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Risk assessment and governance for electricity transmission networks

Expert Workshop

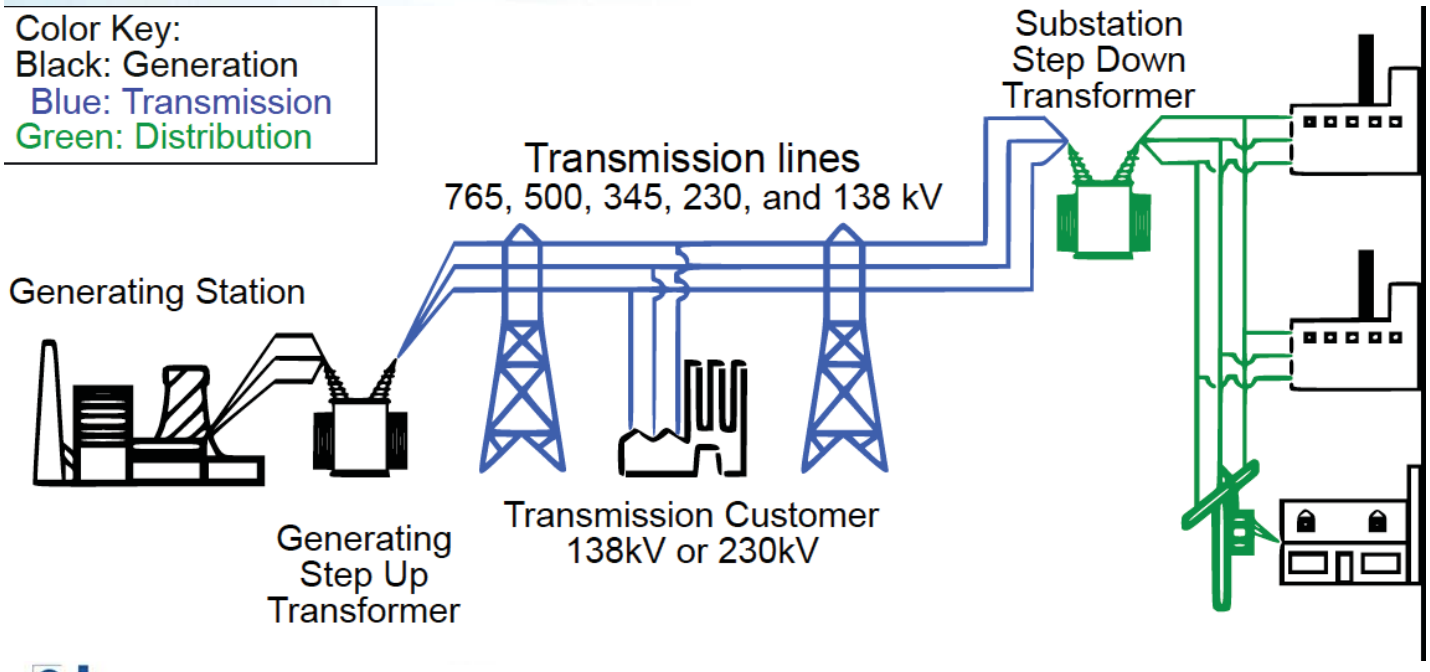
"Sharing Best Practices to Protect Electricity Networks from National Disasters"

Vienna, 2 July, 2014

IIASA, International Institute for Applied Systems Analysis

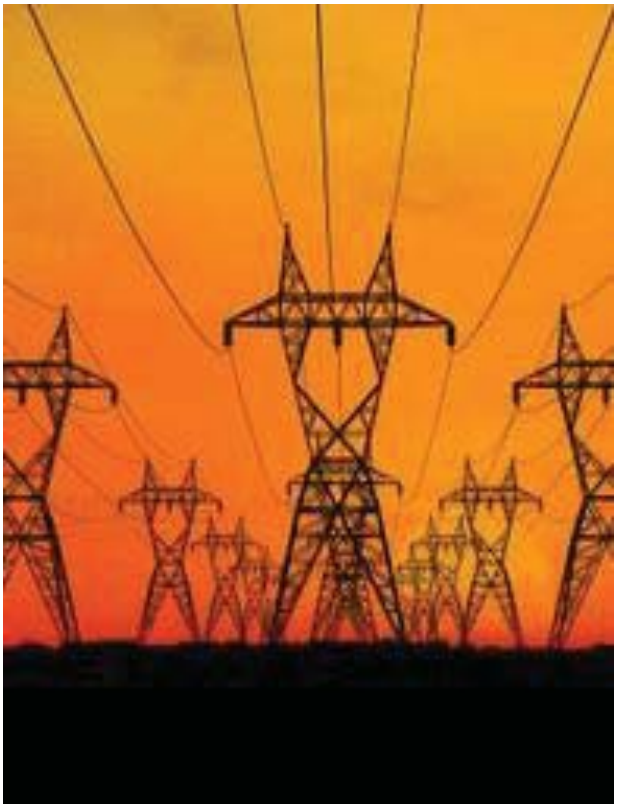
Complexity of the issue and requirements of new risk governance

