GEORISK Project

WP 2.2 Risk Assessment

Ferid Seyidov

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WP 2: RISK ASSESSMENT

MONTHS 1-15, Leader: BRGM

1) Context and Identification of potential risks (BRGM) (months 1-6)
Geothermal Risks register

2) **Risk Assessment (GEC-CO) (months 5 to 12)**
Geothermal Risk Matrix

3) Tools to assess the risks (BRGM) (months 5 to 15)
Development of an online tool for developers globally

Strategy and Methodology

- The objective here was to create the risk portfolio for each country, geological system.
- The Risk Register was taken as a basis for evaluation matrix.
- Qualitative survey was set as a task goal to maximize the value of received data
- Objective was to make the list of stake holders and send 20 enquiries with expected 25% response rate.

List of Stakeholders

Stakeholder	Drilling	Research	Developer/(	Insurance	Other	Contact Person	Email/Contact Data	Responce	Comments
Belgium									
Denmark									
France									
Germany									
Greece									
Hungary									
Iceland									
Poland									
Switzeland									
Turkey									
Optional									

Questionnaire

- The questionnaire sheet is divided on 3 categories of risks
  - Socio Economical
  - Geology and Operational
  - Drilling

- The evaluation is based on real data from the active projects and project developers

- The risk index(RI) of each entry is evaluated based on the specified Frequency and Damage

- Each given risk have attributed Risk Index and Relevance.

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Representation of the Risk Matrix

Where Likelihood (a) is taken as

- (0,001; 0,01; 0,1; 1)

Where Damage (b) is taken as

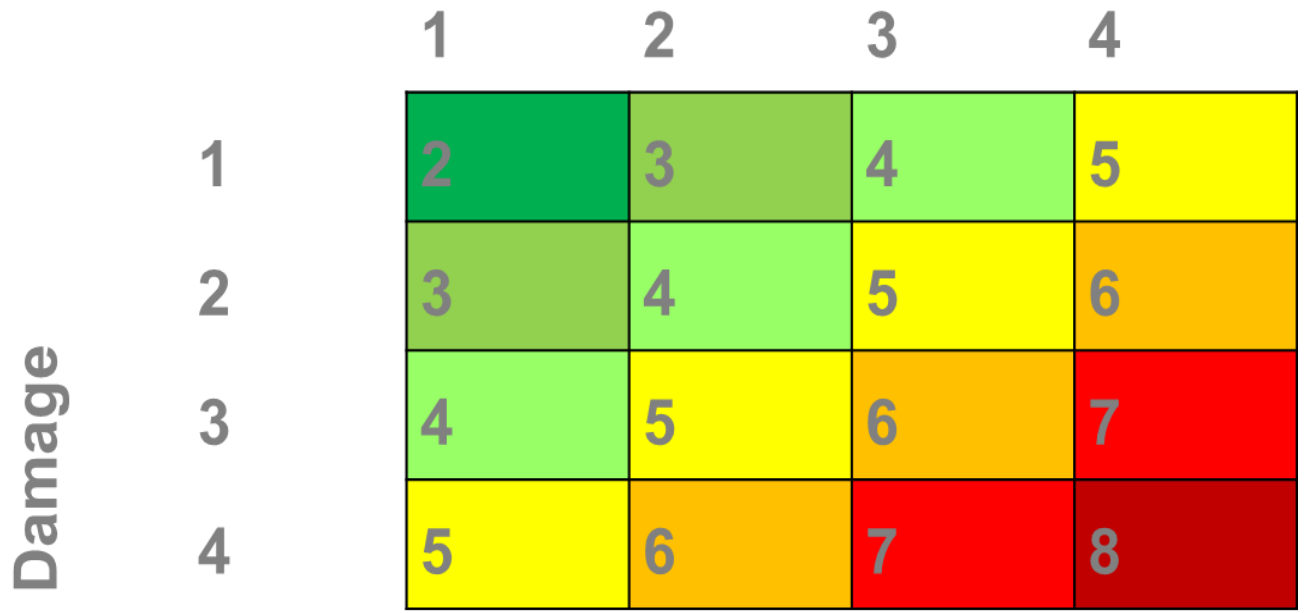
- (1.000; 10.000; 100.000; 1.000.000)

RI is Calculated as a sum of powers:

$$10^a x 10^b = 10^{(a+b)}$$

Here the values are interpreted as following:

- 2-4 – Low level of Risk
- 5-6 – Medium level of Risk
- 7-8 – Critical levels of Risk



