Challenges in risk management and governance

Terje Aven,
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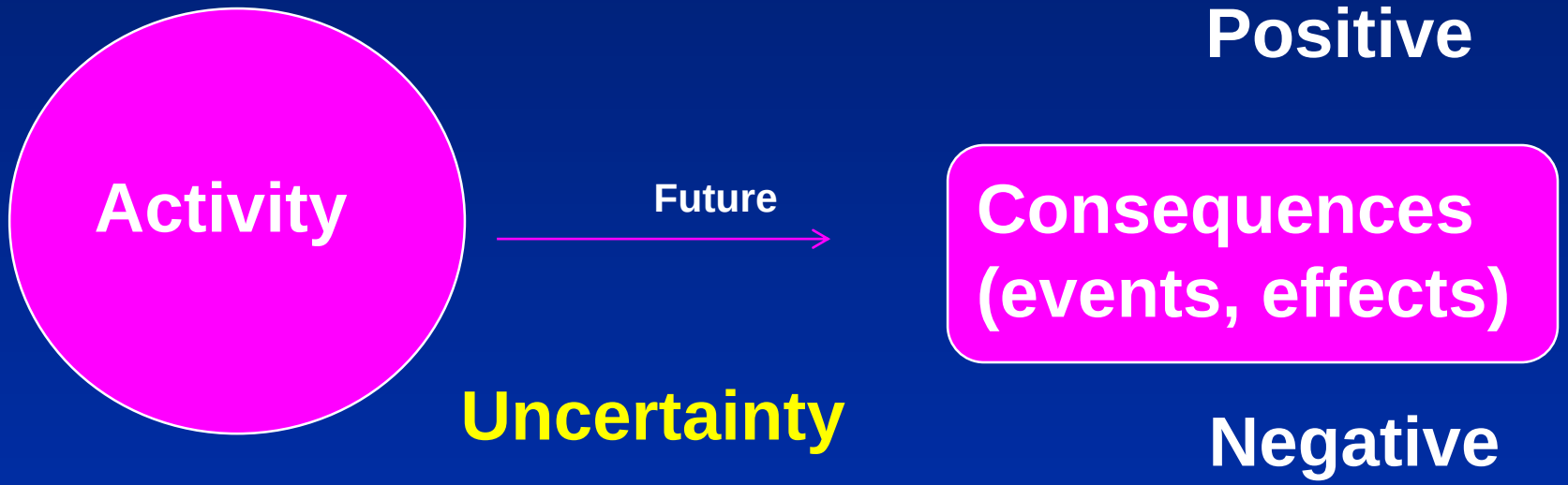
The risk concept



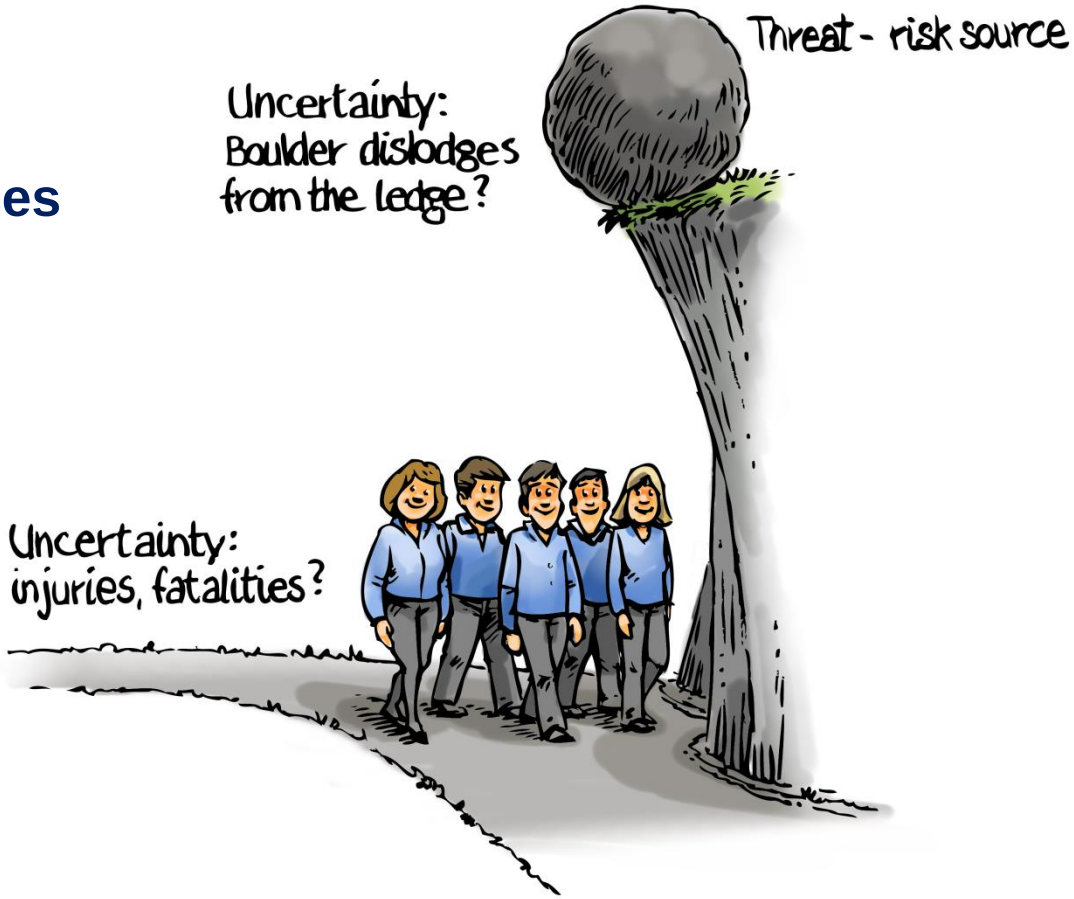
Society for Risk Analysis Glossary, Core Subjects and Key Principles (www.sra.org/resources)

