

# Les indicateurs sont morts, vive les indicateurs! Towards a political economy of S&T indicators: A critical overview of the past 35 years

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## Abstract

Science and Technology (S&T) indicators are contingent knowledge demanding critique and contextualization for validity: they are value-laden devices. Hence their potential for generating biased knowledge, exhibiting the attributes of devices enabling the social construction of bias and ignorance. But indicators are also prone to criticism and debate, thus, potentially, powerful devices for robust knowledge production. The 80s mark the rise of the new field of S&T indicators aiming at better debates and policies, at the inclusion of science in democracy. Since the mid-90s, there is an extraordinary expansion of S&T indicators field. But the situation today is one of collective blindness through the acceleration of unquestioned S&T activities. To make sense of this situation we contend that (1) S&T indicators have largely become ignorance producing devices, that (2) dominant forces have driven the present design and use of indicators, and that (3) the S&T indicators scientific community, conscious of the drift, has distanced itself since the mid-90s while keeping scientifically active. If the three propositions are correct, then the collective responsibility of the S&T indicators scientific community is to call for an ending of the culturally produced ignorance drift and to pave the way for new designs and uses based on its founding 'science in democracy' problematic.

**Key words:** S&T indicators, critique, history, perspectives.

## 1. Introduction

Not pretending at history, I propose here a story of S&T indicators production and use over the past 35 years: What has happened with the S&T indicators movement over one generation, my generation? What has it achieved? Where do we stand now and what are the perspectives?

This storytelling consists in the articulation of the societal, the scientific, and the S&T indicators sub-systems and in the identification of their interactions in time.

My presentation will be sketchy, possibly viewed as provocative or pessimistic. Hopefully, it will allow for reflexivity and for discussing perspectives for the S&T indicators movement.

After having set the stage through some clarifications (Paragraph 1), we move towards a brief story of the S&T indicators movement (Paragraph 2) and conclude highlighting the collective responsibility of the S&T indicators scientific community (Paragraph 3).

## 2. S&T indicators as either ignorance producing or knowledge devices

Prior to the story, a few definitions and clarifications are needed.

### 2.1 The double translation model and the necessity of contextualization

Scientific activity and scientifically based action are seen in this model (Callon 1995) as the round trip of the object of study from and back to the real world (macrocosme) via the laboratory (microcosme)—seen as two translations:

- a. From the macrocosme (the outside, real world) to the microcosm (laboratory): Having framed an hypothesis, scientific knowledge is produced through observation and experimentation in the secluded, controlled, and simplified world of the laboratory,

where a small number of variables are at play and thus where the assumption of ‘everything being equal’ holds, allowing for direct cause–effect analysis.

- b. Back to the macrosome where the knowledge gained from the laboratory is then applied in the real world, this knowledge being the basis for action, called scientifically based action or evidence-based policy.

But, as says the motto, all translations are treasons, and here as well, since the assumption of ‘everything being equal’ never strictly holds in the real world. This implies that most scientific practice and knowledge is—to varying degrees—contingent, so that its critique and contextualization are a necessity for its validity and robustness.

The same process is at play regarding S&T indicators design and use: the real world is translated into data bases and indicators through a design and production process; these indicators are then translated back into the real world for management, policy, and strategy.

Exactly like scientific knowledge, S&T indicators are contingent knowledge demanding critique and contextualization for validity and robustness in the real world.

## 2.2 The design of an S&T indicator embodies a vision and an intention

An indicator is a quantitative parameter characterizing a phenomenon or an object. The design of an indicator results from two decisions, which are two choices:

- the conceptualization of the object or phenomenon of interest (e.g. a theory of citation),
- based on that conceptualization, the identification of one or a very few parameters supposed to embody a desired quality (also called a ‘proxy’), to be measured and become the yardstick for comparison (e.g. the number of citations received in a 2-year window).

Critical issues about S&T indicators are thus: Does, and under what conditions, the indicator measures what it pretends to measure? If yes, is the measurement reliable? If yes, what are the implicit representation and norm associated to it? And, in any case, on what assumptions are based the underlying conceptualisation of the object?

An indicator is thus a value-laden device, based on representations and norms, embodying a vision and an intention.

