Outline

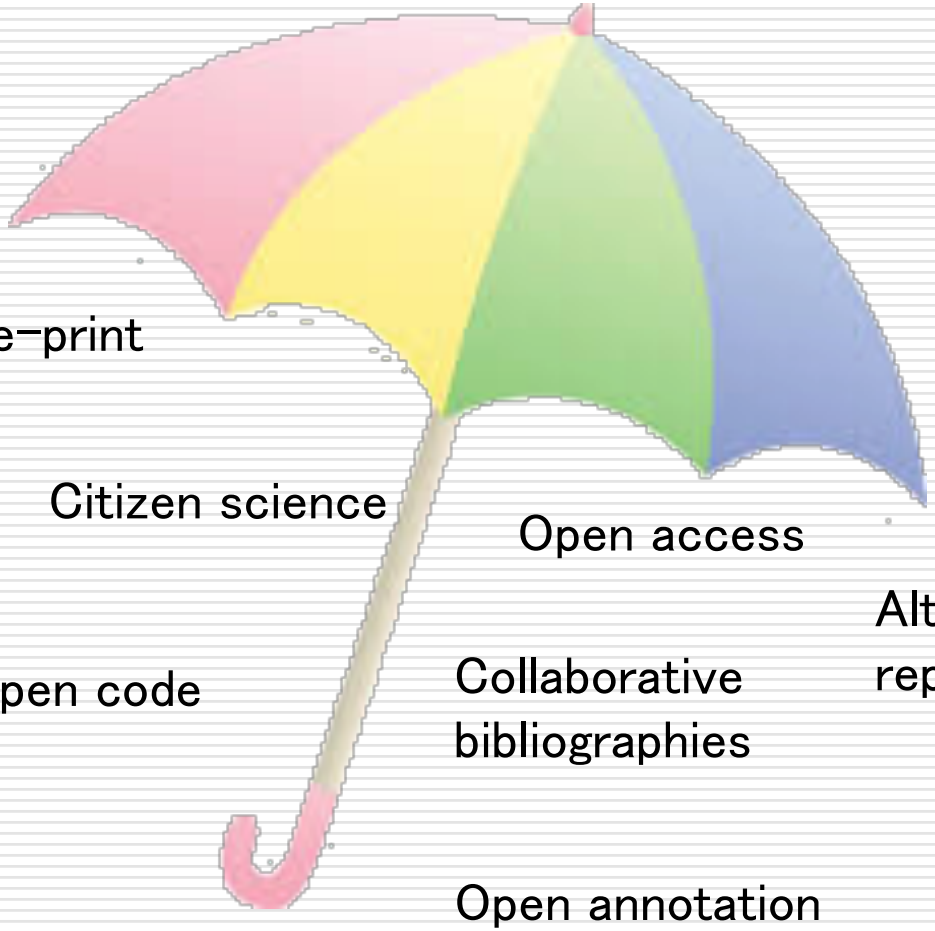
1. What is Open Science?
2. Policy Developments
3. Drivers
4. Role of University Libraries in Open Science Era

1. What is Open Science?

What is Open Science?

… Science has always been open!

Definition: Open Science ...Umbrella Term



Source: European Commission, "Open Innovation, Open Science, Open to the World—a vision for Europe," 2016

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

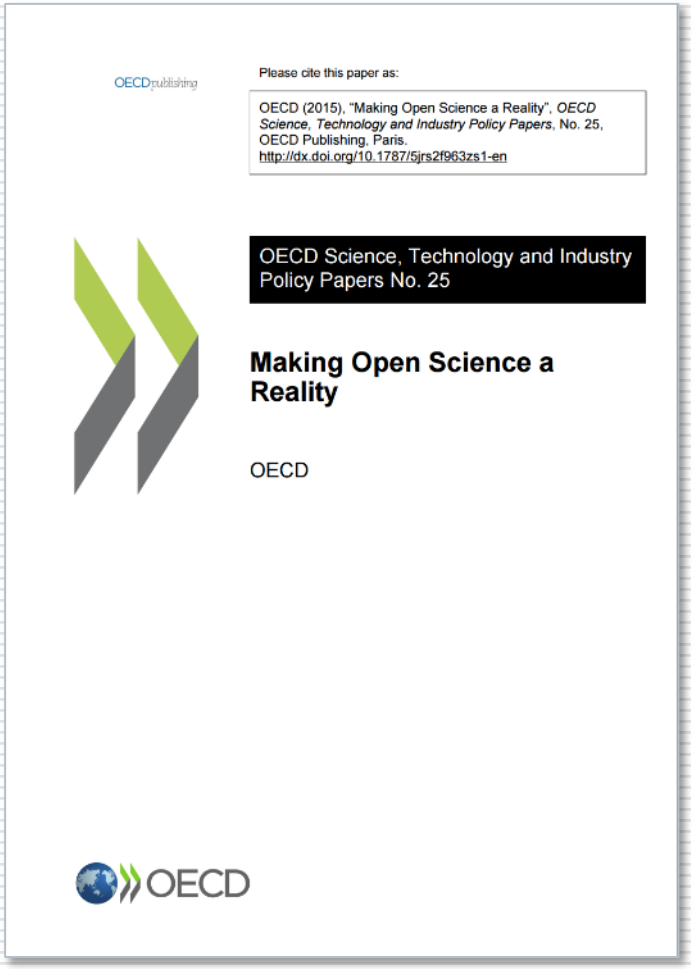
PUBLIC CONSULTATION

'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

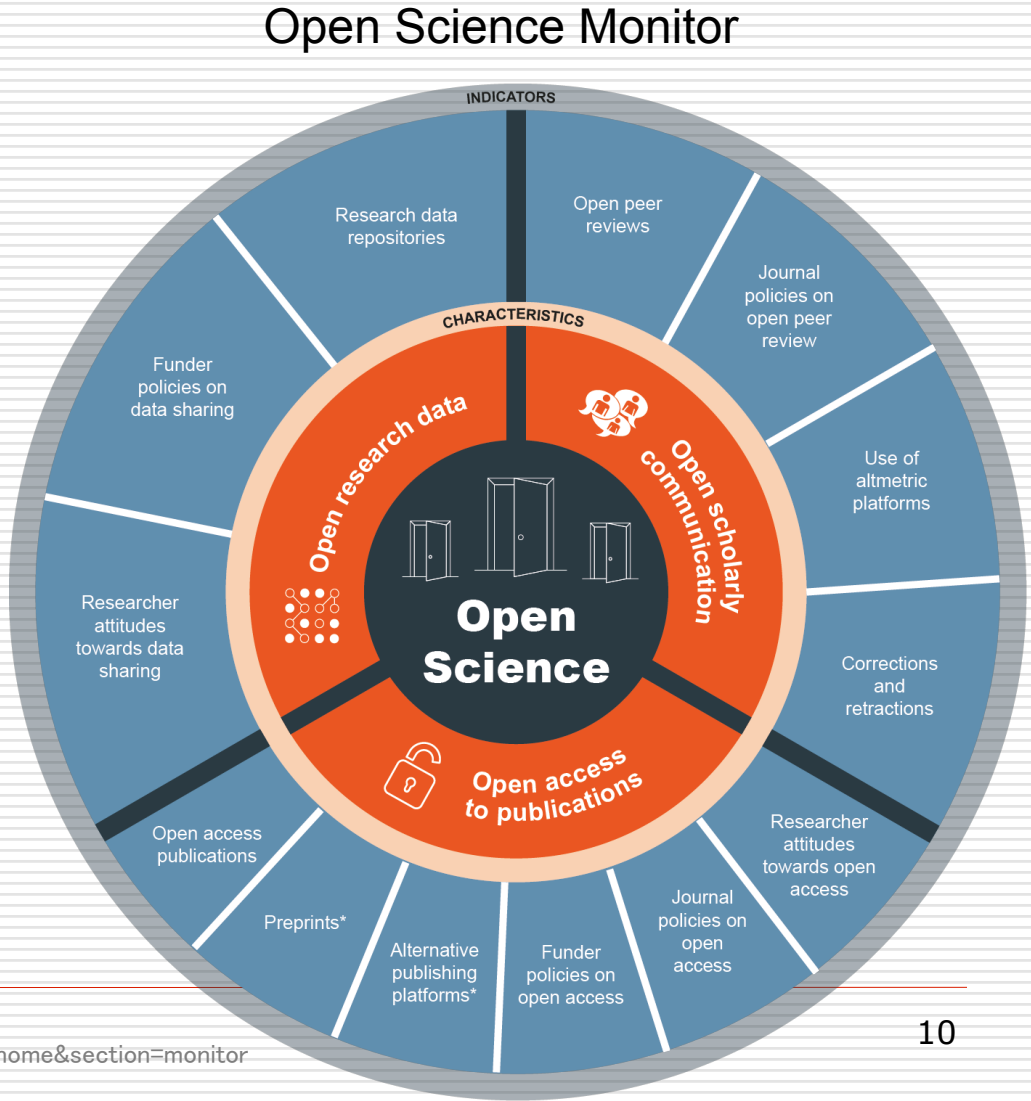
Open Science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. The idea captures a systemic change to the way science and research have been carried out for the last fifty years: 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.

