EIROforum - 2nd Edition - Economics of Big Science

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ECONOMIC IMPACT OF OPEN SCIENCE: initial insights from the PathOS Project

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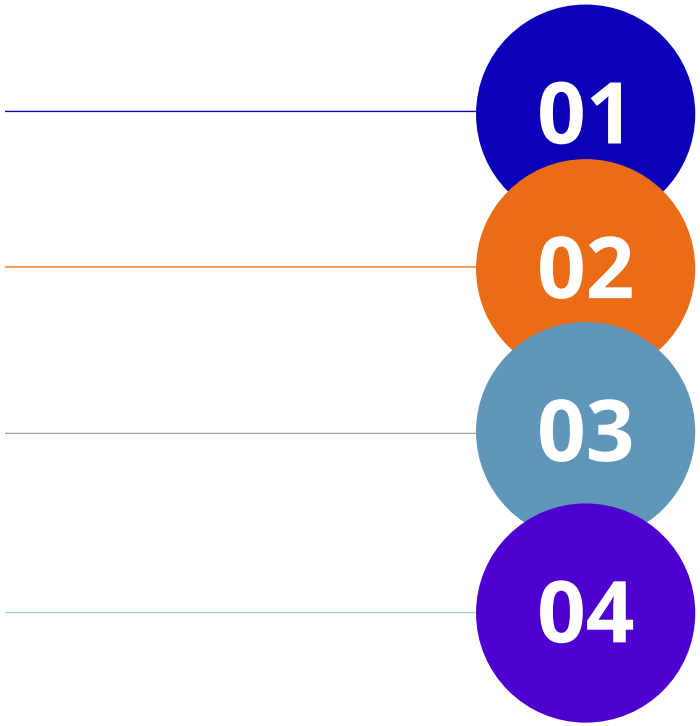
Csil

OUTLINE



Background
The Open Science paradigm

PathOS project
Objective, methodology and tasks

Economic impact
Evidence from literature review

A research agenda
An economic approach to value open data and tools

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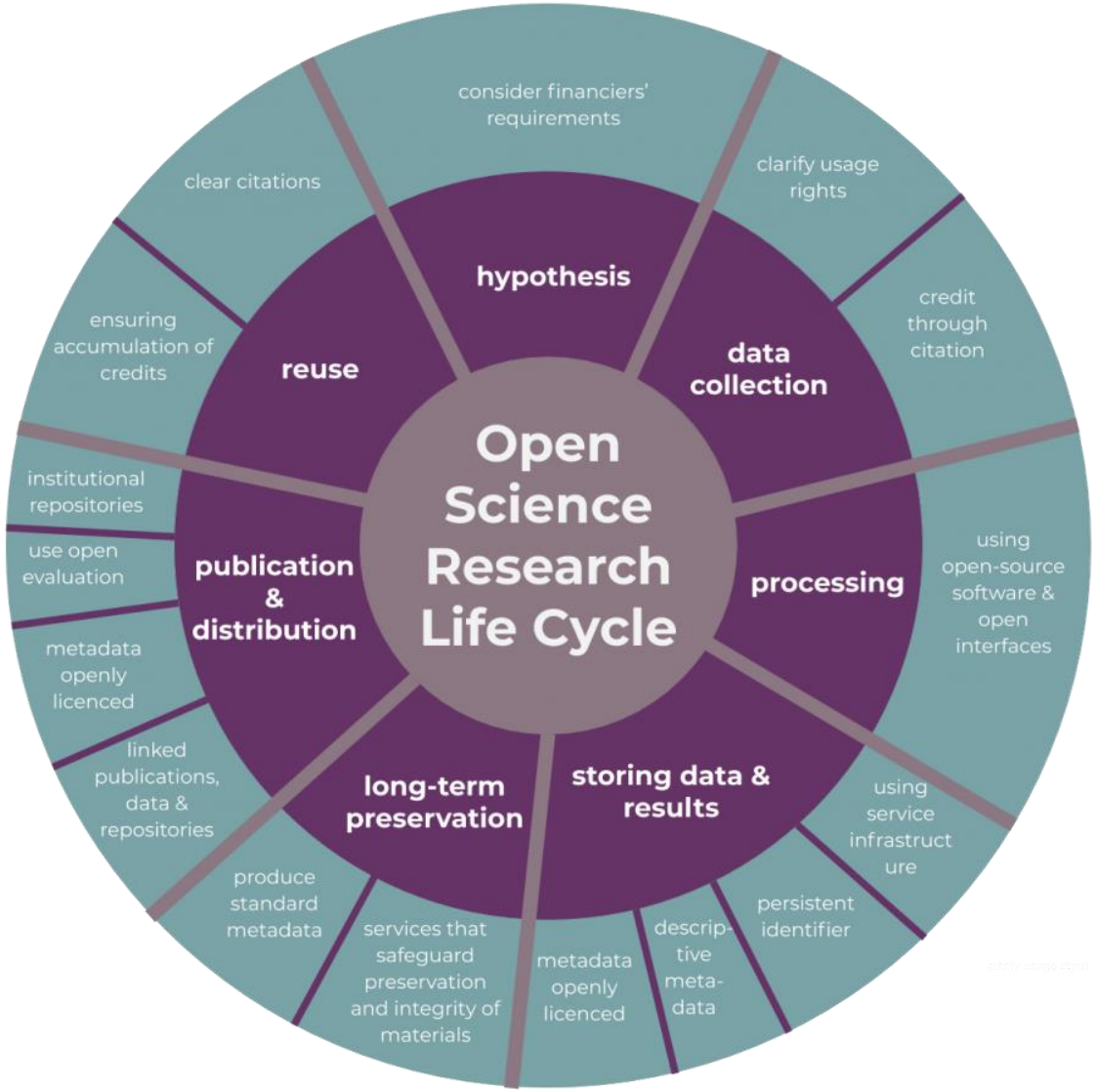
What is Open Science?

