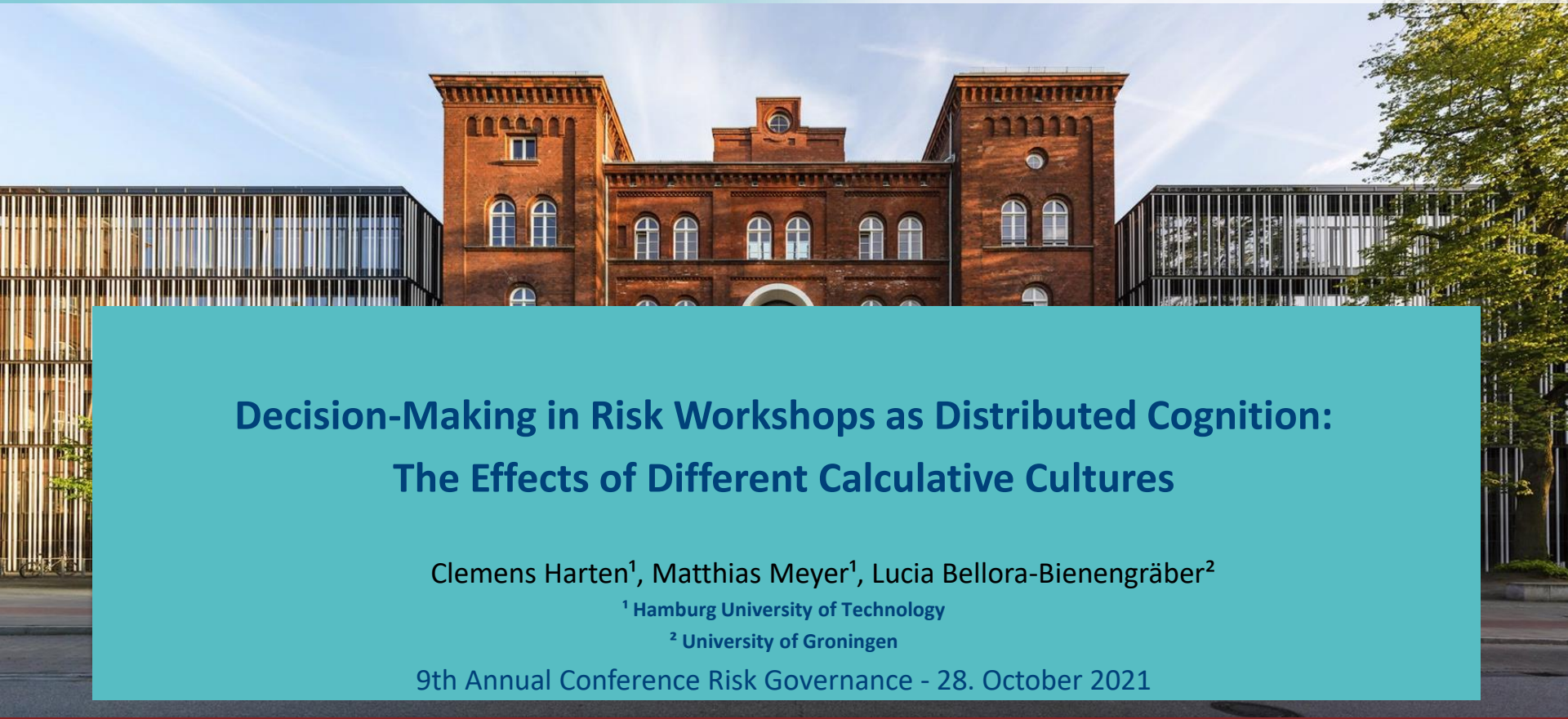

Decision-Making in Risk Workshops as Distributed Cognition: The Effects of Different Calculative Cultures

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Introduction

Calculative culture and its impact on risk assessment

An organizations culture, and specifically its calculative culture, impacts how and which risks are assessed (Power 2007). Mikes (2009) distinguishes *ERM by the numbers* and *holistic ERM*, which differ regarding their approach to assessing risks, raising the question of how the assessment of risks is impacted by the organization's culture.

A cognitive perspective on risk assessment

We need to better understand how actors think and communicate about risks (Power 2016). We can improve the understanding of how risk management happens in organizations by accounting for the sense-making of decision-makers regarding risks (Taarup-Esbensen 2019).