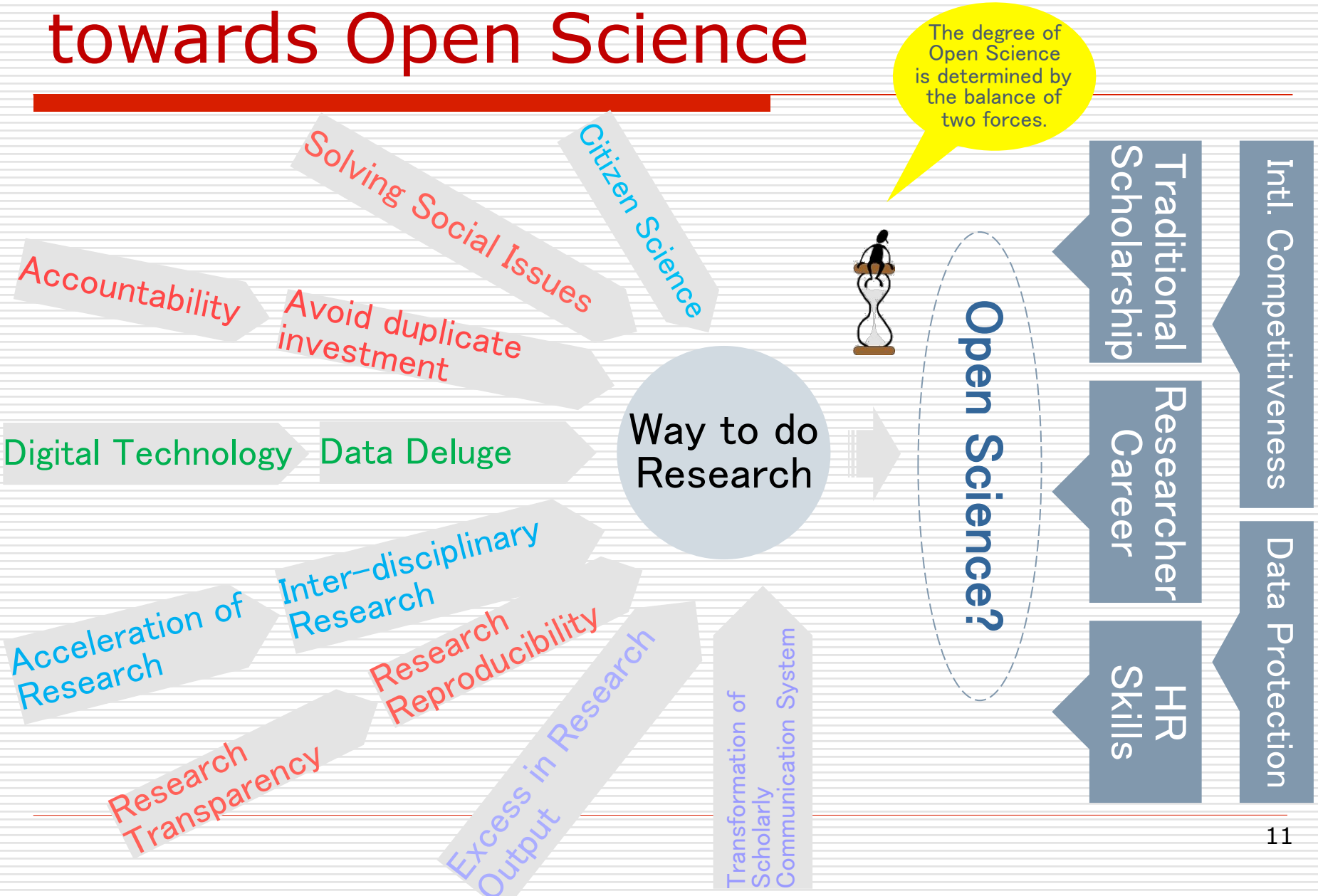
Open Science Monitor

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



Source: Open Science Monitor
https://ec.europa.eu/research/openscience/index.cfm?pg=home&section=monitor

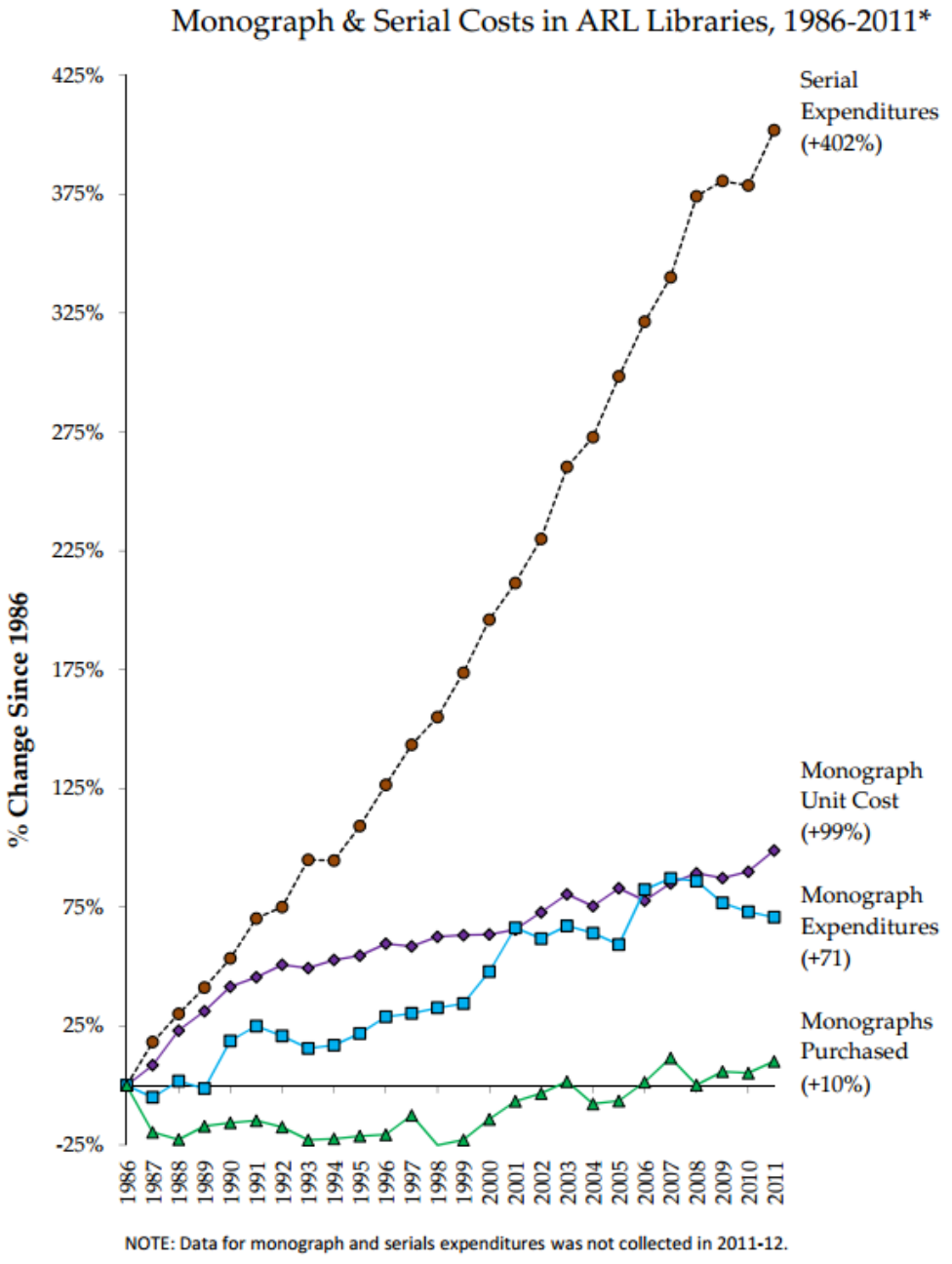
The push and resisting force towards Open Science



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

Protest from Academia (1)

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

We are
writing 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).

Source: Budapest Open Access Initiative
http://www.budapestopenaccessinitiative.org/read

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

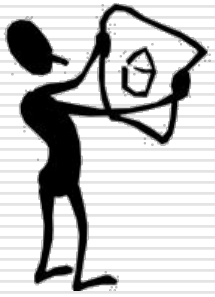
2-2. Policy Developments: Open Access to Research Data

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.

