

Use of argumentation and crowdsourcing techniques for risk assessment and policy development

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Abstract. Risk permeates our lives, in personal decision-making and in public debate and the development of policies for risk management in economics, environment, healthcare, international relations, and countless other domains. This paper presents the idea of using crowdsourcing techniques to support argumentation in public discussions of risk, which has been the topic of a workshop funded by the PURE network for research on environmental risk management.

Public Discussions About Risk

Public discussions of risks are grounded in subjective experiences and beliefs. Researchers have for many years sought an objective interpretation of risk, mostly grounded in scientific theories and mathematical concepts like probability, utility and preference. These struggle to accommodate the complexity of subjective experience.

Cognitive scientists have shown that people are subject to misunderstandings and biases in coping with risk and uncertainty (e.g. refs: Slovik, Fischhoff, Kahneman) to an extent that is sometimes equated with irrationality. Social scientists have shown that the perception and understanding of risk are also influenced by individual personality factors and political positions and attitudes (e.g. Adams, Stirling).

Fox and colleagues¹ developed an approach to decision-making and reasoning under uncertainty from the viewpoint that argumentation is a familiar way of resolving issues and is also a versatile and effective foundation for decision-making under uncertainty (e.g. Fox, Das, Krause) and also provides a secure logical framework for reasoning about risk in complex domains (e.g. Fox, Krause, Judson).

It is widely recognized that discussion of policy on risks, such as fracking and climate change, must engage with many stakeholders (individuals, informal communities, professional groups and commercial interests). This requires a way of combining the objective and subjective viewpoints that is sound and as safe as is practically possible.

The range of concerns is widely accepted, and acknowledged notably in several Royal Society reports, most recently a risk assessment workshop organised in 2005 at the request of Food Standards Agency. This concluded that “Whilst remaining conscious of the need for robust scientific evidence to underpin risk assessment, workshop participants considered the influence of social and institutional assumptions in assessing, managing and communicating risk, particularly in cases where a high degree of uncertainty exists.” The main conclusions from the workshop were:

- Stakeholders and the public (where appropriate) should be consulted on the framing of questions to be put to expert scientific advisory committees;
- A cyclical and iterative process to inform risk assessment, management and communication should be developed;
- Assumptions and uncertainty in risk assessment should be acknowledged;
- Public and stakeholder engagement should be broadened at the different stages of the process, particularly on issues of controversy or high uncertainty;
- It is important to be clear about your audiences and communicate the things that matter to them.

However, advice to government by professional bodies still appears to focus on scientific and technical assessments of risk, leaving influential channels of public debate for outsider interest groups, business lobbies, and of course the press. This lack of progress, we suggest, is in significant part due to the absence of sound and practical ways of engaging with diverse opinions and dissenting viewpoints, both within and beyond the scientific community.

Argumentation, Deliberation and Debate

Argumentation theory has emerged from several traditions (1) philosophical study of discourse and debate (e.g. the Amsterdam School, Walton schemes, eDemocracy) (2) efforts to develop tools to support analysis and critiquing of issues (e.g. http://en.wikipedia.org/wiki/Argument_map#Argument_mapping_software) (3) AI and computer science, particularly non-classical logic and multi-agent systems (influenced by dialectical

¹ Paul Krause, Simon Parsons, Subrata Das, Philip Judson, Morten Elvang-Goransson, David Glasspool and many others

argumentation in legal reasoning e.g. McBurney, Parsons), and (4) argumentation for decision-making under uncertainty focused on aggregating evidence to arrive at the “best” decision (e.g. informed by problems in evidence-based medicine e.g. Fox). All these traditions have led to considerable theoretical work and in many cases useful software for facilitating argumentation in practical applications.

Crowdsourcing Debates for Risk Assessment and Management

“Crowdsourcing is the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers”. (<http://en.wikipedia.org/wiki/Crowdsourcing>)

On behalf of the PURE network² funded by the Natural Environment Research Council the authors recently organised an interdisciplinary workshop to discuss the potential value of argumentation techniques in risk assessment and management. The question addressed by the workshop was whether practical argumentation techniques could be helpful in supporting multidisciplinary debates about complex risks.

One specific software tool “Debategraph” was used to evaluate the potential of using web-based issue analysis and argumentation to engage people in debating risks and their management (www.debategraph.org). Workshop members were presented with a real scenario on the management of major environmental risks on a small volcanic island, and used Debategraph to model two different risk management strategies, and to explore the value of argument graphing techniques in open debate.

