



Universiteit Utrecht

Copernicus Institute of
Sustainable Development



Dynamics of Knowledge Production

Prof. Harro van Lente

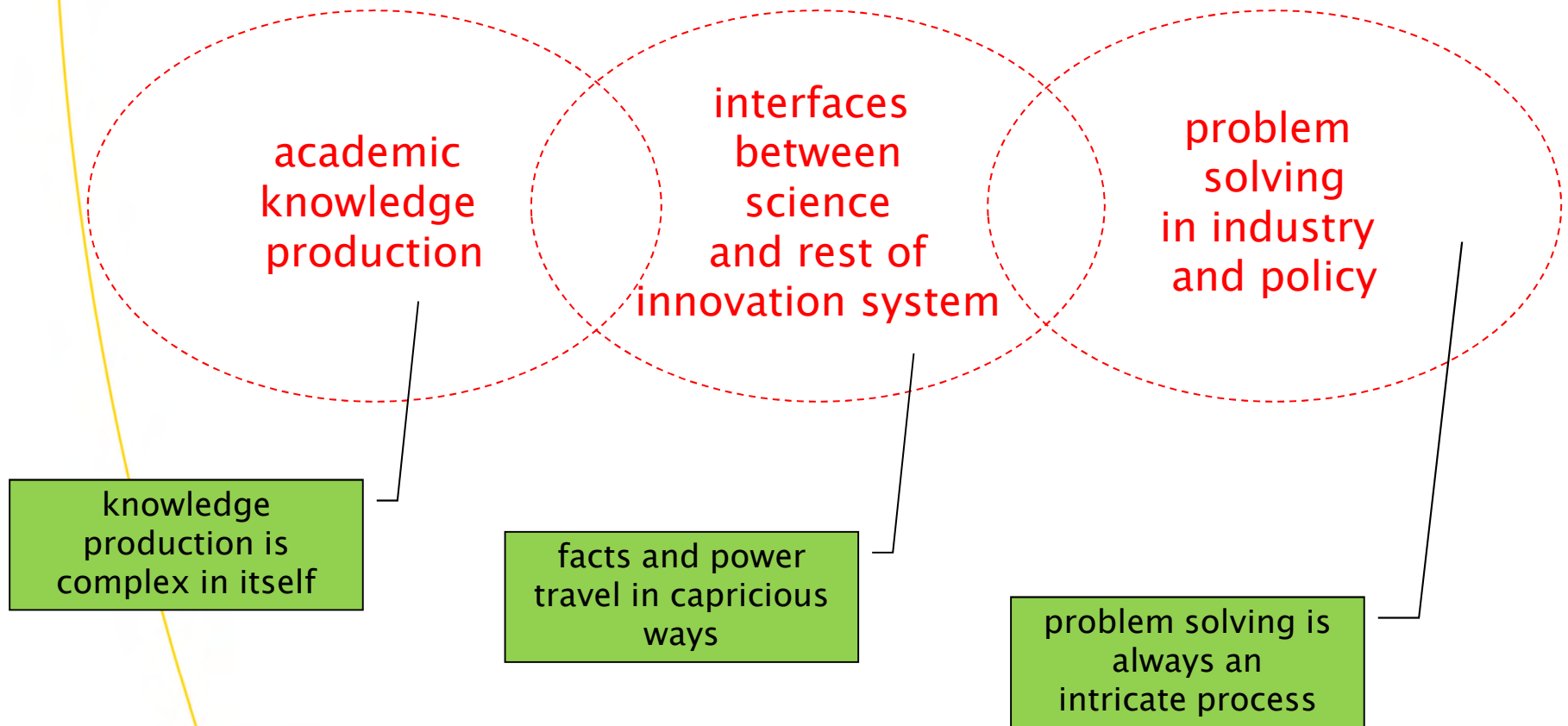


Dynamics of knowledge production - programme

- Some notes on knowledge
- Production of knowledge
- History of knowledge production
- Knowledge production in innovation systems
- Changing systems of knowledge production?



Knowledge in innovation systems





Some notes on knowledge (philosophy of science)

- The problem of reality
- The problem of truth
- The problem of demarcation
- The problem of observation
- The problem of induction



The problem of reality

- realism: reality exists independently of our perception
- idealism: reality depends on human consciousness and observation
- phenomenology: reality does not consist of objects, but of qualities like color, smell
- Descartes: cogito ergo sum



The problem of truth: a statement is true...

- because it corresponds with the facts?
 - theory of correspondence
 - Thomas Aquinas: Veritas est adaequatio rei et intellectus
- because it can be deduced from valid theories?
 - theory of coherence
- because it is accepted as true
 - theory of consensus
- because it leads to useful consequences?
 - theory of pragmatism
- because it is constructed as true
 - theory of constructivism
 - social, historical, cultural conditions



The problem of demarcation

- Knowledge in all sorts:
 - scientific
 - common sense
 - pseudo-scientific
 - religion
- Where are the boundaries?



The problem of observation

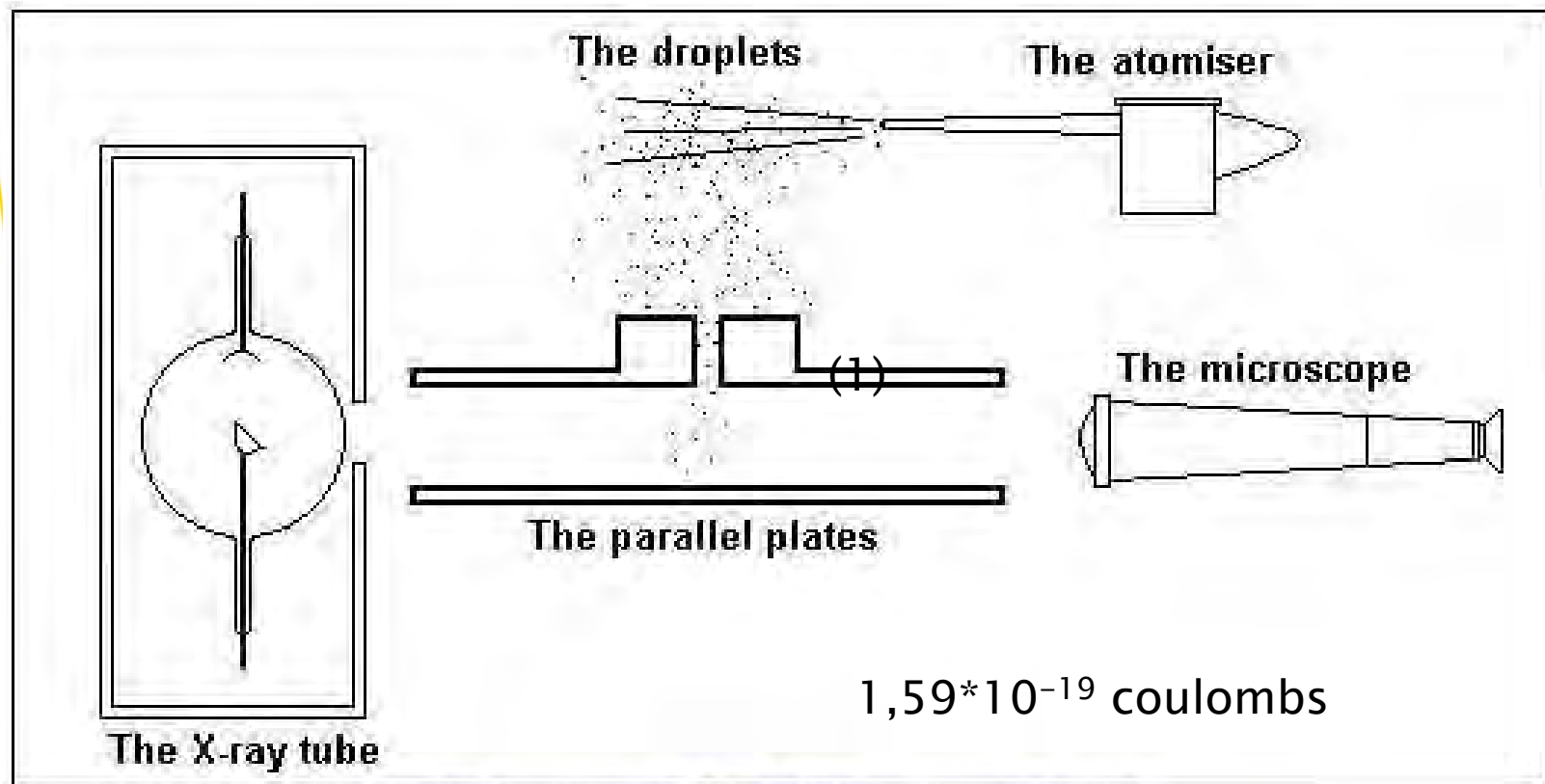
- Is 'neutral' observation possible?
- Is observation without theory possible

- Example Millikan's experiments



The famous Millikan experiment

Nobel Prize in 1923



The diagram of the Millikan experiment.



