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Benchmarking Bibliometrics

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Presented by:

- **Simon Pratt**, Director, Research Strategy & Excellence, Division of the Vice-President, Research and Innovation
- **Heather Cunningham**, Assistant Director, Research and Innovation Services, University of Toronto Libraries
- **Sonia Sugumar**, Associate Director, Corporate Partnerships & Blue Door Community, VP International

DEFY GRAVITY

Agenda

- **Bibliometrics Overview**
  - What is bibliometrics and what is benchmarking?
  - Why benchmarking matters to research
  - How can bibliometrics support benchmarking?
- **Responsible Use of Metrics**
  - Leiden Manifesto
  - Declaration on Research Metrics (DORA)
  - Hong Kong Principles for Assessing Researchers
- **Benchmarking Standards & Practices**
  - Use Cases & Tools
  - Commonly Used Indicators
- **Case Study:** U of T Blue Door: Demonstration the Value of Partnerships

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Learning Objectives

- Understand what bibliometrics is and how it supports benchmarking
- Identify the appropriate tool to use for various bibliometrics use cases
- Identify issues related to responsible use of metrics
- Access support resources for bibliometric tools and resources

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Bibliometrics Overview

Benchmarking

Examples of benchmarking:

- Understand performance in context
- Demonstrate excellence (for example for advocacy or for a grant application)
- Identify trends
- Find other institutions, e.g collaborators.
- Evaluate the performance of a past action. E.g.
  - Did this collaboration work?
  - Did that investment result in a change?
- What else?

Benchmarking

Why do we use benchmarking?

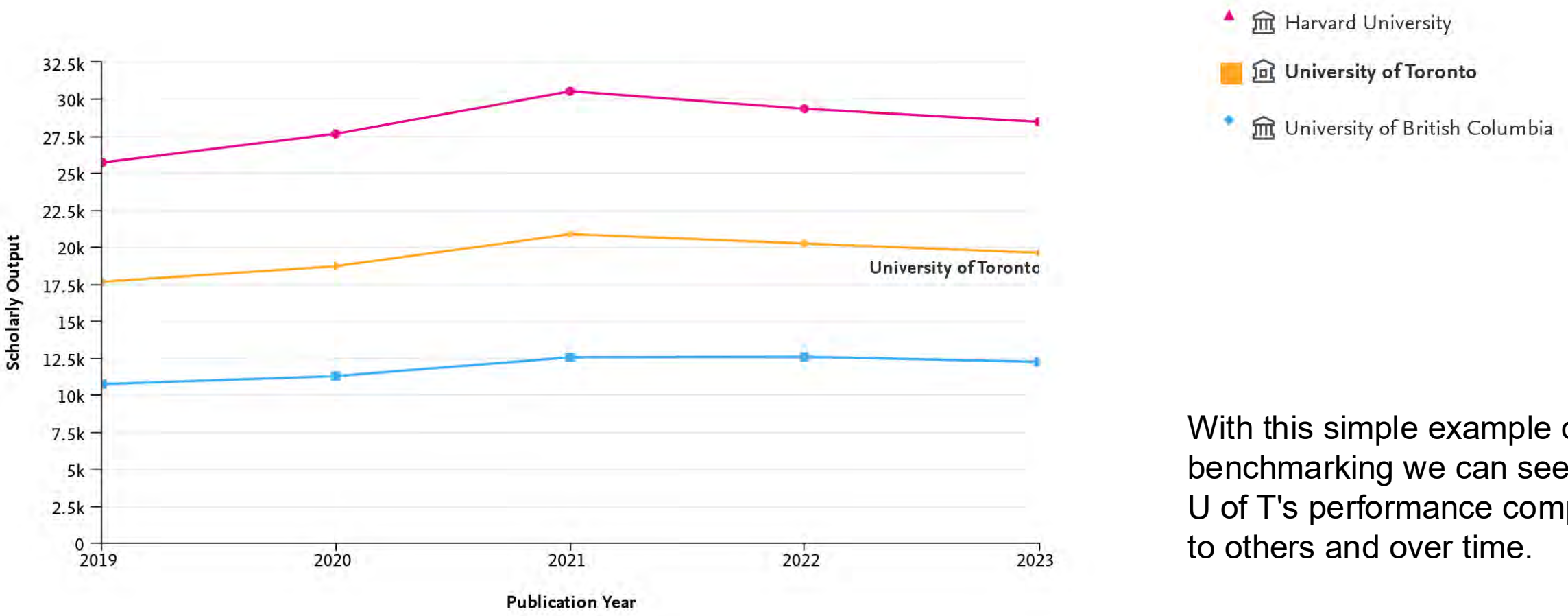
Bibliometrics (and other similar indicators) are numbers, and without some context, those numbers are meaningless.

Benchmarking provides context and can turn raw-data into meaningful information.

For example: How many publications did U of T researchers publish last year?

Answer = 19,603

Benchmarking



With this simple example of benchmarking we can see U of T's performance compared to others and over time.

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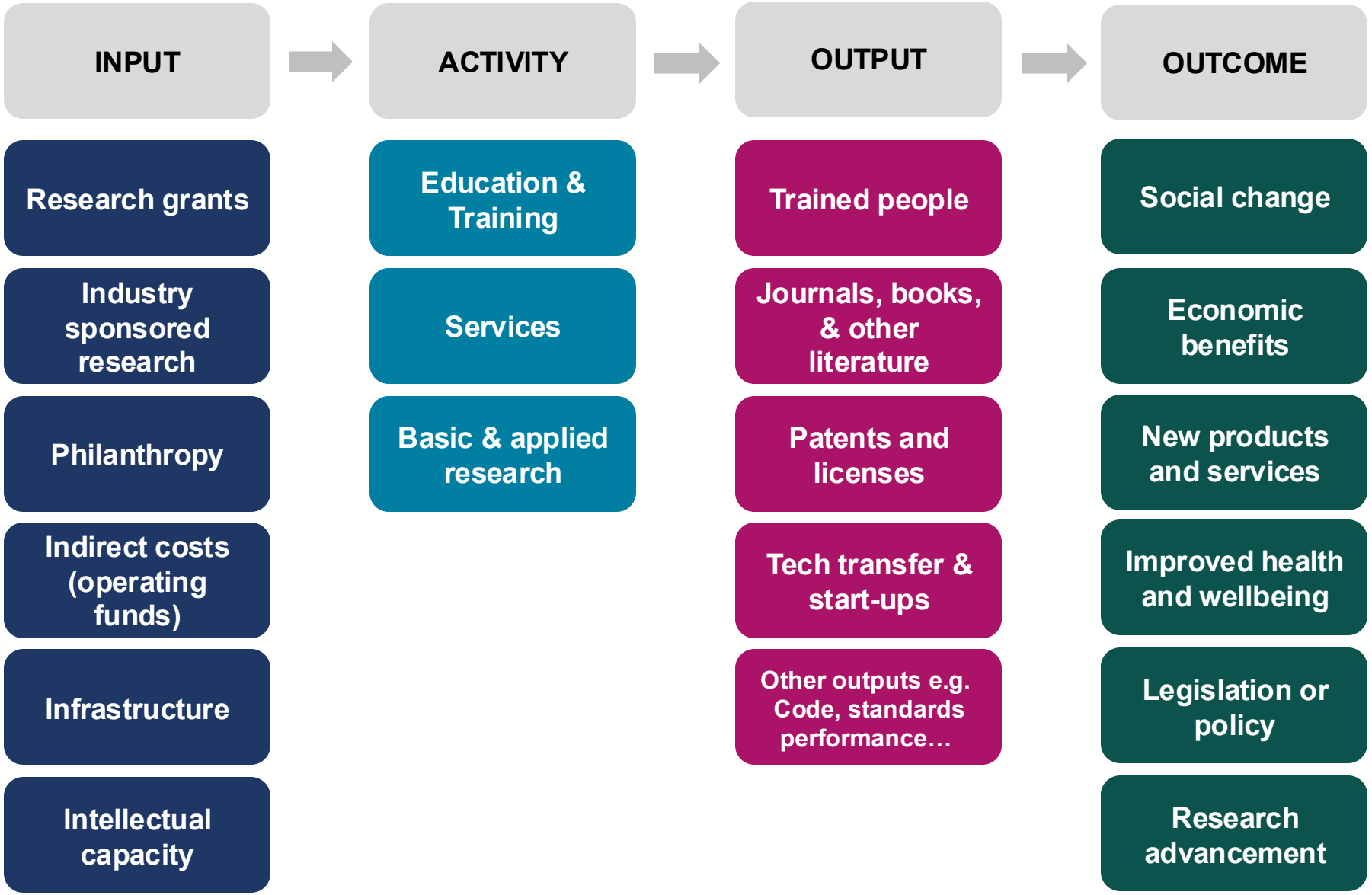
Benchmarking – using a logic model

It is not always necessary, but creating a research evaluation logic model before you start an evaluation can be helpful.

