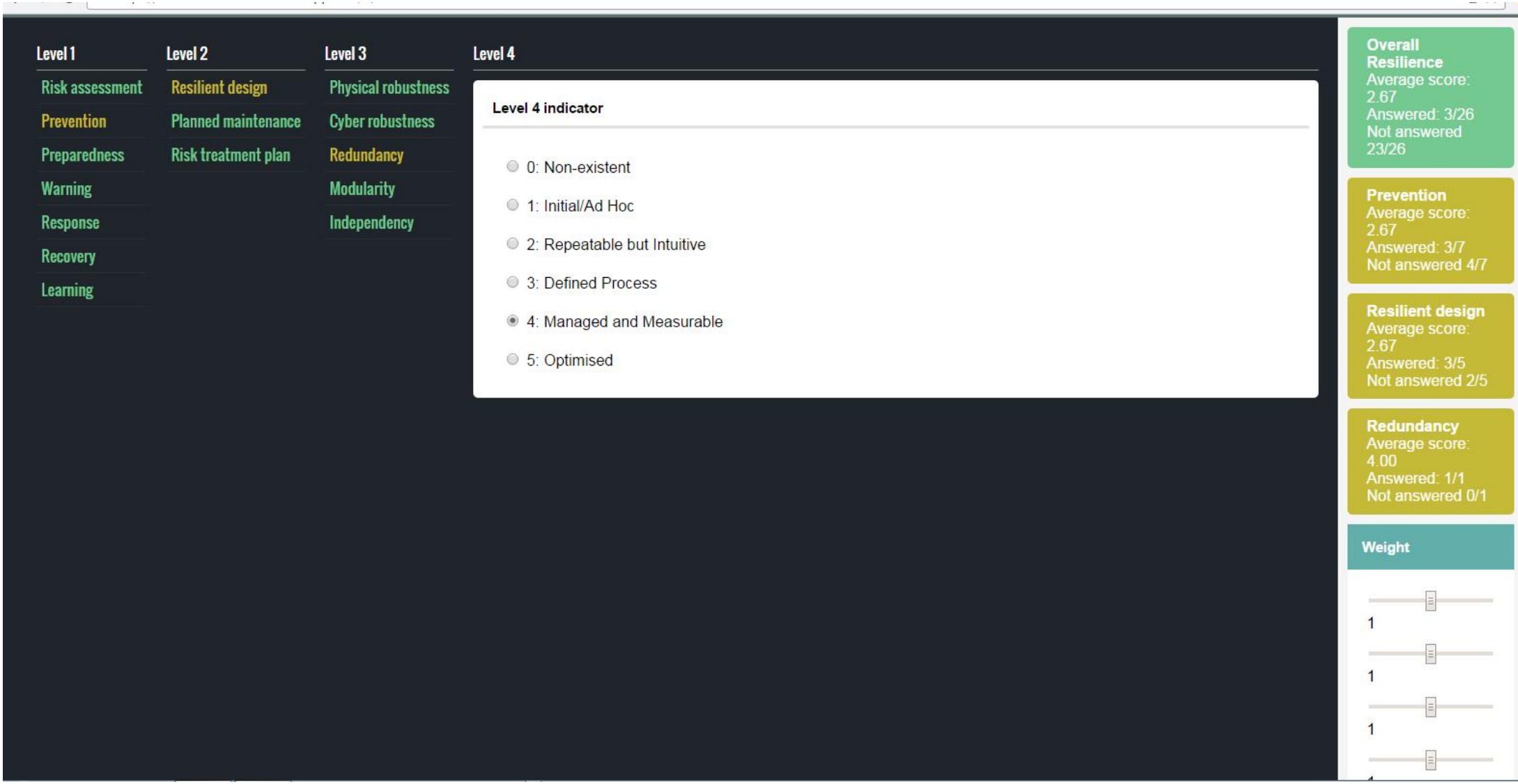


$$CIRI = \frac{1}{7} \sum_{i=1}^{7} L1\ indicator_i$$



DEMOSOFTWARE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Level 2
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Planned maintenance
Risk treatment plan
Level 3
Physical robustness
Cyber robustness
Redundancy
Modularity
Independency
Level 4
Level 4 indicator
0: Non-existent
1: Initial/Ad Hoc
2: Repeatable but Intuitive
3: Defined Process
4: Managed and Measurable
5: Optimised
Overall Resilience
Average score: 2.67
Answered: 3/26
Not answered 23/26
Prevention
Average score: 2.67
Answered: 3/7
Not answered 4/7
Resilient design
Average score: 2.67
Answered: 3/5
Not answered 2/5
Redundancy
Average score: 4.00
Answered: 1/1
Not answered 0/1
Weight
1
1
1

