

Fairness symposium, Leiden University, March 2019

## **“Data Sciences” in the wild**

# **contextualisation and participation for responsible use in policy**

*Based on ‘Indicators in the wild’  
Research Evaluation (2019), 28(1), 7-22.*

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# Towards a responsible use of S&T Indicators

**Misuse and abuse of S&T Indicators** in research evaluation

Scientometrics as 'data science' -- describing science dynamics with data

Reflecting on appropriate **policy use of scientometrics**

**San Francisco  
Declaration  
of Research  
Assessment  
(DORA)**

2016

Don't use  
Impact Factors!!



**The Leiden Manifesto  
for research metrics**

Hicks, Wouters,  
De Rijcke, Waltman  
and Rafols (2015)

*Nature* (23 April 2015)

**The Metric Tide**

HEFCE Report

- Robustness
- Humility
- Transparency
- Diversity
- Reflexivity

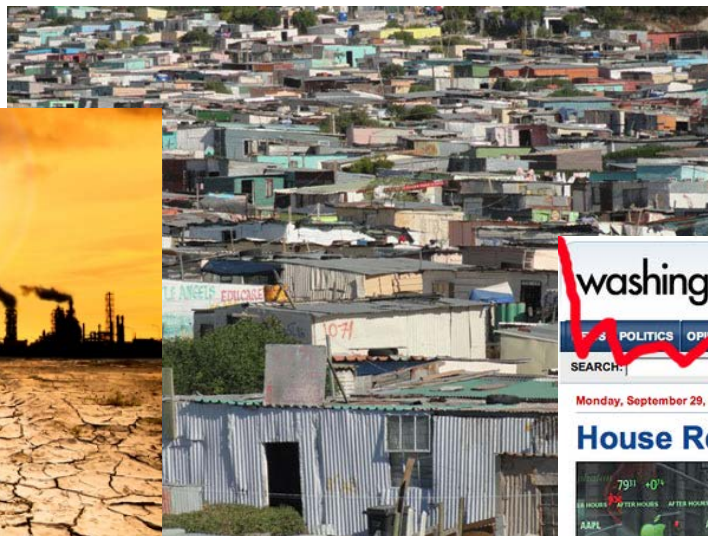
## The argument:

- Policy demand for knowledge that addresses societal problems
- Digital studies perceived as providing new approaches to solve them
- However, societal problems cannot be solved ONLY by science
  - Under conditions of **high uncertainty & lack of value consensus...** one cannot separate knowledge formation from decision-making
  - Decision-making has to **scrutinize assumptions in knowledge**
- **Need to develop ‘Research in the wild’** (‘en plein air’) in hybrid forums for engaging with contextual and diverse expertise
- This implies three moves (Stirling):
  1. **Broadening out** the scope of data and expertise used
  2. Use quantitative tools for **opening up** in processes that include **deliberation**,
  3. **Engaging** with disparate communities in the **framing of problems and questions**

# **DECISION-MAKING UNDER UNCERTAINTY AND LACK OF CONSENSUS**

# Sci Tech & Innovation expected to solve problems... but ... they can have many bad effects

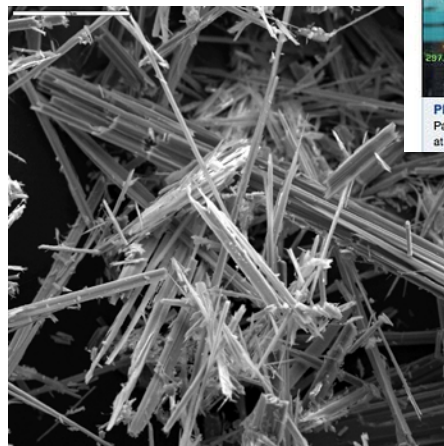
Climate change



Large cities thanks to  
tech but poor housing



Asbestos



Cultural and ethnic suppression

Casino capitalism in  
financial innovation

# The parable of Prussian scientific forestry (*Seeing like a state*, J. Scott)

## Forests in Old Prussia

- Wild
- Uncontrolled
- Unpredictable
- Inefficient



## Enlightenment and Scientific forestry:

- Cut the wild forest
- Plant Norway spruce –reduce diversity
- Increase yield and predictability
- Loss of forest activities for peasants:  
(fruits, hunting, medicinal herbs, etc.)

# The parable of Prussian scientific forestry (*Seeing like a state*, J. Scott)

## Monocultures and Forest death

- Nutrient depletion leading to 20-30% production loss in 2nd generation
- Storm felling
- Pests due to loss of 'services' of insects, birds and animals.



## Restoration forestry or forest hygiene:

- Artificial ant colonies & spiders
- Wooden boxes to provide bird nests
- The dangers of dismembering a complex set of relations and processes to isolate a single element of instrumental value

Planning -- cities, agriculture, etc.

# The parable of Prussian scientific forestry (*Seeing like a state*, J. Scott)

## Task reduction

“Exaggerating only slightly, one might say that the crown's interest in forests was resolved through its fiscal lens into a **single number: the revenue yield of the timber** that might be extracted annually.. ”



## Performativity

“Backed by state power through records, courts, and ultimately coercion, **these state fictions transformed the reality they presumed to observe**, although never so thoroughly as to precisely fit the grid.”



# Three innovation frames (Schot and Steinmueller, 2018)

1. Linear model (postwar until 1980s)
  - Science → Technology → Innovation → Well-being
  - Input (\$, people) and output (pubs, pats) indicators of STI.
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3. **Inclusive or transformative innovation (2010s...)**
  - Innovation not necessarily positive – directions matter.
  - Attention to diverse types of knowledge -- given uncertainty
  - Participation on directions/goals of research and innovation
    - Alignment between research and goals of R&I

# Addressing societal challenges

Complex problems cannot be solved with purely scientific and reductionist approaches

- **High uncertainty** about best of 'solutions'
- **Value-laden** -- social choice about framings and preferences needed
- High degree of **interactivity (feedback)**-- knowing actors shape the system
- Situated **knowledge** is important

**How can Indicators / Data Sciences be used responsibly for policy for complex societal challenges?**

# Criteria for expert/scientific advice to policy

## ***Degree of uncertainty present in a decision context.***

*The greater the uncertainty – both scientific and political – the more important it is for science to focus on policy options rather than simply scientific results.'*

## ***Degree of values consensus on a particular issue.***

*Sharply contested issues raise the political stakes and introduce dynamics quite different from issues which are less controversial.*

Roger Pielke (2007) *The Honest Broker*.

Under conditions of **low consensus** and **high uncertainty**...

...not possible to separate

**knowledge formation & decision making**

-- results depend on contested assumptions

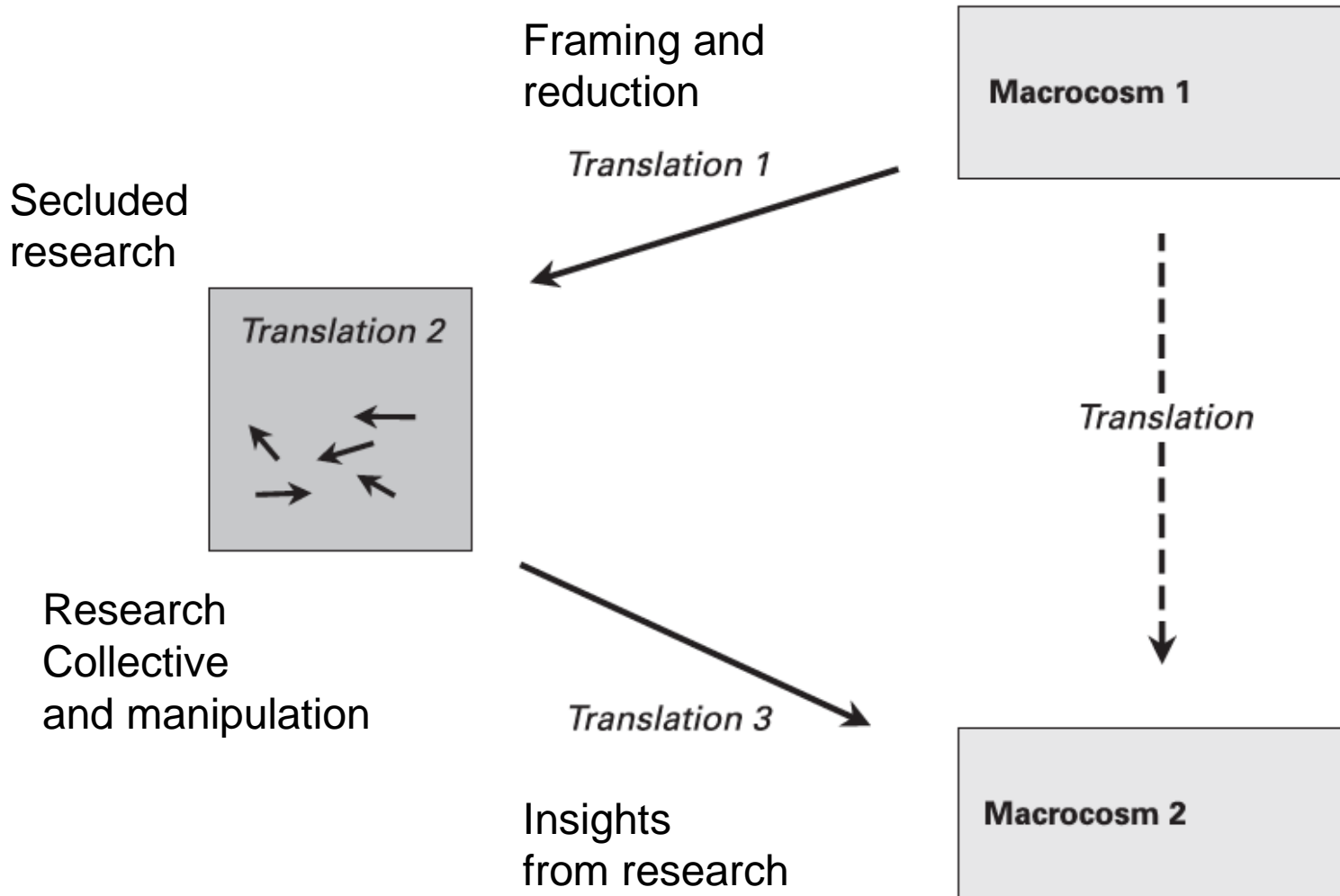
In complex problems - e.g. (research) assessment - typically the case.

How to combine scientific knowledge and decision making?

