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oasis LOSS MODELLING FRAMEWORK

Decision Making under (Deep) Uncertainty:

Futures analysis for resilient strategies - Climate, Energy and Security Perspectives

Presentation to the Insurance Sector at The Oasis Loss Modelling Framework Conference: The Good, the Bad and the Ugly - Complex Systems, Modelling, Decision Making Under Uncertainty Session dated 2nd July 2020

Mark Workman

Energy Futures Lab, Imperial College London

Foresight Transitions Ltd

Analysis Under Uncertainty for Decision Makers Network

FORESIGHT TRANSITIONS

AU4DM Network

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Key Messages

- There is a need to improve the quality of decision making around high impact low probability events (HILP) and under risk and uncertainty.

- Decision support tools are an integral but discrete component of decision-making. There is a need to consider decision making holistically - from an end-to-end perspective.

- The ability to develop the wholesale change needed to improve the quality of decision making under uncertainty is a leadership, cultural and ongoing competency development challenge.

This is an enormous topic: multi-disciplinary in nature, covering a range domains and challenging conventional axioms. What is presented is scratching the surface!

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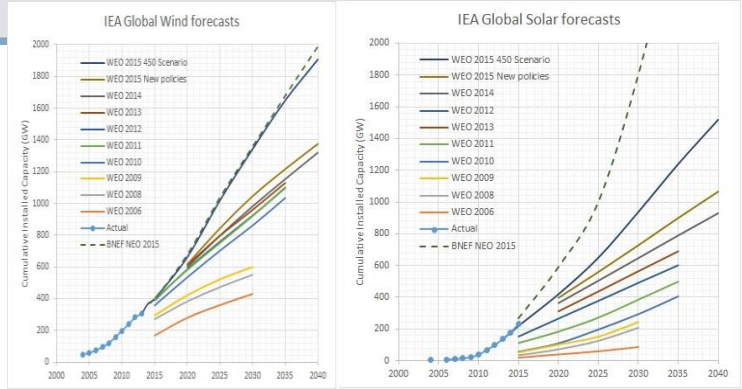
We need to get better

e.g. across a range of domains, sectors, issues and circumstances

WMD in Iraq, 2003

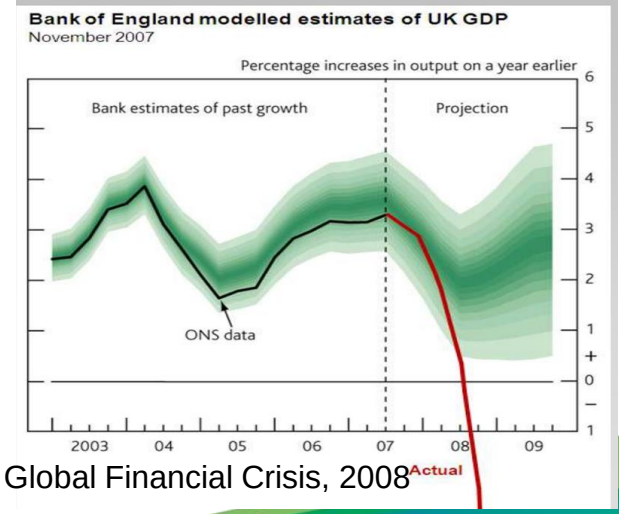
http://cte.jhu.edu/techacademy/fellows/
The Challenger Disaster, 1987

http://www.agdepartment.com
Foot and Mouth Disease, 2001



IEA PV and Wind forecasts 2006 to 2015

Can compare with what happened



Global Financial Crisis, 2008

Corporate Bankruptcies, 2001

http://www.theage.com.au/world/
Italian Earthquake, 2009

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We need to get better

across a range of areas e.g. Intelligence and Finance

- The justification for invading Iraq in 2003 was based on the intelligence community assessment that it possessed Weapons of Mass Destruction (WMD).
  - US Intelligence Community has an annual budget of ~$50 B and employs 20,000 analysts. In 2002, this community concluded White House's assertion that Iraq had WMD were correct

- Global financial crisis of 2008 resulted in the biggest bankruptcies in history, left over 30M people unemployed globally, cost Global GDP US$20 Trillion and brought nation states to the brink of insolvency.
  - In a November 2007 survey of Professional Forecasters - examining 45,000 economic data series foresaw <1 in 500 chance of an economic meltdown as taking place in September 2008

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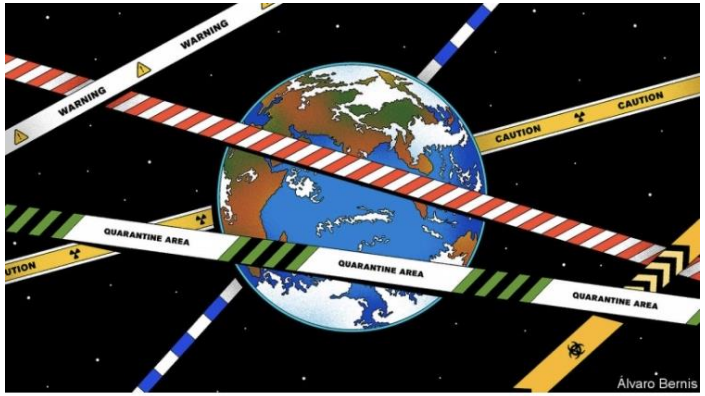
We need to get better

We have the tools we don't use the right ones or use them very well e.g. C-19 pandemic 2020 - ..?



