ORT-application for the vulnerability index

Critical infrastructure safety in context of climate change

Delft

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PSJ

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Content

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

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Introduction PSJ

- SME within the RAIN-project
- PSJ: Prak Security & Judgment
- 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

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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)

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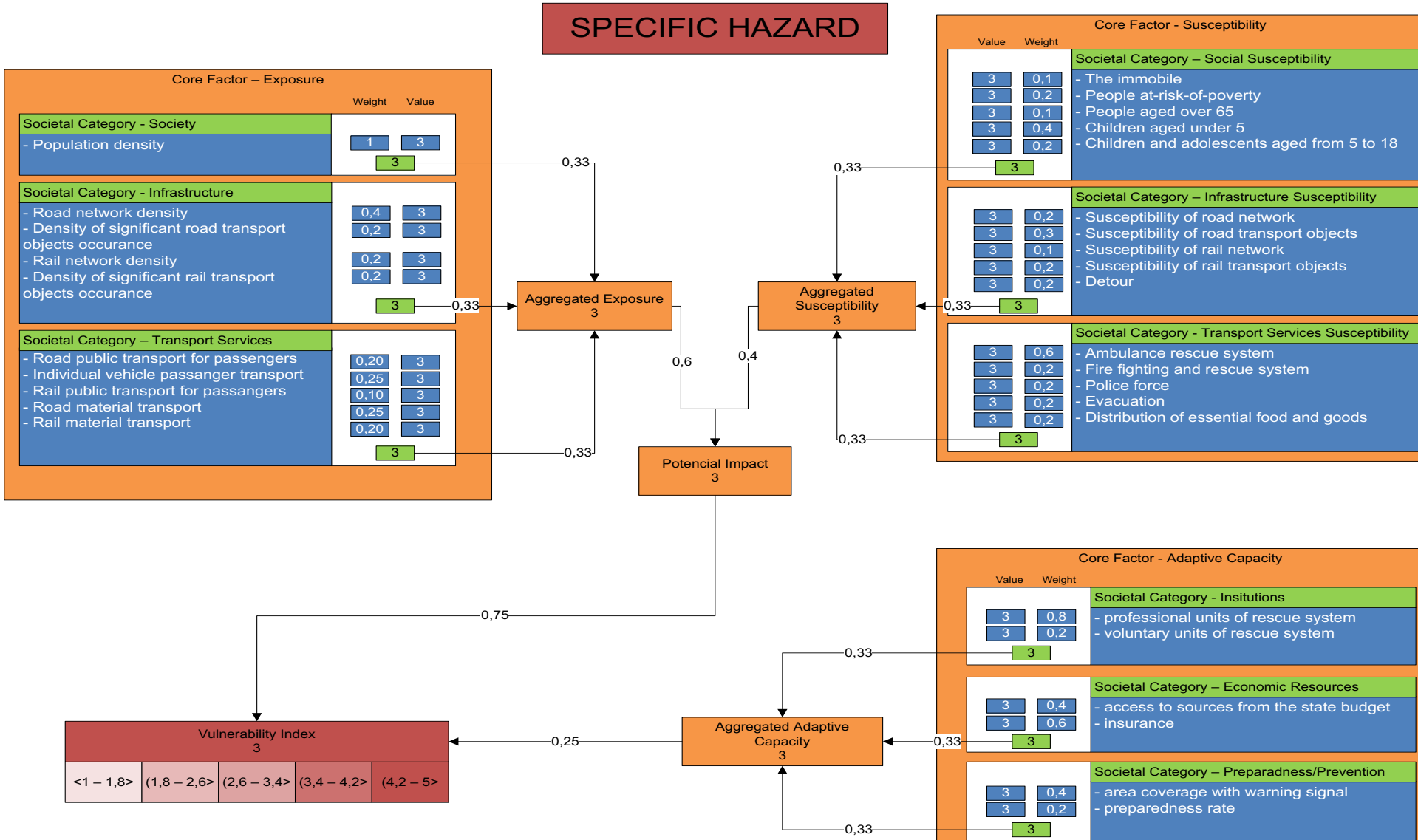
Main element of D3.4