The Risk Concept

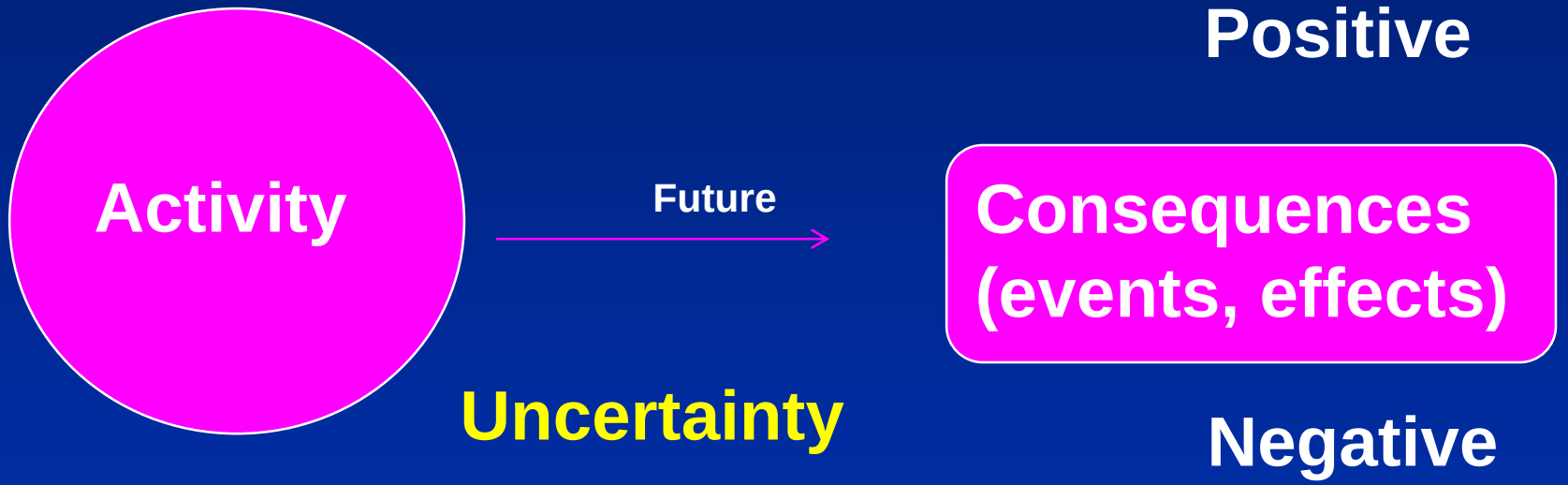
Consequences

Events with some effects

Some effects are undesirable

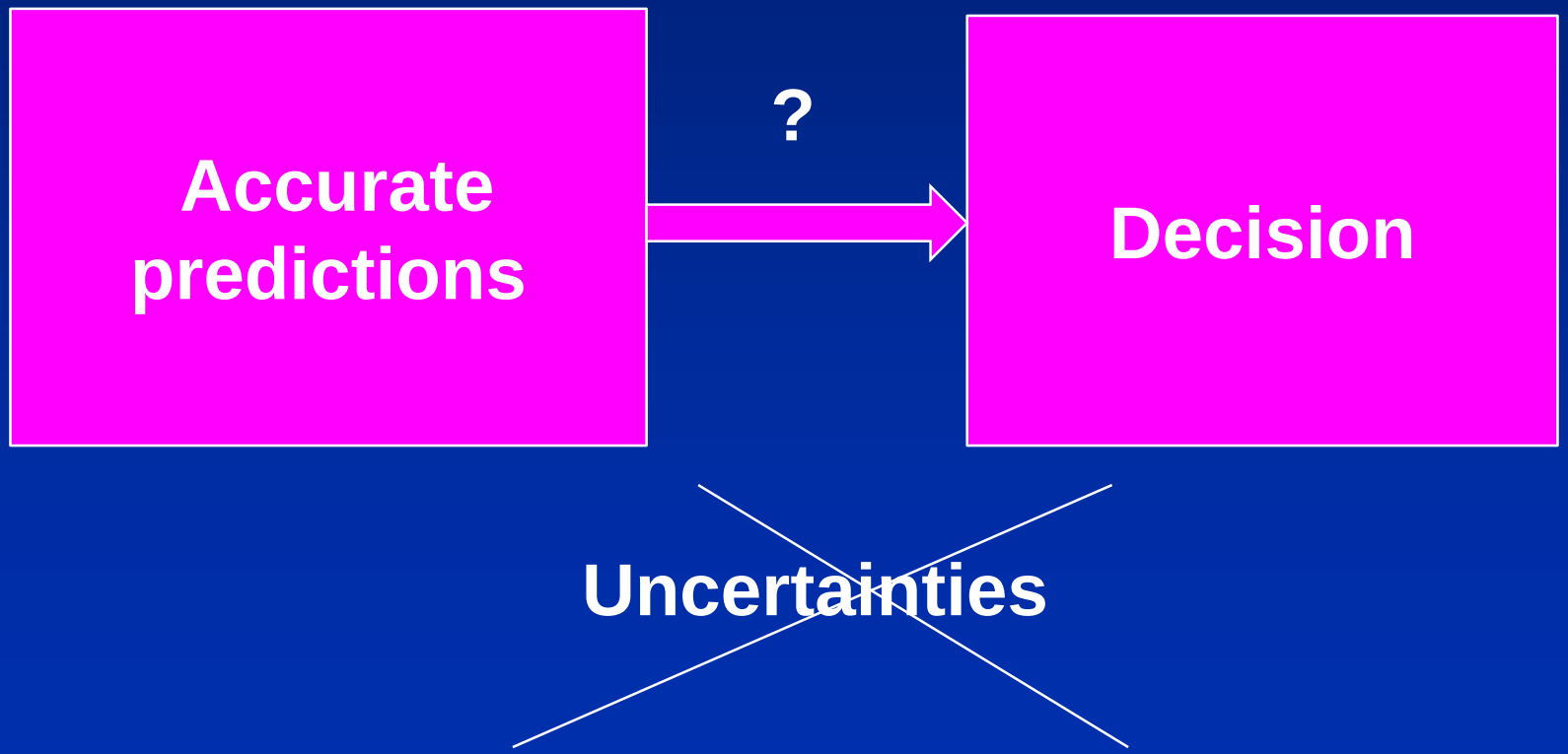


Uncertainty

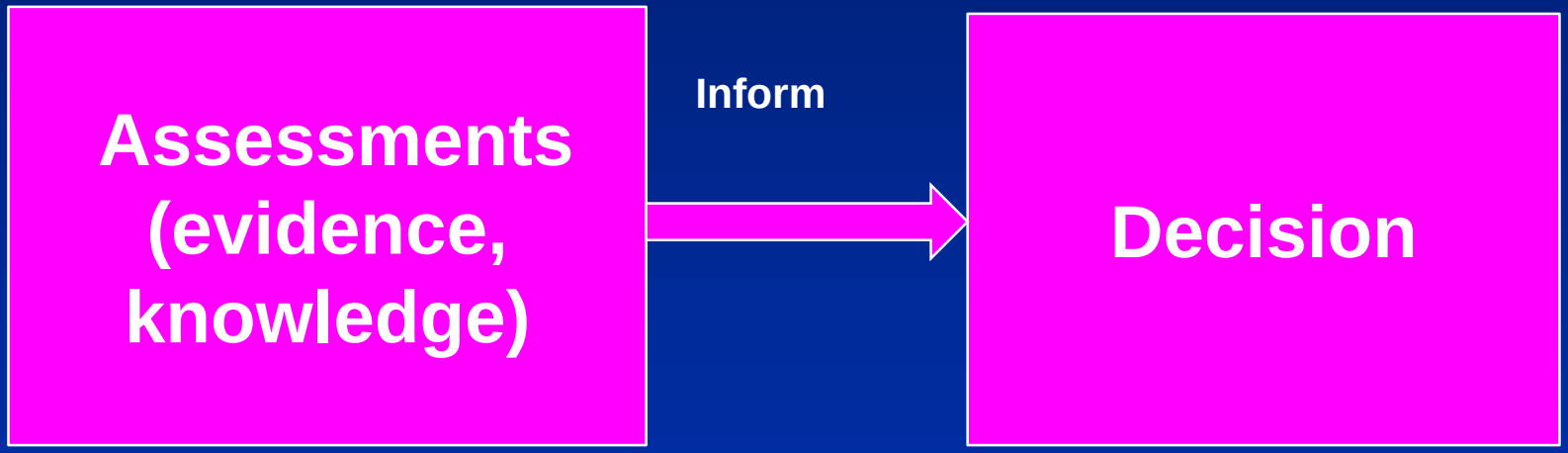


- Different decision alternatives
- Suppose accurate predictions of the consequences can be made

