The conundrum challenges for Research Software and Research Data in Open Science

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Goal

Open Science

Research Software (RS)	**Research Data (RD)**
Definition	Definition
Dissemination	Dissemination
Evaluation	Evaluation

The conundrum challenges

Plan

Open Science: proposed definition - article

(2020-21) TGD, T. Recio. Towards an Open Science definition as a political and legal framework: on the sharing and dissemination of research outputs

Open Science is...

> [EN] *the political and legal framework where research outputs are shared and disseminated in order to be rendered...*
>
> **visible, accessible and reusable**

Version	Title	Date	Publication
V3	Towards an Open Science definition as a political and legal framework: on the sharing and dissemination of research outputs	02/2021	https://zenodo.org/record/4577066 With ref.: Alma Swan, UNESCO, 2012
V2	Towards an Open Science definition as a political and legal framework...	12/2020	POLIS N. 19, pp. 36-56 - PDF
V1	A policy and legal Open Science...	09/2020	https://zenodo.org/record/4075106

Goal: to understand what Open Science is, the motivation for the proposition of this definition, but also to structure information in a complex landscape.

Open Science: structuring the landscape - poster

The future of Open Science asks for a common understanding

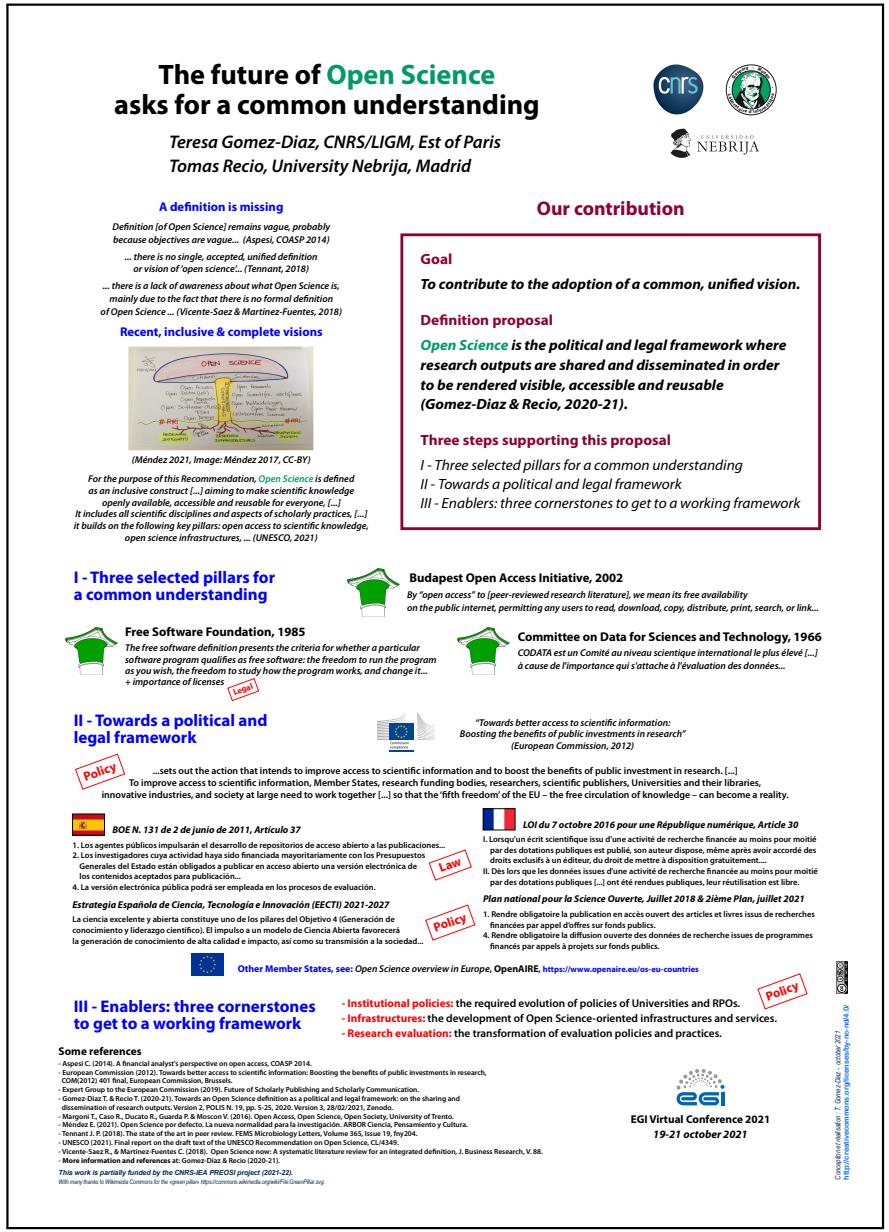
Open Science is
the political and legal framework
where research outputs are shared
and disseminated in order to be rendered
visible, accessible and reusable.

