A MISSING LINK IN THE KNOWLEDGE ECOSYSTEM: PUBLISHING REPRODUCIBLE SCIENCE

INSTITUT FOR
KOMMUNIKATION OG KULTUR
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DEIC CONFERENCE
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PROJEKTLEDER

OUTLINE

Context for the work

Short introduction to Knowledge Exchange

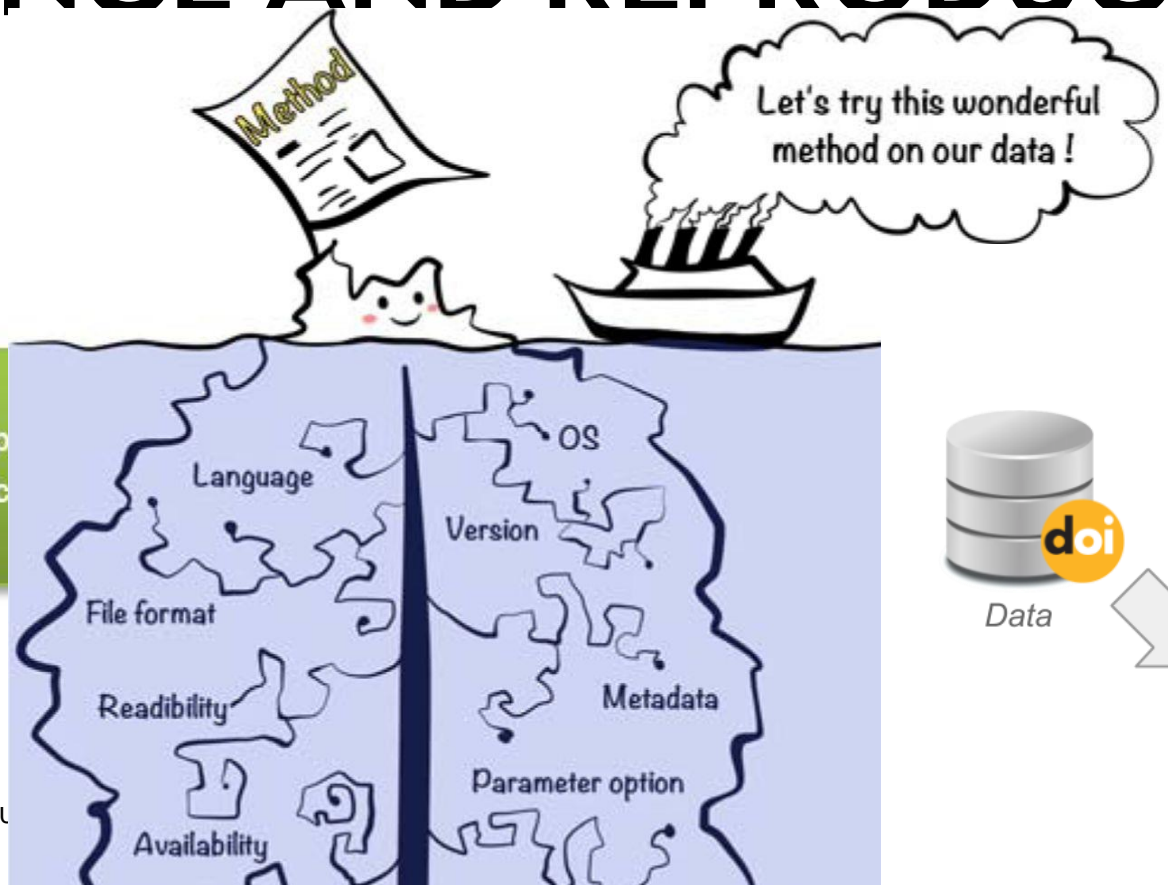
Results from the Knowledge Exchange report