Values



Values



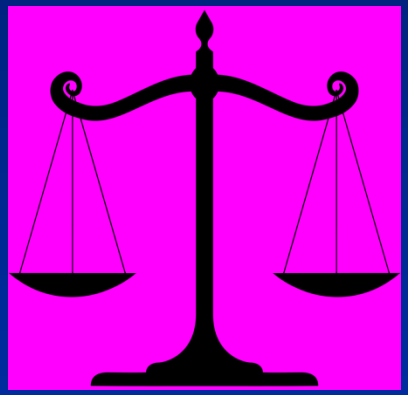
Uncertainties

Balance

Development and Protection

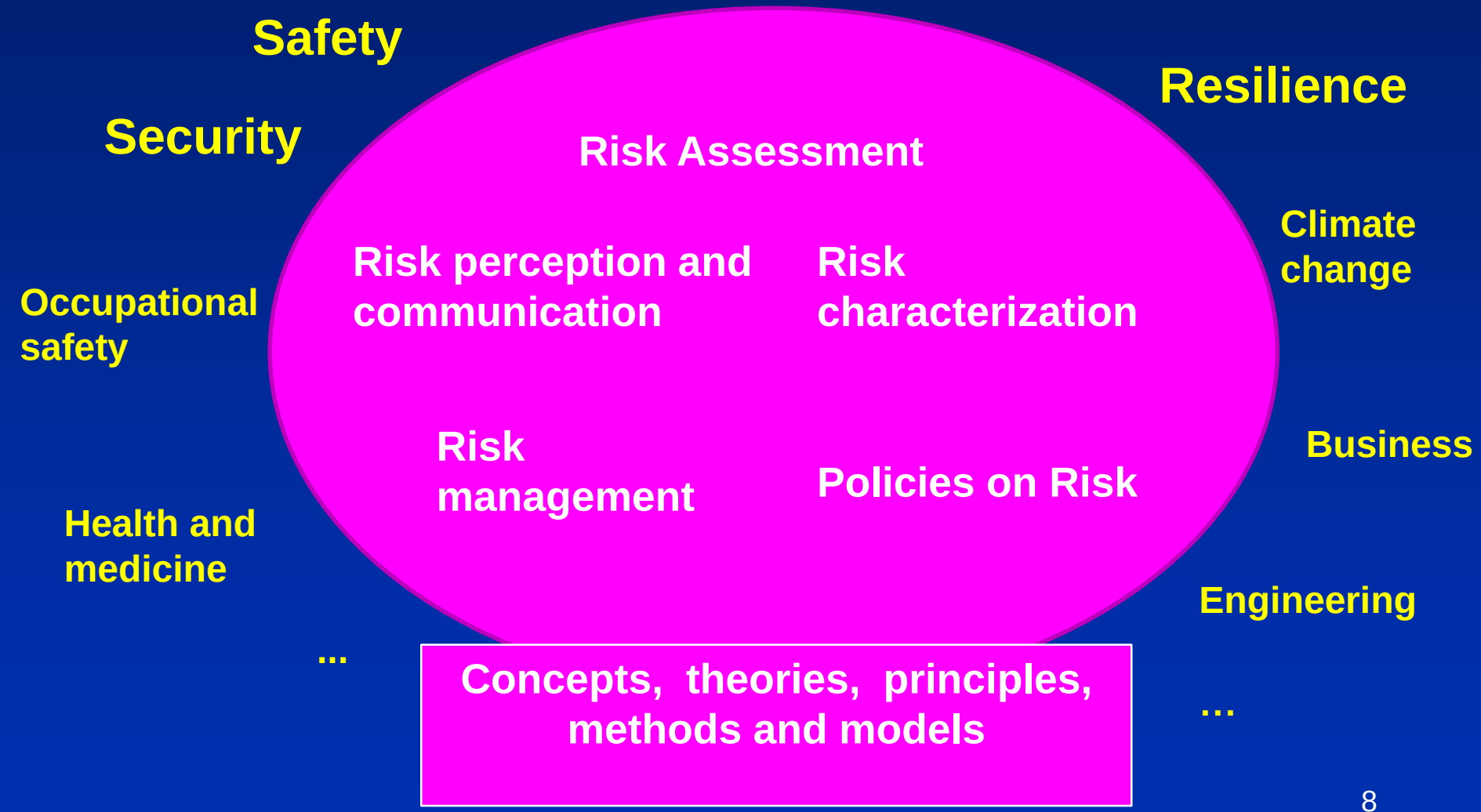
Creating values

Taking risk



Reduce the risks and uncertainties

Risk Analysis



Risk Analysis

Supporting risk knowledge generation for specific activities
Supporting the tackling of risk problems
(Applied risk analysis A)

Generic concepts, principles, approaches and methods on how to understand, assess, communicate and manage risk
(Generic risk analysis B)

Problem

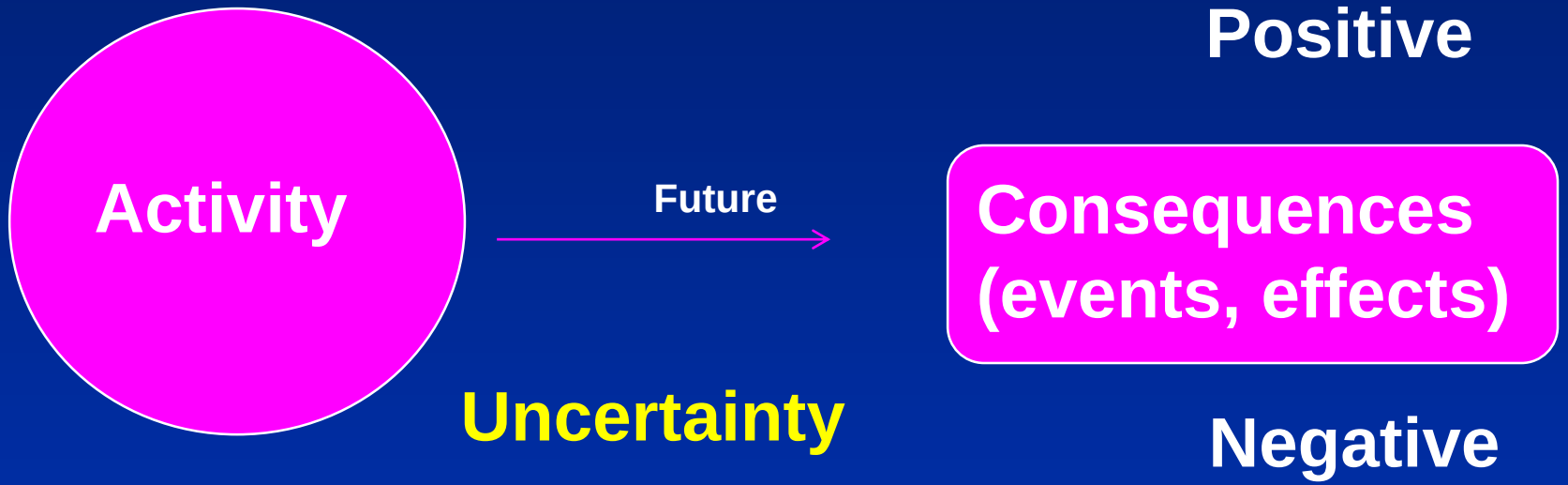
You – an expert in risk analysis

Country X

PM/President

How should we best characterize the risk we face?