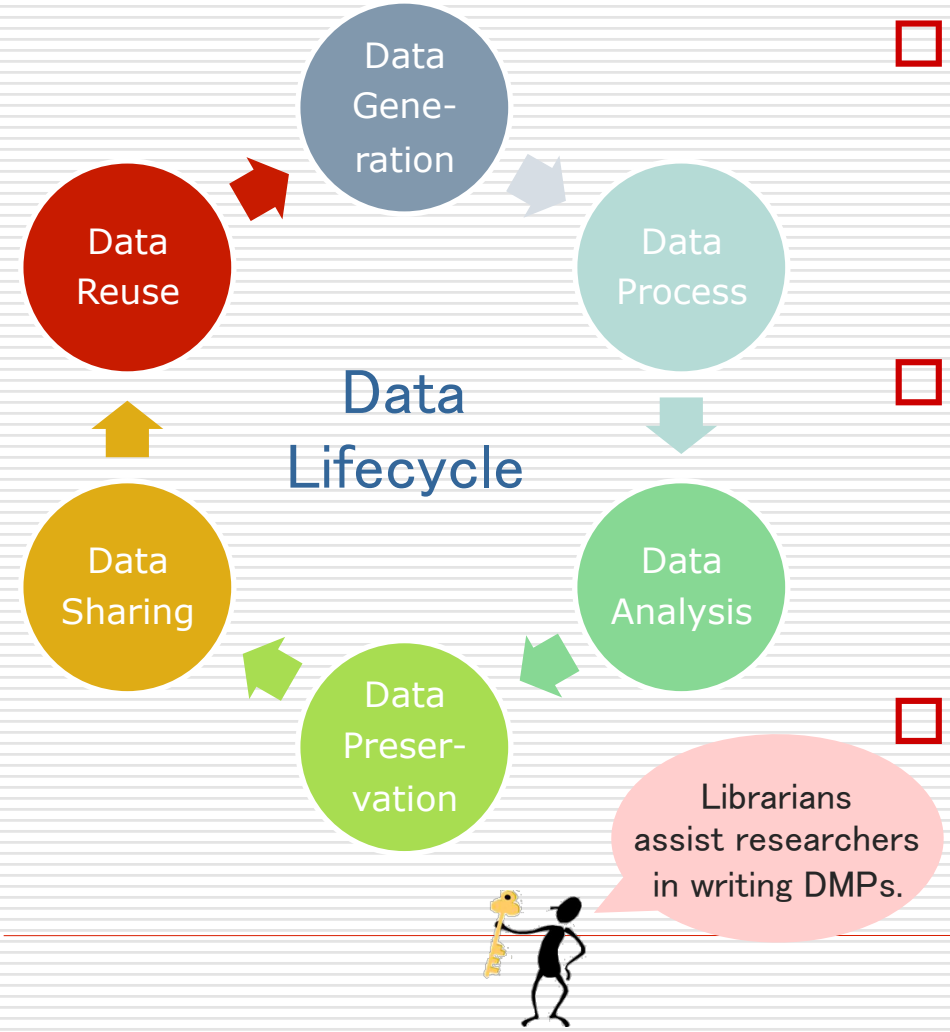
Data Management Plan (DMP) required!

Source: NIH Data Sharing Policy and Implementation Guidance
https://grants.nih.gov/grants/policy/data_sharing/data_sharing_guidance.htm

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 Management Plan (DMP)



- DMP – A plan where researcher state the treatment of data used during research process.
- More and more, research funders are requiring to submit DMP along with research proposal.
- In Japan, JST is asking for DMP since FY2018.

Data Journals and Supplemental Data

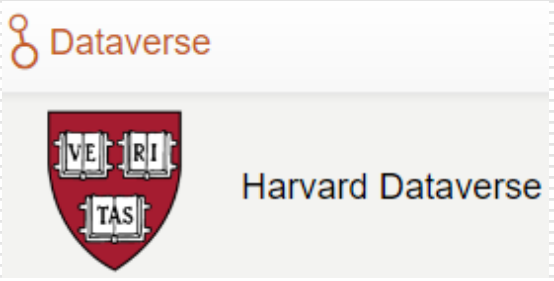
- Data journals established (2014-)
  - Nature: Scientific Data
    - *Scientific Data is an open-access, online-only journal for descriptions of scientifically valuable datasets.*
  - Elsevier: Data in Brief
    - *Data in Brief provides a way for researchers to easily share and reuse each other's datasets 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*

http://www.nature.com/sdata/ https://www.journals.elsevier.com/data-in-brief

Data Repositories

re3data.org
REGISTRY OF RESEARCH 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

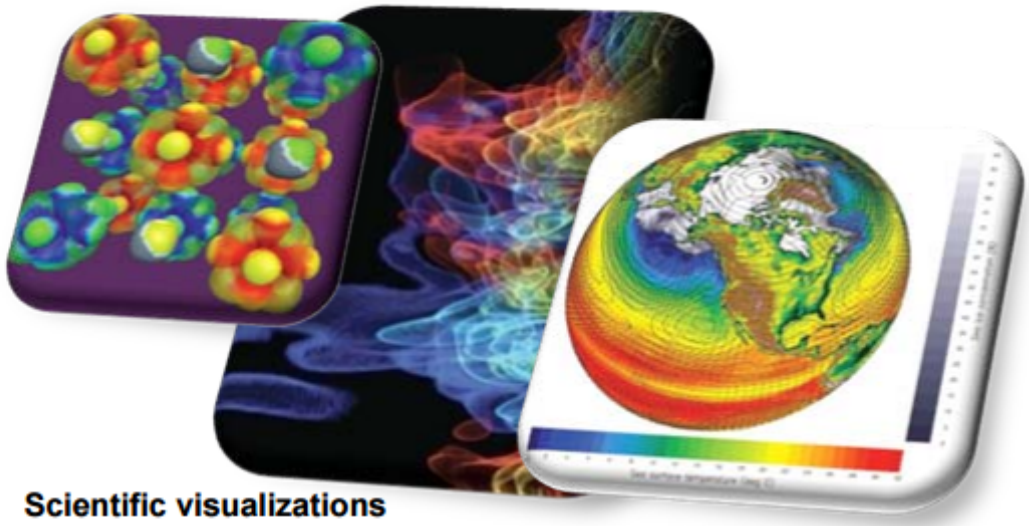
Microsoft External Research

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

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 form 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

With thanks to Jim Gray

The Fourth Paradigm

Data-Intensive Scientific Discovery

EDITED BY TONY HEY, STEWART TANSLEY, AND KRISTIN TOLLE

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.

Source: European Commission: Realising the European Open Science Cloud
https://ec.europa.eu/research/openscience/pdf/realising_the_european_open_science_cloud_2016.pdf#view=fit&pagemode=none

Alliance of Science Organisations in Germany…Research Data WG

- Principles for the Handling of Research Data（2010.6）
- Research Data at Your Fingertips—A Position Paper（2015.2）
- 'Research Data Vision 2025' –A Discussion Paper（2018.2）
- Research Data Management. A Guide for Researchers（2018.3）

Source: https://www.allianzinitiative.de/en/archive/research-data/working-group-documents/

3-2. Drivers

Call for Research Transparency and Research Reproducibility

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)

Pages

Source: The Retraction Watch Leaderboard
http://retractionwatch.com/the-retraction-watch-leaderboard/ (Accessed 2017/03/19)

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/

HOME | CODATA BLOG | EVENTS | NEWS

CODATA

International Council for Science : Committee on Data for Science and

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.

Source: CODATA: Message form President Geoffrey Boulton
http://www.codata.org/message-from-president-geoffrey-boulton

ClimateGate Scandal

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

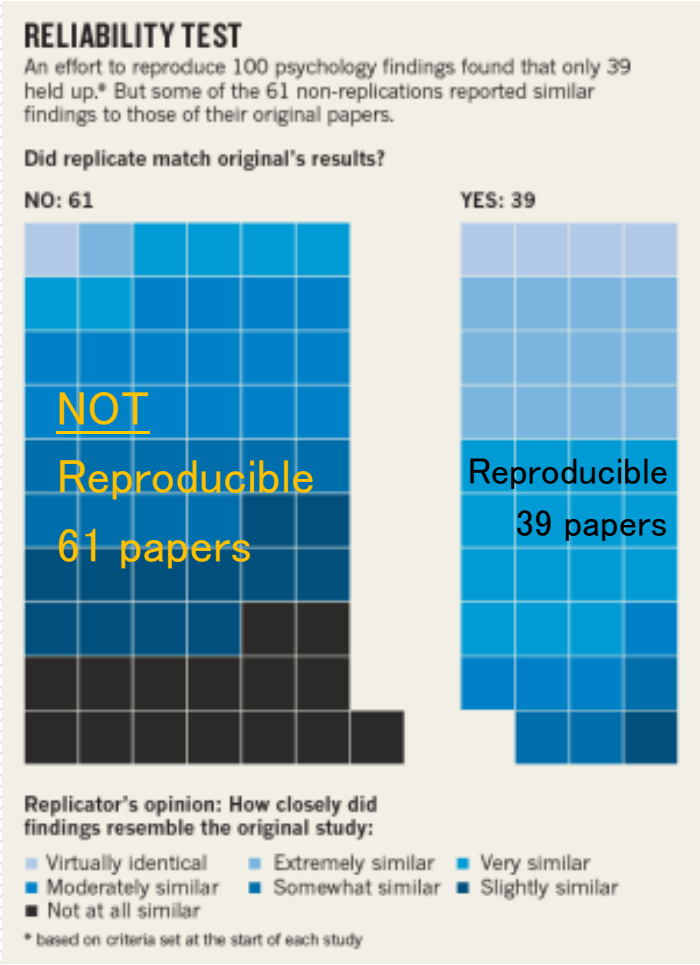
Science International: Open Data in a Big Data World