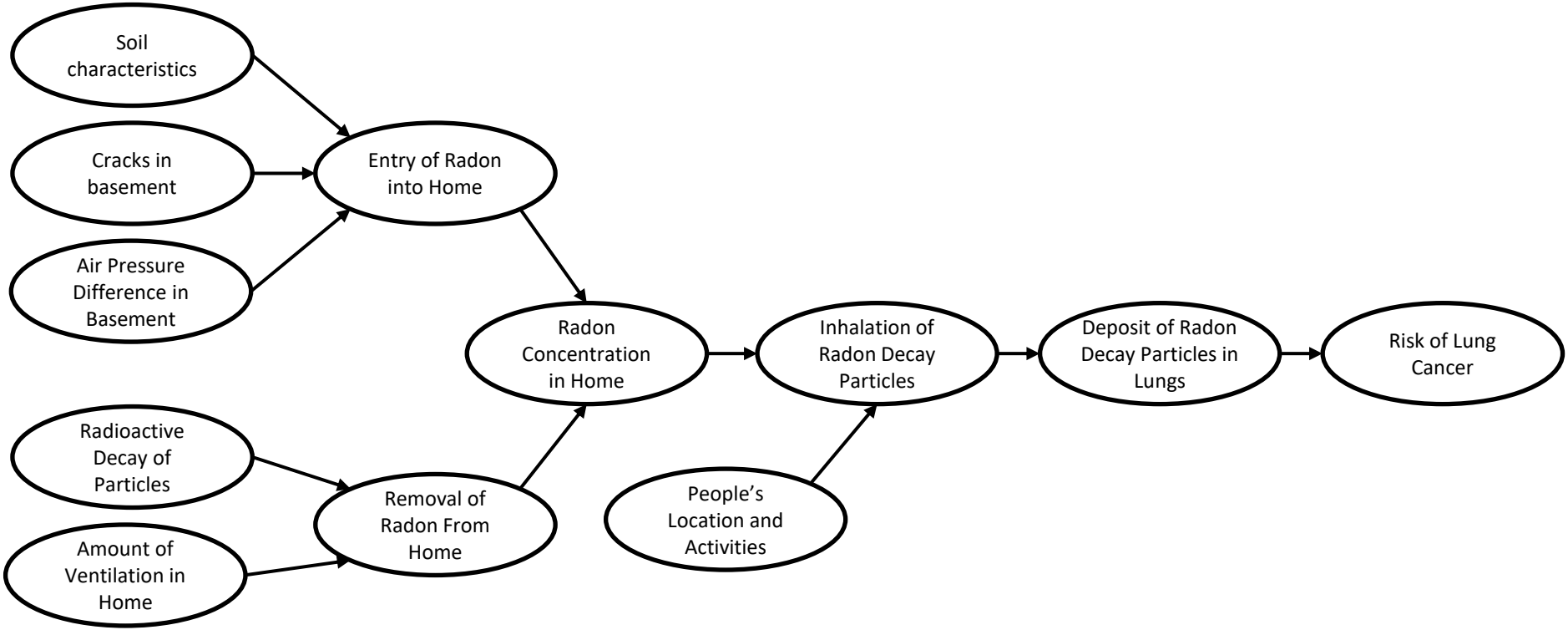
Distributed cognition in risk assessment

Risk assessment needs to bring together expertise from several domains and to include different perspectives on a risk (ISO 2009). The cognitive task of assessing a risk is shared between several stakeholders, a setting described as distributed cognition (Hutchins 1995).

Risk workshops as a tool of risk assessment

A common approach to identify and assess risks are workshops, where people with different roles and hierarchies within the organization discuss and share their knowledge to come to an evaluation of certain risks (COSO 2017). Participants start with a list of predefined risks and discuss each risk for a limited time. The discussion ends with a decision on how to classify a risk, e.g., regarding its impact (Quail 2011).

Theory: How do we make sense of risks?



Mental model taken from (Atman et al. 1994)

Theory: Two calculative cultures

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Calculative idealism

- quantitative enthusiasm
- ERM ‘by the numbers’
- focus on risk quantification
- risk models should be robust and accurate
- risk control limited to quantifiable risks
- ERM as a computational tool

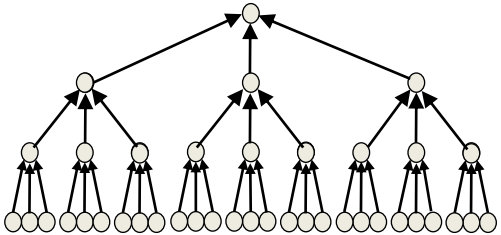
Calculative pragmatism

- quantitative skepticism
- holistic ERM
- focus on risk judgement
- judgement overrides quantitative results
- inclusion of non-quantifiable risks
- ERM as a ‘learning machine’