Possible application for ORT

- Result of D3.4 might be input for a dedicated ORT-application
- 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

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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
  - Delphi-panels
  - Analytic Hierarchy Processing (AHP)
  - Similarity Judgment

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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

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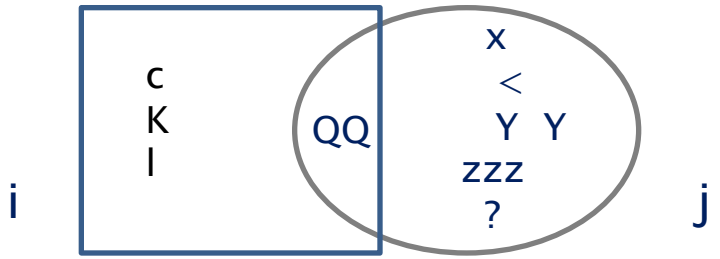
Similarity Judgment

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.

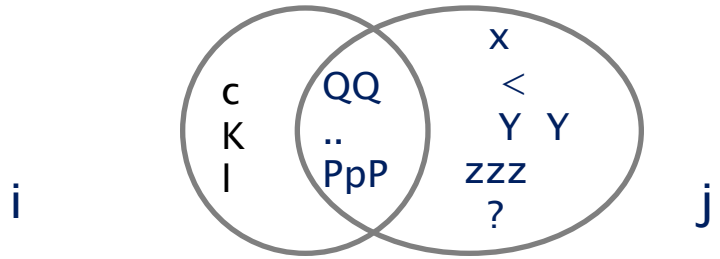
$$S_{ij}=f_{ij} / [f_{ij} + a(f_{i,\ not\ j}) + b(f_{j,\ not\ i})]$$

- S_{ij} : level of similarity
- f_{ij} : common features
- $f_{i,\ not\ j}$: unique features of object 'i'
- $f_{j,\ not\ i}$: unique features of object 'j'
- Relative weights between features
- Outcome is a number between '0' and '1'

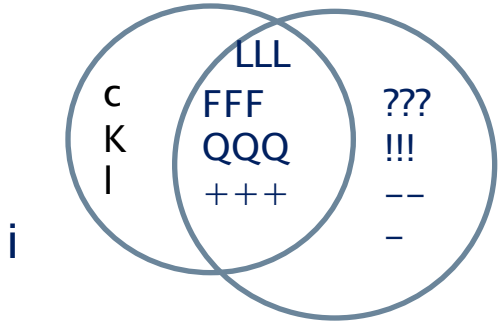
Similarity Judgment



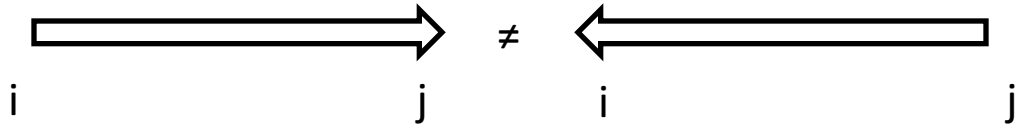
(hardly) no similarity



Certain level of similarity

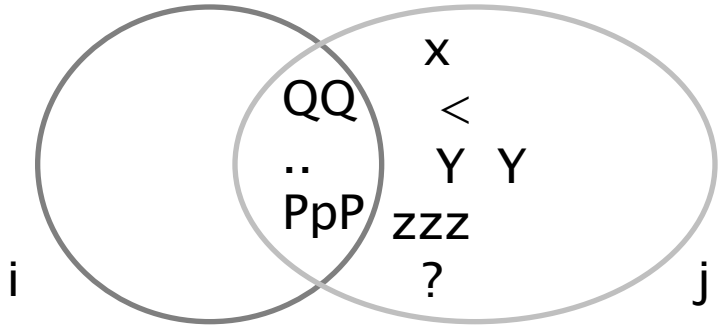


Lot of similarity

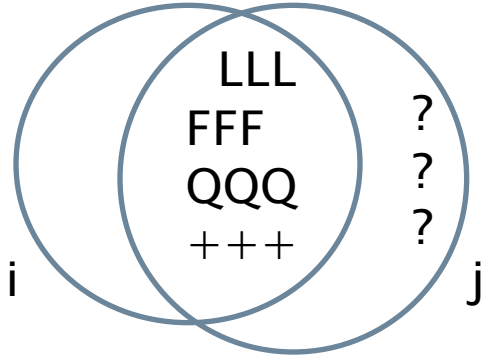


Basis principle within ORT

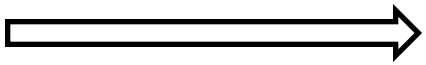
What is level of similarity between object ‘i’ to a reference ‘j’?



