



Reframing AI Large-scale Risks

A Quantum-inspired approach to AI Regulation

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AI Act

Static “product-safety” legislation

- Ex-ante, application-dependent, risk-based legislation
 - AIs deployers must identify **in advance** both known and foreseeable risks
- The 4 risk categories and the risk assessment are **not sufficiently granular and flexible** especially for GPAI, which has **unpredictable applications**

A dynamic risk assessment (Novelli et al 2024)

- **risk magnitude weighs** the impact of AIs on fundamental values, by considering **interactions** among **determinants** (i.e., hazard, exposure, vulnerability, response), their **drivers**, and other **risks** (e.g., sustainability)
- **proportionality judgment** concerning trade offs between risk mitigation measures and the values (positively and negatively) impacted by AIs
- **scenario-based** risk assessment

Enduring limitations

- still an ex-ante (multi-factorial) **linear extrapolation**
- **no systemic** standpoint (Calzati & van Loenen 2023)
- legal norms as **technical standards** (Smuha et al 2021)

→the impact of GPAI is hard to predict because **it does not abide to entailing laws**

→E.g. GenAI as “limited risk”, yet leading to severe **unintended consequences**

Twisting perspective



Quantum Ecology

[Calzati & de Kerckhove 2024](#), MIT Press

Onto-epistemological framework, whose pillars are *uncertainty, complementarity, nonlocality, superposition, entanglement*

Technological paradigm, pivoting around Quantum Information Technologies (QITs)



Wigner's friend thought experiment

- 1) Wigner's friend performs the measurement of a particle (e.g., spin) inside a laboratory.
- 2) For her, the measurement yields a definite outcome (e.g., spin up).
- 3) For Wigner, who is outside the lab and treats the entire scenario as a quantum system, the outcome is not definite yet, i.e., still in superposition.

→ **Configurational realism**: Different observers can assign different "real" states to the same system → **no observer-independent physical phenomenon**.

→ **Relational epistemology**: Two observers can hold **complementary** but **equally valid** knowledge claims about a phenomenon.

→ **Nested inconsistent onto-epistemological configurations** ([Frauchiger & Renner 2018](#))



3 technological ecologies of sens-making

1) **Language** → based on **meaningful world-sensing**
(e.g., law)



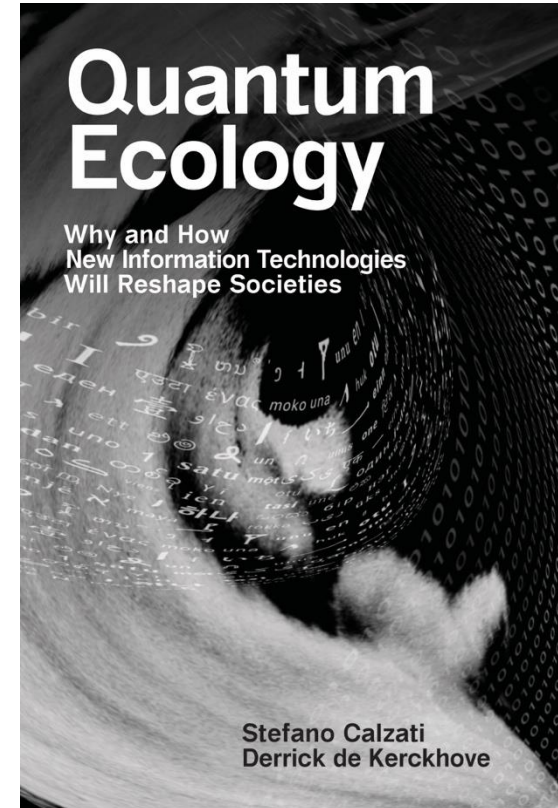
Partial onto-epistemological incommensurability

2) **Digital** → based on **computable world-sensing**
(formatting of sensing into 0s & 1s)



Partial onto-epistemological incommensurability

3) **Quantum** → based on a **probabilistic world-sensing**
(synthetic sensing)



(Digital) ecology as a complex system

- “**An ecology has effects but not causes** in the ordinary sense of a direct relationship between cause and effect.” ([Calzati & de Kerckhove 2025](#))
→ complex system showing **emergent behaviours**
- **Complexity is an issue of framing**, “a way of observing systems, not an absolute class of systems.” ([Gershenson & Heylighen 2003](#))
→ Complexity is an **observer-observed entanglement** (Calzati 2026)
- The phase space of a complex system is “**unprestatable**” as its state changes non-predeterminedly ([Kauffman 2019](#))
→ Agency and system are **mutually implicated**

Quantum-inspired approach to AI regulation

- AI risks are **always systemic**, partly unavoidable and partly unpredictable
- **Operationalisation of quantum principles** as resources for complexity-informed policymaking (cf. [Myeong 2025](#); [Renda 2025](#))
 - How can we regulatorily work with/through **fundamental uncertainty** and **value entanglements of AI effects**?
 - How can we regulatorily accommodate **complementary scenarios** (e.g., counterfactuals or nonlocal trade-offs across scales) coming out of AI uses?