## 2.3 S&T indicators as possible instruments of culturally produced ignorance

When an indicator has been endorsed by institutions and used for years and when it has demanded large investments over time in databases, leading to locks-in and irreversibilities in data time-series and specialized know-how, then the indicator is integrated in the social, professional, and cultural norms and has become the undisputable reality of the object or phenomenon (e.g. the quality of a scientist is their *h*-index).

The indicator has been ‘naturalised’—that is, considered as part of the real world, an indisputable ‘fact’.

From there, the gaming of the indicators by the concerned actors, the lack of critique and contextualization of their embodied but hidden visions and intentions, result in the fact that S&T indicators do not express what they pretend to. They may even deny the knowledge we have gained over the years about S&T activities as the fabric of scientific knowledge. In this case, they put forward results which can be biased or plainly wrong: the S&T indicators thus exhibit all the attributes of ignorance producing devices.

This is all the more problematic that these S&T indicators are embedded in professional practice and heavy investments, considered as indisputable, taken for granted scientific knowledge.

This is how S&T indicators can be daunting instruments of the cultural production of ignorance.

## 2.4 S&T indicators as possible robust and reliable knowledge devices

But indicators can also be knowledge devices which is, after all, their *raison d'être*. Even more, they can be robust knowledge devices: when stakes, expectations, and uncertainties are high, robustness, beyond reliability, is required. A piece of knowledge is called robust if it stands when confronted to a variety of practices and contexts which make sense to a variety of actors.

Indicators can thus be vectors of robust knowledge if their use is the occasion of questioning the vision and intention which they embed. If it is the occasion of contextualizing and performing a critical analysis involving a variety of actors and perspectives. Indicators in this case are debatable objects with a capability to lead to reflexivity, addressing issues of meaning and sense.

Being laden with values, representations, and norms, the indicators are prone to criticism and debate, which make them, potentially, powerful devices for robust knowledge production.

Like Janus, S&T indicators have two faces.

## 3. A brief story of the S&T indicators movement, in its societal and scientific context

I will contrast two periods and assess the present situation.

### 3.1 Period A. Early-80s to mid-90s: Explorations and emergence of a movement

#### 3.1.1 Society

The late post-Second World War period (until 1989) is characterized by fordism (mass production), the establishment of the welfare state while catching up with the US model of production, consumption, and scientific production. But also by the emergence of major changes (oil and monetary crisis), ideological maturation of the forthcoming neo-liberal globalization (Reagan and Thatcher periods), and start of the suppression of tariff barriers (Uruguay round)—but their effects are not yet pervasive.

#### 3.1.2 Science

Science seen as progress and rationality, along with the emergence of science and innovation as a major public policy as referred in a 1979 report: ‘technical advances will provide solutions to both present and future problems (...) it is clear that we must alter both the rate of technical change and its direction’ (Delapalme 1979). Research becomes a central element of the European construction through the creation of the Framework Programme (FP) in 1984.

#### 3.1.3 S&T indicators

The foundations of the S&T indicators production have been laid in the 60s with the Organisation for Economic Co-operation and Development input indicators development (Frascati manual, 1964) and the launch of the Science Citation Index (SCI) by Eugene Garfield (early 60s). But, until the early 80s, progress had been slow: at this date, there is basically one journal (*Scientometrics*), a few S&T

indicators, and essentially input indicators, computed at national level, for a few sectors/fields. Information and Communication Technologies (ICTs) are in their infancy: no Internet (appearing in the 90s), data storage made with 1 M diskettes. ...

The 80s mark the rapid development of a whole new research and professional field of S&T indicators: launch of the Monitor programme (funded by the FP) fostering an S&T indicators scientific community at EU level as part of the science studies community; the SCI begins to be widely used by the S&T indicators community; the National Science Foundation (NSF) Science and Engineering (S&E) indicators reports set new ambitions and serve as a reference, while the OECD develops significantly its activity in this field, followed by UN agencies (UNESCO, UNIDO).

The reason for this emergence—facilitated by the rapid advances of the ICT—is the increasing importance of research and innovation policies for many governments: the development of S&T indicators, seen as an essential tool for the conception, implementation, follow-up, and evaluation of these policies, becomes a strategic issue.