Catastrophic risks

What's the worst that could happen?

The covid-19 pandemic has found the world unprepared for unlikely-but-dangerous events. This need not be the case

Briefing | Jun 25th 2020

National Risk Register, 2017

Overall relative impact score	Between 1 in 20,000 and 1 in 2,000	Between 1 in 2,000 and 1 in 200	Between 1 in 200 and 1 in 20	Between 1 in 20 and 1 in 2	Greater than 1 in 2
5				Pandemic influenza	
4			Coastal flooding Widespread electricity failure		
3		**Major transport accidents** **Major industrial accidents**	Effusive volcanic eruptions Emerging infectious diseases Inland flooding	Severe space weather Low temperatures & heavy snow Heatwaves Poor air quality events	
2		Public disorder Severe wildfires	Animal diseases Drought	Explosive volcanic eruption Storms & gales	
1			**Disruptive industrial action**		

Relative likelihood of occurring in the next 5 years

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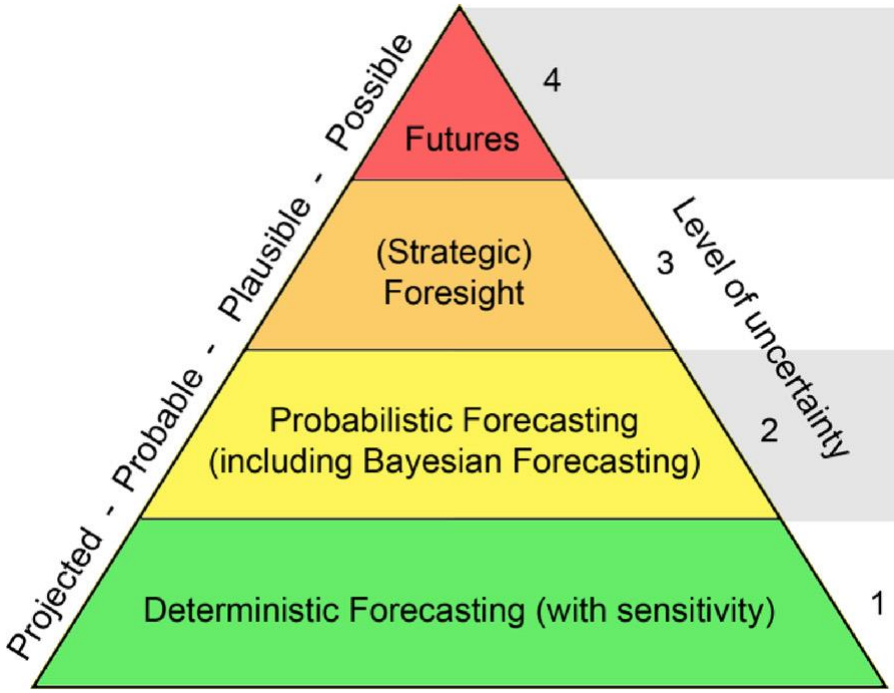
Decision Making - Holistic and End to End perspective

Understand Uncertainty - then match our tools to the relevant levels of uncertainty about the future

Uncertainties are Pervasive

- Stochastic uncertainties
- Epistemological uncertainties
- Ontological uncertainty
- Computational uncertainties
- Judgemental uncertainties.
- Modelling errors
- Social and ethical uncertainties
- Endpoint uncertainties Ambiguities.
- Implicit value judgements and/or preferences.
- Implementation uncertainty
- Ethical uncertainties



Non-fiction, visualisations of all kinds of possible futures, including those with dire consequences and surprises.

Coherent view of plausible futures without need to be explicit on the likelihood of these futures.

Probabilistic projections in which all uncertainties are presented and measured by probabilities.

Deterministic projection based on a combination of trend extrapolation and expert judgement.