The risk concept

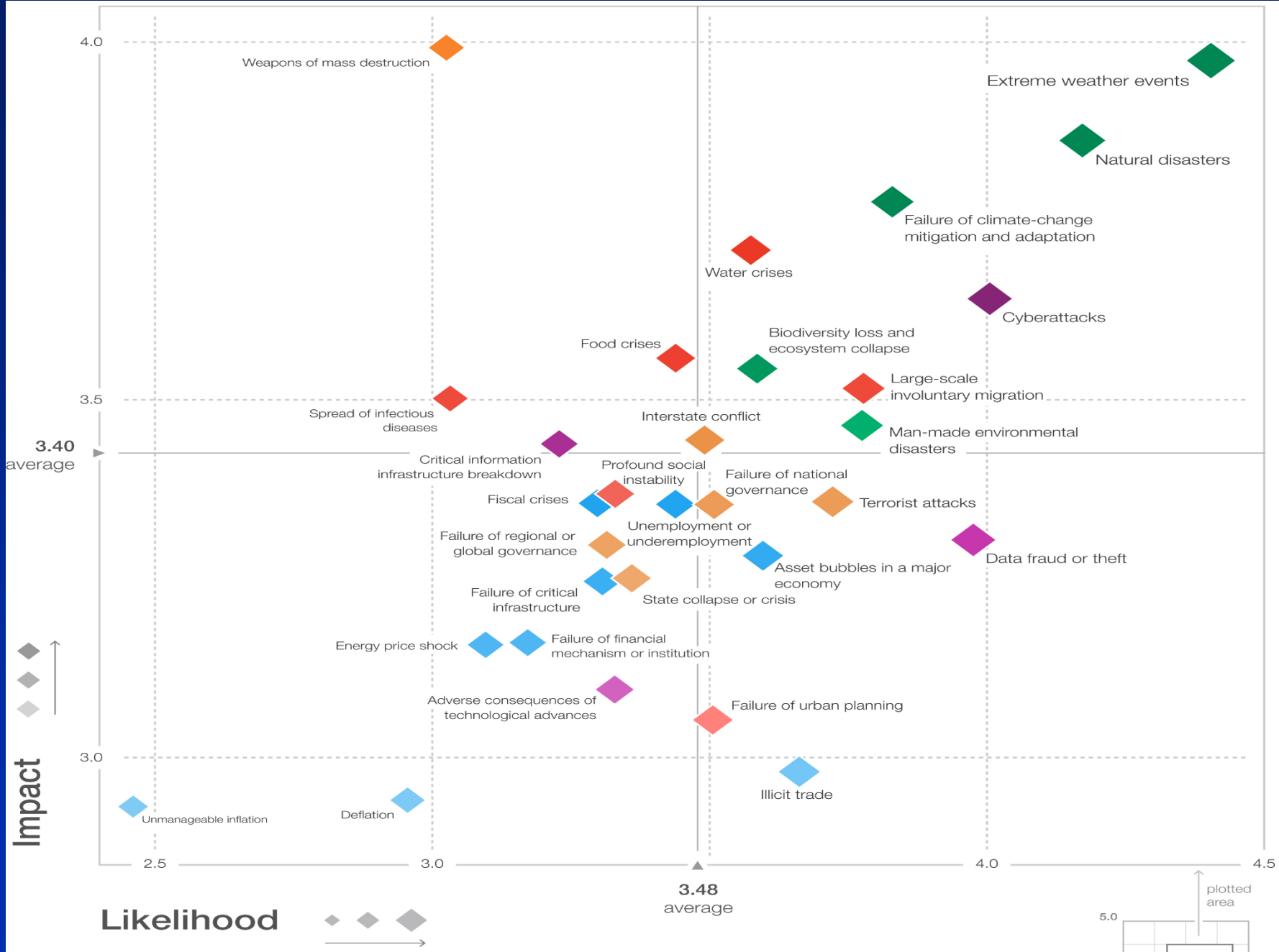


Expressing uncertainty

Probability

Knowledge

$$P(A \mid \text{assumption}) < 0.0000001$$


4.0
3.5
3.40
average
3.0
Impact
2.5
3.0
3.48
average
4.0
4.5
Likelihood
Weapons of mass destruction
Extreme weather events
Natural disasters
Failure of climate-change mitigation and adaptation
Water crises
Cyberattacks
Biodiversity loss and ecosystem collapse
Food crises
Large-scale involuntary migration
Spread of infectious diseases
Interstate conflict
Man-made environmental disasters
Critical information infrastructure breakdown
Profound social instability
Failure of national governance
Fiscal crises
Terrorist attacks
Unemployment or underemployment
Failure of regional or global governance
Data fraud or theft
Asset bubbles in a major economy
Failure of critical infrastructure
State collapse or crisis
Energy price shock
Failure of financial mechanism or institution
Adverse consequences of technological advances
Failure of urban planning
Illicit trade
Unmanageable inflation
Deflation
plotted area
5.0

A_1	$P(A_1)$	$E[\text{impact}\mid A_1]$
A_2	$P(A_2)$	$E[\text{impact}\mid A_2]$
A_3		
...		

Example A: Natural disaster

B_1	$P(B_1)$	Strength of knowledge
B_2	$P(B_2)$	Strength of knowledge
B_3		
...		

Example B: Natural disaster with significant impact

Characterisation of risk

- Specfied events, effects
- Expressed uncertainties

Expressing uncertainty

Probability

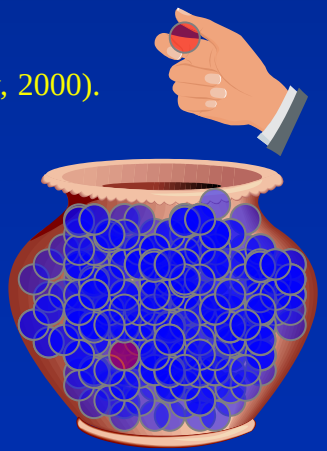
Knowledge

How do you interpret a probability judgment $P(A) = 0.95$ and $P(A) \geq 0.95$ used to express the assigner's uncertainty and degree of belief ?

A: Most of the current global warming trend is the result of human activity (IPCC)

Knowledge-based probability

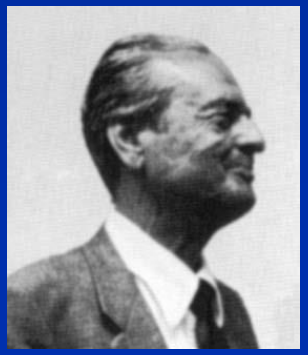
- P(A|K) = 0.95
- The assessor compares his/her uncertainty (degree og belief) about the occurrence of the event A with drawing a red ball from an urn that contains 100 balls where 95 are red (Kaplan and Garrick 1981, Lindley, 2000).