From Robert Millikan's notebook

Nobel Prize in 1923

- *This is almost exactly right & the best one I ever had!!!*
[20 December 1911]
- *Exactly right* [3 February 1912]
- *Publish this Beautiful one* [24 February 1912]
- *Publish this surely / Beautiful !!* [15 March 1912, #1]
- *Error high will not use* [15 March 1912, #2]
- *Perfect Publish* [11 April 1912]
- *Won't work* [16 April 1912, #2]
- *Too high by 1½%* [16 April 1912, #3]
- *1% low*
- *Too high e by 1¼%*



Problem of induction

- Induction: concluding from n cases
- Logically flawed
 - in contrast to deduction
- Classic example (Karl Popper):
 - N observations that swans are white does not exclude the possibility that swan $N+1$ is black



Production of Knowledge

- Derek J. de Solla Price, *Little Science, Big Science*, 1960
- Increase of about 5% per year
- Doubling every 15 years.
- Today: several million articles / year

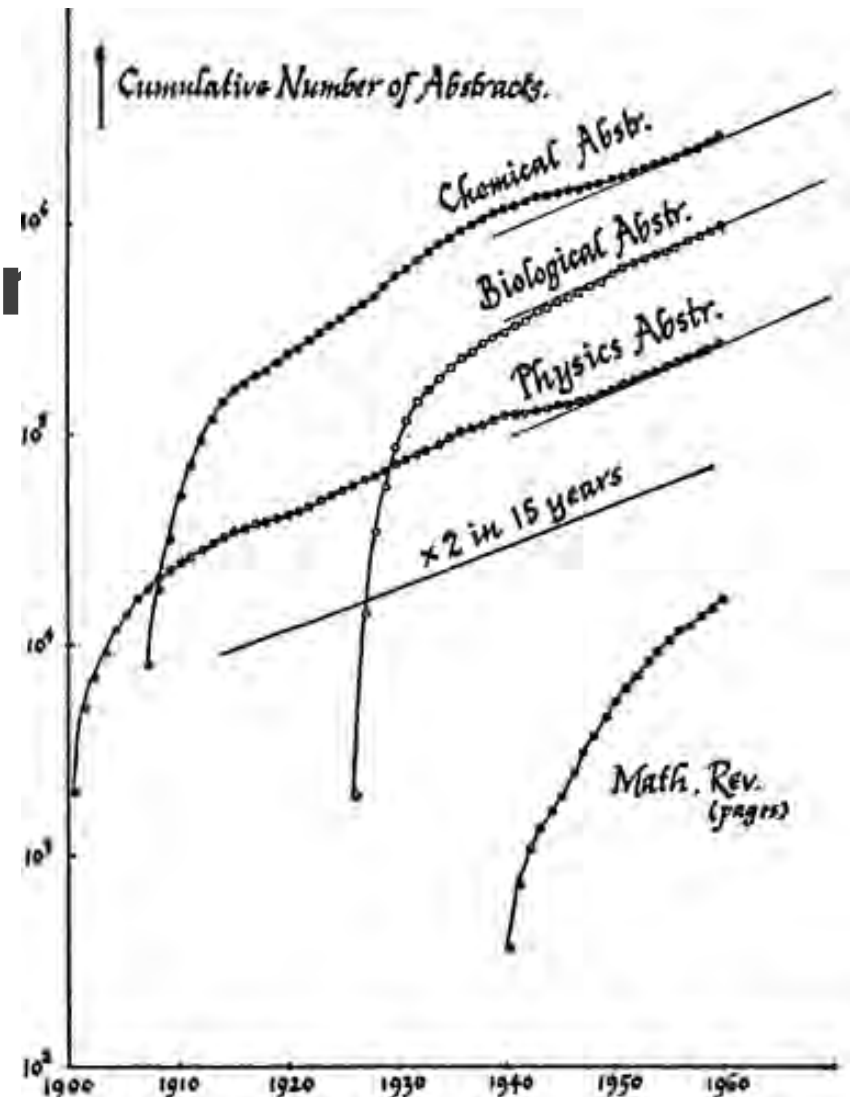
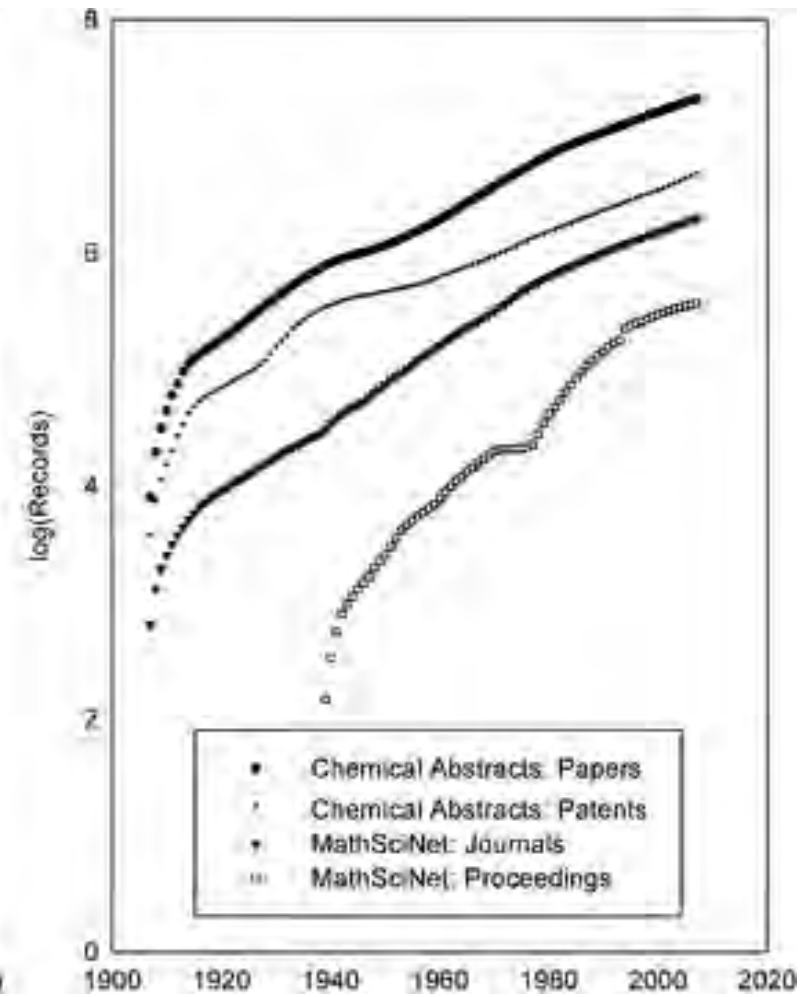
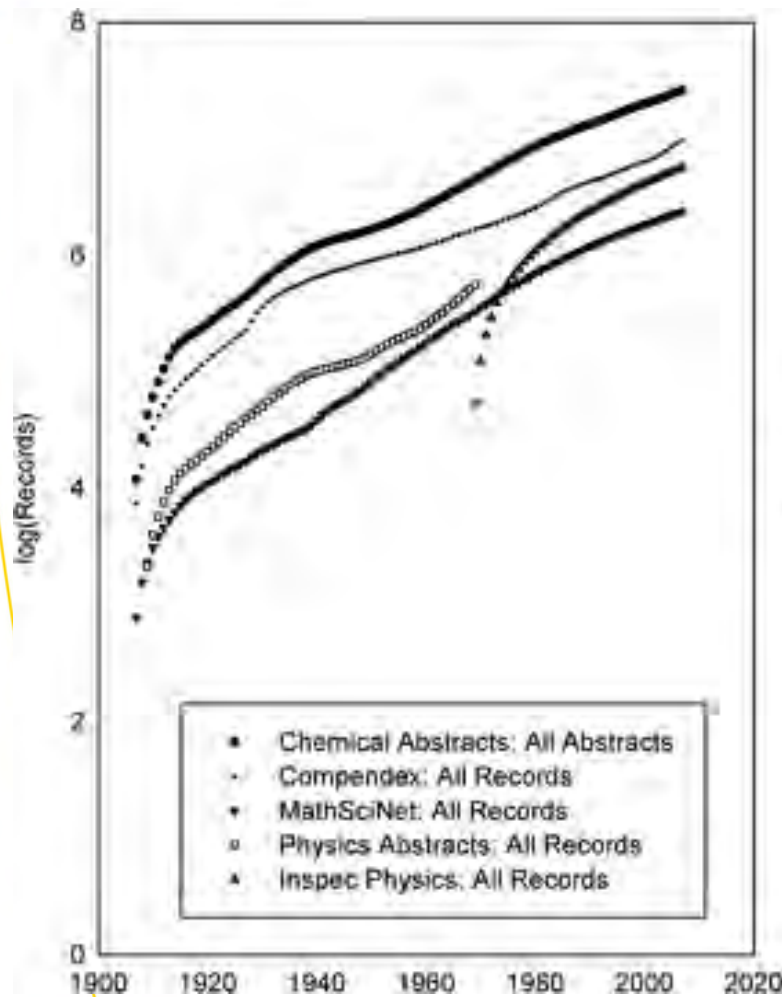


Fig. 2. CUMULATIVE NUMBER OF ABSTRACTS IN VARIOUS SCIENTIFIC FIELDS, FROM THE BEGINNING OF THE ABSTRACT SERVICE TO GIVEN DATE

It will be noted that after an initial period of rapid expansion to a stable growth rate, the number of abstracts increases exponentially, doubling in approximately 15 years.