Applying

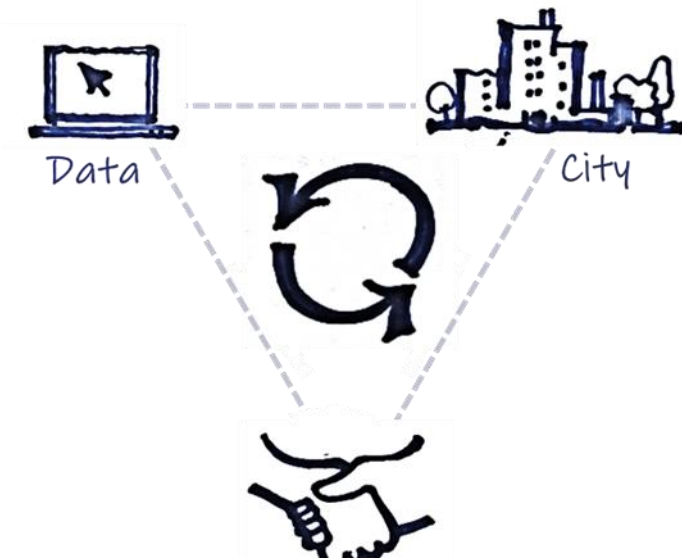
A teaching example in data ethics

“Technology is neither good nor bad; **nor is it neutral.**” ([Kranzberg 1985](#))

AI as “**pharmakon**” of the digital ecology: at once, good & bad; both poison & antidote.

→ AI applications produce **value-laden entanglements** (good & bad) and **uncertain consequences** (intended & unintended)

→ **Systemic inconsistencies** addressed through quantum-inspired **speculative design**



From “problem solving” to “problem opening”

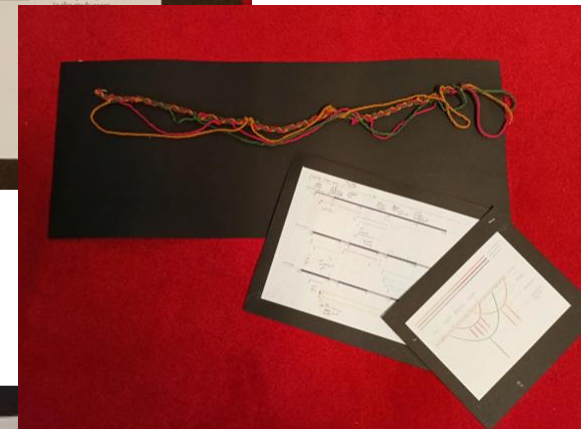
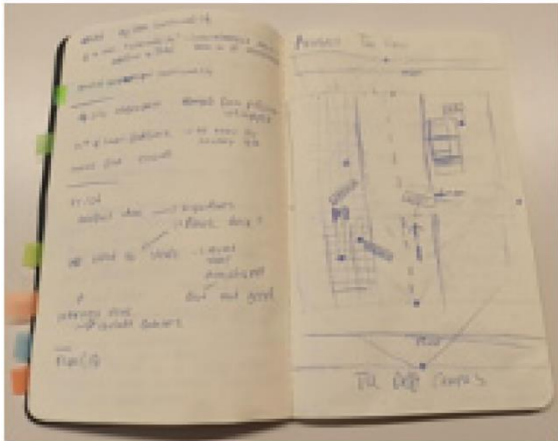
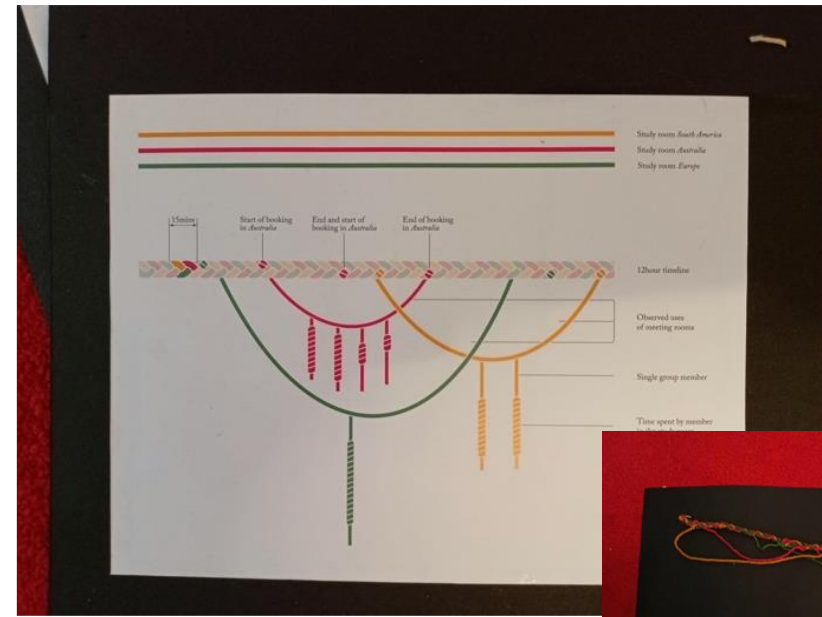
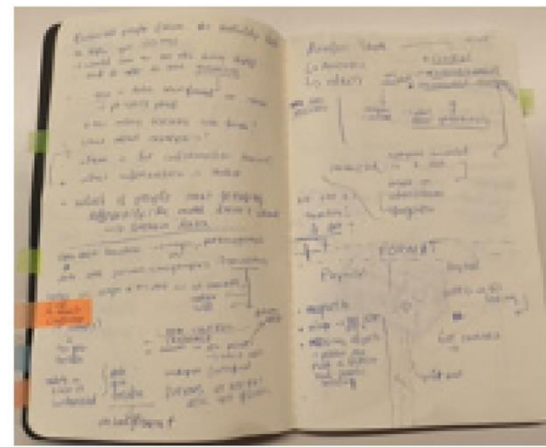
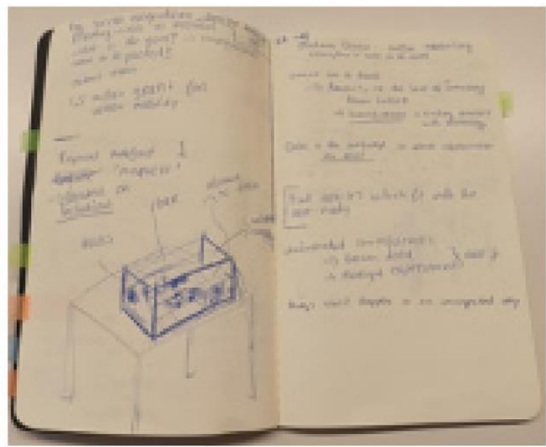
[Calzati & Ploeger 2023](#)

