

The Open Science Trend and the Role of University Libraries

WS on Next Generation Repositories

April 12, 2018

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National Institute of Informatics

Outline

1. What is Open Science?
2. Policy Developments
3. Drivers
4. Challenges of Open Science
5. Role of University Libraries in Open Science Era

1. What is Open Science?

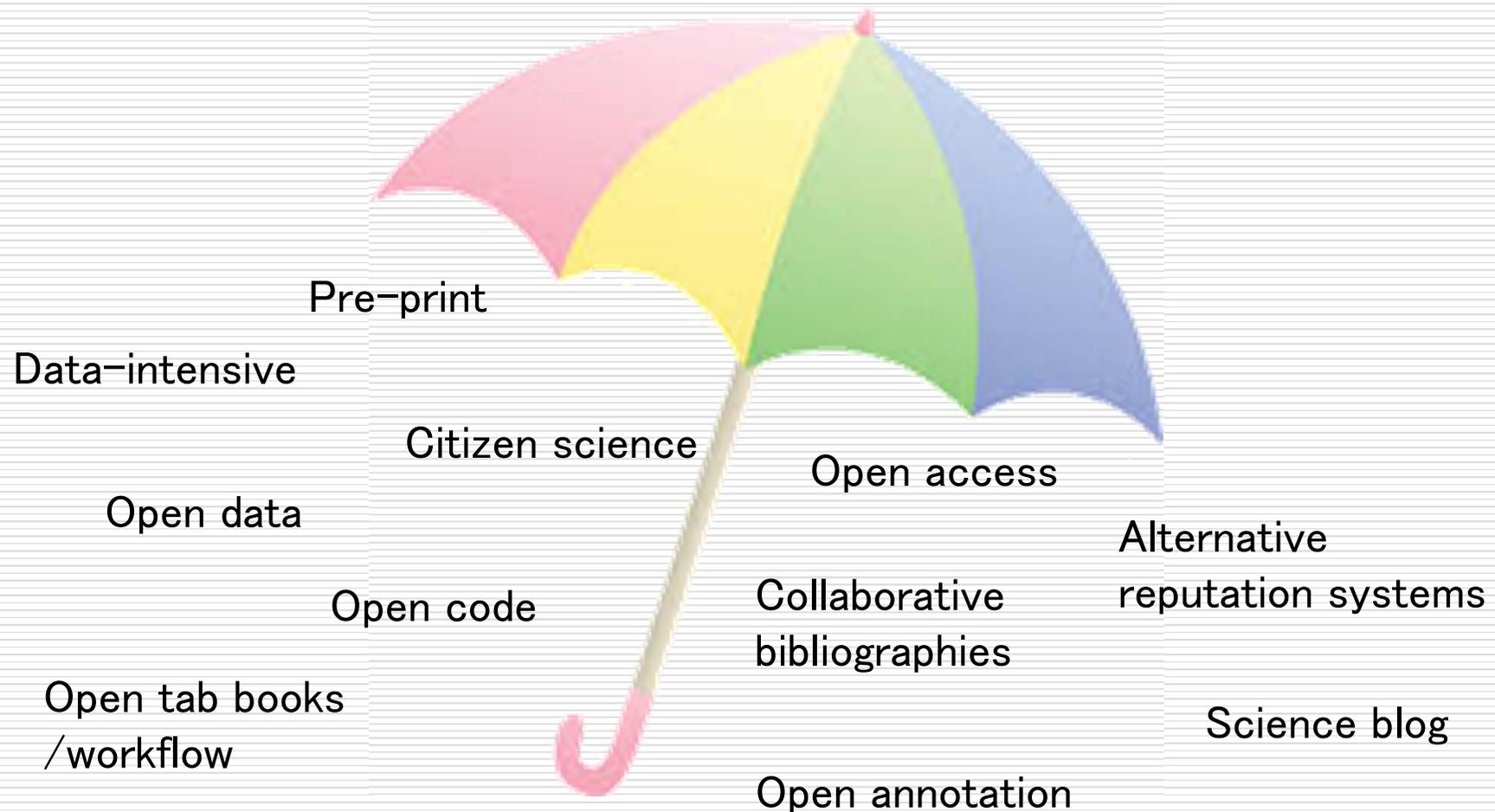
What is Open Science?



... Science has always been open!

Definition: Open Science

...Umbrella Term



Definition: Open Science

- ❑ Said to have no fixed definition
- ❑ General understanding:

- New ways of doing research and organizing science
- Enabled through digital technology
- Reshaping academic value systems

Open Science...European Commission (2014)

...Public Consultation 'Science 2.0': Science in Transition



EUROPEAN COMMISSION

DIRECTORATES-GENERAL FOR RESEARCH AND INNOVATION (RTD) AND
COMMUNICATIONS NETWORKS, CONTENT AND TECHNOLOGY (CONNECT)

BACKGROUND DOCUMENT

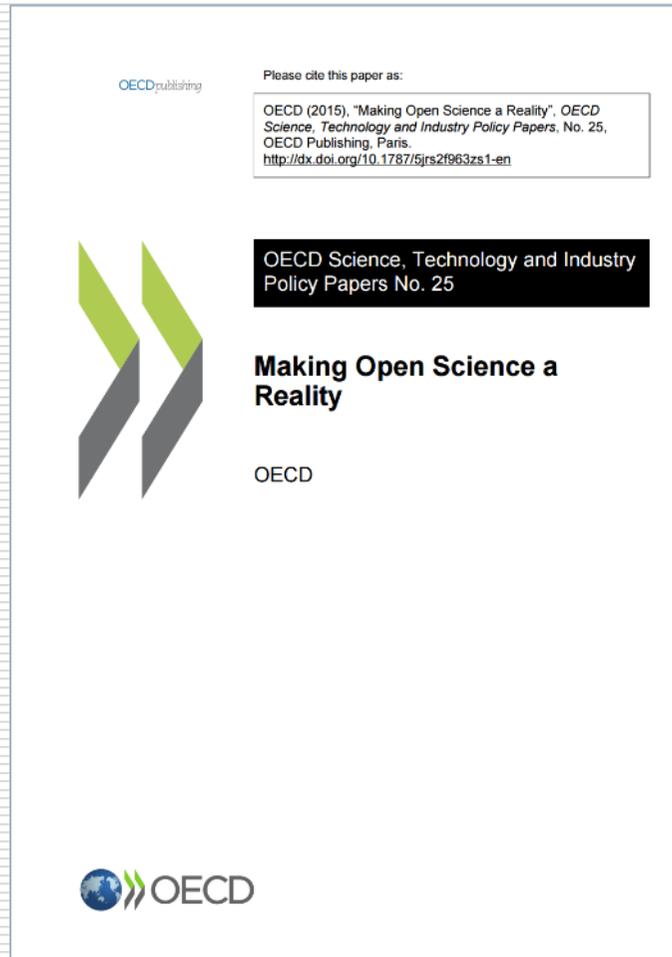
PUBLIC CONSULTATION

'SCIENCE 2.0': SCIENCE IN TRANSITION

'Science 2.0' describes the **on-going evolution in the modus operandi of doing research and organising science**. These changes in the dynamics of science and research are enabled by **digital technologies** and driven by the **globalisation of the scientific community**, as well as the increasing societal demand to address the **Grand Challenges** of our times. They have an **impact on the entire research cycle**, from the inception of research to its publication, as well as on the way in which this cycle is organised.

