Introduction to risk assessment and communication - risk

Ullrika Sahlin, Lund University

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Figure 1: The Global Risks Landscape 2016

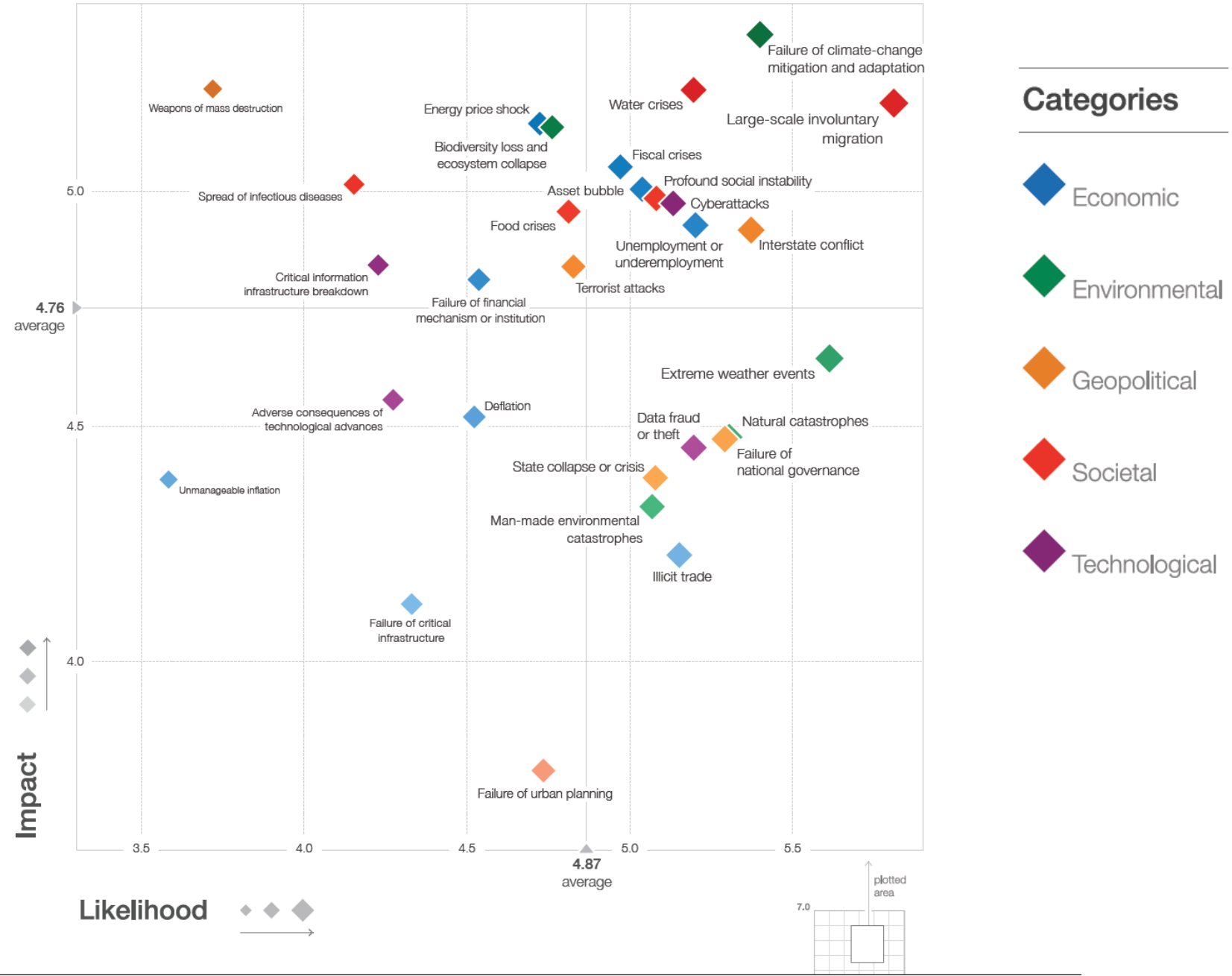


Figure 1.1: The Global Risks Landscape 2014

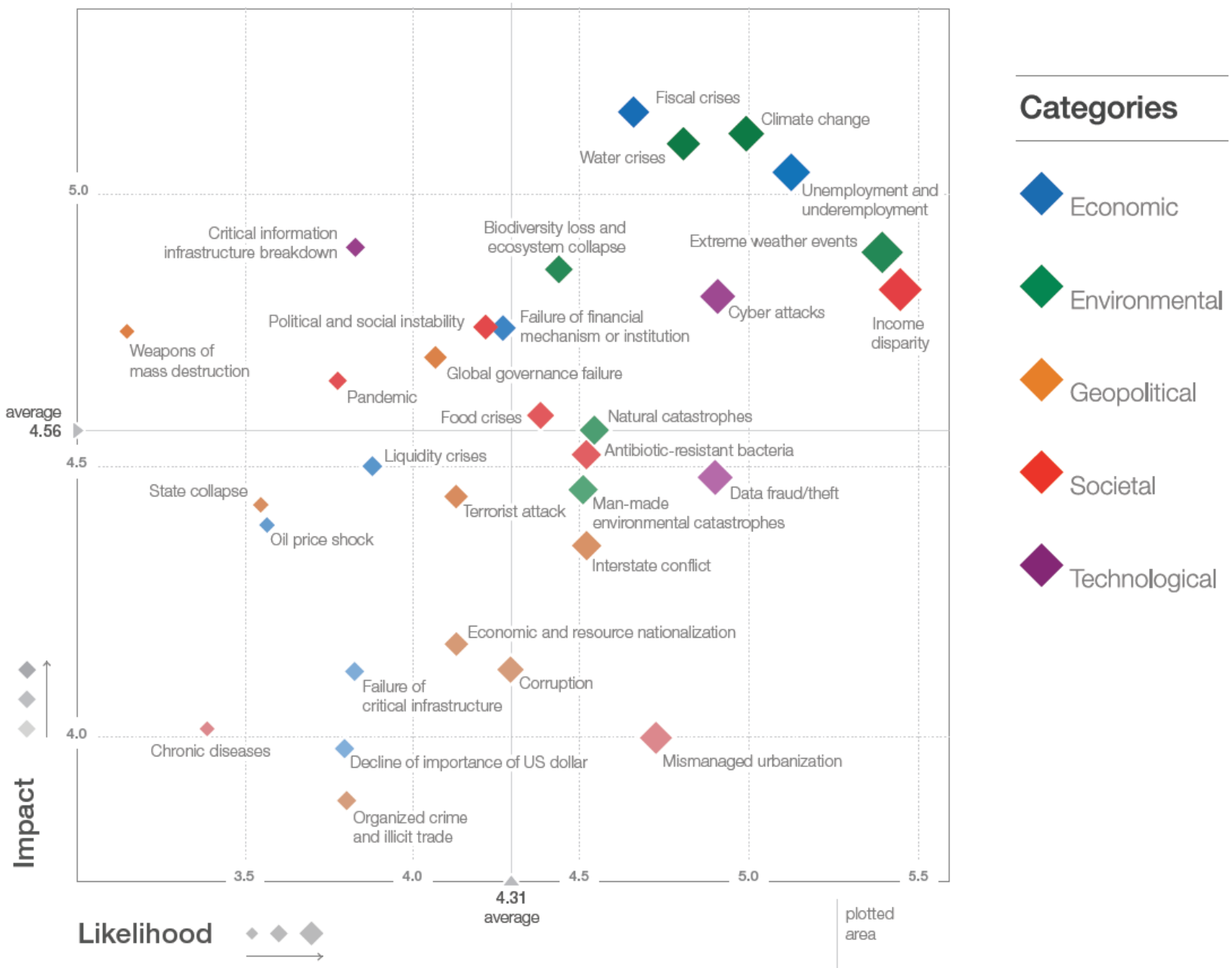
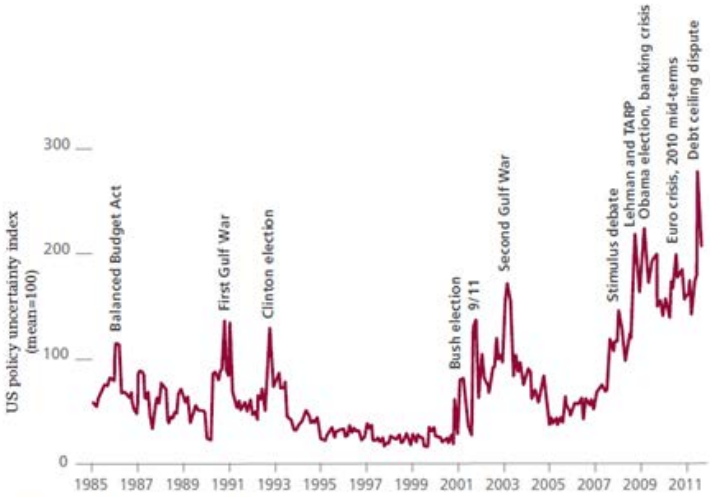