Dorsser et al 2018

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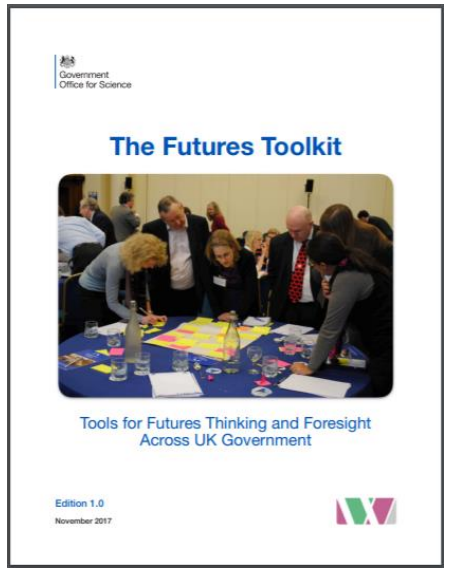
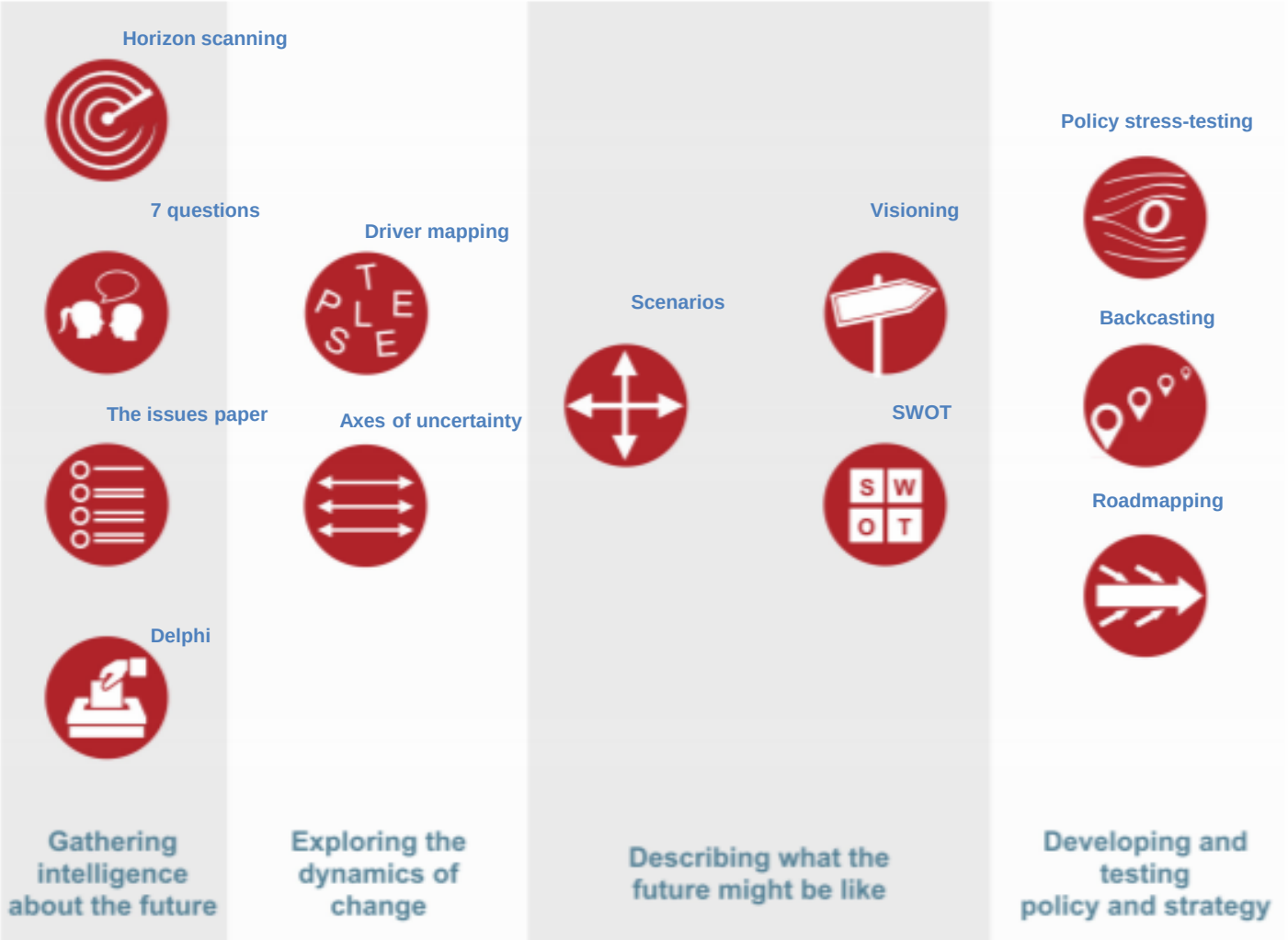
Decision Making - Holistic and End to End perspective

So how do we think more broadly about the future? Tools exist - just not employed appropriately





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Decision Making - Holistic and End to End perspective

Match decision support tools to the relevant levels of uncertainty - Consolidative to Exploratory Modelling

Level 1 to 3 Uncertainties *(as per Slide 6)* **- Complicated Systems:**

- Nested components
- Reductionist thinking is possible as the behaviour of each component is understandable independent of the whole.
- Allows predictions - effectively a core component of scientific method

Level 4 Uncertainties *(as per Slide 6)* **- Complex Systems:**

- Characterised by a large number of interacting components;
- Aggregated activity is nonlinear; and
- Tend to exhibit hierarchical self-organisation.

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Decision Making - Holistic and End to End perspective

Match decision support tools to the relevant levels of uncertainty - Consolidative to Exploratory Modelling

- **Consolidative Models** - gather all relevant knowledge into a single package which, once validated can be used as a surrogate for the real world: Used for prediction.
- **Exploratory Models** - Map assumptions onto consequences, without privileging any one set of assumptions. Supports iterative problem-solving.

