TIER2

Enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility

Introduction to TIER2

Tony Ross-Hellauer

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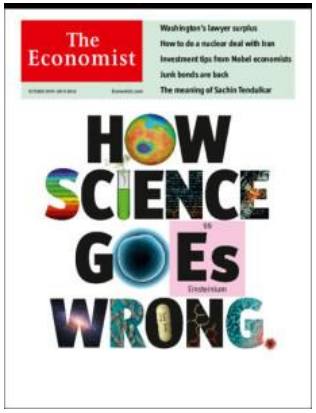
What is reproducibility?

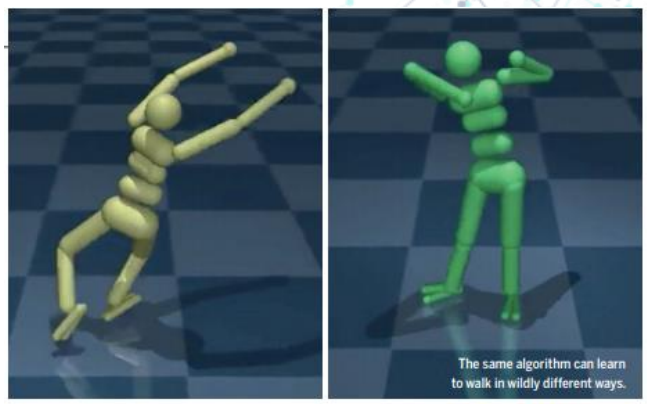
- Cornerstone of *scientific* enquiry
- Definitions vary (a lot)
  - Not only in using the same words for different things (reproducibility / replication) but also in taxonomies for the various elements of research that can be made reproducible/replicable
- At its highest level, just obtaining consistent results when repeating experiments and analyses

Reliability of findings are in question



Why Most Published Research Findings Are False

John P. A. Ioannidis



COMPUTER SCIENCE

Artificial intelligence faces reproducibility crisis

Unpublished code and sensitivity to training conditions make many claims hard to verify

nature REVIEWS DRUG DISCOVERY

Believe it or not: how much can we rely on published data on potential drug targets?

Florian Prinz, Thomas Schlange & Khusru Asadullah

BMJ

BMJ 2014;348:g3725 doi: 10.1136/bmj.g3725 (Published 13 June 2014)

Evidence based medicine: a movement in crisis?

Trisha Greenhalgh and colleagues argue that, although evidence based medicine has had many benefits, it has also had some negative unintended consequences. They offer a preliminary agenda for the movement's renaissance, refocusing on providing useable evidence that can be combined with context and professional expertise so that individual patients get optimal treatment

Power failure: why small sample size undermines the reliability of neuroscience

Katherine S. Button[1,2], John P. A. Ioannidis[3], Claire Mokrysz[1], Brian A. Nosek[4], Jonathan Flint[5], Emma S. J. Robinson[6] and Marcus R. Munafò[1]

Causes

- Lack of transparency
- Poor reporting of methods
- Lack of sharing of data/code
- Lack of reproduction/replication studies
- Publication bias towards reporting of positive results
- Questionable research practices

Especially over the last 10 years, lots of new and exciting research, tools and practices have been put in place to improve levels of reproducibility.

But, taking stock, there is broader potential.

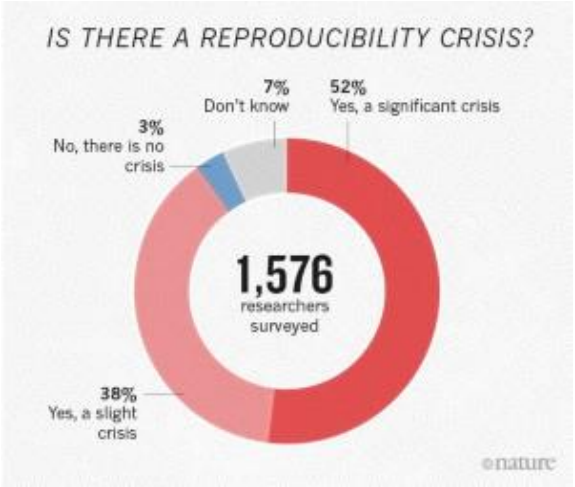
Some strategic priorities 

TIER2

1. Frame reproducibility as a reformation, not a crisis

An opportunity not a crisis

2016: “Survey sheds light on the ‘crisis’ rocking research.”



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

2023: Broader consideration that the “crisis” narrative is unhelpful at best, if not just plain factually wrong.