I Three selected pillars
- BOAI (2002)
- Free Software Foundation (1985)
- CODATA (1966)

II Towards a political and legal framework

III Enablers:
- Institutional policies
- Infrastructures
- Research evaluation

EGI Virtual Conference 2021, Lisbon, 19-21 october 2021
https://padlet.com/gwenfranck/EGI2021Posters



UNESCO Recommendation on Open Science

- 40th session, 11/2019
- Members States asked for an international standard-setting instrument
- 2020: awareness, consequence of the COVID-19 pandemic
- Large consultative process, global and regional consultations, preliminary report
  https://unesdoc.unesco.org/ark:/48223/pf0000374409
- 41st session, 23/11/2021 - final UNESCO Recommendation on Open Science
  https://unesdoc.unesco.org/ark:/48223/pf0000379949
- Unanimously adopted by the Member States (193 countries)

For the purpose of this Recommendation, **open science** is defined as an **inclusive construct** that combines various movements and practices **aiming to make** multilingual **scientific knowledge openly available, accessible and reusable for everyone**, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community.

It comprises **all scientific disciplines and aspects of scholarly practices, including basic and applied sciences, natural and social sciences and the humanities**, and it builds on the following key pillars: open scientific knowledge, open science infrastructures, science communication, open engagement of societal actors and open dialogue with other knowledge systems.

Followed by Open Science working groups,
https://www.unesco.org/en/open-science/implementation#open-science-working-groups

Plan

Research Software definition

(2007) TGD. Autour de la valorisation de logiciels développés dans un laboratoire de recherche
(2009) TGD. Guide laboratoire pour recenser ses développements logiciels
(2011, 2015) TGD. Article vs. Logiciel : questions juridiques et de politique scientifique dans la production de logiciels

Un logiciel du laboratoire *est un programme utile pour faire avancer la recherche qui a été produit avec la participation d'un membre du laboratoire.*

Il arrive souvent que des publications de recherche soient associées.

- goal: to do research
- a member of the lab participates to the code writing (similar to publications)
- the main production is the publication, software is an associated object

(2019) TGD, T. Recio. On the evaluation of research software: the CDUR procedure
(2024) TGD, T. Recio. Open comments on the "Open Letter: Establishing a national research software award"

Research software (RS) *is a well identified set of code that has been written by a well identified research team. It is software that has been built and used to produce a result published or disseminated in some article or scientific contribution.*

Each RS encloses a set of files containing the source code and the compiled code. It can also include other elements as the documentation, specifications, use cases...

Research Software dissemination procedure

Easy to adapt to many situations, also valid for (research) data.

- Choose a name, avoid trademarks and proprietary names, associate date, version...
  (2018) DoRANum or Harvard. File Naming Conventions
- (*) (research team step) Establish list of authors/contributors (% participation, affiliations). Consider a Software Management Plan (2018, TGD, G. Romier, PGLR V3.2, PRESOFT)
- (*) Establish the list of main functionalities.
- (*) Establish the list of included software & data components, their licenses
- **Choose a license**, have an agreement (signed) with rightholders and authors, consider FLOSS licenses. Beware of license compatibility and inheritance issues.
- Choose a website, forge, deposit for dissemination, indicate licenses and how to cite the work. Use PIDs if possible.
- (*) Archive a tar.gz or similar regularly to keep track of added functionalities.
- Inform your laboratories and head institutions (if not done in the license step).
- Set and indicate clearly a contact address.
- **Distribute** your (research) software or data component.
- Inform the target scientific community. Consider Software or Data papers...

(*) To be reviewed with each new version.