Shift from a "Predict than act" logic to "Agree on Decisions"

- **"Predict than act":** What will the future be? **->** what is the best near-term decision? **->** How sensitive is the decision to the conditions?
- **"Agree on Decisions":** Propose strategy and decision context **->** Use analytics to stress test strategy **->** identify new and revised strategies that are more robust

RofASSS

Review of Artificial Societies and Social Simulation

CONTENT SUBMISSION QUES

CONTENT

DON'T TRY TO PREDICT COVID-19. IF YOU MUST, USE DEEP UNCERTAINTY METHODS

APRIL 17, 2020 THESUBMISSIONAUTHOR 1 COMMENT

By Patrick Steinmann[a], Jason R. Wang[b], George A. K. van Voorn[a], and Jan H. Kwakkel[b]

[a] Biometris, Wageningen University & Research, Wageningen, the Netherlands, [b] Delft University of Technology, Faculty of Technology, Policy & Management, Delft, the Netherlands

(A contribution to the: JASSS-Covid19-Thread)

Abstract

We respond to the recent JASSS article on COVID-19 and computational modelling. We disagree with the authors on one major point and note the lack of discussion of a second one. We believe that COVID-19 cannot be predicted numerically, and attempting to make decisions based on such predictions will cost human lives. Furthermore, we note that the original article only briefly comments on uncertainty. We urge those attempting to model COVID-19 for decision support to acknowledge the deep uncertainties surrounding

Decision Making - Holistic and End to End perspective

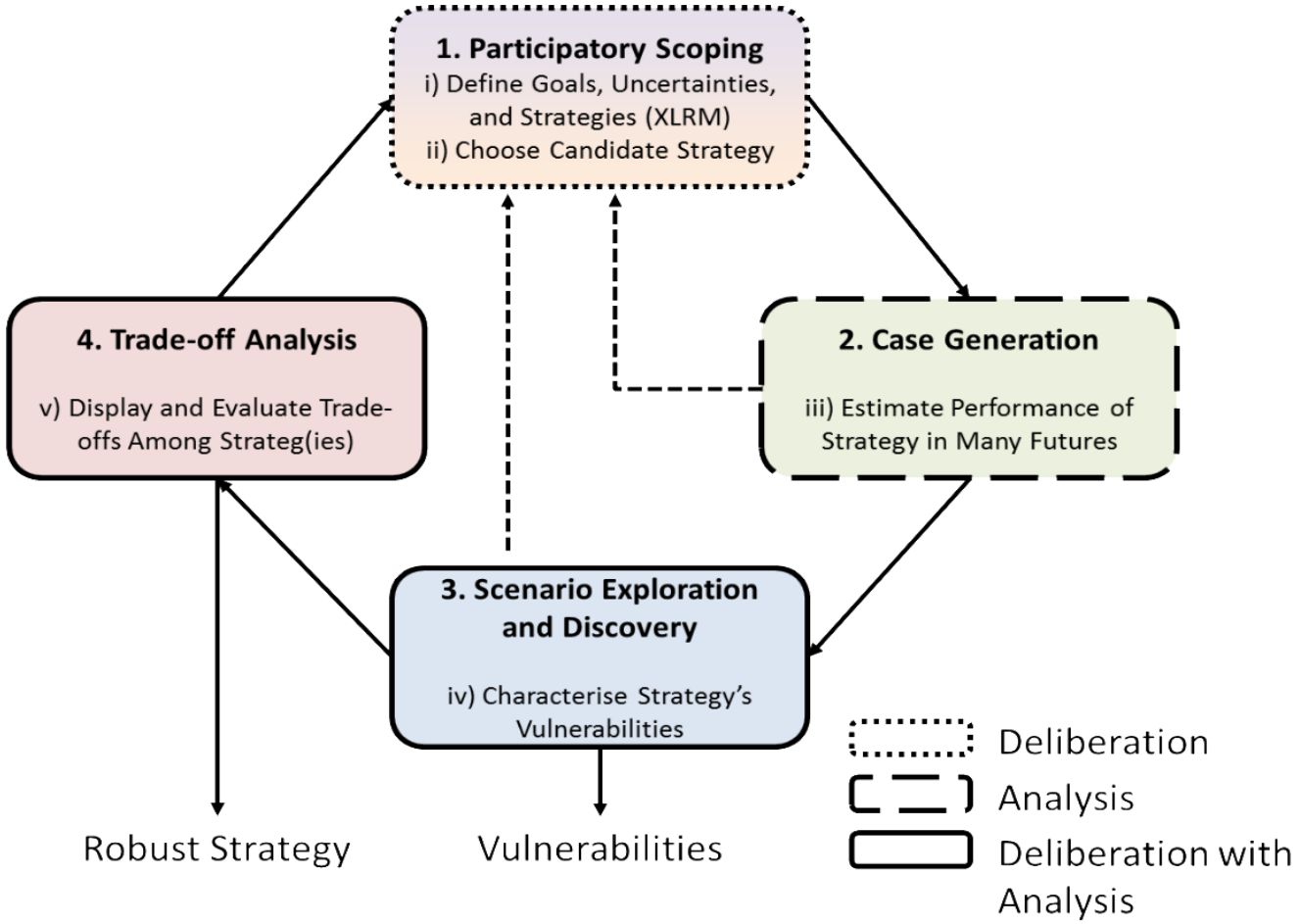
Match decision support tools to the relevant levels of uncertainty - Consolidative to Exploratory Modelling