Munafo et al (2022): “it is more constructive in our view to frame it as an opportunity to reflect on which aspects of relevant working practices continue to be effective, which can be improved, and which new ways of working can beneficially be introduced to the research ecosystem.”

Munafò, M.R., Chambers, C., Collins, A. et al. The reproducibility debate is an opportunity, not a crisis. BMC Res Notes 15, 43 (2022). https://doi.org/10.1186/s13104-022-05942-3

Fanelli D. Opinion: Is science really facing a reproducibility crisis, and do we need it to? Proc Natl Acad Sci USA. 2018;115(11):2628–2631. pmid:29531051

Center epistemic diversity.

2

Forms of reproducibility across research contexts

- Discussion on reproducibility led by specific disciplines like medicine & psychology
- Yet, per Leonelli: “Reproducibility for data-intensive research comes in a variety of forms geared to specific features of the research environment”, e.g.,:
  - Assumed degree of control over research conditions
  - Dependence on statistics as inferential tool
  - Precision of the research goals
  - Dependence on researchers’ judgement”
- And what of non-data intensive research? (Open question)

Leonelli, S. (2018), "Rethinking Reproducibility as a Criterion for Research Quality", https://doi.org/10.1108/S0743-41542018000036B009

Leonelli - Sources of epistemic diversity relevant to Open Science*

MATERIAL
- Target objects
- Materials

CONCEPTUAL

METHODOLOGICAL
- Standards
- Methods

INFRASTRACTURAL (capacity res. environment)
- Funding
- Infrastructures
- ICT and other technologies
- Mobility and transports

SOCIO-CULTURAL
- System of research assessment (locally and nationally)
- Legal and ethical accountability
- Geo-political location
- Language
- Values and goals
- Characteristics of researchers (gender, class, ethnicity, age, physical ability..)

INSTITUTIONAL
- Career stage and power dynamics
- Institutional and administrative support
- Field of study and related norms / venues for publishing and exchange
- Intellectual property regimes

Leonelli S. 2021. Open Science and Epistemic Diversity: Friends or Foes? DOI: 10.1017/psa.2022.45

3. Systematize evidence for informed policy across contexts

Q. How do reproducibility interventions affect outcomes across contexts?

- Currently, much of the debate and evidence comes from a relatively narrow slice of the research spectrum
- Need to acknowledge that across contexts (e.g., disciplinary, geographic, demographic), communities face different problems and are at different levels of readiness
- Even within research areas, not all interventions equally effective
  - E.g., Vazire (2018) suggests that although increased reproducibility may raise productivity in general, productivity may be reduced in some subfields
- What generalities can we find in common issues across disciplines, and what specificities?

Vazire, S. 2018. "Implications of the Credibility Revolution for Productivity, Creativity, & Progress." Perspectives on Psychological Science 13 (4): 411–17. https://doi.org/10.1177/1745691617751884.

4. Work together to boost capacity at all levels

Elements of research culture change (from Nosek, 2019)

- Treat reproducibility as a “full stack” problem
- Joined-up approaches for coordinated change at all levels
- Building on the great strides already made
  - Reproducibility Networks
  - **Open** infras, e.g., OSF, EOSC
  - Research assessment reform (COARA)

