

# Science and Technology Indicators In & For the Peripheries. A Research Agenda

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## Abstract

This paper aims to propose a research agenda that explores the problems that emerge when S&T indicators are used in peripheral contexts, that is, in geographical or social spaces that are somehow marginal to the centres of scientific activity. In these situations evaluators and decision-makers are likely to use indicators that were designed to reflect variables relevant in the dominant social and geographical contexts --i.e. in the leading countries, languages, disciplines, etc.--, but that are usually not adequate in peripheral contexts. We propose to examine various dimensions of periphery. First, the cognitive dimension: areas of research, such as the humanities that capture less attention (and resources) than the more prestigious disciplines, such as molecular biology. Second, the geographical dimension: e.g. global south vs. global north, regions vs. metropolises. Third, the social group dimension: women, the poor, or perhaps the elderly have social needs that are different from those of richer or more powerful groups --and the problems affecting the former tend to be less researched than those of the latter. The research agenda proposed would investigate the mechanisms by which performance indicators tend to be biased against the peripheries (e.g. bias in language, journal or topic coverage in conventional databases). We suggest how these biases may suppress scientific diversity and shift research towards a higher degree of homogeneity.

## Conference Topic

Science policy and research assessment

## Introduction

Science and technology indicators are becoming increasingly used over a wide variety of contexts as research activities become prominent in a larger range of countries, a broader set of organisations, and over a wider range of disciplines or topics (Sa, Kretz et al., 2013). Given that the indicators used in new contexts are often the same, or close adaptations of the indicators used in the traditional disciplines, elite universities and dominant scientific countries, one may wonder about their validity (i.e. adequacy of the indicator to the concept/object it is supposed to measure) and their robustness (or sensitivity to contingency in the measuring conditions) (Gingras, 2014).

In this work-in-progress contribution, we propose that many of the new contexts where indicators are used constitute what we call the peripheries or the margin of the research system: spaces that have less visibility, less prestige and/or less resources. As peripheries, these spaces have not had the capacity or influence to develop home-grown indicators suited for their activities -- and are instead relying on indicators borrowed from the central or dominant disciplines and/or countries. For example, it is a recurrent debate in policy to which extent scientometric indicators can be used in the social sciences and humanities (Martin, Tang and Morgan, 2010). Another recurrent example is the case of peripheral countries such as Brazil, where studies have shown that publication practices and citations differed significantly from those in the leading scientific nations, given that they "are significantly influenced by factors "external" to the scientific realm and, thus, reflect neither simply the

quality, influence nor even the impact of the research work referred to." (Velho, 1986, p. 71; see also Velho & Krigge, 1984).

In this contribution we explore dimensions in which the use of indicators in peripheral contexts may be problematic, providing misleading information for research assessment or strategy development. In these contexts, we propose that alternative methods should be explored and potentially developed to create new indicators that are fit for purpose.

This exploration will be developed into the central research agenda for a joint conference of the networks RICYT (the Ibero-American network of Science and Technology Indicators, <http://www.ricyt.org>) and ENID (the European Network of Indicators Designers, <http://enid-europe.org>) to be celebrated in Valencia between 14 to 16 December 2014.

## **A relational and multidimensional conceptualisation of periphery**

The Oxford English Dictionary defines "periphery" as

*"The region, space, or area surrounding something; a fringe, margin. Now chiefly: the outlying areas of a region, most distant from or least influenced by some political, cultural, or economic centre."*

Its cousin, the Oxford Dictionary of English provides a slightly different definition:

*"A marginal or secondary position in, or aspect of, a group, subject, or sphere of activity."*

There is already a long history of grappling with the question of peripheries in relation to global social and economic change and development (Prebisch, 1949). Science studies in Latin America have long discussed their peripheral situation and how it meant that their scientific knowledge was dependent, "transplanted" and thus often not properly adapted to their domestic needs -- rather the needs of the Northern countries exploiting their economic resources. For example Vessuri (2004, p. 174) explains that:

*"Irrespectively of their capabilities, these scientific thinkers were "peripheral" in three senses: in their marginal position in the outer ridges of European culture; in their partial commitment to the scientific endeavour (forced by the immediate pressures for survival in the middle of often unstable contexts, and the economic and political urgencies of new nations); and in their role as agents for the exploitation of natural resources of economic interest for the European centres of power, who gave them legitimacy and support." (Our translation from Spanish)*

A noticeable characteristic of this description is the multidimensional nature of the "sense" or spaces of the peripheries of Latin American scientists: culturally (or cognitively), institutionally (partial commitment), in economic terms (unstable resources and dependent on European funding) and in the topics addressed (those of interest to the centres of power).

These definitions suggest two important traits of the notion of periphery, as illustrated by Vessuri's quote above. First, it refers to a situation that is somehow marginal, far from the centre, and where, consequently, less attention is paid. The periphery is therefore *always defined in relation to a centre* where the main locus of the relevant activity resides.