Traditional tools designed for systems with:

- A single relevant decision-making actor
- Well-understood behavior
- Agreement on objectives among audience for the analysis

Today requires policy analytic methods and tools that embrace:

- A diversity of priorities, goals, and values among participants to the decision
- Irreducible uncertainty regarding the consequences of our actions
- A decentralized, poly-centric decision-making audience



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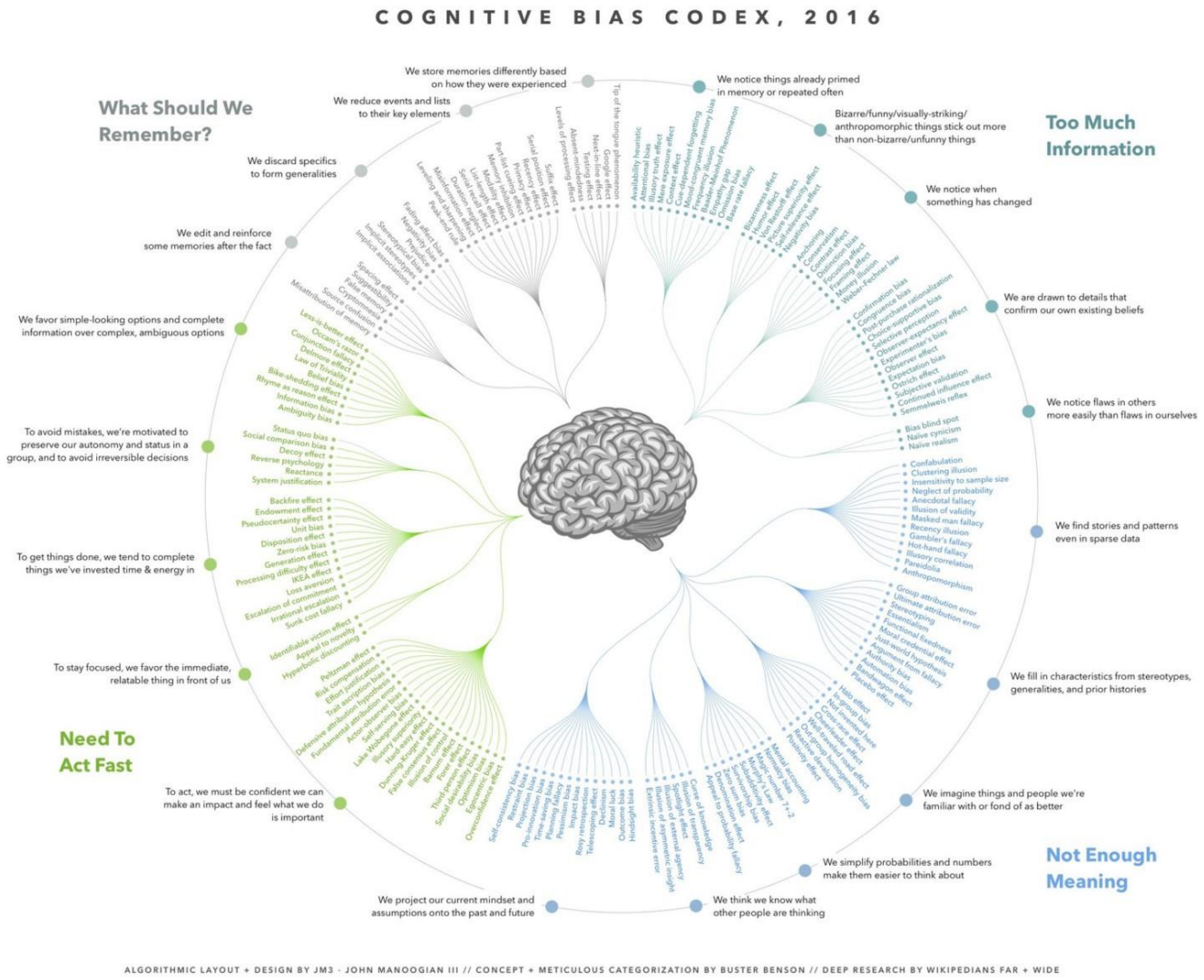
Decision Making - Holistic and End to End perspective

More than decision support tools expanding imagination is critical – this means being aware of biases