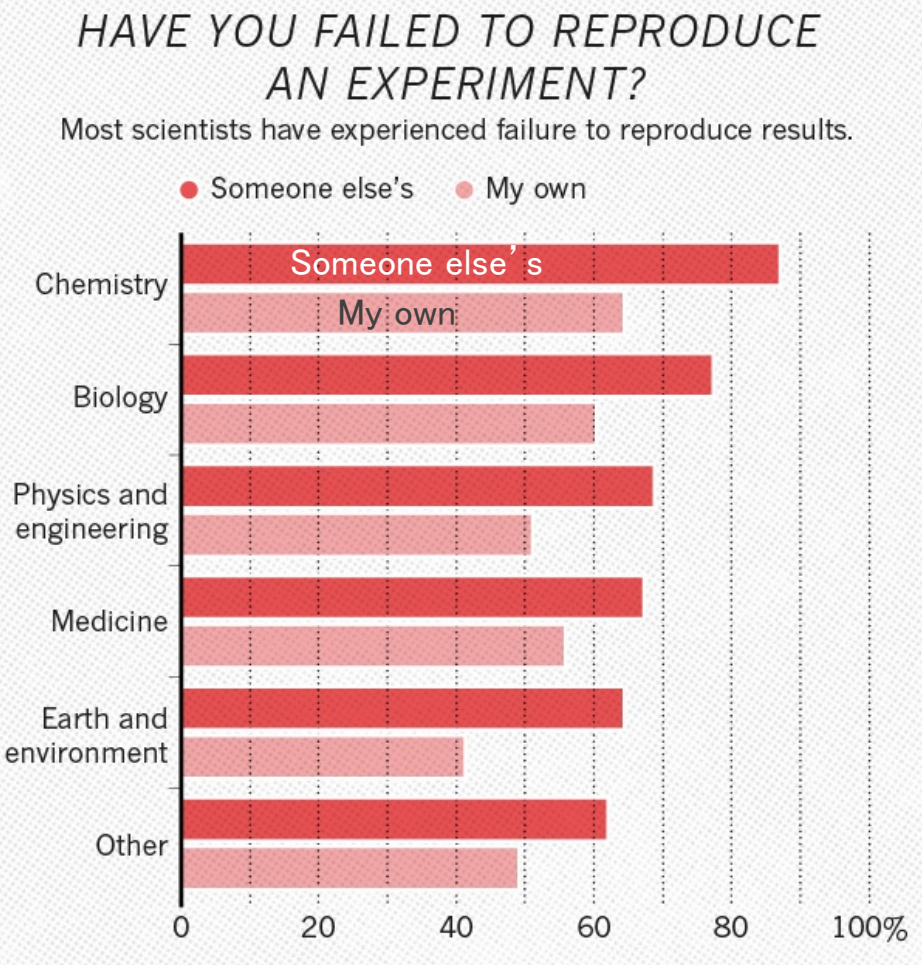
- The accord identifies the opportunities and challenges of the data revolution as today's predominant issue for global science policy. It proposes fundamental principles that should be adopted in responding to them. It adds the distinctive voice of the scientific community to those of governments and 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

ICSU iap ISSC twas

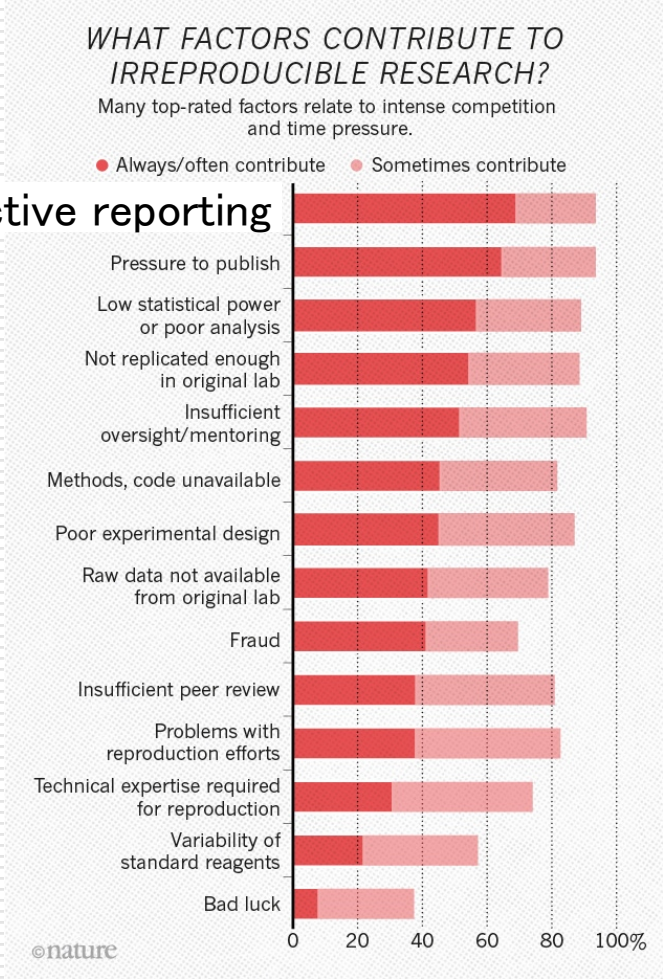
Reproducibility Project: Psychology

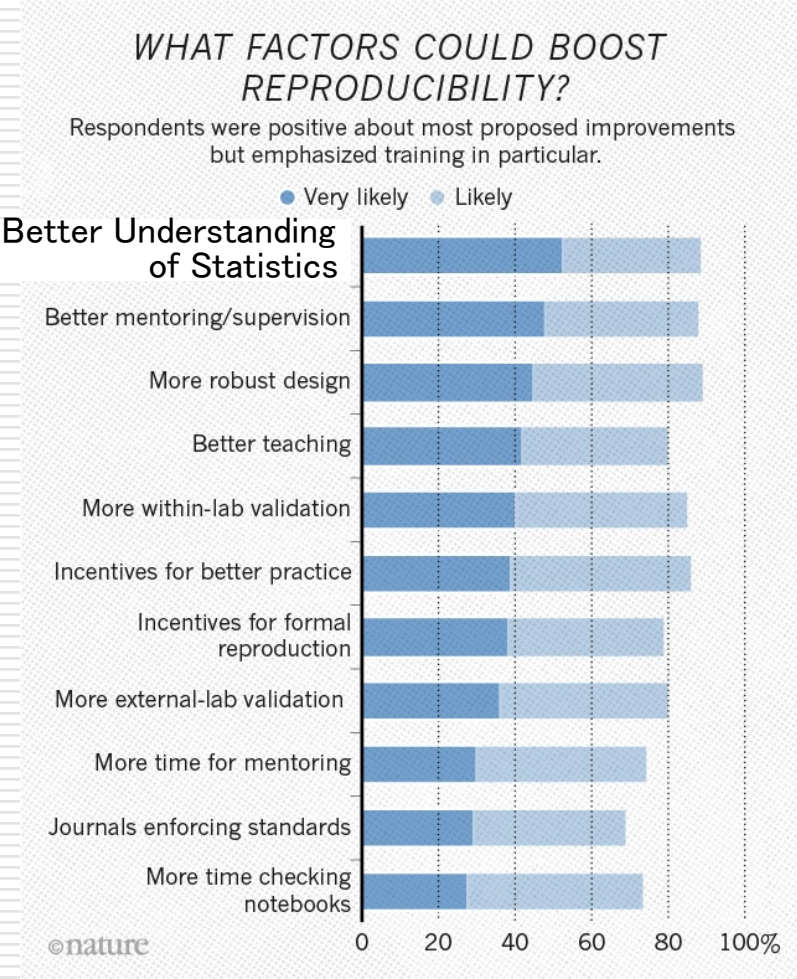




Source: Nature, "Over half of psychology studies fail reproducibility test" (2015.9.27)
https://www.nature.com/news/over-half-of-psychology-studies-fail-reproducibility-test-1.18248

What Factors Contribute to Irreproducible / Reproducible Research?