Open Science...OECD (2015)

...Making Open Science a Reality

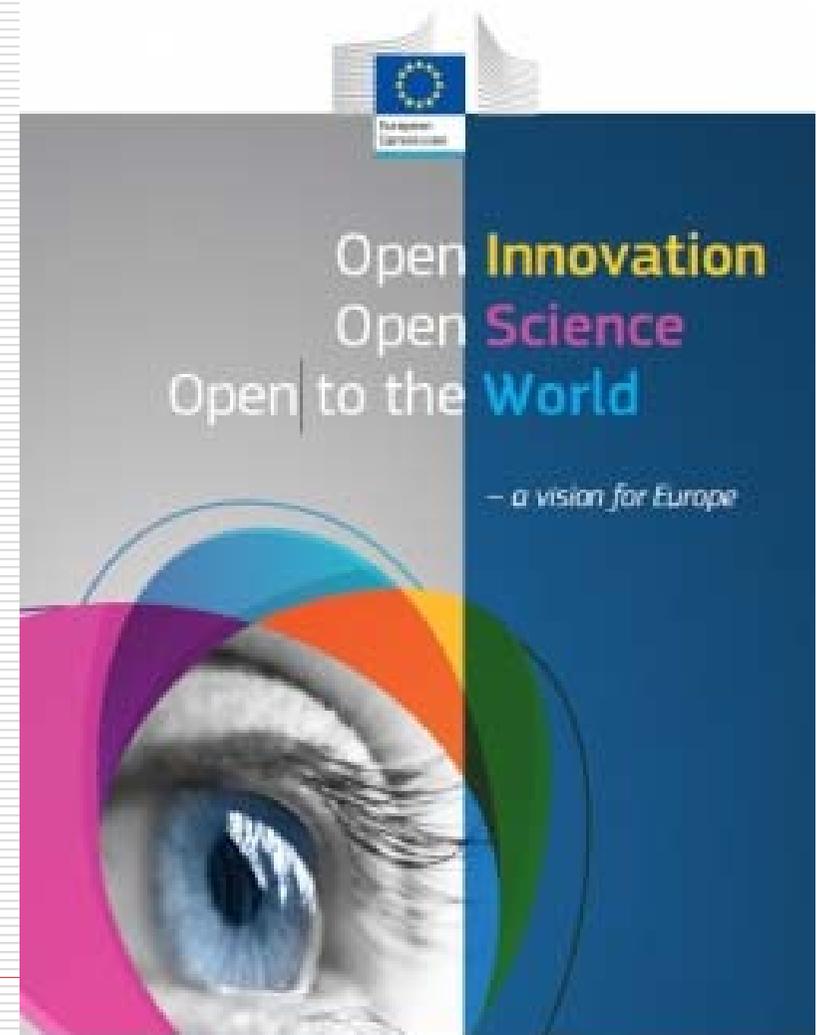


Open science commonly refers to **efforts to make the output of publicly funded research more widely accessible in digital format** to the scientific community, the business sector, or society more generally. Open science is the encounter between the age-old tradition of openness in science and the tools of information and communications technologies **(ICTs) that have reshaped the scientific enterprise** and require a critical look from policy makers seeking to **promote long-term research as well as innovation.**

Open Science...European Commission (2016)

...Open Innovation, Open Science, Open to the World

Open Science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. The idea captures a systemic change to the way science and research have been carried out for the last fifty years: shifting from the standard practices of publishing research results in scientific publications towards sharing and using all available knowledge at an earlier stage in the research process.



Open Science...European Commission (2016) ...Amsterdam Call for Action on Open Science

Open science is about the way researchers work, collaborate, interact, share resources and disseminate results. A systemic change towards open science is driven by new technologies and data, the increasing demand in society to address the societal challenges of our times and the readiness of citizens to participate in research.



European Open Science Cloud (EOSC)

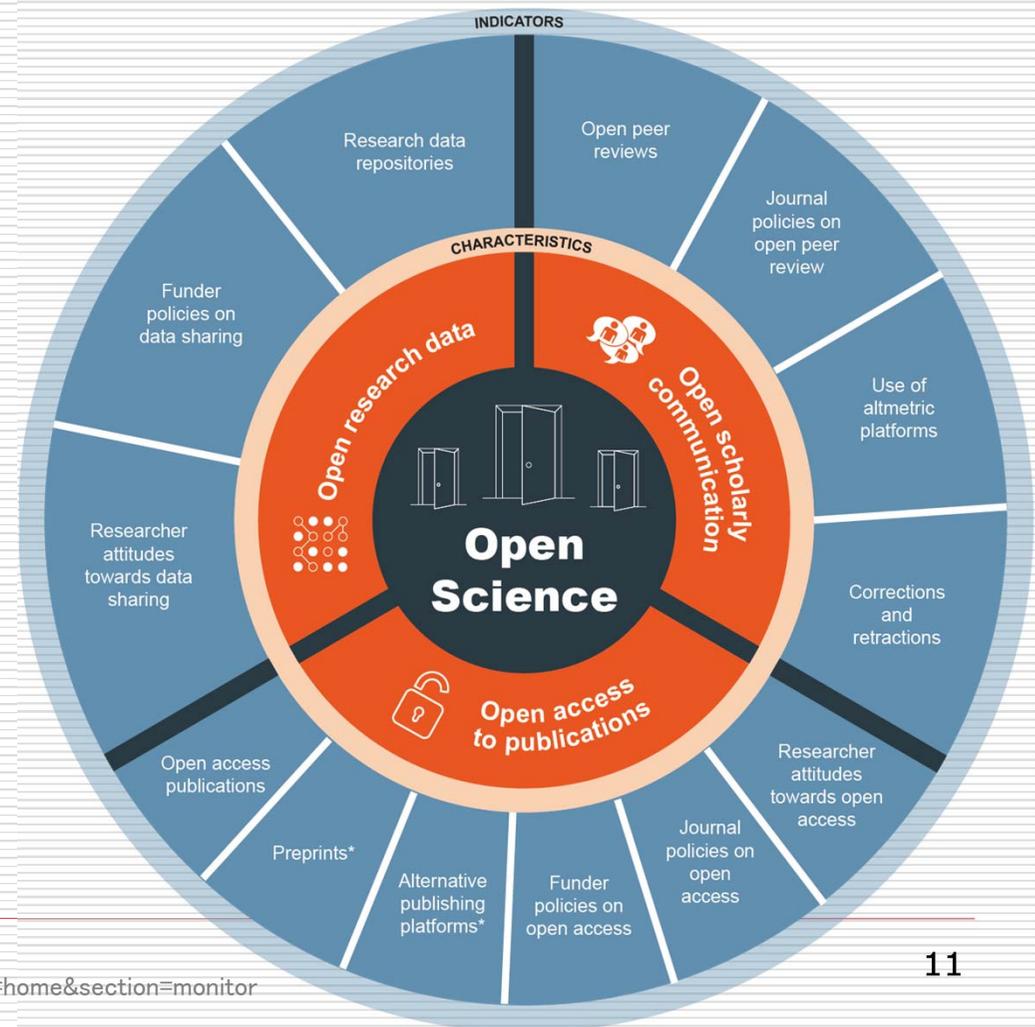
- EOSC aims to accelerate and support the current **transition to more effective Open Science and Open Innovation** in the Digital Single Market.
- KEY FACTORS:
 - New modes of scholarly communication
 - **Modern reward and recognition practices** need to support data sharing and re-use.
 - **Core data experts** need to be trained and their career perspective significantly improved.
 - A real stimulus of **multi-disciplinary collaboration** requires specific measures in terms of review, funding and infrastructure.
 - The transition **from scientific insights towards innovation needs** a dedicated support policy.