“ efforts— by researchers, governments, research funding agencies or the scientific community itself—to make the primary output of publicly funded research more widely accessible in digit al format to the scientific community, the business sector, or society more generally.”

(OECD 2015)



Open Science as an EU priority

Since 2016 the EC OS policy is organised around eight ambitions:

i) Rewards and Incentives
ii) Research Indicators and Next-Generation Metrics
iii) Future of Scholarly Communication
iv) European Open Science Cloud
v) FAIR Data
vi) Research Integrity
vii) Skills and Education
viii) Citizen Science

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Funded by
the European Union

PathOS

Open Science Impact Pathways

Programme: Horizon Europe

Call: HORIZON-WIDERA-2021-ERA-01

Type of Action: Research and Innovation

Topic: Modelling & quantifying the impacts of Open Science practice

Grant Agreement No.: 101058728

Duration: Sep 2022 – Aug 2025 (36M)

Budget: €2M

Main Objective

*Identify and quantify the **Key Impact Pathways of Open Science in science, society and the economy** to improve understanding and lead to effective policy-making*

Beyond state of the art:

- identify the **Causal Pathways** for Open Science and estimate **OS Impact Indicators** for selected case studies following a **data-driven, AI assisted** approach
- provide a framework for **Cost Benefit Analysis for open science practices** and apply it to select case studies

Objectives & Measurable Outputs

- **Objective 1:** model how open science uses available resources and generates scientific, economic and societal impacts.
- **Objective 2:** quantify and qualify open science impacts.
- **Objective 3:** operationalise and test methods & indicators that measure the OS impact through case studies.
- **Objective 4:** develop a cost-benefit analysis (CBA) methodology for OS and testing it on selected practices.
- **Objective 5:** stimulate and structure an inclusive participation from policy & decision makers in R&I design and implementation.