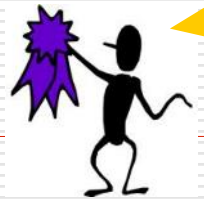




Source: Nature, “1,500 scientists lift the lid on reproducibility” (2016.7.26)
https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

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

In reality, the major driving force for RDM is scientific misconduct prevention

- MEXT: “Guideline for Dealing with Scientific Misconduct” (2014)

  「研究活動における不正行為への対応等に関するガイドライン」

  - Strengthening the guideline in 2006.
  - Holds institutions to be responsible for research transparency and preventing scientific misconduct.

- Science Council of Japan: “Reply: For the Enhancement of Soundness of Scientific Research” (2015)

  日本学術会議「（回答）科学研究における健全性の向上について」

  - “Ten-Years Preservation Rule for Research Data”

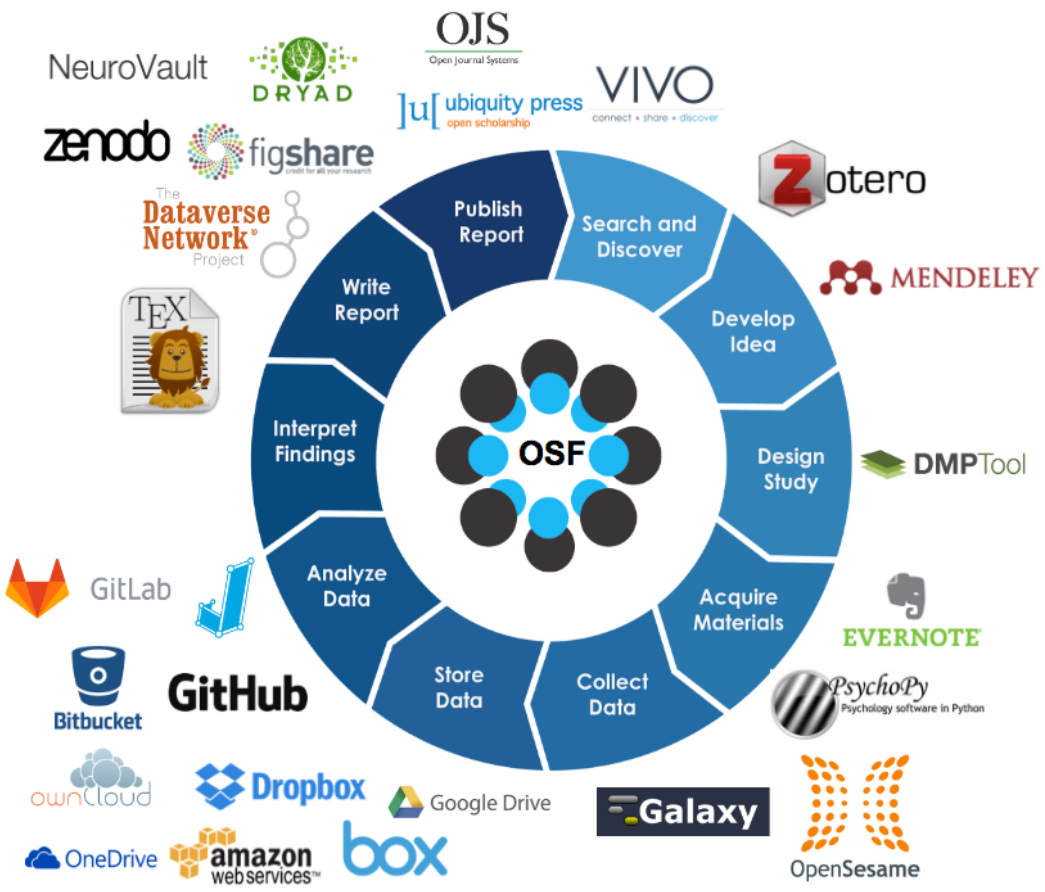
    研究データ10年保存ルール

3-3. Drivers

Social Demand

Globalization and Collaboration

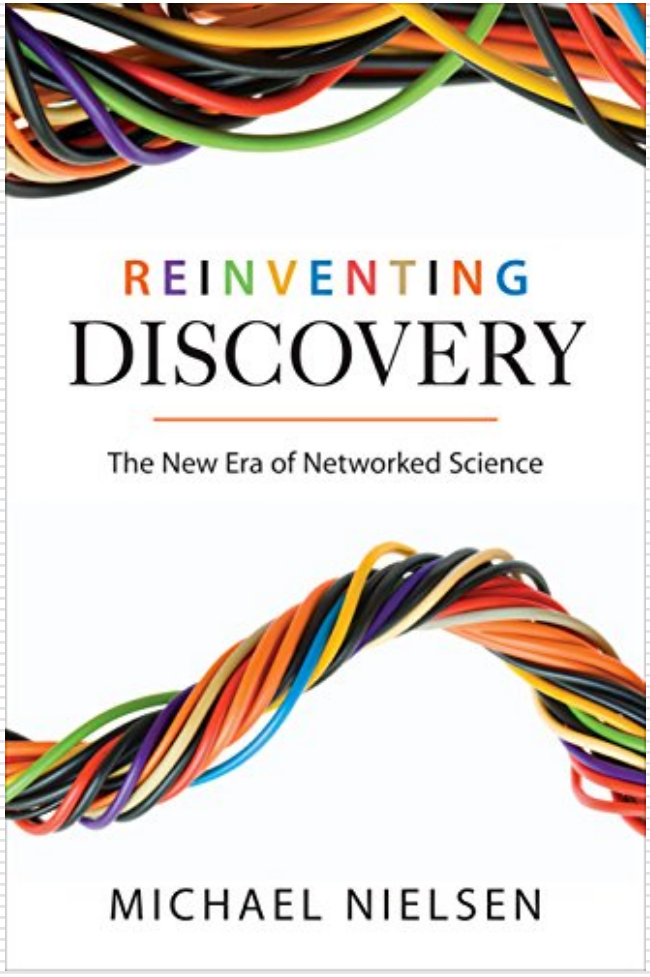
- More and more researchers working on international collaboration projects
  - Need for sharing and storing information
  - Need for online collaboration platform



Source: Open Science Framework
https://cos.io/our-products/open-science-framework/

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.