Certain level of similarity



Lot of similarity



Analytic Hierarchy Process

- Pairwise comparison of agreed criteria
- Level of equality
  - Figure between ‘1’ and ‘9
  - ‘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 Analytic Hierarchy Process (EVM multiple inputs)

K. D. Goepel Version 08.05.2013 http://bpmsg.com

Only input data in the light green fields and worksheets!

n=	6	Number of criteria (3 to 10)	Scale:	1	
N=	12	Number of Participants (1 to 20)	α:	0,15	Consensus:
p=	0	selected Participant (0=consol.)	2	7	Consolidated

Objective Set weights for scoringproces Atb

Author Prak/van Gelder

Date 10-Jun-14 EVM check:

Table	Criterion	Comment
1	Ideologie	
2	Capaciteiten	
3	Weerstand	
4	Risico- en hinderacc	
5	Profiel	
6	Tijdsgeest	
7		
8		
9		for 9&10 unprotect the input sheets and expand the
10		question section ("+" in row 66)

Result

Eigenvalue lambda: 6,018

Consistency Ratio 0,37 GCI: 0,01 CR: 0,3%

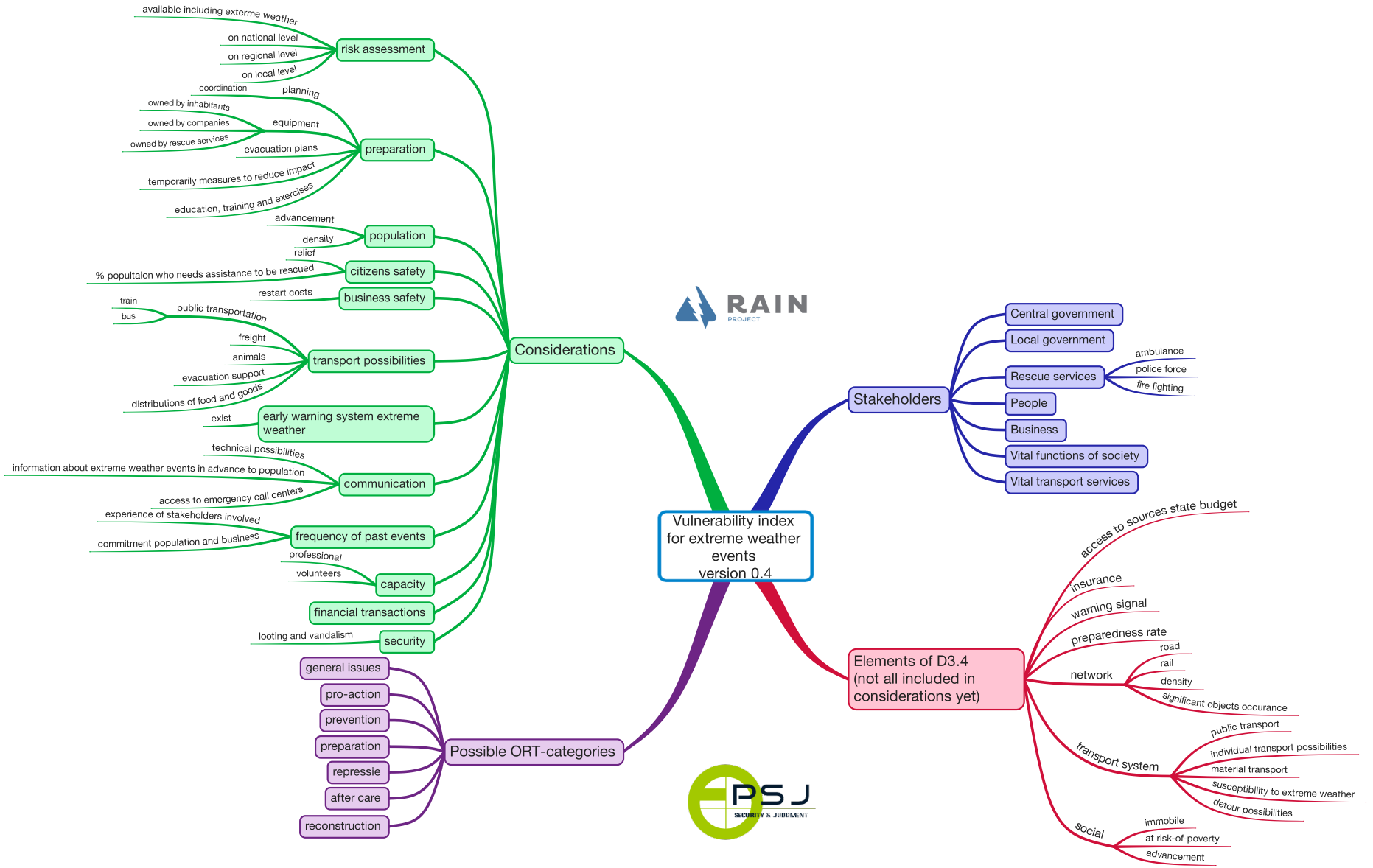
Matrix

	1 Ideologie	2 Capaciteiten	3 Weerstand	4 Risico- en hinderacceptatie	5 Profiel	6 Tijdsgeest	7 0	8 0	9 0	10 0
1 Ideologie	-	1 1/7	1	1	1	1 1/7	-	-	-	-
2 Capaciteiten	7/8	-	1 1/7	1	7/8	1	-	-	-	-
3 Weerstand	1	7/8	-	1 1/7	1	1 1/7	-	-	-	-
4 Risico- en hinderacceptati	1	1	7/8	-	7/8	1	-	-	-	-
5 Profiel	1	1 1/7	1	1 1/7	-	1 1/7	-	-	-	-
6 Tijdsgeest	7/8	1	7/8	1	7/8	-	-	-	-	-
7 0	-	-	-	-	-	-	-	-	-	-
8 0	-	-	-	-	-	-	-	-	-	-
9 0	-	-	-	-	-	-	-	-	-	-
10 0	-	-	-	-	-	-	-	-	-	-