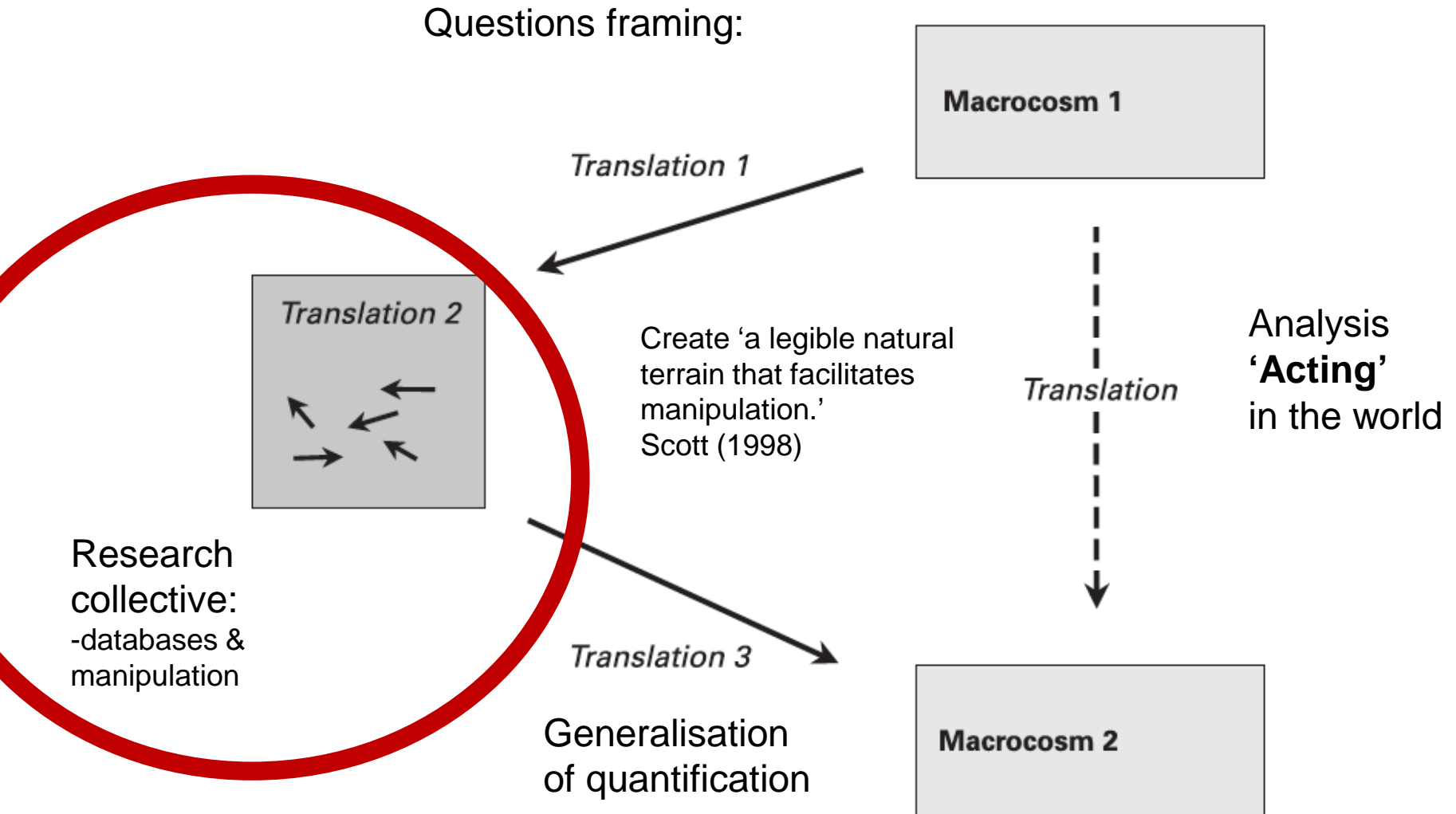
**'DATA SCIENCE' AS SECLUDED RESEARCH:  
THE WORLD IN DIGITAL TRACES**

# How science changes the worlds: Translations

(Callon, Lascoumes & Barthe, 2001, Acting in an uncertain world)

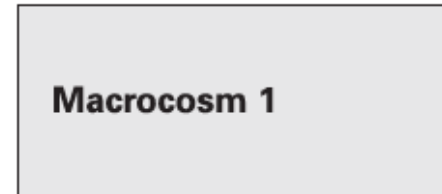


# Data sciences (scientometrics) as a 'secluded science'

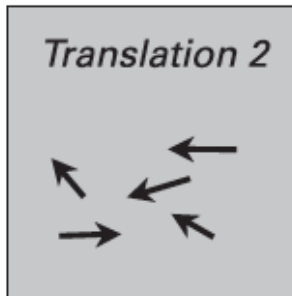


# Use of scientific expertise in policy: dependence and isolation

Framing based on dominant discourses:  
Biotech / Nanotechnologies  
*Ignoring existing alternative practices*



Translation 1



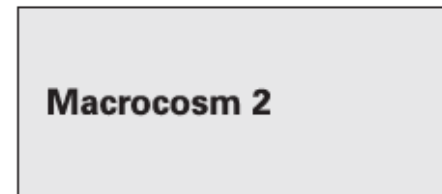
Institutions  
(state, univ.  
industry)

Translation

as patrons  
and users

SHAPING  
THE WORLD

Translation 3



Closed Research Collective:

Dominant databases  
Poor coverage of language,  
topics, regions, countries  
Data in few labs.

Gaps: Insights inconsistent  
with world's complexity (agro, med)

**FAIRNESS**



**TOWARDS 'DATA SCIENCE' IN THE WILD:  
BROADENING OUT, OPENING UP, & ENGAGEMENT**

## Research in the wild (Callon et al. 2001)

### Secluded research:

carried out under controlled conditions, with standardised objects, allowing comparability and reproducibility.

