

# Do Science, Technology and Innovation Indicators Actually Indicate?

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# Introduction

- Statistics do not exist in themselves
  - Contexts, values, interests ...
    - Race; professionalization; management
- ‘Models’ as Frameworks for Statistics
  - Linear model of innovation: proclaimed dead
  - Demand pull: disappeared
  - Ecological: in vogue

# Linear Model of Innovation

- Basic research → Applied research → Development
- Indicators
  - Inputs (money, people)
  - Activities (basic research, applied research, development)
  - Output (papers, patents)

# Demand pull Model

- Demand has given no indicators
  - What is demand: expressed needs, including ‘social’ needs (development)
  - If demand is taken seriously: need of information on impacts
    - More than productivity
    - More than statistical correlations
  - If impacts are taken seriously: need of information on mechanisms

# What has happened?

- Source of the idea
  - Early studies: 1960s
    - Emblematic study: Hindsight (DoD)
    - But also contracted studies from NSF, including Myers and Marquis: unexpected results
  - Issue
    - Management: factors (not theory)
  - Then: Langrish, SAPPHO, Utterback, ...
  - Conclusion: “coupling”

# Fate of the model

- A short period (1965-1974)
- Assassins
  - NSF (versus DoD)
  - Mowery and Rosenberg (get all citations to early studies)
- A caricature (SPRU)
  - A figure with boxes and arrows: Needs → R&D → Production
  - Continue to be read sequentially
  - Schmookler made representative (like Schumpeter)

# Alternatives (I)

- Ecological models
  - Recursive, systemic, integrated, ...
  - Conceptual (rather than empirical)
  - Not falsifiable
- What is a model, an approach, a framework, a theory?

# Alternatives (II)

- “It is possible to come up with as many causes as one wishes for any event that ever took place in the course of history (...). Whether I introduce one cause, two, five, or an infinite number of causes says nothing at all about the quality of my historical reflections” (Koselleck, 1972).

# Alternatives (III)

- What has been lost?
  - A logic
- Evaluation studies: logic model
  - Read the linear model backward
    - Research ← Development ← Production ← Needs (Goals)
  - Support where needs demand it
    - If the technology exist already: support production, imitation and diffusion
    - If it does not exist (but science is already available, which is often the case for technologies): support development
    - If the science does not exist: support research

# Indicators (I)

- Back to basic concepts: research, development, production
- Criteria: Method and output
  - Scientific: discoveries (rather than intentions)
  - Engineering: inventions (prototypes)
  - Production (manufacturing): new products and services

# Indicators (II)

- Separate D from R
  - Many thoughts on classifications of research, but:
  - Open the black-box of D: what categories for D?
- Impacts
  - More than economics
- Mechanisms
  - Serendipity, delay, problems of attribution?
  - How Input transforms into Output; how Output transforms into Impact

# Conclusion

- What about innovation?
  - I have avoided the term. Why?
    - A multifaceted concept
    - A long history; pejorative for 2,500 years
    - Has become a slogan
  - Occur at every step (not just commercialization)
    - A substantive (novelty)
    - A verb (introducing change)
    - A process (from idea to application)