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



Criteria

ORT | Objective Ranking Tool — Peter Prak — uitloggen

Voorpagina | Klanten | Projecten

RAIN (Dublin) - WP 3.4

Bewerken

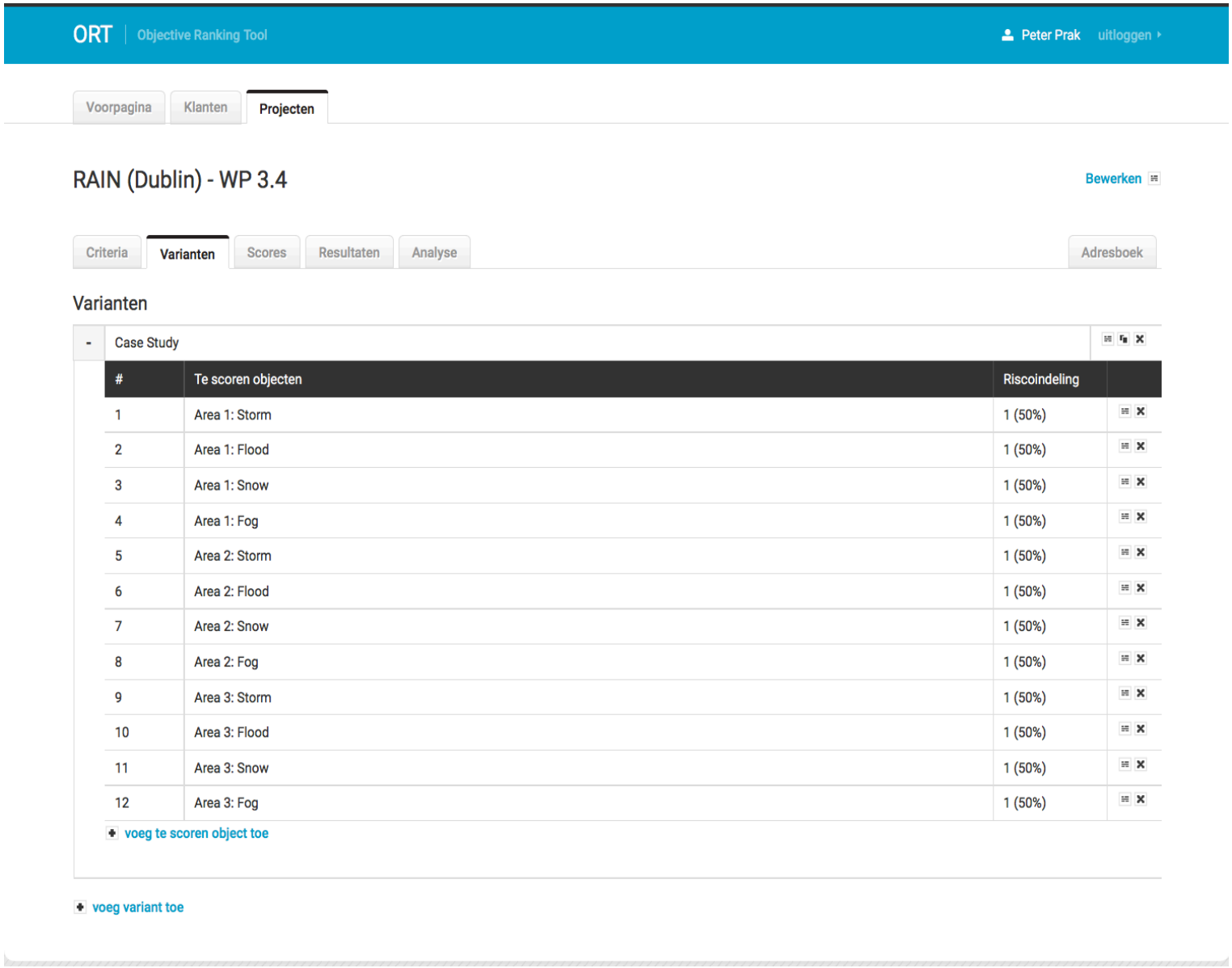
Criteria | Varianten | Scores | Resultaten | Analyse | Adresboek

Criteria

criteria exporteren

	Naam	Percentage	Type	Beinvloedbaar	Subcriteria
-	**Aggregated Adaptive Capacity**	**25.00%**			**3**
-	**Societal Category: Institutions**	**33.33%**			**2**
	Professional units of rescue system	80.00%	additive	ja	
	Voluntary units of rescue system	20.00%	additive	ja	
-	**Societal Category: Economic Resources**	**33.33%**			**2**
	Access to sources from the state budget	40.00%	additive	ja	
	Insurance	60.00%	additive	ja	
-	**Societal Category: Prepardness/Prevention**	**33.34%**			**2**
	Area coverage with warning signal	40.00%	additive	ja	
	Preparedness rate	60.00%	additive	ja	