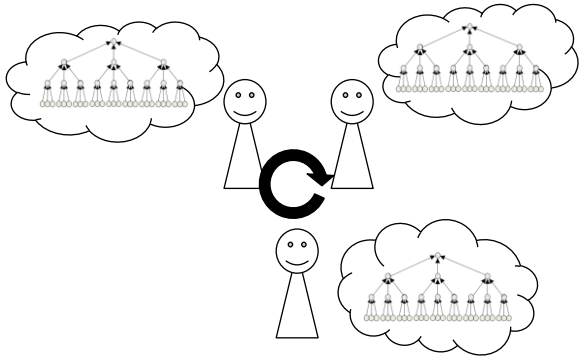
As described by Mikes (2009), Power (2007)

Method: Simulating risk workshops

Ideal causal model
(randomly generated)



Simulated risk workshop with participants
(limited knowledge)



Workshop risk assessment

High probability,
medium likelihood.

Benchmark risk assessment

High probability,
medium likelihood.

cf. (Harten et al. 2021)

Calculative cultures and cognitive architecture

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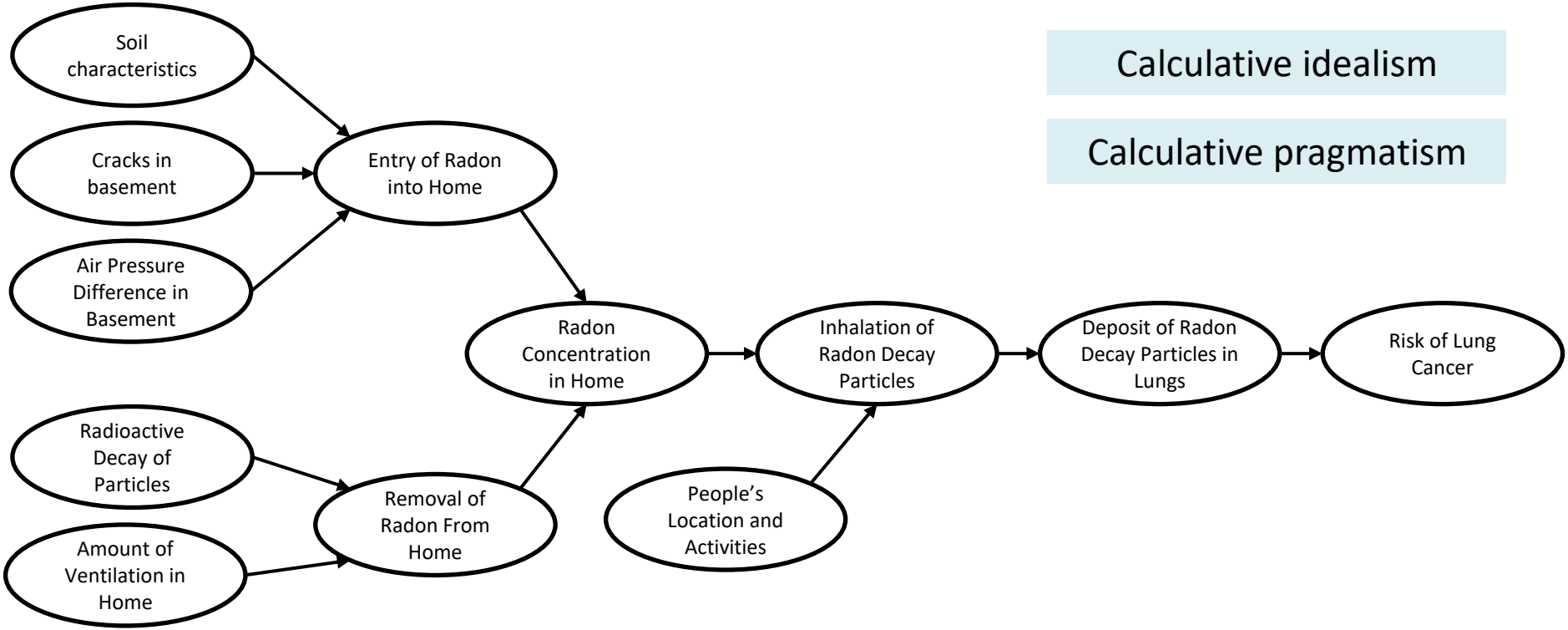
Matching calculative culture with cognitive architecture

In order to simulate the cognition of risk workshop participants, we need to choose a cognitive architecture to process the participants' mental models. We identify two cognitive architectures that are suitable to model the cognition of quantitative enthusiasts and quantitative sceptics.