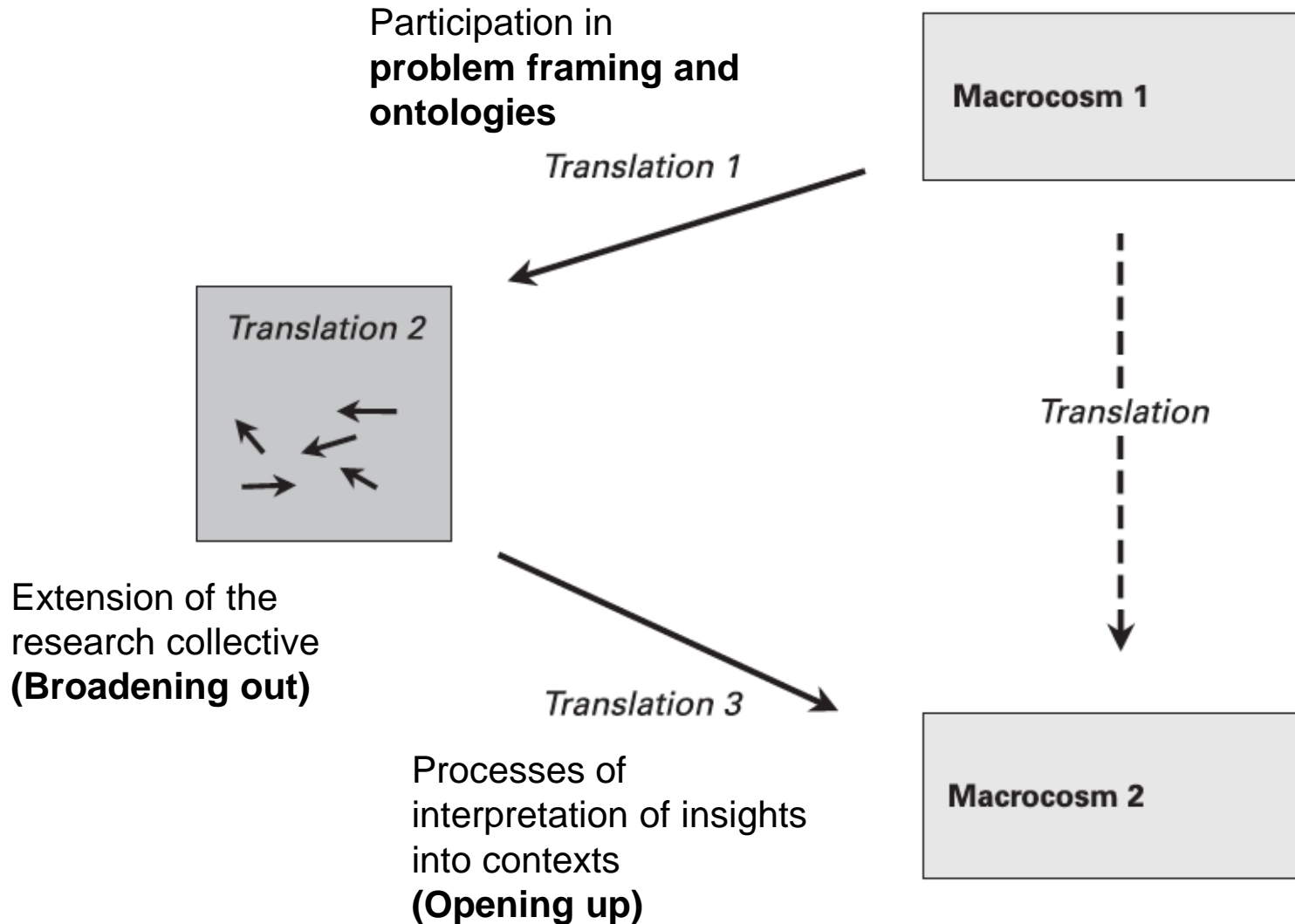


### Research in the wild:

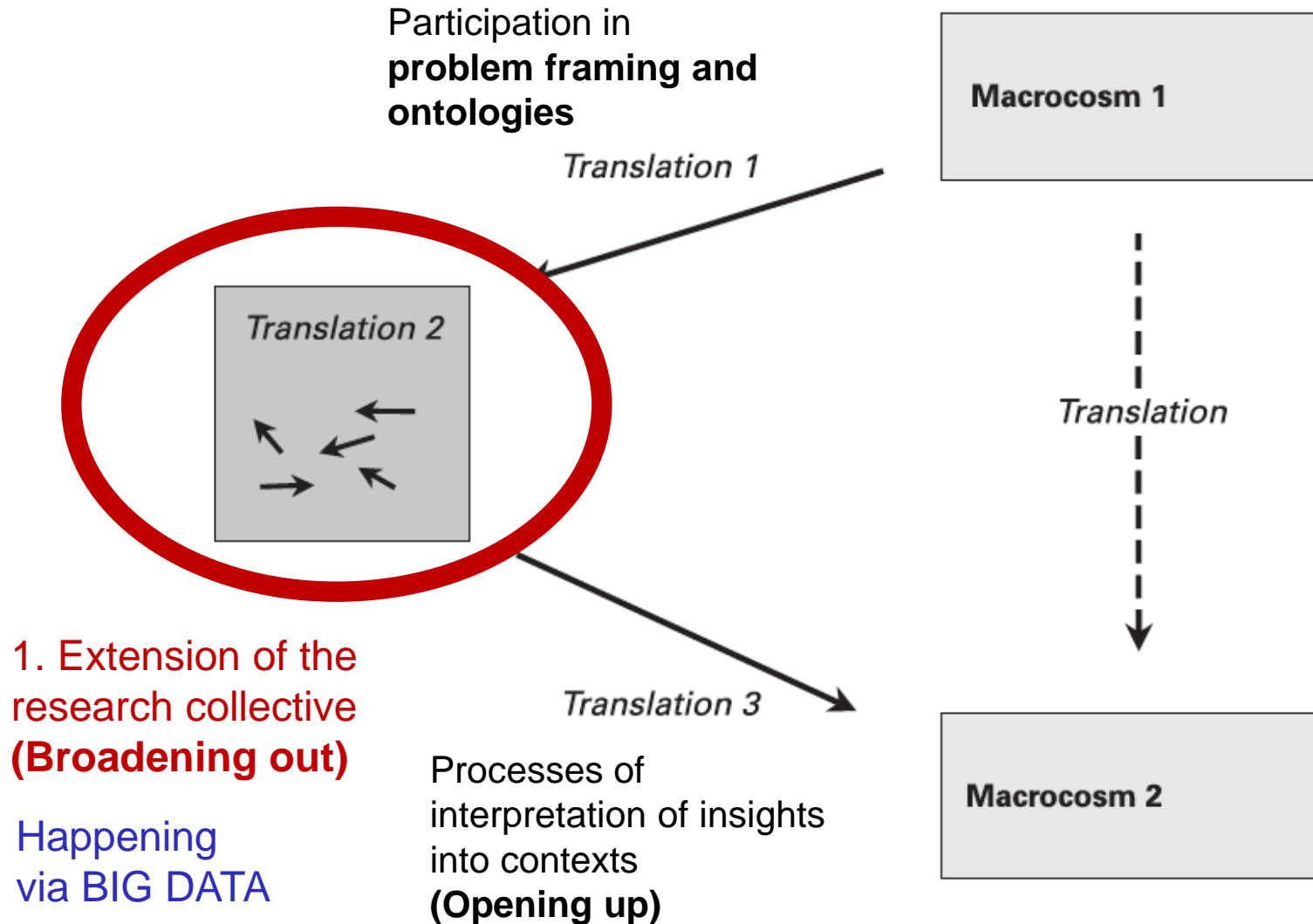
conducted out of the lab, under diverse, uncertain conditions and local contexts.



# Collaboration between secluded res. and res. in the wild



# Collaboration between secluded res. and res. in the wild



# 1. Broadening out data: Expanding the research collective

**This is about pluralising inputs**

**In terms of relevant data in scientometrics:**

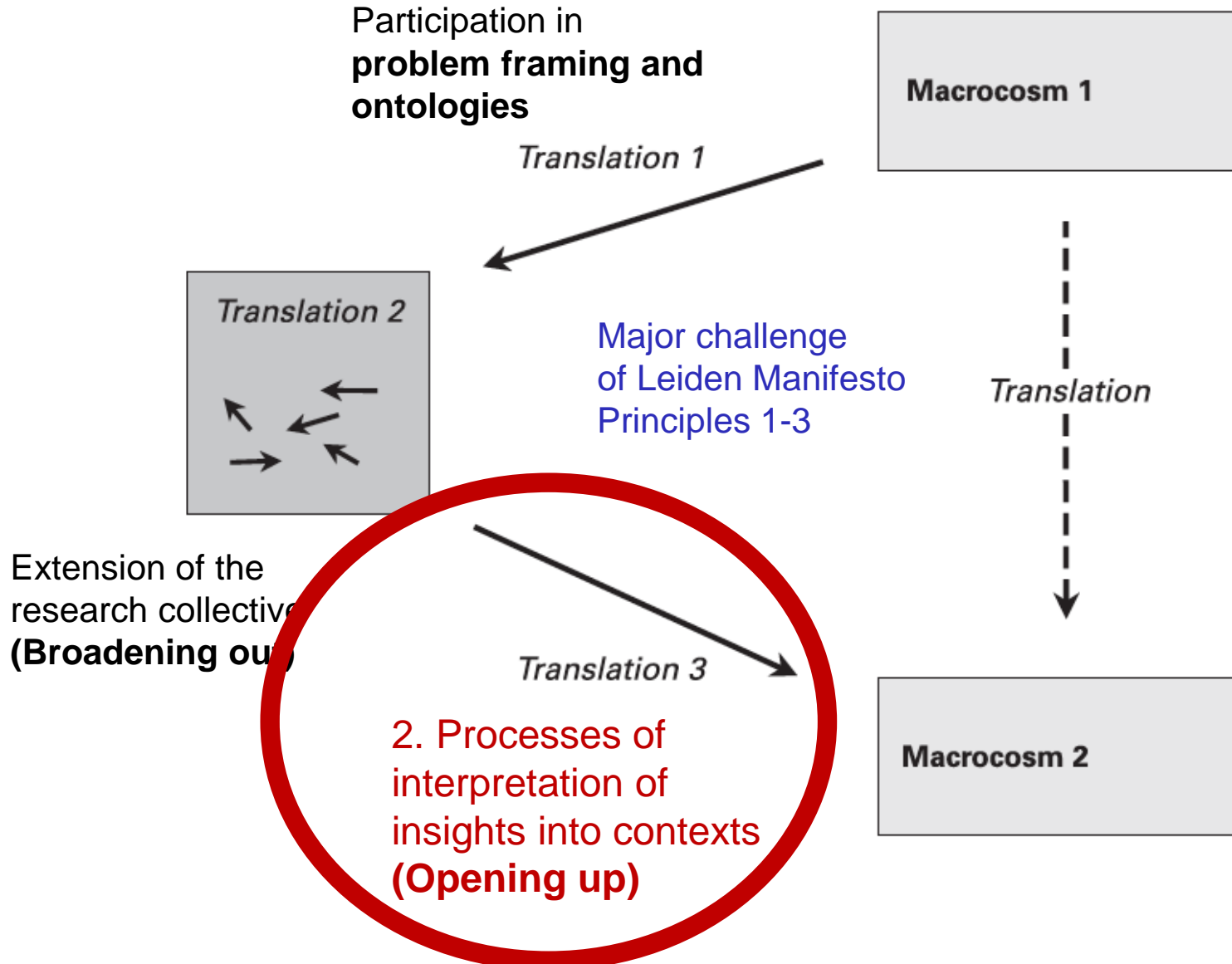
- Previously only: Web of Science or Scopus to....
  - Media → Analysis of news, policy discourse
  - Social media data → Altmetrics
  - Health data → Global disease burden, Healthcare data
  - Economic data → Consumption, exports, etc.

**In terms of expertise of qualitative research (not only digital traces).**

- Mixed-methods
- Case studies
- Participatory methods in research

Checking robustness beyond *in silico*

## 2. Collaboration between secluded research and research in the wild:



## 2. Quantification as a tool in policy deliberation











- ‘Conventional’ use of quantification (‘Science Arbiter’--Pielke)
  - Purely analytical character (i.e. free of normative assumptions)
  - Seeking convergence
  - Aimed at justifying ‘best-choices’ (e.g. excellence)

→ **Unitary and prescriptive advice**
- ‘Opening up’ quantification (‘Honest broker’ --Pielke)
  - Aimed at locating context and dynamics
    - Not predictive, or explanatory, but exploratory
  - Construction of indicators is based on choice of perspectives
    - Make explicit the possible assumptions and choices on what matters
  - Supporting debate
    - Making science policy more ‘socially robust’

→ **Plural and conditional advice**

# Quantitative evidence for opening up: Allowing for flexibility in interpretation

**Closing down: Unique and prescriptive**  
**Proposing “best choices”**  
Rankings -- ranking list of preferences

Academic Ranking of World Universities - 2011				
World Rank	Institution	Country	National Rank	Total Score
1	Harvard University		1	100.0
2	Stanford University		2	72.6
3	Massachusetts Institute of Technology (MIT)		3	72.0
4	University of California, Berkeley		4	71.9
5	University of Cambridge		1	70.0
6	California Institute of Technology		5	64.7
7	Princeton University		6	61.2
8	Columbia University		7	60.4
9	University of Chicago		8	57.5
10	University of Oxford		2	56.4

*how much?*  
*how fast?*  
*who's ahead?*



# Quantitative outputs: Allowing for flexibility in interpretation

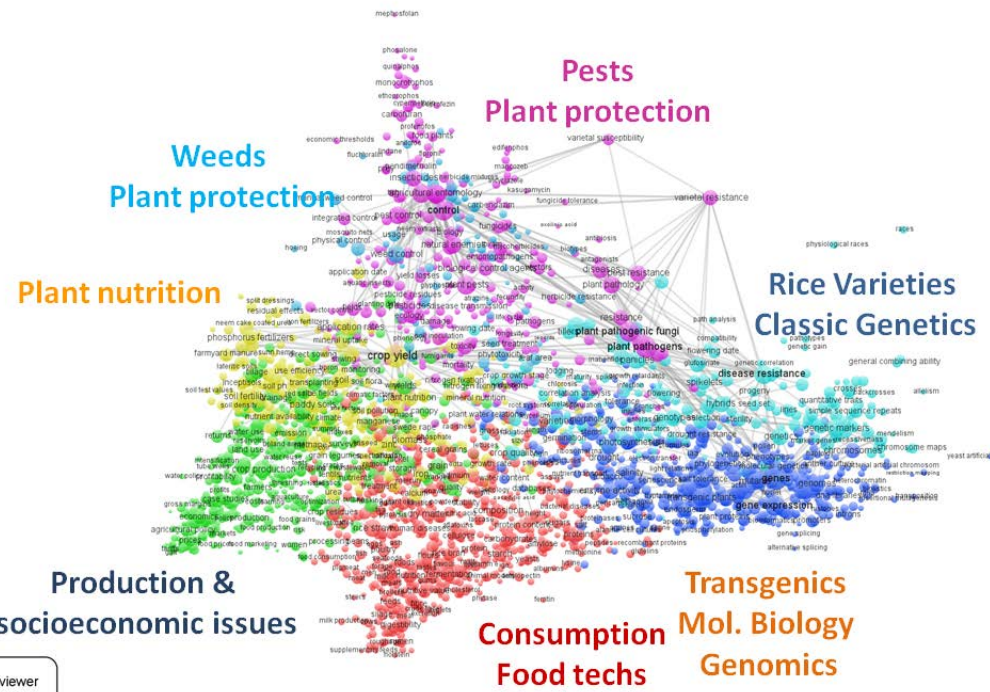
which way?  
what alternatives?  
why?

