

Defining and Evaluating Success in Open Science: Metrics Experimentation on Five National Geological Surveys via Web of Science and Altmetric

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Introduction

Canada's Open Government commitment[1] provides a strong pillar for maximizing access to federal funded scientific research for greater collaboration and engagement with the scientific community, the private sector, governments of all levels and the public. There is growing recognition that assessing the wider benefits and impacts of research (economic, social, environmental and health) should be valued alongside traditional research performance metrics. Knowledge translation of research findings into policies and practice also requires improved understanding to effectively demonstrate the full potential of science discoverability, accessibility, interoperability and reusability[2].

This collaborative case study was undertaken by a federal science program manager and a research librarian in order to better understand the development and application of scholarly metrics. The knowledge and insight gained provides new strategies to advance research management for enhanced organizational impact.

Methodology

Five national geological surveys were considered as the data source for this comparative study including Geological Survey of Canada (GSC), United States Geological Survey, NERC British Geological Survey, Geological Survey of Norway and Geoscience Australia. All of these government-funded geoscience research agencies from democratic developed countries were selected based on their similarities in research cultures, research focuses, and publication venues[3]–[7]. The metrics data about these research organizations were obtained from Clarivate's Web of Science[8] and InCites[9], and Altmetric[10] platforms.

The authors referenced the *Europe's Research Library Network (LIBER)'s Scholarly Metrics Recommendations for Research Libraries* [11] as a framework to highlight the attention and influence the scholarly works have received. Data were collected for open scholarly metrics related to scholarly outputs (e.g., number of published articles, top journals where they were published, key research areas, funders and collaborators) and those related to the impact of scholarly works (e.g. times cited, percentage of documents cited). Additionally, qualitative information (e.g. tweets containing the DOI to the article, policies that cited scholarly works) provided a rich source for understanding context on works, stakeholders, publishers and organizations.

Data were then analyzed by organization via Web of Science, InCites, or Altmetric as appropriate. Separate findings from the organizations were compared against benchmarks established to form a foundation of research activities across different organizations.

Results and Discussions

Results were interpreted by looking at the applicability of metrics, evolution of research mandates, transparency and openness in research data infrastructure, stakeholders of scientific organizations, target groups in scholarly works and publication venues. Normalization between these organizations of different sizes and productivity was a key starting point and benchmark of this research. Web of Science has developed a statistic they refer to as "Category Normalized Citation Impact" (hereafter referred to as CNCI), which is calculated based on citations per paper, normalized for subject, year and document type[10]. In Figure 1, we can see how the different geoscience organizations rank according to this CNCI value. Despite the disparity between factors such as the number of documents in the Web of Science database and times cited, we can see the CNCI values vary only by 0.29 (σ 0.125).

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Figure 1. InCites Category Normalized Citation Impact (CNCI) for All Scholarly Outputs by Organization

Name	Web of Science		Category Normalized	Times	Docs Cited
	Rank	Documents	Citation Impact	Cited	Percentage
United States Geological Survey	1	53,374	1.54	1,610,088	85.22%
Geological Survey of Norway	2	2,212	1.52	57,876	87.25%
Geoscience Australia	3	1,786	1.39	53,705	86.56%
NERC British Geological Survey	4	7,487	1.32	162,653	84.87%
Geological Survey of Canada	5	11,041	1.25	277,352	84.45%

Such results provide insights to questions that we explore in our paper:

1. Why do tens of thousands of greater publications result in such an apparently small relative increase in the CNCI? How can an organization efficiently increase their impact?
2. Given budgetary constraints facing many organizations, is there a better and more efficient pathway to increase impact of government survey R&D?
3. Who is being impacted by the scholarly activities?
4. Does the measured impact focus on right target audience given the mandate of the organization?

Our experimentation looks not only at the CNCI to delve into these questions; we also explore metrics such as open access documents, top journals in which the organizations are publishing and alternative metrics (e.g., mentions in social media, policy and patents, news and blogs). Our results concur with the research assessment community that individual indicators fail to do justice to the richness of research, and that caution needs to be exercised when metrics are used across different disciplines to assess their contribution to the development of research excellence (“quality”) and impact (“usefulness”).

As such, we conclude that responsible metrics are difficult to attain, but should be achievable with strategic intelligence and intent as they pertain to organizations, research themes and topical areas of science. Moreover, metrics should also include indicators that are more difficult to quantify such as economic and health benefits, and those supporting foundational scientific knowledge (e.g. thematic maps that are seldom referenced but form a fundamental understanding for most geoscience studies).

Responsible metrics assess the value attached to both scientific quality and usefulness and set future pathways for science policy and research assessment. To better position us in supporting the effective governance and management of research cultures, it takes effort from a multidisciplinary group of experts in scientometrics, research funding, research policy, publishing, and research science, management and administration.

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