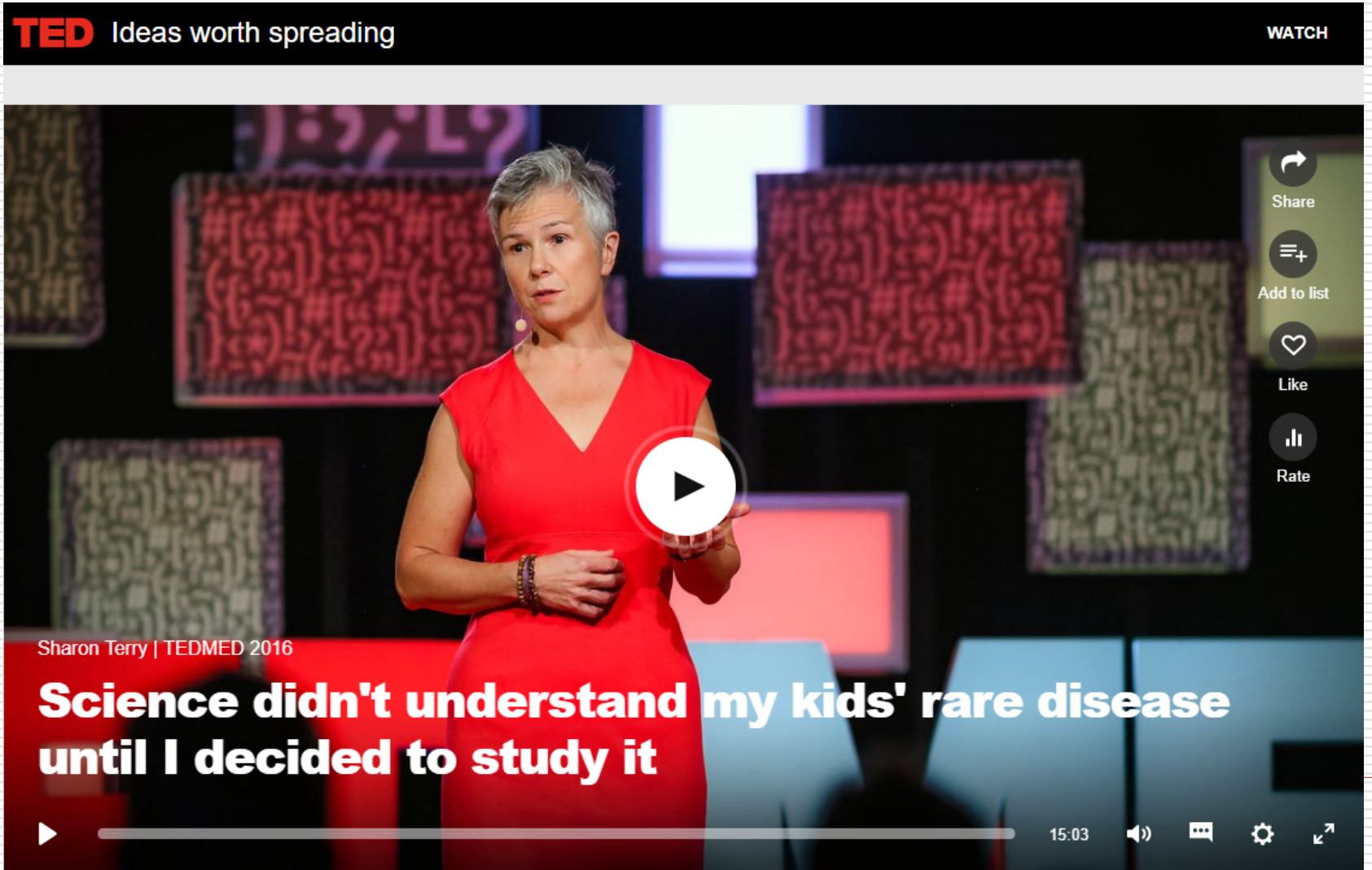


https://www.amazon.co.jp/Reinventing-Discovery-New-Networked-Science-ebook/dp/B005OQGZ54
http://sparc.arl.org/news/sparc-honors-michael-nielsen-innovator-bringing-open-science-mainstream

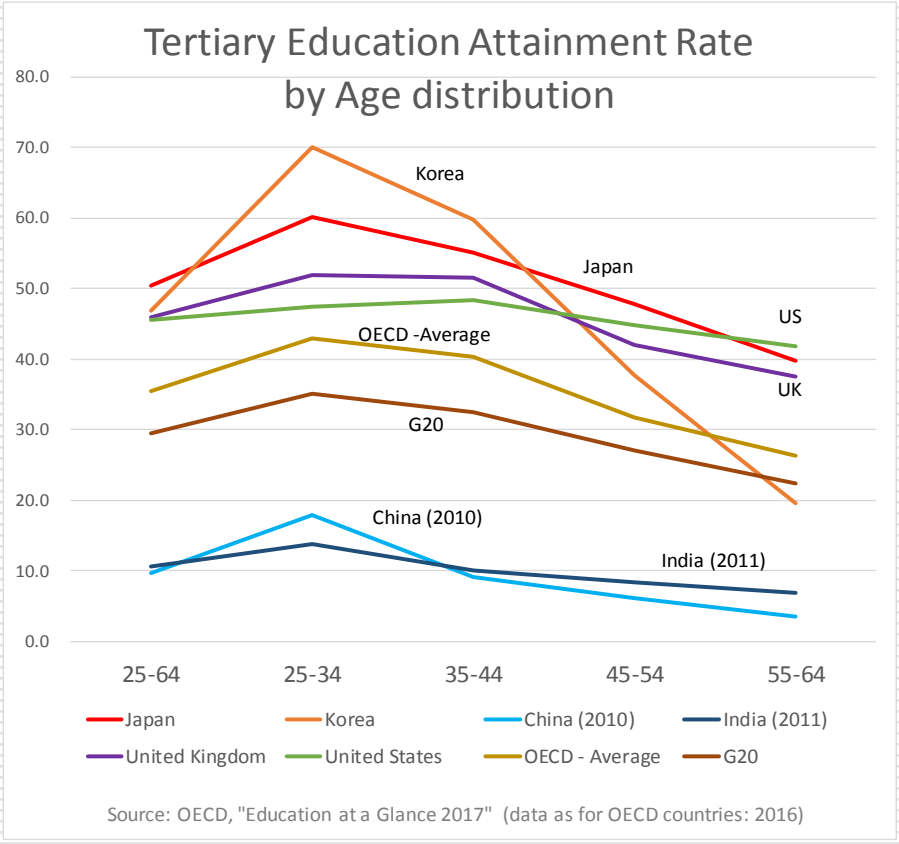
Citizen Science…examples

- 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 push which triggered US government to adopt OA policy



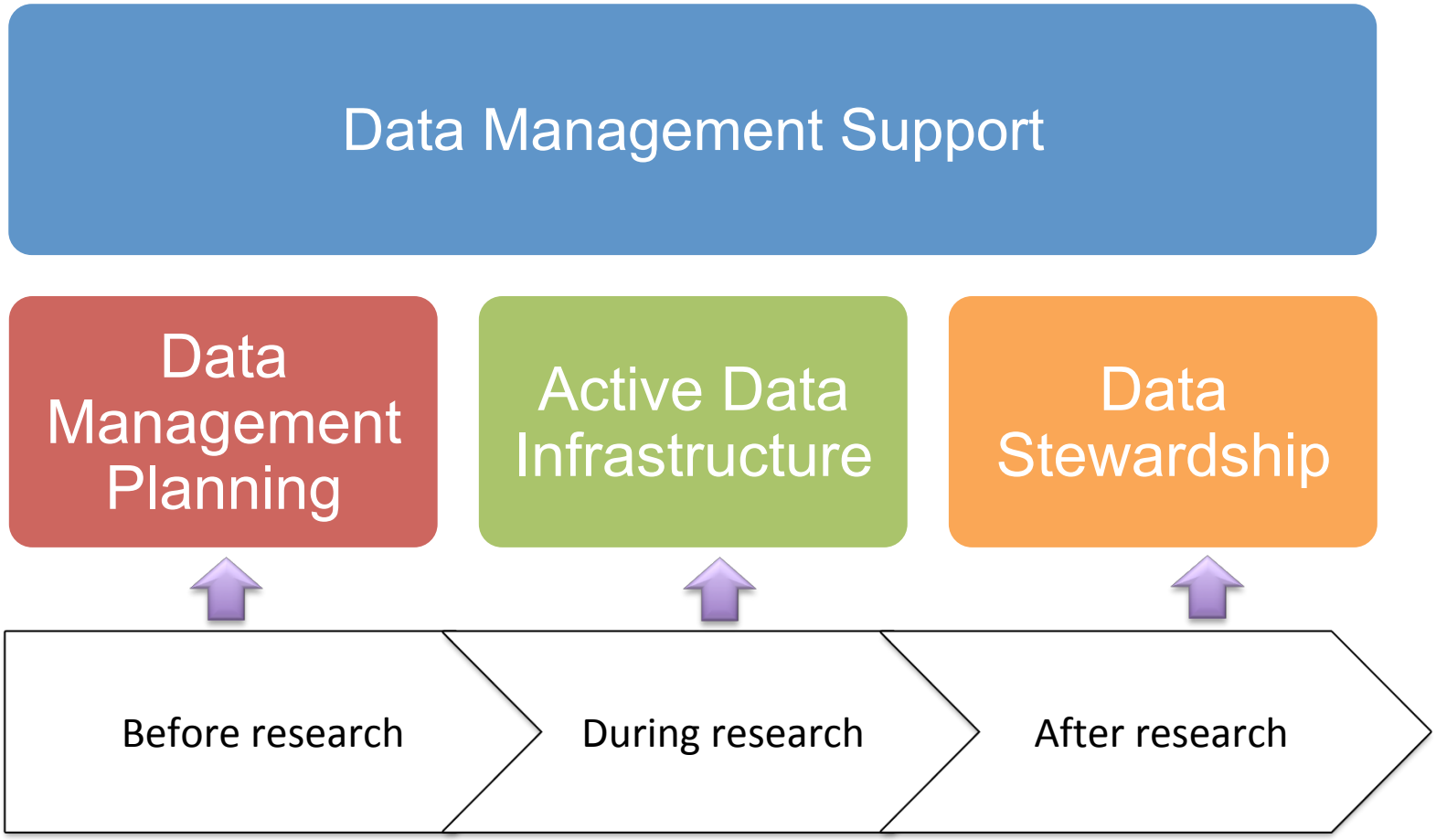
The shrinking gap between society and the academia



- 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.