K: background knowledge

Subjective probabilities

- The probability of the event A, P(A), equals the amount of money that the assigner would be willing to put on the table if he/she would receive a single unit of payment in the case that the event A were to occur, and nothing otherwise …



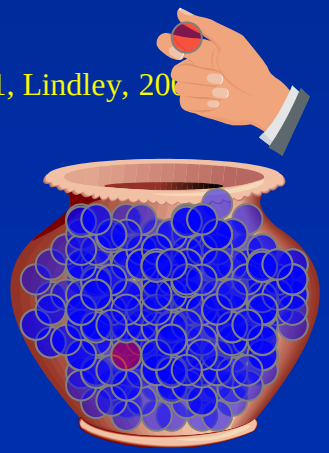
1930

Bruno de Finetti

Subjective probabilities

- A mixture of uncertainty assessments and value judgments
- Many other such interpretations exists (Ramsey, Savage …)
- Common in the economic literature and among decision analysts

- $P(A) \geq 0.95$
- The assessor compares his/her uncertainty (degree of belief) about the event A to be true (occur) with drawing a red ball from an urn that contains 100 balls where 95 or more are red (Kaplan and Garrick 1981, Lindley, 20



Probability

Frequentist probability
P_f

Jugdmental/ knowledge-based, subjective probabilities P

Variation

Assessor's expression of uncertainty – a degree of belief

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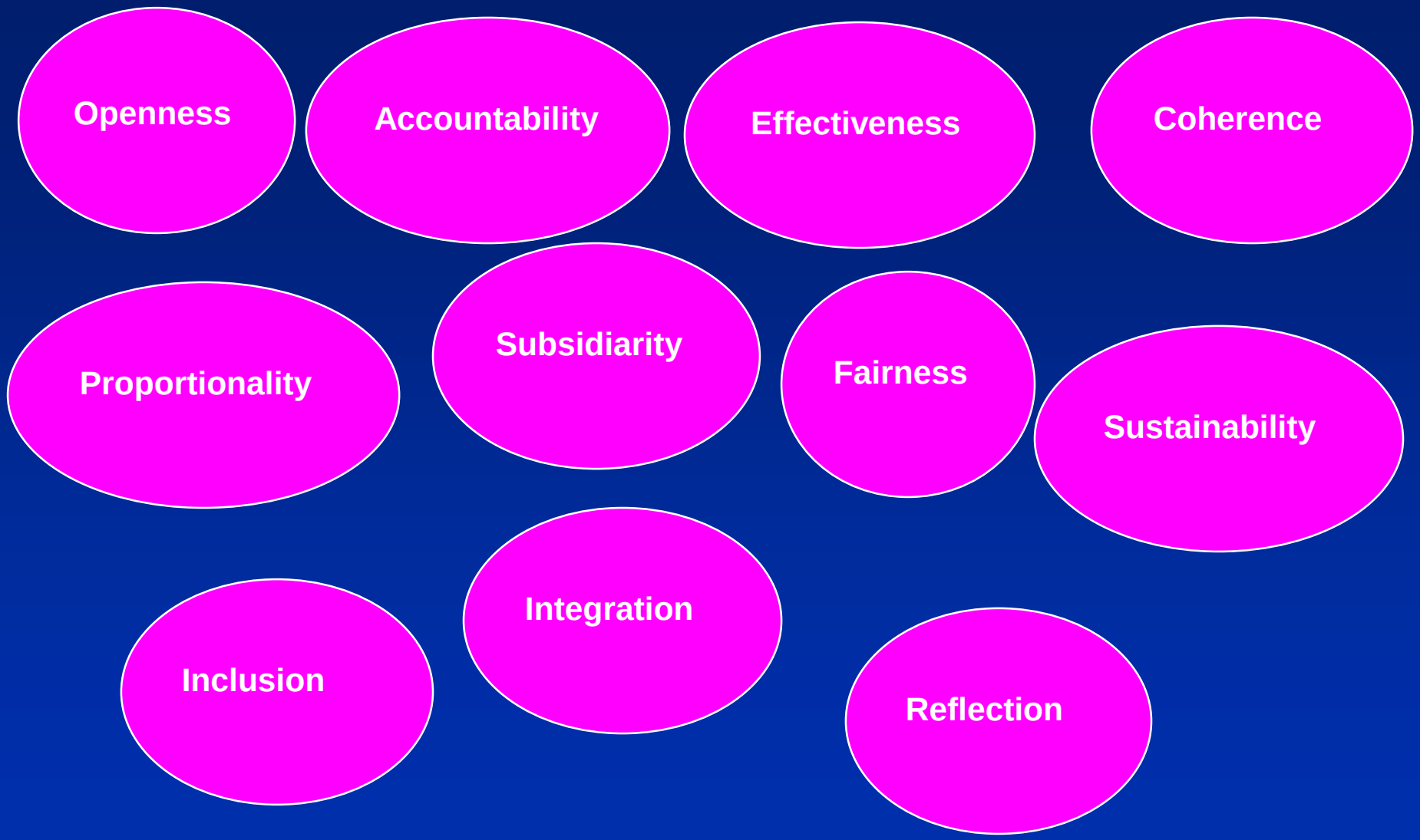
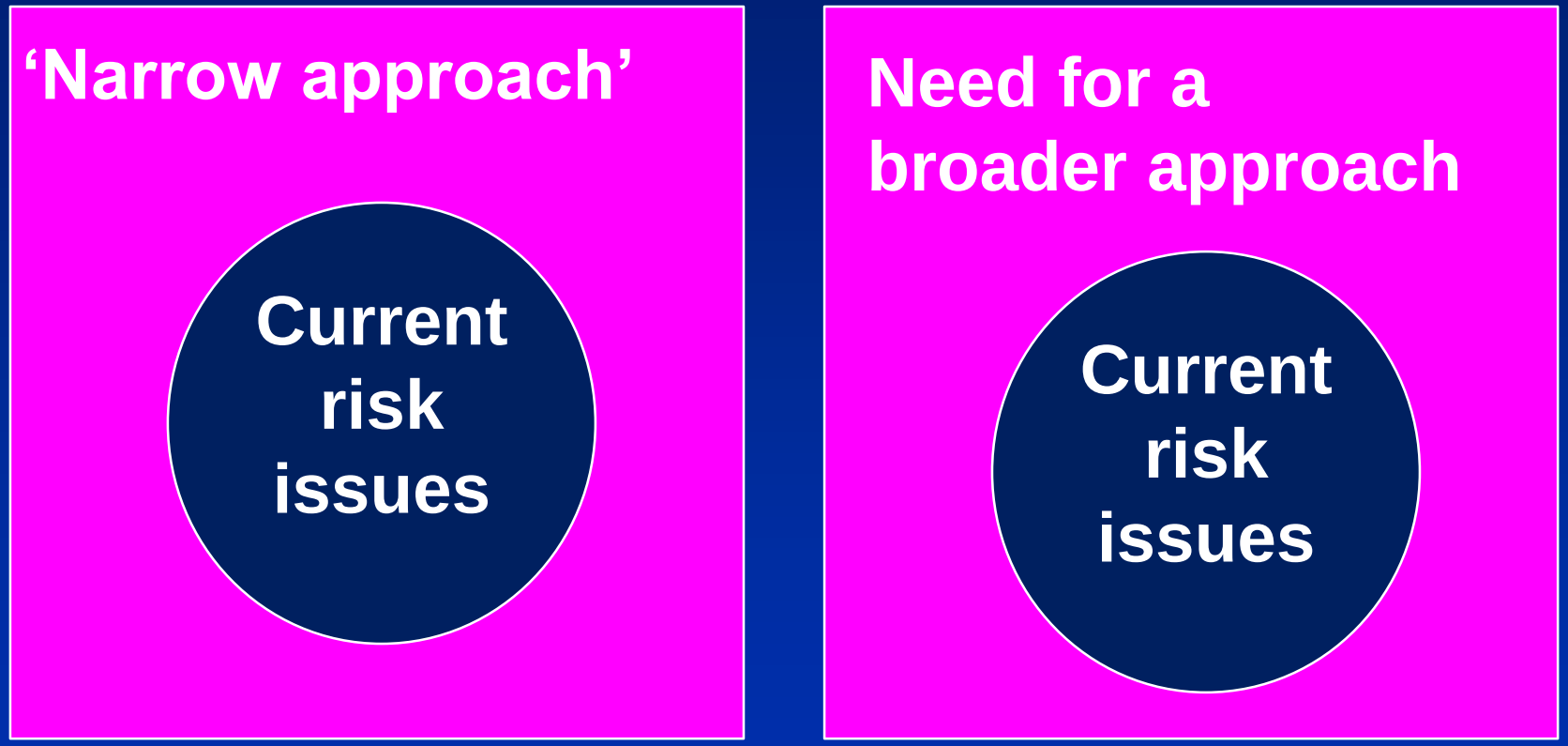
Risk governance:

The application of governance principles to the identification, assessment, management and communication of risk (SRA Glossary 2015)


Openness
Accountability
Effectiveness
Coherence
Proportionality
Subsidiarity
Fairness
Sustainability
Integration
Inclusion
Reflection

The risk issues were handled as if they were simple



Risk issues class	
Simple	‘Objective’ probabilities available
Uncertainty	i) a potential for extreme consequences and ii) large uncertainties concerning what will be the consequences
Value differences	I) a potential for extreme consequences and II) different values related to the risks (consequences at stake, uncertainties)

Risk issues class	
Simple	‘Objective’ probabilities available
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Problem

Country X

President/PM

You – expert in risk analysis

What are the key strategies for dealing with risk?

Main strategies for handling risk

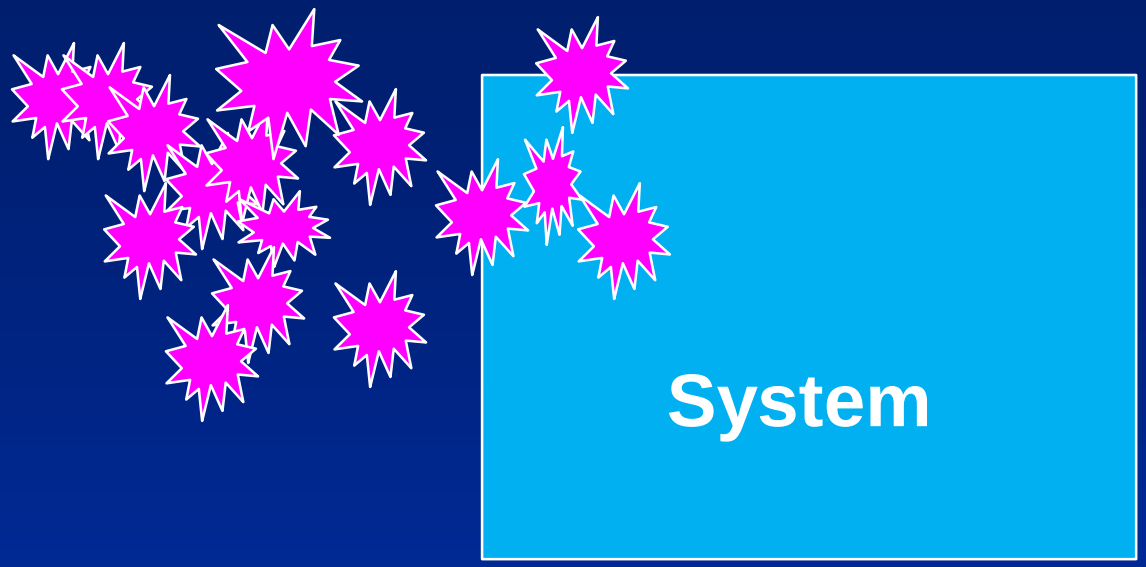
Risk assessment informed

Robustness, resilience, cautious policies …

Dialogue

Balancing other concerns

From risk to resilience


System

Resilience can be improved by strengthening immune systems, diversification and flexible response options

We also need to address risk to understand how and when serious threats may occur, and avoid them, and also guide the resilience management to use the available resources in a best possible way