The next slide is an example of a pathway logic model but there are many other relevant models. It is impossible to have a perfect model.

The thought process in establishing the model is useful and it will help you determine what you are actually measuring and identify shortfalls in what can be measured.

Pathway logic model example



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What is bibliometrics?

Bibliometrics is the use of quantitative methods to analyze scholarly literature. Typically, by counting publications and the citations to those publications as indicators of research productivity and impact. Examples of indicators you may know include:

- Citation Impact
- Journal Impact Factors
- H-index.

Bibliometrics is closely related to:

- Scientometrics – covering the measurement of science in general.
- Informetrics – covering all types of information.
- Alt-metrics (or alternative metrics): looking at usage data such as views, downloads, tweets, mentions, etc.
- Recent developments include: policy citations, patent citations.

Why is bibliometrics valuable or relevant?

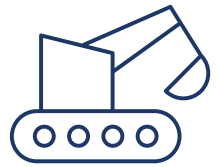
Scholarly literature is the main forum for research communication in most disciplines.

Although there are challenges, bibliometrics can provide robust and comparable measures of the research productivity and impact of various entities such as:

- Individuals
- **Institutions**
- **Countries**
- Journals
- Topics/subjects

What are the main challenges?

Citations are only one measure of impact: When a paper is cited by another paper, it is an indication of utility or influence, usually in a positive way. Measuring the number of citations a paper accrues indicates the impact that the research has had on other scholars.



However, bibliometrics says next to nothing about other types of impact such as:

- Economic impact
- Environmental Impact
- Societal impact
- Cultural impact
- Impact on health and wellbeing
- Etc.

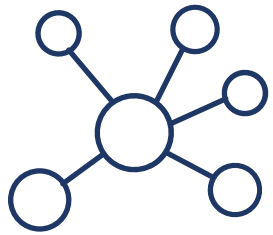
There are some new tools and resources, such as patent citations, policy citations and media impact that are indicating some of these different types of impact.

Additionally, the tools include papers limited by the SDG so you can do some fundamental analysis in the ways in which research is contributing to some of the above.

What are the main challenges?

There can be significant comparability problems. Particularly with regards to the subject area, age of the research, data source, language, and country or region. For example:

- Papers in the life sciences are more frequently cited than mathematics.
- The databases do not cover non-English literature well.
- Social scientists often publish in books which may not in the databases.
- Arts & Humanities research outputs may not in the form of literature at all.
- Computer Science and Engineering publish as conference proceedings, and these are inconsistently covered in the databases.



When looking at individuals: equity, diversity and inclusion are significant challenges.

Bibliometric indicators can be manipulated.

Massive Multi-author Papers

- Large multi-national research projects in areas such as astrophysics, particle physics, epidemiology and genetics can result in papers with hundreds and sometimes thousands of co-authors.
  - Sometimes called “Massive Multi-author Papers” (MMA)
  - How much did each author contribute?
  - These types of papers can accumulate tens of thousands of citations.
  - The volume of citations can skew some of the metrics, such as citations per paper.
  - Especially if you are looking at a small data set.
- There are many ways to overcome this challenge but perhaps the best way to handle this is to take MMAs out of your analysis for some indicators and look at complementary indicators.

Citation context, self-citation, and negative citations.

The act of citing a work can have different meanings depending on context. This can be also be subject specific:

Example 1 – Utility (common in all disciplines):

> *The meta-regression tool MR-BRT developed by Zheng et al.[33], was used for modeling.*

Example 2 – Discussion or argument (more common in social science):

> *We position our study in some foundational debates about the ascendance of statistics in areas of public policy and administration (Levy, 2001)*

Citation context, self-citation, and negative citations.

Self-citations are not inherently bad. It is normal for a scholar to build on their own work.

However, the manipulation of citations through self-citation is clearly undesirable. A common type of manipulation is for journal editors to require articles to cite the journal, or even the editor's papers, before accepting them.

- Some of the tools allow you to automatically remove self-citations.

To a certain extent scholarly publishing is self-policing through the peer-review process and bad behaviour is not prevalent, but you should be aware that it happens. Especially if looking at small data-sets.

Negative citations tend to occur at a low rate (<5%). We expect the rate of the negative citations to be the same for two entities of large size (e.g. universities or countries). Care should be taken with smaller data-sets.

Confidence in bibliometric indicators

Field	Small data set: Individual person	Medium data set: Division	Large data set: Institution / country
Arts & Humanities	Very low	Very low	Low
Social Sciences	Low	Medium	Medium
Engineering / Computer Sci.	Low	Medium	Medium
Life Sci, Physical Sci. Health	Medium	High	High
Particle physics, Astrophysics, Public medicine	Results can be impacted by massive multi-author papers.		

Appropriate Use of Metrics

Responsible Use of Metrics - Frameworks

San Francisco Declaration on Research Assessment (DORA): https://sfdora.org/

§recognizes the need to improve the ways in which the outputs of scholarly research are evaluated, beyond the journal impact factor

Leiden Manifesto for Research Metrics: http://www.leidenmanifesto.org/

§10 principles to guide research evaluation

Hong Kong Principles for Assessing Researchers: https://osf.io/m9abx/

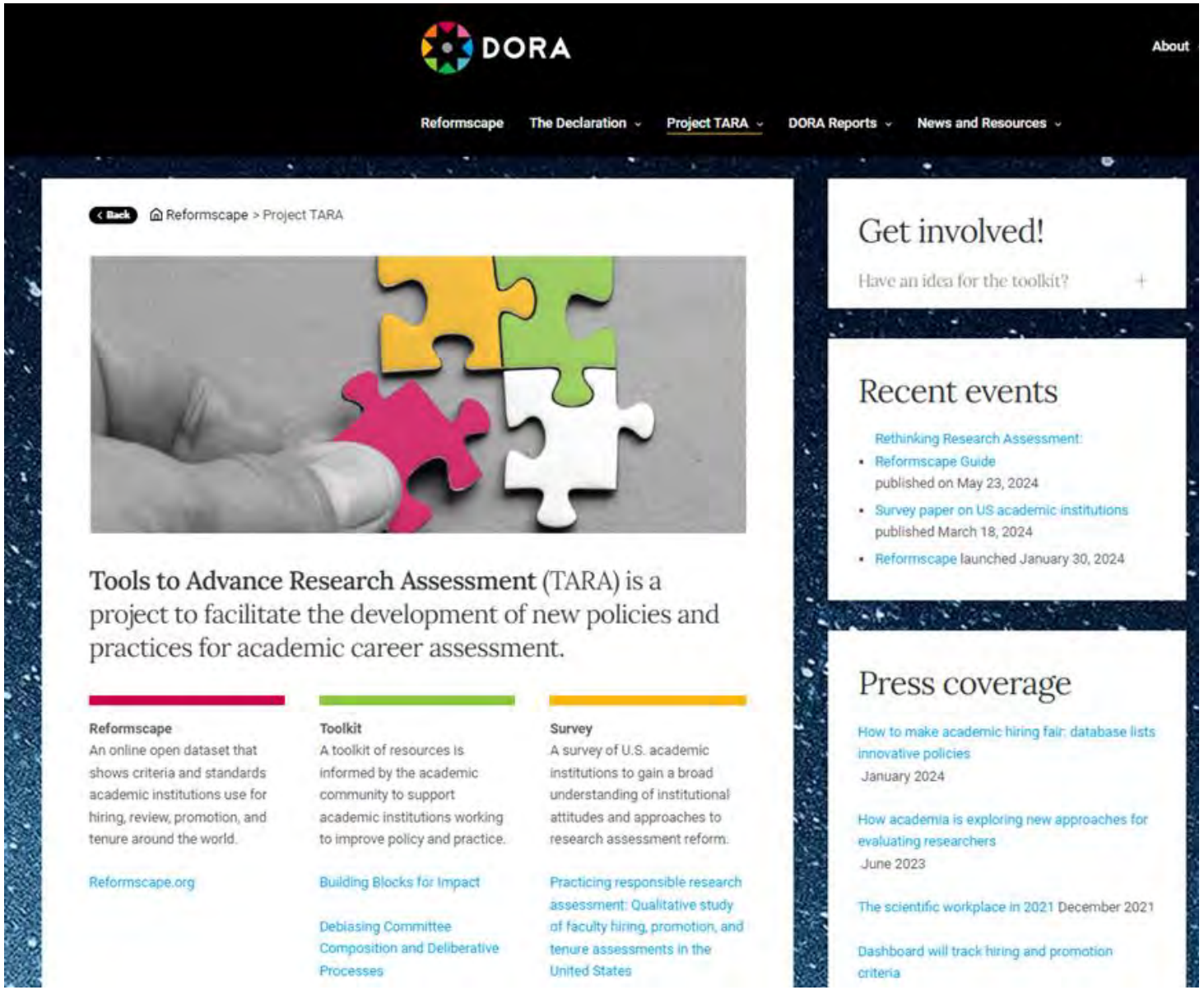
§Assessing researchers based on research integrity & transparency