Alternatives



#	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%)
12	Area 3: Fog	1 (50%)

Scoring

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Bewerken

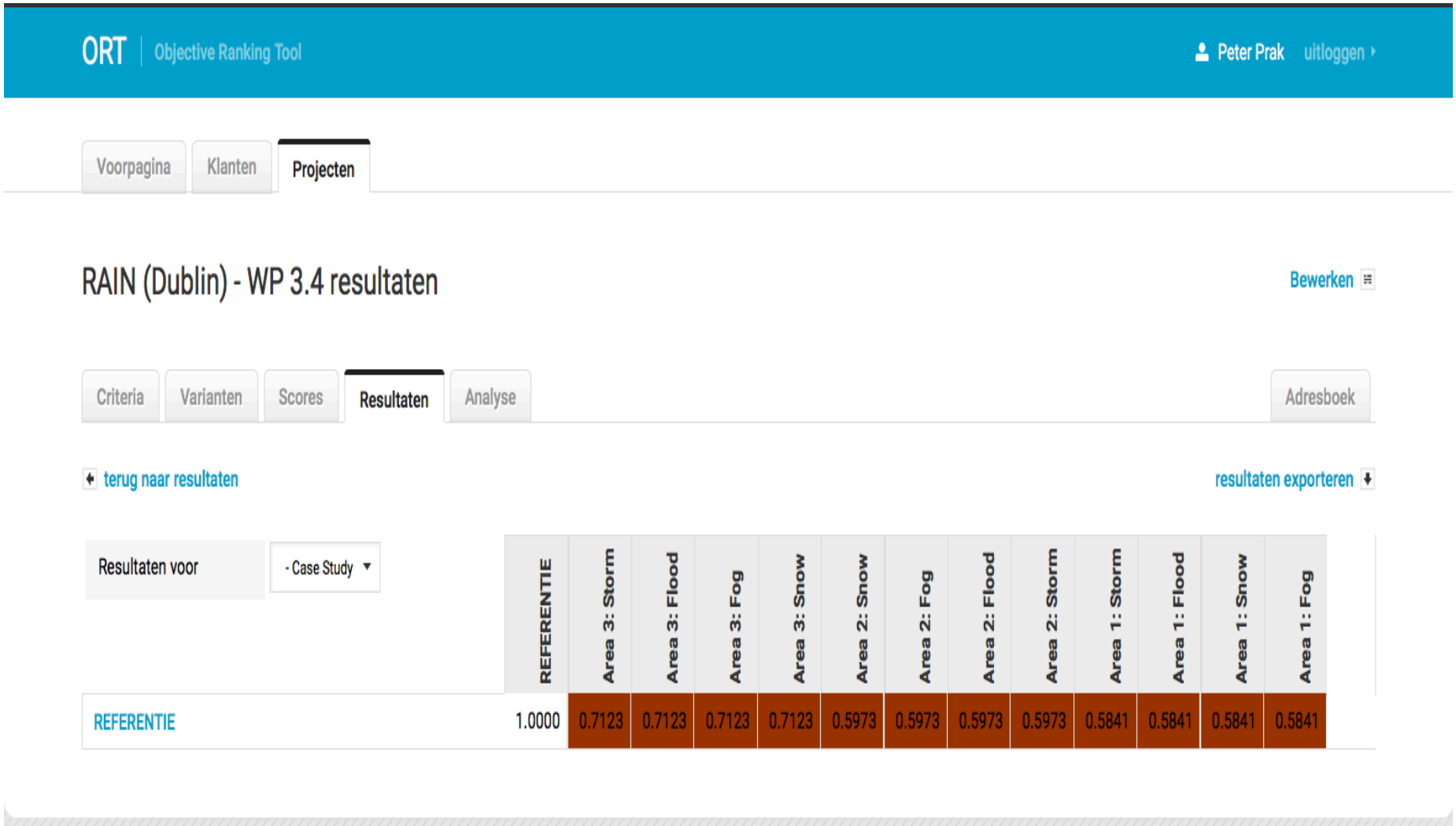
Criteria | Varianten | **Scores** | Resultaten | Analyse | Adresboek

scoreblad exporteren

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
Insurance	60.00%	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	33.34%												
Area coverage with warning signal	40.00%	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	60.00%	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7

Results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Peter Prak uitloggen
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RAIN (Dublin) - WP 3.4 resultaten
Bewerken
Criteria
Varianten
Scores
Resultaten
Analyse
Adresboek
terug naar resultaten
resultaten exporteren
Resultaten voor
- Case Study
REFERENTIE
Area 3: Storm
Area 3: Flood
Area 3: Fog
Area 3: Snow
Area 2: Snow
Area 2: Fog
Area 2: Flood
Area 2: Storm
Area 1: Storm
Area 1: Flood
Area 1: Snow
Area 1: Fog
REFERENTIE
1.0000
0.7123
0.7123
0.7123
0.7123
0.5973
0.5973
0.5973
0.5973
0.5841
0.5841
0.5841
0.5841