Balance

Development and protection

Develop, creating values

Take risk

Reduce the risks and uncertainties

E[NPV], cost-benefit analyses

ALARP

Cautionary-precautionary

Risk acceptance criteria

E: Expected value

- Cautionary principle

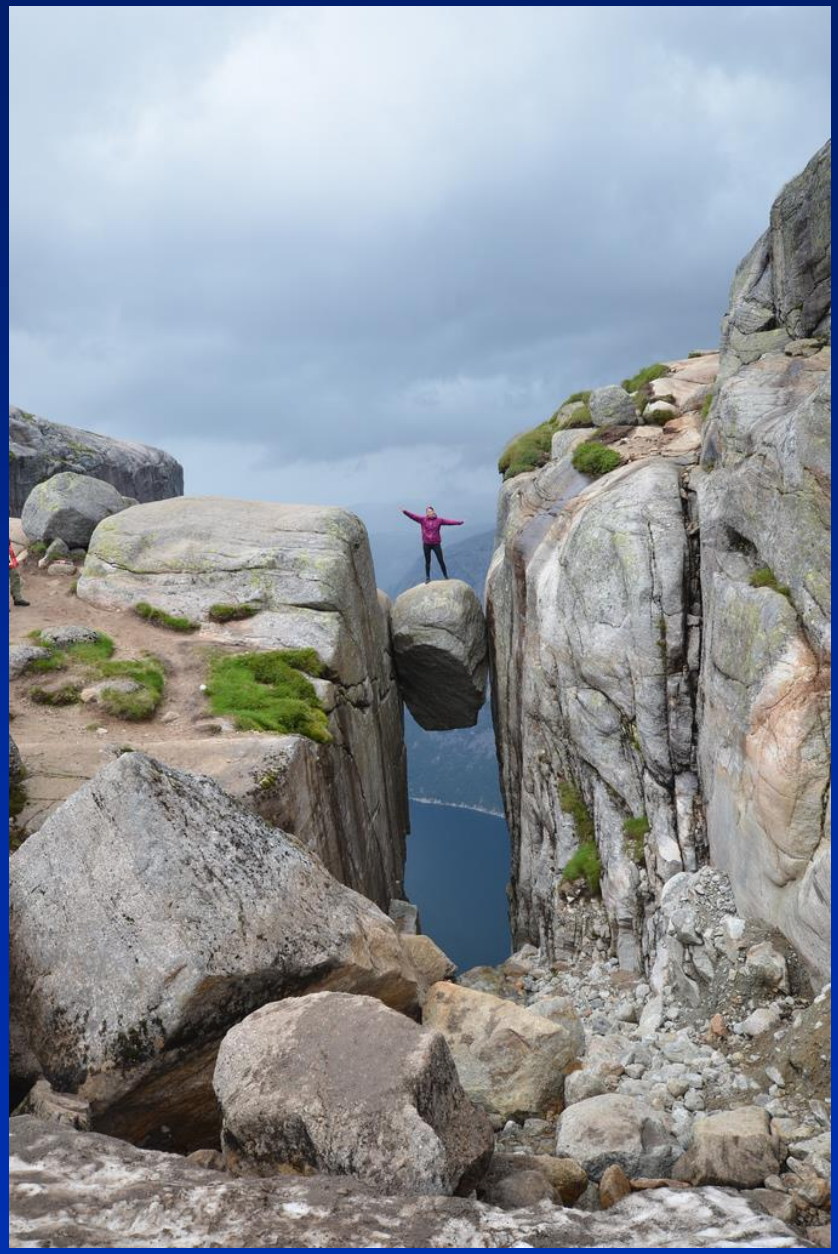
- Precautionary principle

If the consequences of an activity could be serious and subject to (scientific) uncertainties, then cautionary measures should be taken or the activity should not be carried out

German Ethics Commission, which paved the way for the Governmental phase-out decision:

Roughly half of the commission stated that nuclear energy is not acceptable because of its catastrophic potential, independent of the probability of large accidents occurring and also independent of its economic benefit to society

Is cautionary/precautionary thinking wise (rational)?



Thanks

Literature

- Society for Risk Analysis Glossary, Core Subjects and Key Principles (www.sra.org/resources)
- Aven and Renn (2018) Some foundational issues related to risk governance and different types of risks
- Aven and Renn (2018) Improving Government Policy on Risk: Eight Key Principles
- Aven, T. (2017) How some types of risk assessments can support resilience analysis and management. Reliability Engineering & System Safety, 167, 536-543.
- Aven, T. (2016) Risk assessment and risk management: review of recent advances on their foundation. European Journal of Operational Research, 25: 1-13. Open access. Invited paper.

- Extra

Governments should be open and transparent about their understanding of the nature of risks to the public and about the process they are following in handling them

Challenge: a professional language and terminology that makes this communication work effectively

P

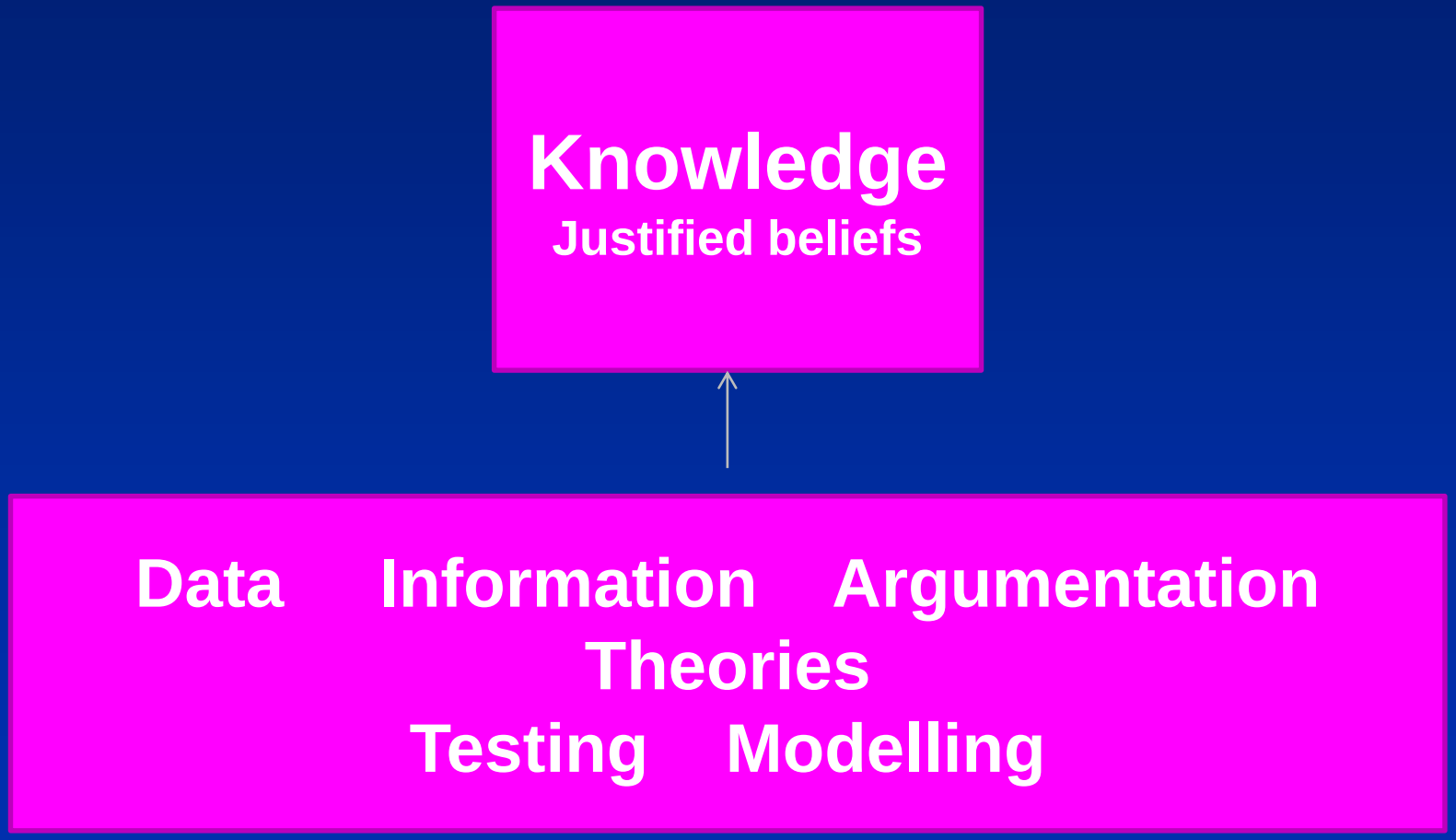
Risk

Good risk communication

Good risk analysis science

Good communication

Scientific knowledge



Risk Analysis

1. nature (natural science),
2. ourselves (e.g. psychology and medicine),
3. our societies (social sciences),
4. our own physical constructions (e.g. technology and engineering),
5. our own mental constructions (e.g. linguistics, mathematics and philosophy)

Supporting risk knowledge generation in medicine, natural sciences, etc. Supporting the tackling of risk problems (A)

Generic concepts, principles, approaches and methods on how to understand, assess, communicate and manage risk (B)

Risk Analysis

SRA Glossary
www.sra.org/resources

Supporting risk knowledge generation in medicine, natural sciences, etc. Supporting the tackling of risk problems (A)