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Questionnaire

General Information										Level of Experience*				
Output*						Reservoir Type*			County and Region*	Geology	Social/Economical	Drilling	Operation/Develop	Note
														Please visit The legend Sheet for information
		Phases						Consequences		Risk Evaluation				
Topic*	ID	iE*	DT*	OD*	PC*	Description		EPA*	HSE*	Likelihood*	Damage Level*	Ri*	Relevance*	Comments*
Managerial and Social-Economic	A-1		x	x	x	External natural hazards damaging the infrastructure		x	x					
	A-2		x	x	x	Anthropogenic hazard damaging the infrastructure		x	x					
	B-1		x	x	x	Changes in policies, laws, taxes and regulations put development/economy in jeopardy		x						
	B-2	x	x	x		Lack of financing for the next phases		x						
	B-3	x	x	x		Low social acceptance put barrier to development		x						
	B-4		x	x		Public opposition against nuisances from the exploitation		x						
	B-6	x	x	x		Lack or loss of clients		x						
	B-8	x	x	x		Significant changes of energy costs		x						
	C-1		x	x	x	Low financing for work leading to low safety standards			x					
	B-5		x	x		Unanticipated delays and costs in operations (materials, services, maintenance)		x						
	C-2		x			Suboptimal design of well leads to reduced flow rate		x						
	C-3	x	x	x	x	Best practices not applied (data acquisition, modelling, decision making, design of wells / plants, construction)		x	x					
	C-4		x			Unsuitable contracts (roles and responsibility not clearly defined) leading to suboptimal performance or exploding costs		x	x					
	C-8		x	x		Organization is not experienced / financially robust enough for the challenge		x						
	B-9	x	x	x		The research or exploitation permit is changed in favor of another resource		x						
	C-9	x		x		Demand analysis and forecast are inaccurate		x						
Operation and Geology	D-1		x			Flow rate lower than expected (reservoir)		x						
	D-2			x		Flow rate degrades over time		x						
	D-3		x			Temperature lower than expected (reservoir)		x						
	D-4			x		Temperature degrades too quickly		x						
	D-5		x			Pressure lower/higher than expected		x						
	D-6			x		Pressure is changing during the operation in an unexpected way		x						
	B-7		x	x	x	Neighbouring operators cause negative changes to the reservoir parameters.		x						
	D-7		x	x	x	Fluid chemistry/ gas content / physical properties are different from expected		x	x					
	F-6			x		NCG Production		x						
	C-5		x	x		Human error leading to failure during work (including either insufficient background and/or regulations)		x						
	D-8			x		Fluid chemistry/ gas content / physical properties change		x	x					
	D-9		x			Target formation is missing in the well (unexpected geology, insufficient exploration)		x						
	D-10		x			Target formation has no/insufficient fluid for commercial production		x						
	D-11		x			Geological lithology or stratigraphy is different than expected		x						
	D-12		x	x	x	Excessive scaling in the geothermal loop		x						
	D-13		x	x	x	Excessive corrosion in the geothermal loop		x						
	D-14			x		Particle production ("sanding")		x						
	D-15			x		Hydraulic connectivity between wells is insufficient for commercial use		x						
	D-16		x	x		Re-injection of the fluid is more difficult than expected		x						
	D-17			x		Degradation of the reservoir (structure, properties, deteriorating whole-scale further commercial utilization)		x						
	F-8		x	x	x	Loss of integrity of surface equipments (leakage from the tanks, pipeline, heat-exchanger, etc.)		x	x					
Drilling	E-1		x			Fluid losses leading to severe technical issues		x	x					
	C-7		x			Damage to the well/reservoir while drilling or testing		x	x					
	E-2		x			Wellbore instability		x						
	E-3		x			Trajectory issues (deviation from target)		x						
	F-8		x			Loss of integrity of surface equipments (leakage from the mud mud pit; well head and etc.)		x	x					
	F-7		x	x		Loss of integrity of the wellbore (connection of well fluid with surface; inter layer fluid connection; etc.)		x						
	C-6		x			Wrong choice of stimulation fluids or techniques damaging the reservoir/well		x						
	E-7		x	x		Issues in transporting/handling radioactive sources for logging		x	x					
	E-8			x		Technical failure of the equipment		x						
	E-9		x			Well casing collapse		x						
	F-1		x	x	x	Blowouts		x	x					
	F-2		x	x	x	Fluid communication between different formations due to ineffective isolation of the well		x	x					
	F-3		x	x		Induced seismicity (above sensitivity level)		x	x					
	F-4		x	x	x	Surface subsidence or uplift		x	x					
	F-5		x	x		Toxic emissions due to gases and fluids produced in-situ		x	x					
	G-5		x	x	x	Human error leading to failure during work (including either insufficient background and/or safety regulations)		x	x					
	E-5		x	x	x	Technical failure/difficulties during drilling (due to any additional causes that were not mentioned)		x						
Additional Notes*														