Figure 1.1.1: The Evolving Risks Landscape, 2007–2016

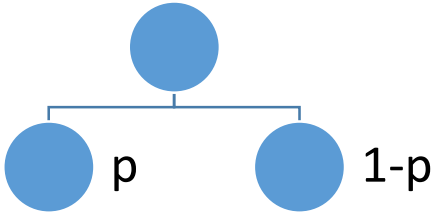
Source: World Economic Forum 2007–2016, *Global Risks Reports*.

Risk

Figure 1:
Index of US economic policy uncertainty



Notes: The index is composed of three sets of measures: monthly news articles containing 'uncertain' or 'uncertainty', 'economic' or 'economy', and policy-relevant terms (scaled by the smoothed number of articles containing 'today'); the number of tax laws expiring in coming years; and a composite of quarterly forecasts of government expenditures and one-year CPI (consumer price index) from the Philadelphia Fed Survey of Forecasters. The data are available at www.policyuncertainty.com.



Risk assessment

A general idea of risk assessment according to an engineer

- Establish the values and objectives
- Describe the system
- Identify risk scenarios
- Estimate likelihoods and consequences for all risk scenarios
- Present results on risks
- Evaluate risks (choose management alternative)

But what if

- Multiple sources to events
- Multiple linked events
- Impact on multiple values
- Many people affected
- Not necessarility those making the decisions
- High values at stake
- Long term effects
- Solutions requiring a sacrifice of another value
- Scientific uncertainty

Department for Environment, Food and Rural Affairs (DEFRA, UK)

- Our task is to minimise the risks of environmental damage,

  while at the same time ensuring economic growth and social progress

- Supply the scientific rationale for decision making in a timely manner

Framework for environmental risk assessment and management according to DEFRA

(1) formulate the problem

(2) carry out the assessment of the risk

(3) Identify and appraise the management options available

(4) address the risk with the chosen risk management strategy

Iteration, communication and learning are important parts of risk assessment and management

Risk assessment according to an environmental manager

- Inform risk questions with a range of stakeholders
- When a risk problem is highlighted, the source, pathways and receptors under potential threat should be recognised
- Outline data requirements for assessment and the methods needed for data collection and synthesis
- Do initial risk screening and prioritisation to allocate resources for the assessment
- Estimate risk (likelihoods and consequences)
- Evaluate the significance of the risk based on collected evidence

Risk assessment according to an environmental manager(cont.)

- Consider the risk management options in terms of their positive and negative effects according to technical and economic factors, environmental security, social issues and organizational capabilities
- Chose a strategy involving terminating, mitigating, transferring, exploiting or tolerating the risk
- Monitor the implemented strategy to ensure the risk is controlled to an acceptable level
- Each component should include openness and transparency, and involve stakeholders when feasible

The environmental risk question

What (is happening)