(2010) TGD. Diffuser un logiciel de laboratoire : recommandations juridiques et administratives
(2014) TGD. Free software, Open source software, licenses. A short presentation including a procedure for RS and data...
(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)

Results: national survey in France, spring 2023

(2024) Production et valorisation des logiciels issus de la recherche publique française

https://cnrs.hal.science/hal-04844037

National survey, all research labs in public institutions, spring 2023:

- listed 1331 research software items
- all scientific communities
- around 80% disseminated with license
- FOSS licenses in 69% of cases, 10% with proprietary licenses (business partner)
- authors involved in license choices in 90% of cases

Many training sessions since 2009, see (for example):

- Les logiciels de la recherche et leurs licences : trois visions sur un objet
  https://hal.science/hal-02434287
- Le thème PLUME Patrimoine logiciel d'un laboratoire,
  https://zenodo.org/communities/plume-patrimoine-logiciel-laboratoire/records?q=&l=list&p=1&s=20
- http://igm.univ-mlv.fr/~teresa/logicielsLIGM/

Protocol(s) **CDUR**: research evaluation and RS

(2019) TGD, T. Recio. On the evaluation of research software: the CDUR procedure

(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)

Designed to help evaluated researchers, evaluation committees, decision makers...
also valid for (research) data.

(C) Citation measure if RS is well identified as a research output:
good citation form, but also metadata, best citation practices...
legal point: authors, affiliations, participation %

(D) Dissemination best dissemination practices, in agreement with
the scientific policy of the evaluation context
policy point: Open Science, **legal point:** licenses

(U) Use "software aspects" **of RS**: correct results, facilitate reuse, good softw.
practices: doc, test, install, up to read the code, launch RS...
point reproducibility: validation of scientific results

(R) Research "research aspects": quality of the scientific work, proposed and coded
algorithms & data structures, related publications, collaborations...
point research: impact

Flexibility of application: each decision maker or evaluation committee **sets its own CDUR protocol** adapted to the evaluation context and goals.

Plan

Software is a legal object

(2011, 2015) TGD. Article vs. Logiciel : questions juridiques et de politique scientifique dans la production de logiciels

(2022) TGD, T. Recio. Research Software vs Research Data I (Definition)

- [FR] Code de la propriété intellectuelle (CPI), Article L. 112-2 :
  un *logiciel* est une œuvre de l'esprit protégée par le droit d'auteur.
- [FR] Arrêté du Ministère de l'Industrie du 22 décembre 1981 (vocabulaire de l'informatique) :
  un *logiciel* est un ensemble des programmes, procédés et règles, et éventuellement de la documentation, relatifs au fonctionnement d'un ensemble de traitement de données.
- [EC] Directive 2009/24/EC, 23/04/2009, on the legal protection of computer programs:

  For the purpose of this Directive, the term *computer program* shall include programs in any form, including those which are incorporated into hardware.

  This term also includes *preparatory design work* leading to the development of a computer program provided that the nature of the preparatory work is such that a computer program can result from it at a later stage.

(2019) TGD, T. Recio. On the evaluation of research software: the CDUR procedure

Research software (RS) *is a well identified set of code that has been written by a well identified research team. It is software that has been built and used to produce a result published or disseminated in some article or scientific contribution.*

Each RS encloses a set of files containing the source code and the compiled code. It can also include other elements as the documentation, specifications, use cases...

Data as a legal object?

(2011) The Knowledge Exchange report. The Legal Status of Research Data in the Knowledge Exchange Partner Countries

(2018) A-L Stérin. Diffuser des données de la recherche dans le respect du droit et de l'éthique

(Stérin) *En droit, on ne sait pas ce qu'est une donnée :*

une donnée, en soi, ne relève pas d'un régime juridique spécifique.

data, in itself, does not fall under any specific legal regime.

(K. Exchange) *It is important to know the legal status of the data to be shared. [...]*
not all data are protected by law,
and not every use of protected research data requires the author's consent. [..]

Whether data are in fact protected must be determined on a case-by-case basis.

Analyze on a case-by-case basis, in a team (roles), experts are maybe necessary:

- legal point of view, see all applicable legal rules: copyright, sui generis, image rights, personal data, respect for privacy, reuse of public information...
- scientific point of view, examples: temperature, Lexicon-Grammar tables at LIGM, STRENDA guidelines (enzyme activities), TDWG (Biodiversity Information Standards), environmental information, geographical information...
- technical point of view, data collected, processed, analyzed, shared & disseminated

See: A. Robin, (2022) Droit des données de la recherche, (2023) Journée d'ouverture du Printemps de la donnée

Plan

And for Research Data...

(2022) TGD, T. Recio. Research Software vs Research Data I (Definition)
(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)

We propose for Research Data:

- Definition
- Dissemination procedure
- Protocols CDUR for Research Data evaluation
- Answers to "Borgman's conundrum challenges"

(2012) Christine L. Borgman. The conundrum of sharing research data, Journal of the American Society for Inf. Sci. Technol.