- Current situation in transmission networks
- New requirements on grid architecture
- Climate change impacts and natural hazards



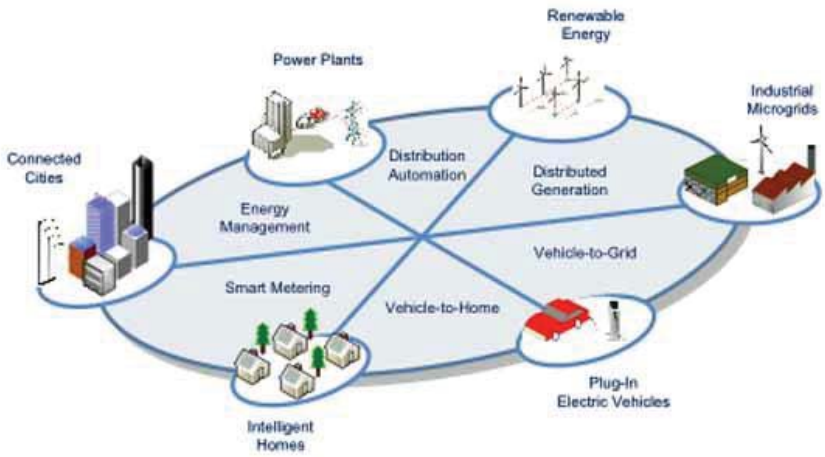
Current situation in transmission networks in Europe

- Majority of grids is 30-40 years old (Ecofys, 2008)
- Cross-border interconnectors (Battaglini, 2009)
- In some countries no single line at voltages higher than 200 kV was constructed during the last 10 years (ETSO, 2006)
- Distribution lines



New requirements on grid architecture

- Designed 50 years ago to satisfy needs with generating plants located near load areas
- Diversification of electricity supply located in different areas



Smart Grid building blocks

Grids at the border of their capacity to integrate growing volumes of renewable energy electricity (EWEA, 2005)

Several new km need to be constructed to secure market integration, security of supply and accommodate renewable energy expansion (ENTSO-E, 2010)

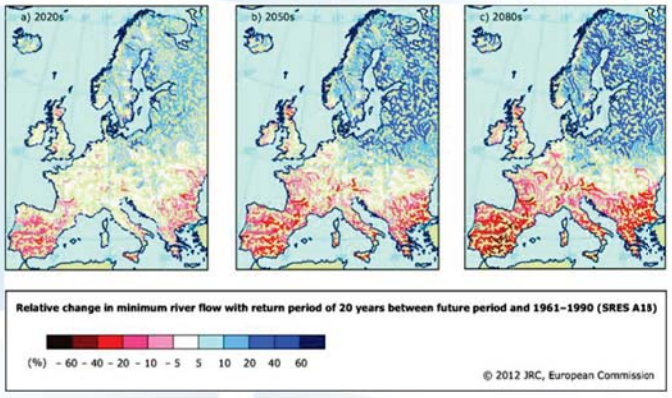
Natural hazards affecting electricity networks