Open Science Monitor

- Includes open access to scientific results (publication and data)
- However, it is more than that...!
 - ✓ Researcher Attitude
 - ✓ Open Peer Review
 - ✓ Altmetrics
 - ✓ Correction and Retractions

Open Science Monitor



2-1. Policy Developments: Open Access to Research Publications

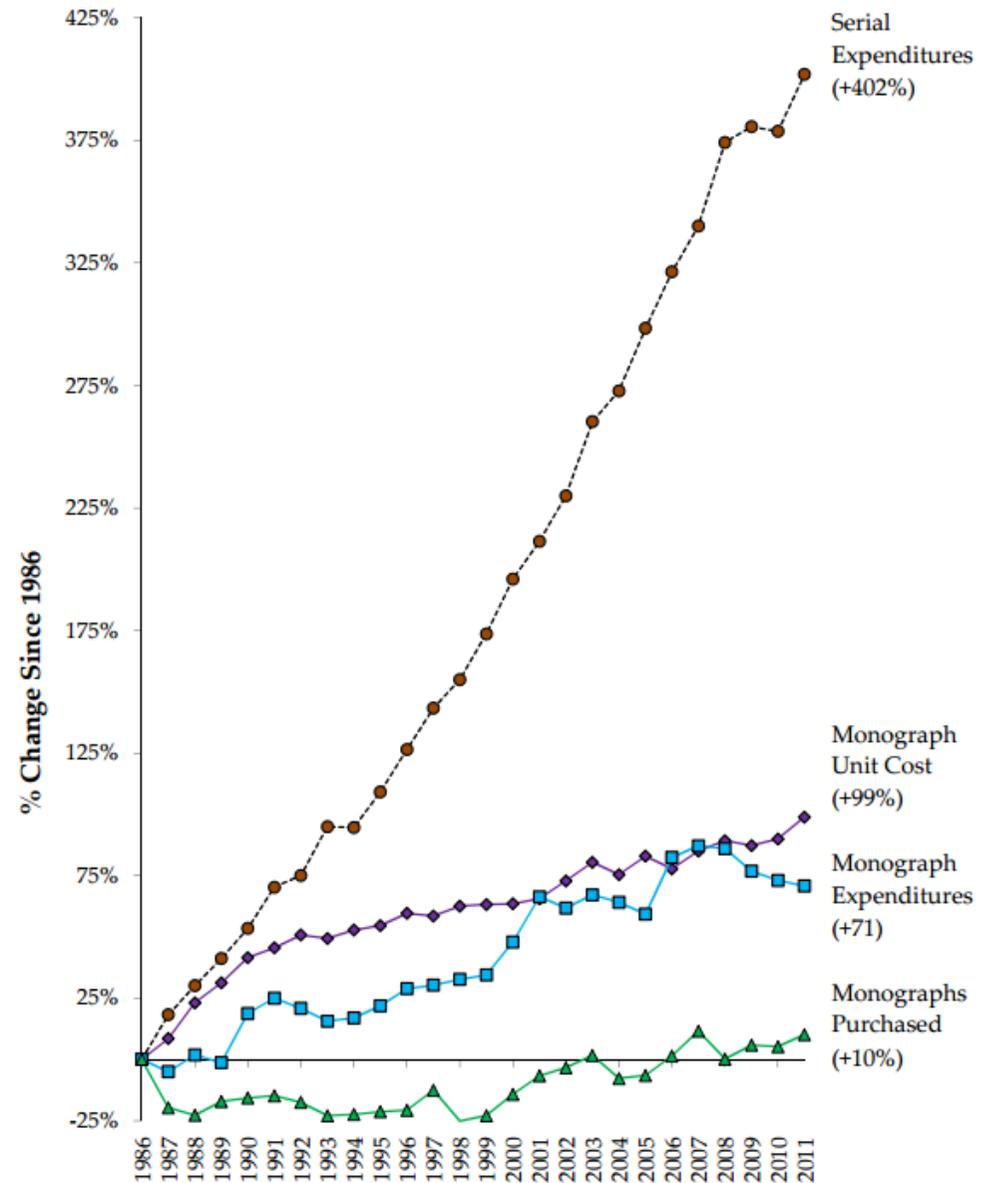
How it started: "Serials Crisis"

□ Journal subscription cost rising faster than the inflation speed

■ Four times higher in 2011 than 1986

Source: ARL Statistics 2010-11 Association of Research Libraries, Washington, D.C.
*Includes electronic resources from 1999-2011.
<http://www.arl.org/storage/documents/monograph=serial=costs.pdf>

Monograph & Serial Costs in ARL Libraries, 1986-2011*



NOTE: Data for monograph and serials expenditures was not collected in 2011-12.

Protest from Academia (1)

We are writing the articles!

Isn't it unfair that the publishers are making profit, and many academics cannot even afford to read the articles?!

The journal subscription is too expensive!



Protest from Academia (2)

□ “Subversive Proposal”

- Steve Harnad (1994)
- Called for scholarly articles to be freely available on the Internet, instead of published in print for the sake of royalties.

□ “An Open Letter to Scientific Publishers”

- 34,000 scholars worldwide (2001)
- Called for the establishment of an online public library and pledging to refrain from publishing in traditional non-open-access journals.

Protest from Academia (3)



□ “Budapest Open Access Initiative (BOAI)”, (2002)

- Provided definition of OA

- Two ways to achieve OA:

1. Self-Archiving (green OA)

- Author’s final manuscript or the publisher’s version after a certain embargo period is archived on a website accessible worldwide.

2. Open-access Journals (gold OA)

- Subscription fees are omitted instead of a fee charged to the author, usually called the article processing charge (APC).

Move at Governmental-level

□ Protest from a medical patient

- *"It is unfair that taxpayers do not have access to academic articles and thus cannot study their own medical condition, as the price of academic journals is exorbitant".*

□ Funding agencies start making OA a mandate for scholarly articles funded publicly

- NIH(US)-2008-"NIH Public Access Policy"
- RCUK(UK)-2013-provides grant to universities for APC

2-2. Policy Developments: Open Access to Research Data

From Access to Research Publications to Access to Research Data

Publicly-
funded
Research

Research
Data



Research
Publications



Rationale for making Research Data publicly available

□ Accountability

- Publicly funded research should be transparent

□ Economic Efficiency

- Reuse of data leads to new findings without additional investments

□ Global Challenges Solving and Innovations

- Combining data from multiple discipline leads to solving global challenges
- Industries using data leads to innovations



Declaration on Access to Research Data from Public Funding

30 January 2004 - C(2004)31/REV1

□ Governments:

- Australia, Austria, Belgium, Canada, China, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Russian Federation, the Slovak Republic, the Republic of South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States

□ Commitments:

- **Work towards the establishment of access regimes for digital research data from public funding**

□ Principles:

- Openness, Transparency, Legal conformity, Formal responsibility, Professionalism, Protection of intellectual property, Interoperability, Quality and security, Efficiency, Accountability

Data Sharing Policy, NIH (2003-)

In NIH's view, **all data** should be considered for data sharing. Data should be **made as widely and freely available as possible** while safeguarding the privacy of participants, and protecting confidential and proprietary data. To facilitate data sharing, investigators submitting a research application requesting \$500,000 or more of direct costs in any single year to NIH on or after October 1, 2003 are expected to **include a plan for sharing final research data** for research purposes, or state why data sharing is not possible.