San Francisco Declaration on Research Assessment

- Shortcomings of Journal Impact Factor
- Alternative research assessment approaches
- Address structural inequalities in academia

From: https://sfdora.org/

DORA - Tools to Advance Research Assessment (TARA)



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Leiden Manifesto for research metrics

1. Quantitative evaluation should support qualitative, expert assessment
2. Measure performance against the research missions of the institution, group, or researcher
3. Protect excellence in locally relevant research
4. Keep data collection and analytical processes open, transparent and simple
5. Allow those evaluated to verify data and analysis
6. Account for variability by field in publication and citation practices
7. Base assessment of individual researchers on a qualitative judgement of their portfolio
8. Avoid misplaced concreteness and false precision
9. Recognize the systemic effects of assessment and indicators
10. Scrutinize indicators regularly and update them

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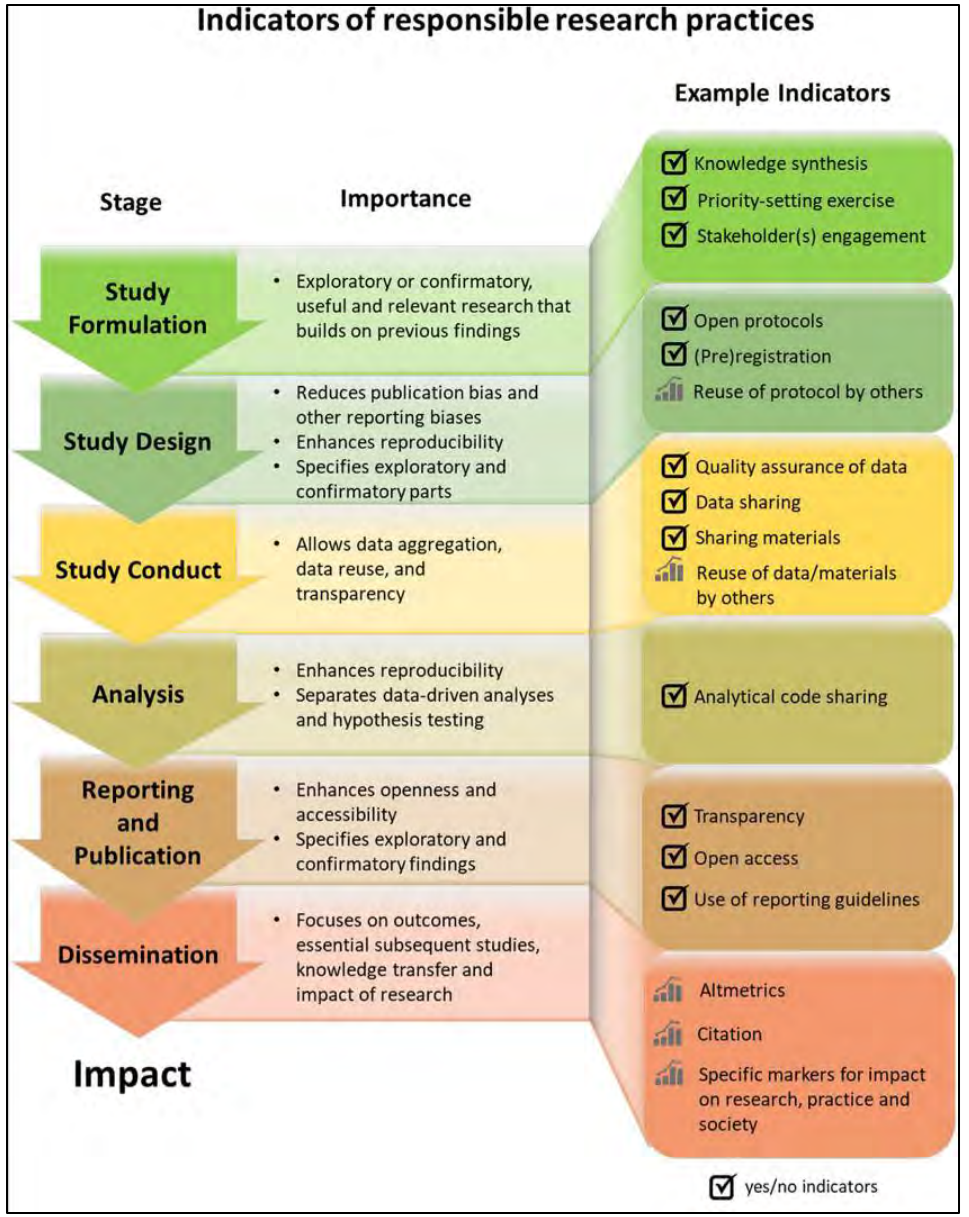
Hicks, D., Wouters, P., Waltman, L. *et al.* Bibliometrics: The Leiden Manifesto for research metrics. *Nature* **520**, 429–431 (2015). https://doi.org/10.1038/520429a

Hong Kong Principles for Assessing Researchers



From: Moher D, Bouter L, Kleinert S, Glasziou P, Sham MH, et al. (2020) The Hong Kong Principles for assessing researchers: Fostering research integrity. PLOS Biology 18(7): e3000737. https://doi.org/10.1371/journal.pbio.3000737

Benchmarking Standards & Practices

The main tools

Clarivate InCites: https://incites.clarivate.com/

- You may need to be on campus (or access via VPN) to complete the initial registration. Once you have registered you can access anywhere.
- Based on the *Web of Science.*
- Powerful and quick on-the-fly analytics, can create your own benchmarks.
- Nice visualizations.
- Good on-line help and support.

The main tools

Elsevier SciVal: https://www.scival.com/

- Should be able to access with UTOR ID. Click the  icon in the top right corner to start the registration process.
- Based on *Scopus.*
- Innovative metrics, e.g. patent citations and media mentions.
- Calculates some metrics off-line, which can be frustrating.
- The data source, Scopus, has more journal coverage than the Web of Science, especially for regional journals and the humanities.

Other useful tools

Overton: https://www.overton.io/

- Overton is a database of policy documents that provides links back to the scholarly research that is cited by the policy document.
- It is still a very new resource and so far, it is not well understood. But it is very exciting!
- U of T has a subscription, but you should register/login for all the features.

Other useful tools

Open Alex https://openalex.org/

- Open Alex is a free and open catalog of research.
- It is based on Microsoft Academic Graph and Crossref.
- It has very broad scope of coverage, but not curated.
- It doesn't have the advanced analytical capabilities of InCites or SciVal.
- Although it does have a web interface, to make the most of it for analytical purposes you will need use their API.

Other useful tools

- **Dimensions**: https://app.dimensions.ai/
- You can register for free, but access to all the features requires a subscription. U of T doesn't have one (more on this later).
- Yet another database of scholarly research.
- Broader coverage than Web of Science or Scopus, more like Google Scholar or Open Alex.
- High quality meta-data, such as affiliation information.
- Alt-metrics are fully integrated.
- It is one of the main sources for the university's Elements, more on this soon.