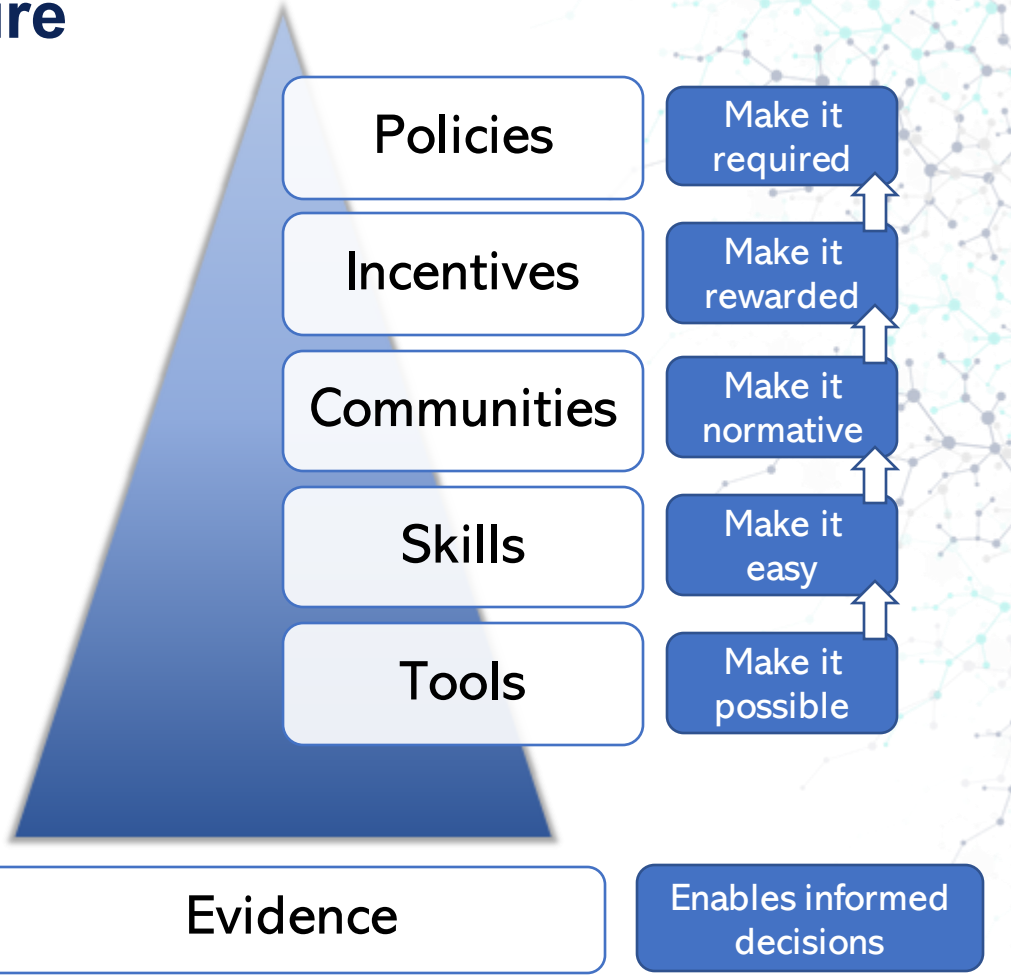
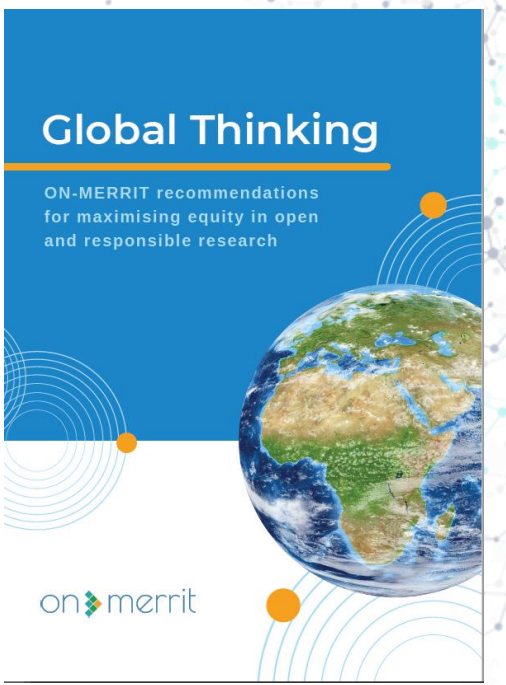


Figure adapted from CC BY figure in: Nosek, B. 2019. “Strategy for Culture Change.” 2019. https://www.cos.io/blog/strategy-for-culture-change.

5. Emphasize inclusion to minimize unintended consequences and maximize equitable transition

Avoiding unintended consequences

- Not all impacts will be positive, and trade-offs and unintended consequences are to be expected
- Need special attention on ways that variance in epistemic diversity alters what is desirable in terms of reproducibility
- Respect differences in levels of advancement in dealing with these issues across these contexts
- Ensure that policies reflect this diversity, and harness openness of infrastructures, tools, services, and training to move as a global community



Cole,, Reichmann, Ross-Hellauer. (2022). Global Thinking. ON-MERRIT recommendations for maximising equity in open and responsible research. https://doi.org/10.5281/zenodo.6276753