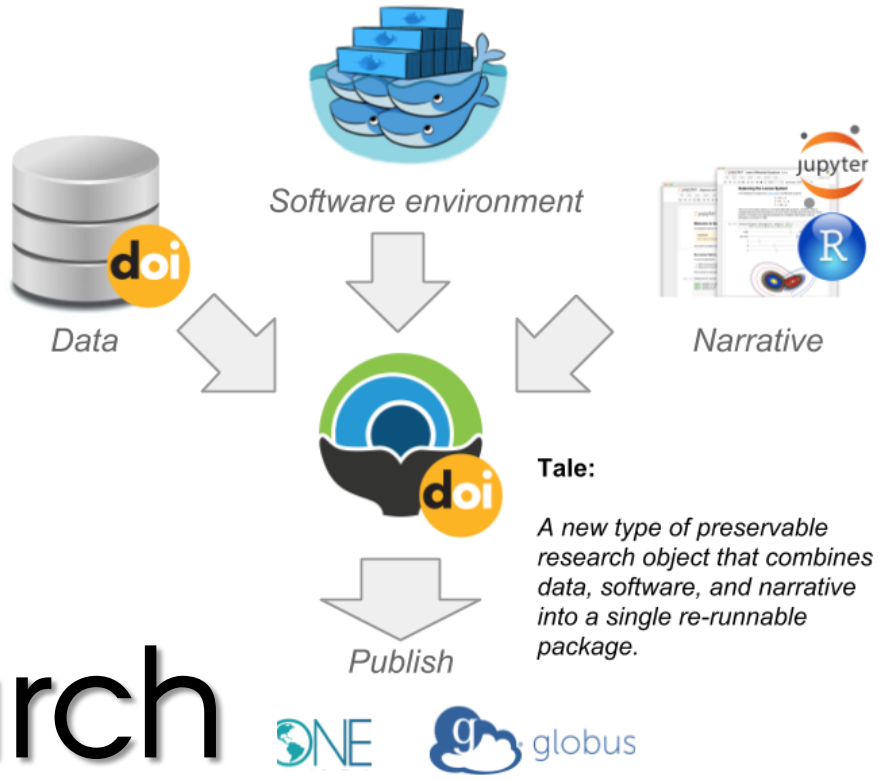
- Litterature review
- Final Report

https://bit.ly/KEPRROReport

OPEN SCIENCE AND REPRODUCIBLE SCIENCE

From: https://www.fosteropenscience.eu/open-science-introduction



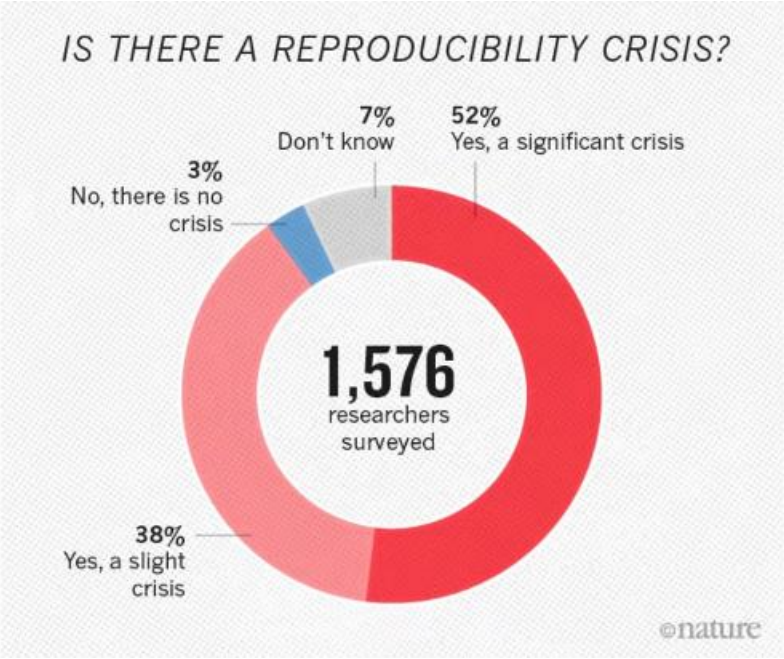


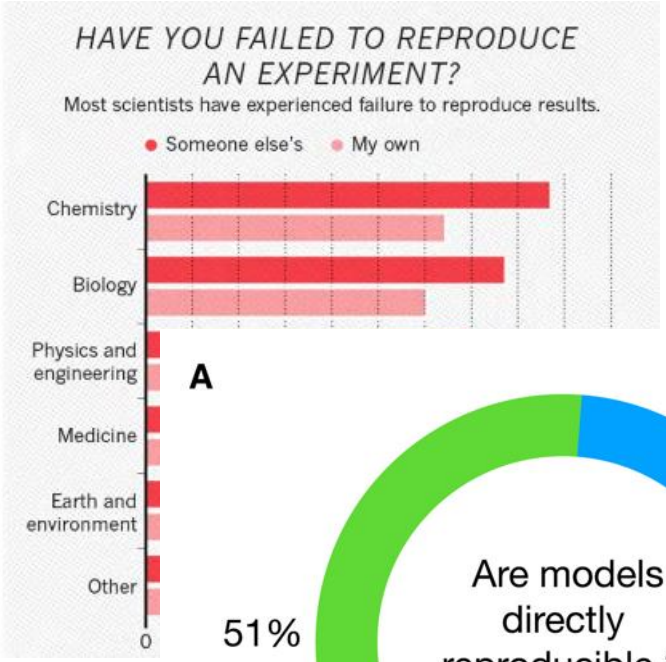
Trustworthy research

Experimenting with reproducibility: a case study of robustness in bioinformatics
Yang-Min Kim, Jean-Baptiste Poline, Guillaume Dumas
GigaScience, Volume 7, Issue 7, July 2018,
https://doi.org/10.1093/gigascience/giy077