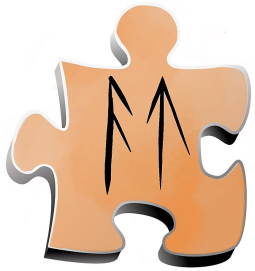
"Borgman's conundrum challenges":

> *Data sharing is thus a conundrum. [...]*
> *The challenges are to understand which data might be shared, by whom, with whom, under what conditions, why, and to what effects. Answers will inform data policy and practice.*

Definition for Research Data

(2022) TGD, T. Recio. Research Software vs Research Data I (Definition)

(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)



Research Data (RD) *is a well identified set of data that has been produced (collected, processed, analyzed, shared & disseminated) by a research team. The data has been collected, processed and analyzed to produce a result published or disseminated in some article or scientific contribution.*

Each research data encloses a set (of files) that contains the dataset maybe organized as a database, and it can also include other elements as the documentation, specifications, use cases, and any other useful material as provenance information, instrument information...

It can include the research software that has been developed to manipulate the dataset (from short scripts to research software of larger size) or give the references to the software that is necessary to manipulate the data (RS or other).

Four main characteristics:

- the purpose of collection and analysis is to do research, to answer scientific questions
- it has been produced by a research team
- the produced research results are presented in scientific articles (or other contributions)
- data has associated software for its manipulation, which can also be Research Software

Image: Archibald Tuttle, https://commons.wikimedia.org/wiki/File:Wiki-puzzle-piece-runes-AT.jpg
https://andreashelley.com/blog/futhark-runes-symbols-and-meanings/

Research Data dissemination procedure

(2010) TGD. Diffuser un logiciel de laboratoire : recommandations juridiques et administratives
(2014) TGD. Free software, Open source software, licenses. A short presentation including a procedure for RS and data...
(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)

- Choose a name for the RD, avoid trademarks and proprietary names, associate date, version... (2018) DoRANum or Harvard. File Naming Conventions
- (*) (research team step) Establish list of contributors (maybe with % of participation) + affiliations. Deal with author rights if any. Consider a Data Management Plan (DMP).
- ★ Deal with other legal (or ethical) issues, if any, (with experts?).
- (*) Establish the list of software and data components, their licenses.
  Best citation practices.
- **Choose a license**, have an agreement (signed) with rightholders and authors. Beware of license compatibility and inheritance issues.
- Choose a website, forge, deposit for dissemination, indicate licenses and how to cite the work. Use PIDs if possible.
- ★ (*) (research work step) Facilitate reuse: how the RD was used for your research. Traceability is important, archive in .tar.gz regularly, keep track of related publications... Review documentation, PGD, website...
- Inform your laboratories and head institutions (if not done in the license step).
- Set and indicate clearly a contact address.
- **Distribute** your Research Data.
- Inform the target scientific community. Consider Data papers...

(*) To be reviewed with each new version.

Protocol(s) **CDUR**: research evaluation and RD

(2019) TGD, T. Recio. On the evaluation of research software: the CDUR procedure
(2022) TGD, T. Recio. Research Software vs Research Data II (Dissemination, CDUR)

Designed to help evaluated researchers, evaluation committees, decision makers...

(C) Citation measure if the RD is well identified as a research output: good citation form, but also metadata, best citation practices...
legal point: authors (if $\exists$ copyright) and/or contributors, affiliations, participation %

(D) Dissemination best dissemination practices, in agreement with the scientific policy of the evaluation context, DMPs, legal (and ethical) issues
policy point: Open Science, ⋆ **legal point:** other legal issues, licenses

⋆ **(U) Use** "data aspects" **of the RD**: quality, facilitate reuse, documentation, use examples... and information on needed software (maybe RS)
point reproducibility: validation of scientific results

(R) Research "research aspects": quality of the scientific work, proposed and coded algorithms & data structures, related publications, collaborations...
point research: impact

Flexibility of application: each decision maker or evaluation committee **sets its own CDUR protocol** adapted to the evaluation context and goals.

Plan

Borgman's conundrum challenges for Research Data

(2012) Christine L. Borgman. The conundrum of sharing research data, Journal of the American Society for Inf. Sci. Technol.