Data Management Plan (DMP) required!

Policy Developments in Research Data Sharing

- 2003, NIH, Data Sharing Policy
- 2004, OECD Declaration on Access to Research Data from Public Funding
- 2007, OECD Principles and Guidelines for Access to Research Data from Public Funding
- 2007, Biotechnology and Biological Sciences Research Council (BBSRC-UK), Data Sharing Policy
- 2011, Research Councils UK, Data Sharing Policy
- 2011, NSF, Data Sharing Policy
- 2013, OSTP-US, Increasing Access to the Results of Federally Funded Scientific Research
- 2014-20, Horizon 2020, Open Research Data Pilot

Data Journals and Supplemental Data

□ Data journals established (2014-)

■ Nature: Scientific Data

The logo for Scientific Data, featuring the text "SCIENTIFIC DATA" in white on a dark blue rectangular background.

- *Scientific Data is an open-access, online-only journal for descriptions of scientifically valuable datasets.*

■ Elsevier: Data in Brief



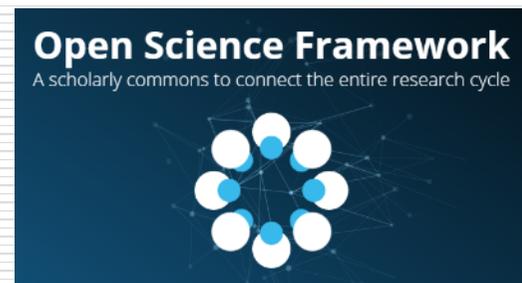
- *Data in Brief provides a way for researchers to easily share and reuse each other's datasets by publishing data articles.*

□ Supplemental Data

- *Supporting material that cannot be included, and which is not essential for inclusion, in the full text of the manuscript, but would nevertheless benefit the reader.*

Data Repositories

□ General



□ Disciplinary Data Repositories

➤ Numerous

3-1. Drivers

Data-Intensive Scientific Discovery

The Fourth Paradigm: Data-Intensive Scientific Discovery

Tony Hey

Corporate Vice President

Microsoft External Research



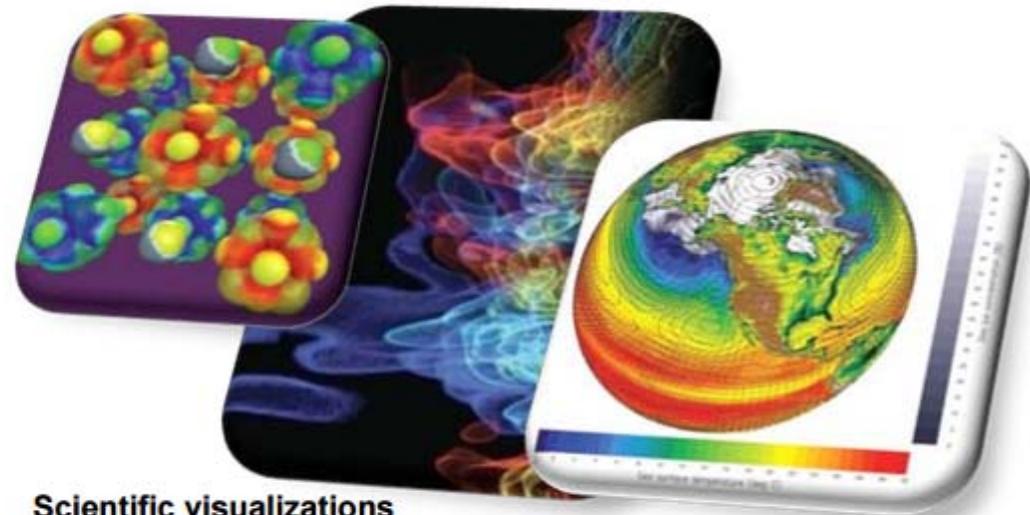
A Digital Data Deluge in Research

- Data collection
 - Sensor networks, satellite surveys, high throughput laboratory instruments, observation devices, supercomputers, LHC ...
- Data processing, analysis, visualization
 - Legacy codes, workflows, data mining, indexing, searching, graphics ...
- Archiving
 - Digital repositories, libraries, preservation, ...



SensorMap

Functionality: Map navigation
Data: sensor-generated temperature, video camera feed, traffic feeds, etc.



Scientific visualizations

NSF Cyberinfrastructure report, March 2007



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Emergence of a Fourth Research Paradigm

1. Thousand years ago – **Experimental Science**
 - Description of natural phenomena
2. Last few hundred years – **Theoretical Science**
 - Newton's Laws, Maxwell's Equations...
3. Last few decades – **Computational Science**
 - Simulation of complex phenomena
4. Today – **Data-Intensive Science**
 - Scientists overwhelmed with data sets from many different sources
 - Data captured by instruments
 - Data generated by simulations
 - Data generated by sensor networks
 - eScience is the set of tools and technologies to support data federation and collaboration
 - For analysis and data mining
 - For data visualization and exploration
 - For scholarly communication and dissemination



Astronomy has been one of the first disciplines to embrace data-intensive science with the Virtual Observatory (VO), enabling highly efficient access to data and analysis tools at a centralized site. The image shows the Pleiades star cluster from the Digitized Sky Survey combined with an image of the moon, synthesized within the WorldWide Telescope service.