**Model 1: Unique and prescriptive**  
Proposing “best choices”  
Rankings -- ranking list of preferences

**Model 2: Plural and conditional**  
Exploring complementary choices  
Facilitating options/choices in landscapes

Academic Ranking of World Universities - 2011

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3	Massachusetts Institute of Technology (MIT)	USA	3	
4	University of California, Berkeley	USA	4	
5	University of Cambridge	UK	1	
6	California Institute of Technology	USA	5	
7	Princeton University	USA	6	
8	Columbia University	USA	7	
9	University of Chicago	USA	8	
10	University of Oxford	UK	2	

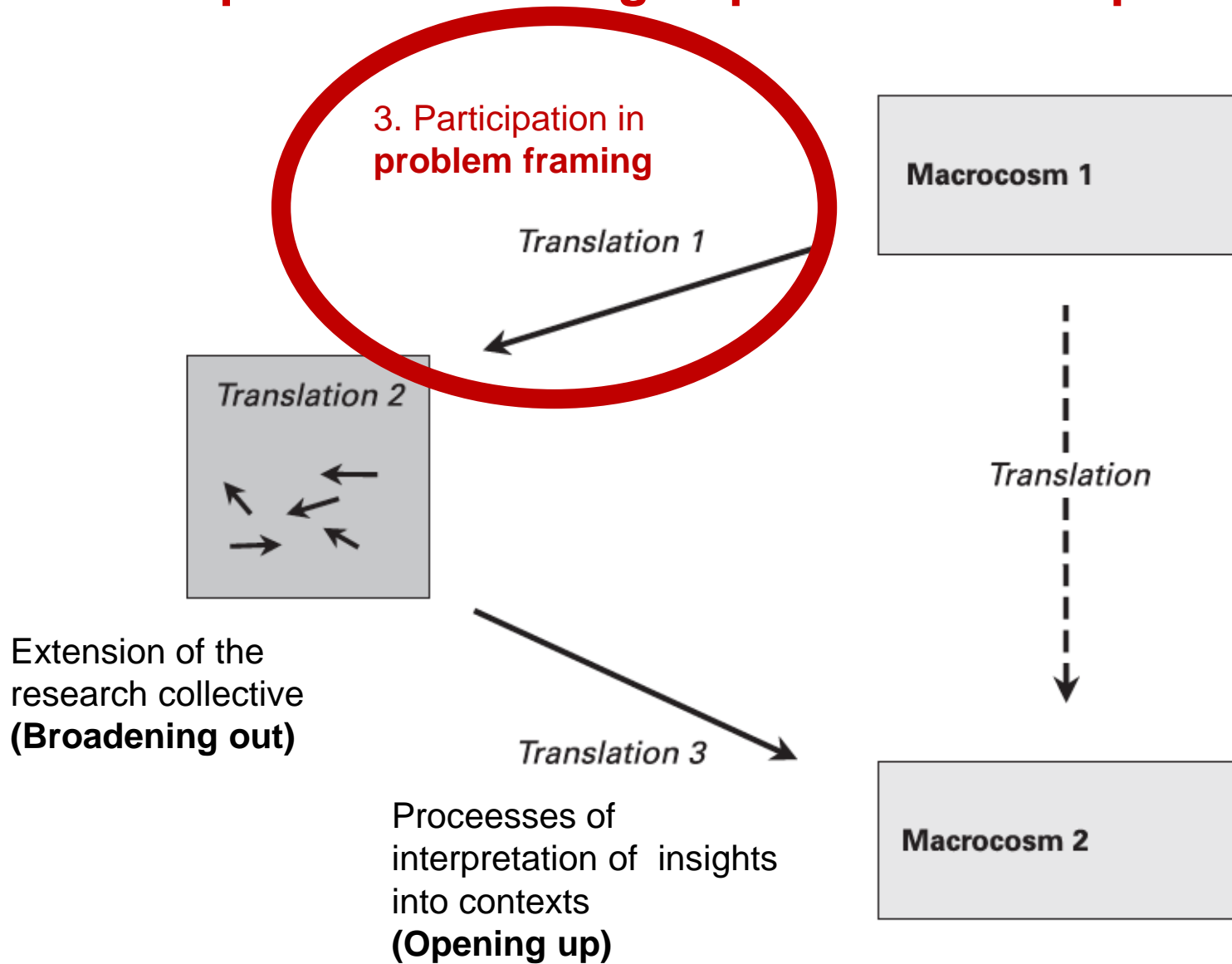


# Opening up the debate with quantitative evidence

Facilitate that users:

1. Dig into the underlying data and algorithms and to see what is behind the numbers (e.g. disaggregating categories)
2. Explore robustness of descriptions (e.g. showing uncertainties),
3. Show contrasting dimensions and options (e.g. via visualisations),
4. Help users reflect on the relation between options against their values and interest (e.g. by highlighting in a visualisation the options chosen by stakeholders with explicit interests)

# 3. Participation in framing of problems and questions



# Summary: Towards transdisciplinary collaborations

Transdisciplinary teams needed for:

- Participation of relevant stakeholders
- Social scientists linking with qualitative insights, interviews, ethnography
  - **Evaluative inquiry** (De Rijcke, Holtrop and colleagues at CWTS)

Complementarities between Data Science and Qualitative Approaches

(gross simplification of traits)

Data science? / Scientometrics	STS / Qualitative Approaches
Secluded research	Research in the wild
Positivist	Interpretative
Value-free	Value-laden
Technocratic State	Civil Society
Quantitative	Qualitative
Top-down	Bottom-up
Expert-based	Participatory
<b>Closing down</b>	<b>Opening up</b>

**CONCLUSIONS:**  
**PLURALISING QUANTIFICATION**

# An agenda for pluralising indicators / data sciences

- **Broadening out the inputs (happening)**
  - Data sciences already expanding the research collective
- **Opening up the outputs to users (happening??)**
  - Results of data science as tools for deliberation
    - Develop types of outputs that allow exploration of choices.
    - Private ownership of data and algorithms is problematic & questionable
- **Embedding quantification in plural social appraisal processes**
  - Participatory processes on design, creation and use of algorithms.
    - Collaborations with experts on qualitative and participatory methods and beyond

# Why to engage with responsible science?

Rationales for pluralisation and participation (Stirling, 2004)

- 1. Substantive:** it produces more socially robust knowledge  
More thorough scanning of knowledge. Inclusion of plural perspectives.
- 2. Normative:** Under a democratic view, pluralisation is good on its own  
From a tool to project 'the perspectives' of incumbent institutions, towards becoming an 'honest broker', facilitating deliberation.
- 3. Instrumental/Strategic:** it provides credibility and legitimacy.  
A window of opportunity to reposition the perception as data science as public good

# The values of science (in authoritarian times?)

In 1942, Merton wrote about the 'aspirational' values of science

- Communalism (shared knowledge)
- Universalism (all humans can participate)
- Disinterestedness (public good)
- Organised Scepticism (scrutiny & transpar.)

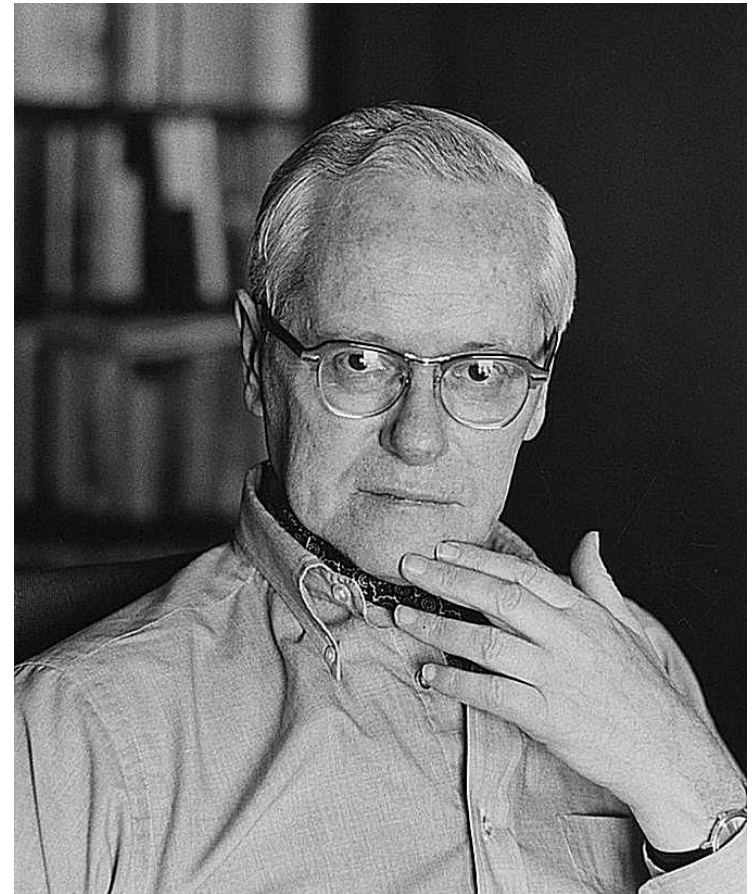
His argument was prompted by use of science in authoritarian regimes (1930s-40s):

His answer: 'Good' science (of CUDOS) blossoms in pluralistic, democratic societies.

- Now in authoritarian times?
- State and corporate control (China?)
  - Suppression of right and liberties, for migrant or cultural/social minorities and dissent in general.
- Technocratic orders vs. public good

Robert K. Merton

The normative structure of science





# The argument

- Policy demand for knowledge that addresses societal problems
- Digital studies perceived as providing new approaches to solve them
- However, societal problems cannot be solved ONLY by science
  - Under conditions of **high uncertainty & lack of value consensus...** one cannot separate knowledge formation from decision-making
  - Decision-making has to **scrutinize assumptions in knowledge**
- **Need to develop ‘Research in the wild’** (‘en plein air’) in hybrid forums for engaging with contextual and diverse expertise
- This implies three moves in ‘translation’:
  1. **Broadening out** the scope of data and expertise used
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# Science use for informing decision in hybrid forums

Hybrid forums are collaboration between secluded research and research in the wild.

“In hybrid forums, in which (...) [priorities] are discussed, uncertainties predominate, and everyone contributes information and knowledge that enrich the discussion.” Callon et al. 2001

**But how should hybrid forums be organised, so as to incorporate quantitative evidence?** (Yes, it is our problem as well)

Challenge: To develop processes with ‘responsible’, ‘inclusive’, ‘opening up’ use of quantitative evidence in S&T.

**Evaluative inquiry** (De Rijcke, Holtrop and colleagues at CWTS)

# Unspoken assumptions in policy use of knowledge

Expectations that S&T will help solve social problems -- now Data Science.