Wind storms, ice storms, earthquakes, tsunami and floods

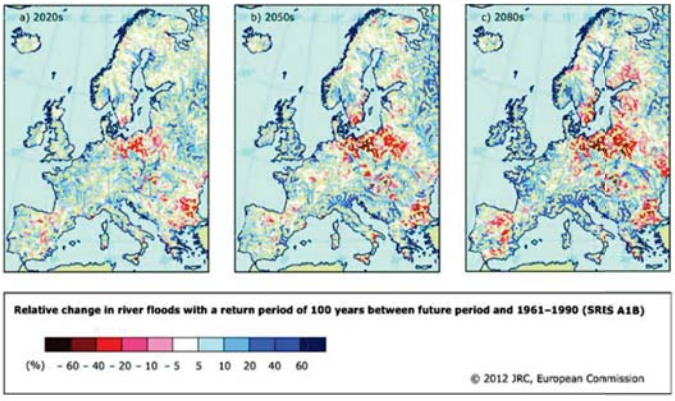
Location	Millions of people affected	Date
India	670	30-31 July 2012
Indonesia	100	18 Aug. 2005
Brazil	97	11 Mar. 1999
Brazil, Paraguay	87	10-11 Nov. 2009
United States, Canada	55	14-15 Aug. 2003
Italy, Switzerland, Austria, Slovenia, Croatia	55	28 Sep. 2003
United States, Canada	30	9 Nov. 1965

Projected climate change impacts

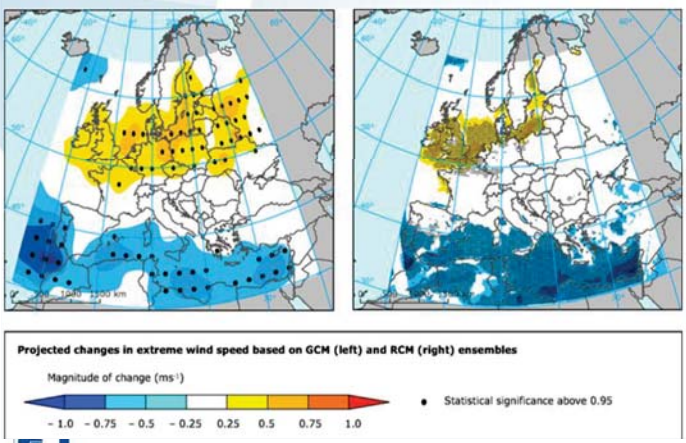
Projected change in minimum river flow with return period of 20 years



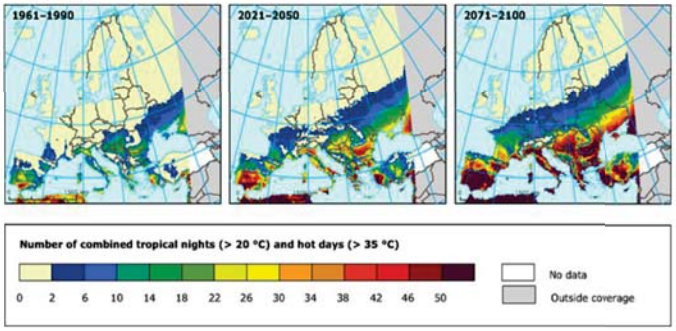
Projected change in river floods with a return period of 100 years



Projected changes in extreme wind speed based on GCM and RCM ensembles

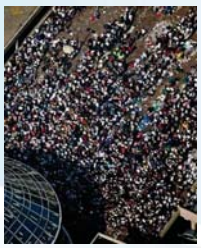


Projections of extreme temperatures as represented by the combined number of hot summer (June-August) days (TMAX>35°C) and tropical nights (TMIN>20°C



Source: EEA, 2012; EC, 2012

Natural risks and disasters are becoming an interactive mix of natural, technological and social events (e.g. Katrina, Fukushima Di-Chi nuclear accident, Deepwater Horizon Oil spill, etc.)



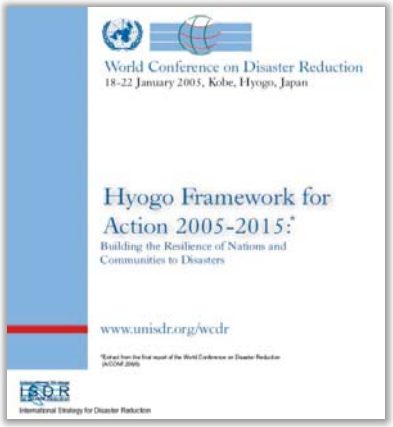
Separate natural hazards, however, are usually treated separately by scientists, engineers, disaster response managers and local authorities.

This leads to the spatial, temporal and causal relationships (such as cascading effects) that often exist between these hazards to be neglected. The same is true for the consequences of these interactions.