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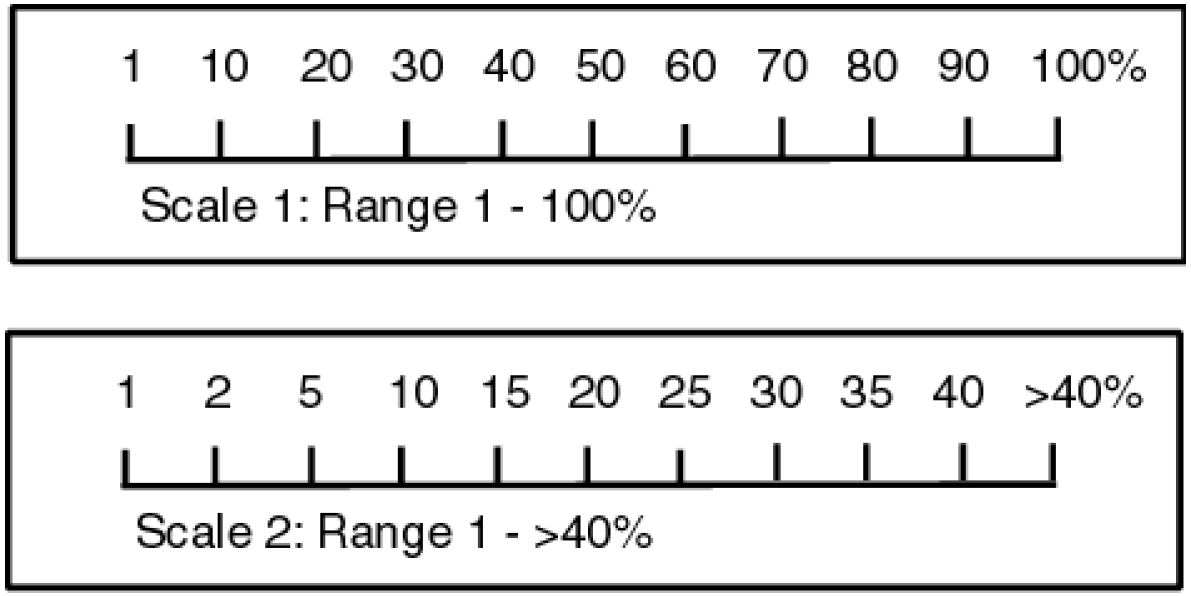
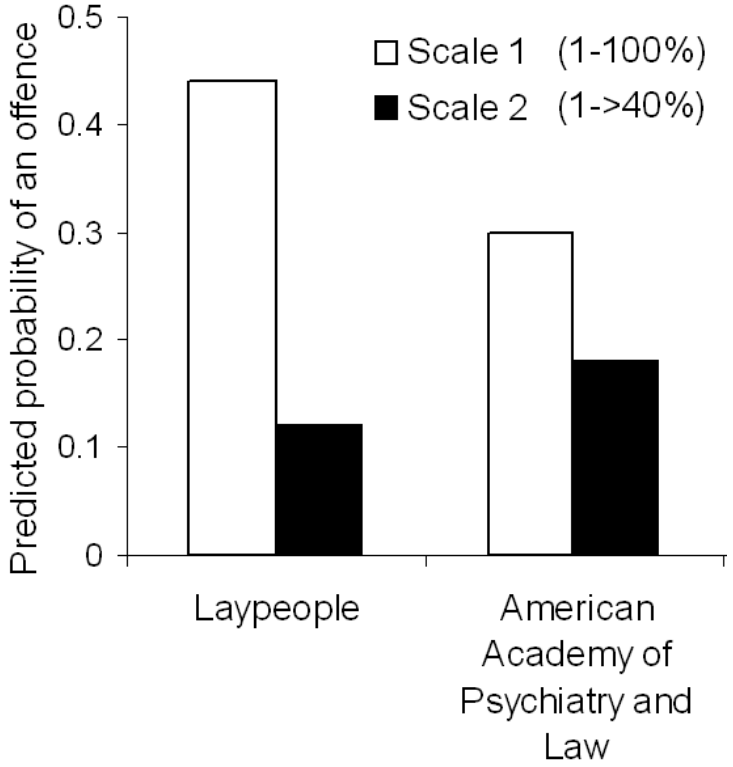
Decision Making - Holistic and End to End perspective

How a decision is framed can alter the decision that people make

How likely is it a violent criminal will re-offend?





Slovic et al (2000)

Decision Making - Holistic and End to End perspective

Statistical Heuristics impacts perceived risk e.g. Base Rate Neglect

- Assume you have been exposed to an illness. The probability that you have contracted the illness is 1/1,000. The medical test is 99% accurate.
- Unfortunately, you have tested positive.
- What is the probability that you have the illness?

- There is only a 9% chance that you have the illness given you have tested positive

	Positive	Negative	Total
Have Illness	0.99 ≈ 1	0.01 ≈ 0	1
Don't have Illness	9.99 ≈ 10	989.01 ≈ 989	999
Total	≈ 11	≈ 989	1000

11 people tested positive, but only 1 has the illness. So, the probability you have the illness given that you have tested positive is 1/11 or about 9%!