ESIMERKKI

EXAMPLE of how to define Level 3 & 4 values*

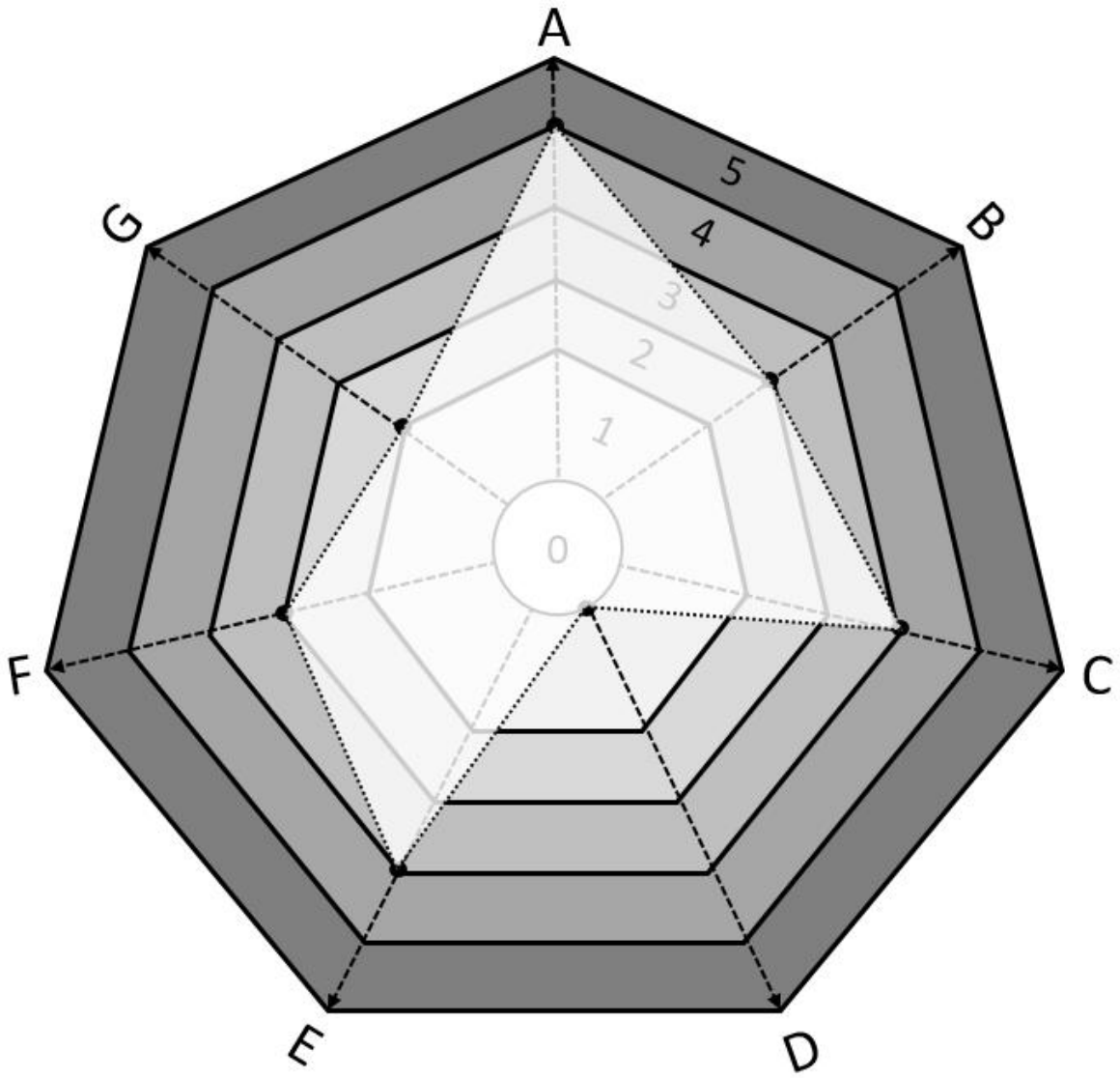
Airport X fuel logistics

L1 PREVENTION > L2 Resilient design > L3 Redundancy > L4 Reserve storage capacity

0	Service disrupted for more than 90 days	0 m^3 reserve storage capacity
1	Service disrupted for 30-90 days	38 630 to 4 600 m^3 reserve storage capacity
2	Service disrupted for 7-30 days	53 440 to 38 630 m^3 reserve storage capacity
3	Service disrupted for 3-7 days	56 020 to 53 440 m^3 reserve storage capacity
4	Service disrupted for less than 3 days	57 950 to 56 020 m^3 reserve storage capacity
5	No disruption to service	>57 950 m^3 reserve storage capacity

*Based on Greg Baker's (SPFR, Norway) background paper for the Improver Project

Level 1	**Risk assessment**	**Prevention**	**Preparedness**	**Warning**	**Response**	**Recovery**	**Learning**
Level 2	Failure data gathering	Safety and security culture	Preparedness plan and crisis organization	Audits	Situation awareness	Downtime	Evaluation
	Knowledge of the context	Physical and cyber entrance control	Redundancy plan	Monitoring	Decision-making	Reduced service level	Institutional learning
	Risk assessment procedure	Risk treatment plan	Cooperation agreements (external resources)	Early warning and alarm	Coordination (internal and external)	Costs	Implementation of lessons
	Monitoring and review	Risk communication	Capability building		Communication (internal and external)	Unplanned maintenance	Technological upgradability
	Testing and simulation	Resilience plan	Capacity building		Resource deployment	Restart	
		Resilient design	Technical supportability		Absorption/ damage limitation	Autonomy	
		Planned maintenance	Interoperability (internal and external)		Externalised redundancy	Insurance	
		Information sharing	Stakeholder management				



A – Risk assessment : 4
B – Prevention: 2
C – Preparedness: 3
D – Warning : 0
E – Response: 3
F – Recovery: 2
G – Learning : 1

JATKOKÄYTTÖ

Mahdollinen jatkohanke, jossa kehitetään kyseinen metodologia ja vastaava softaware teknologiatasolle 7 (TRL7) eli sitä testataan operationaalisessa ympäristössä yhteistyössä kriittisen infrastruktuurin operaattorin kanssa (esim. HUS ja HELEN)

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