- **Handbook of Open Science impact indicators** and their "recipes"
- **Open Science impact pathways framework** building on current state-of-the-art literature (+ online registry)
- **OS impact measures for Case Studies**
- **Operationalization** toolkit: a set of tools and data that measure OS impact indicators
- A **Cost Benefit Analysis framework** for OS practices
- Cost Benefit analysis **report** for indicative case studies
- a **training programme** for policy makers, policy officers and research administrators.
- the **PathOS website** - *https://pathos-project.eu/*

Expected Outcomes & Impact

Outcomes

- **in-depth understanding** of the mechanisms and underpinnings of Open Science practices, and their **positive and negative causal effects** on outcomes inside but also outside academia
- **recommendations** to key actors in the R&I ecosystem
- innovative **tools and methods**

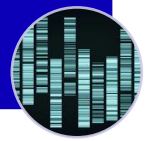
Impact

- enable effective, evidence-based Open Science policy prioritisation
- maximize the impact of Open Science
- increase R&I capacity in EU research systems

Anchored by Case Studies

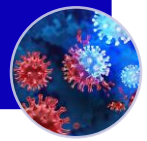
Innovation from open research resources - ELIXIR

Bioinformatics



Open science practices during the Covid-19 pandemic

COVID-19



Fostering innovation in climate change - Horizon 2020

Climate

Open science on remedying structural inequalities

Gender

Cross cutting effects due to open research data from national repository

EASY – The Netherlands

Research data and knowledge use / uptake in non-academia

FRANCE

Accelerating collaborations within academia & industry

RCAAP - Portugal

Target Groups

R&I policy makers/officers

Involved in focus groups from the case studies. Liaise with DG-RTD, Science Europe members and funders (awareness/problem setting/validation).

Research managers

Use proxies such as EUA, LIBER and EARMA. Invite in targeted workshops and present findings via policy briefings in respective newsletters.

R&I evaluators

Experts in Scientometrics. Present and evaluate findings. Use TGB and CSIL networks to bring policy officers to targeted workshops and webinars.

Open Science experts

Libraries, RIs.. Use Open AIRE, Elixir, LIBER networks. Present findings in webinars and tech clinics.

RI & National

Use ELIXIR's 22 national Nodes plus EMBL-EBI (the European Node of ELIXIR), liaise to ESFRI (Athena RC) and ERIC Forum. Liaise with OpenAIRE's National Open Access Desks and EOSC Association members.

OA Publishers

Present findings in OASPA conferences. Solicit collaborations with non-OA publishers related to TDM.