https://wholetale.org/

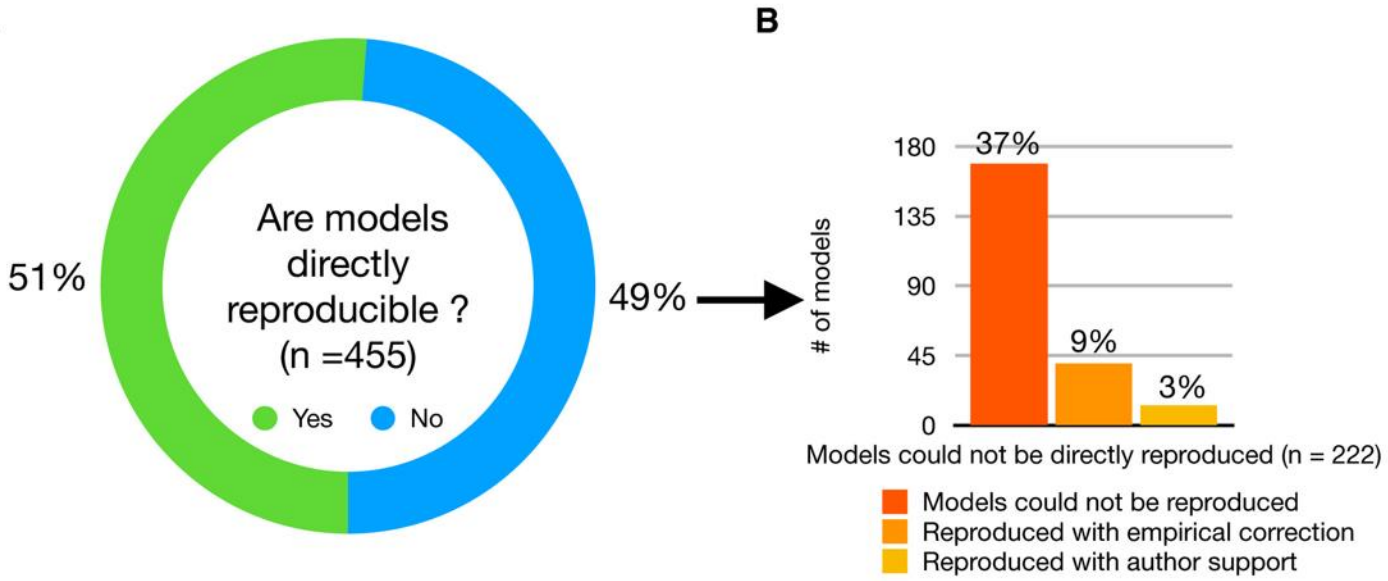
THE REPRODUCIBILITY CRISIS?





Baker, M. 1,500 scientists lift the lid on reproducibility. *Nature* **533,** 452–454 (2016). https://doi.org/10.1038/533452a

Reproducibility in systems biology modelling
Krishna Tiwari et al.
Mol Syst Biol (2021)17:e9982
https://doi.org/10.15252/msb.20209982



WHAT IS THE STATUS OF PUBLISHING REPRODUCIBLE RESEARCH?

KE initiated activity on **publishing reproducible research outputs** to:

- Conduct a gap analysis
- Investigate researchers' need in order to make research outputs more reproducible
- How infrastructures (both technical and social) can support them.

The main focus is on requirements to enable researchers to publish reproducible research output.

KNOWLEDGE EXCHANGE

A collaboration of 6 national organisations within Europe

DFG German Research Foundation

Jisc (United Kingdom)

DeiC Danish e-infrastructure Coopertion

SURF (Netherlands)

CSC IT Centre for Science (Finland)

CNRS Centre national de la recherche scientifique (France)

KNOWLEDGE EXCHANGE MISSION & OBJECTIVES

Knowledge Exchange

"To enable open scholarship by supporting an information infrastructure on an international level"

Compare and inspire strategies, policies and operational practice

Improve partners' performance sharing practice and lessons learnt and exploring beneficial cooperation

Explore new developments in the area of Higher Education and Research infrastructures and services

Facilitate networks of experts to exchange views and provide recommendations on desired developments

Commission studies in areas of mutual interest

Advise and influence peer organisations, national and international policy bodies and the EC

