

A SAGE
White Paper

The Latest Thinking About Metrics for Research Impact in the Social Sciences

SAGE Publishing

Based on a workshop convened by SAGE Publishing including representatives from the Alfred P. Sloan Foundation, Altmetric, the Center for Advanced Study in the Behavioral Sciences at Stanford University, Clarivate Analytics, Google, New York University, School Dash, SciTech Strategies, the Social Science Research Council, and the University of Washington.

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This paper summarizes the key points from a workshop SAGE Publishing organized in February 2019 with a group of world-leading experts on research impact.

It includes several key insights and recommended actions, including the following:

1. The full scholarly community must believe that new impact metrics are useful, necessary, and beneficial to society.
2. A robust new regime of impact measurement must transcend, but not necessarily supplant, current literature-based systems.
3. A new regime of social science impact measures must integrate the experiences and expectations of how nonacademic stakeholders will define impact.
4. All stakeholders must understand that although social science impact is measurable, social science is not STEM, and social science's impact measurements may echo STEM's but are unlikely to mirror them.
5. Social science needs a global vocabulary, a global taxonomy, global metadata, and finally a global set of benchmarks for talking about impact measurement.

Introduction

Traditionally, impact within academia has been synonymous with citation counts, but how do we move beyond this? Although it will always be imperative to have basic, curiosity-driven research in social science, much research must have a significant and positive real-world *impact* that extends beyond citations in other research. The impact of that more applied research can vary widely—influencing policy or practice, engaging the public, delivering economic benefits, or supporting advances in the physical sciences—but how to show this impact in a widely accepted and replicable manner has escaped our disciplines. There is little agreement, or even understanding, about how to measure the societal impacts of such research (Tregoning, 2018). Social science research is particularly difficult to evaluate given the inherent challenges in understanding and measuring what are social (and often subjective) phenomena, and research outputs can be overlooked as obvious or commonsensical (Reale et al., 2018).

However, governments and other funders increasingly call on researchers to demonstrate the societal impact of their work, generally without specifying any commonly agreed-on set of best practices or definitions. In the United Kingdom, impact case studies for the Research Excellence Framework (REF) 2021 will be used to award 25 percent (up from 20 percent in REF 2014) of about £2 billion per year of public research funding. These case studies are qualitatively peer-reviewed by panels and officially don't use citations, though they may still have an influence. Although it's not tied to funding yet, the UK's emerging Knowledge Exchange Framework (KEF) can also evaluate research impact, alongside the wider effects that universities can have.

In the United States, the Pentagon's Defense Advanced Research Projects Agency (DARPA) has recently tasked social scientists with creating an artificial intelligence system, known as SCORE, to quantitatively measure the reliability of social science research and “thereby increase the effective use of [social and behavioral science] literature and research to address important human domain challenges” (Russell, n.d., para. 1).

And the National Science Foundation, the primary funder of basic academic research in social science, requires “broader impacts” to be explicit in the research it funds but offers no metrics for what broader impacts are. Historically, perception of impact in the social sciences has largely had a qualitative cast, for success stories in human behavior and societal good, or in policy drafted and laws enacted, were seen as the definition of impact. Being able to qualitatively describe how investments in the social sciences have paid dividends later—the *raison d'être* of the American Golden Goose Awards, for example—has been key to “selling” social science to a broader audience. But a more metrics-driven approach, including widely accepted and policy-meaningful measures, will still be required when deploying impact outside of academe.

It's worth making explicit that neither the REF nor the U.S.-based examples, nor most funders, use literature-based measures like journal citations as a primary measurement. Yet citations and journal impact factors remain the traditional lingua franca of impact for academics, and a majority of social scientists (and in fact most academics) are leery of new methods of showing impact (Bakker et al., 2019). (Any new measures also must address those concerned about what they see as the creeping corporatization of higher education or that science still waiting to be used “by definition has no space for performance metrics” [Prewitt, 2016, para. 9].)

TAKEAWAY No. 1: The full scholarly community must believe that new impact metrics are useful, necessary, and beneficial to society.