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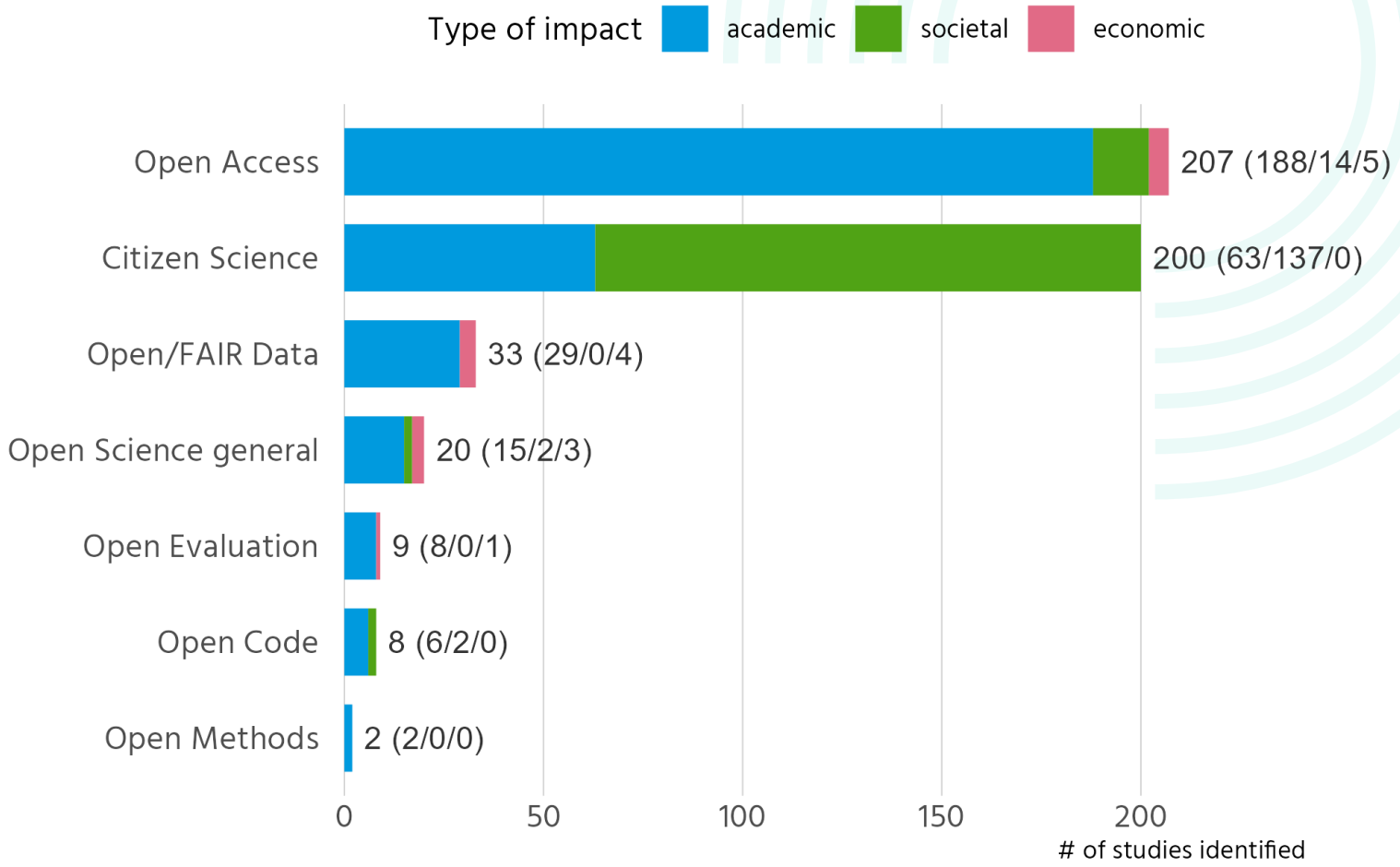
Scoping evidence of Open Science Impact

- RQ: What **evidence** exists in the literature regarding the effect of Open Science on (1) academic, (2) societal, and (3) economic impact of research?
- Phase 1: systematic scoping of peer-reviewed literature – 30,000 initial records from Web of Science and Scopus
  - Title screening, abstract screening, full-text screening with focus on *evidence* of impact
- **479 relevant studies** identified (311 academic, 155 societal, 13 economic)

More information available in "PathOS - D1.2 Scoping Review of Open Science Impact" (https://doi.org/10.5281/zenodo.7883699)

Overview of identified studies across aspects of OS and types of impact



Key findings by impact area

Academic impact

- Open Access: considerable evidence based on citations (reach and "citation advantage"); exclusionary nature of APCs; threats to quality by "predatory publishing"
- Open/FAIR Data: evidence of data reuse and a citation advantage for associated papers
- Open Code and Software produce efficiency gains in software development and may also increase citations of associated papers
- Citizen Science increases efficiency and scope of data collection, but data quality is sometimes of issue.
- Open peer review shows neutral to positive effects on review quality.

Societal impact

- Citizen Science: evidence of diverse impacts including educational, climate/environment, policy and governance, engagement and empowerment benefits for participants and their communities
- Open Access: public engagement, use in policy-making, and health-related outcomes.

Economic impact

- Only 13 papers identified as relevant, mostly in biomedical and health domains.
- Some positive indications of the potential of OA and Open/FAIR data to power economic activity, but largely without rigorous quantification.