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Survey Results

- France – 4 responses
  Dogger Basin
- Germany – 4 responses
  Molasse Basin
  Upper Rhine Valley
- Greece – 7 responses
  Shallow geothermal resources of Macedonia and Thrace
  Deep Sedimentary Reservoirs
  Aegean Volcanic Arc
- Hungary – 18 responses
  Middle depth Pannonian Basin
  Deep Panonian Basin
- Poland – 10 responses
  European Intracratonic Basin and North German Basin
- Turkey – 6 respondents
  Reservoirs in Wester Turkey
- Switzerland – 4 respondents
  Reservoirs in Eastern Switzerland

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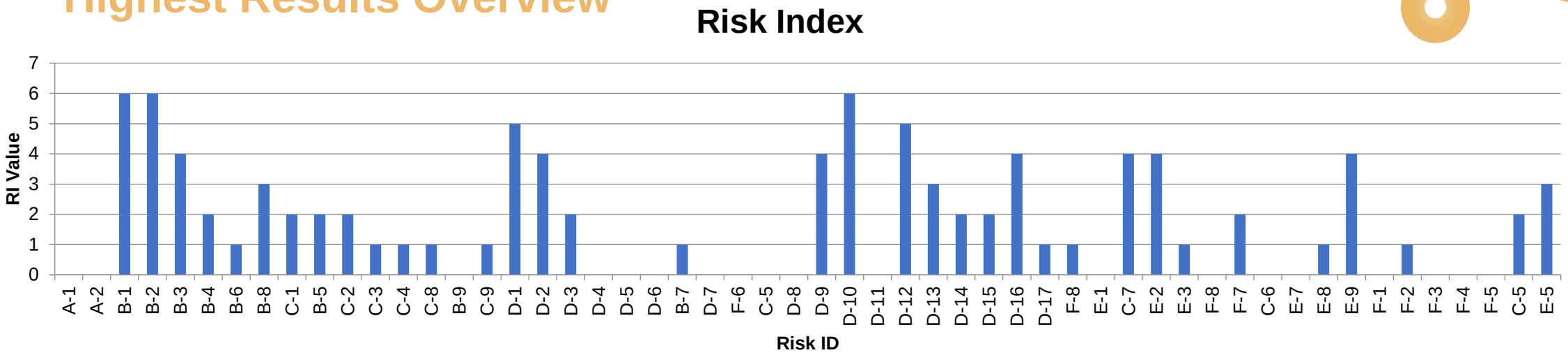
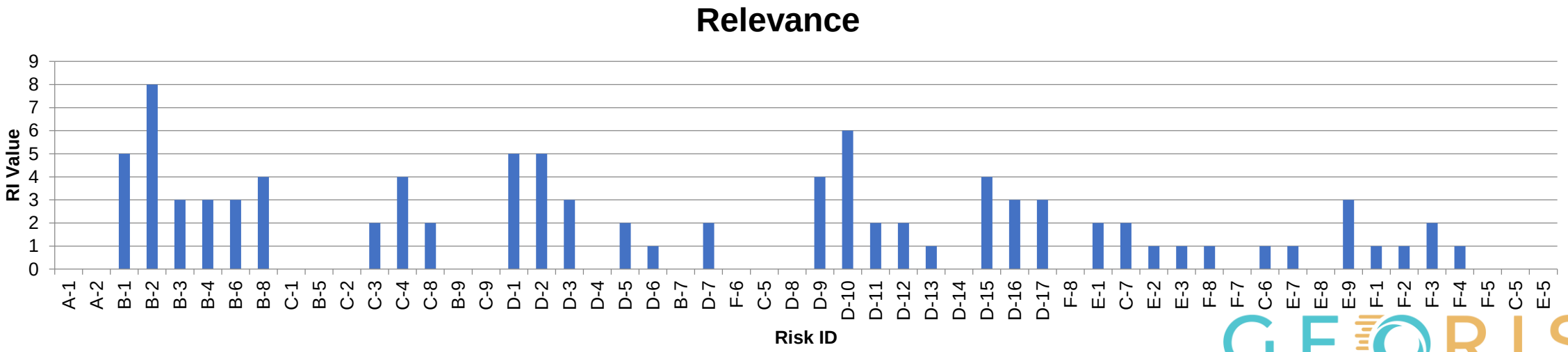
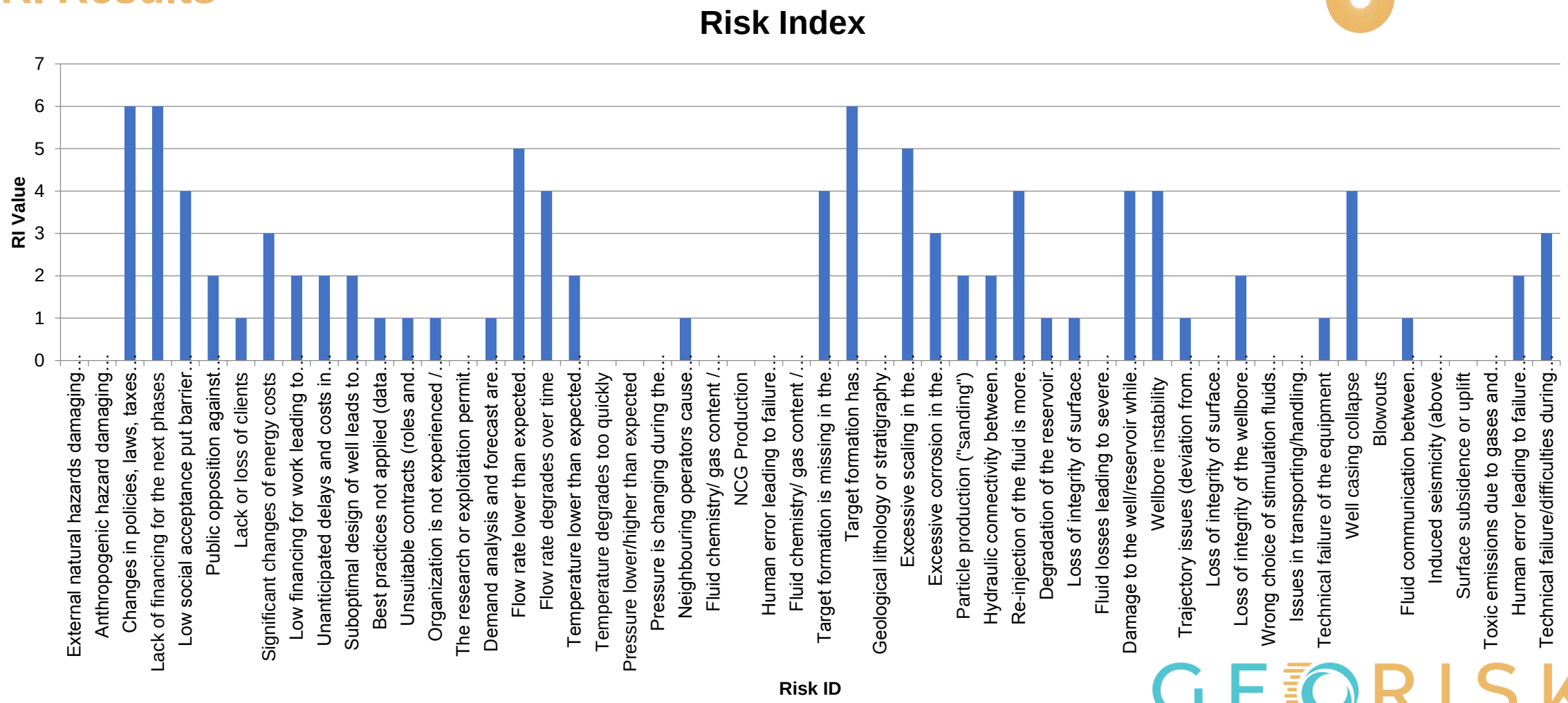
Highest Results Overview