These relationships and unforseen negative effects may amplify the risk to a infrastructure and community

In risk assessment research and policy: There is currently much debate on multi type hazard and risk assessment

"Research methods and tools for multi-risk assessments should be developed and strengthened"
(priority 3, indicator 3.3; UN/ISDR 2005)



"The Council of EU underlines the usefulness of a multi-hazard approach to a Community disaster prevention framework"
(Council Conclusions on a Community framework on disaster prevention within the EU, 2009)

Protecting electricity networks

requires not only technical and economic capabilities

But

also understanding of governance of the complex process, including decision-making, institutional structure, acceptance and risks perceptions of different stakeholders

1. Why do we need new governance approach? Because there are several barriers for adapting grids to new requirements and to climate change

Barriers		Policy recommendations	
49%	Lack of comprehensive and stable regulations	26%	Common European approach for regulations
40%	Regulations do not reflect current situation in Europe	21%	Improvement of permission procedures
21%	Grid planning is driven by national interests, coordination at EU level is weak	13%	New approach for ownership and management of grids
17%	Lengthy and complex permitting	10%	Improvement of regulations for new technologies
		9%	Involvement of additional stakeholders

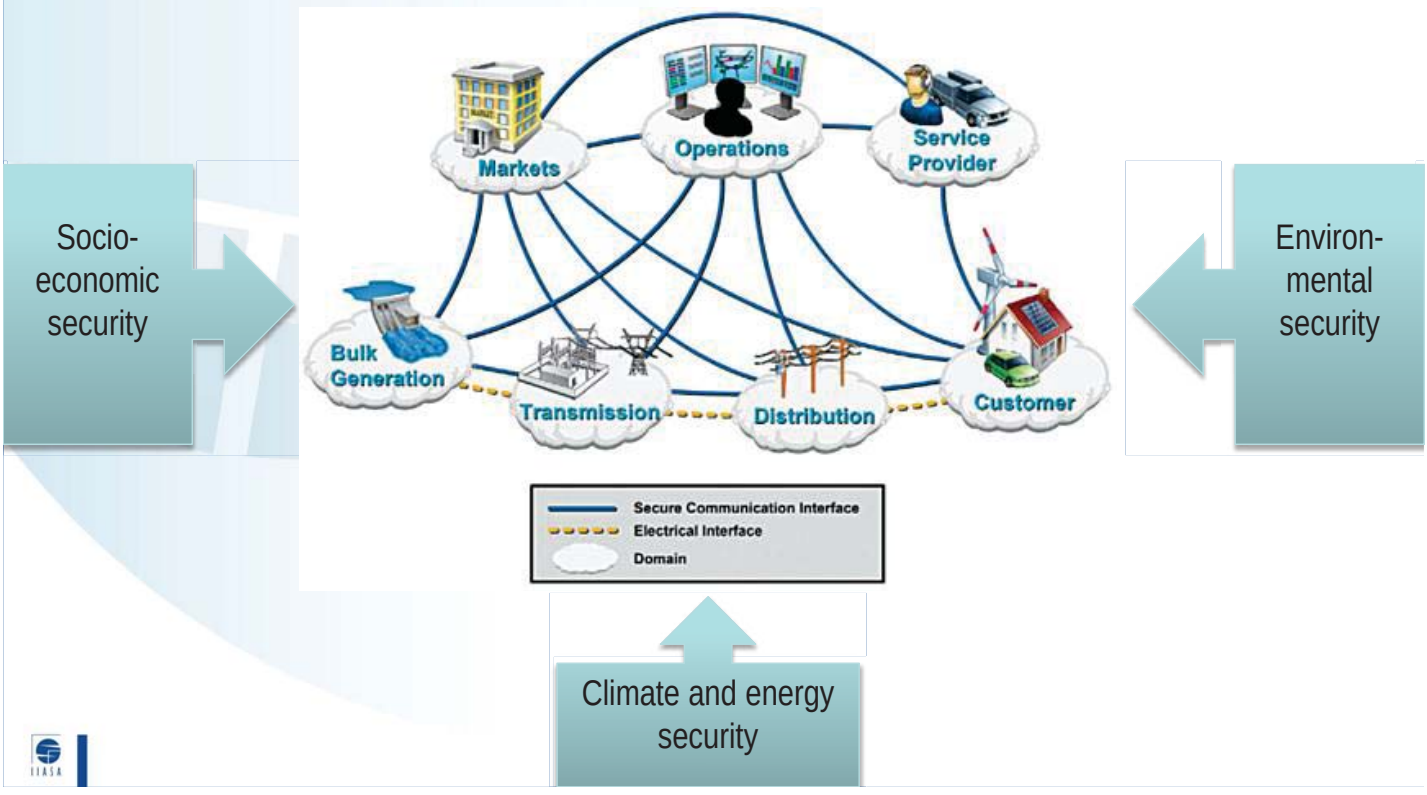
Survey among transmission systems operators (TSOs) in 2012, Germany (66%), other EU countries (17%), non-EU countries (16%)