Research

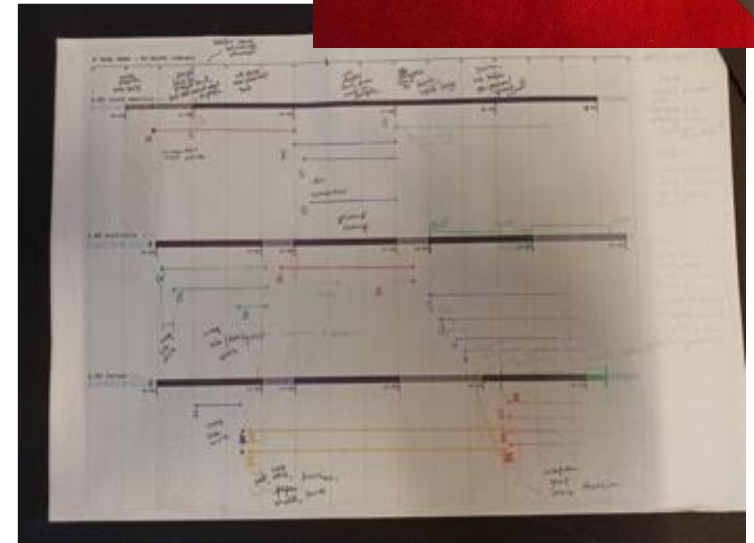
- 1) **Identification** of a case study
- 2) **Framing** of the case study (e.g., how it is presented; how it works; etc.)
- 3) **Data-value entanglements** (e.g., values in/excluded; data in/excluded)
- 4) **Open-ended scenarios** (e.g., possible un/intended consequences)

Design

- a) **Project journal**
- b) **Artefact** (e.g., physical/digital object exposing/redressing the tensions identified)
- c) **Author’s statement** describing the artefact



“Design is **indeterminate** in order to be practical” ([Easterling 2021](#))



Thank you

<https://stefanocalzati.com>

(Mi Lin, book cover's artist, [Milandia 瀾瀾之域](#))

Quantum Ecology

Why and How
New Information Technologies
Will Reshape Societies

Stefano Calzati
Derrick de Kerckhove