In this environment, practices around impact will be adopted that are driven more by (and likely more suitable for) STEM disciplines than the social sciences. This is already being seen. A recent survey of four American universities remarked that social sciences are shifting how they demonstrate impact away from models used in the arts and humanities toward ways “more aligned with the Sciences and Health Sciences” (Bakker et al., 2019, p. 565). Concerns arise, for example, because social sciences tend to have fewer multiauthor publications and exhibit lower overall citation counts as compared to

STEM subjects (Parish, Boyack, and Ionnidis, 2018). Social science impact also may manifest itself over longer periods than in more iterative sciences and may require “relevant qualitative and complementary quantitative indicators” to truly see impact in complex social contexts (Reale et al., 2018, p. 302). Social sciences are also more likely to rely on books and book chapters, which tend to be harder to index in academic search engines than journal citations. And many such search engines have relatively poor coverage of social science publications.

TAKEAWAY No. 2: A robust new regime of impact measurement must transcend, but not necessarily supplant, current literature-based systems.

This need for common and accepted metrics and these obstacles to developing them have led SAGE Publishing to support efforts to better assess social science impact. We have launched a sustained campaign that asks those in the field how “good” social science is assessed, how existing measures could be improved, and if new solutions could be developed. (Updates on this ongoing effort are found on the new Impact section of the community site Social Science Space, which is also being used to gather ideas and host a healthy debate about impact with any global actors engaged on the topic.)

This campaign aims to do the following:

1. Help researchers, editors, and learned societies across disciplines navigate questions around research metrics and impact.
2. Bring together leading thinkers to find solutions.
3. Develop metrics literacy by helping researchers understand existing methods of measurement and—working together—find ways to better showcase their work. Identify and promote those metrics that incentivize real-world impact.
4. Help institutions and researchers get their work into the right hands, at the right time, and in the right format, while more clearly identifying its impact outside of academe.
5. Explore how the social sciences in particular need better metrics and identify nuances across academic disciplines.
6. Ascertain if new indicators or approaches are achievable and useful and, if so, promote these across academia, funders, and other key influencers.

Impact Metrics Workshop—February 2019

One of the first things SAGE did to support these goals was to bring together a group of people who have already made extraordinary contributions in the world of social science impact and metrics (see Appendix I) at a workshop, hosted by Google at their Mountain View, California, campus in February 2019.

The goals for the workshop were the following:

- Initiate a discussion among key experts on impact, to learn about the pitfalls and opportunities in this area
- Hear about current and emerging work that could support good practice around metrics, especially for the social sciences
- Solicit feedback on SAGE plans and activities to date
- Create a basis for further discussions about how SAGE can take this initiative forward through 2019

This paper is a summary of that workshop and is intended to engage a wider audience in this important debate.

Discussions were wide-ranging, and although we didn't create a definitive set of solutions or conclusions, a lot of valuable ground was covered. This paper broadly follows the structure of the day and covers the following topics:

- The varying needs of different stakeholders related to impact
- Some of the complexities raised by questions of impact
- A discussion on frameworks for thinking about impact
- How we might propose a validating test for measures of impact: the “funder test”
- A summary of tools and data sources that might help to measure impact
- Recommendations for further action

These topics are tightly connected, so the discussion under each often has elements of other topics mixed in.

Stakeholders

Our list of stakeholders was long—because anyone who could be affected by research is a potential stakeholder—and so each group we discussed has a very different relationship to impact. The following grouping reflects the discussion on the day, and we do not claim that the categorization is complete or the only way to group or categorize stakeholders.

In discussing these different kinds of needs, it was frequently mentioned that current metrics remain mainly literature-based, and we expressed a hope that impact measurement could soon meaningfully go beyond those kinds of measures.

Academic Stakeholders—Individual

The first obvious group we touched on are the individuals involved in academia: researchers and lecturers. For those conducting research, being able to measure the wider impact of their work would allow them to tell a more rounded story of their scholarship that goes beyond the number of articles published, or citation counts to those articles, or citation counts to the journals containing the articles. It was suggested that early career researchers may be more interested in broader measures of impact over academic impact, for it can be achieved more quickly. The individual researcher is also a consumer of research, and if broad measures of impact were available this might make it possible for researchers to better search the literature to find more relevant material for their own research.

University leadership (e.g., deans), managers, and research administrators could use this information to capture faculty goals that might enable them to reward the full range of work researchers are undertaking.

One cohort often overlooked is students. When students decide on what academic disciplines to pursue, the ability to show the impact the social sciences are having (e.g., social change or economic value) could draw more students into those disciplines.