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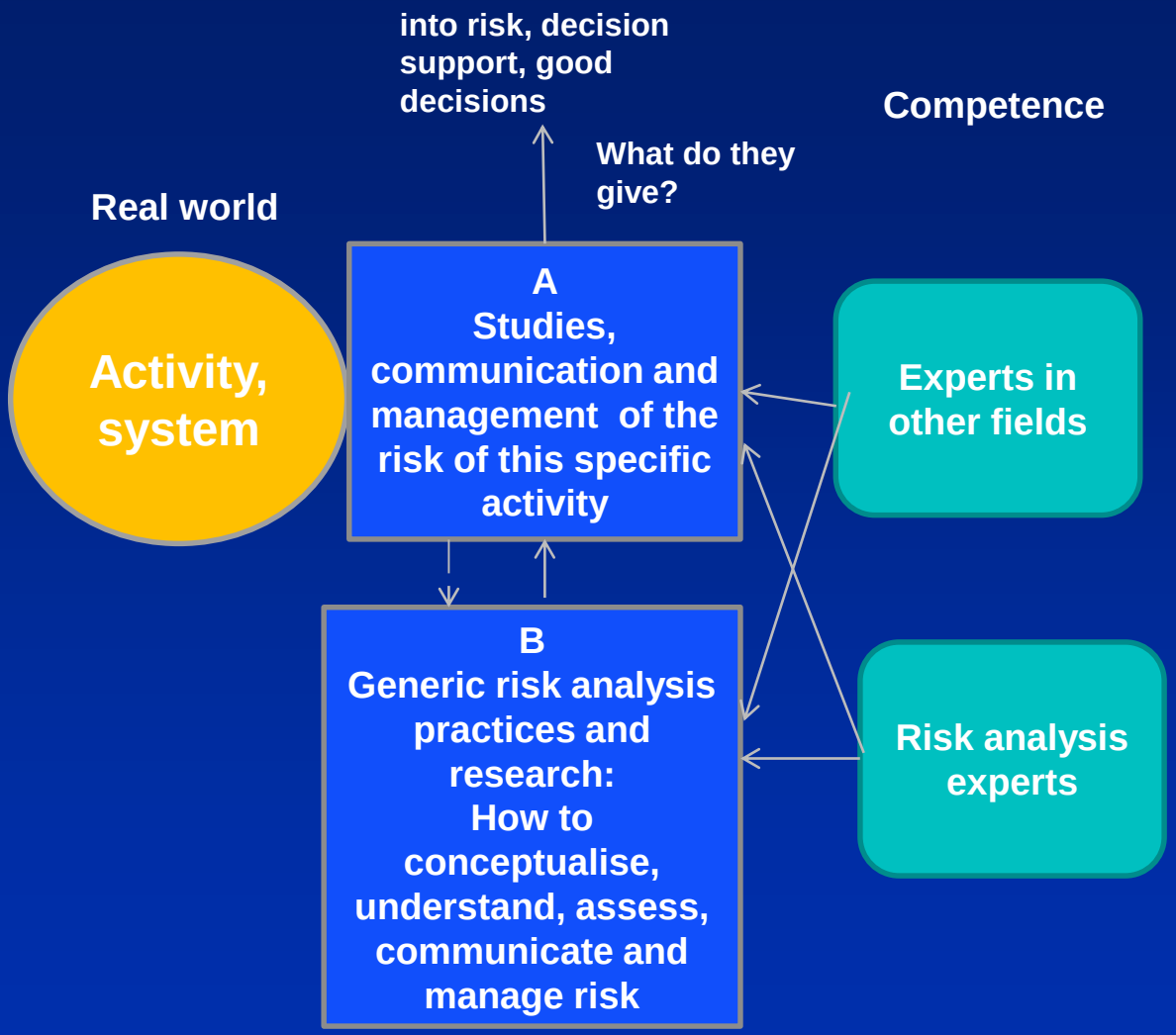
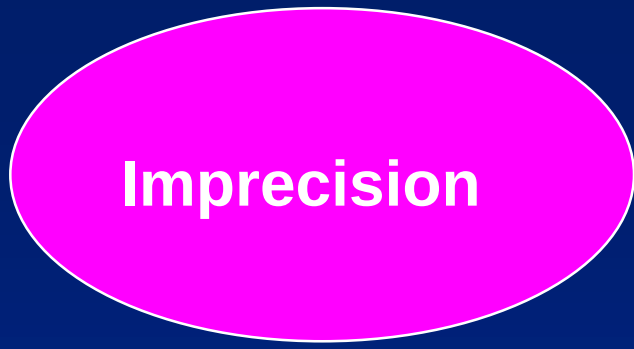

into risk, decision support, good decisions
What do they give?
Competence
Real world
Activity, system
A
Studies, communication and management of the risk of this specific activity
Experts in other fields
B
Generic risk analysis practices and research:
How to conceptualise, understand, assess, communicate and manage risk
Risk analysis experts

Principle

This process of balancing different concerns can be supported by cost-benefit balancing methods, but this type of formal analyses needs to be supplemented with broader judgements of risk and uncertainties, as well as stakeholder involvement processes

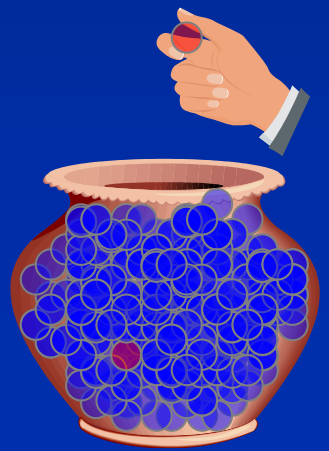


- Probability (knowledge-based, frequentist)
- Imprecise probability
- P(A|K), K knowledge
- Probability model
- Model uncertainty

Knowledge-based probability

- P(A|K) = 0.1
- The assessor compares his/her uncertainty (degree og belief) about the occurrence of the event A with drawing a specific ball from an urn that contains 10 balls (Kaplan and Garrick 1981, Lindley, 2000).

K: background knowledge



Other types of probabilities

- Logical probabilities
  - P(h|e), which measures the objective degree of logical support that evidence e gives to the hypothesis h

Risk

Risk = uncertainty/potential/possibility

Risk = objective probability distributions

Risk = event …

1980 2018

Risk is expected value

Risk is consequences and probability

Risk is consequences and uncertainties

Aven, T. (2012) The risk concept. Historical and recent development trends. Reliability Engineering and System Safety. 115, 136–145.

Uncertainty

Imprecision

Variation

Uncertainty: P(temp increases >2) = 0.75

Imprecision P(temp increases >2) > 0.50

Variation P_f(«1») = ?

P(temp increases >2 |K)

K: Knowledge

Risk metrics

P(A)

VaR

F-N curve

E[Loss]

$P(B_1)$ $E[Loss|B_1)$
$P(B_2)$ $E[Loss|B_2)$
…

Knowledge base must always be included

Expected utility theory

Cost-benefit analysis

a) Unknown unknowns

b) Unknown knowns

c) Known but not believed to occur because of low judged probability

Extreme consequences

IPCC – Intergovernmental panel on climate change

1. Global warming takes place and is extremely likely (greater than 95% probability) to be the result of human activity

2. Ocean acidification will increase for centuries if CO2 emissions continue, and will strongly affect marine ecosystems (with high confidence).

3. The threshold for the loss of the Greenland ice sheet over a millennium or more, and an associated sea level rise of up to 7 m, is greater than about 1°C (low confidence) but less than about 4°C (medium confidence) of global warming with respect to pre-industrial temperatures.

Confidence: evidence + agreements

Statement Event A	Uncertainty measure Q	K SoK

K: knowledge
SoK: Strength of knowledge