

Eleven Ways to Measure the Immeasurable and Count the Incalculable

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Abstract

In 2017 Ocean Networks Canada (ONC), a research infrastructure operator, sought to redefine its core reporting metrics. We asked, “which metrics should we hold as key, essential metrics to drive our organizational priorities and decision making?” This question helped us define a collection of eleven sets of yardsticks, some inward-looking, others squarely focused on societal outcomes. Here, we introduce the individual metrics adopted, insights they are helping us glean and some of their inherent challenges. ONC’s core funding agency, the Canada Foundation for Innovation (CFI), continues to emphasize scientific output as a primary criterion. We measure this by counting peer-reviewed presentations and publications resulting from use the facility and ONC’s data archives. But this seemingly clear-cut metric has been a thorny one to define, track and grow. Training and support for post-secondary students is another core reporting metric, however this measurement is also fraught with ambiguities. Some of the easier metrics to track are those specifically related to facility operations, such as reliability and user satisfaction. But we were perplexed by the question of how to measure “optimal use” of the facility, as mandated by CFI. Optimal use is hard to define for an underwater infrastructure design like ONC’s, which can be flexibly extended with no hard limits on hardware capacity, archive volume or data access. When it comes to societal benefit, our approach has been twofold. One set of metrics examines technology transfer, grants and contracts. Another set focuses on our engagements and active collaborations with governmental, indigenous and non-governmental organizations. However, some outcomes remain challenging to measure. While it is straightforward to count up our external interactions and collaborations, how can we quantify their current and future societal impact? These and related questions will be explored.

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I Scientific Contributions

Total and Average Citations, 2006-2018 (last update: 15 Nov 2018)

Journal articles, conference presentations, book sections, theses, published datasets

Devilish Details:

- How to quantify impact?
- How much data should be used for something to count?
- What about symposia, workshops, grad seminars?
- Should undergrad honours theses count?
- Should review papers count?
- How to know if someone used our data?

II Periodic Evaluation

The metrics themselves are not set in stone, and are subjected to periodic review and evaluation: *How could our measurements improve?*

Community Interests
Community-based observatories address local needs and interests, such as "How thick is the ice?" in an Arctic setting.

Partnerships
A unique interdisciplinary partnership between ocean technologists and particle physics researchers is enabling deep-sea biologists to study bioluminescence using highly sensitive photodetectors installed for a trial neutrino detection array.

Engaging New Audiences
Working with indigenous communities not only enables scientific monitoring, but also supports skills and workforce development for youth seeking to forge careers in marine technology and locally relevant applied sciences.

3 Tech Xfer

Technical reports*, licenses*, patents*, spin-offs†

* Many † Few

2 HQPs (Highly Qualified Personnel)

- Undergrads
- M.Sc. Students
- Ph.D. students
- Postdocs
- Research Associates
- Technicians

internships, expeditions, thesis support, term projects, visiting research terms, workshops, training sessions

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Apples – Oranges – Lemons:

- Ph.D. = undergrad intern?
- Single = multiple engagements?
- Principal = supplementary data use?

Why not count:

- Numbers of engagements?
- Hours spent engaging HQPs?

4 Users

Registered or unregistered* users who access the data archive, online analytical tools or data products. Ideally broken down by: province, country, sector.

Oceans 2.0 Users per Month

* Removing login increased user counts

Tools for Counting:

- Google Analytics (geographic distribution, users accessing data via websites)
- Database searches (registered users, Application Programming Interface (API) users)
- Targeted Annual Survey (Sector composition (n))

How do we avoid double counting?

- Data served through multiple channels
- Google Advertising Features can track users across devices, but... How do we protect privacy?

10 Indigenous Engagement

Active partnerships with indigenous communities.

Matches a major area of focus for the current Canadian government.

Stages of Engagement:

- 1) Awareness: Community has heard of us.
- 2) Connection: Identifying mutual areas of interest.
- 3) Partnership: Working relationship established.

9 Informing Policy

Number of civil servants, NGO representatives, officials engaged.

8 Collaborations

MOUs, research agreements, national/international projects.

5 Optimal Use

Number of active data streams divided by average full-time equivalent staff count.

$$\frac{8585}{130} = 66$$

Benefits:

- Shows effort (across the org.) to support data streams.
- Ratio increases with efficiency/ productivity improvements.
- Helps indicate impacts of staffing shortages.

Cautions:

- Does not indicate actual use of data streams.
- Many staff members are not directly involved in supporting data streams.

6 Satisfaction

Percentage of users* who are "extremely" or "moderately" satisfied with the facility's:

- Infrastructure & instrumentation;
- Quality of data and data products;
- Online tools and data access;
- Responsiveness.

*Sample size of 183 / 1524 (35%)

Survey Monkey used

Biggest challenge: getting responses

Individual, personal emails most effective (least scalable)

7 Reliability

Ratio of "non-compromised" to total deployed instruments.

Compromised Categories include Failures: (communications, mechanical, sensors), **Interference** (acoustic, electrical) and **Sensor Problems** (degradation, biofouling)

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Perplexing is the question of how to measure "optimal use" of the facility. This criterion is hard to define for an underwater infrastructure design like ONC's, which can be flexibly extended with no hard limits on hardware capacity, archive volume or data access. When it comes to societal benefit, our approach has been twofold. One set of metrics examines technology transfer, grants and contracts. Another set focuses on our engagements and active collaborations with governmental, indigenous and non-governmental organizations. However, some outcomes remain challenging to measure. While it is straightforward to count up our external interactions and collaborations, how can we quantify their current and future societal impact?