THE FOUR PHASES

Literature review

- Literature review slide deck (Interim report); Chiarelli, A., Loffreda, L., & Johnson, R. (2021). Publishing Reproducible Research Outputs - Literature findings. Zenodo. https://doi.org/10.5281/ZENODO.4675457

Online survey

Interviews with selected stakeholders

Dissemination of results

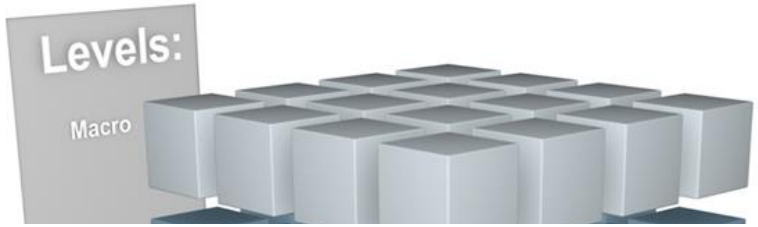
THE KE Knowledge Exchange OPEN SCHOLARSHIP FRAMEWORK

A model to better understand the complexity of Open Scholarship, by looking at three perspectives in one view:

Actors (micro / meso / macro)

Arenas (political / ec

Research Phase (c project / dissemin



LITTERATURE REVIEW

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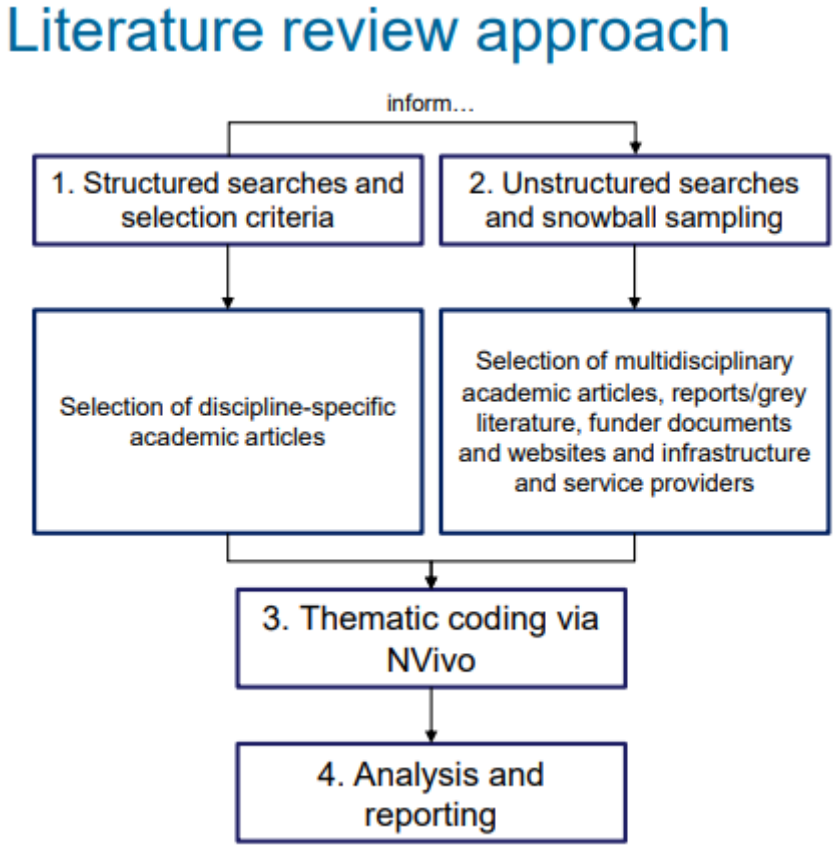
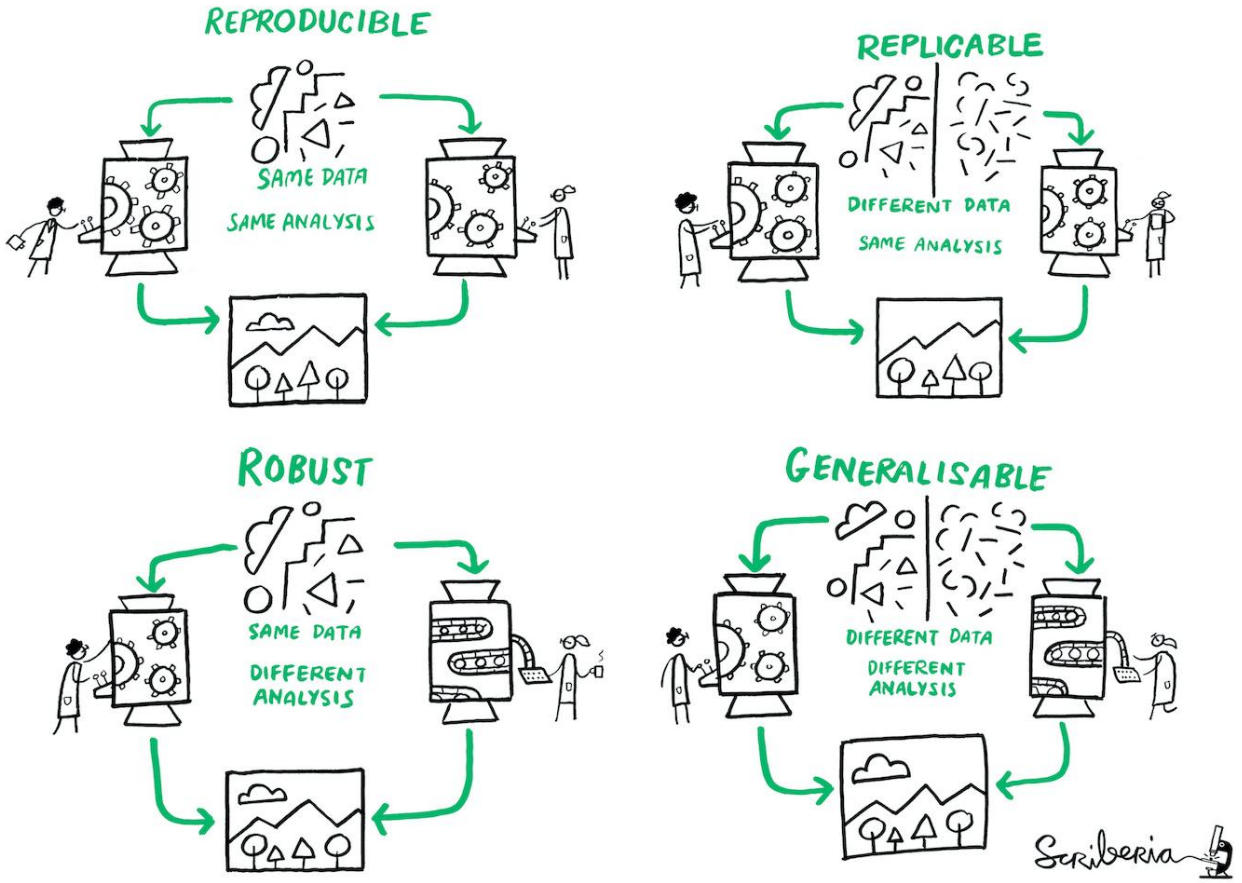
Wanted activities:

- identify research areas which **have reached some kind of common understanding**, definition, discourse, taxonomy regarding reproducibility,
- identify **different perspectives** on reproducibility depending on research areas
- provide an **overview of existing infrastructure** solutions to foster reproducibility
- provide an **overview of relevant** organisations & stakeholders to target when trying to find survey respondents / interview partners
- **map different research areas** on a spectrum of reproducibility



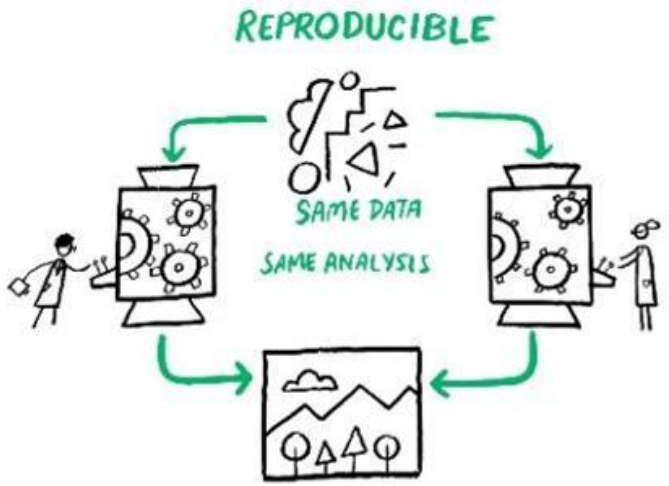
DEFINITIONS

		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable



The Turing Way project illustration by Scriberia. Used under a CC-BY 4.0 licence.
DOI: 10.5281/zenodo.3332807.¶

TYPES OF REPRODUCIBILITY:



- **Computational reproducibility (code + data)**
- Empirical reproducibility (methods + data)
- Statistical reproducibility (preregistration+ statistical details: tests, model parameters, threshold values etc.)

https://slideplayer.com/slide/14344911/

KEY BARRIERS

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Key barriers

Rewards and incentives

- Current incentives are not conducive to reproducible science (n=24)
- Current evaluative metrics focus on quantity and impact rather than on quality and reproducibility (n=11)