A 1986 Report to the French Minister for Research (Arvanitis et al. 1986) expresses particularly well this twofold and largely shared perspective:

- a. A need for an active S&T policy: ‘The major task for the coming years is to imagine institutions providing to public authorities their initiative and arbitration capabilities on the major orientations of S&T development’ (p. 10)
- b. Indicators as the instrument of an ambitious and open S&T policymaking: ‘Indicators feed analysis and argumentation by opening the black box of the scientific community and of the political decision (...) establishing an intelligible relationship between scientific substance and political priorities (...) contributing to an informed debate, moving the decision from the arbitrary to arbitration’ (pp. 40–1).

The problematique of the S&T indicators movement as it is launched at that time is to better characterize the science system for substantive debates and relevant policies at the service of socio-economic development—in other words it is to include science in democracy (Barré 2001, 2010).

## 3.2 Period B. Mid-90s to present: a landslide of instrumentalized S&T indicators

### 3.2.1 Society

The neo-liberal economic paradigm sweeps the world, unleashing the forces of globalization and imposing its generalized competition and competitiveness doxa.

### 3.2.2 Science

Advent and generalization of the so-called New Public Management to the science system, integrating it in the neo-liberal paradigm at all levels—organizations (universities, laboratories, and public research organizations), journals, projects, researchers, and cognitive levels. This results in the generalization of new modes of funding, managing, strategy, and policymaking—new ways of doing research.

### 3.2.3 S&T indicators

Extraordinary expansion of S&T indicators production and use: they have become ubiquitous, universally and instantaneously accessible, up to date, and available at all scales from the individual to the world (Web of Science, Scopus, and Google Scholar available

between 2001 and 2004.) They have become the infrastructure for the generalized competition in science and its linkage to funding, human resources and financial markets (Intellectual property, start-up firms.) In parallel, a huge and highly profitable industry of scientific information (journals publishers, ICT giants, data providers, consulting firms...) is quickly developing.

These characterize a powerful ‘scientific-industrial complex’ which includes technoscience. And which—among many other things—supports and is supported by the S&T indicators infrastructure.

## 3.3 The present: Where do we stand now?

### 3.3.1 Society

There is a shared consciousness that humanity has entered the Anthropocene—marking the profound disruption of the planetary, but also of the economic and social machine, as well as the disruption of our collective values, including those regarding science. Since 1980, the top 1% of the wealthiest people in the world has captured 27% of the wealth increase, while the 50% poorest captured 12%—increased wealth largely due to the S&T advances and innovations during the period (Alvaredo et al. 2018).

### 3.3.2 Science

Numerous signs of disruption in the science system such as the recurrent issues of reproducibility and credibility (fake scientific journals). Confidence in science is undermined by the pervasive conflicts of interest linked to the ubiquitous corporate funding of researchers, projects, and institutions and by corporate or political strategies to influence science through journal board infiltration, media influence and campaigns, legal action, political funding. ...

In parallel, the paradigm for research funding based on S&T promises has become hubris and turned into pseudoscience ideology (transhumanism, augmented humans...).

The situation is one of an ever-larger gap between what is expected from science and what is delivered, for example regarding the societal European ‘Grand Challenges’ or the United Nations (UN) Sustainable Development Goals. Scientific actors run as squirrels in their cage: collective blindness along with the acceleration of unquestioned S&T activities powered by ever-escalating promises grounded on the ever more devastating impacts of the previous round of promises—all this wrapped as progress through massive investments in ideological formatting.

### 3.3.3 S&T indicators

They are in a schizophrenic situation. On the one hand the policy and strategic debates are essentially framed in terms of these unquestioned mainstream S&T indicators providing biased knowledge and participation to the above-mentioned formatting. On the other hand, declarations such as the San Francisco Declaration on Research Assessment—DORA (2012), manifestos such as the Leiden Manifesto (Hicks et al. 2015), and reviews such as the Independent Review of the Use of Metrics in Research Assessment for the UK government (Wilsdon 2015; Wilsdon et al. 2015)—warn of the perils of this situation, calling desperately for a ‘responsible metrics’.

## 4. The S&T indicators scientific community is confronted with its collective responsibility

I suggest this story leads to three propositions, resulting, if they are valid, in a perspective for the S&T indicators community.

