



ORT-application for the vulnerability index

Critical infrastructure safety in context of climate change Delft April 4, 2016 Peter Prak PSJ <u>peter.prak@psjadvies.nl</u> <u>www.rain-project.eu</u>

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Content

- 1. Introduction PSJ
- 2. Task 3.4 vulnerability index
- 3. Introduction ORT
- 4. Elements for the index
- 5. Approach







Introduction PSJ

- SME within the RAIN-project
- PSJ: <u>Prak Security & Judgment</u>
- Raised in 2009, full self-employed since 2015
- Area's of interest
 - ✓ security concepts
 - ✓ decision support
 - ✓ education & training
 - ✓ research & development
- Clients: governments, rail and road industry, museum, university, insurance company, police







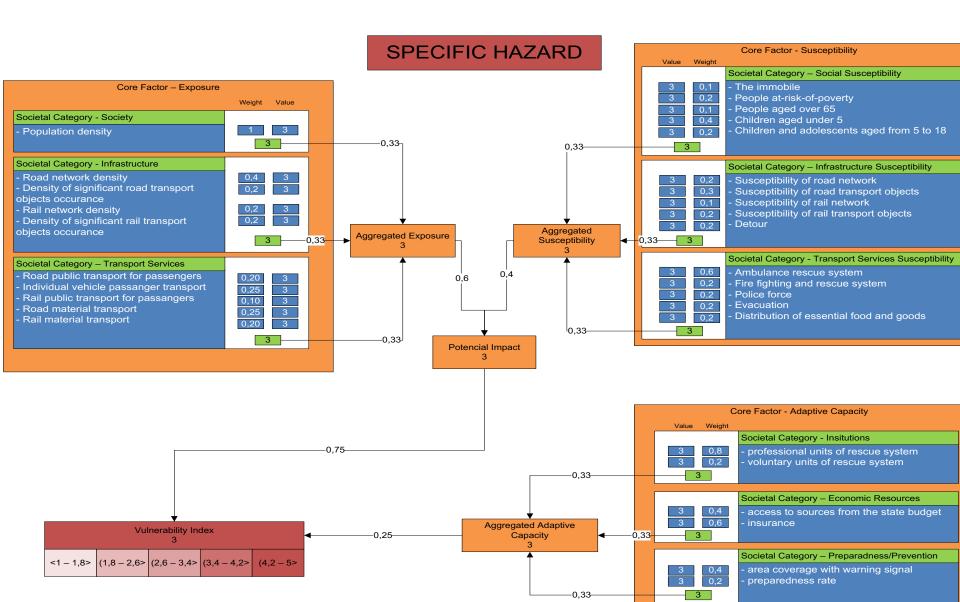
Task 3.4 of Description Of Work

- Methodology for measuring critical land transport vulnerability
 - Common methodology is not sufficiently developed
 - How to measure
 - Usable for improving risk reduction and preparedness
- Task led by UNIZA: Zilinska Univerzita V Ziline Slovakia
- Deliverable 3.4 methodology for measuring societal vulnerability (dec 2015)





Main element of D3.4 A RAIN







Possible application for ORT

- Result of D3.4 might be input for a dedicated ORTapplication
- Uniform method to measure the level of vulnerability
 - In any region
 - For different stakeholders
 - For different extreme weather events
 - To support decision making where to invest to improve







Introduction of ORT Objective Ranking Tool

- ORT: decision support and ranking tool
- Principles developed during post academic course at TU Delft in 2009, web-based application developed since 2014
- Aim of 2009: to answer the question for the determination of the most vulnerable objects for terrorist attacks in the rail system
- Three scientific principles behind
 - o Delphi-panels
 - Analytic Hierarchy Processing (AHP)
 - o Similarity Judgment







Why using ORT

- Incorporate -interests of- stakeholders
- Pursue unanimity in decisions
- Considerations: why and what
- Flexible
- Sensitivity analyses
- Value for money
- In any decision making process, prioritisation, ranking and comparison
- In any domain, within a common process