Science must move from data to information to knowledge



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With thanks to Jim Gray

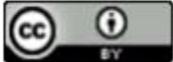




The
F O U R T H
P A R A D I G M

DATA-INTENSIVE SCIENTIFIC DISCOVERY

EDITED BY TONY HEY, STEWART TANSLEY, AND KRISTIN TOLLE



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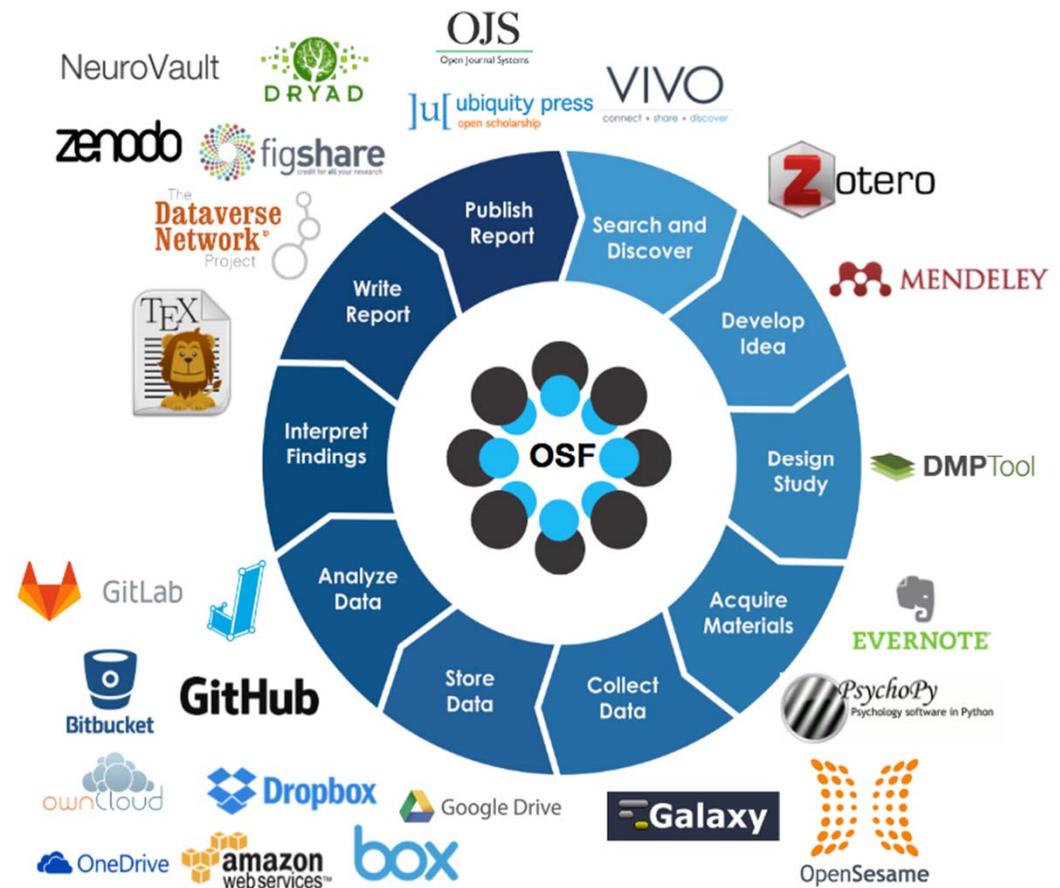


3-2. Drivers

Social Demand

Globalization and Collaboration

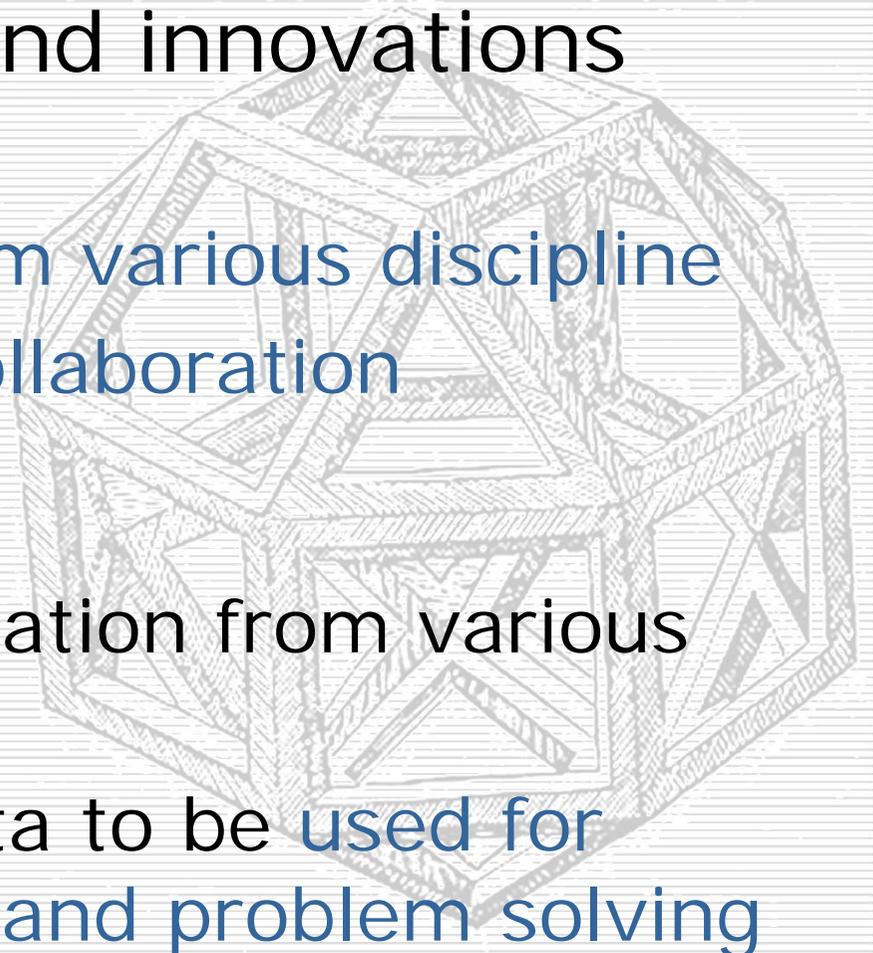
- More and more researchers working on international collaboration projects
 - Need for sharing and storing information
 - Need for online collaboration platform



Global Challenge and Innovations

- Global challenges and innovations requiring:
 - Combining data from various discipline
 - Multi-disciplinary collaboration

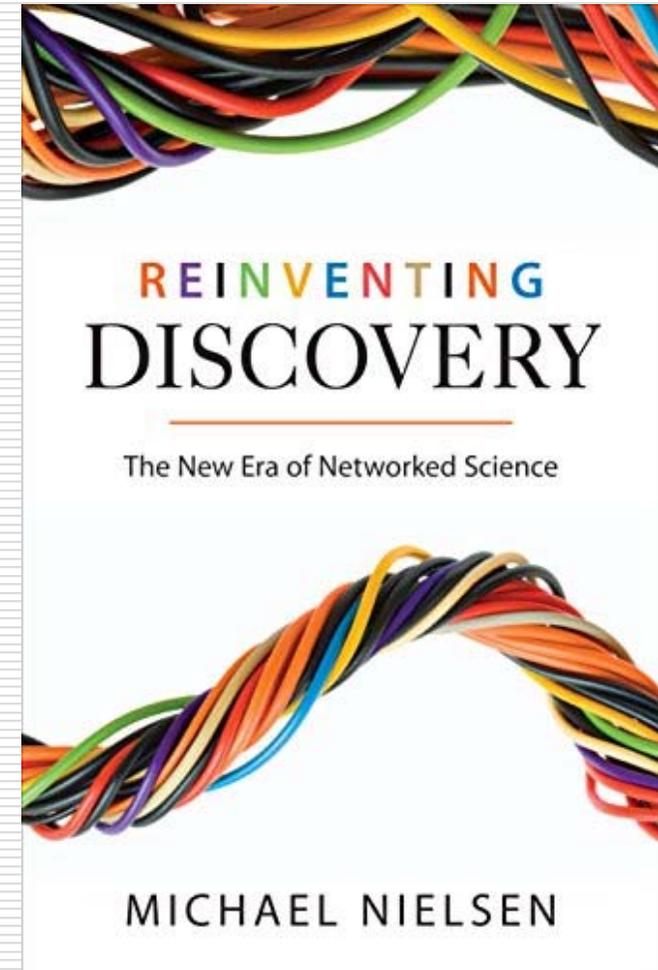
- Data sharing could:
 - Enable data combination from various discipline
 - Enable research data to be used for industrial purposes and problem solving



Michael Nielsen

Reinventing Discovery

- ❑ SPARC honors Michael Nielsen as **innovator for bringing Open Science into the mainstream** (2012)
- ❑ Reinventing Discovery tells the exciting story of an unprecedented **new era of networked science**.
- ❑ It demonstrated various cases with strong emphasis on **citizen science**.