Peder Olesen Larsen & Markus von Ins (2010) The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index, *Scientometrics*, Vol 84(3): 575–603.



Another view:

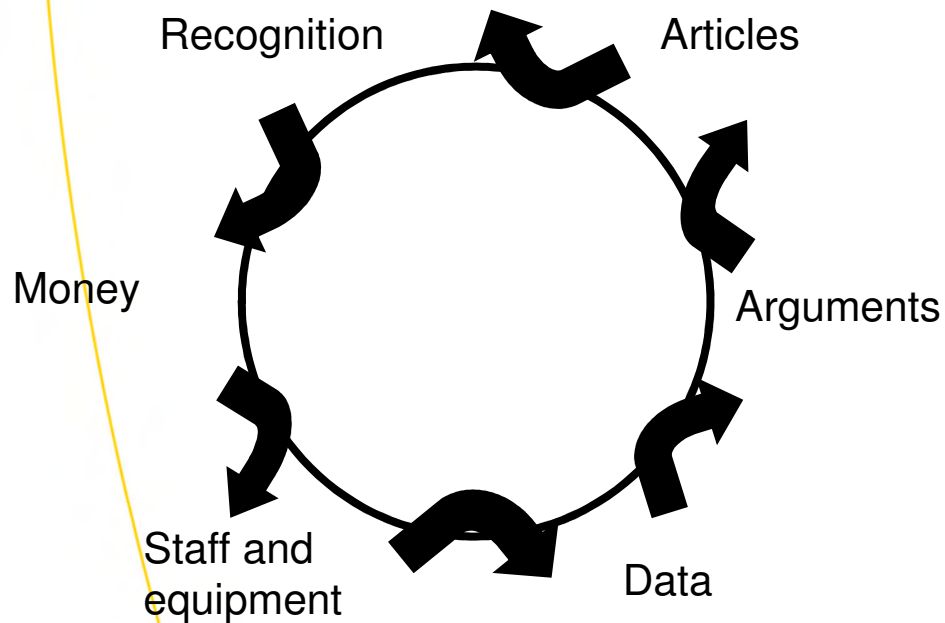
Laboratory Life (1979)

Bruno Latour and Steve Woolgar

- Enter the laboratory as ethnographer
- Study the tribe:
 - customs and rituals
 - beliefs
 - power structure
- Results:
 - obsessive writing
 - they say they study nature
 - how do they do it?



the key internal dynamics: credibility cycle

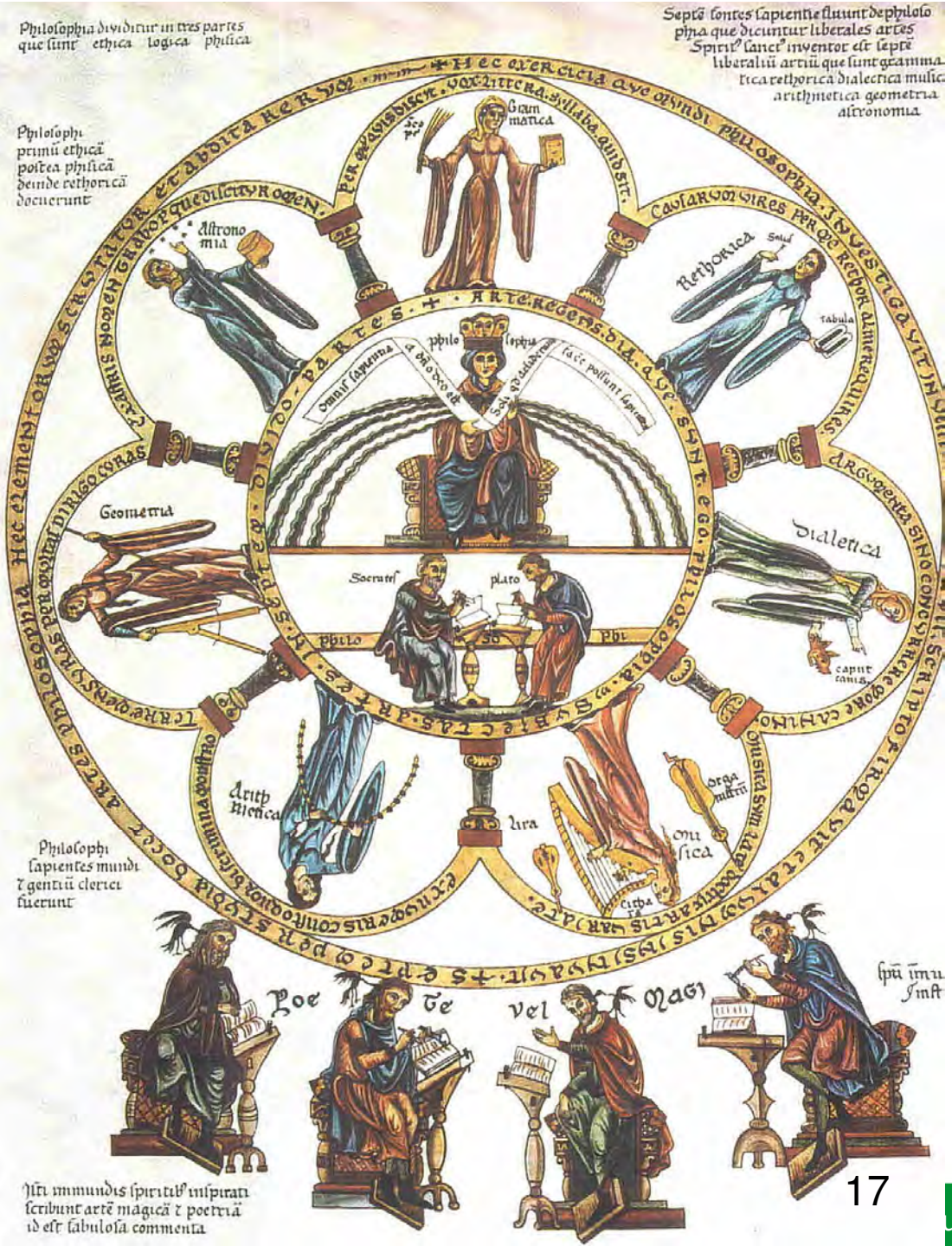


The 'credibility cycle' presents the work that scientists do: transitions of resources



History of knowledge production

- Antiquity: philosophy as the mother of science
- Medieval academic training: trivium en quadrivium
- First disciplines in relation to societal developments





The seven 'free arts'

- Trivium
 - 1. Grammar
 - 2. Rhetorics
 - 3. Dialectics
- Quadrivium
 - 1. Arithmetics
 - 2. Geometrics
 - 3. Astronomy
 - 4. Musica



Francis Bacon (1561 – 1626)

- political and scientific career
- transformer of science
- Prime Minister
- “Knowledge is power”





The Proficiency and Advancement of Learning (1605)

- pseudo-science
- decadent debates
- decadent learning



Novum Organum (1620)

- useful knowledge through observations
- knowledge will improve the fate of mankind

Multi pertransibunt et augebitur scientia

many will pass
and our knowledge will grow





First sentences:

- Man ... understands as much as his observations on the order of nature permit him...
- The unassisted hand, and the understanding left to itself, possess but little power. Effects are produced by the means of instruments...
- Knowledge and human power are synonymous....