The workshop members³ represented a cross-section of environmental scientists, risk researchers and others. They were excited by the potential of these new tools, and concluded that they may be sufficiently promising to justify deeper investigation of available techniques and technologies and evaluation in practical policy development and management of major risks.

Debategraph and other issue modeling tools are gaining popularity but do not yet exploit the value of formal argumentation and decision models. Unfortunately there are few tools that offer this while also being mature for practical use.⁴ The dialectical and evidential approaches both offer new ways to support deliberation and debate in complex decision-making and policy development, ranging from argument analysis and evidence assessment to automatic summarization and natural language communication. Most of these ideas are, however, still in the realm of research. Despite the lack of an automated argumentation capability Debategraph is raising awareness among influential users⁵ of how argumentation techniques can have significant value in practical problems like risk management and opening the way to a new generation of technologies which fully exploit the potential of argumentation theory and techniques.

References

Adams, John see web site <http://www.john-adams.co.uk/about/>

Das S, Fox J, Elsdon D & Hammond P “A flexible architecture for autonomous agents” *Journal of Experimental & Theoretical Artificial Intelligence* Volume 9, Issue 4, 407-440 1997

Fischhoff, Baruch see web site <http://www.cmu.edu/dietrich/sds/people/faculty/baruch-fischhoff.html>

² <http://www.nerc.ac.uk/research/programmes/pure/background.asp?cookieConsent=A>

³ **Workshop participants and background:** Prof. John Adams, (UCL; Risk perception); Prof. Peter Ayton, (City University; Understanding/communication of risk); Dr. Katie Atkinson, (University of Liverpool; eDemocracy, argumentation theory); Dr. Jake Chandler, (University of Munich; Research Fellow, mathematical philosophy); Dr. Simon Day, (UCL; Earth Science); Torran Elson, (PURE Network); Dr. Carina Fearnley, (Aberystwyth University; Earth sciences and environmental risk); Prof. John Fox, (Oxford University, UCL; argumentation and risk, healthcare, *workshop chair*); Prof. Simon French, (Warwick and Manchester University; Statistics, Risk, Emergency management); Dr. Vera Hazlewood, (PURE Network); Dr. Philip Judson, (Lhasa UK Ltd; Toxicological risk); Prof. Patrick McSharry, (Oxford University; Smith School; Crowdsourcing risk); Prof. Wassila Ouerdane, (Ecole Centrale Paris; Multi-criteria decisions and argumentation) – *contributor*; Prof. John Preston, (University of East London; EPSRC’s Global Uncertainties Fellow); Dr. David Price, (DebateGraph.org; visualisation of debate); Prof. John Rees, (NERC and British Geological Survey); Prof. David Spiegelhalter, (Cambridge; Statistics, Public Understanding of Risk) – *contributor*; Prof. Thorsten Wagener, (University of Bristol; Engineering Sciences).

⁴ Possible candidates include the Dungine open source argumentation engine (though this is really only a component for use in other applications); the Carneades Argumentation System (though a reviewer of this paper says it lacks the maturity of the Debategraph user interface) and the Tallis decision support platform (though the argumentation model it uses is oriented towards evidential rather than dialectical argumentation).

⁵ Including the White House, the UK Prime Minister’s Office, and CNN.

- Fox J "Will it happen? Can it happen? A new approach to formal risk analysis" *Risk, Decision and Policy*, 4, 1999
- Fox J, Parsons S "Arguing about beliefs and actions" in Hunter and Parsons (ed) *Applications of Uncertainty Formalisms*, Lecture Notes in Computer Science Volume 1455, 1998, pp 266-302
- Fox J "Arguing about the Evidence: a logical approach" in Dawid, Twining and Vasilaki (eds) *Evidence, Inference and Enquiry*, OUP/The British Academy, 2011.
- Kahneman, Daniel *Thinking fast and slow*, Macmillan 2011 see also http://en.wikipedia.org/wiki/Thinking,_Fast_and_Slow
- Krause P, Fox J & Judson P "An Argumentation Based Approach to Risk Assessment" *IMA Journal of Mathematics Applied in Business and Industry*, 5: 249-263, 1994.
- Krause P, Fox J, Judson P, "Is there a role for qualitative risk assessment?" *Proc. Uncertainty in Artificial Intelligence (UAI'95)* 386-393 Morgan Kaufmann Publishers Inc. San Francisco, CA (1995)
- McBurney P, Parsons S "Risk Agoras: using dialectical argumentation to debate risk" *Risk Management* (2000)
- Slovik P see web site <http://psychweb.uoregon.edu/people/slovic-paul>
- Stirling, A see web site <http://www.sussex.ac.uk/spuru/people/peoplelists/person/7513>