Academic Stakeholders—Institutional/Organizational

Institutions and organizations have specific relationships with impact measurement.

Deans could use such measures to determine whether their institution is producing “enough” of the “right” kind of impact (e.g., a state university showing a positive impact at the state level).

Specific journals, publishers, or societies better at supporting impact policies could in turn better attract authors or support subscriptions.

Mission-based organizations and funders interested in having a real-world impact are clearly key stakeholders. As noted, they often lack clear or robust ways of determining whether the research they fund has the kind of impact that supports their strategic aims or charitable objectives.

Societal Stakeholders

Specific communities involved in (or the subjects of study for) social science research have a potential interest in measuring the impact of that work. The general public more broadly may have an interest in measuring the impact of social science, whether as a wise use of taxes or an effective way to address pressing problems, and policy makers can make the case for less or more funding to the social sciences based on that interest, as we see with What Works Centres in the UK.

Commercial Stakeholders

Companies that currently provide information to measure scholarly and traditional outputs—such as Elsevier, Clarivate, and others—could have an additional interest if measures of broader impact became important to their traditional markets.

Entrepreneurs and entrepreneurial academics developing new metrics, tools, data sources, and other research infrastructure would have an interest in the progress of the initiative and opportunities they could address.

People working on user interfaces, system design, or service design might be impacted if there are clearer ways of being able to understand society and measure wider impacts (e.g., the dynamics of followers and likes on Twitter).

TAKEAWAY No. 3: A new regime of social science impact measures must integrate the experiences and expectations of how nonacademic stakeholders will define impact.

Academia

We discussed how impact measurement could affect things more broadly, rather than just at the individual stakeholder level.

Social science itself may change if we were to introduce robust measures of impact. It might increase the pursuit of more data use, data sharing, and computationally intensive versions of social science.

Within academia more broadly, understanding of the value of social science might change. Finally, how we understand the dynamics of the research process might change, and behaviors might move toward supporting societal outcomes over purely publication-based outcomes. It might lead to the ability to understand the organization of science and the “science of science” better.

Key Questions and Definitions

We felt an important role for impact measurement was to incentivize the “right” research, but we couldn’t set out what constitutes the right research. How can we equip social scientists to make that (fraught) case? Being able to tell the story of the importance of their research is increasingly important and increasingly difficult. Adding to ever-present pressures such as the need to justify funding are growing societal concerns around many types of new data that could be used by social scientists. Data at scale gathered by systems have led to the rise of surveillance capitalism, and now real trade-offs need to be discussed around the potential impact of gathering or using this kind of data. For example, it can feel wrong to say we are setting out to find out more about people in order to influence their behavior, as seen with the Behavioural Insights Team or “nudge unit” in the UK. A comparison was drawn to

nanotechnology, where a huge investment driven by the hopes for creating a transformative future met widespread fears (such as the “grey goo” scare) about the little-understood technology’s potential to devastate life.

Talking about impact comes with a lot of open questions, often centered on the increasing availability and variety of outputs, alongside more measuring methods and tools. There are a growing number of assessment frameworks and statements around impact from entities such as the Wellcome Trust, Universities UK, UK Research and Innovation (UKRI), REF, KEF, and the European Commission. In the UK, REF asks for impact case studies, and in the United States, the American Science and Technology for America’s Reinvestment Measuring the Effects of Research on Innovation, Competitiveness and Science (known as STAR Metrics) tracks the impact of federal research and development investments.

Nonetheless, no single framework has global adoption, nor is there a “bag of metrics” that serves across disciplines or geographies in the same way as scholarly metrics such as the impact factor or the H-index. Despite their flaws, these scholarly metrics are ubiquitous, but this generates important questions for potential impact metrics, starting with the question of whether this should be done, could be done, and could be done well without echoing the issues of the past. And if it turns out that “new,” broader measures of social science impact look a lot like the measurement of STEM impact, should it be done differently? Workshop participants noted that although many STEM disciplines have a clear connection with real-world and economic impact, many STEM disciplines such as cosmology do not have such a direct path to societal impact. What can we learn from how those disciplines describe themselves and justify their levels of investment?