Source: Battaglini, Komendantova, Brtnik, Patt, 2012

Risk governance and regulatory framework across EU

- Legal procedures for 110-400 kV overhead lines are comparable, but planning and implementation differ (ENTSO-E, 2010)
- Priority Interconnection Plan: lack of harmonization in planning and authorization procedures (EC, 2007)
- Absence of best practices (EWIS, 2007)
- Lack of transparency in grid connection projects and lack of coordination between authorities at national, regional and local levels (Ecofys, 2008)
- Absence of European long-term strategic grid planning (Greenpeace, 2008)

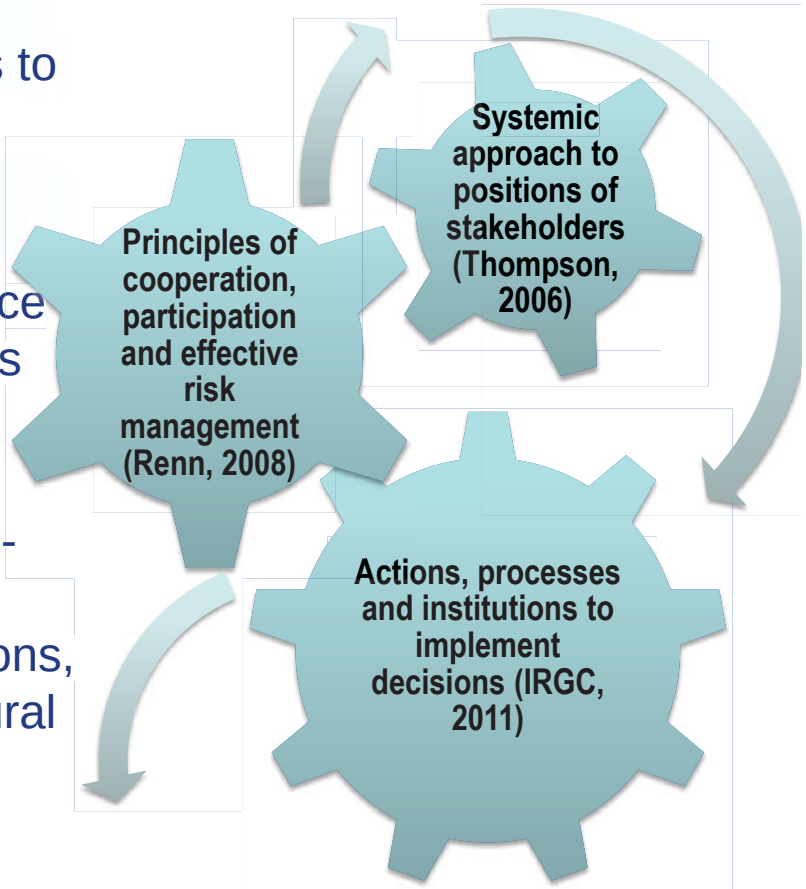
2. Why do we need new governance approach? To address different views on security and complexity of the changing grid architecture



Risk governance is more than communicating scientific results to stakeholders and analyzing how these results are perceived and implemented

But it is also

- working with stakeholders to co-generate actionable knowledge
- analysis of how governance structures shape decisions and outcomes
- understanding of decision-making processes, public acceptance, risk perceptions, cognitive biases and cultural perspectives



Risk governance framework was designed at national and sub-national levels – changes are needed to take into account views and expertise of stakeholders