Work of knowledge in policy (enlightenment):

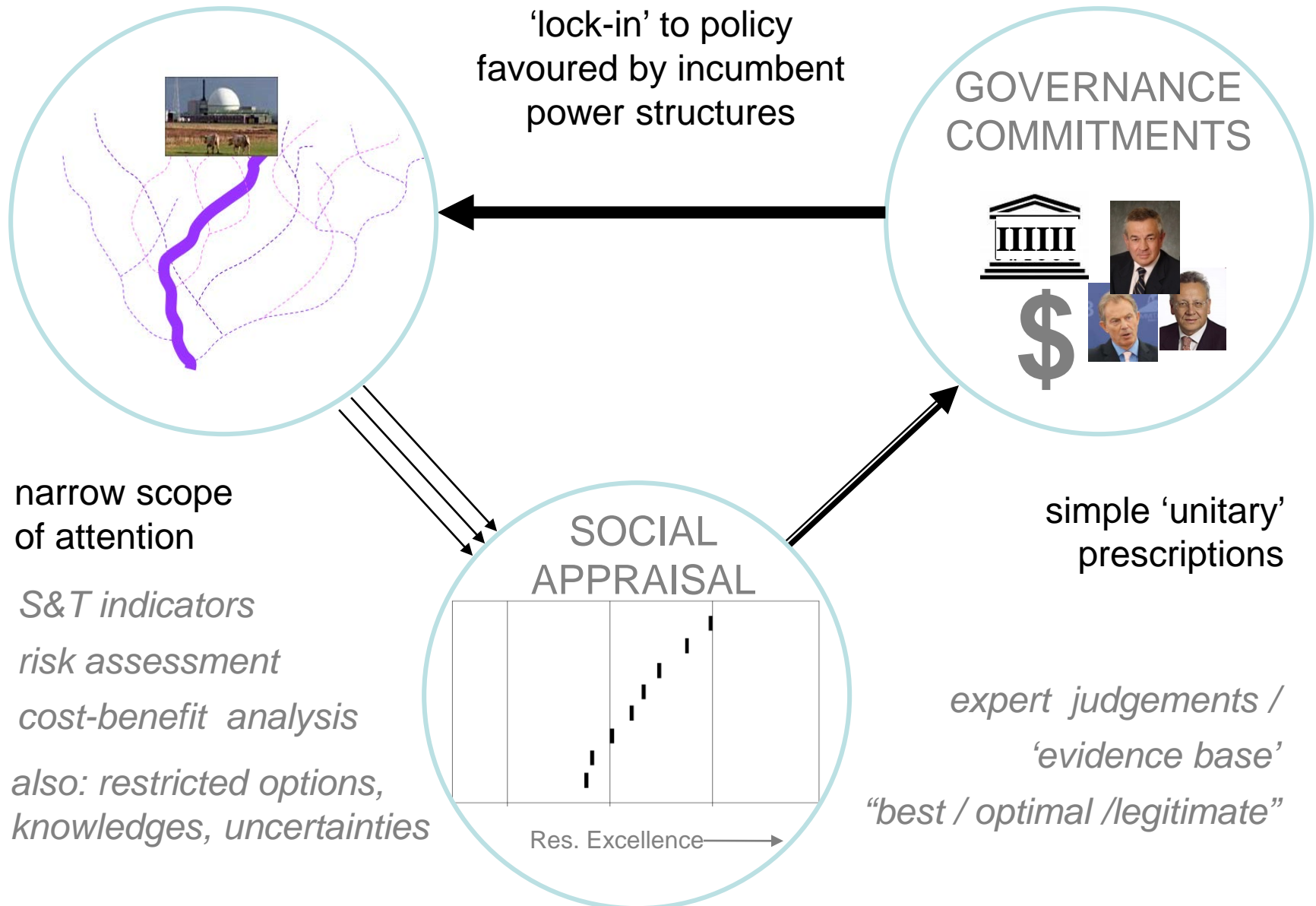
- Knowledge (from science) leads to well-being
- State (e.g. univ. admin) is benevolent in its use
- Expertise (e.g. scientometrics) serves the public good

However – instances of assumptions breaking down

- no agreement on benefits of research (highly contested)
- the state/admin can favour particular interests
  - Nuclear energy? Pharma? Social media companies?
- experts' views can be aligned with state/particular interests
  - e.g. favouring therapeutics over prevention

# Closing down in policy dynamics

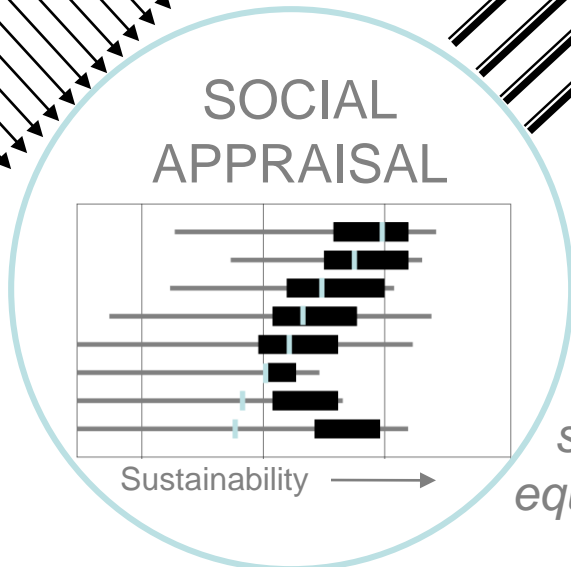
Stirling (2010)



# Breadth, Plurality and Diversity

Stirling (2010)

dynamic portfolios  
pursuing diverse  
trajectories



broad-based  
processes of appraisal

*multiple: methods,  
criteria, options, frames,  
uncertainties, contexts,  
properties, perspectives*

'opening up' with  
'plural conditional'  
outputs to policymaking

*viable options under:  
conditions, dissonant views,  
sensitivities, scenarios, maps,  
equilibria, pathways, discourses*

# The road and the landscape

“The algorithms have freed us from group travel, forced viewpoints (...) **But they also help to subject the user to this calculated, efficient, automatic route**, which adapts to our desires by secretly regulating the traffic of others. **With the map, we lost the landscape. The path we follow is the "best" for us.**

**But we do not know how to identify what it represents in relation to other possible routes, alternative routes (...)** . We are not going back to group travel and their omniscient guide. On the other hand, we must be wary of automatic guidance. We can understand it and subject those who conceive it to vigilant criticism. **We must ask the algorithms to show us and the road, and the landscape.”**

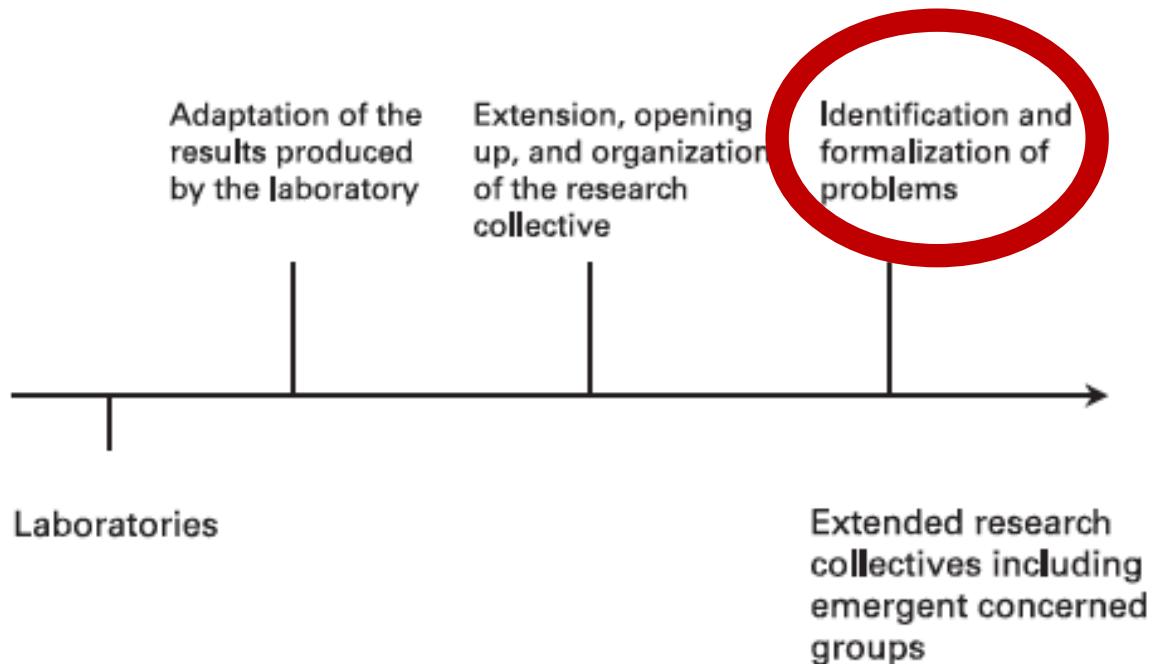
*Dominique Cardon (2015) What algorithms dream*

*(ad hoc translation from French -- A quoi rêvent les algorithmes)*

### 3. Participation in framing of problems and questions

According to Callon, the most difficult move is extending research in the identification and framing of problems.

- Most often problem is a given by state institutions
- Problematisation / enrichment by other stakeholders
- Qualitative techniques – interviews, focus groups, etc.
- Importance in delineation and ontology building.





# Misalignment between research and societal needs



Perceived mismatch between discourses (or expectations) of research and actual outcomes.