Because some social science impact is diffuse or might take years to manifest, what is the right time frame for considering impact? (Ken Prewitt has dubbed this *USBAR*—Unintended Social Benefits Appreciated Retroactively.) How might we connect the story of impact today with the impact of their historical precedents? Can and should we evaluate historical impacts?

If social sciences are more complex than STEM fields, owing to the underlying complexity of the systems under study, will the connection between research in social sciences and direct impact always be harder to tease out than for STEM? In cases where models of thought or concepts are the output, are there issues of “obliteration through incorporation” as ideas just become “common sense” (without credit to the thinkers)? And how do you identify (and credit) the influence of underlying concepts as ideas transmit themselves through a population?

TAKEAWAY No. 4: All stakeholders must understand that although social science impact is measurable, social science is not STEM, and social science’s impact measurements may echo STEM’s but are unlikely to mirror them.

Might measures be done on a subdomain basis? Are the 34 units of assessment from the REF the right way to classify those domains, and if not, how else might we do that? If we do develop new measurements, how do we make them responsible in terms of researcher well-being and careers? What else do we need to provide in terms of education, a framework for understanding how to use and apply these metrics, and the support available?

The HumetricsHSS project has set out some thinking on humane indicators of excellence for the humanities and social sciences, such as equity and collegiality, and provides a good entry point to addressing some of these questions.

Models for Assessing Impact

After looking at who is affected by this topic, some of the questions around why we might want to measure impact, and the many challenges associated with actually doing that in the social sciences, we also discussed different models of how we might measure impact.

Academic Outputs Model

Academic outputs are the most common way to assess impact along with citations to those outputs. We wondered whether it might be possible to go beyond these kinds of outputs, for example, creating topic models of all scholarly outputs and linking these to records of what has been funded. If we could model a scholarly production function, the results of such an analysis likely would describe scholarly impact more robustly.

One challenge with this is that existing scholarly outputs look at primary versus secondary effects (e.g., scholarly record or metrics), rather than actual impact. We noted that REF case studies (such as the number of eyes on news coverage of research) and KEF data (such as consultancy income a university generates) are proxies for impact and not direct impact.

We listed the following as examples of the contrast between primary and secondary measures of impact:

Primary measures of impact:

- New inventions
- New methods used
- New data/code used
- Policies influenced
- Practice changed

Secondary measures of impact:

- Economic activity
- Changes to health
- Changes to education

Person-Centered Model

Another approach is to look at the unit of analysis from a person-centered rather than a document-centered point of view. It was best summarized at the workshop with the statement, “The best way to transmit knowledge is to wrap it up in the human being.” Documents are just one output. It is individuals who make research useful and usable, so what if we focus on individuals as the engine of change? This could involve tracking things like their career placements or startups and new innovations they’re involved with. Mapping authors rather than documents can be used to pivot from a document-centered to a people-centric analysis. Because people are the embodiment of ideas, this is a way of looking at how ideas transmit and have an effect in the world. Tracing the activities of and the connections between human beings is a hard thing to do, but it could be where we’re able to tell the strongest or at least most compelling story about a society.

Four Quadrants Model

Another model would ask about impact within specific and broadly orthogonal domains and, by so doing, support researchers whose work has different kinds of impact. The four following domains could help paint a fuller picture.

Academic. Has the work advanced our knowledge of the world? This domain is currently the best understood, with many indicators and metrics of impact already present.

Practitioner. Has the work led to an improvement in how fellow researchers are able to conduct their work? This might be indicated by creating new research methods, building tools that get adopted, or creating datasets that get reused.

Societal. Has the work led to changes in society? This might be indicated by being able to tie academic advice directly to changes in policy, regulation, or legislation. It could be related to economic output, productivity, or changes to GDP.

Public. Has the work changed public understanding? In contrast to societal change, this would look at changes in the public debate, public engagement and outreach activities, and possibly changes to the spread and nature of information spread on networks (from news networks to social and private networks).

We discussed that each of these four areas will have specific types of signals that evidence impact in those areas. We expect that some of these signals will be more robust and developed than others.

We noted that the approach of looking at impact by different domains is not new, and there are other examples such as the Social Impact Open Repository (SIOR).