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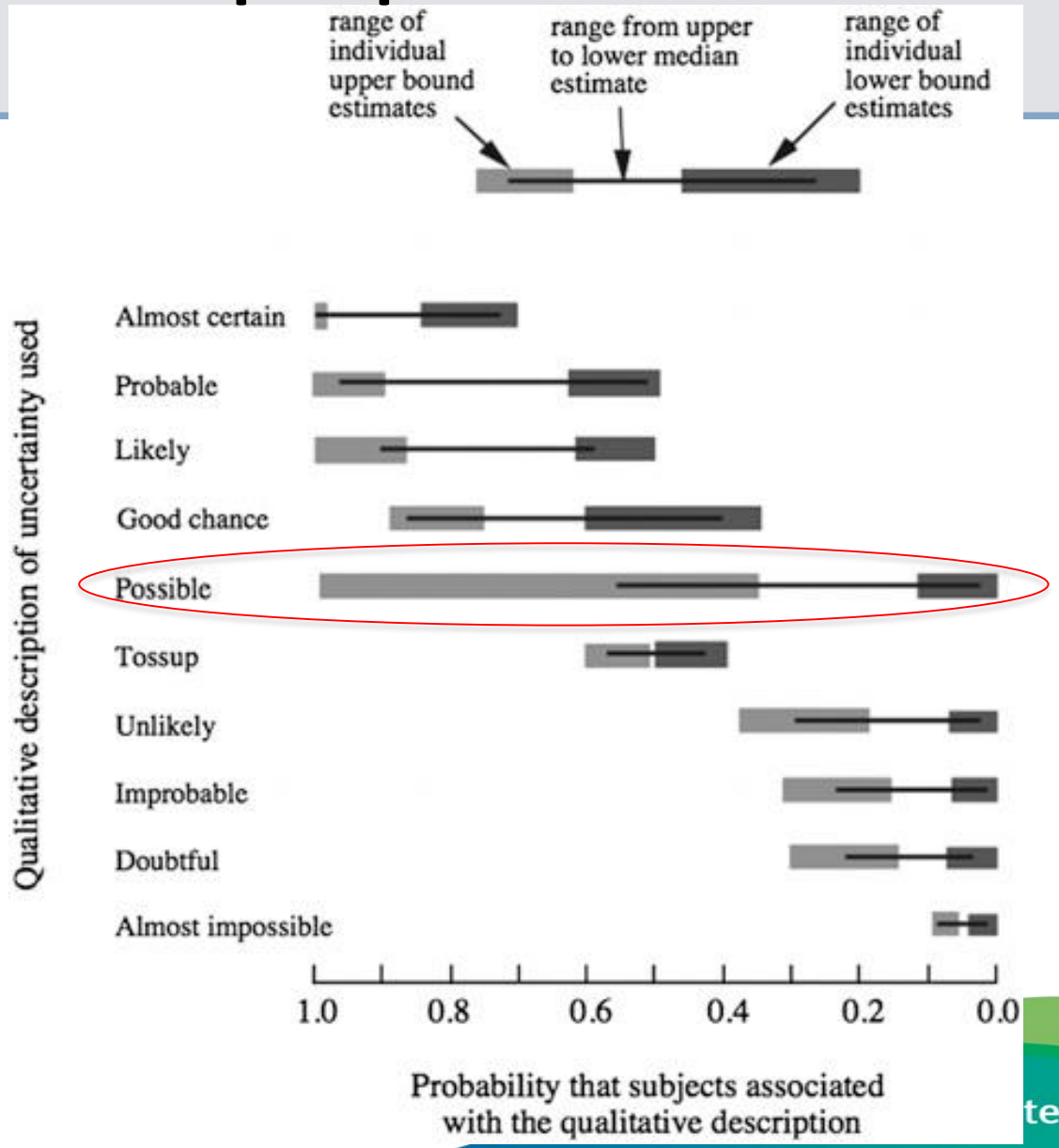
Decision Making - Holistic and End to End perspective

Vagaries of verbal descriptions

Verbal descriptions of uncertainty can mask important, often critical, differences between the views of different experts.

Members of the Executive Committee of the EPA Science Advisory Board were asked to assign numerical probabilities to uncertainty words that had been proposed for use with EPA cancer guidelines



Source: Morgan MG (1998) Uncertainty analysis in risk assessment. Hum Ecol Risk Assess 4(1):25–39.