**Societal challenges:**

**Energy, environment, health.**

**More research or more excellent research...**

**...does not mean better societal outcomes**

**Monitoring tools and incentives are part of the problem.**

# Three innovation frames (Schot and Steinmueller, 2018)

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  - **Attention to diverse types of knowledge -- given uncertainty**
  - **Participation on directions/goals of research and innovation**
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# Types of knowledge to address societal challenges

## Complex problems -- can't be solved from the lab

- **High uncertainty** about best of 'solutions'
- **Value-laden** -- social choice about framings and preferences needed
- High degree of **interactivity**-- knowing actors shape the system
- Situated **knowledge** is important

## Strategies

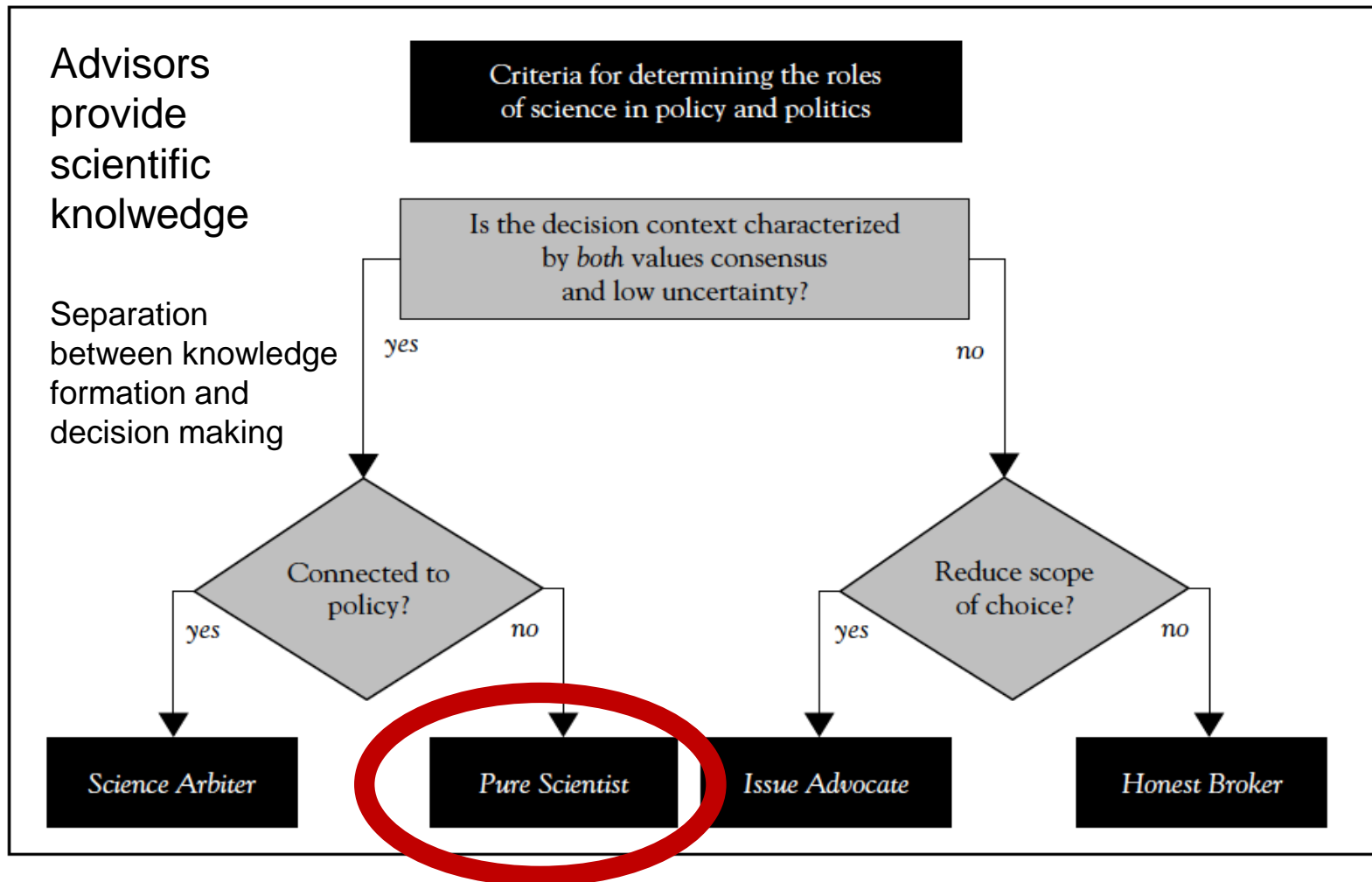
- **Diversity: keep multiple options open**
- **Direction: diagnose preferred options according to values**
- **Participation: stakeholders are part of the solutions**

## Knowledge democracy -- deliberative processes of mutual learning

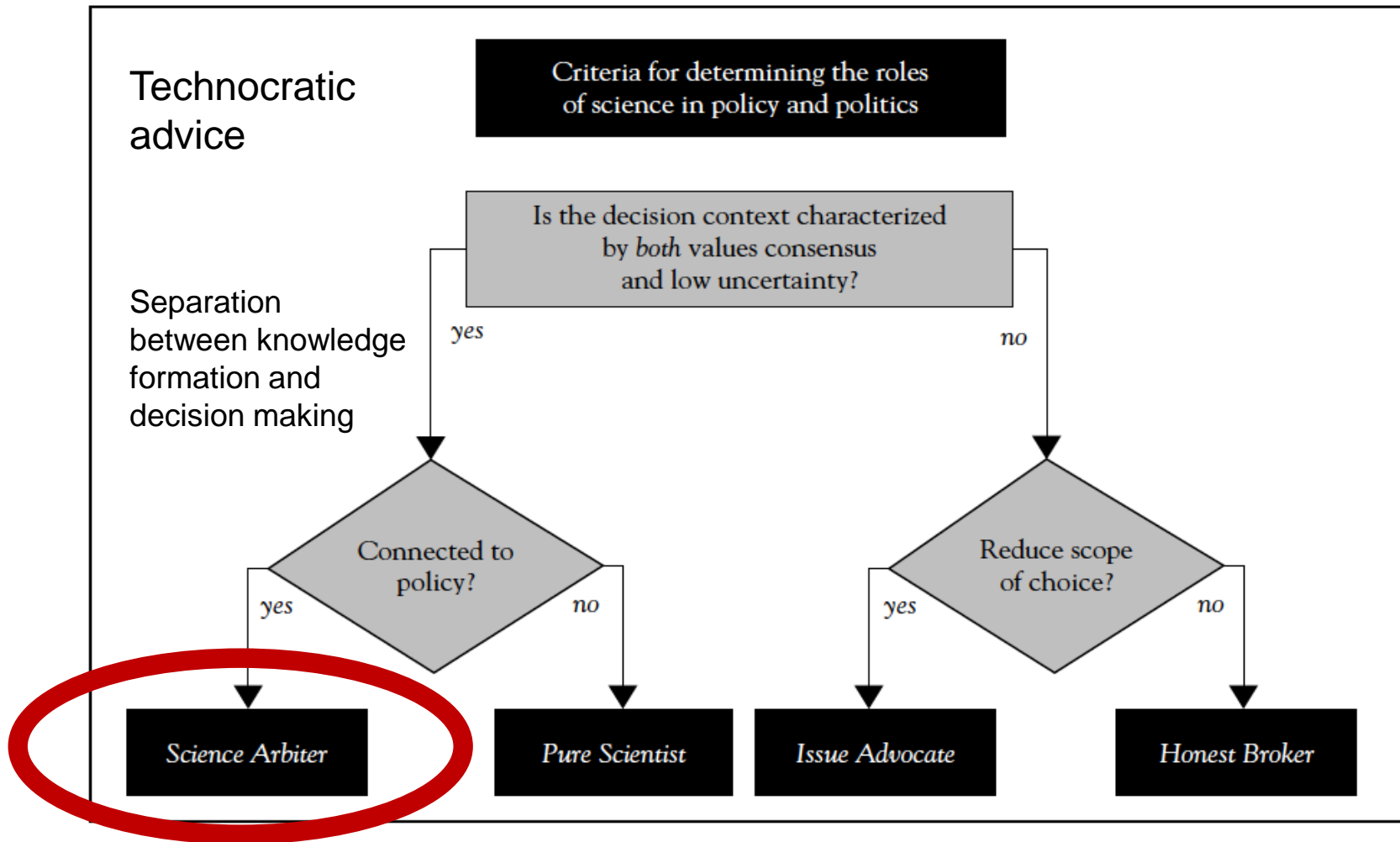
### Points of attention

- Reductionist knowledge (academic) only one of the forms. Humility
- Attention to value pluralism
- Reflexivity about who participates, whose interests are served

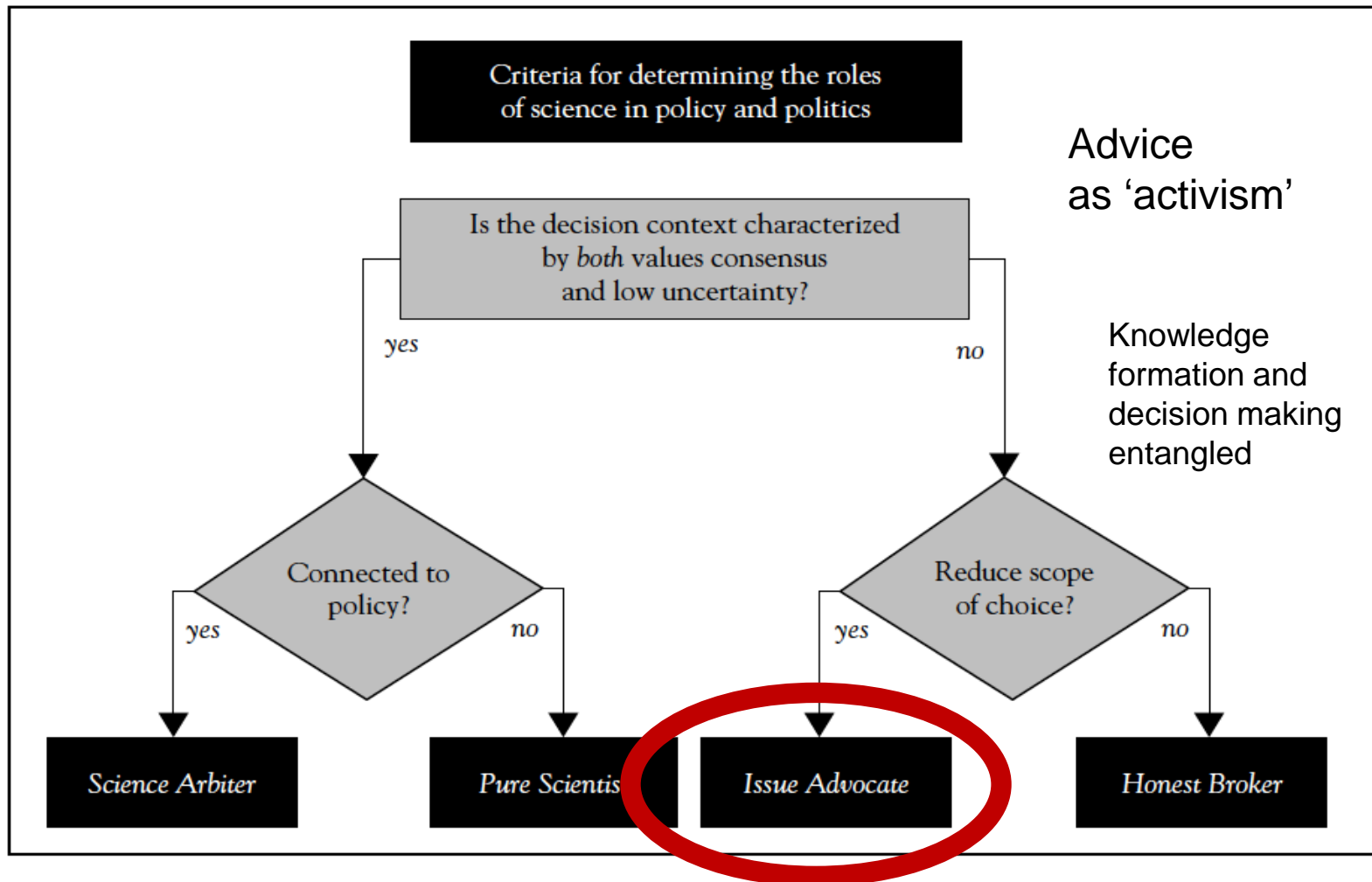
# Uncertainty and values consensus in impact assessment