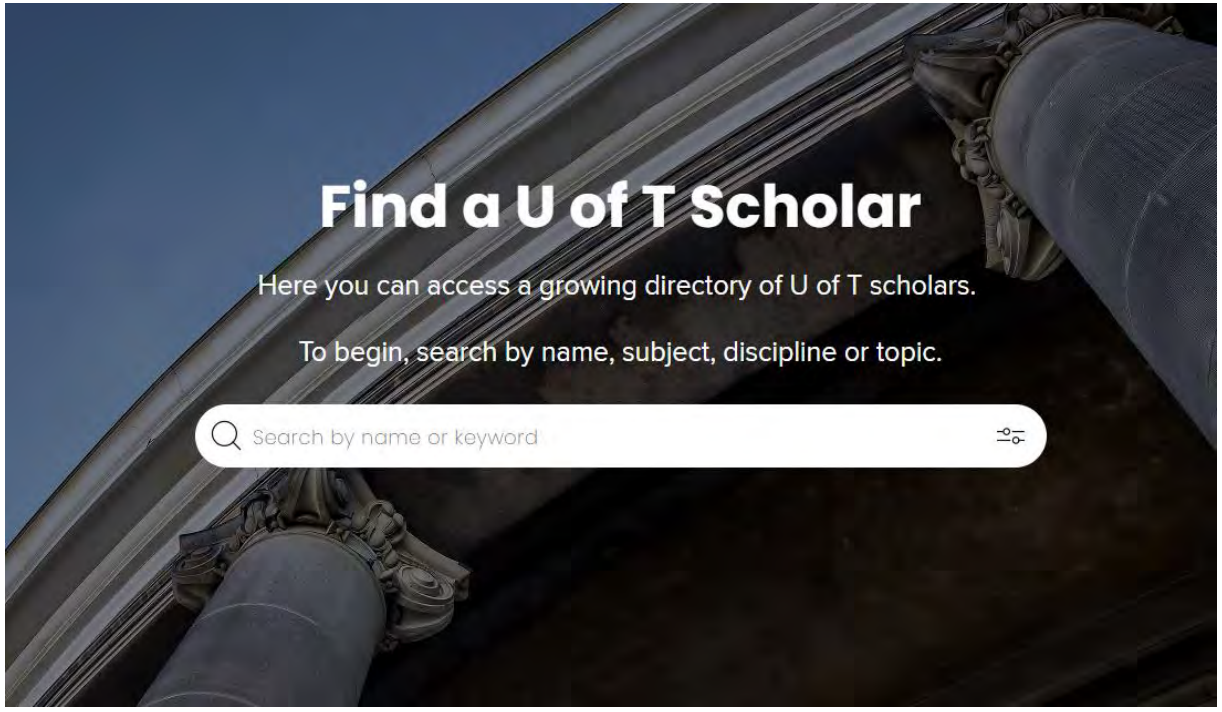
Other Useful tools

Google Scholar: https://scholar.google.ca/

- Academics use it and will often expect everyone else to use it, but:
  - It covers a lot of stuff, not just journals, but it is not curated. Much of the additional content is not peer-reviewed, some is not even scholarly.
  - There are a lot of duplications of articles and pre-prints. Although Google Scholar unifies pre-print and final copy, they count the citated references of both versions, which inflates citation counts.
  - There is no attempt to index affiliation information or other meta-data.
  - There are no analytical capabilities.
- Google Scholar can be an appropriate tool if you wish to generate list of people, their articles and their citations.
  But…..

Other useful tools - Discover Research / Elements

- Discover Research / Elements: is the Recommended Source for U of T Faculty, Individual and Unit Bibliometrics and Altmetrics.
- Discover Research https://discover.research.utoronto.ca/ is the public facing directory of U of T scholars.



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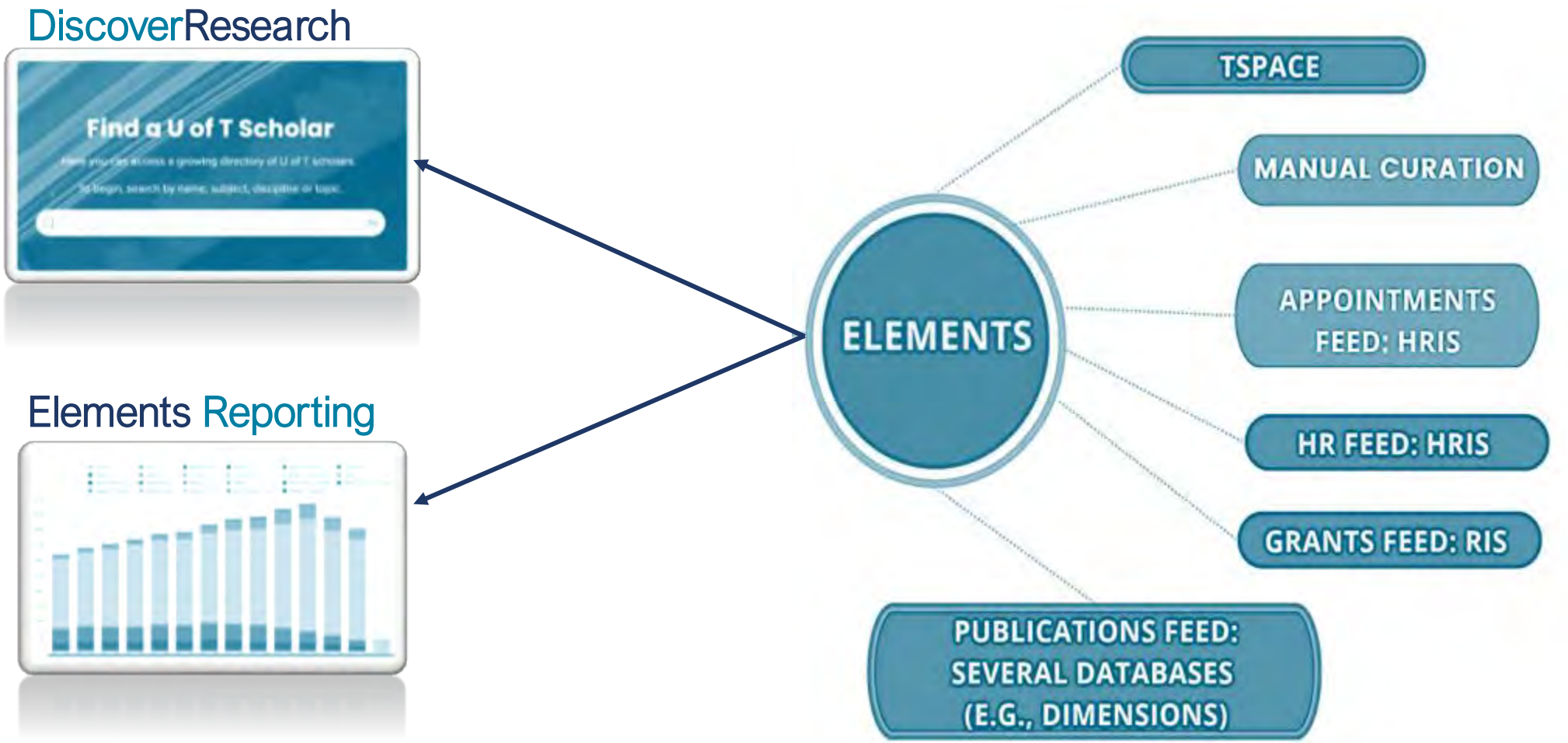
Elements is the powerful research and scholarly activity data service that supports DiscoverResearch

The vast dataset that is built and maintained for Discover Research is also an institutional resource for unprecedented bibliometric data



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Elements combines data from disciple-spanning, trusted sources

Comparing Web of Science to Elements
Example: Barbara Fallon

	Web of Science	Elements
Journal articles	118	151
Books & Book Chapters	6	31
Series	2	
Conference Presentation		205
Presentation / Lecture		26
Policy Document		4
Other Reports		7

- All 126 items in Web of Science were in Elements
- Elements contained 425 items
  - 235 automatically uploaded
  - 190 entered by curators

Barbara Fallon,
Associate Vice-President, Research, Professor of Social Work

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The Other Barbara Fallons in Web of Science

Barbara L. Fallon
neuroscientist, pharmacologist, forensic analyst
2 articles

Barbara Fallon
Department of Physiology, Michigan State University
2 articles

Other useful tools

When **Discover Research / Elements** does not make sense:

- Benchmarking: Elements cannot compare or benchmark to other institutions or countries.
  - Elements is centered around people and will include all publications of an individual, including papers they have written when they were affiliated somewhere else.
- Past faculty: Elements has only current faculty.
- Non-faculty researchers: Elements does not include post-docs, doctoral students, staff, etc.
- Trending topics - clustering

Key metrics

Publication counts:

- A basic measure of research volume.
- Typically limited to: *Articles, Review Articles, Books, Book chapters, and conference proceedings*.
- Different fields have different publication rates. Therefore, you should take the subject mix of entities into account. It is best practice to only benchmark in one field / subject.
    - e.g. How does Engineering at Waterloo compare to U of T
- Proportion, or share, of a larger entity (Canada, World, etc) can be useful context.

Key metrics

Total citation count:

- A measure of how much influence the entity had.
- Closely linked to the size of the entity being measured.
- Citations accumulate over time, must take the age of publication into account.
- Very subject dependent. Must use methodologies to account for this.

- Compare like-to-like or use *normalized* metrics to overcome challenges in comparison.

Key metrics

Citation Impact or citations per paper:

- The average number of citations per paper. Calculated as the total number of citations divided by the total number of papers.
- Be careful with the nomenclature, don't confuse with *Journal Impact Factors*, impact in a broader sense, or quality.
- Here is an example calculation of citation impact for two researchers, using only one indicator can be misleading.