Calculative culture	Cognitive architecture	Properties
Calculative idealism	Bayesian networks	• Encodes causal relationships • Quantifiable; calculative tool • Relies on precise input
Calculative pragmatism	Constraint satisfaction networks	• Encodes coherence-based relationships • Modeled after human cognition • Qualitative focus, judgement oriented

Two perspectives on a risk



Calculative idealism

Calculative pragmatism

Figure taken from (Atman et al. 1994)

Two perspectives on a risk

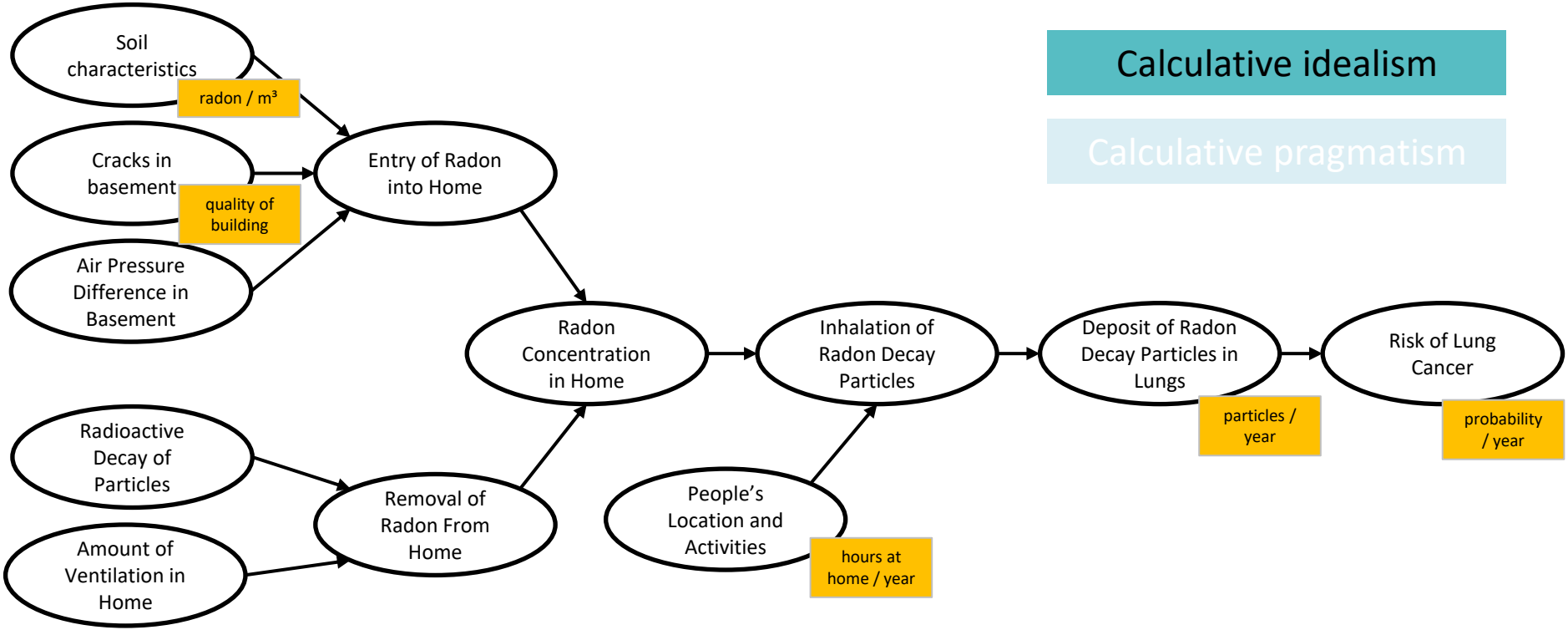
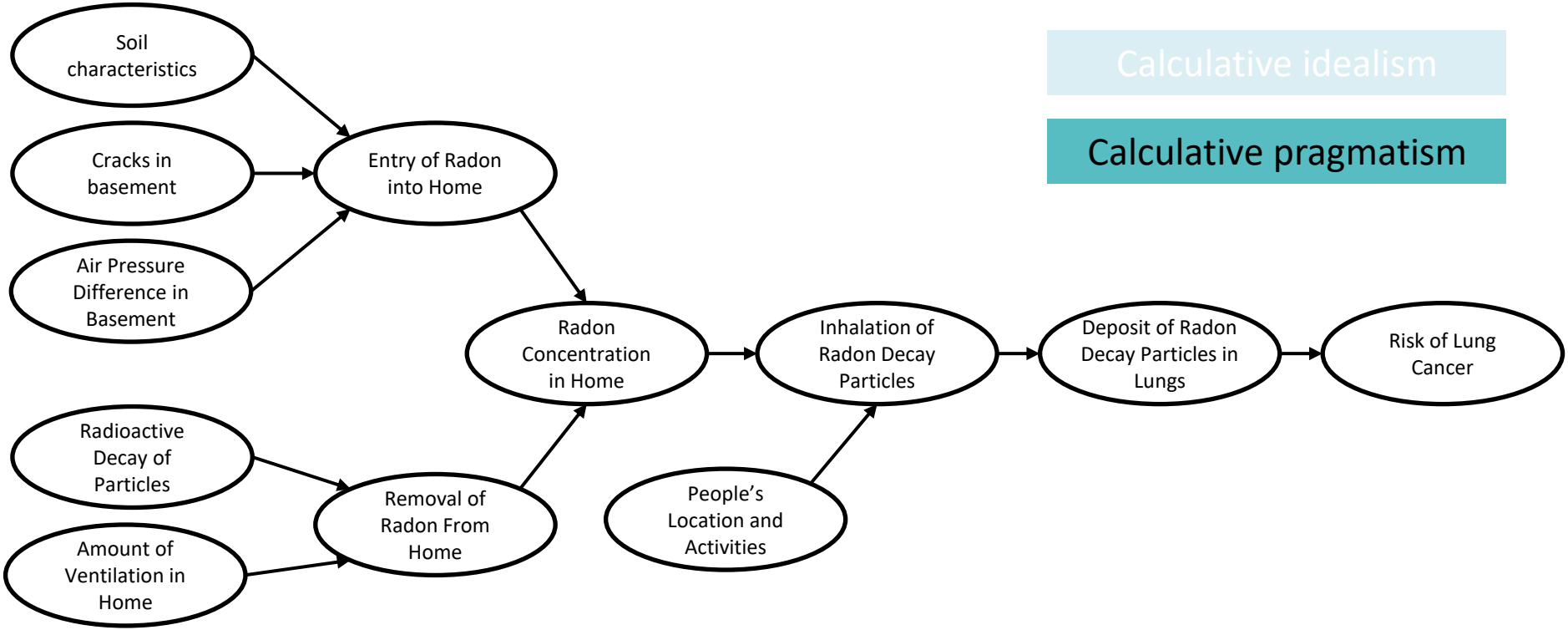