New Atlantis (1627)

- ideal community of scientists
- supported by government
- division of labor



Division of labour in New Atlantis

- **Merchants:**
 - collect books and instruments
- **Pioneers:**
 - design new experiments
- **Compilers:**
 - present data in tables
- **Benefactors:**
 - think about practical consequences and benefits
- **Inoculators:**
 - perform experiments
- **Interpreters:**
 - interpret the results



History of disciplines

- 19th century: chemistry, biology, sociology, psychology, etc.
- 20th century: professionalisation, specialisation, cross fertilisation.
- 21th century?



Conclusion: the rise of disciplines

- ...is a set of tools, concepts, methods, theories to study a part of reality
- ... has its own worldview (basic assumption)
- ... has its own social structure

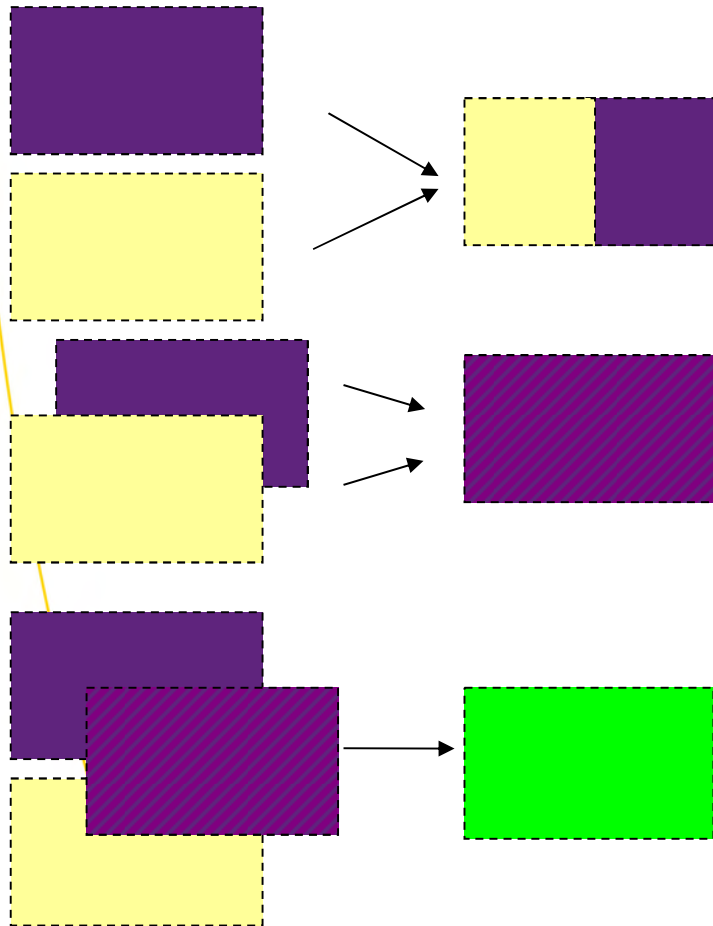


Integrating disciplines

- Ideal of 'unity of knowledge'
- Relating to societal problems
- Cross fertilization: borrowing methods and concepts



Disciplines and disciplines



Multidisciplinary

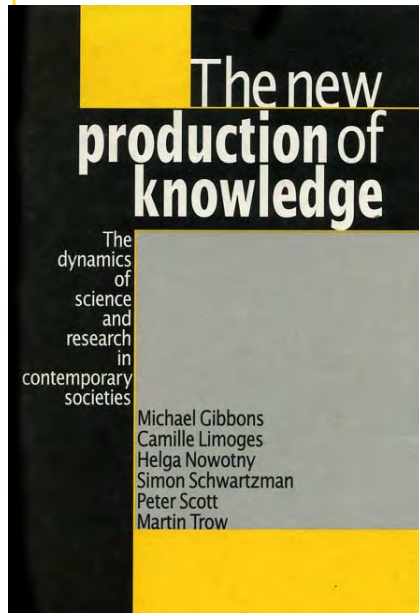
Interdisciplinary

Transdisciplinary



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Mode 2 knowledge production

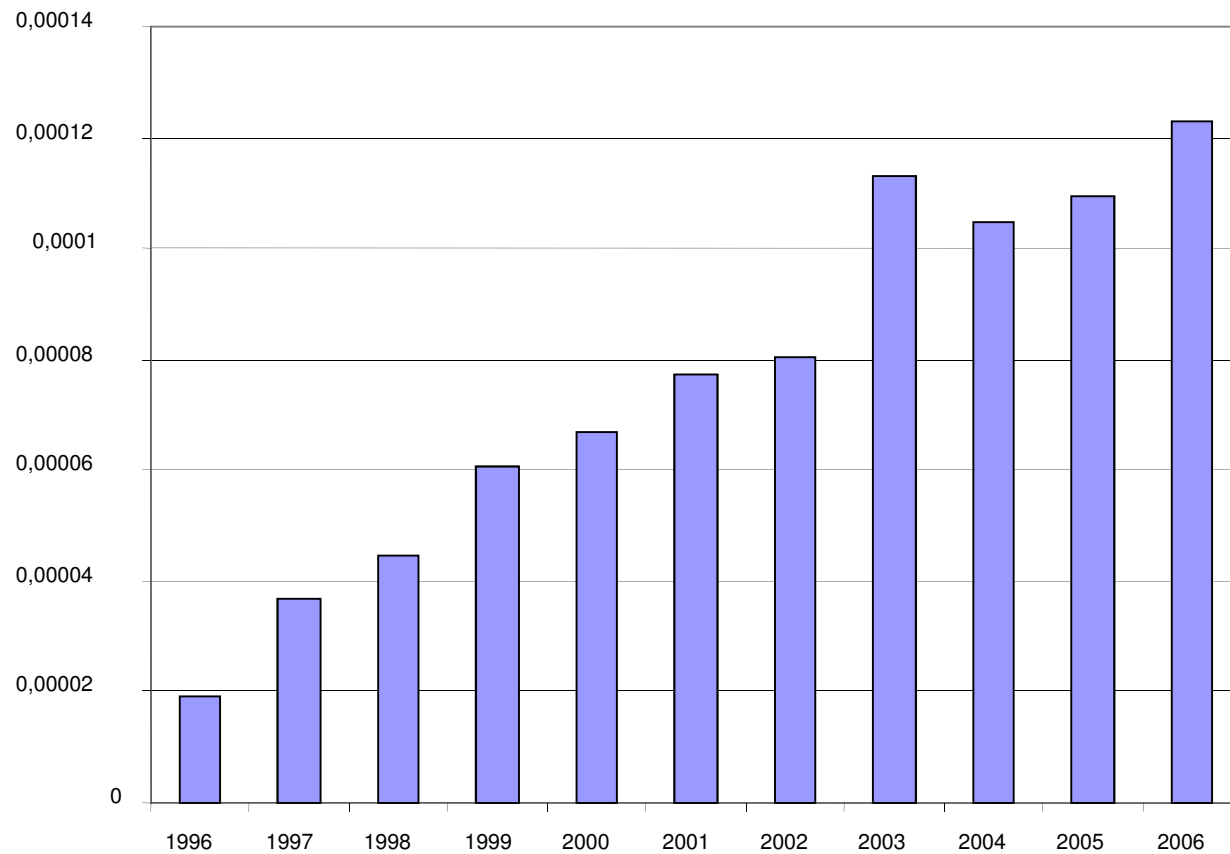


- Context of application
- Transdisciplinary
- Heterogeneity
- Reflexivity / social accountability
- Novel quality control

- >1000 scientific citations
- Influence in policy in science, technology and innovation