Analyses

Voorpagina | Klanten | Projecten

RAIN (Dublin) - WP 3.4 resultaten

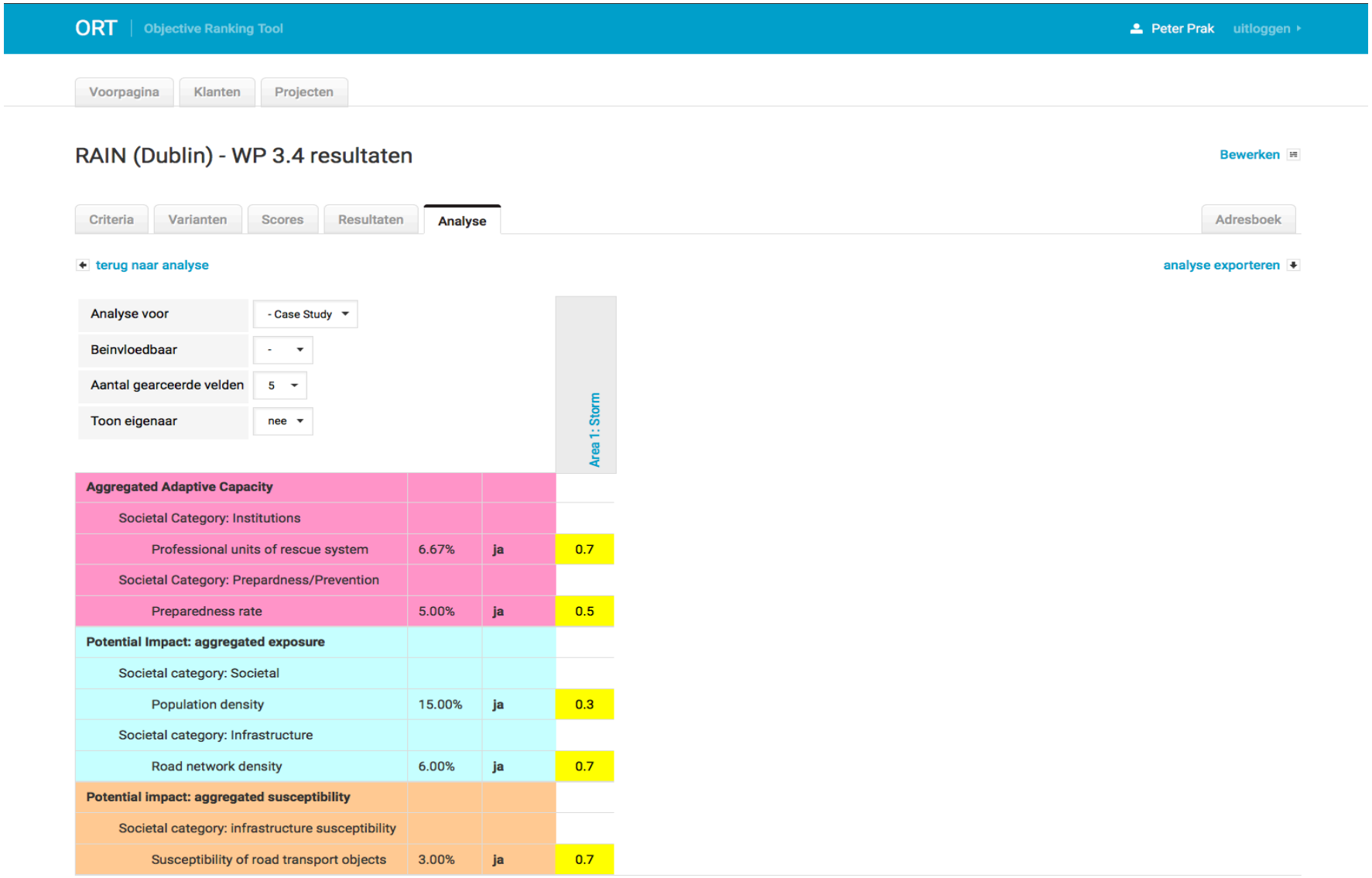
Bewerken

Criteria | Varianten | Scores | Resultaten | **Analyse** | Adresboek

analyse exporteren

Analyse voor	- Case Study											
Beinvloedbaar	-											
Aantal gearceerde velden	5											
Toon eigenaar	nee											
			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
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

Detailed analyses



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

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