Similarity Judgment

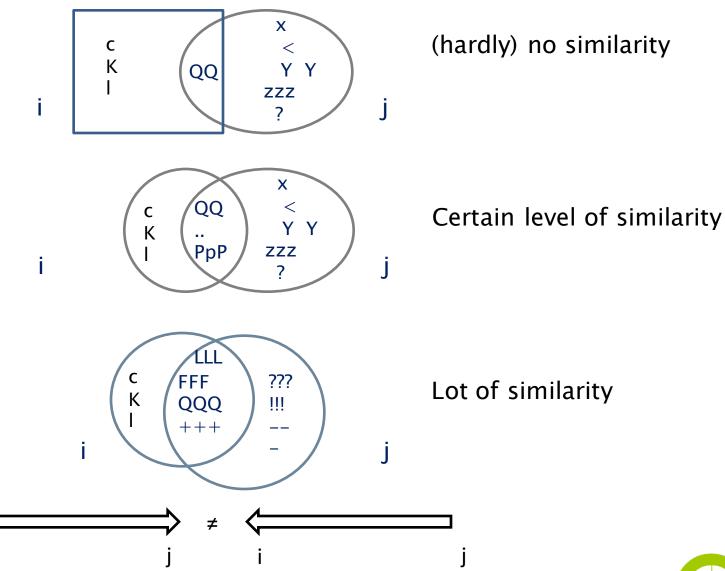
The level of similarity between two objects is the relationship between the common weighted features of both objects divided by the sum of these common weighted features and the number of weighted unique features of both objects.

$$S_{ij}=f_{ij} / [f_{ij} + a(f_{i, not j}) + b(f_{j, not i})]$$

- S_{ij}: level of similarity
- f_{ii}: common features
- f_{i, notj}: unique features of object 'i'
- f_{j, noti}: unique features of object 'j'
- Relative weights between features
- Outcome is a number between '0' and '1'

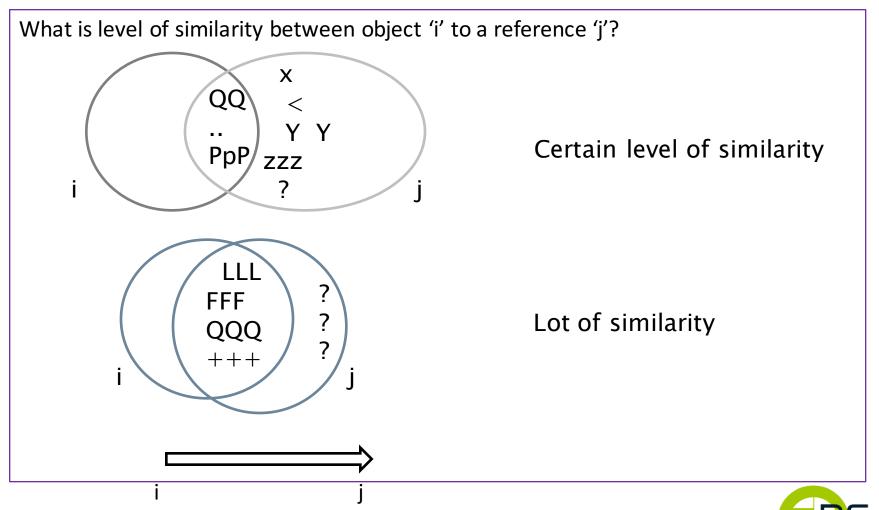


Similarity Judgment





Basis principle within ORT



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Analytic Hierarchy Process

- Pairwise comparison of agreed criteria
- Level of equality
 - Figure between '1' and '9
 - o '1' is equal
 - '9' is extreme non equal
- Statistic checks
- No consensus needed
- Within AHP seven criteria as a maximum due to consistency
- More levels possible, ORT supports 343 criteria at the moment

AHP Ana								ultiple	inputs))		
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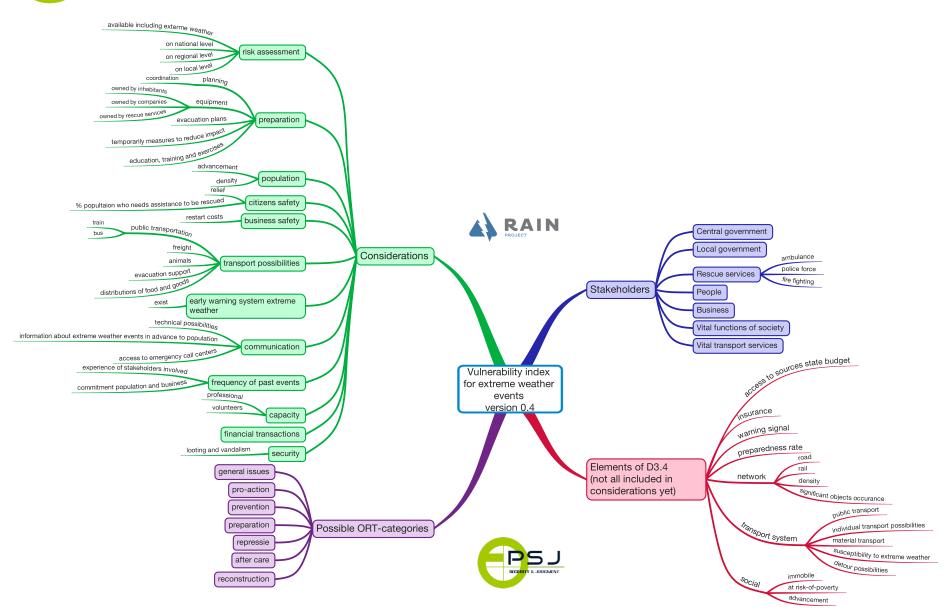