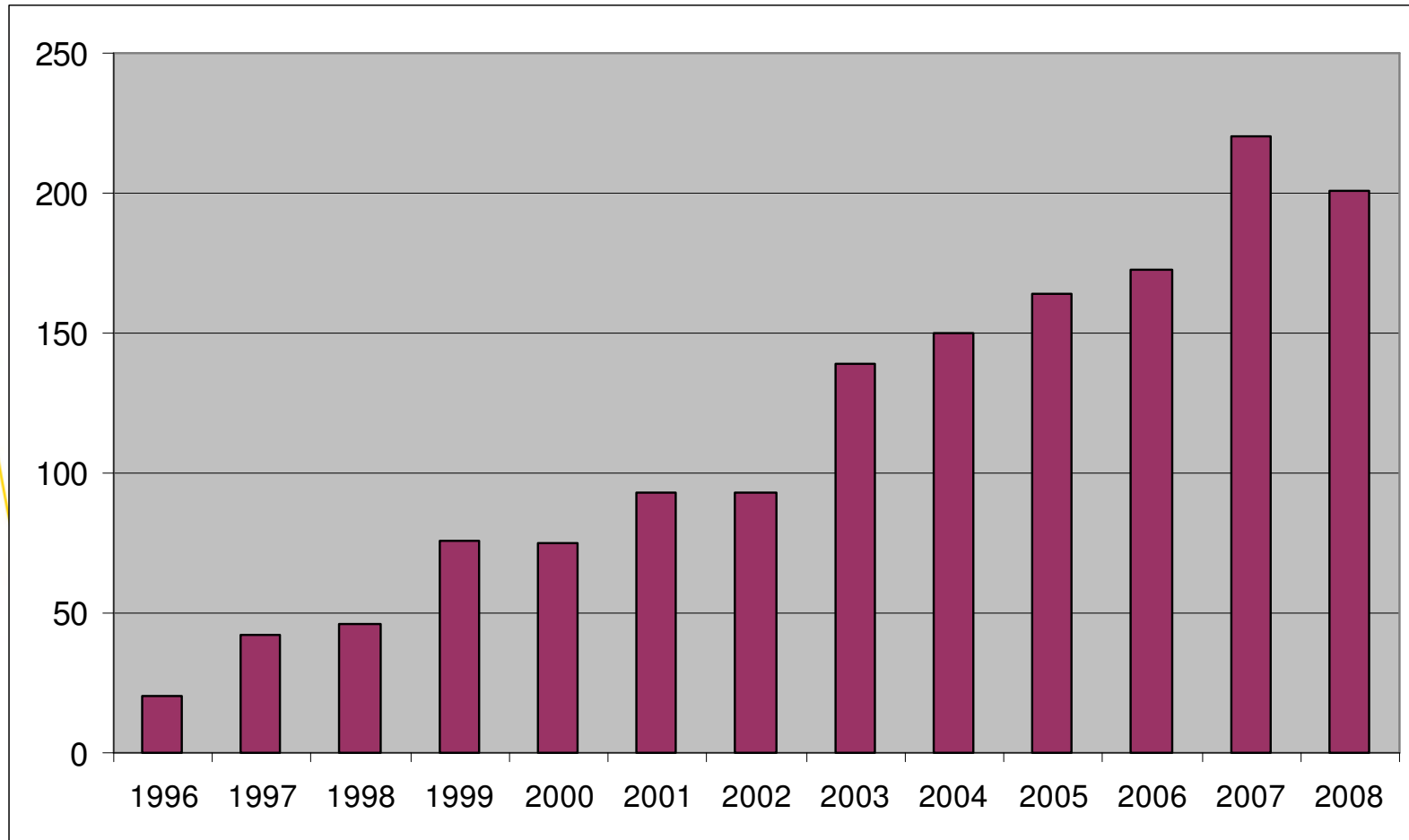


The Rise of Mode 2





The Rise of Mode 2 continued





Alternative diagnoses

- Strategic science
 - Post-normal science
 - Triple Helix
 - The enterprise university
 - Academic capitalism
 - Finalization science
 - Post-academic science
- All address changes on cognitive, organizational and/or societal level
- Wide scope of NPK is exceptional



Not so famous...

Concept	(main) publication	Number of citations
Post-normal science	Funtowicz and Ravetz, 1993	204
Triple Helix	Etzkowitz and Leydesdorff, 2000	175
Post-academic science	Ziman, 2000	97
Academic capitalism	Slaughter and Leslie, 1997	315
Enterprise university	Marginson and Considine, 2000	106
Strategic research	Irvine and Martin, 1984	58
Innovation systems	Edquist, 1997	298
Finalization science	Böhme et al., 1983	22
From science to research	Latour, 1998	24



Review of criticism

Empirical validity	Lack of empirical evidence Incorrect historical perspective Exaggerated claims
Conceptual strength	Weak coherence Lack of theoretical underpinning
Normative implications	Mode 2 is better?



Contested claims

	Weak	Disputed	Strong
Context of application	Green bar		
Transdisciplinarity	Green bar	White bar	
Heterogeneity	Green bar		
Reflexivity	Green bar	White bar	
Quality control	Green bar		White bar



Research agenda

For instance:

Quality control

New procedures and actors?

New criteria?

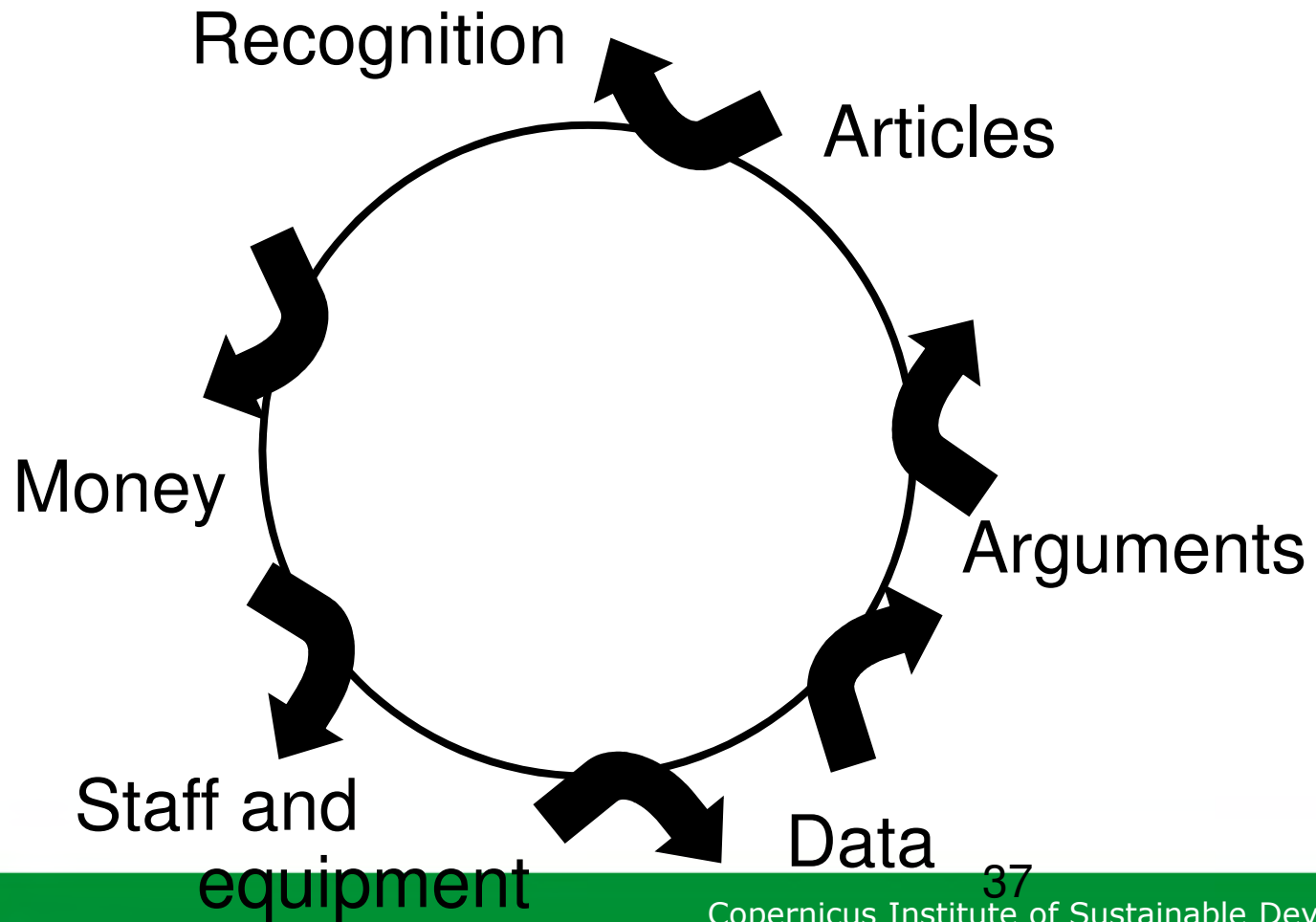
New competition for
relevance?

→ No superficial phenomena? Significantly present?