Publishing and reporting standards

- Code, data and methods are not always available or complete (n=14)
- Lack of detail in methods (n=12) and poor documentation due to limitations on word/page counts (n=11)
- Need for better reporting standards for authors and peer reviewers (n=6)

Technical and analytical skills

- Lack of training and mentoring, including in computing analysis, coding and novel techniques (n=22)
- Lack of familiarity with computing and software for reproducibility (n=3)

← Macro and Meso → ← Meso and micro →

Chiarelli, A., Loffreda, L., & Johnson, R. (2021). Publishing Reproducible Research Outputs - Literature findings. Zenodo. https://doi.org/10.5281/ZENODO.4675457

THE REPORT

Sections:

- Introduction
- Framing the research reproducibility discourse
- Stakeholders, roles and responsibilities
- Incentivising and enabling reproducible publication practices
- Technological innovation
- Covering the costs of reproducible publication practices
- Conclusion

FRAMING THE RESEARCH REPRODUCIBILITY DISCOURSE

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Reproducible practices can take advantage of today's rapidly growing infrastructures

Key benefits of reproducible research include

- increased confidence in findings and results
- an ability to continue one's (or someone else's) work in the future
- higher transparency, openness and trust in science

Some barriers can hinder reproducible practices

- Incentive structures
- differences in the technical capabilities of researchers
- limited connectivity between technical solutions
- inconsistent reporting standards
- research methods

"The traditional, two-dimensional article is no longer enough. These days you'd like to have dynamic plots, interactive plots, maybe even interactive data when you actually sift through the thing." Publisher

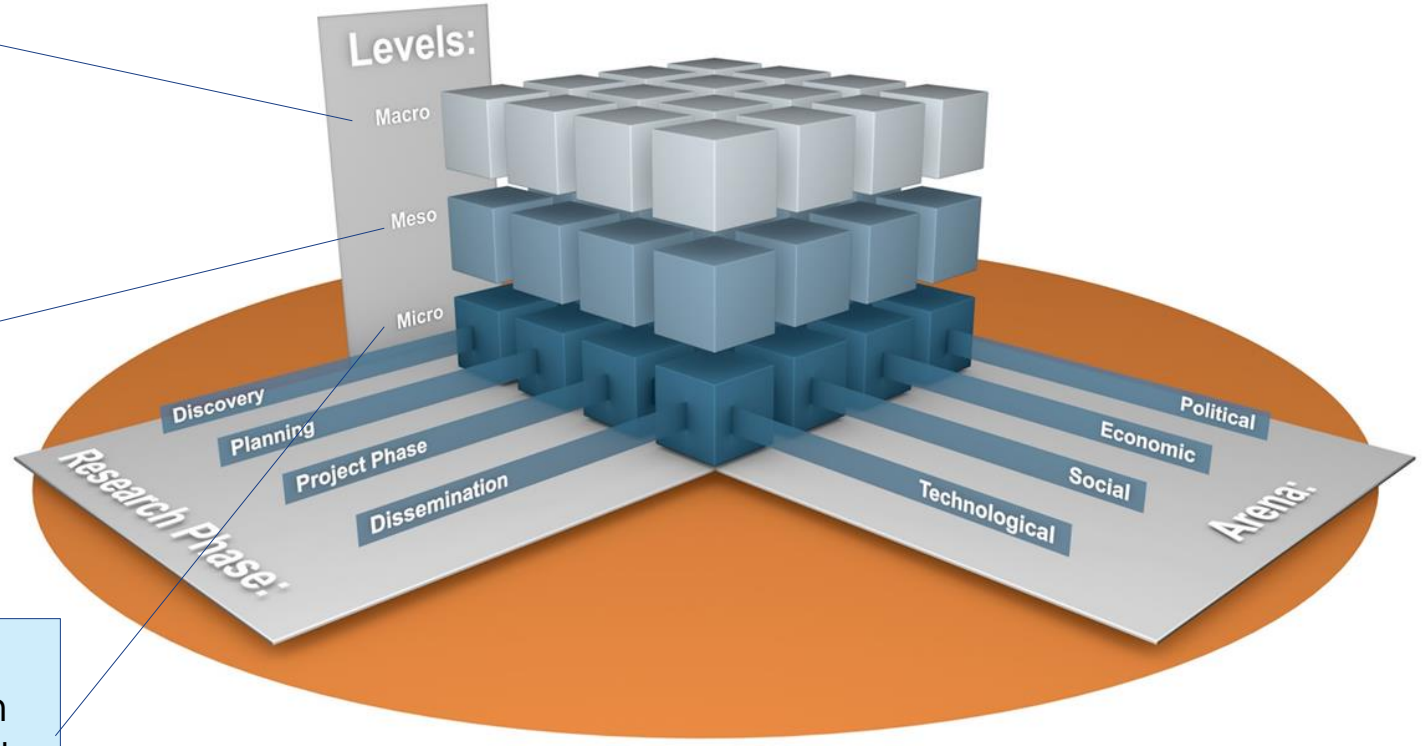
"I think if people are taught how to set up workflows that are reproducible, it also benefits them in the first place. If I have to touch the same project three years in the future, I might have forgotten what specifically I did, and if there is good documentation, everything is there and I save a lot of time." Researcher

