RECONSIDERING CONFIDENCE IN ASSURANCE CASES

From quantification to strength-of-knowledge aggregation

Andreas Hafver[1], Dag McGeorge[1], Frank Børre Pedersen[1] and Roger Flage[2]

[1]DNV, Oslo, Norway
[2]University of Stavanger, Norway

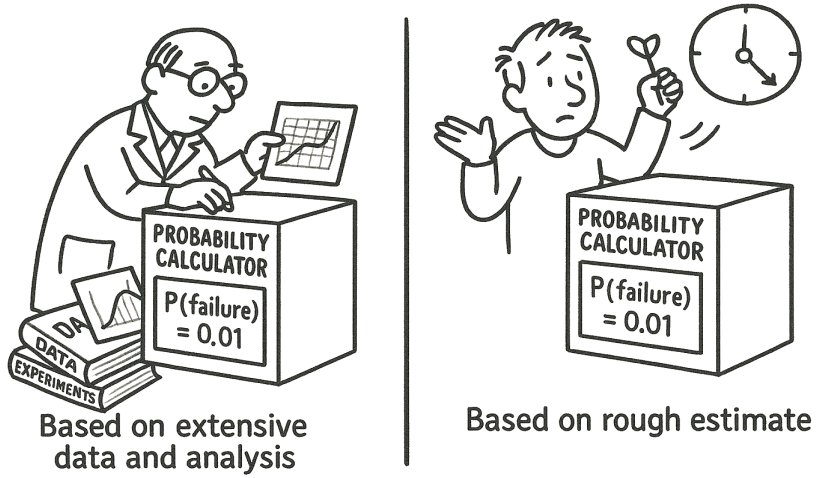
The problem

Quantitative approaches are often used to express and propagate confidence…

- Probabilities and Bayesian networks
  (e.g. Guo 2003, Denney et al. 2011, Hobbs and Lloyd 2011, Zhao et al. 2012)
- Dempster–Shafer theory
  (e.g., Cyra and Gorski 2008a,b, Guiochet et al. 2015)
- Subjective logic
  (e.g., Duan et al. 2015, Yuan et al. 2017)
- Evidential reasoning
  (e.g., Nair et al. 2014, 2015)

… but have been criticised based on:

- Inconsistencies in results
  (Graydon and Holloway 2017)
- Ambiguous interpretation

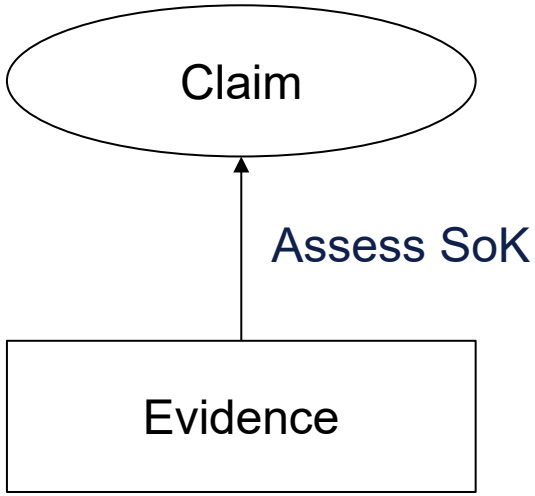


- Quantitative confidence assessments take much effort but end up creating ambiguous results.
- Ultimately, we end up doing some qualitative evaluations anyway.
- **Could we do better by performing rigorous qualitative assessment straight away?**

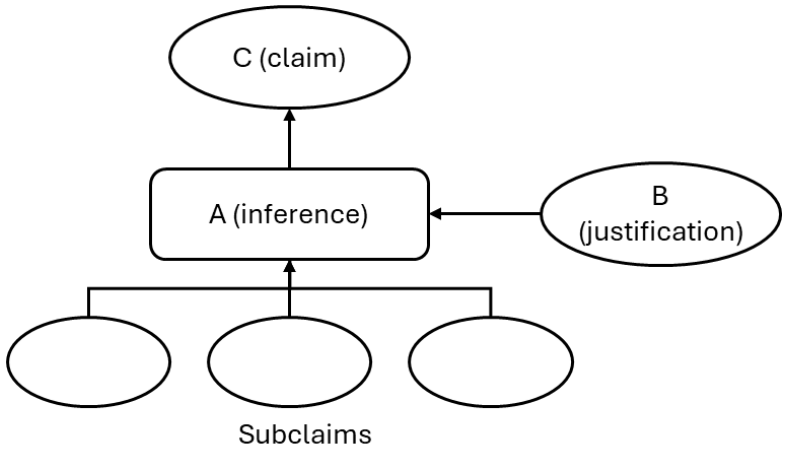
Our proposed solution

Strength of knowledge (SoK) to assess confidence in the evidence incorporation

(Flage and Aven 2009, Aven 2013 & 2014, Berner and Flage 2016)