Leadership, cultural and competency challenge

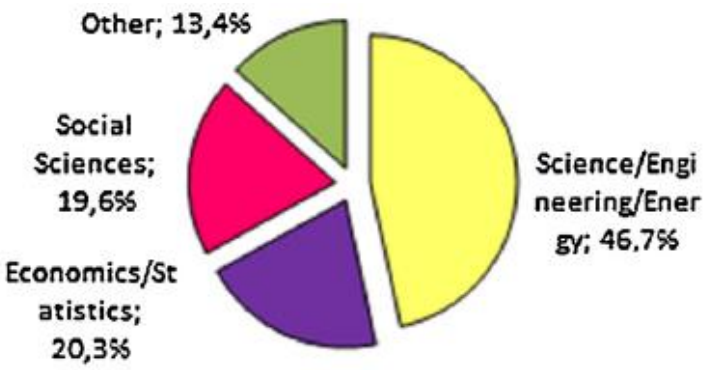
Need for more ex-post analysis in decision making under risk and uncertainty

"A professional cricketer runs up, bowls, and immediately turns back to his mark without looking to see whether his effort is on target. That is of no interest to him. Only rarely has he thought it might be good to see if he actually hits the wicket, and he has never considered statistically calculating the accuracy of his bowling and comparing it to the bowling of others. **Lacking good feedback, he never adjusts how he bowls. He just keeps doing the same thing over and over again, expecting things to work out fine.**

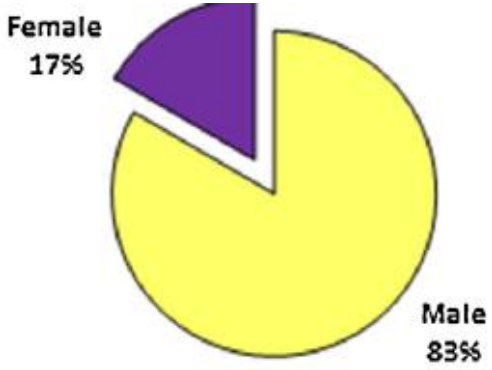
Of course this is silly. A cricketer who behaved this way would not be selected. And yet this is a workable analogy for what many forecasters, whose predictions shape all of our lives, actually do."

Leadership, cultural and competency challenge

Lack of diversity and disciplinary chauvinism

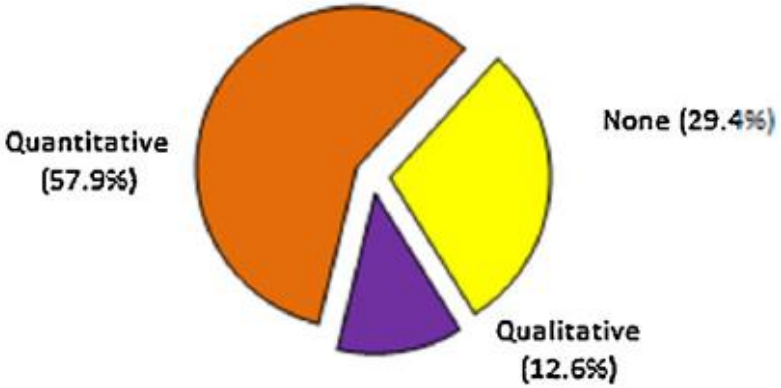


Author Disciplinary Training (n=9597)

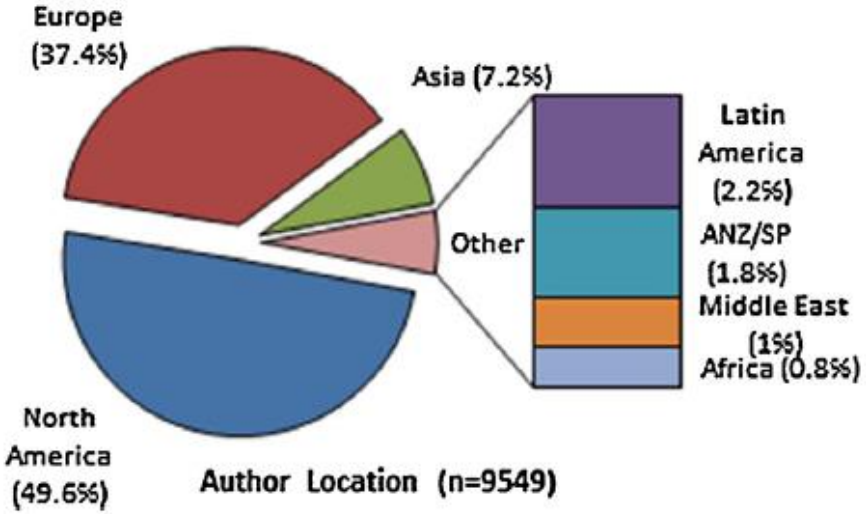


Author Gender (n=9549)

Disciplinary, gender, methodological, and geographic trends in energy studies research, 1999 – 2013 for Energy Sector.



Article Methods (n=5012)



Author Location (n=9549)

Source: Sovacool et al., 2015, Integrating social science in energy research. In Energy Research & Social Science 6 (2015) 95–99

Leadership, cultural and competency challenge

Research and Competency Development

- There is a substantive body of research on decision support tools - they are proliferating.
- There is a substantive body of research on decision science.
- Where there is a lack of research is the interface between the effectiveness of the decision support tools in realising high quality decision making along the decision value chain.

- *Therefore there is a* ***need for testing of different tools and techniques to get evidence of their effectiveness so as to put the best-proven techniques into practice.***

- Effectively the development of a *Decision Quotient Research Programme to develop a more holistic and competency based approach to decision making*