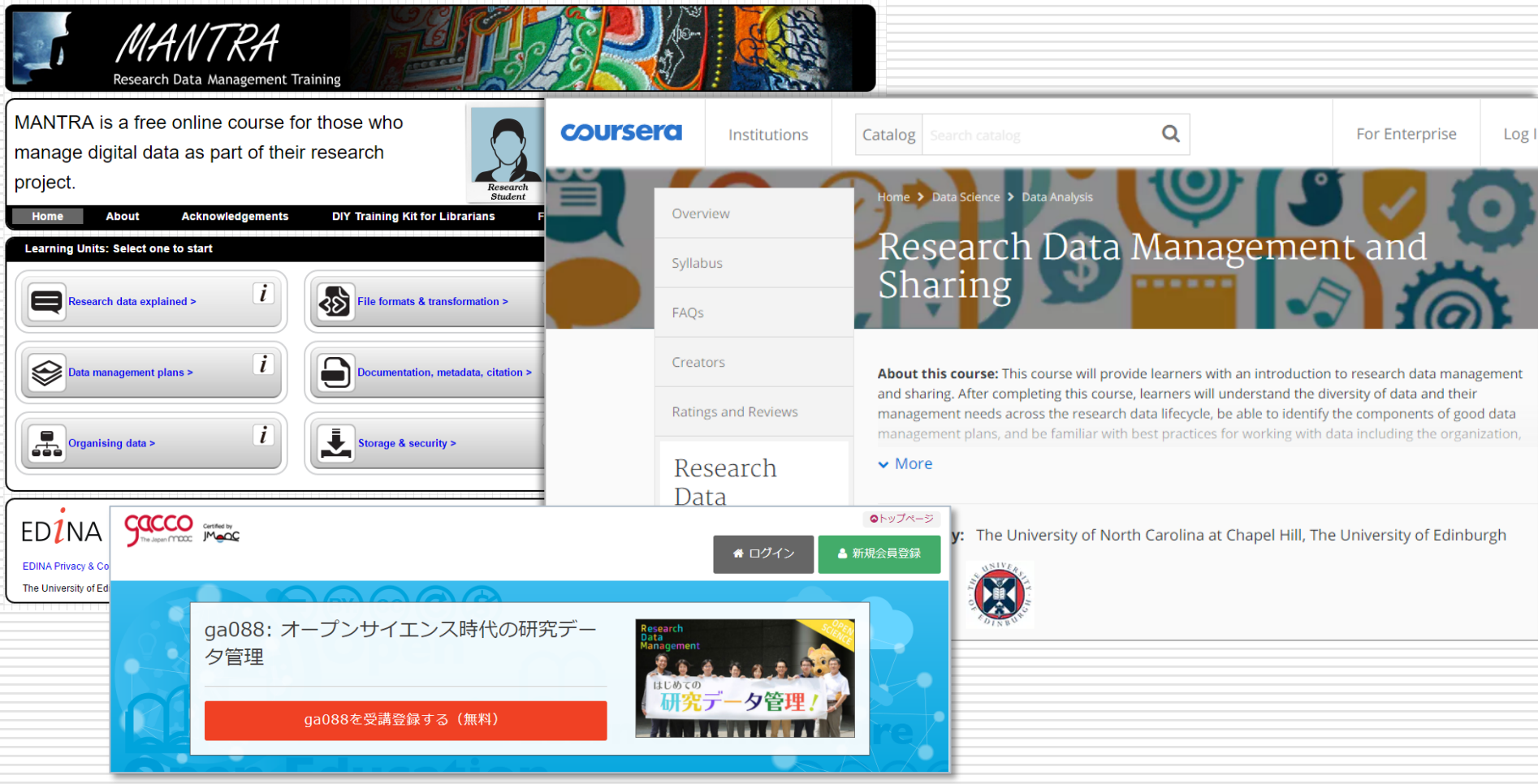
4. The Role of University Libraries In Open Science

How we classify our tools and services



2,542 grant proposals

Providing Training for Research Data Management



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

JPCOAR Research Data TF

- RDM Training Course
  1. Review and Analyze existing Training Materials
     Essentials 4 Data Support, MANTRA, RDM Rose, RDM Support, Research Data Management and Sharing (COURSERA)
  2. Define Syllabus
  3. Develop Slides, Scripts and then Video Production
  4. Provide from JPCOAR Site (Slides) and Japanese MOOC (Course)

JPCOAR SITE	Access	DL
2017.06	936	903
2017.07	286	342
2017.08	393	318
2017.09	429	308
2017.10	362	238
2017.11	515	301
2017.12	355	113
2018.01	313	131
Total	3,589	2,654

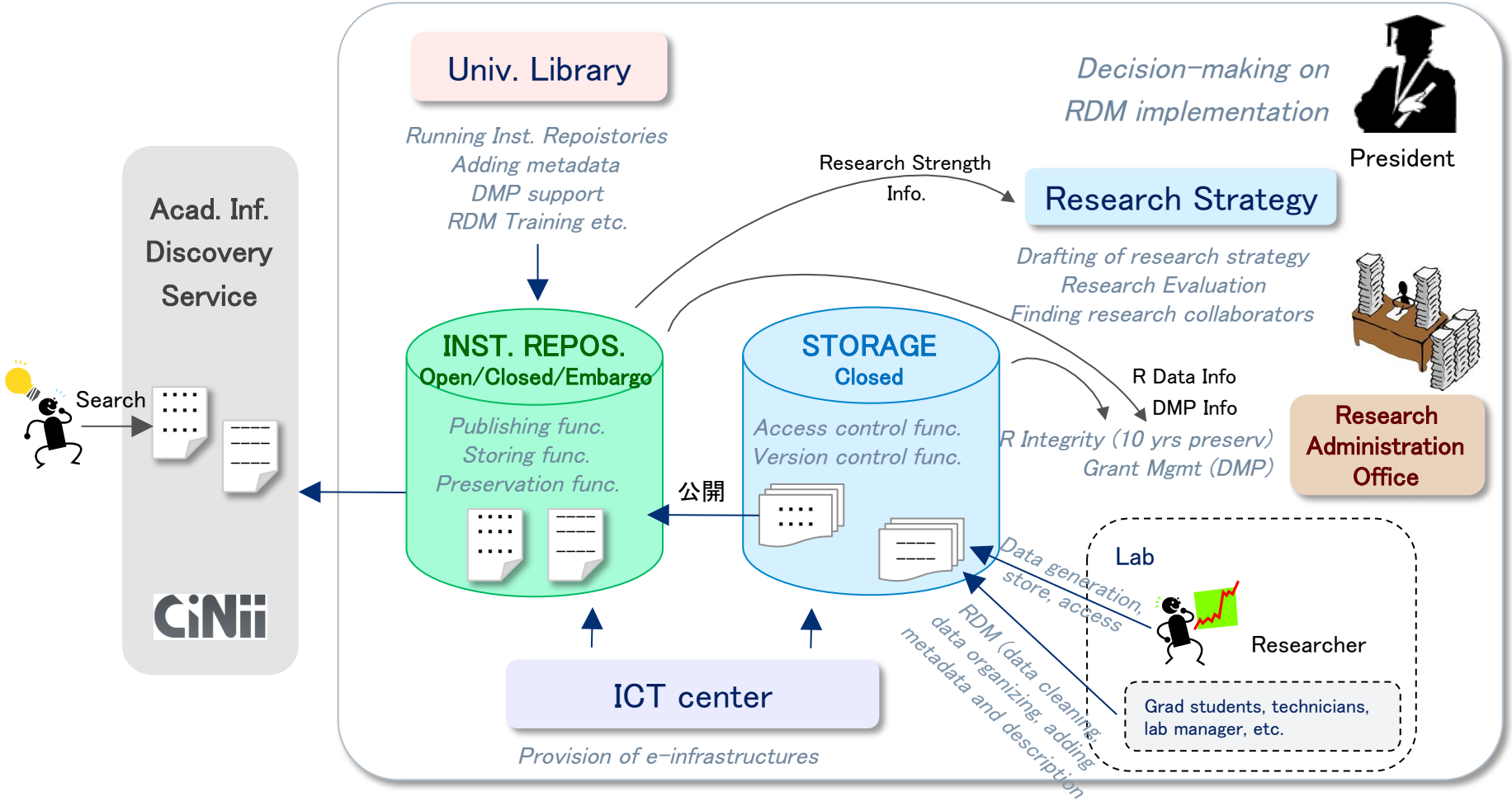
	Participants	Completion Rate
RDM Course	2,305	25%
JMOOC Ave.	4,145	15%