Second, the concept can *relate to many different dimensions* (political, cultural, economic, different "spheres of activity"). In turn these dimensions may or may not be linked with a geographic location; for instance a centre of economic activity will be a specific geographic location. Geographic locations tend to be centre (or periphery) for a variety of dimensions: it is common for political, economic and cultural activities to cluster around geographical centres of power and influence. Similarly, peripheral regions will be peripheral along several dimensions and so the application of the term peripheral to a region has come to indicate a situation of structural disadvantage with broad economic, political and social implications. Developing countries were long ago described as "the" periphery, but within every geographical region we can also encounter peripheral zones (Southern European and Eastern European countries as peripheral to the European Union, or relatively poor regions as

peripheral within their country). Yet, not all dimensions will be correlated for a specific locality. Cambridge is a geographic centre of learning and research (a centre in a cognitive dimension) but, as a city, it is not a centre of political power, although the social group of Cambridge alumni, lecturers and researchers are part of both a political and a cognitive centre. Also, not all relevant dimensions need to have a geographical expression. One can think for instance of social dimensions like gender or class that can be interpreted under the lenses of centre and periphery but are not associated with specific geographic localities. We can therefore refer to peripheral social groups (the disenfranchised, the poor...) whose economic and social needs will be different from those of richer or more powerful communities, even when part of this groups may be located in centres of political power (e.g. the poor neighbourhoods in Washington DC).

Similarly, cognitive dimensions are not necessarily associated with geographic locations; for instance, cognitive peripheries would include areas of research that do not capture the attention of mainstream politicians and receive more limited resources. From this perspective, many fields in the humanities could be considered a peripheral field of knowledge when compared to mainstream natural or engineering sciences.

### **How conventional indicators are problematic in the peripheries**

As we have seen, the notion of a periphery is thus fundamentally a relational one. A periphery is always constituted in relation to a centre, or core. From an indicator perspective, the same entity may thus be peripheral or central depending on the frame of analysis. A particular region may be the centre of nanomaterials research in a particular country, but peripheral in relation to global nanomaterials research, for example. Whether the region is depicted as periphery or centre depends on the frame of comparison. A problem with the *use of indicators* is thus the risk of inappropriate comparisons that can render important activities as relatively trivial.

A second problem relates to whether what is being measured about a particular entity is relevant knowledge in terms of the needs, objectives or valued activities of that entity. The application of an indicator constructed to reflect the needs, objectives or valued activities of another entity may not produce useful information – only a mismatched comparison. A problem with the *content of indicators* is thus the risk of inappropriate comparisons that can render important activities as relatively invisible or lacking in impact. The use of indicators can thus play a role in *constituting peripheries*.

Our goal in this section is to analyse how indicators developed to assess policies and activities related to Science and Technology address peripheral spaces and whether they have constitutive (intended or unintended) effects on these peripheries. We therefore need to identify the dimensions that are relevant to the conduct of S&T.

Each periphery faces its own knowledge generation and application context and may be better analysed using specific, tailored indicators. Yet, by and large they need to rely on indicators, and analytical models developed for the studies of "centre" spaces. Evaluators and decision-makers are likely to use indicators that were designed to reflect variables relevant in the dominant social and geographical contexts --i.e. in core regions, languages, disciplines, etc--, but that are usually not adequate in peripheral spaces.

Let us see some examples of dimensions where use of indicators in the periphery is problematic.

#### *Language*

Language has long been known to be a major problem for performance measures, given that non-English articles tend to be much less cited. Van Leeuwen et al. (2001) showed that the inclusion or not of non-English publications in the analysis of citation impact has a major influence in the outcomes of indicators. Van Raan et al. (2011) showed that this also had

major effects in university rankings. Vasconcelos et al. (2008) showed that language proficiency is highly correlated with citation impact and h-index of researchers. This means that for the purposes of comparison, non-English publication should be excluded in most analysis.

### *Gender*

In many fields of science, women tend to publish less and accrue less citations than men. However, various studies have consistently found that women tend to do more interdisciplinary research (e.g. Leahey, 2007; Van Rijnsoever and Hessels, 2011). Hence, the effect of gender on performance depends on the indicators choice: if publications and citations are taken as a measure of the value of a contribution, the indicators will tend to disadvantage female researchers.

### *Basic vs. applied vs. research*

Applied studies tend to cite fundamental studies more than the reverse. As a result, fundamental research tends to appear as more central in global science maps (Rafols, Porter and Leydesdoff, 2010). This is possibly a perception bias without serious repercussions. The serious problem is that even within a given scientific field as defined by conventional classifications such as Web of Science Categories, applied research tends to be significantly less cited than fundamental research (van Eck et al., 2013).

### *Interdisciplinary research*

Interdisciplinary research can be thought of as peripheral to the extent that it is published in areas outside the disciplinary cores. It turns out that interdisciplinary research tends to be published in journals with lower rating in journal rankings and, within a field, with journals with a lower Journal Impact Factor (Rafols et al., 2012). As a result interdisciplinary research tends to be in a disadvantage when using this type of journal-based indicators (with citation indicators, the effect may vary as it depends on relative citation rates between fields that are being cross-fertilised).

## **Conclusions**

S&T indicators tend to be biased against organisations, countries or disciplines in the periphery. This is possibly due to the fact that indicators were not initially designed for the peripheries. At the same time, the use of these indicators in assessments linked to the distribution of resources can have constitutive effects, reinforcing for instance the peripheral character of a region or discipline. These remain unresolved problems for S&T indicators and their use in evaluation. In this contribution we shed light on this bias in multiple dimensions, in order to foster critical awareness of the problems caused by biases as well as the development of context sensitive indicators (Lepori & Reale, 2012).

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