Pragmatic Model—The “Funder Test”

A pragmatic model was also suggested. Many of the questions around impact are open ended and abstract. If we can't boil our arguments and sources of evidence down to the point where we can convince willing funders that an investment in our research would make good use of their funds, then either the problem of impact is truly intractable, or we are failing to make the case despite there being sufficient evidence to support it. What would it take to convince a significant funder that any given project could be reviewed at the end point and real-world impact could be measured? We spent some time considering what data or tools might be available today to answer a question like this, and although we didn't generate a definitive answer, we did produce a list of potential data sources and tools that are listed in Appendix II. This could be described as the “funder test.” In a way the funder test can be used as a tool to test the hypothesis we generate around how to describe impact. If our arguments are sufficient to get funded, we have shown traction on how to show impact.

Next Steps

At the end of the workshop we drew up a number of recommendations for specific actions.

1. 10-year impact reports

Current citation metrics tend to favor articles over the last 3 to 5 years. The idea here is to look at articles for a field that were published 10 years ago but have either continued to be used over that time span or have had recent use. Although this is a citation-based metric, it could reward academic contributions that have had a sustaining, long-term, or delayed-release impact on their fields. This is very implementable and could provide a useful window on the evolution of research.

2. Common format for funder reporting

Many funders provide reports on what they fund, who they fund, duration of grants, grant amounts, and qualitative anecdotes, yet these reports are published in a variety of inconsistent formats. We suggested that funders work toward a core set of common terms for information about the grants they award, published in a consistent way. This would aid in aggregating funding information and guide grantees in stating their impact narrative. Technically this problem is highly tractable but would require community effort to coordinate.

3. Better publisher output to help indexers identify and track citations to social science work

Services like Google Scholar and Clarivate's Web of Science track citations between research outputs in a variety of ways, but some ways social science work has been cited can cause problems for these systems. This can lead to underreporting of citations. We recommend using bibliographies over footnotes for references and listing references by themselves instead of embedding them in running text. Although the technical implementation is straightforward, in that indexing services would

immediately just start recognizing citations in these formats, implementing this change requires social science scholars to change their citing behavior. Publishers could ensure that their journals and books accept references in this format for these disciplines.

4. Collaborate on a metadata model that could be used by different constituents in the ecosystem

Could the community work toward a standardized vocabulary to help us describe the impact of research? This would help in making comparisons, or looking at trends over time. It possibly requires answers to many of the questions posed here before they could be formally described by a vocabulary; however, there are already components that could be built on, such as the Contributor Roles Taxonomy (see <https://www.casrai.org/credit.html>).

TAKEAWAY No. 5: Social science needs a global vocabulary, a global taxonomy, global metadata, and finally a global set of benchmarks for talking about impact measurement.

5. A literature review of research into research assessment, including citations and more holistic impact measures

There is a growing volume of literature on research impact in the social sciences. Is it time to do a systematic review of the literature?

6. Allocate a portion of funding for other disciplines to social sciences to research the human aspects of new discoveries (e.g., ethics, implementation, legal/business/political context).

Many STEM research grants now include a fixed amount to account for outreach activities. Could there be a similar amount set aside dedicated to the impact implications of the research?

7. Can more be made of the methods and data used by market research or commercial social research firms such as YouGov and Ipsos MORI or of tech companies such as Google and Facebook?

We encourage the adoption of programs like Social Science One. But how can we make sure that our research that uses industry data is accelerated into public discourse and not caught in an 18-month+ review cycle?

Some Final Thoughts on Measuring Research Impact

Research requires funding, and the funding of research does not happen in isolation. Economic questions about research and value for money cannot be avoided. We have to ask how much really great social science we can do per dollar and how we can show that it's well spent. An ability to do this will enable us to convince different audiences of the value of social science research.

At the same time, we have to recognize that researchers want fair, relative measures of the impact of their work. We felt that they want that benchmarked by their discipline, by career stage, and with guidance in advance of how to frame their impact.

Conversations around measuring the impact of the social sciences are only just getting started. We need to continue debating these topics, and teasing out these complexities so we can continue to help better tackle the growing list of challenges society faces.