	Total Publications	Total Citations	Citation Impact
Researcher A	1	50	50
Researcher B	10	200	20

- Citation Impact is very subject dependent.
- Calculations can be skewed by a small number of highly cited papers

Key metrics

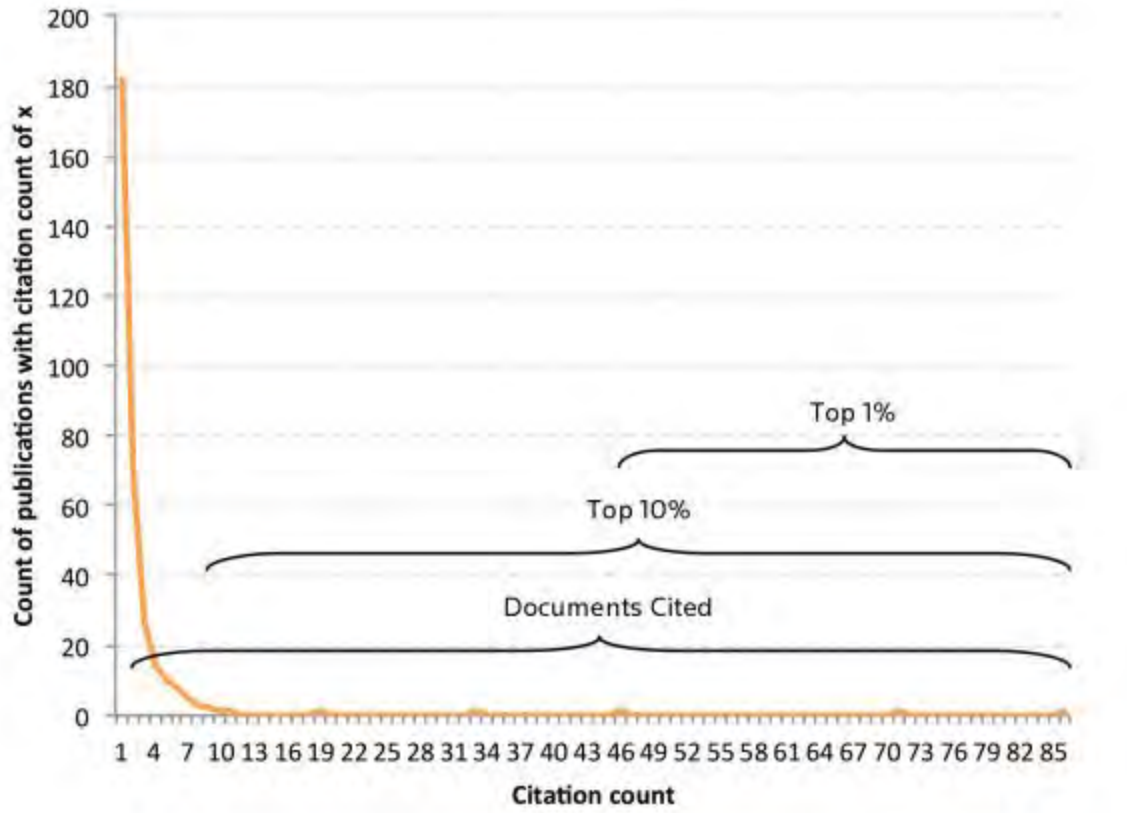
Normalized Citation Impact (NCI, FWCI, CNCI):

- A modification of the citations per paper calculation to overcome comparability problems with subject, age of research, and document type.
- It is calculated as the “actual citations” divided by the “expected citations”
  - Where the "expected citations" is based on the average number of citations per paper in the same subject, year, and document type.
  - A value of 1.0 is world average and a value of 2 would mean that the entity has been cited twice as often as the world average.
- Can be skewed by small number of highly cited papers.
- Results can be very inconsistent for recent papers. Recommend that you don’t use for papers that are less than two years old.

Key metrics

Top X% :

- The number of papers that are among the top X% in a given subject, year and publication type. 10% is the most commonly used.
- Excellent complement to the Normalized Citation Impact.
- Not skewed by small numbers of highly cited papers. (which is good and bad)
- A measure of excellence.



Key metrics

H-index (Hirsch Index)

The H-index is usually associated with individuals, but it is possible to calculate it for any set of papers. However, this can be confusing.

- The h-index is calculated such that there must be at least n publications that have received at least n citations. i.e. a h-index of 5 means that there are 5 papers that are cited 5 times or more.
- Very age and subject dependent. No attempt to normalize.
- Results tend to be correlated with the total citation count.
- Not a very useful measure but popular.

Key metrics

Journal Impact Factor (JIF)

- It is average number of times that articles published in a journal in the preceding two years were cited in the current year.
- It is about the journal as a whole and doesn't tell you anything about the individual articles in the journal.
- It is definitely NOT recommended for benchmarking.
- It is mostly only recommended if you are trying to evaluate journals.

- Note that DORA (and others) specifically recommend that you do not use the JIF!

Subjects

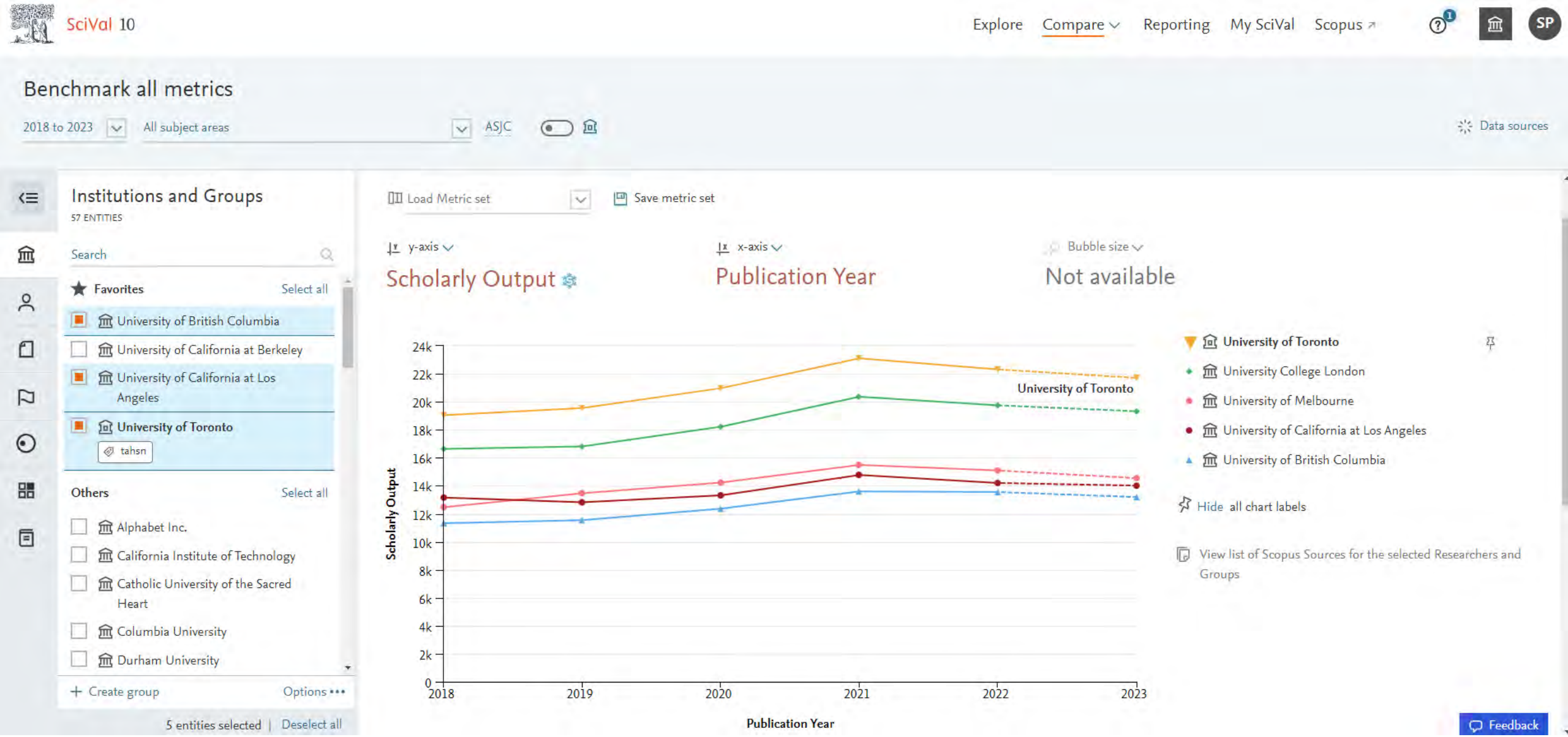
There are many ways to define a subject for an analysis:

- Compare divisions/departments, in a university, or across different universities
  - Within U of T, you could do this using Discover Research / Dimensions
  - But it is impossible to compare to other universities as we don't know their divisions and departments. And anyway, they won't have the same scope.
- Instead, we typically use the subject areas that are included in the tools.
  - The default subject categories are based on assigning journals to subjects. Individual articles within those journals will vary in scope considerably.
  - However, the tools also provide topics or clusters. These are algorithmically derived using citations and keywords to assign individual articles.