Standardization initiatives, public authorities

Distribution and Transmission Systems Operators, vendors, manufacturers

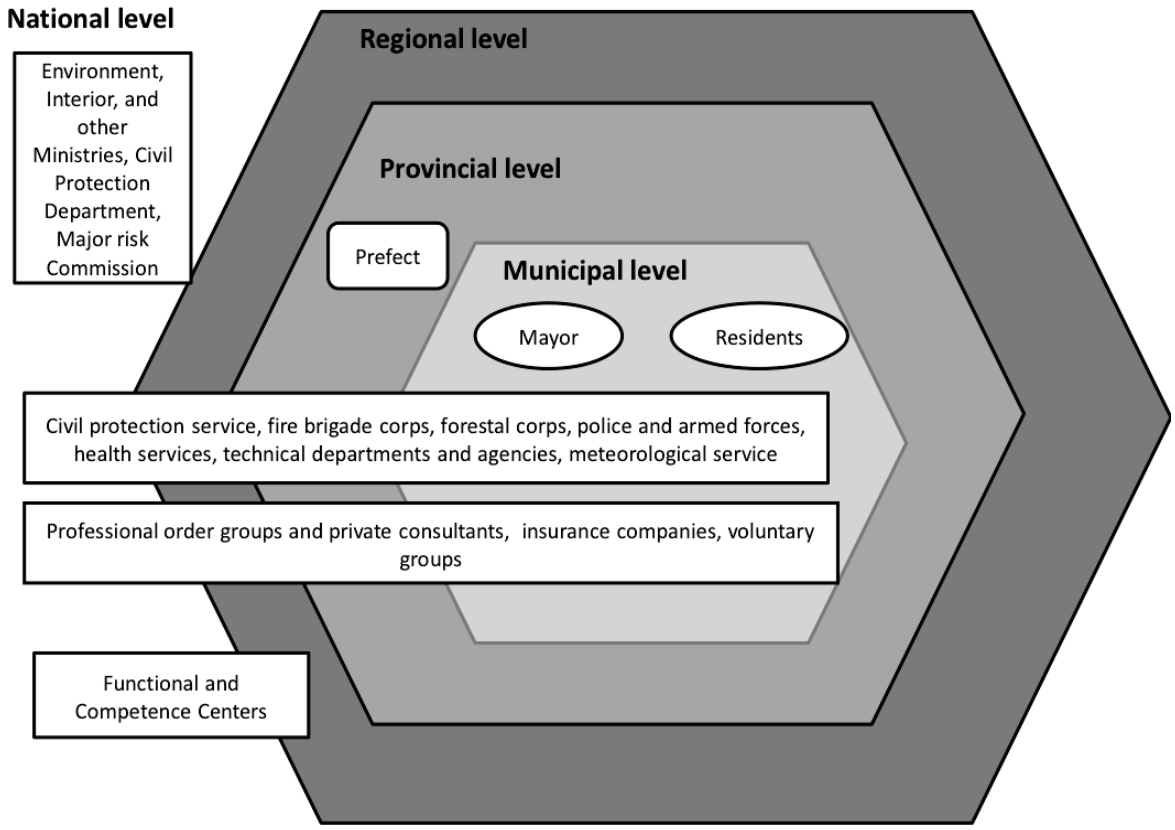
Governance of adaptation of electricity networks to climate change

Civil society

3. Why do we need new governance approach? To address multi-risk issues, including cascading effects

- Interactions between risks (Marzocchi, 2009)
- Considera-tion of multiple hazards in interdepen-dency (Selva, 2013)
- Growing knowledge about multi-risk assessment (White, 2001)
- Links between science and implementation (Kappes, 2012)
- Social dimensions of risk (Assmuth, 2010)
- Brings together knowledge, technology and actors (Fleisch-hauer, 2007)

Variety of stakeholders involved into risk assessment at different governance levels