References

- Bakker, C., Bull, J., Courtney, N., DeSanto, D., Langham-Putrow, A., McBurney, J., & Nichols, A. (2019). *How faculty demonstrate impact: A multi-institutional study of faculty understandings, perceptions, and strategies regarding impact metrics*. Association of College & Research Libraries Conference, Cleveland, OH, April 10–13, 2019.
- Parish, A. J., Boyack, K. W., & Ioannidis, J. P. A. (2018). Dynamics of co-authorship and productivity across different fields of scientific research. *Plos One*, *13*(1): e0189742. <https://doi.org/10.1371/journal.pone.0189742>.
- Prewitt, K. (2016, November 6). Good science will always find its use. [Blog post]. Retrieved from www.socialsciencespace.com/2015/11/prewitt-good-science-will-always-find-its-use/.
- Reale, E., Avramov, D., Canhial, K., Donovan, C., Flecha, R., Holm, P., . . . René Van Horik, R. (2018). A review of literature on evaluating the scientific, social and political impact of social sciences and humanities research. *Research Evaluation*, *27*(4), 298–308.
- Russell, A. (n.d.). *Systematizing Confidence in Open Research and Evidence (SCORE)*. Arlington, VA: Defense Advanced Research Projects Agency. Retrieved from <https://www.darpa.mil/program/systematizing-confidence-in-open-research-and-evidence>
- Tregoning, J. (2018). How will you judge me if not by impact factor? *Nature*, *558*(7710), 345. doi: 10.1038/d41586-018-05467-5

Appendix I: Workshop Attendees

1. Anurag Acharya, Distinguished Engineer, Google; Cofounder, Google Scholar
2. Euan Adie, CEO of Open Policy; Founder of Altmetric
3. Kevin Boyack, CEO, SciTech Strategies
4. Sam Burrige, Director of Strategy and Transformation, Clarivate Analytics
5. Danny Goroff, Vice President and Program Director, Alfred P. Sloan Foundation
6. Timo Hannay, Founder of SchoolDash and nonexecutive director of SAGE Publishing
7. Julia Lane, Professor in the Wagner School of Public Policy, New York University; Provostial Fellow in Innovation Analytics and a Professor, Center for Urban Science and Policy
8. Betsy Rajala, Program Director, Center for Advanced Study in the Behavioral Sciences at Stanford University
9. Jason Rhody, Program Director, Social Science Research Council
10. Jevin West, Assistant Professor, DataLab, iSchool, University of Washington
11. Camille Gamboa, Corporate Communications and Public Affairs Director, SAGE Publishing
12. Ian Mulvany, Head of Transformation and Product Innovation, SAGE Publishing
13. Ziyad Marar, President of Global Publishing, SAGE Publishing
14. Miranda Nunhofer, Vice President of HSS Editorial, SAGE Publishing

Appendix II: Impact Resources (Data, Tools, and Infrastructure)

Over the course of the day, we discussed various resources and data sources that could help in creating a model of social science impact, summarized here. Some of these are specific resources and others are types of resources.

Name and URL	What Is It?	Notes
Altmetric.com	Tracks “attention measures” for research outputs, a key source for “altmetric” data.	Founded in 2011, it now provides a comprehensive API into its data.
Citations	A research output referencing another research output.	The long-established primary method of assessing research “impact, though restricted to impact on other research.”
The Conversation	Mainstream media outlet for topical academic research.	
CrossRef	A not-for-profit membership organization that makes research outputs easy to find, cite, link, and assess.	Has a robust API that includes information on citations, key metadata about articles, funding information, and other data.
Depsy	Helps log the (oft overlooked) impact of research software by mining the dependency graph of key pieces of scholarly software.	Was active until 2018 and is now in maintenance mode.
The Digital Object Identifier (DOI) System	Provides digital infrastructure to create consistent links to resources and associated metadata.	DOIs are registered for most scholarly journal articles and many datasets and are increasingly being used for diverse scholarly outputs.
Eigenfactor	Academic research project used to map, analyze, and evaluate scholarly influence, using novel network analyses.	Features freely available Eigenfactor and Article Influence scores, adjusted across disciplines. Includes journal prices. Uses 5-year citation data.
Fast Track Impact	Training, advice, examples, templates, and tools. Based on a relational approach and peer-reviewed research.	
Full publication text	The actual full research output, typically a publication such as a journal article.	
Funders and fundees (or granters and grantees)	Different funders use a range of methods to award funding that often involve some form of research impact assessment.	Can contain useful data about researchers/team characteristics, which apply, and which are successful.
Higher Education Business & Community Interaction HE-BCI survey	An annual survey of UK institutions’ financial and output data related to knowledge exchange.	Running since 1999, used to inform the allocation of funding.
HR records	Human resources in research organizations, or national organizations such as the U.S. Census Bureau, have data about researchers.	
ifi CLAIMS	Global patent database.	