→ Address diversity of research fields

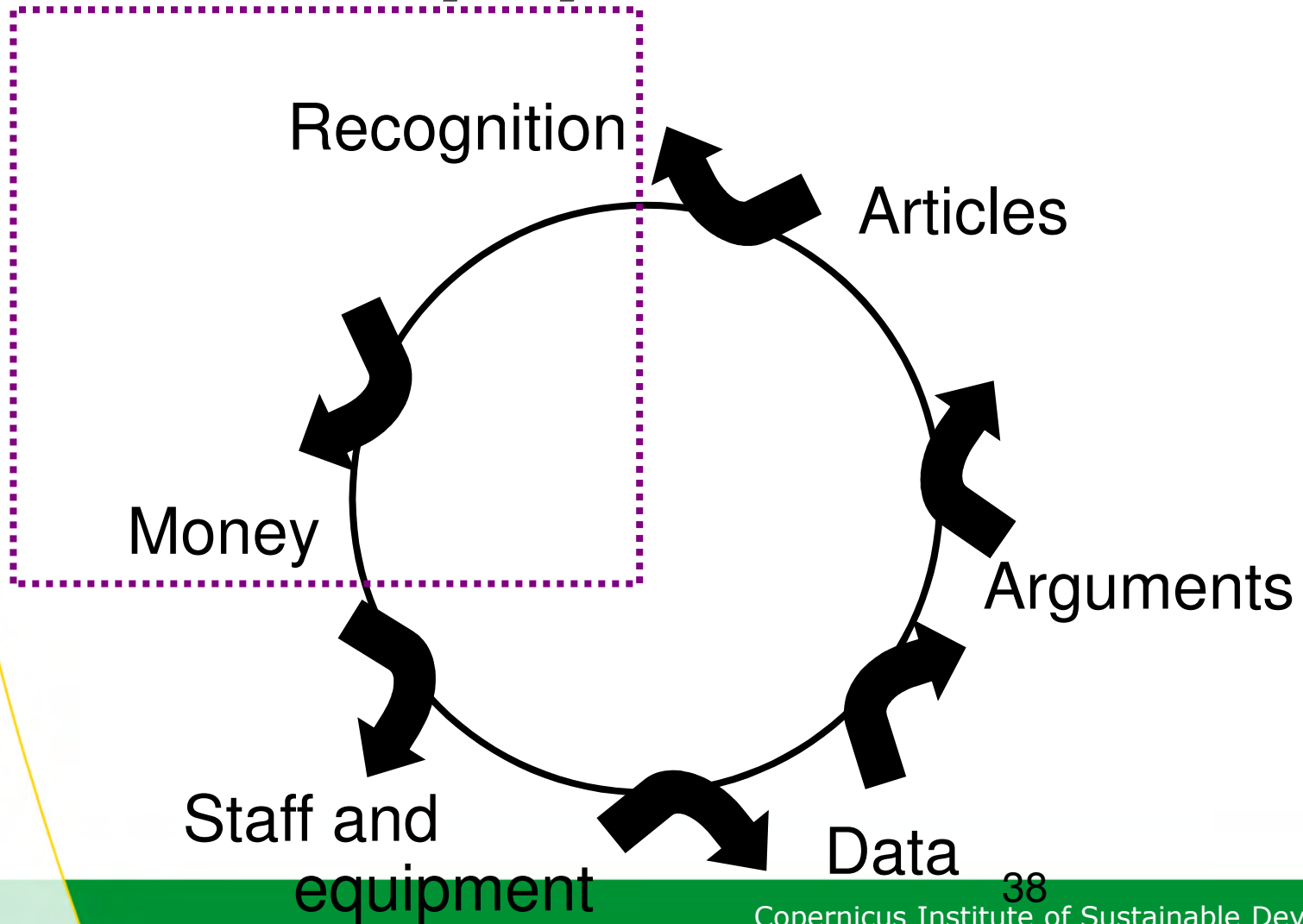


Credibility cycle



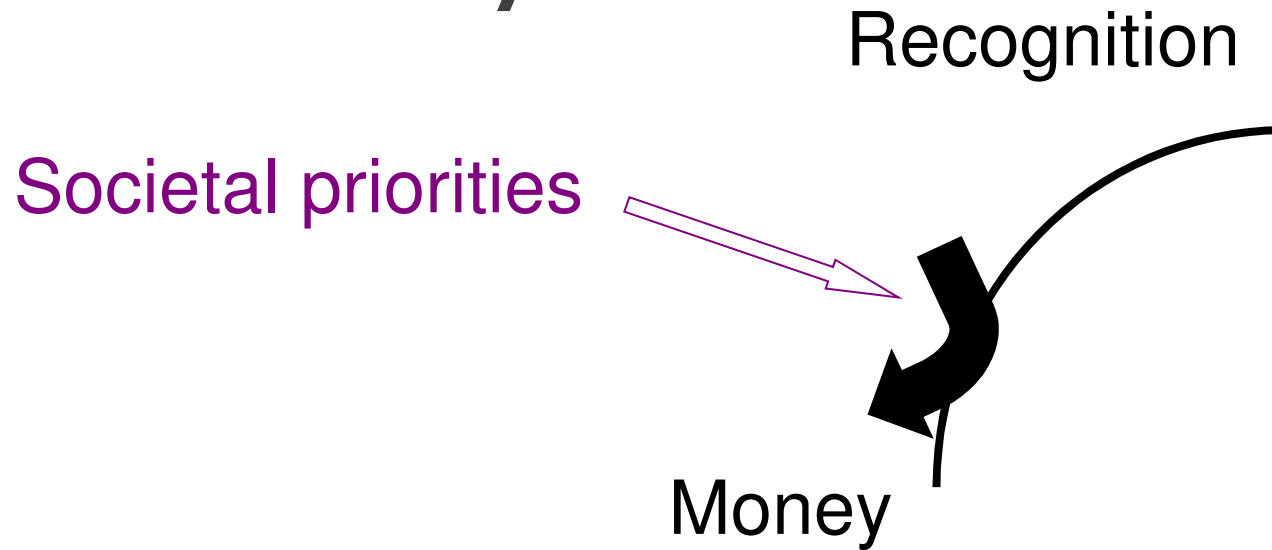


Credibility cycle





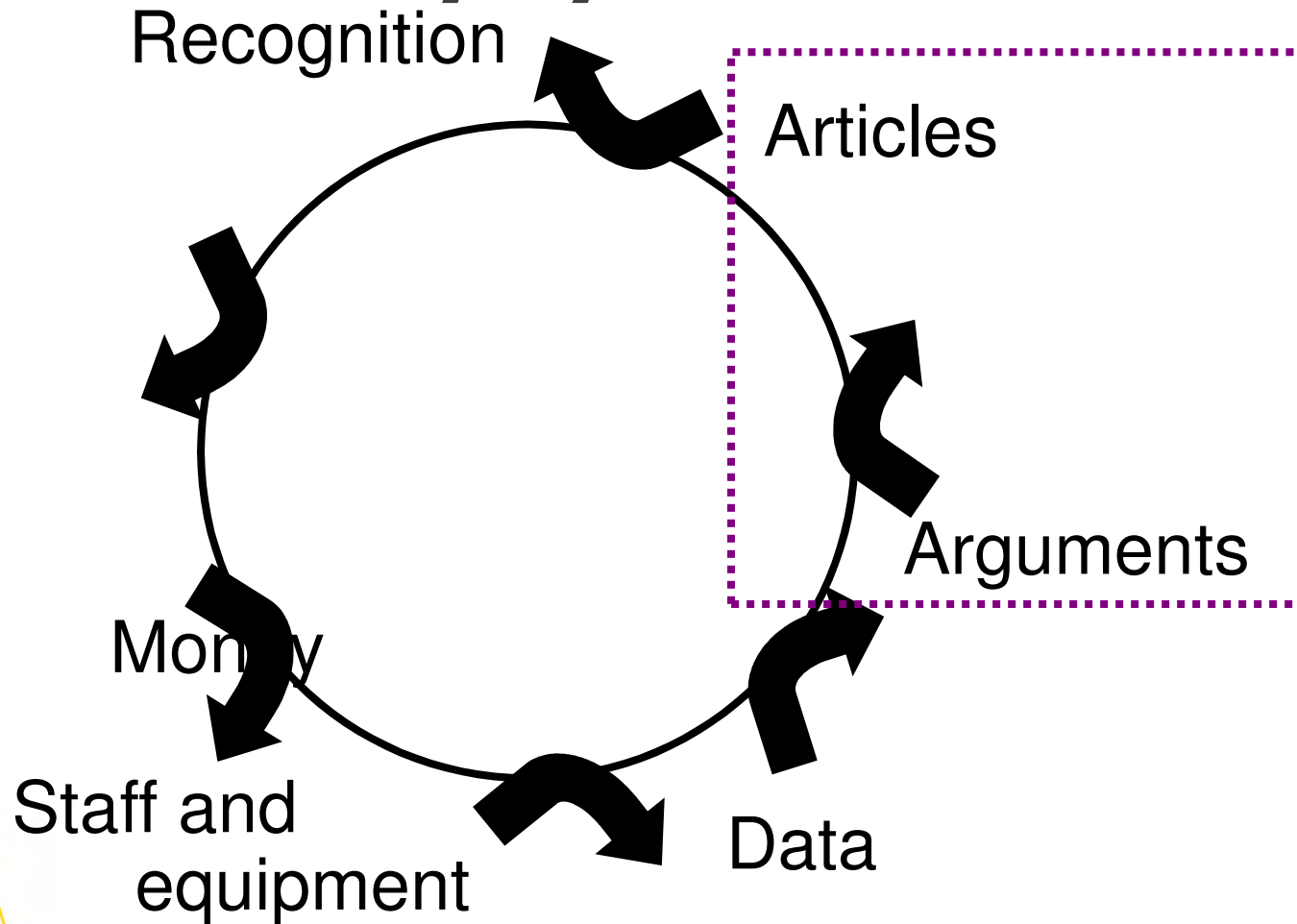
Conversion 1/6



- Many funding sources require 'relevance' or partnerships
- But not always decisive