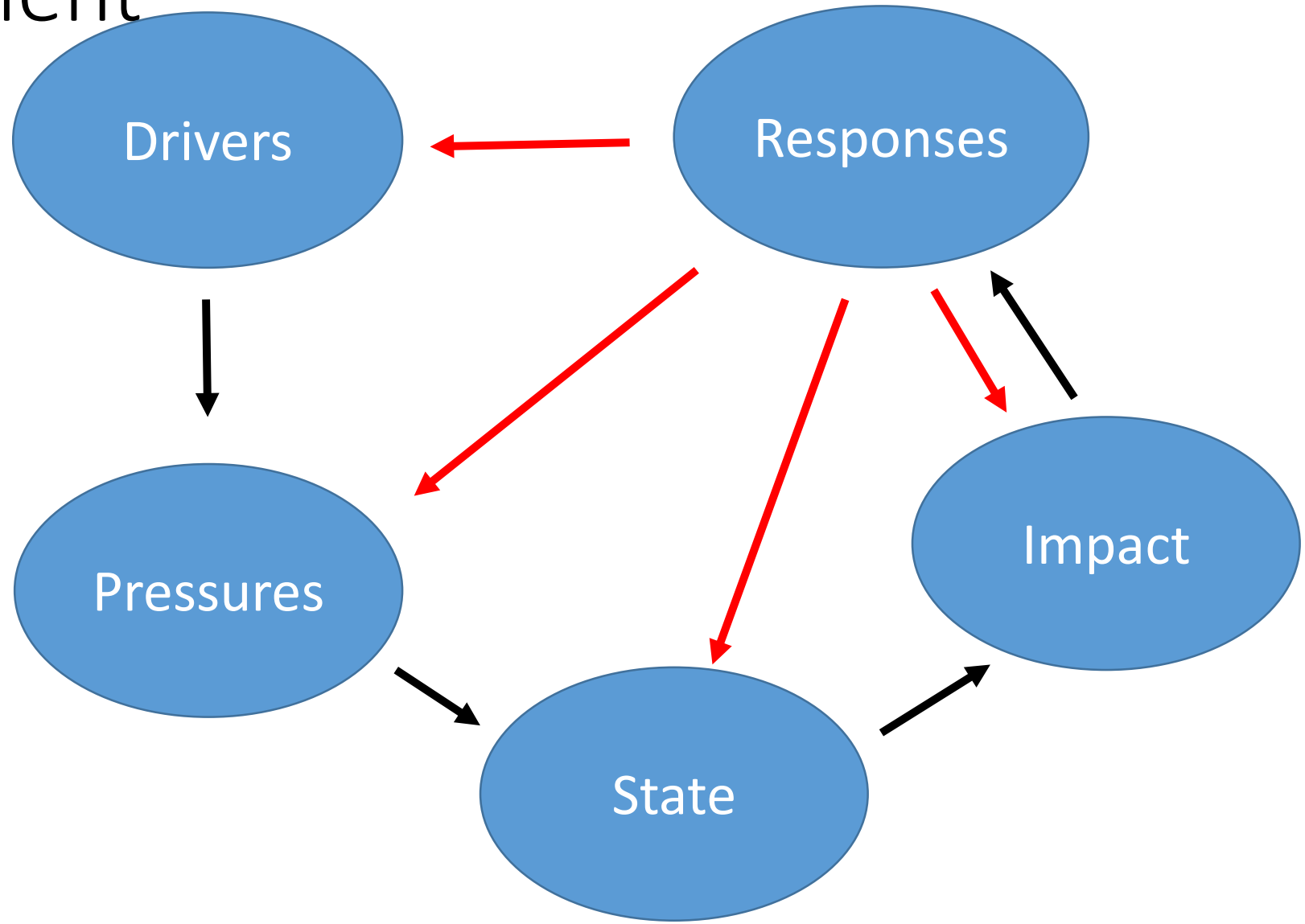
to whom (or which part of the system),

where (location) and

when (in time)?

What are the boundaries of the problem under consideration? – captured by a conceptual model

The DPSIR paradigm for Environmental risk assessment



Drivers-Pressures-State-Impacts-Responses

- Drivers: the forces that increase or mitigate pressures on the environment (e.g. changes in land use)
- Pressures: the stresses that an activity, situation or agent places on the environment (e.g. waste disposal)
- State: the condition of the environment (e.g. land productivity decline)
- Impacts: the consequences or effects of environmental degradation (e.g. crop yield decline)
- Responses: those made by society to the environmental situation (e.g. conservation and rehabilitation)