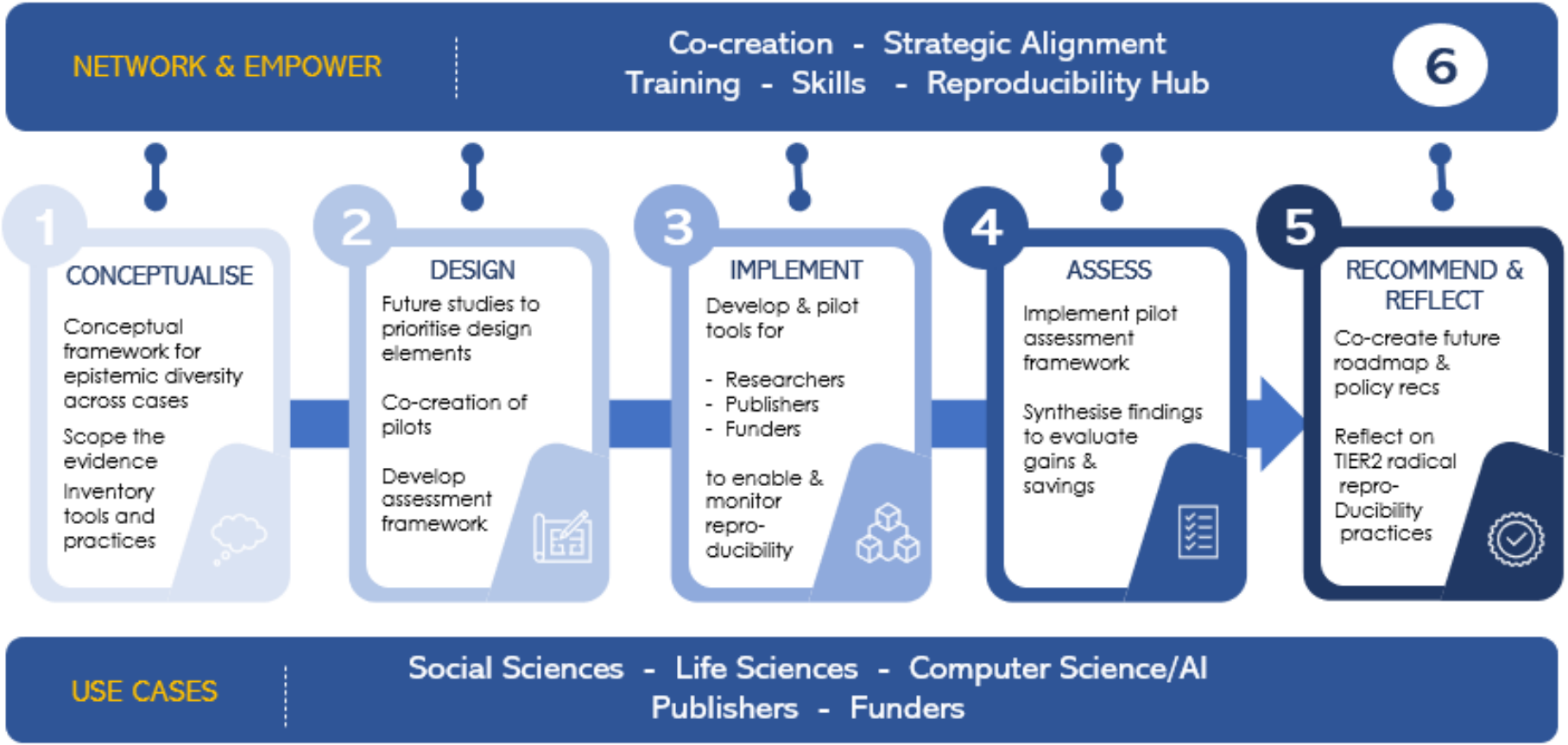
How to account for, and operationalise, all these factors?