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Content of any ORT-analyses

- 1. Define question
- 2. Delphi-panel
 - Common analyses of stakeholders, interests and considerations
 - Analyses of the criteria to use
 - Set weight factors by Analytic Hierarchy Processing (AHP)
- 3. Develop alternatives
- 4. ORT analyses with Similarity Judgment
 - Score every alternative on the criteria
 - Discuss results
 - Execute sensitivity analyses
- 5. Draft report

D3.4 transfered to ORT A PROJECT





Adresboek
Adresboek

criteria exporteren 💌

Criteria

Naa	am	Percentage	Туре	Beinvloedbaar	Subcriteri	a
Agg	gregated Adaptive Capacity	25.00%			3	H
-	Societal Category: Institutions	33.33%			2	
	Professional units of rescue system	80.00%	additive	ја		Ħ
	Voluntary units of rescue system	20.00%	additive	ја		Ħ
-	Societal Category: Economic Resources	33.33%			2	Ħ
	Access to sources from the state budget	40.00%	additive	ја		×
	Insurance	60.00%	additive	ја		Ħ
-	Societal Category: Prepardness/Prevention	33.34%			2	12
	Area coverage with warning signal	40.00%	additive	ја		12
	Preparedness rate	60.00%	additive	ja		

Alternatives

1 (50%)

∺ X



RT Ob	ective Ranking Tool	💄 Peter Prak 🛛 uitlog
Voorpagina	Klanten Projecten	
AIN (Dı	ıblin) - WP 3.4	Bewerk
Criteria	Varianten Scores Resultaten Analyse	Adresbo
Case S	tudy	11 Fe
#	Te scoren objecten	Riscoindeling
1	Area 1: Storm	1 (50%)
2	Area 1: Flood	1 (50%)
3	Area 1: Snow	1 (50%)
4	Area 1: Fog	1 (50%)
5	Area 2: Storm	1 (50%)
6	Area 2: Flood	1 (50%)
7	Area 2: Snow	1 (50%)
8	Area 2: Fog	1 (50%)
9	Area 3: Storm	1 (50%)
10	Area 3: Flood	1 (50%)
11	Area 3: Snow	1 (50%)