Strategies for an inclusive risk managment

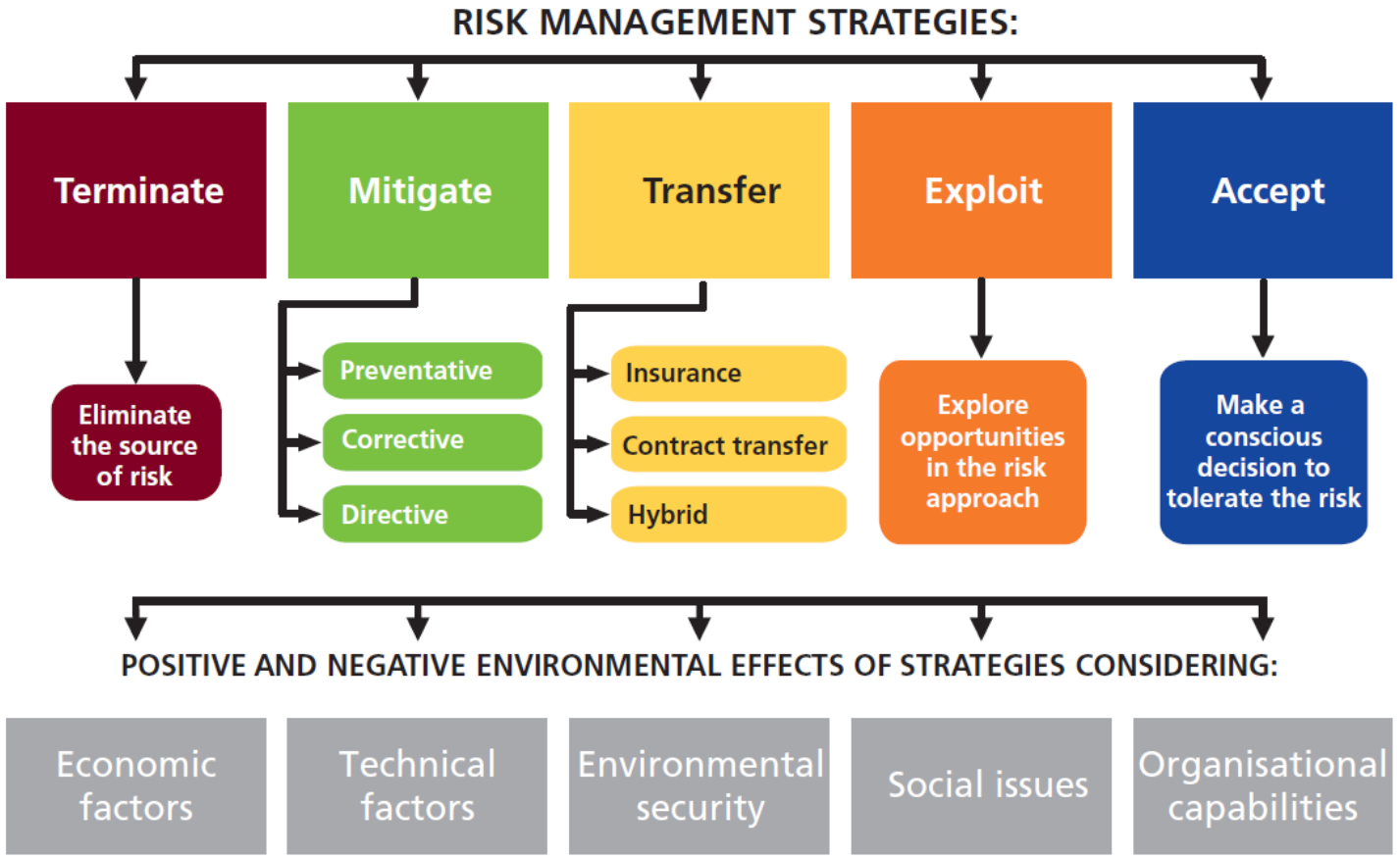


Figure 16: Identifying the optimal risk management technique involves consideration of the effects associated with economic and technical factors, environmental security, social issues and organisational capabilities (after Aon Corporation, 2011).

What to do about it?
What do we care about?

The goal of risk management:

Environmental security

- Protecting and enhancing our environment and allowing economic sustained growth in the long term
- Environmental security aims to achieve a better quality of life for everyone now, and for generations to come. The overall aim is to ensure that economic and environmental benefits are available to everybody.
- Sustainability is a core aim
- Use collective partnerships ensuring economic demands and social needs

Why stakeholder and public involvement is becoming valuable in environmental managment

- Good decisions are often informed by the knowledge and concerns of stakeholders and the public, and are understood and supported by the people who may be directly affected by them
- Benefits:
  - resolution of conflict
  - social learning
  - integration of a broader knowledge base
  - community support
  - credibility of the process
- Analytical-deliberative decsion processes – public discussion, debate and reflection about the risk assessment itself alongside the analysis of risk

A UK crop circle, created by activists to signify uncertainty over where genetic contamination can occur.

Keep it complex

UNCERTAINTY MATRIX

A tool to catalyse nuanced deliberations: experts must look beyond risk (top left quadrant) to ambiguity, uncertainty and ignorance using quantitative and *qualitative* methods.