Credibility cycle





Conversion 5/6

Articles (Patents)

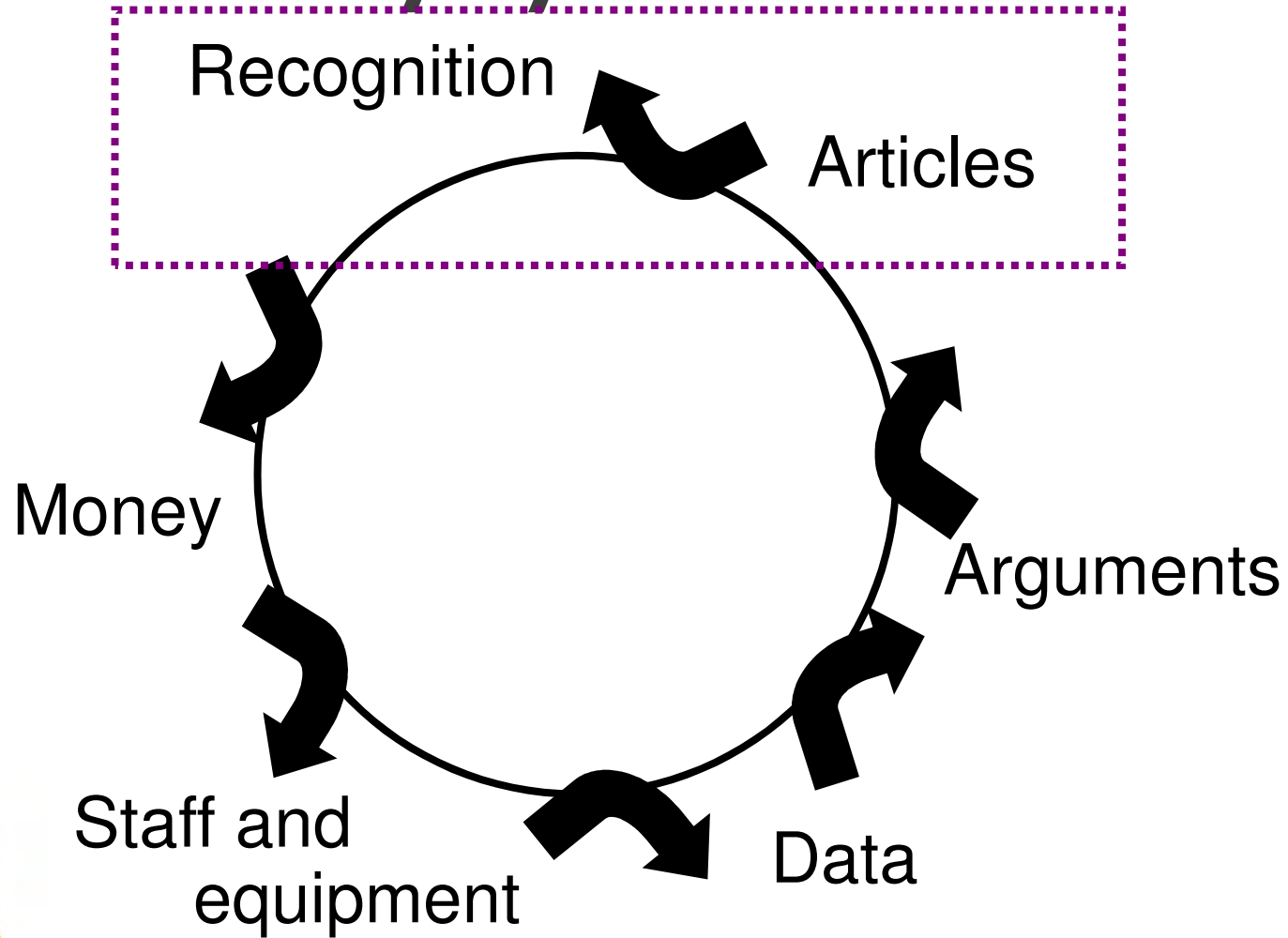
Peer review

Arguments

- Quality or quantity?
- 'Societal relevance' hardly matters
- Sometimes contractual patent delay