Citizen Science...examples

□ Galaxy Zoo

- Crowdsourced astronomy project where people classify galaxies

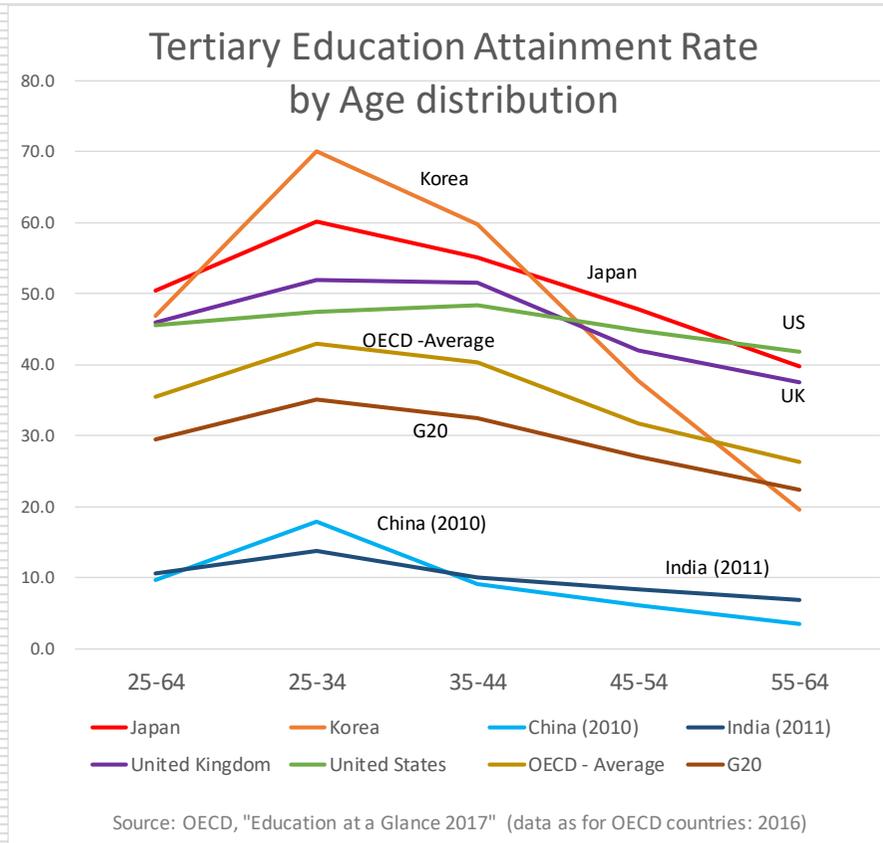
□ Foldit

- Online puzzle video game about protein folding

□ eBird **eBird**

- Online database of bird observations

The shrinking gap between society and the academia



- Tertiary education attainment rate is rising, especially for younger generation.
- Thus, citizens literacy and analytical skills are getting comparable to the academia.
- This results in stronger demand for accountability and societal problem-solving.

3-3. Drivers

Call for Research Transparency

Retraction Watch

Tracking retractions as a window into the scientific process

The Retraction Watch Leaderboard

with 21 comments

Who has the most retractions? Here's our unofficial list (see notes on methodology), which we'll update as more information comes to light:

1. [Yoshitaka Fujii](#) (total retractions: 183) Sources: [Final report of investigating committee](#), [our reporting](#)
2. [Joachim Boldt](#) (96) Sources: [Editors in chief statement](#), [additional coverage](#)
3. [Diederik Stapel](#) (58) Source: [Our cataloging](#)
4. Adrian Maxim (48) Source: [IEEE database](#)
5. [Peter Chen](#) (Chen-Yuan Chen) (43) Source: [SAGE](#), [our cataloging](#)
6. Hua Zhong (41) Source: [Journal](#)
7. [Shigeaki Kato](#) (39) Source: [Our cataloging](#)
8. [James Hunton](#) (37) Source: [Our cataloging](#)
9. [Hendrik Schön](#) (36) Sources: PubMed and Thomson Scientific
10. [Hyung-In Moon](#) (35) Source: [Our cataloging](#)
11. [Naoki Mori](#) (32) Source: PubMed, [our cataloging](#)
12. Tao Liu: (29) Source: [Journal](#)
13. [Cheng-Wu Chen](#) (28) Source: [our cataloging](#)
14. [Gideon Goldstein](#) (26)
15. [Scott Reuben](#) (25)
16. Gilson Khang (22) Sources: [WebCitation.org](#), [WebCitation.org](#), [journal](#)
17. [Friedhelm Herrmann](#) (21)
18. [Noel Chia](#) (21)

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Pages

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[Meet the Retraction Watch staff](#)

[About Adam Marcus](#)

[About Ivan Oransky](#)

[The Center For Scientific Integrity](#)

[Board of Directors](#)

[The Retraction Watch FAQ, including comments policy](#)

[The Retraction Watch Transparency Index](#)

[The Retraction Watch Leaderboard](#)

ClimateGate Scandal



FOX NEWS .com Fair & Balanced

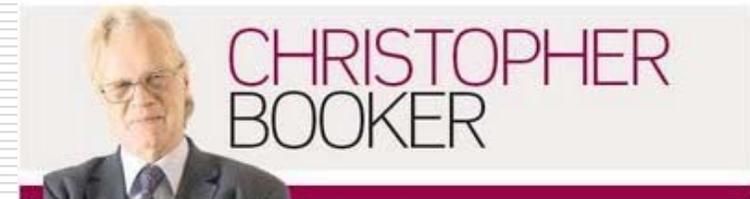
What's Hot On the Job Hur
Watch Live STRATEGY RO

HOME U.S. WORLD BUSINESS POLITI

Do E-Mails Reveal Scientist Claims On Climate Change are... BUNK?

NASA

Hackers break into servers of a major British climate change research facility and purportedly uncover e-mails urging scientists to 'hide the decline' of temperatures, manipulate data and silence skeptics.



This is the worst scientific scandal of our generation

Telegraph



<http://blog.heartland.org/2011/11/heartland-institute-mentioned-in-climategate-emails-rounds-1-and-2-part-1/>

<https://wattsupwiththat.com/2009/11/28/telegraphs-booker-on-the-climategate-scandal/>

<https://thinkprogress.org/climategate-hacked-emails-reveal-global-warming-deniers-are-crazed-conspiracy-theorists-ea8dfeb792b3#ke1ie5d3v>



CODATA

International Council for Science : Committee on Data for Science and

HOME | CODATA BLOG | EVENTS | NEWS

ABOUT ▾ EVENTS ▾ MEMBERSHIP ▾ INITIATIVES ▾ TASK GROUPS ▾ WORKING GROUPS

Message from President Geoffrey Boulton

- Recent decades have seen an unprecedented explosion in the human capacity to acquire, store and manipulate data and information and to instantaneously communicate them globally, irrespective of location...
- ...**Effective exploitation of Big Data** depends fundamentally upon an international **culture of 'Open Data'** that involves **sharing of data and their availability for re-use and re-purposing.**