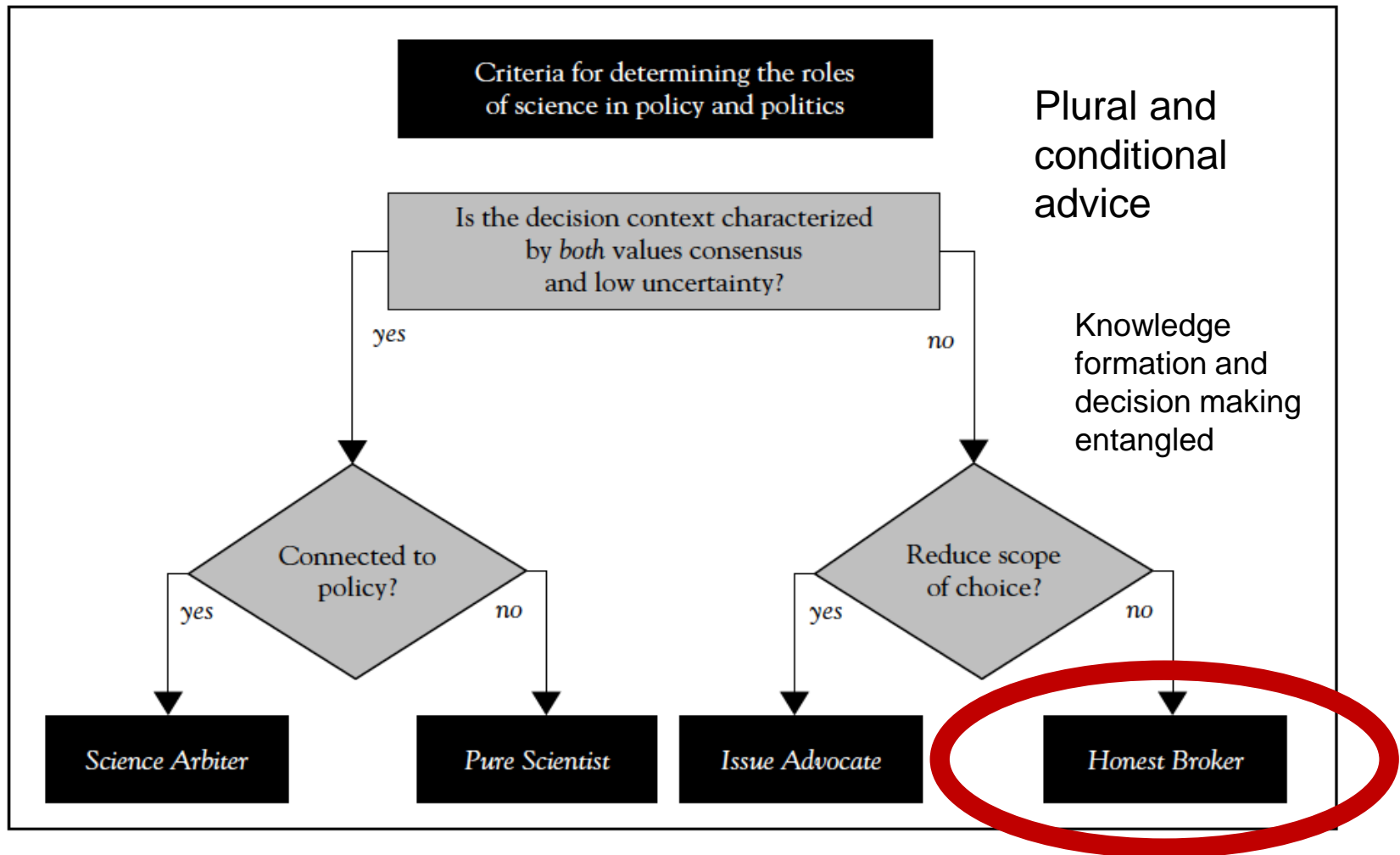
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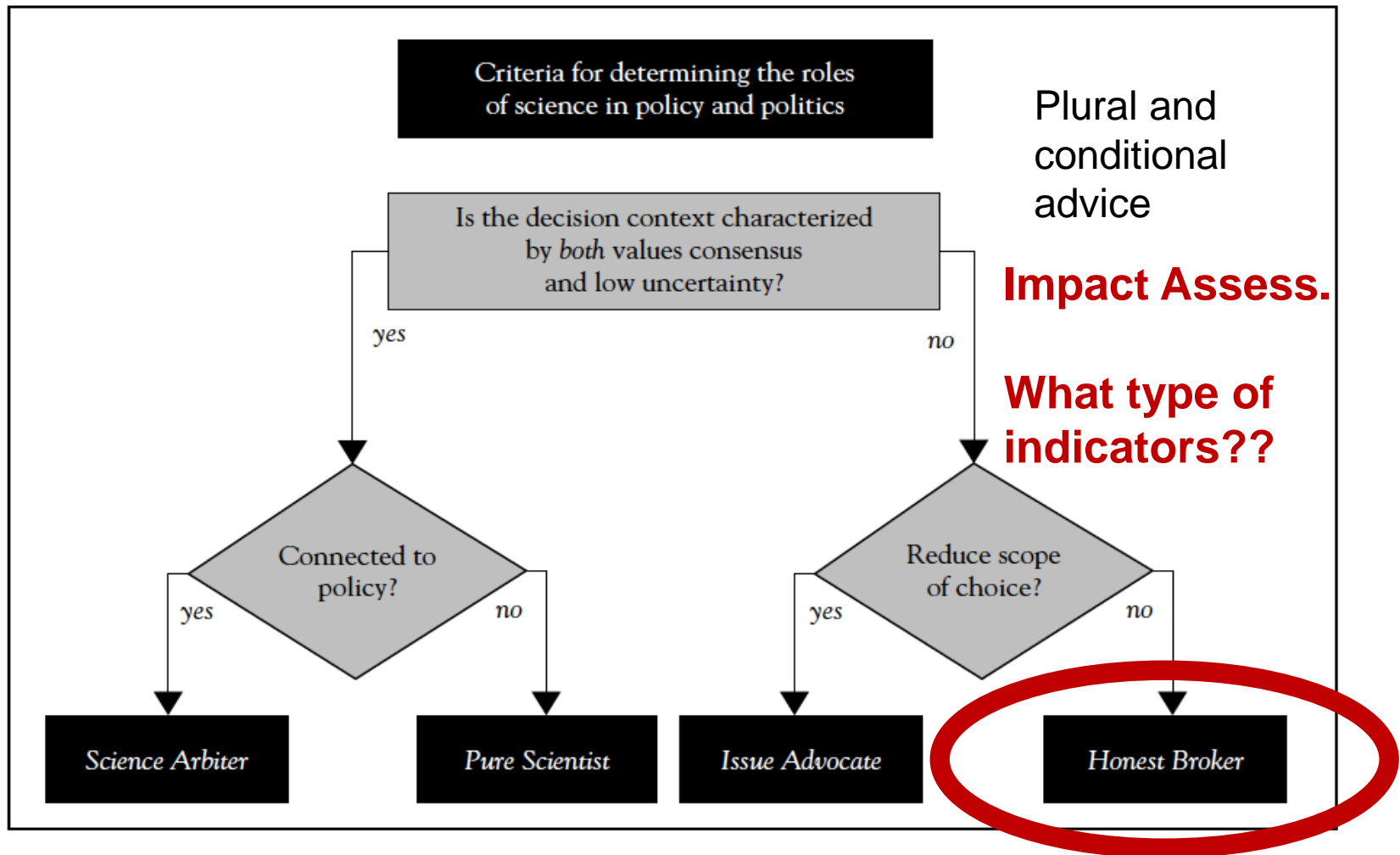


# Uncertainty and values consensus in impact assessment





# Uncertainty and values consensus in impact assessment



# Appraisal of expertise for advice

## **Appraisal:**

**‘the ensemble of processes through which knowledges are gathered and produced in order to inform decision-making and wider institutional commitments’ Leach et al. (2008)**

**Breadth:** extent to which appraisal covers diverse dimensions of knowledge

**Openness:** degree to which outputs provide an array of options for policies.

# Policy use of S&T indicators: Appraisal

## Appraisal:

**‘the ensemble of processes through which knowledges are gathered and produced in order to inform decision-making and wider institutional commitments’ Leach et al. (2010)**

Example:

Allocation of resources based on research “excellence”

**Breadth:** extent to which appraisal covers diverse dimensions of knowledge

Narrow: citations/paper

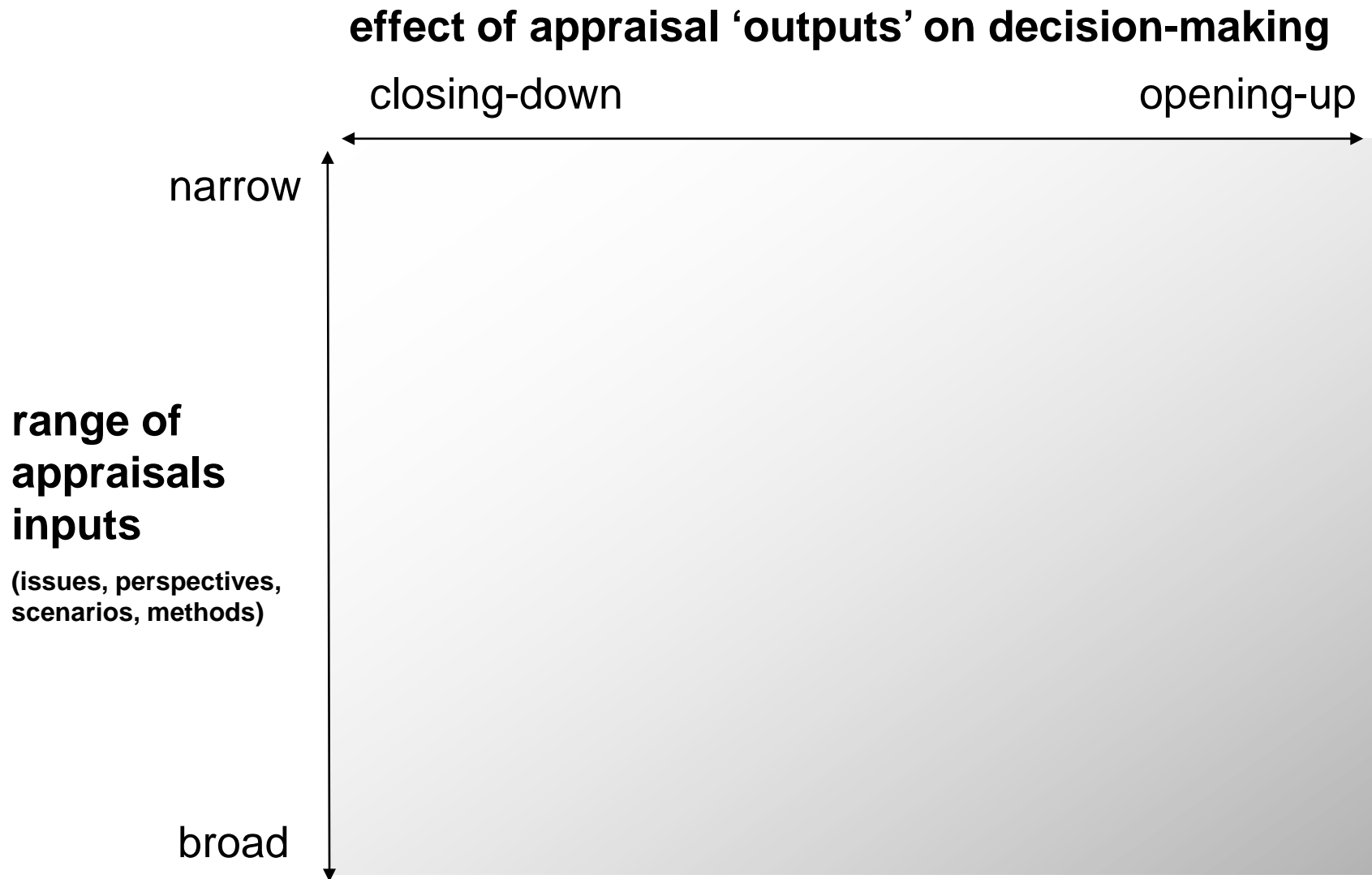
Broad: citations, peer interview, stakeholder view, media coverage, altmetrics