**Proposition 1: S&T indicators have largely become ignorance producing devices.**

The story above reveals massive contradictions:

- the programme of the indicators movement set-up in the '80's (Period A) is a total failure—recall that S&T indicators *raison d'être* was to provide knowledge so that science policy could foster the production of relevant science to be put at the service of humanity: but today, a generation later, the planetary, social, and science systems are in disruption;
- the S&T indicators movement is an incredible success story: a huge operational success, at the basis of a large and profitable industry, reshaping practices and strategies of all components of the science system, all over the world; and
- at the same time all S&T indicators indeed point that more and more science is performed, and it is more and more excellent.

How to make sense of such contradictions? What proposition can be put forward?

The proposition is that S&T indicators have fundamentally become ignorance producing devices. They contribute to our blindness and ignorance while pretending to provide scientifically based understanding and governance of the research enterprise and its productions.

**Proposition 2: Dominant forces have driven the present design and use of indicators.**

The above-mentioned massive contradictions are not an issue in policy circles. How can this be explained? How can such production of biased—at least inadequate—knowledge be accepted and used for policy orientation and management regarding science? How to make sense of such an incredible situation?

The proposition is that since the late '90's (Period B) indicators design and use have been shaped and produced by the scientific-industrial complex—the dominant forces—which have found their interest in it.

It is straightforward to understand why those mainstream S&T indicators have become the instruments of insertion of the science system into the neo-liberal economic paradigm and practices: a quantitative measure of entities expresses their equivalence in substance, thus their comparability, that is, the possibility of their being in competition and their valuation. This amounts to embedding science in a market logic.

S&T indicators play a central function in the insertion of the science system in the neo-liberal paradigm, at three levels: as instruments (1) of embedment of science in a market logic, (2) of the rise of a powerful and highly profitable scientific information economic sector, and (3) of culturally produced ignorance resulting in (supposed) evidence providing wrong signals, forbidding the debate, focusing on means rather than on ends and longer-term implications.

Such service record amply justifies the continuing support of the current mainstream S&T indicators by the dominant forces of the scientifico-industrial complex. It can last as long as society accepts that the orientations of its science system are based on inadequate knowledge and do not address its needs while pretending so on (supposed) 'evidence based' arguments.

**Proposition 3: The S&T indicators scientific community, conscious of the drift, has distanced itself since the mid-90s while keeping scientifically active.**

This proposition states that, since the mid-90s (Period B), the S&T indicators scientific community has been, on the whole, conscious of the misuses of the mainstream indicators and of the

political intentions for which there were put to serve. It has thus distanced itself from the dominant forces of the S&T indicators production, all the more that:

- the mainstream indicators production and provision has positioned itself within the ICT firms producing the data (vertical integration), working with methodologies not published in journals (usually not disclosed at all) and with source data not accessible either (and which are proprietary)—placing itself clearly outside the scientific community; and
- the giant firms concerned have been able to invest amount of resources immeasurable with those of academia, thus being in a position to eliminate altogether the problematic of the S&T indicators movement as it had been set up in the 80s.

In this situation, the indicators community, with little public financial support, has concentrated on research, being quite active in methodological developments and experimentations—away from the mainstream which has become an ignorance producing device at the service of its funders.

## 5 Perspective for the S&T indicators community

If the three propositions are correct, a major consequence follows, as a perspective for the S&T indicators scientific community: it is its collective responsibility to call for an ending with the ignorance production drift and to pave the way for new designs and uses based on its founding 'science in democracy' paradigm.

The situation is such that it calls for urgent changes, possibly—but not necessarily—leading to a consensus with the dominant forces on the necessity to build robust and relevant S&T indicators-based knowledge for science policy—before it is too late to address seriously problems which will soon affect us all.

A first move would be to take stock of the relevant knowledge, methodological assets, and infrastructures of the S&T indicators community (such as the RISIS platform) and to build a coalition based on the active research networks (such as the European Network of Indicators Designers—ENID) and groups behind the recent Manifestos, Declarations, and Reports which point towards the direction advocated here.

## 6. Conclusion: les indicateurs sont morts, vive les indicateurs!

The current mainstream S&T indicators are dead—having betrayed their *raison d'être* and having lost their legitimacy. Such ignorance producing indicators and their underlying logic must strongly be denounced.

But we desperately need robust and relevant indicators for better debates and better policies to address the challenges of our time within a 'science in democracy' framework.

So: *vive les indicateurs!* long life to the indicators, in their new—or re-newed—paradigm.

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