• voeg te scoren object toe

Area 3: Fog

12

SECURITY & JUDGMENT

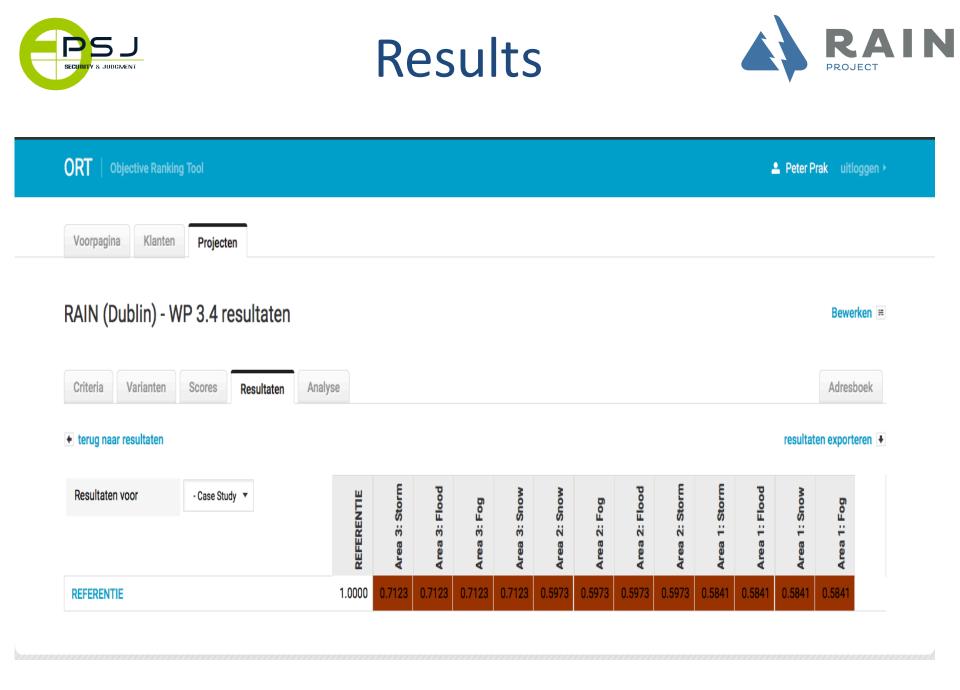


PSJ

SECURITY & JUDGMENT



ORT Objective Ranking Tool											🔺 Peter	Prak ui	tloggen
Voorpagina Klanten Projecten													
RAIN (Dublin) - WP 3.4 scoren												Bew	verken
Criteria Varianten Scores Resultaten	Analyse											Adre	sboek
											score	blad expo	rteren
Scores invullen voor - Case Study -		Area 1: Storm	Area 1: Flood	Area 1: Snow	Area 1: Fog	Area 2: Storm	Area 2: Flood	Area 2: Snow	Area 2: Fog	Area 3: Storm	Area 3: Flood	Area 3: Snow	Area 3: Fog
Aggregated Adaptive Capacity	25.00%												
Societal Category: Institutions	33.33%												
Professional units of rescue system	80.00%	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -	0.7 -
Voluntary units of rescue system	20.00%	0.3 -	0.3 -	0.3 -	0.3 -	0.5 -	0.5 -	0.5 -	0.5 -	0.3 -	0.3 -	0.3 -	0.3 -
Societal Category: Economic Resources	33.33%												
Access to sources from the state budget	40.00%	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -
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Insurance	60.00%	0.1 -	0.1										
	60.00% 33.34%	0.1 👻	0.1										
Insurance		0.1 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.5 -	0.7 -	0.7 -	0.7 -	0.7 -









Bewerken 🖛

Voorpagina Klanten Projecten

RAIN (Dublin) - WP 3.4 resultaten

Criteria Varianten Scores Resultaten	Analyse												Adre	esboek
												an	alyse expo	orteren 🔹
Analyse voor - Case Study -														
Beinvloedbaar - 👻														
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			Area 1: Storm	Area 1: Flood	Area 1: Snow	Area 1: Fog	Area 2: Storm	Area 2:	Area 2: Snow	Area 2:	Area 3: Storm	Area 3: Flood	Area 3: Snow	Area 3:
Professional units of rescue system	6.67%	ja	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Voluntary units of rescue system	1.67%	ja	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3
Societal Category: Economic Resources														
Access to sources from the state budget	3.33%	ja	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Insurance	5.00%	ja	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Societal Category: Prepardness/Prevention														
Area coverage with warning signal	3.33%	ja	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7
Preparedness rate	5.00%	ja	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7
Potential Impact: aggregated exposure														
Societal category: Societal														
Population density	15.00%	ja	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9
Societal category: Infrastructure														
Road network density	6.00%	ja	0.7	0.7	0.7	0.7	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7
Density of significant road transport objects occurance	3.00%	ja	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9
	0.000			~ ~				0.7	0.7	0.7	0.5	0 F	0 F	



Detailed analyses



IN (Dublin) - WP 3.4 resultaten	ORT Objective Ranking Tool			
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Population density15.00%ja0.3Societal category: Infrastructure	Potential Impact: aggregated exposure			
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Road network density 6.00% ja 0.7 Rential impact: aggregated susceptibility F F		15.00%	ja	0.3
ential impact: aggregated susceptibility				
		6.00%	ja	0.7
Societal category: intrastructure susceptibility				
Susceptibility of road transport objects 3.00% ja 0.7				





Way ahead

- April 5 workshop in Delft
 - Discuss approach, possibilities
 - Decide on criteria, weights and alternatives
 - With specialists from the field
- Based on results built dedicated ORT-application
- Discuss results with specialists
- Draft report to include within D3.4







RAIN Project

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