"Borgman's conundrum challenges":

> *Data sharing is thus a conundrum. [...]*
>
> *The challenges are to understand which data might be shared, by whom, with whom, under what conditions, why, and to what effects. Answers will inform data policy and practice.*

Borgman's conundrum challenges for RD + how? + where?

Answers inform policy makers and research funders

(1997) National Research Council. Bits of Power : Issues in Global Access to Scientific Data
(2012) Christine L. Borgman. The conundrum of sharing research data
(2022) TGD, T. Recio. Research Software vs Research Data I (Definition)

RD = Research Data produced by a Reseach Team.

Which data to be shared? Team decision about the RD to be shared, in which form, and when

By whom? The RD production Team who has collected, processed, analyzed, and decides to share & disseminate the RD

How? Following a dissemination procedure like the one proposed here

Where? Many repositories available, see for example

Registry of Research Data Repository, https://www.re3data.org/

With whom? Each scientific communication act has its own target public, initially it can be the one of the associated publications, but maybe there is some interdisciplinary value, so...

(2012) *intended users may vary from researchers within a narrow specialty to the general public*

Under what conditions? the license gives the RD sharing conditions

Why, and to what effects? to answer funding demands (Institution, project funding...), to follow Open Sciences policies and/or best practices, for validation and reproduction of published results... research evaluation...

(1997+2012) *The value of data lies in their use.*

(2013) Michael Arentoft (EC, DG Research & Innovation, Open Science), OS FAIR 2023, http://opensciencefair.eu/keynotes/co-creating-enablers-for-practicing-open-science-the-ec-perspective

The conundrum challenges for RS

Answers inform policy makers and research funders

(2024) TGD, T. Recio. The *Conundrum Challenges* for Research Software in Open Science

RS = a Research Software produced by a Research Team.

Which software to be shared? Team decision about the RS to be shared, which version, in which form, and when. This may be a complex decision:

which components, which versions to share, to share early versions or not, experimental branches or not...

By whom? The RS production Team who is involved in the development, its documentation, its maintenance... and that has decided to share & disseminate the RS

How? Following a dissemination procedure like the one proposed here

Where? RS can be shared in repositories like Zenodo, in forges like GitHub, or in institutional repositories, in web pages (personal, project...)

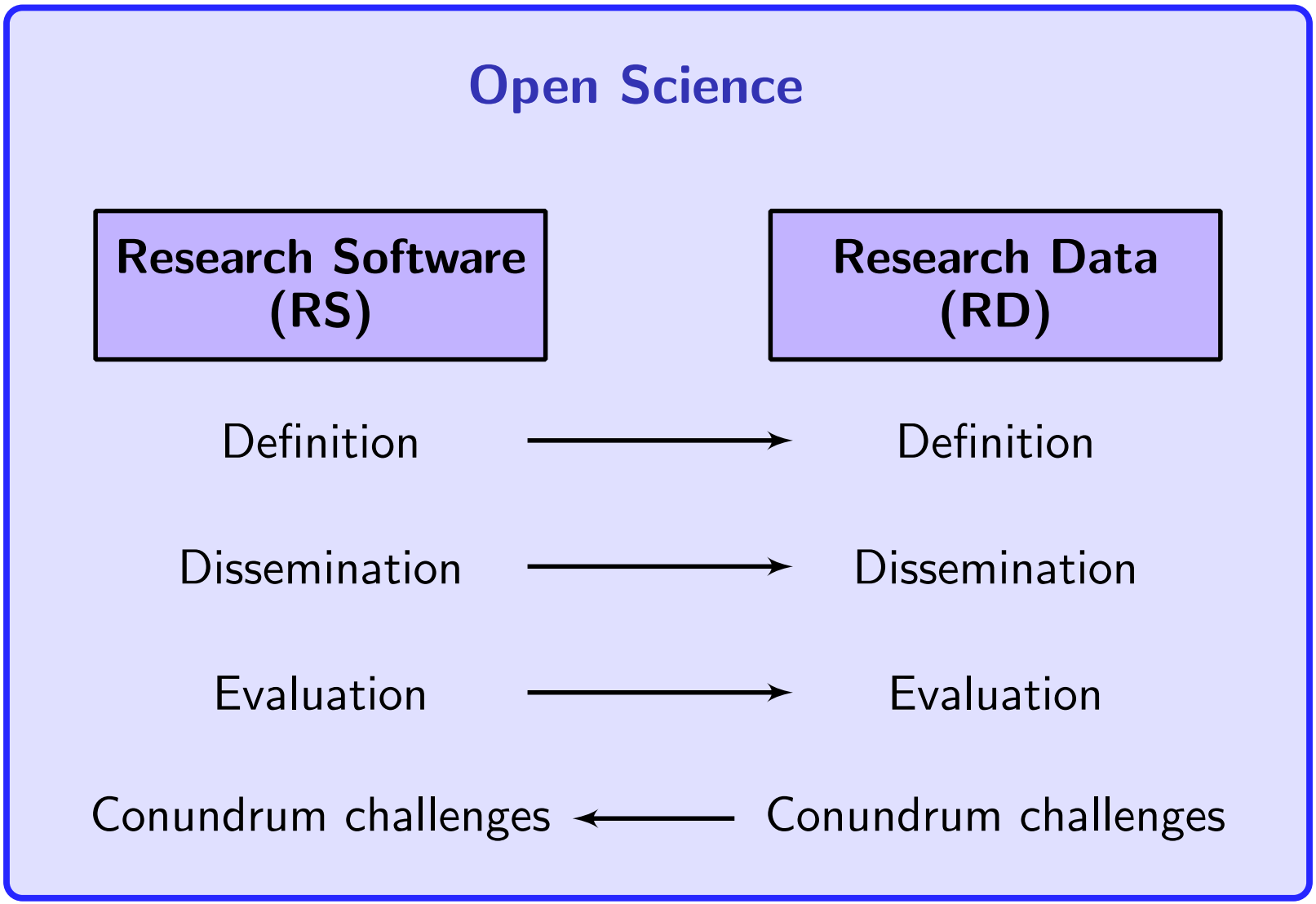
With whom? Each scientific communication act has its own target public, initially it can be the one of the associated publications, but maybe there is some interdisciplinary value, so...