Knowledge about possibilities

Knowledge about probabilities	Unproblematic	Problematic
Unproblematic	**RISK** • Risk assessment • *Optimizing models* • *Expert consensus* • Cost–benefit analysis • Aggregated beliefs	**AMBIGUITY** • Interactive modelling • *Participatory deliberation* • *Focus & dissensus groups* • Multicriteria mapping • Q-method, repertory grid
Problematic	• Interval analysis • Scenario methods • Sensitivity testing • *Decision rules* • *Evaluative judgement* **UNCERTAINTY**	• Monitoring & surveillance • Reversibility of effects • *Flexibility of commitments* • *Adaptability, resilience* • *Robustness, diversity* **IGNORANCE**

Political pressures tend to push attention from ‘plural conditional’ (dark shading) to ‘single definitive’ (light shading) methods.

So - What makes risk assessment different from data analysis?

Purposes of data analysis

- Hypothesis testing
- Estimation
- Assessment
- Quantification of uncertainty
- Decision analysis

RA different with respect to

- Predict things that we haven't seen yet
- Use of expert knowledge
- Influenced by human values
- Consider human behaviour in assessment and communication
- Integrate multiple source of (secondary) information
- Need to consider uncertainty (aleatory and epistemic)
- Problem with high values at stake - tension, secret data
- Transparent and well-motivated principles behind assessment

Definining risk – a never ending debate

- Risk = - Expected Utility
- Risk triplet - What can happen? How likely is it? What are the consequences?
- Risk = likelihood * consequence
- Risk is the consequences of the activity and associated uncertainties (SRA glossary 2015)
- Risk is uncertainty about and severity of the consequences of an activity with respect to something that humans value (SRA glossary 2015)
- Risk is the effect of uncertainty on objectives (ISO 31000:2009)
- Safety, Security, Vulnerability, Resilience

http://sra.org/news/sra-develops-glossary-risk-related-terms

ISO

- Risk is the effect of uncertainty on objectives
- NOTE 1 An effect is a deviation from the expected — positive and/or negative.
- NOTE 2 Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).
- NOTE 3 Risk is often characterized by reference to potential **events** (2.17) and **consequences** (2.18), or a combination of these.
- NOTE 4 Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated **likelihood** (2.19) of occurrence.
- NOTE 5 Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood.

Separate risk as a concept from how risk is measured!

Qualitative definition of probability

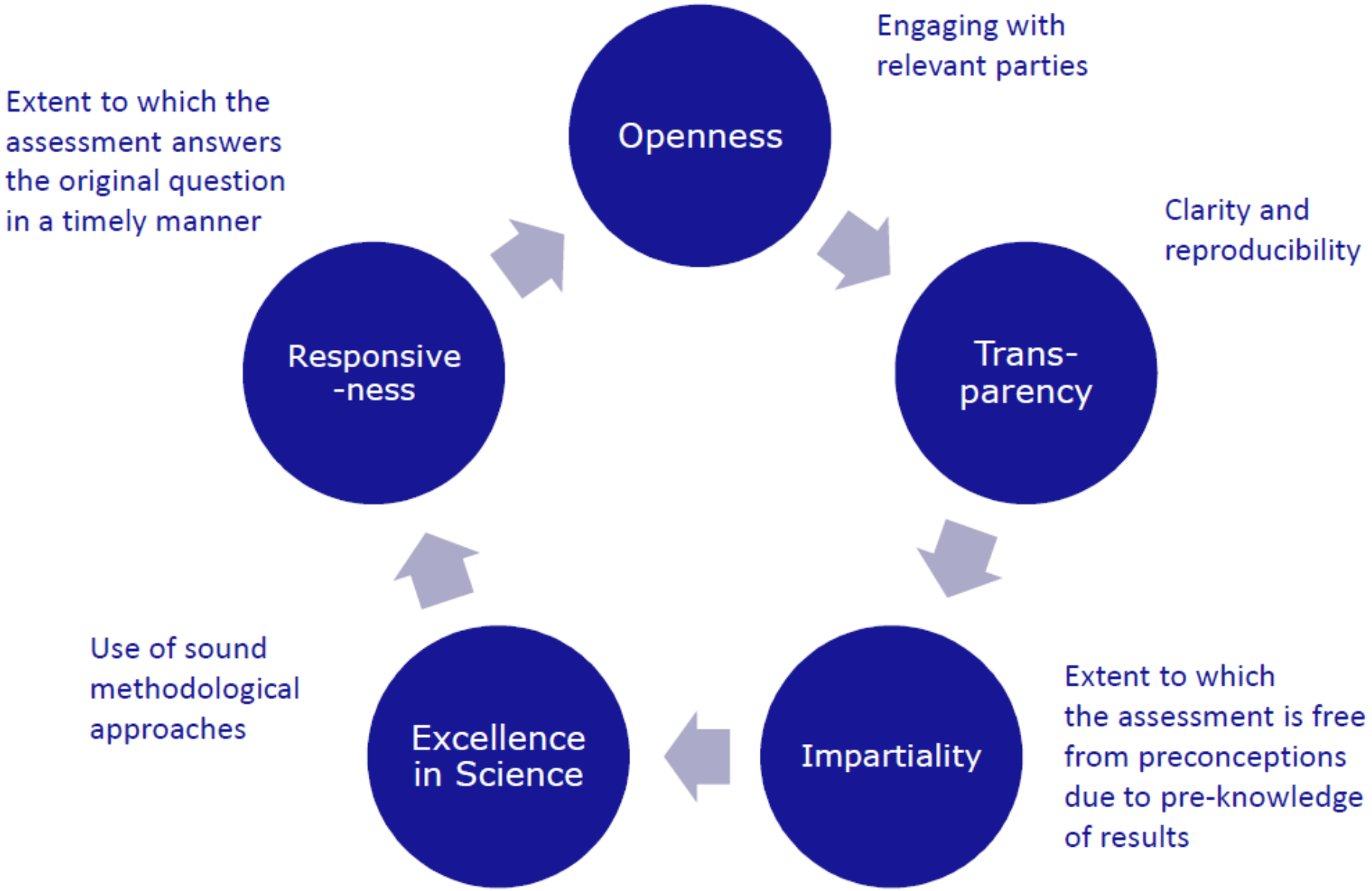
- A measure for representing or expressing uncertainty, variation or beliefs, following the rules of probability calculus