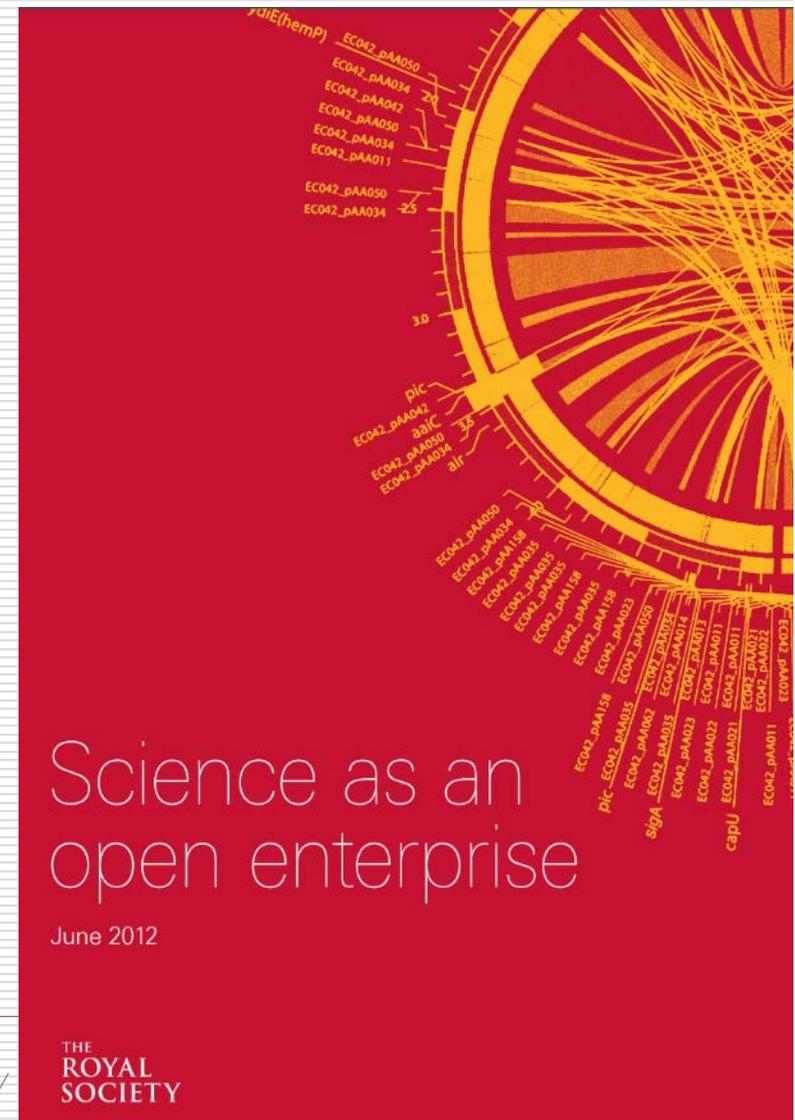


The Royal Society: Science as an open enterprise (2012)

AREAS FOR ACTION

- ❑ **Scientists need to be more open** among themselves and with the public and media
- ❑ **Greater recognition** needs to be given to the value of data gathering, analysis and communication
- ❑ **Common standards** for sharing information are required to make it widely usable
- ❑ **Publishing data in a reusable form** to support findings must be mandatory
- ❑ **More experts in managing and supporting** the use of digital data are required
- ❑ **New software tools** need to be developed to analyse the growing amount of data being gathered

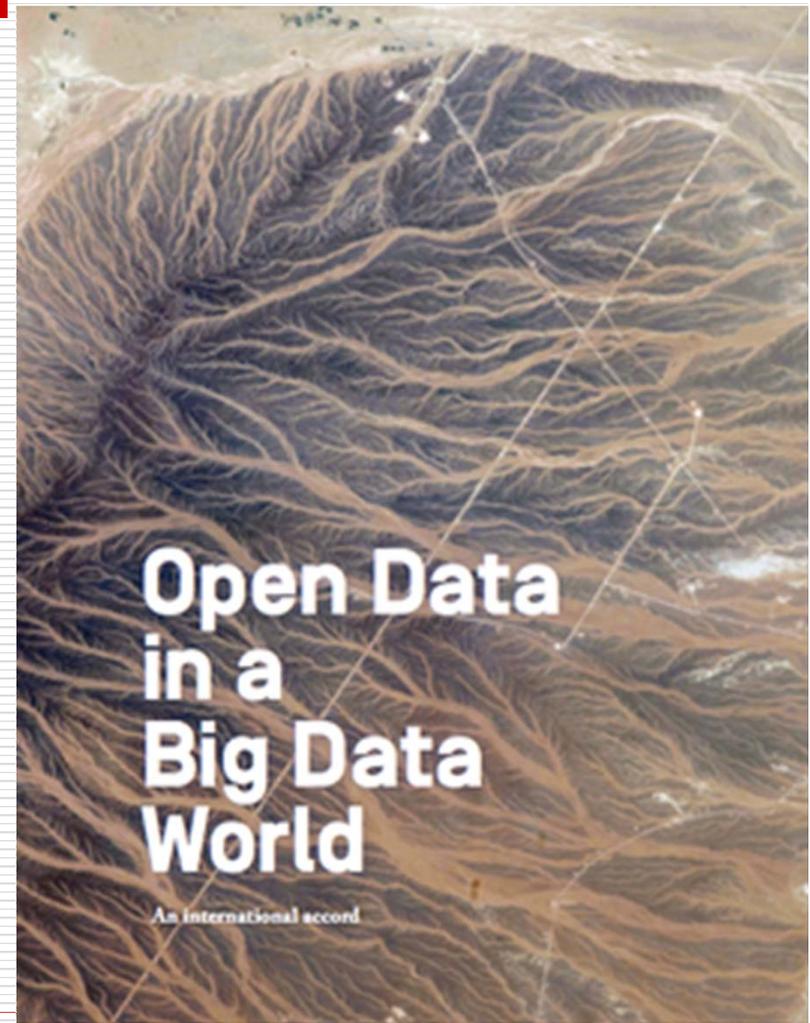
Source: Royal Society: Final report – Science as an open enterprise
<https://royalsociety.org/topics-policy/projects/science-public-enterprise/report/>



Science International: Open Data in a Big Data World

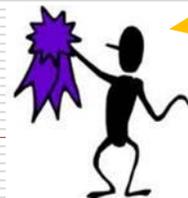
- The accord identifies the opportunities and challenges of the **data revolution** as today's predominant issue for global science policy. It proposes fundamental principles that should be adopted in responding to them. It adds the distinctive voice of the scientific community to those of governments and inter-governmental bodies that have made the case for **open data as a fundamental pre-requisite** in **maintaining the rigour of scientific inquiry** and **maximising public benefit** from the data revolution in both developed and developing countries.

Source: Science International: Open Data in a Big Data World
<http://www.icsu.org/science-international/accord>



Open Research Data as Good Science Practice

- ❑ Science is by definition knowledge with evidence, which can be reproduced by others.
 - Scientists have to publish their idea openly.
 - Scientists must also show the evidence.
- ❑ In **print age**, only research articles could be published as evidence.
- ❑ In **digital age**, digital research data can also be provided as evidence.

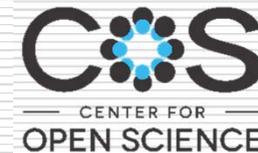


Research data is even better than just articles for the establishment of science!

Academics in Action for Research Transparency

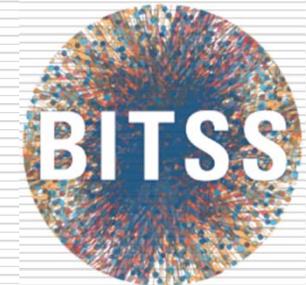
□ Reproducibility Project: Psychology

- Center for Open Science



□ Berkeley Initiative for Transparency in the Social Sciences

- Center for Effective Global Action
(CEGA), UC Berkeley



□ Peer Reviewers' Openness Initiative



4. Challenges and Innovation in Academic Reward System

Challenges of Open Science

□ Who is going to do the work?