Three-valued logic to propagate confidence through internal assurance argument steps



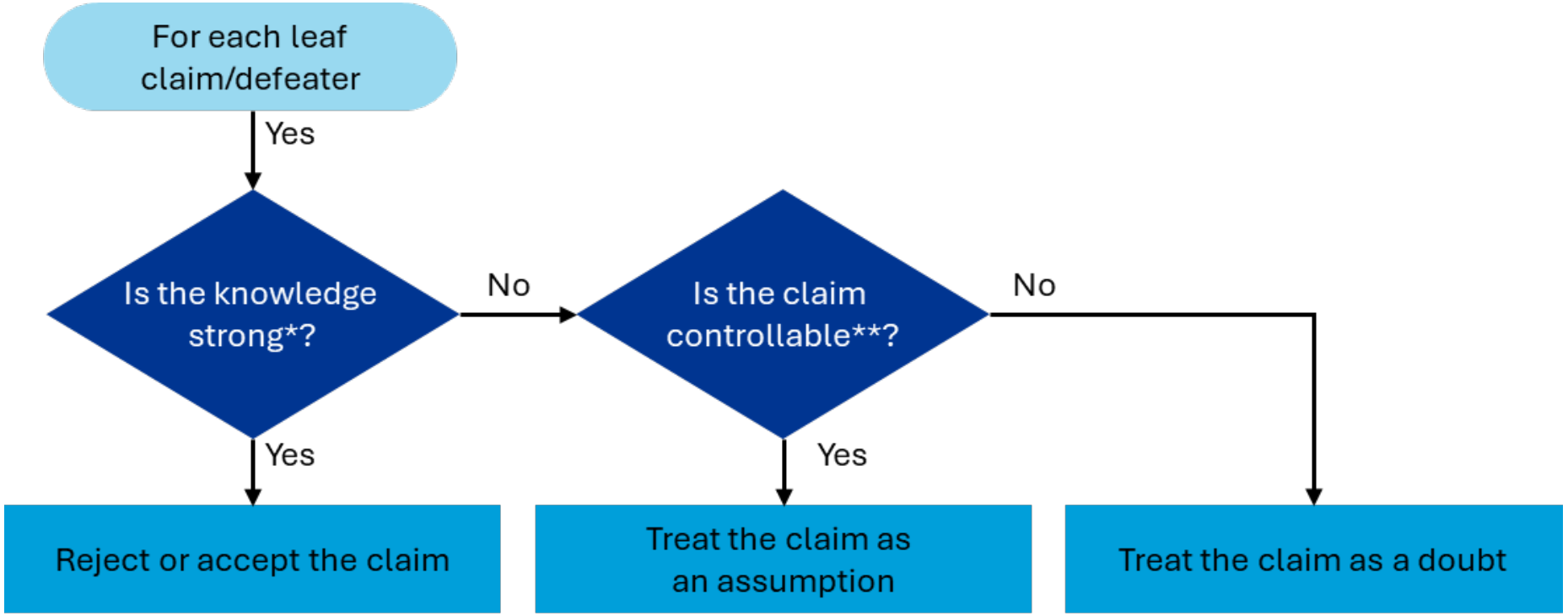
If B=T then A else U	B		
	F	U	T
A F	U	U	F
A U	U	U	U
A T	U	U	T

T (true): Strong knowledge supporting the claim

F (false): Strong knowledge refuting the claim

U (uncertain): Weak knowledge in either direction

Strength-of-knowledge criteria



*** Is the knowledge strong?**

- What is the **direction** of the evidence?
- What are the **interpretations** of the evidence
- What are the **sources** of the evidence?
- What are the **methods** behind the evidence?

**** Is the claim controllable?**

- Are there reliable means to **enforce the claim**?
- Can we **detect if it becomes invalid or uncertain**?
- Can we demand or assume that **somebody else controls it**?

Concluding remarks

Our main contributions:

- A method for **propagating strength-of-knowledge (SoK)**
- **Adapted SoK criteria** for assurance cases

Why is this interesting?

- Three-valued logic **allows confidence propagation in a way that differentiates between inference and justifications** (we do know that some practitioners already do this).
- The proposed **strength-of-knowledge criteria can function as generic acceptance criteria** for evidence incorporation (additional acceptance criteria can be elaborated in justifications).

Thank you!

Andreas.Hafver@dnv.com
+47 99573565

www.dnv.com