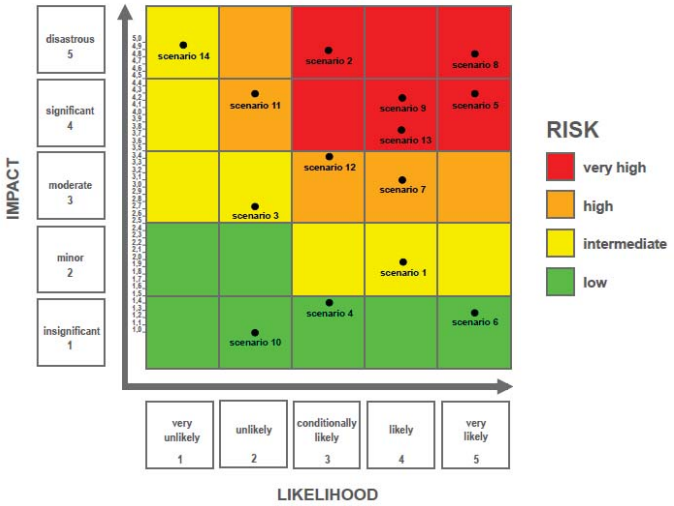
Source: Komendantova, Scolobig, Vinchon, 2013

Involving stakeholders judgments into risk assessment

- Risk Matrix presents a visual two-dimensional display of the "ranking" of the risk for a region:
  - Frequency and severity scale that is relevant to the region of interest.
  - The scale will help in interpreting historical experience and translating expert opinion in a consistent manner.
- It is a simple approach for setting priorities

Frequency Index	Exceeance Probability	Return Period
Very Unlikely	0,00001	100.000
Unlikely	0,0001	10.000
Rare	0,001	1.000
Likely	0,01	100
Very Likely	0,1	10

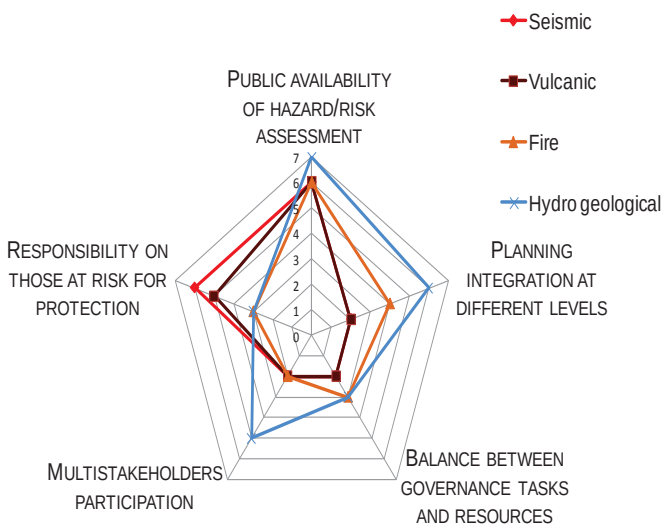
	Casualty		Damage	
	Percent	Rate	Percent	Rate
Catastrophic	0.001	100000	0.01	1/10000
Significant	0.01	10000	0.1	1/1000
Moderate	0.02	5000	0.5	1/200
Limited	0.1	1000	2	1/50
Minor	1	100	>20	>1/5



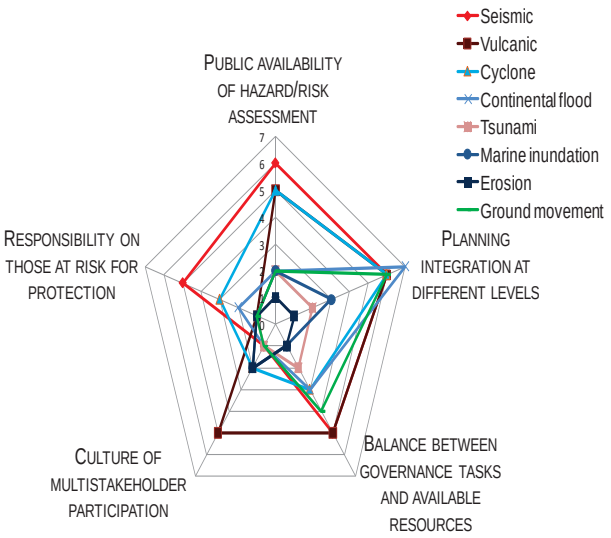
Source: BBK, 2010

Stakeholders' cooperation and communication: test sites

Naples



Guadeloupe



[Evaluation provided on 1-7 Likert scale: 1 minimum, 7 maximum]

To create an environment where these issues can be discussed at the local level

Territorial platforms for data and knowledge exchange for researchers and practitioners

"Technical capacity" may be well developed, main weakness is in institutional capacity (resources, planning integration)

Source: Scolobig, Komendantova et al., 2014

Risk, Policy and Vulnerability Program at IIASA

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