- Incentive for sharing data
- Cost of sharing data
- Training and carrier



I want to write my article before sharing data!

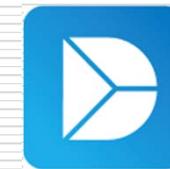
□ What for sensitive data?

- Data with privacy concern or industrial confidentiality can be excluded

Changing Academic Reward System

□ Recognizing data

- Data journals
- Data citations



□ Recognizing social impact

- Altmetrics



Making data available increases citations

- Alter, Pienta, Lyle
 - 240%, social sciences *
- Piwowar, Vision
 - 9% (microarray data) †
- Henneken, Accomazzi
 - 20% (astronomy) #

Edwin Henneken, Alberto Accomazzi, (2011) Linking to Data – Effect on Citation Rates in Astronomy. <http://arxiv.org/abs/1111.3618>

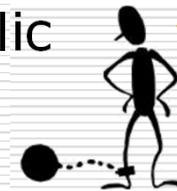
* Amy Pienta, George Alter, Jared Lyle, (2010) The Enduring Value of Social Science Research: The Use and Reuse of Primary Research Data. <http://hdl.handle.net/2027.42/78307>

† Piwowar H, Vision TJ. (2013) Data reuse & the open data citation advantage. PeerJ PrePrints 1:e1v1
<http://dx.doi.org/10.7287/peerj.preprints.1v1>

Changing Scholarly Communication ...Peer Review System

□ Open Peer Review

- Reviewer's comments are open to public with/without the name of reviewer
- Enabling transparent peer review



It takes too long until published!

□ Post Publication Peer Review

- Peer review done after publishing
- Speeding up publishing, and allowing to count impact in peer review

Too many paper to review!



□ Cascading Peer Review

- Peer review comments transferred to next submission
- Reducing costs and improving efficiencies in peer review



Do the reviewers really understand my work?

5. The Role of University Libraries In Open Science

Open Science at Academic Institution Level



1. Hold accountability

- ✓ Meeting mandates by funding agencies
- ✓ Research transparency and reproducibility

2. Promoting research

- ✓ Providing proper research environment
- ✓ Accelerating research

3. Disseminating research of the institution

4. Linking academia and society

Tangible actions in Open Science at Academic Institutions



1. Hold accountability for research

- ✓ Research office caring for mandates and transparency
- ✓ Providing infrastructure for data storage

2. Disseminating research

- ✓ Make research discoverable and reusable
- ✓ Provide institutional repositories

3. Promoting research

- ✓ Provide access to scholarly contents, promoting OA
- ✓ Promoting new research paradigm, data-intensive science
- ✓ Advocating researchers for new research paradigm
- ✓ Evaluate research within institution

4. Linking academia and society

- ✓ Matching the needs of society with the seeds of researchers

Tangible actions in Open Science at Academic Institutions



1. Hold accountability for research

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University library related activities highlighted!

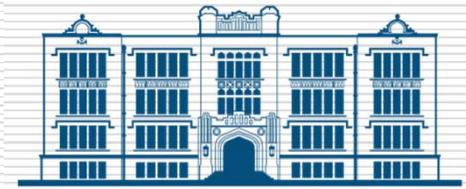
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Role of University Libraries in promoting Open Science



1. Providing scholarly contents within institution

- ✓ Acquiring and locating scholarly contents (books, e-journals, other)
- ✓ Promoting open access

2. Stewarding scholarship within institution

- ✓ Provide storage for active data and long-term preservation
- ✓ Provide DMP tool

3. Disseminating scholarship of institution

- ✓ Provide institutional repository for publishing
- ✓ Adding proper metadata and curating data

4. Advocating for good scholarship practices, i.e. Open Science

- ✓ Working on Knowledge Graph (linking publication, data, researcher, grant, etc)
- ✓ Provide RDM Training



How we classify our tools and services

Data Management Support

Data Management Planning

Active Data Infrastructure

Data Stewardship

Before research

During research

After research



PURR

PURDUE UNIVERSITY RESEARCH REPOSITORY

FACT:

MANY FUNDING AGENCIES REQUIRE DATA MANAGEMENT PLANS WITH GRANT PROPOSALS.

purrr.purdue.edu

2,542 grant proposals



PURR IS YOUR SOLUTION FOR:

DATA MANAGEMENT PLANS

READY-MADE BOILERPLATE TEXT TO PUT IN YOUR PROPOSALS, TUTORIALS AND BEST PRACTICES, SUPPORT FOR DEVELOPING A GOOD DATA MANAGEMENT PLAN

COLLABORATION

PURR PROVIDES A FREE HUBZERO™ PROJECT SPACE FOR PURDUE RESEARCHERS AND THEIR COLLABORATORS TO WORK TOGETHER ON RESEARCH AND SHARE DATA AND TOOLS ONLINE

PUBLISHING YOUR DATA

PUBLISH YOUR RESEARCH DATA WITH DIGITAL OBJECT IDENTIFIERS THAT OTHER SCHOLARS CAN USE TO EASILY FIND AND CITE YOUR DATASETS

ARCHIVING YOUR DATA

YOUR DATA WILL BE PRESERVED AND MADE ACCESSIBLE FOR LONG-TERM ACCESS IN A SECURE, TRUSTWORTHY DIGITAL REPOSITORY



OVER 2,542 GRANT PROPOSALS FROM PURDUE HAVE INCLUDED DATA MANAGEMENT PLANS SINCE 2011

PURR IS A PURDUE RESEARCH CORE FACILITY DEVELOPED BY THE OFFICE OF THE VICE PRESIDENT FOR RESEARCH, PURDUE LIBRARIES, AND INFORMATION TECHNOLOGY AT PURDUE

To learn more, visit
PURR at purrr.purdue.edu
or contact **Courtney Earl Matthews**
purrr@purdue.edu
765-496-2770



Providing Training for Research Data Management

The screenshot displays the Coursera interface for the MANTRA course. At the top, the course title 'Research Data Management and Sharing' is prominently featured. Below this, a navigation menu includes 'Overview', 'Syllabus', 'FAQs', 'Creators', and 'Ratings and Reviews'. A sidebar on the left lists learning units such as 'Research data explained', 'File formats & transformation', 'Data management plans', 'Documentation, metadata, citation', 'Organising data', and 'Storage & security'. A Japanese promotional banner at the bottom of the screenshot advertises the course as 'ga088: オープンサイエンス時代の研究データ管理' (ga088: Open Science Era Research Data Management) and includes a button to register for the course for free.

<http://datalib.edina.ac.uk/mantra/>

<https://www.coursera.org/learn/data-management>

https://lms.gacco.org/courses/course-v1:gacco+ga088+2017_11/about

University Libraries in Open Science Era



- ❑ Expanding the scope of scholarly contents
 - ✓ Books, journals, gray-literature, *research data*
- ❑ Develop new services for new contents
 - ✓ DMP tools, RDM training
 - ✓ Data curation, facilitating reuse of scholarship
 - ✓ Building knowledge graph
- ❑ Advocating of good scholarship practices in the Open Science era!
 - ✓ Promoting open access and RDM
 - ✓ Disseminating and promoting reuse of scholarship
 - ✓ Caring for research transparency and reproducibility
 - ✓ Advocating for new research paradigm

*As the steward of scholarship of the institution,
be the change agent for new research paradigm!*