Now Developing Next Version, especially focusing on RDM Supporters

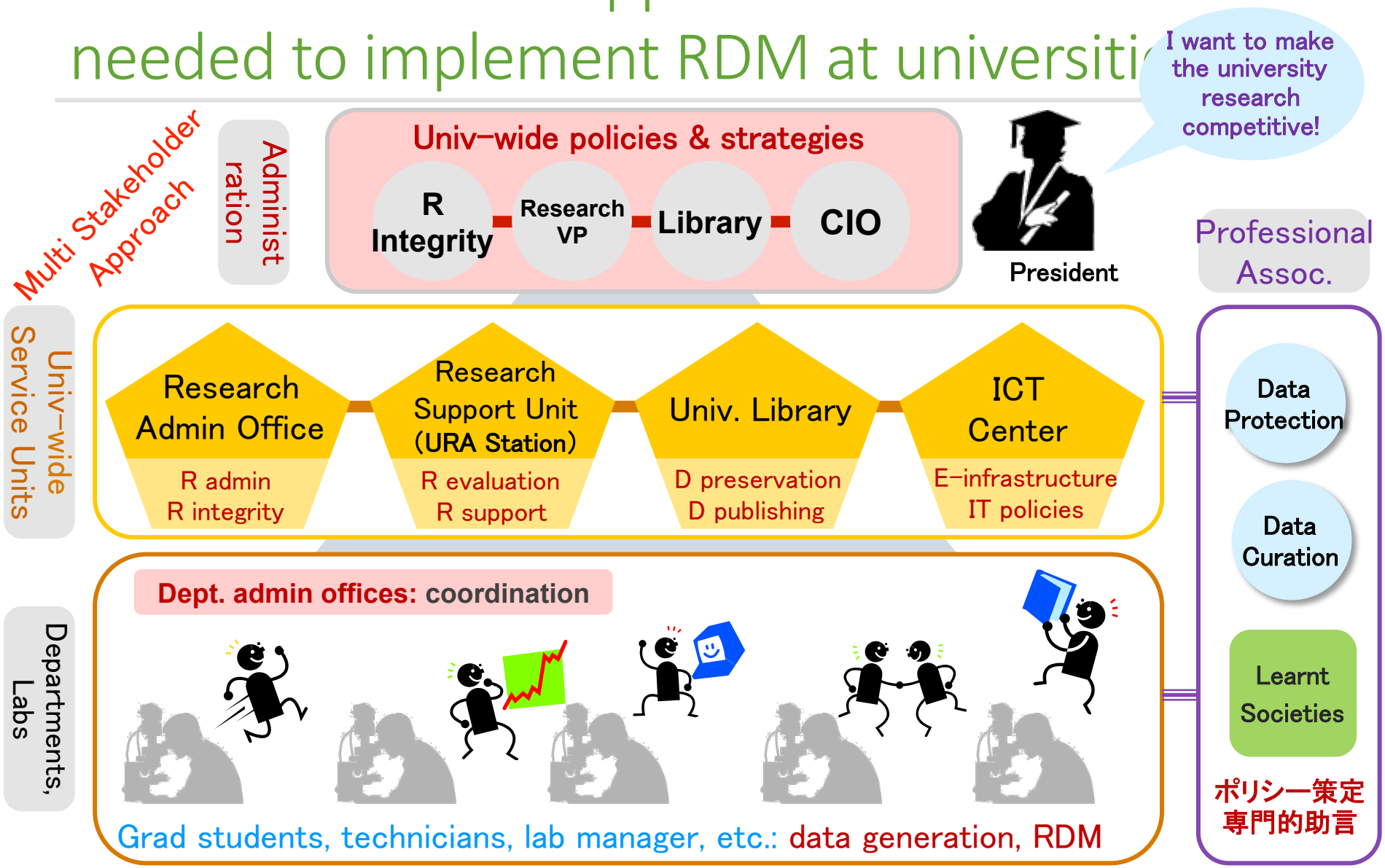
Open Science at Academic Institution Level

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

RDM implementation in an academic institute



Multi-stakeholder Approach needed to implement RDM at universiti



Why an RDM Charter?

- Participants at AXIES-RDM session started to claim,
  - *"We need a charter in order to convince the university administration and to get the researchers and staff engaged!"*

✓ AXIES

- Academic eXchange for Information Environment and Strategy
- Community of CIOs and ICT centers of universities in Japan.
- Counterpart to EDUCAUSE in the US

“RDM Charter for Academic Institutions”

- RDM Charter
  - Not for researchers, but
  - For academic institutions!

Researcher

- Purpose of RDM Charter
  - Give university administration ideas and options to implement RDM in respective institutions.

“RDM Charter for Academic Institutions” …Composition

- The Charter (3 pages)
  - Addresses the viewpoints why academic institutions needs to take RDM seriously.
  - Viewpoints in bullet points:
    I. Role of academic institutions in RDM
    II. Policies and organizations for RDM needed in acad. Institutions
    III. RDM procedures in acad. Institutions
    IV. RDM Purpose options in acad. Institutions
    V. Digital platform functions needed for RDM in acad. Institutions
    VI. Human resources development for RDM in acad. Institutions
    VII. Reuse and service options of research data in acad. institutions
- Appendix (12 pages)
- Glossary (12 terms, 3 pages)
- References (2 pages)

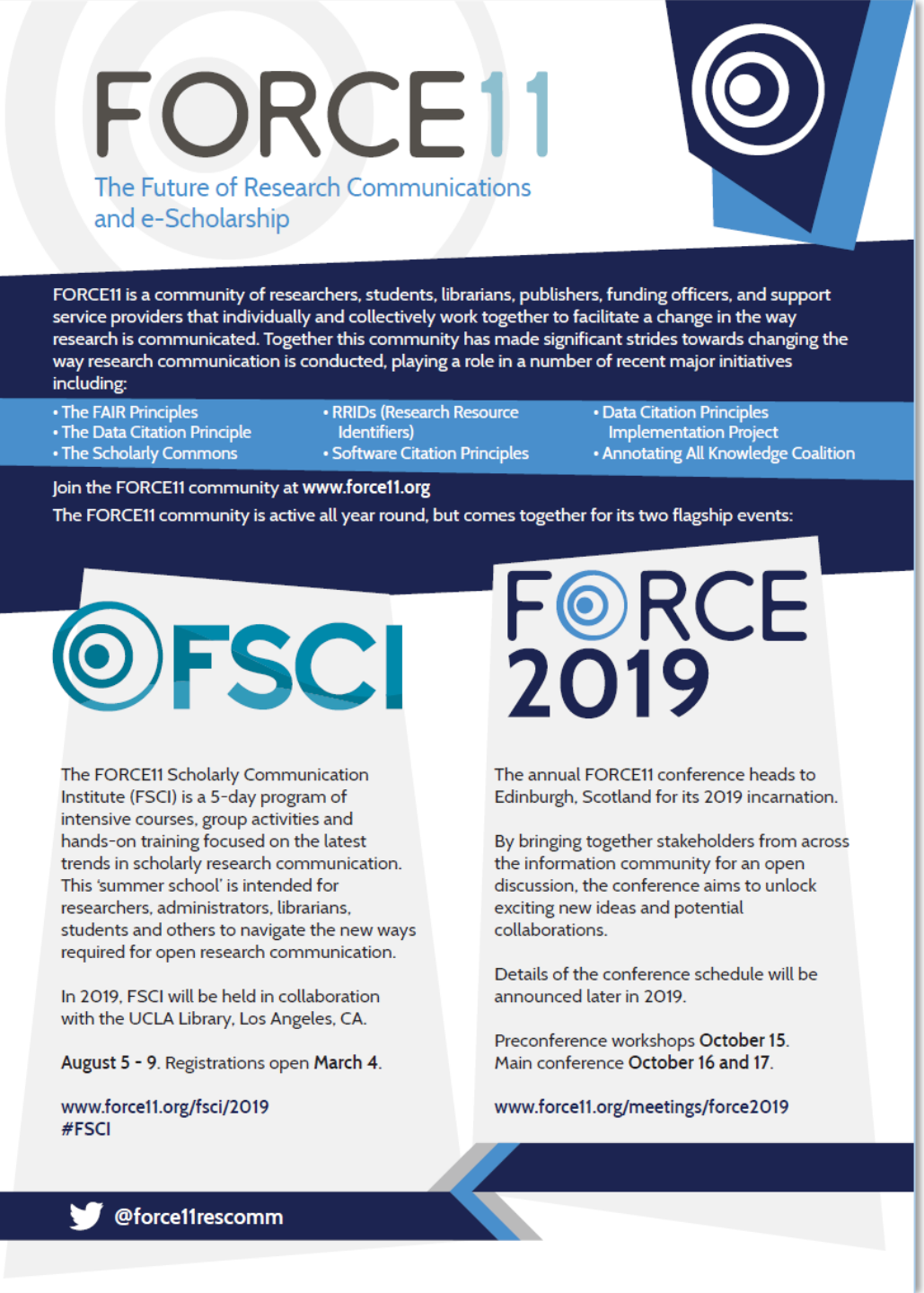
Role of University Libraries in promoting Open Science

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

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!



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- Registration is free!
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- Travel fellowship will be available for participants from developing countries for below two events!

FORCE11 events:

FSCI

- August 5-9 @ UCLA
- FORCE11 Scholarly Communication Institute—a 5-day intensive program!

FORCE2019

- October 15-17 @ Edinburgh
- Annual FORCE11 conference