intended users may vary from researchers within a narrow specialty to the general public

Under what conditions? the license gives the RS sharing conditions

Why, and to what effects? to answer funding demands (Institution, project funding...), to follow Open Sciences policies and/or best practices, for validation and reproduction of published results... research evaluation...

Conclusions (1/2)



Conclusions (2/2)

We have built a framework to study Research Software, to understand and to explain them, and to promote their contribution to Open Science.

It is constructed in three stages: definition, dissemination, evaluation.

We have proposed a similar framework for Research Data:

- Definition
- Dissemination procedure
- CDUR evaluation protocols

We have provided, within this RD framework, answers to the Borgman's conundrum challenges. By further exploring our comparison methodology applied to RS and to RD, we have also provided answers to the conundrum challenges for RS.

Our objective is to bring elements of discussion to contribute to this complex and under construction building of Open Science.

This shows the strength of our work on Research Software, as well as of the applied comparison methodology.

Other teams have also adapted our CDUR RS work to nanomaterials (2023 TRAAC).

References - Legal questions (1/4)

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Podcasts *Code for Thought*

A selection of podcasts by Peter Schmidt:

18/07/2022 Open Science and Research Software, with Teresa Gomez-Diaz, https://codeforthought.buzzsprout.com/1326658/episodes/10822132-open-science-and-research-software

31/01/2023 Open Access, Open Knowledge, with Jean-Claude Guédon, https://codeforthought.buzzsprout.com/1326658/episodes/12129577-open-access-open-knowledge

18/07/2023 [EN] Open Data, Open Software - with Teresa Gomez-Diaz, https://codeforthought.buzzsprout.com/1326658/episodes/13216530-en-open-data-open-software-with-teresa-gomez-diaz

And the associated preprint:

TGD, T. Recio, Podcast Code for Thought: Research Software and Research Data in Open Science, Zenodo, 18/07/2023, https://zenodo.org/records/8159906

30/07/2024 [EN] Planning your research software - a workshop in Paris, https://codeforthought.buzzsprout.com/1326658/episodes/15479406-en-planning-your-research-software-a-workshop-in-paris

10/09/2024 [FR] L'apprentissage automatique et la reproductibilité - avec Pascal Monasse (LIGM), https://codeforthought.buzzsprout.com/1326658/episodes/15649531-fr-l-apprentissage-automatique-et-la-reproductibilite-avec-pascal-monasse-ligm

And also...

14/02/2023 Conference Report : FOSDEM 2023, https://codeforthought.buzzsprout.com/1326658/episodes/12226071-conference-report-fosdem-2023

See: https://codeforthought.buzzsprout.com/