Analysis

Let's do some analysis!

https://www.scival.com/



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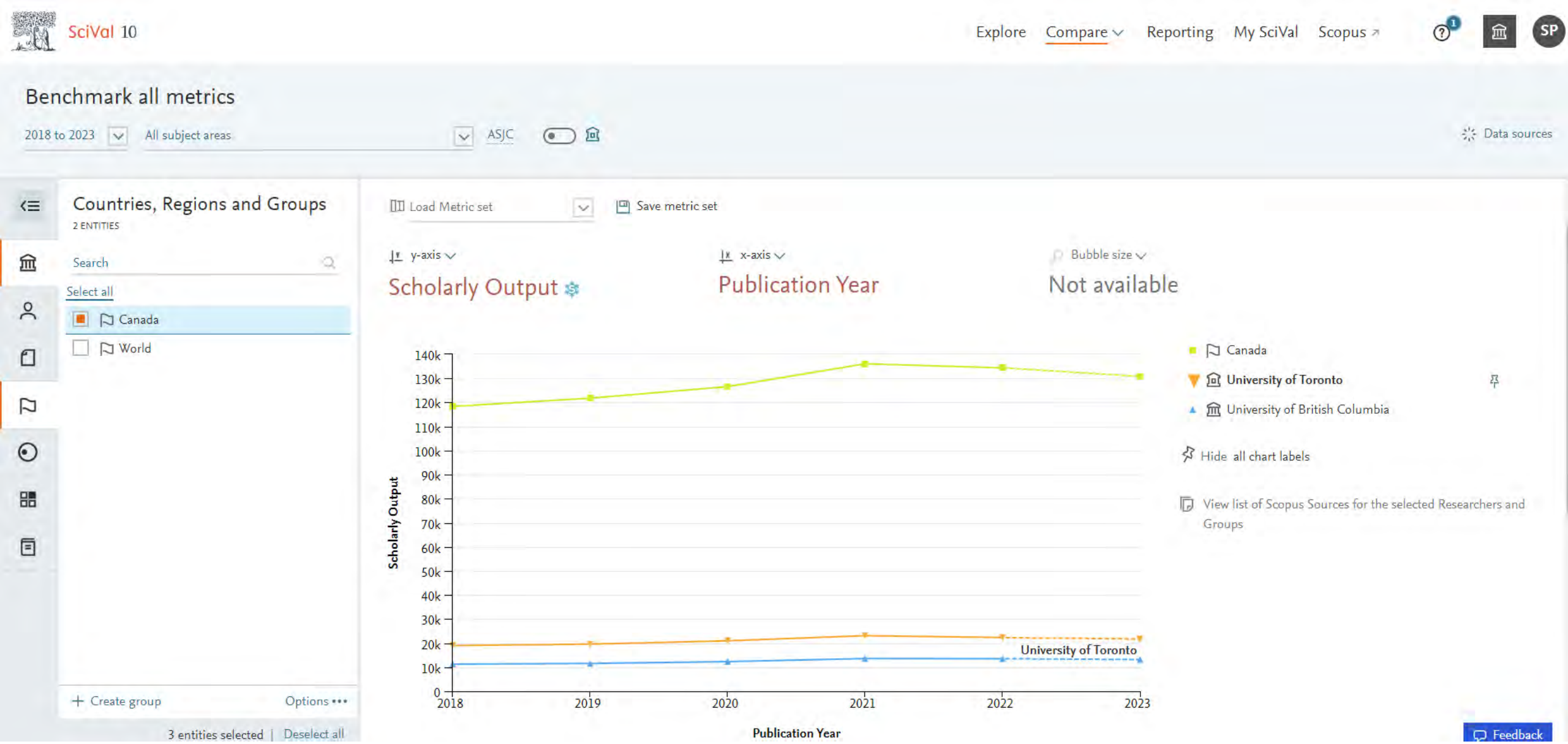
SciVal 10
Explore
Compare
Reporting
My SciVal
Scopus
SP
Benchmark all metrics
2018 to 2023
All subject areas
ASJC
Data sources
Countries, Regions and Groups
2 ENTITIES
Search
Select all
Canada
World
Create group
Options
3 entities selected | Deselect all
Load Metric set
Save metric set
y-axis
Scholarly Output
x-axis
Publication Year
Bubble size
Not available
140k
130k
120k
110k
100k
90k
80k
70k
60k
50k
40k
30k
20k
10k
0
Scholarly Output
2018
2019
2020
2021
2022
2023
Publication Year
University of Toronto
Canada
University of Toronto
University of British Columbia
Hide all chart labels
View list of Scopus Sources for the selected Researchers and Groups
Feedback

SciVal 10

Explore | Compare | Reporting | My SciVal | Scopus

Benchmark all metrics

2018 to 2023 | All subject areas | ASJC | Data sources

Countries, Regions and Groups

2 ENTITIES

Search

Select all

- Canada
- World

+ Create group | Options

3 entities selected | Deselect all

Table | Chart

Metric guidance | + Add to Reporting | Export

Load Metric set | Save metric set | Manage multiple metrics | Add metric

One metric over time: Scholarly Output | Heatmap

Entity	Remove all	2018	2019	2020	2021	2022	2023	Overall
Canada		118,386	121,813	126,573	136,026	134,384	130,808	767,990
University of British Columbia		11,329	11,547	12,361	13,600	13,554	13,193	75,584
University of Toronto		19,038	19,554	20,971	23,107	22,313	21,707	126,690

View list of Scopus Sources for the selected Researchers and Groups

Metrics details

Metric 1: **Scholarly Output**
Types of publications included: all.

Metric 2: **Publication Year**

Feedback

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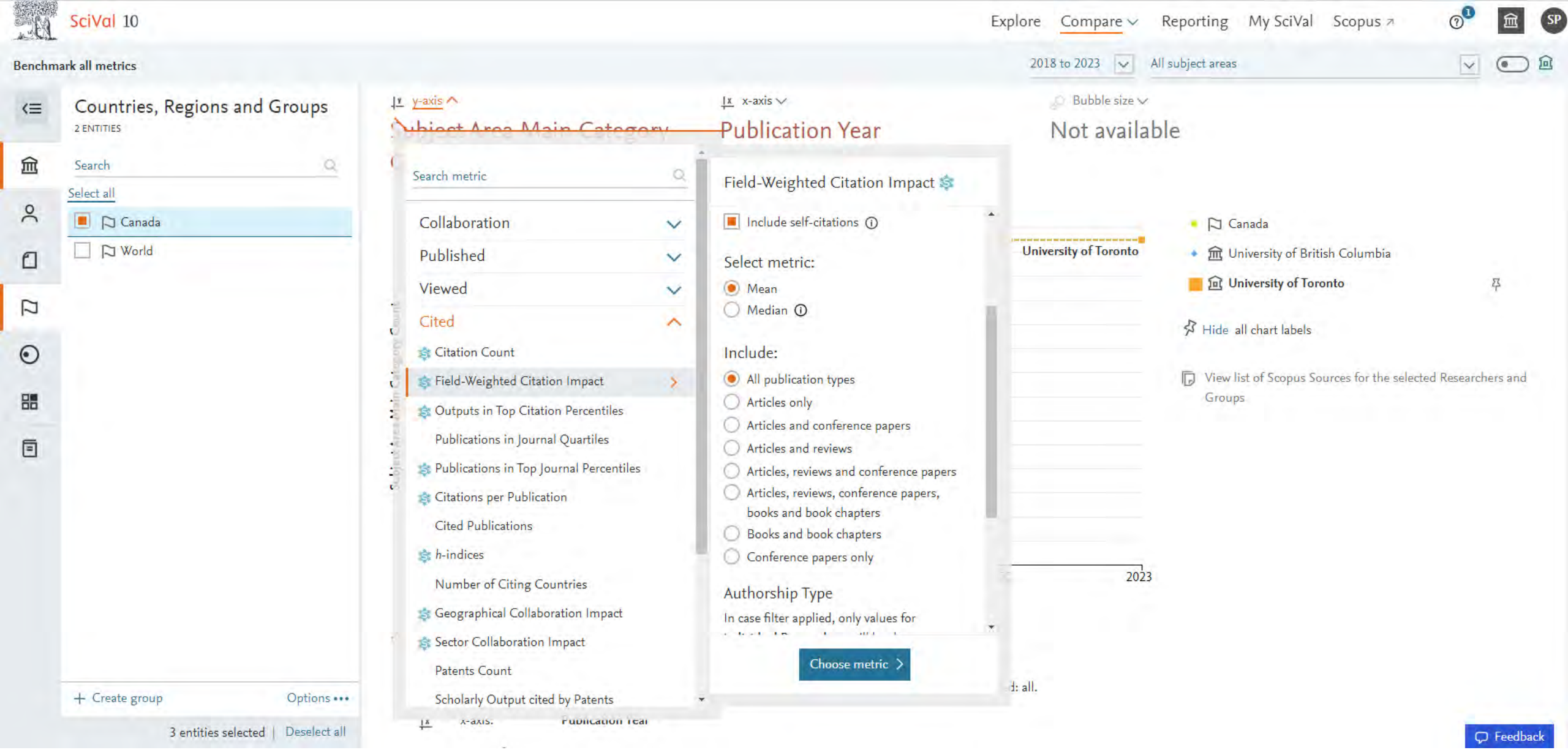
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Subject Area Main Category
x-axis
Publication Year
Bubble size
Not available
Search metric
Collaboration
Published
Viewed
Cited
Citation Count
Field-Weighted Citation Impact
Outputs in Top Citation Percentiles
Publications in Journal Quartiles
Publications in Top Journal Percentiles
Citations per Publication
Cited Publications
h-indices
Number of Citing Countries
Geographical Collaboration Impact
Sector Collaboration Impact
Patents Count
Scholarly Output cited by Patents
Field-Weighted Citation Impact
Include self-citations
Select metric:
Mean
Median
Include:
All publication types
Articles only
Articles and conference papers
Articles and reviews
Articles, reviews and conference papers
Articles, reviews, conference papers, books and book chapters
Books and book chapters
Conference papers only
Authorship Type
In case filter applied, only values for
Choose metric
University of Toronto
2023
Canada
University of British Columbia
University of Toronto
Hide all chart labels
View list of Scopus Sources for the selected Researchers and Groups
Feedback