STAKEHOLDERS, ROLES AND RESPONSIBILITIES

Macro level:
Research funding organisations see reproducibility as part of a broader discussion

Meso level:
- Disciplines should communicate their requirements, and publishers should implement
- Research performing organisations do not tend to mandate reproducible publication practices

Micro level:
Researchers and research groups have direct control over everyday practices



INCENTIVISING AND ENABLING REPRODUCIBLE PUBLICATION PRACTICES

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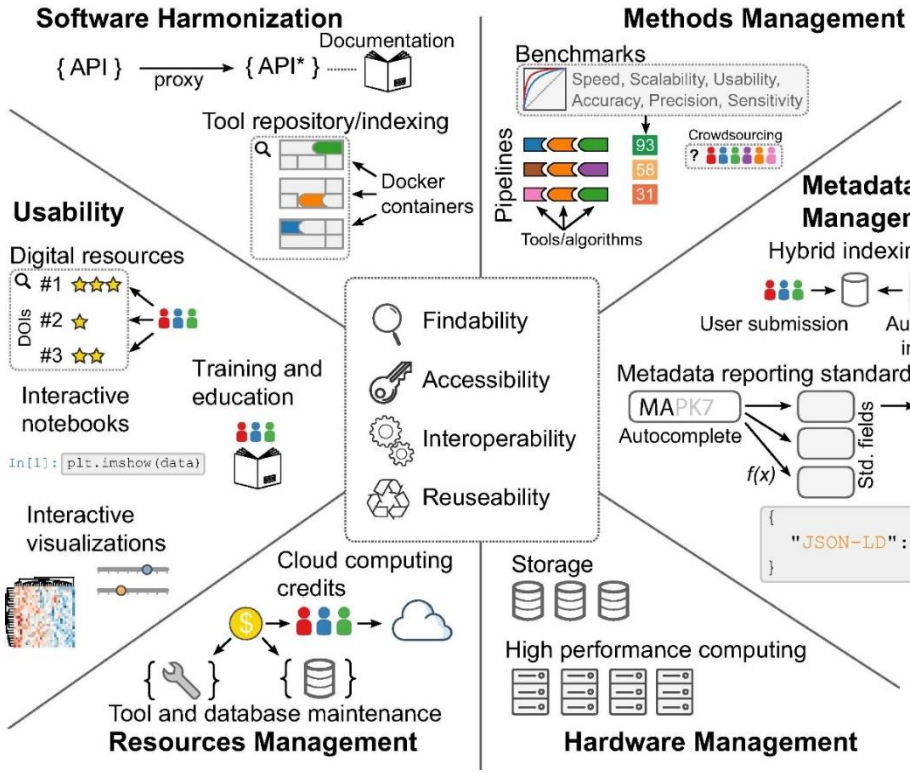
Current incentives and support for reproducible publication practices are limited

New training and support pathways are developing across the world



"I believe it comes down to hiring practices and funding practices, and there are a number of activities underway to try and get data and code and other outputs recognised in the system for research assessment." Publisher

Kathleen M. Jagodnik, et al.
Developing a framework for digital objects in the Big Data to Knowledge (BD2K) commons: Report from the Commons Framework Pilots workshop, Journal of Biomedical Informatics, Volume 71, 2017, https://doi.org/10.1016/j.jbi.2017.05.006.