**Openness:** degree to which outputs provide an array of options for policies.

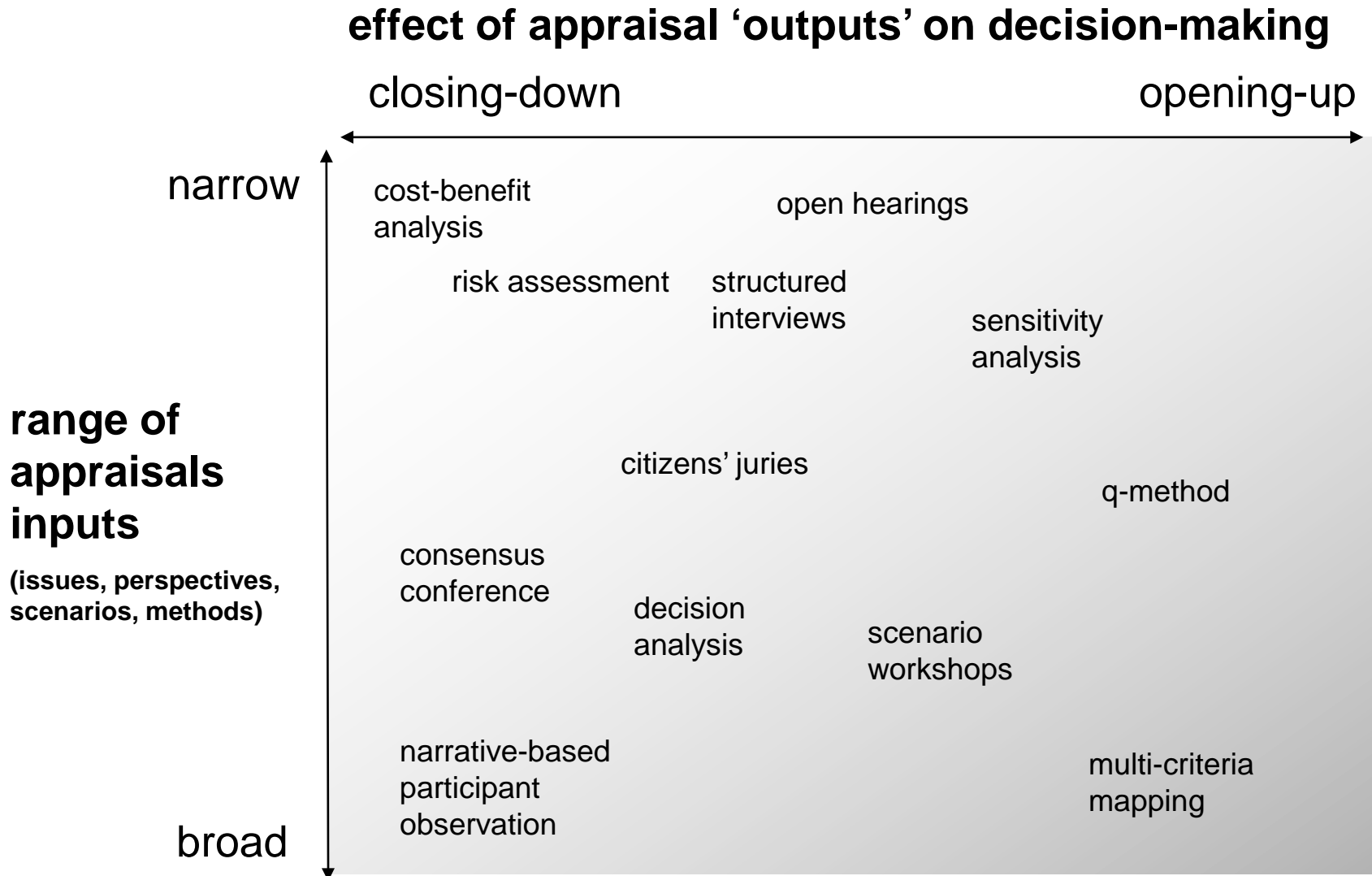
Closed: fixed composite measure of variables → unitary and prescriptive

Open: consideration of various dimensions → plural and conditional

# Appraisal methods: broad vs. narrow & closing vs. opening



# Appraisal methods: broad vs. narrow & close vs. open





# Broadening out S&T Indicators

## effect of appraisal 'outputs' on decision-making

closing-down

opening-up

narrow

Conventional  
S&T indicators??

Incorporation plural  
analytical dimensions:

global & local networks  
hybrid lexical-actor nets  
etc.

range of  
appraisals  
inputs

(issues, perspectives,  
scenarios, methods)

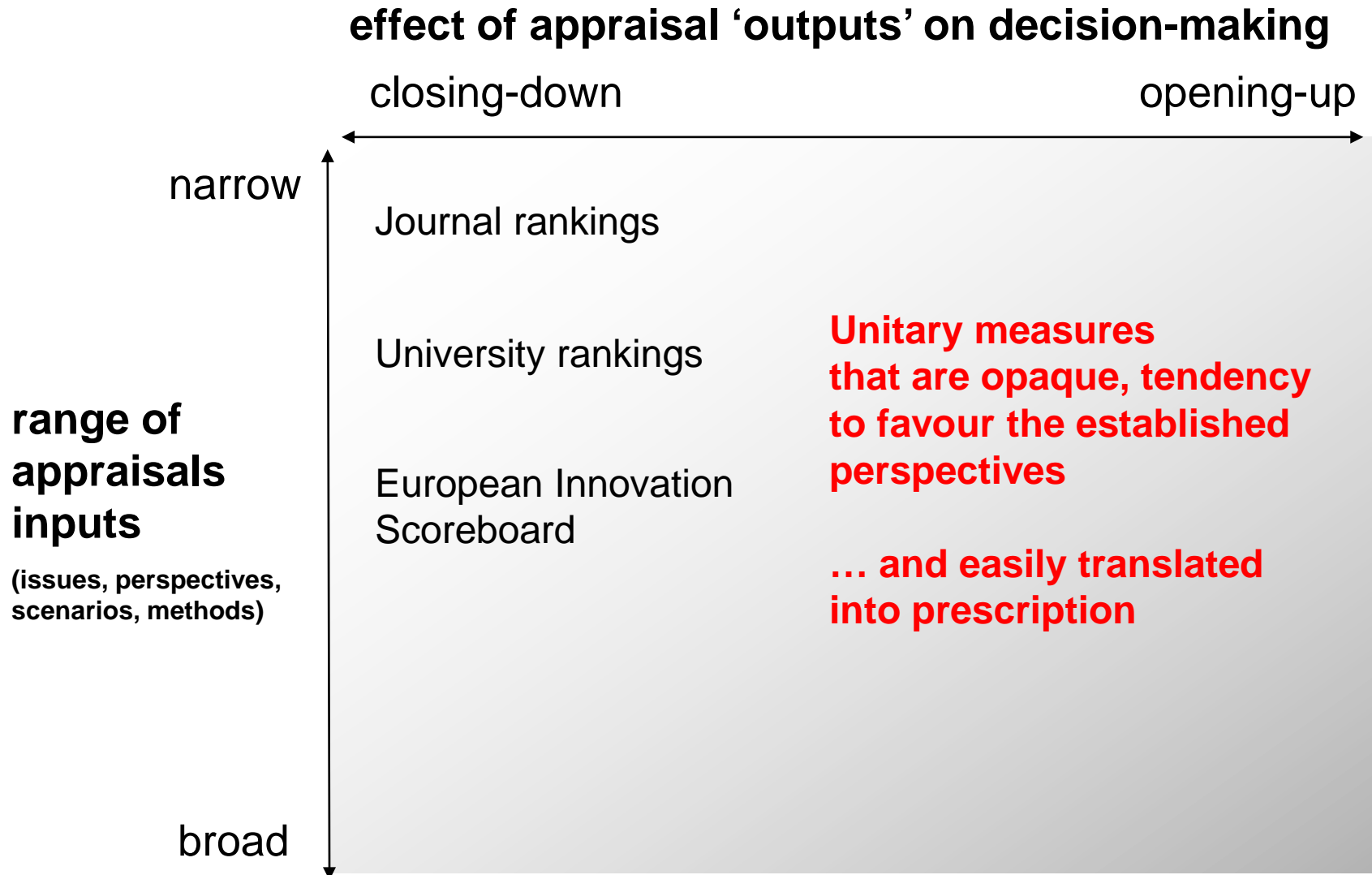


Broadening out

New analytical inputs:  
media, blogosphere.

broad

# Appraisal methods: broad vs. narrow & closing vs. opening





# Opening up S&T Indicators

## effect of appraisal 'outputs' on decision-making

closing-down

opening-up

narrow

Conventional  
S&T Indicators??



opening-up

**range of  
appraisals  
inputs**

(issues, perspectives,  
scenarios, methods)

broad

Making explicit underlying  
conceptualisations and  
creating heuristic tools to facilitate  
exploration

NOT about the uniquely *best* method  
Or about the unitary *best* explanation  
Or the single *best* prediction