RI Results


Risk Index
RI Value
0
1
2
3
4
5
6
7
External natural hazards damaging...
Anthropogenic hazard damaging...
Changes in policies, laws, taxes...
Lack of financing for the next phases
Low social acceptance put barrier...
Public opposition against...
Lack or loss of clients
Significant changes of energy costs
Low financing for work leading to...
Unanticipated delays and costs in...
Suboptimal design of well leads to...
Best practices not applied (data...
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Organization is not experienced /...
The research or exploitation permit...
Demand analysis and forecast are...
Flow rate lower than expected...
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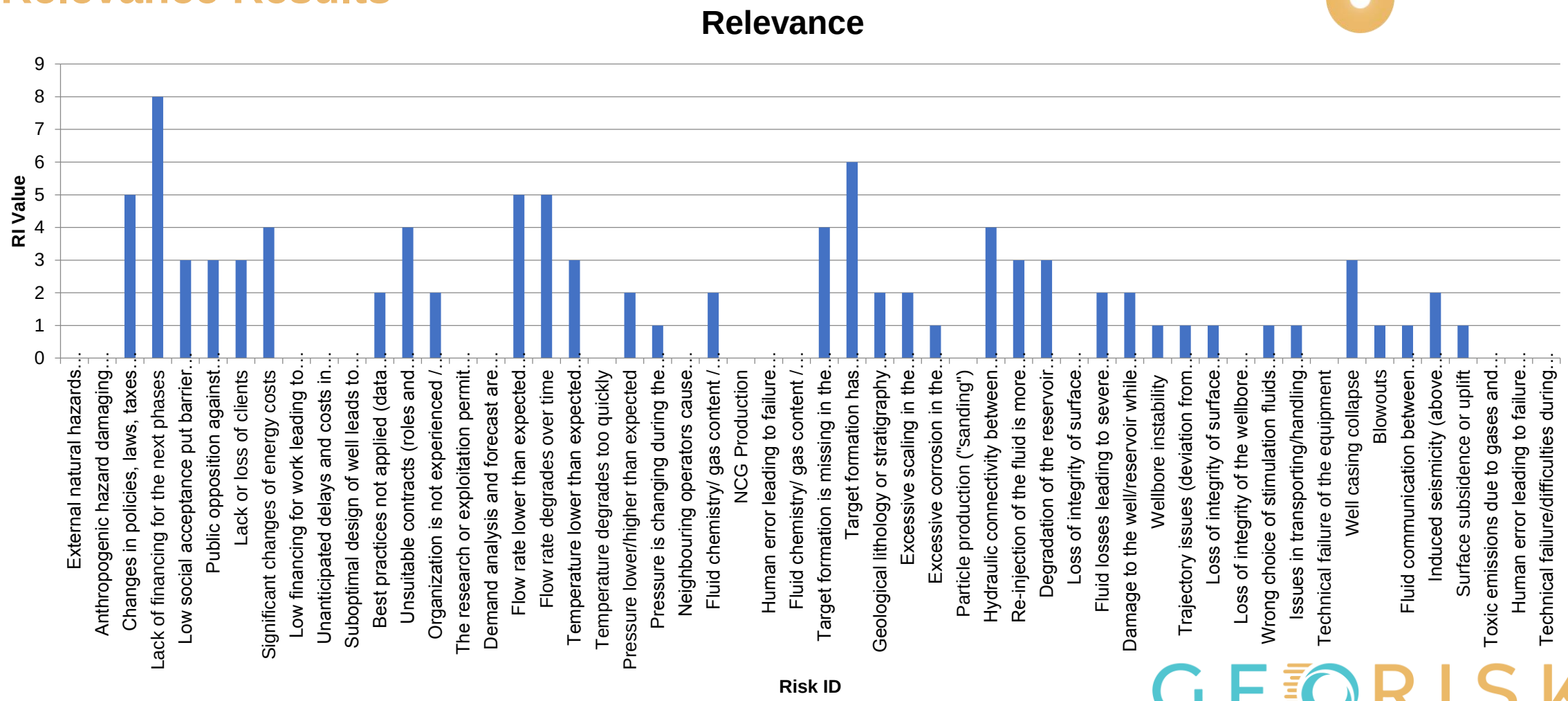
Temperature lower than expected...
Temperature degrades too quickly
Pressure lower/higher than expected
Pressure is changing during the...
Neighbouring operators cause...
Fluid chemistry/ gas content /...
NCG Production
Human error leading to failure...
Fluid chemistry/ gas content /...
Target formation is missing in the...
Target formation has...
Geological lithology or stratigraphy...
Excessive scaling in the...
Excessive corrosion in the...
Particle production ("sanding")
Hydraulic connectivity between...
Re-injection of the fluid is more...
Degradation of the reservoir...
Loss of integrity of surface...
Fluid losses leading to severe...
Damage to the well/reservoir while...
Wellbore instability
Trajectory issues (deviation from...
Loss of integrity of surface...
Loss of integrity of the wellbore...
Wrong choice of stimulation fluids...
Issues in transporting/handling...
Technical failure of the equipment
Well casing collapse
Blowouts
Fluid communication between...
Induced seismicity (above...
Surface subsidence or uplift
Toxic emissions due to gases and...
Human error leading to failure...
Technical failure/difficulties during...
Risk ID

Relevance Results



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