Figure taken from (Atman et al. 1994)

Two perspectives on a risk

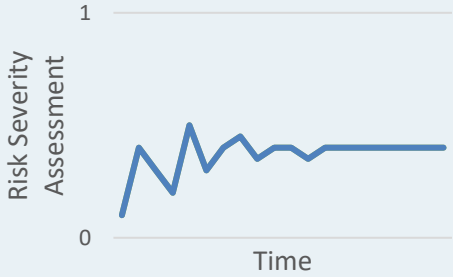
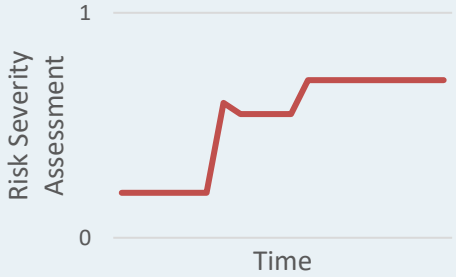


Calculative idealism

Calculative pragmatism

Figure taken from (Atman et al. 1994)

Comparison of calculative cultures

	Calculative idealism / Bayesian networks	Calculative pragmatism / constraint satisfaction networks
Typical development during a (simulated) risk workshop	• Assessment changes with each new input • Large changes in the beginning, less reaction after a while • Weak path dependency	• Assessment can be unchanged with new input (absorption) • Assessment changes rarely, but strongly • Strong path dependency
Illustration of change of the assessment over time		
Implications for risk workshops	• Strong swings in assessment indicate low certainty • Discussion should continue until assessment stalls	• A stable assessment does not indicate high certainty • Important to consider the starting point of participants • Structure of the discussion is especially important

Simulation results for Bayesian networks are published in (Harten et al., 2021), simulation experiments for CSN are in progress.

Discussion

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How does calculative culture impact the outcome of risk workshops?

- We simulate discussions in risk workshops using two different cognitive architectures (Bayesian networks and constraint satisfaction networks), representing two different calculative cultures (calculative idealism and calculative pragmatism).

- The simulated discussions, which happen within the same risk workshop framework, show different characteristics, depending on the cognitive architecture chosen.

- Real workshop participants are likely to show behavior related to both approaches, dependent on their personality, the corporate culture, the design of the risk workshop and the nature of the risk under discussion.

- Risk workshop facilitators need to be mindful of how the workshop participants make sense of the risk, and the implications this has on the requirements for the structure of the risk workshop.

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