Quantitative definitions of probability

- A personal probability (subjective)
- A relative frequency (propensity/frequentist)
- Chance in situations with finite number of outcomes (classical)

Risk assessment is the scientific analysis of uncertain outcomes, both positive and negative

PRINCIPLES


Openness
Engaging with relevant parties
Trans-parency
Clarity and reproducibility
Impartiality
Extent to which the assessment is free from preconceptions due to pre-knowledge of results
Excellence in Science
Use of sound methodological approaches
Responsive-ness
Extent to which the assessment answers the original question in a timely manner

Risk analysis is a scientific field of study

when understood as consisting primarily of

A. knowledge about risk-related phenomena, processes, events, etc.
B. concepts, theories, frameworks, approaches, principles, methods and models to understand, assess, characterize, communicate, and manage risk, in general and for specific applications (the instrumental part)

Hansson, S. O., & Aven, T. (2014). Is Risk Analysis Scientific? Risk Analysis, 34(7)

Validity of a risk analysis

"The degree to which the risk analysis describes the specific concepts that one is attempting to describe"

- The degree to which the produced risk numbers are accurate compared to the underlying true risk
- The degree to which the assigned probabilities adequately describe the assessor's uncertainties of the unknown quantities considered
- The degree to which the epistemic uncertainty assessments are complete
- The degree to which the analysis addresses the right quantities

Aven 2011. Quantitative Risk Assessment – The Scientific Platform.

Reliability in a risk analysis

"The extent to which the risk analysis yields the same results when repeating the analysis"

- The degree to which the risk analysis methods produce the same results at reruns of these methods
- The degree to which the risk analysis produces identical results when conducted by different analysis teams, but using the same methods and data
- The degree to which the risk analysis produces identical results when conducted by different analysis teams with the same analysis scope and objectives, but no restrictions on methods and data

Aven 2011. Quantitative Risk Assessment – The Scientific Platform.

Risk analysis as a scientific field

"Risk analysis has a large overlap with many other disciplines but it clearly has a core subject area,

namely, the concepts, theories, frameworks, approaches, principles, methods, and models to understand, assess, characterize, communicate, and (in a wide sense) manage risk,

which is at most a peripheral topic in other disciplines.

This makes risk analysis a discipline in its own right, albeit one with a strong interdisciplinary character."

Hansson, S. O., & Aven, T. (2014). Is Risk Analysis Scientific? Risk Analysis, 34(7)