SciVal 10

Explore | Compare | Reporting | My SciVal | Scopus

Benchmark all metrics

2014 to 2023 | All subject areas | ASJC | Data sources

Institutions and Groups

57 ENTITIES

Search

Favorites Select all

- University of British Columbia
- University of California at Berkeley
- University of California at Los Angeles
- University of Toronto
  - tahsn

Others Select all

- Alphabet Inc.
- California Institute of Technology
- Catholic University of the Sacred Heart
- Columbia University
- Durham University

+ Create group | Options •••

3 entities selected | Deselect all

Table | Chart

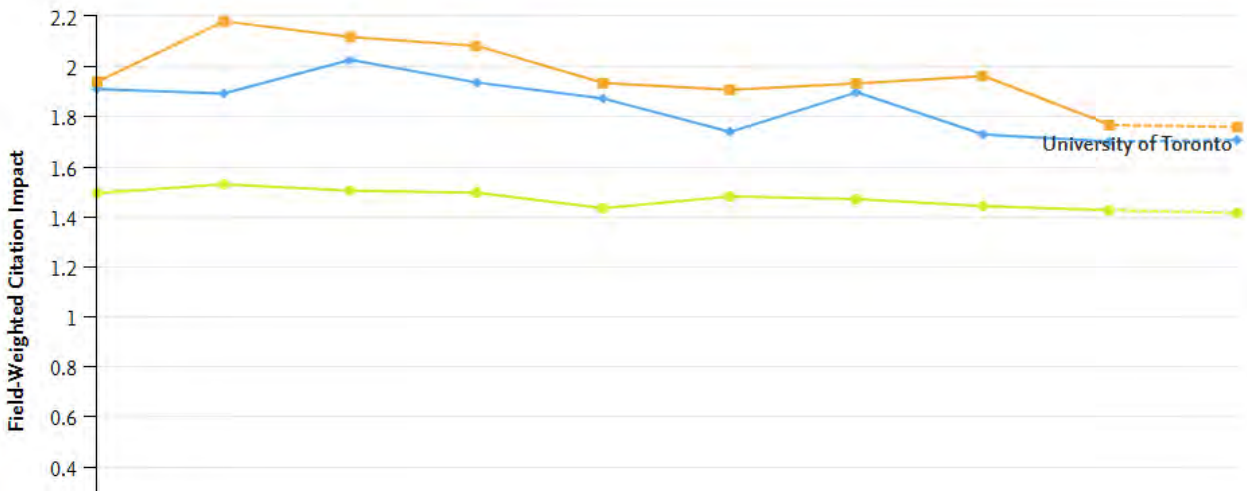
Metric guidance | + Add to Reporting | Export

Load Metric set | Save metric set

y-axis: Field-Weighted Citation Impact

x-axis: Publication Year

Bubble size: Not available



- University of Toronto
- University of British Columbia
- Canada

Hide all chart labels

View list of Scopus Sources for the selected Researchers and Groups

Feedback

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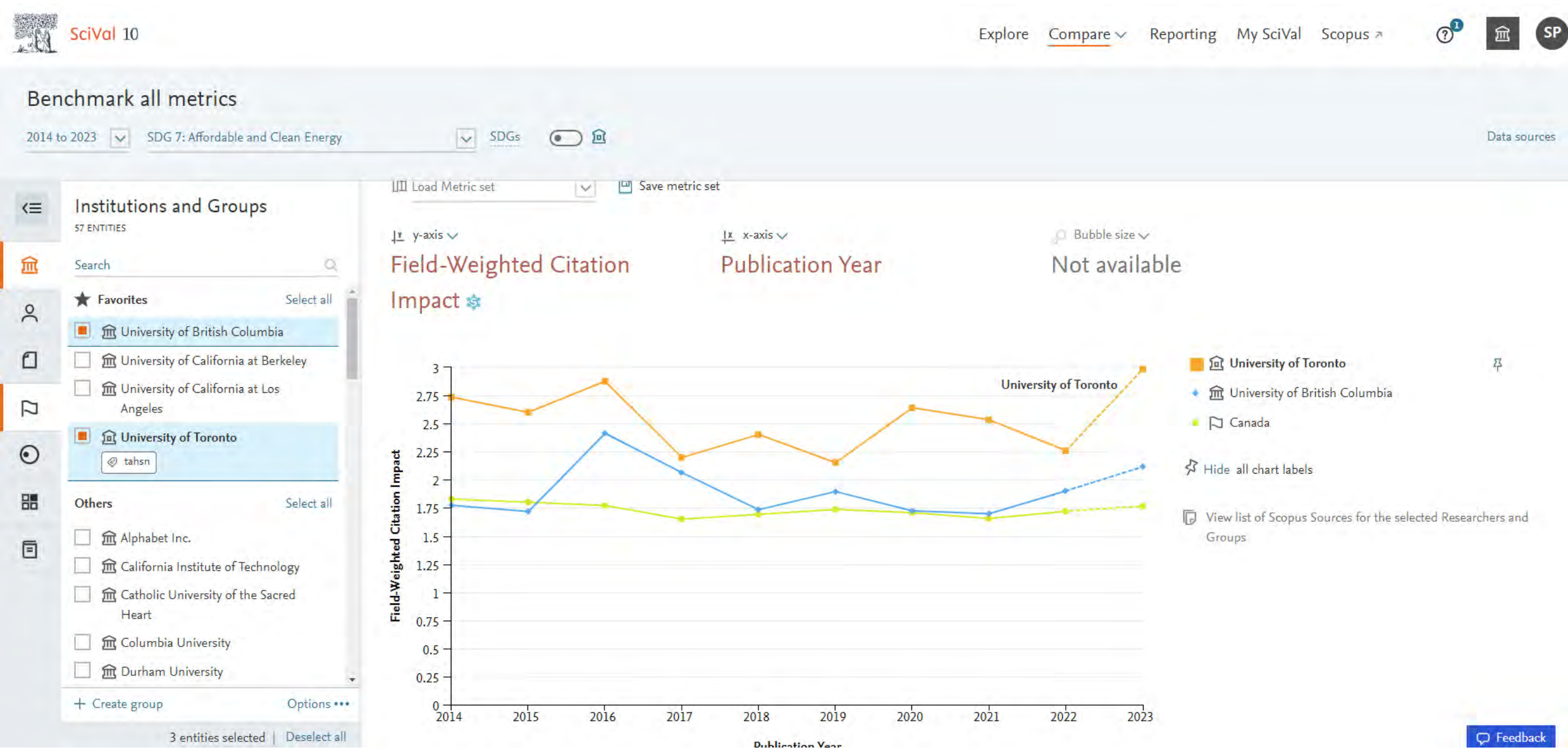
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SDG 7: Affordable and Clean Energy
SDGs
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Save metric set
Institutions and Groups
57 ENTITIES
Search
Favorites
Select all
University of British Columbia
University of California at Berkeley
University of California at Los Angeles
University of Toronto
tahsn
Others
Select all
Alphabet Inc.
California Institute of Technology
Catholic University of the Sacred Heart
Columbia University
Durham University
Create group
Options
3 entities selected
Deselect all
y-axis
Field-Weighted Citation Impact
x-axis
Publication Year
Bubble size
Not available
University of Toronto
Field-Weighted Citation Impact
Publication Year
University of Toronto
University of British Columbia
Canada
Hide all chart labels
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Feedback