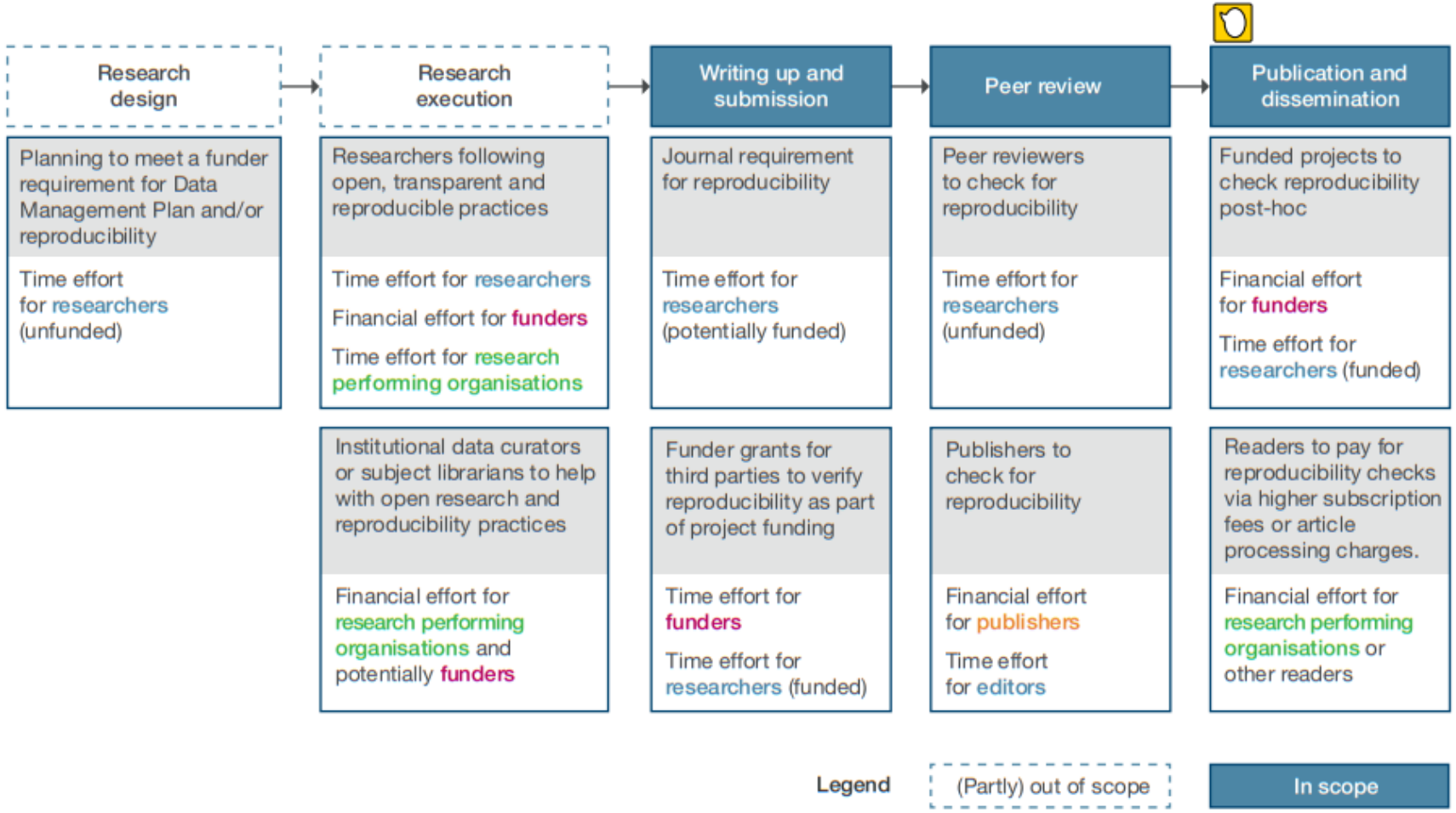
TECHNOLOGICAL INNOVATION

Many digital infrastructures for reproducible publication practices are already available

> "There's lots of innovation needed in the infrastructure landscape. It's not about inventing something new that doesn't exist, it's about making the things that do exist better… and to lower the barrier to entry for people at different stages of knowledge." Infrastructure provider

COVERING THE COSTS...

Figure 5. Financial efforts, time efforts and research funding models



FIVE TAKE-AWAY MESSAGES

	Reproducibility **is part of the vision for open science**, alongside concepts such as replication, robustness and the generalisation of research findings. It is difficult to pursue culture change with regard to reproducibility without considering this broader context.
	**Stakeholder collaboration** is needed to continue developing reproducible publication practices. All players from the individual researcher to national and international bodies have a role to play, including in the context of policy development and implementation.
	**Incentives** for reproducible publication practices are **currently limited**. Research performing organisations are beginning to support researchers in meeting their growing reproducibility expectations, and there is **increasing demand for new training and support pathways** in this area.
	**The management, curation and sharing of research data and methods are necessary conditions for reproducible publication**. It is essential for these practices to become the norm to push the reproducibility agenda forward, and some dedicated institutional roles such as data stewards may be required to keep up with the demand for support.
	Reproducible publication practices require a **range of technological solutions**, but most contributors agreed that these are **already available** in today's research landscape. The key technical gap appears to be the **interoperability** between available tools and workflows; however, we also note that technological solutions for reproducibility are not currently covered as part of training curricula.

QUESTIONS

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