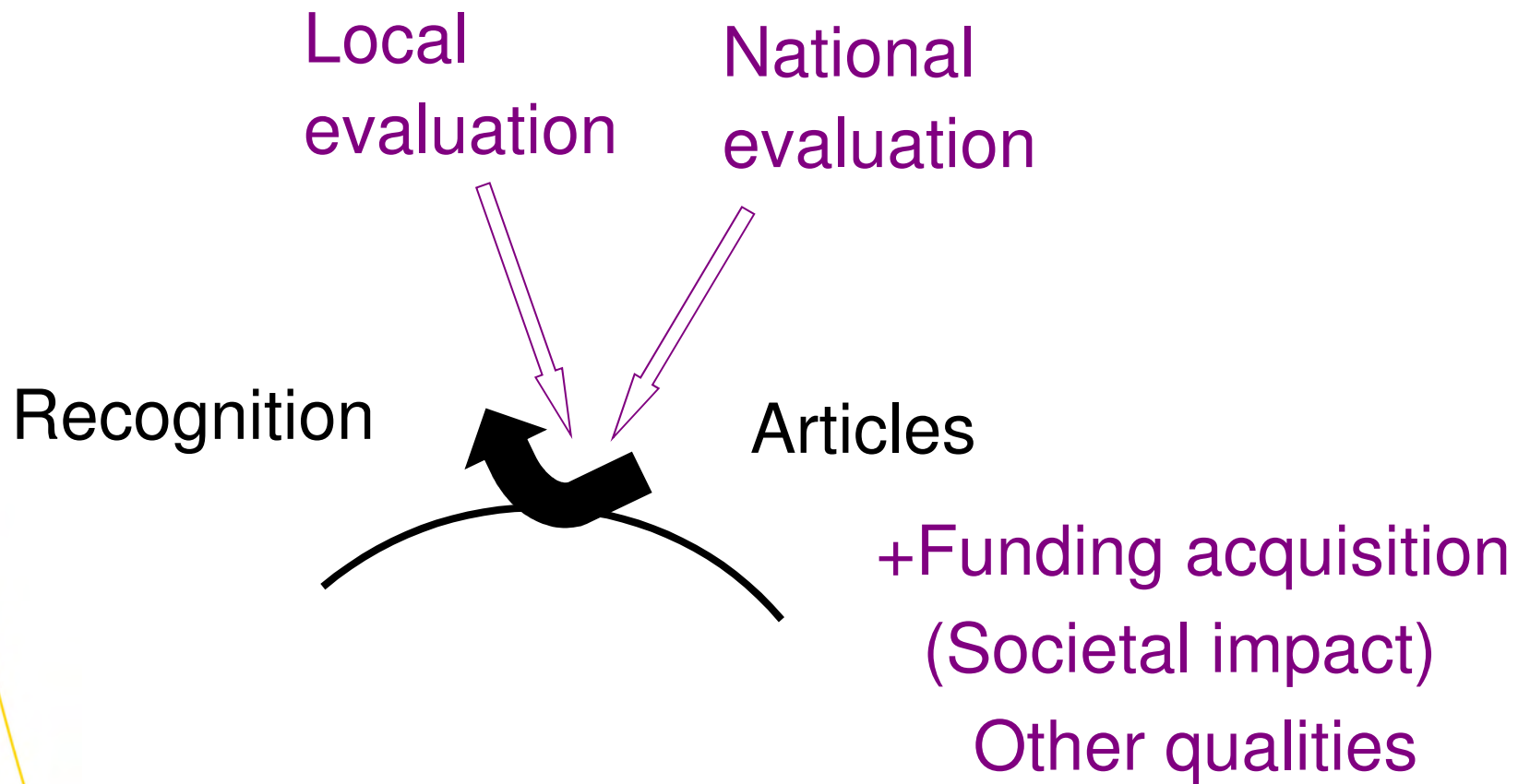


Credibility cycle



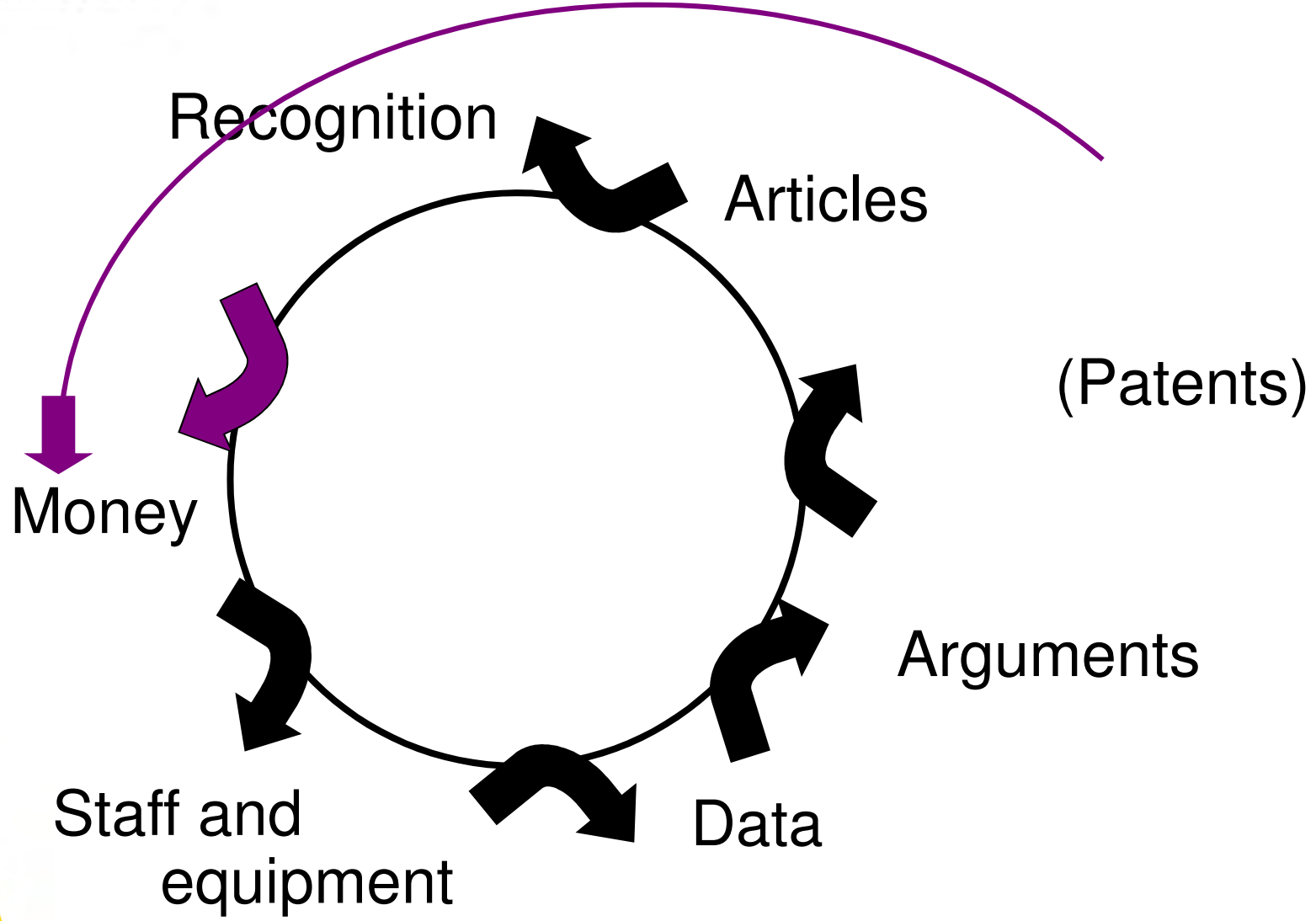


Conversion 6/6



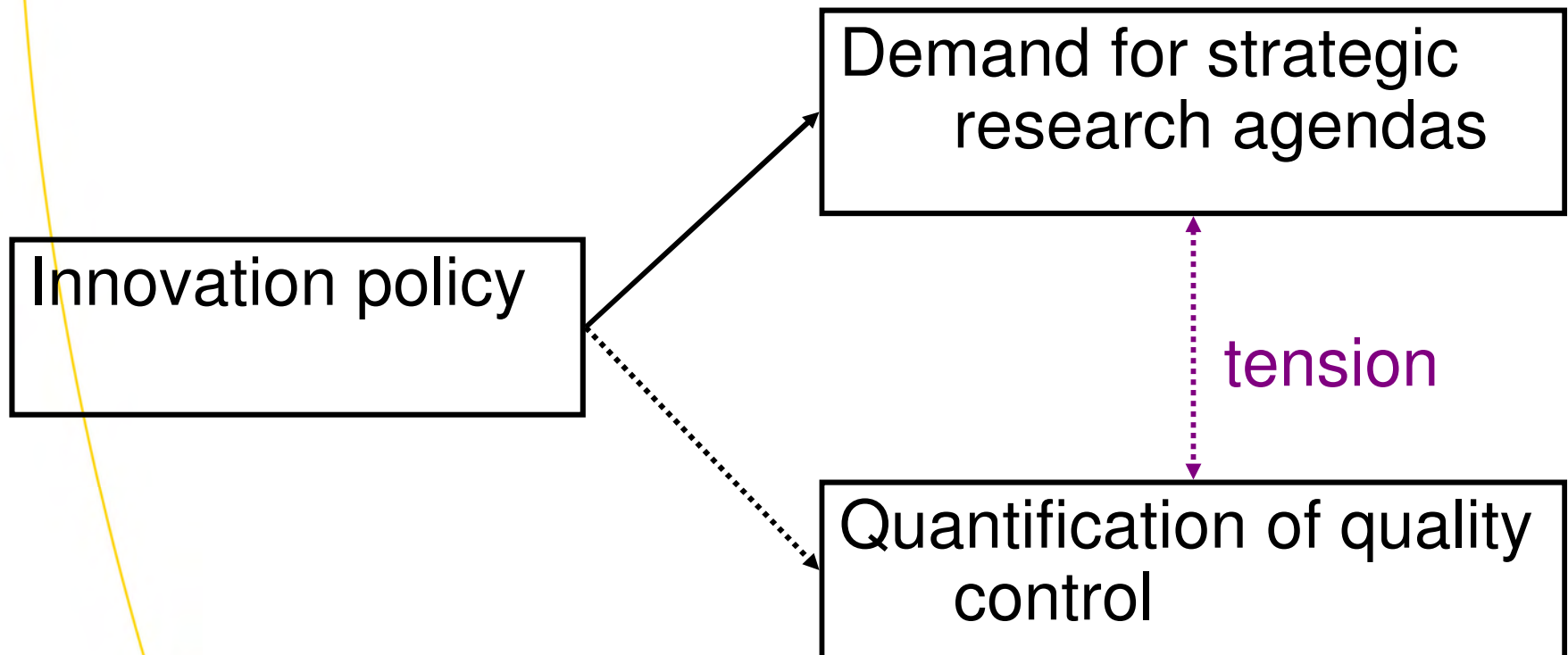


Business





The relevance paradox





Differences between fields

- Biochemistry / paleo-ecology: basic research in a strategic area
- Catalysis / genetics: basic research with direct applications
- Environmental chemistry / toxicology: cannot accomodate conflicting forces



Stokes' model

Quest for Fundamental Understanding ?	Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	No		Pure applied research (Edison)
		No	Yes
		Considerations of Use ?	



Conclusion about Mode 2 thesis

- Successful manifest
 - Identifies trends that deserve consideration
- Empirical validity partly doubtful
 - Further research is desired
- Oversimplified conceptualization
 - Mode 1 and 2 are extremes
 - Disconnect the Mode 2 attributes



Knowledge production is not just production of truth

- Reason 1: Our knowledge is always mediated by our values, perspectives, theories and measurement tools. In many cases, it must deal with uncertainty (about impacts and causes), complexity (in terms of mutual dependences of actors and topics) and ambiguity.



Knowledge production is not just production of truth

- Reason 2: what counts as useful and adequate knowledge is not easily determined, with people holding different views about this. Expectations about science have changed. During the last century, the *relevance* of science has changed, from a provider of enlightenment, to a societal problem solver or an economic motor.



Knowledge production is not just production of truth

- Reason 3: the *boundaries* of 'science' are not fixed but constantly negotiated. This leads to efforts to draw and protect boundaries, as well as attempts to profit from blurred boundaries, such as with experiments of co-production of knowledge. .



Knowledge in innovation systems