SciVal 10

Explore | Compare | Reporting | My SciVal | Scopus

University of Toronto

2018 to 2024 | All subject areas

Summary

Bibliometrics
- Publication metrics
- Citation metrics
- Views metrics
- Journal quartiles

Contribution
- Authors
- Scopus Sources

Research Fields
- Topics
- Research Areas
- Subject Areas
- SDGs

Rankings
- Ranking positions
  - QS World University Rankings

Performance indicators

Outputs in Top 10% Citation Percentiles

+ Add to Reporting

Show as field-weighted

University of Toronto:
18.0%
Canada:
14.7%

> Analyze in more detail

Publications in Top 10% Journal Percentiles

+ Add to Reporting

by CiteScore Percentile

University of Toronto:
40.5%
Canada:
35.9%

> Analyze in more detail

International Collaboration

+ Add to Reporting

University of Toronto:
55.1%
Canada:
55.2%

> Analyze in more detail

Academic-Corporate Collaboration

+ Add to Reporting

University of Toronto:
5.4%
Canada:
4.5%

> Analyze in more detail

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Geographical Collaboration

Metric guidance + Add to Reporting Export

International, national and institutional collaboration by the University of Toronto in the selected year range.

Metric		Scholarly Output	Citations	Citations per Publication	Field-Weighted Citation Impact
International collaboration	55.1%	75,584	1,916,605	25.4	2.45
Only national collaboration	27.7%	38,037	417,657	11.0	1.21
Only institutional collaboration	9.6%	13,220	144,914	11.0	1.10
Single authorship (no collaboration)	7.5%	10,272	44,860	4.4	0.91

Academic-Corporate Collaboration

Metric guidance + Add to Reporting Export

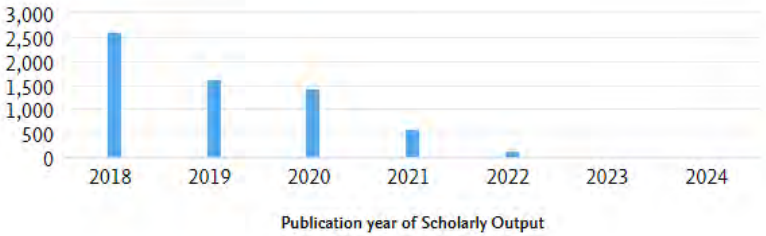
Academic-corporate collaboration by the University of Toronto in the selected year range.

Metric		Scholarly Output	Citations	Citations per Publication	Field-Weighted Citation Impact
Academic-corporate collaboration	5.4%	7,358	454,224	61.7	5.56
No academic-corporate collaboration	94.6%	129,755	2,069,812	16.0	1.65

Analyze more sectors >

Patents Count

+ Add to Reporting Export



5,791

count of patents citing the Scholarly Output published at the University of Toronto

View list of patents

Scholarly Output cited by Patents

+ Add to Reporting Export

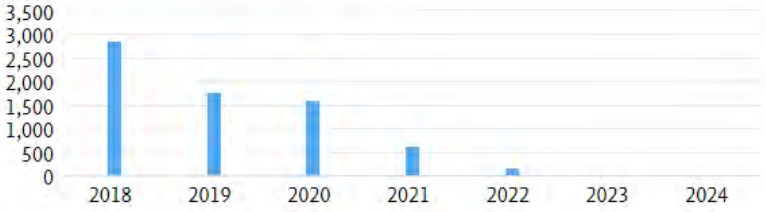
2,785

count of Scholarly Outputs at the University of Toronto that have been cited in patents

View list of publications

Patent-Citations Count

+ Add to Reporting Export



7,082

count of Patent-Citations received at the University of Toronto

Feedback

Case Study @ U of T | Blue Door

Demonstrating the Value of Partnerships

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DEFY GRAVITY

Blue Door

Portal — Single point of entry

Community — Share best practices

CRM — Coordinate prospects

Why international corporate partnerships?

Research Excellence

- Increases research resources and allows for access to proprietary data sets
- Creates a real-world “pull” for next generation product/service innovations
- Improves commercialization likelihood
- Elevates citation counts and leads to higher impact publications

Student Training

- Provides hands-on and on-site training
- Encourages workforce-relevant course content and equipment exposure
- Supports industrial interactions & professional network-building

Institutional Prominence

- Increases global industrial brand
- Leverages and strengthens existing international academic partnerships
- Unlocks international funding opportunities
- Supports recruitment of top global talent

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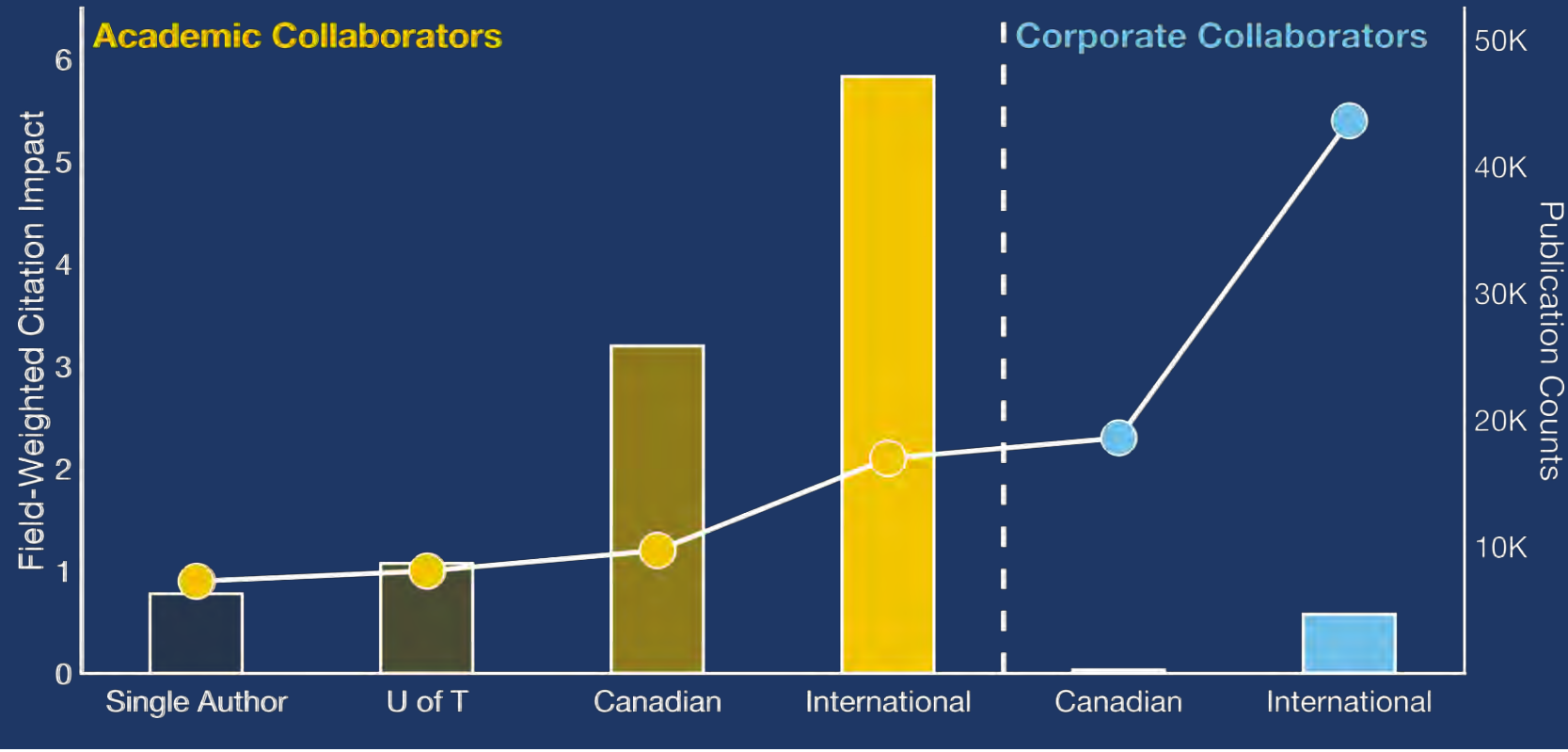
Why international corporate partnerships?

Research excellence → Graduate employability → Institutional Prominence

- $
- Datasets
- Market for IP
- Research Impact



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