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Economic impact of OS

efficiency gains (e.g., cost savings, productivity improvements)

enablement (e.g., new product development, new collaborations)

(Fell, 2019)

Efficiency gains

Access cost savings

Accessing scientific outputs for free

Labour cost savings

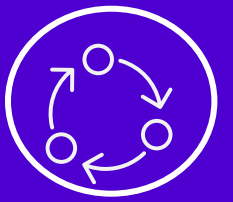
Saving the time of producing the same output

Storage cost savings

Availability of open repositories affects store habits of researchers

Transaction costs

Time and the money saved for agreements and procedure to access data



Enablement effects

New products/ services

New products and services are enabled by knowledge spillovers

New companies

The OS environment enables new ecosystems of companies

Patents and licence

Increased patent registration of innovative products, services, and technologies

Using stated preferences to estimate the value of OS

1. Value of data repositories in different fields by UK research data centres (Beagrie and Houghton 2014)
2. Impact assessment of the European Bioinformatics Institute (EMBL-EBI) data and services using a CV approach to quantify the WTP for having the services and WT A to forego them (Beagrie and Houghton, 2016, 2021)
3. Research Collaboratory for Structural Bioinformatics (RCSB) protein data bank op erating at Rutgers University and the University of California San Diego (Sullivan e t al., 2017)
4. The value and impact of Nectar Virtual Laboratories (VLs) (Sweeny et al., 2017)
5. Socio-economic impact and a cost-benefit analysis of a European Research Infras tructure for Heritage Science (E-RIHS) (Vignetti et al., 2019)
6. Benefit of the OpenAIRE project (Open Access Infrastructure for Research in Euro pe) (Koundouri et al., 2021)

CBA of selected OS practices

Case studies scoping:

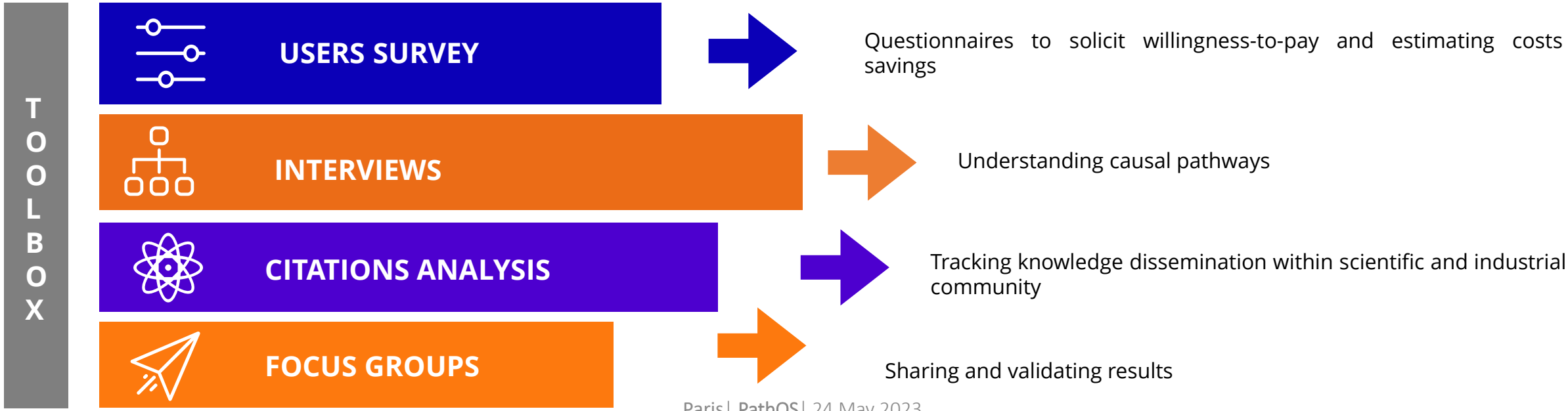
1. Selecting the appropriate object of analysis (e.g. a software package, a dataset, an infrastructure, a repository, a platform for data sharing, a service of access to open data)
2. Selecting the appropriate impact pathway and area
3. Setting the time frame for the analysis
4. Mapping the stakeholders involved in the development, financing and implementation of the initi ative

Challenges:

1. Defining an appropriate counterfactual
2. Tracking output and users
3. Attributing costs and benefits

Next steps

1. A CBA methodology for open science: December 2023 (updated in December 2024)
2. Case studies scoping and selection: November 2023
3. Data collection: June 2024
4. Processing and Validation: February 2025



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Thank you

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