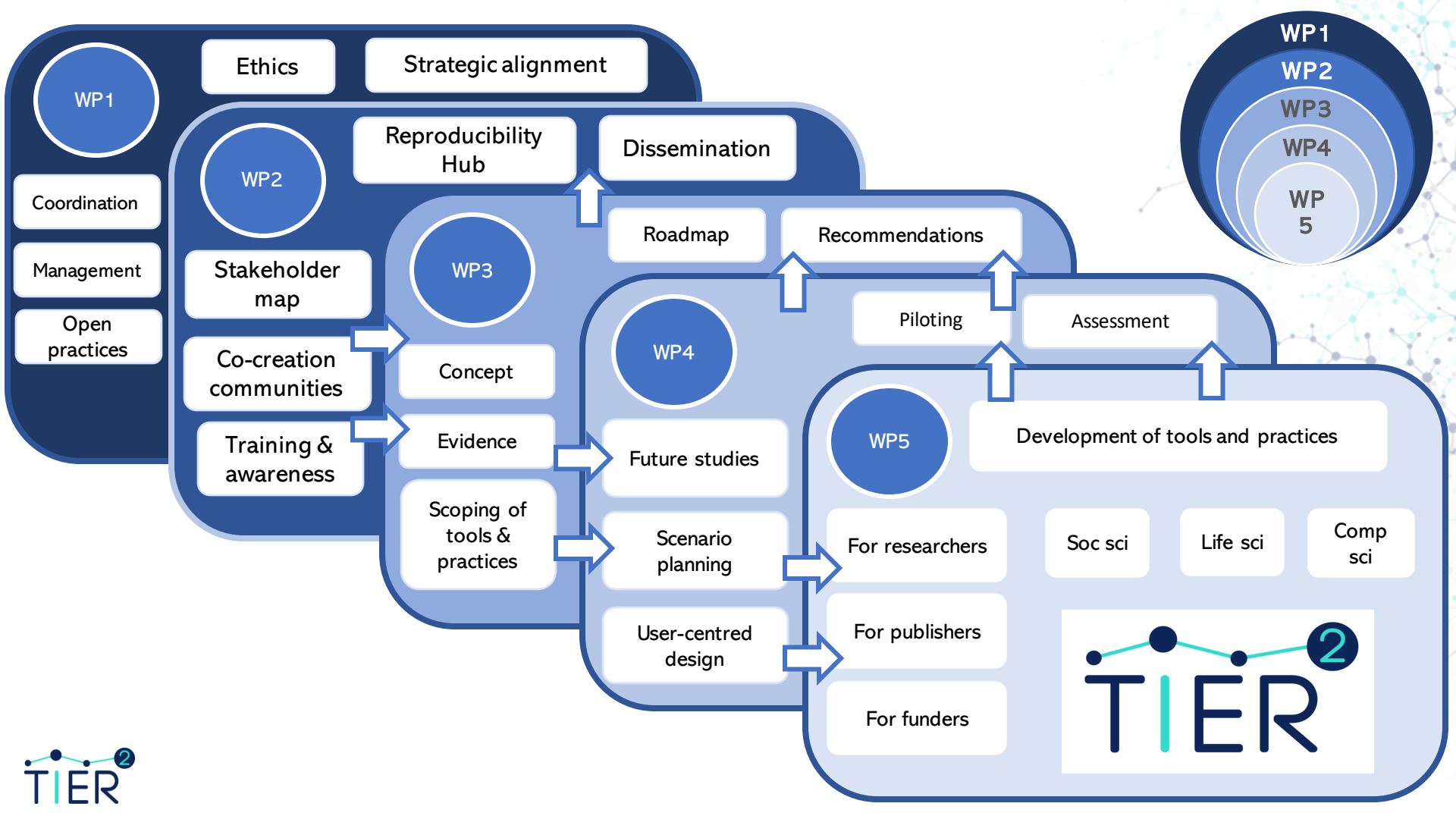
TIER2: enhancing Trust, Integrity And Efficiency In Research through next-level Reproducibility

- Investigate reproducibility in social, life, computer sciences, plus funder and publisher contexts
- Co-creative approach to creating and evaluating new reproducibility tools and practices
- 10 partners from across Europe
- 2 million Euros from EC Horizon Europe and UKRI
- January 2023 to December 2025

http://tier2-project.eu/

TIER2 methodological steps




WP1
Ethics
Strategic alignment
Coordination
Management
Open practices
WP2
Reproducibility Hub
Dissemination
Stakeholder map
Co-creation communities
Training & awareness
WP3
Roadmap
Recommendations
Concept
Evidence
Scoping of tools & practices
WP4
Piloting
Assessment
Future studies
Scenario planning
User-centred design
WP5
Development of tools and practices
For researchers
For publishers
For funders
Soc sci
Life sci
Comp sci
WP1
WP2
WP3
WP4
WP 5
TIER2

New tools for researchers, publishers, funders

- Reproducibility Hub (incl. checklists)
- Reproducibility Management Plan tool
- Reproducible research workflow tools
- Data/code review workflow
- Standards for threaded publications
- Funder Reproducibility Plan instrument
- Reproducibility monitoring dashboard

Thank you!

Contact: Tony Ross-Hellauer (TIER2 Project Coordinator)
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Read more:

Ross-Hellauer, Klebel, Bannach-Brown, Horbach, Jabeen, Manola, Metodiev, Papageorgiou, Reczko, Sansone, Schneider, Tijdink, Vergoulis. 2022. TIER2: enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility. *RIO Journal*. https://doi.org/10.3897/rio.8.e98457

Ross-Hellauer. 2023. Strategic priorities for reproducibility reform. PLoS Biology 21(1). https://doi.org/10.1371/journal.pbio.3001943