Impact Story	Tracks the online reach of research (e.g., social media, blogs, news) based on the output list of an individual researcher.	Researchers create profiles for themselves.
Journal Scholar Metrics	A bibliometric tool to measure the performance of art, humanities, and social science journals, using Google Scholar.	
KEF metrics/narratives	A new framework in England based on university-level metrics and narrative statements.	
Kudos	Helps researchers grow their online reach (e.g., via social media).	
Maps of Science	Mapping domains of research and the relationships between them.	
Nesta's innovation mapping and code	Nesta is a UK-based innovation foundation whose work includes mapping the innovation landscape.	
Open Knowledge Maps	Maps links between academic publications within disciplines.	
Open Syllabus Project	Database of publicly accessible university syllabi.	Over 1 million syllabi (including citations and other metadata).
ORCID	Unique identifiers for researchers that can be used to map researchers to their output.	Researchers set up their own profiles, and ORCIDs integrate tightly into the publishing ecosystem. Currently a little over 6 million ORCIDs have been coined. The data are openly available.
Overton.io	Maps the connection between policy papers and the research papers that those policy papers cite.	Founded in 2019, currently in private beta.
Peer review (review aggregation platforms such as Publons)	Allows researchers to claim credit for their peer reviews.	
Postpublication peer-review platforms (e.g., Pubpeer)	Allows commentary on researcher articles after publication.	Pub Med Central ran such a system called Pub Med Commons but discontinued it. Comments were preserved using the hypothes.is system (https://web.hypothes.is/blog/archiving-pmc-comments/).
Public policy document databases	For example, Hansard in the UK Parliament or Congressional Research Reports in the United States.	
Publish or Perish	Aggregates citation data from different academic search engines.	Illustrates the very different coverage of each academic search engine.
REF 2014 impact case studies	Database of 6,975 UK university research impact case studies.	Has an API.
Reference management software	Software to help researchers use citations (e.g., Mendeley).	Can be used to identify not only what researchers are citing but also what they are reading.
Research summary services (e.g., F1000Prime)	F1000Prime identifies and recommends important articles in biology and medical research publications.	

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ScholCommLab/cancer-news	An analysis of U.S. government-funded cancer research mentioned in online media.	
scite.ai	Uses machine learning to identify supporting and contracting citations to a work.	
Social Science Thesaurus by SAGE	An ontology of 61,121 social science concepts.	
The American Science and Technology for America's Reinvestment Measuring the Effects of Research on Innovation, Competitiveness and Science (known as STAR Metrics)	American federal/institutional repository of data/tools for assessing the impact of federal R&D investments.	Lists all federal awards. Effectively shelved in 2016, becoming the less ambitious and simpler Federal Reporter.
Traditional media	For example, newspapers, TV, and radio.	
Academic search engines/databases	Some examples below.	Varying coverage for different disciplines.
Baidu Scholar	Chinese academic search engine.	
Bielefeld [University] Academic Search Engine (BASE)	German academic search engine.	144 million documents, with abstracts, from 7,000 sources.
CORE	Dedicated to open access research papers, with access to full text.	136 million documents, with abstracts.
Google Scholar	A global index of articles, theses, books, abstracts, and court opinions, from academic publishers, professional societies, online repositories, universities, and other websites.	
Microsoft Academic	Employs advances in machine learning, semantic inference, and knowledge discovery for scholarly information search.	210 million documents, with abstracts.
Science Open	Focuses on open access, with some Altmetrics scores.	
Science.gov	Free access to search results from more than 15 U.S. federal agencies.	200 million documents, with abstracts and links to many full texts.
Scopus	The largest abstract and citation database of peer-reviewed literature: scientific journals, books, and conference proceedings.	37,000 titles, from 12,000 publishers, of which 34,000 are peer-reviewed journals.
Semantic Scholar	Aims to use algorithms for more relevant search results.	40 million documents, with abstracts.
Web of Science	Provides access to multidisciplinary research connected through linked content citation metrics from multiple sources within a single interface.	33,000 journals.