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Národní technická knihovna
National Library of Technology

National Centre
for Information Support of Research,
Development, and Innovation

Introduction to Research Data Management

… and how not to get overwhelmed by data

Martin Schätz, Adéla Jílková

November 7, 2023

The project National Centre for Information Support of Research, Development and Innovation with the identification code MS2101 is implemented with the support of the Ministry of Education, Youth and Sports.

Agenda

1. What is research data and why manage it?

- Motivation and benefits of Research Data Management (RDM)
- Research data and RDM overview

2. How to approach Research Data Management?

- RDM frameworks (Open Science and FAIR principles)
- RDM strategies and techniques
- RDM plan

What is research data and why manage it?

Research data and Research data management

Research data

- Any information **collected**, **observed**, **generated,** or **created** during the research process to produce and support research findings

Research data management

- A set of practices, strategies, and activities, including data **organization, documentation**, **storage**, and **sharing**
- Covers all stages of the research process
- Ensures the effectiveness, reproducibility, and reuse of research data

Why manage research data?

It can help:

Keep the research process organized, secure, and smooth

- Increase efficiency, save time and resources
- Share data with colleagues
- Reduce risk of data loss and improve data security

Enhance global data sharing (Open Science and FAIR principles)

- Enable data reuse and enhance collaboration
- Increase the visibility and impact of research
- Increase transparency and improve trust in research findings
- Support research integrity and validation of research results

It may be mandatory (institutional, publisher, or research funder requirements)

Research data

Different fields and disciplines

- Natural and life sciences
- Medical and health sciences
- Engineering and technology
- Social sciences
- Arts and humanities

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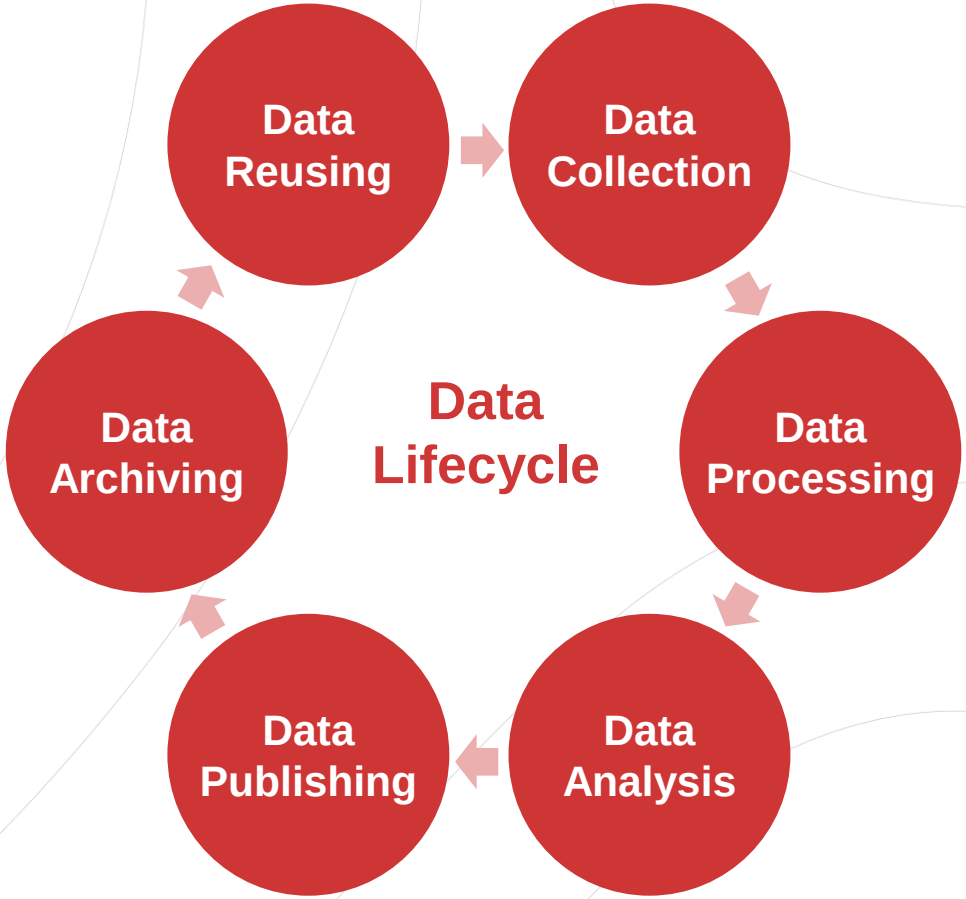
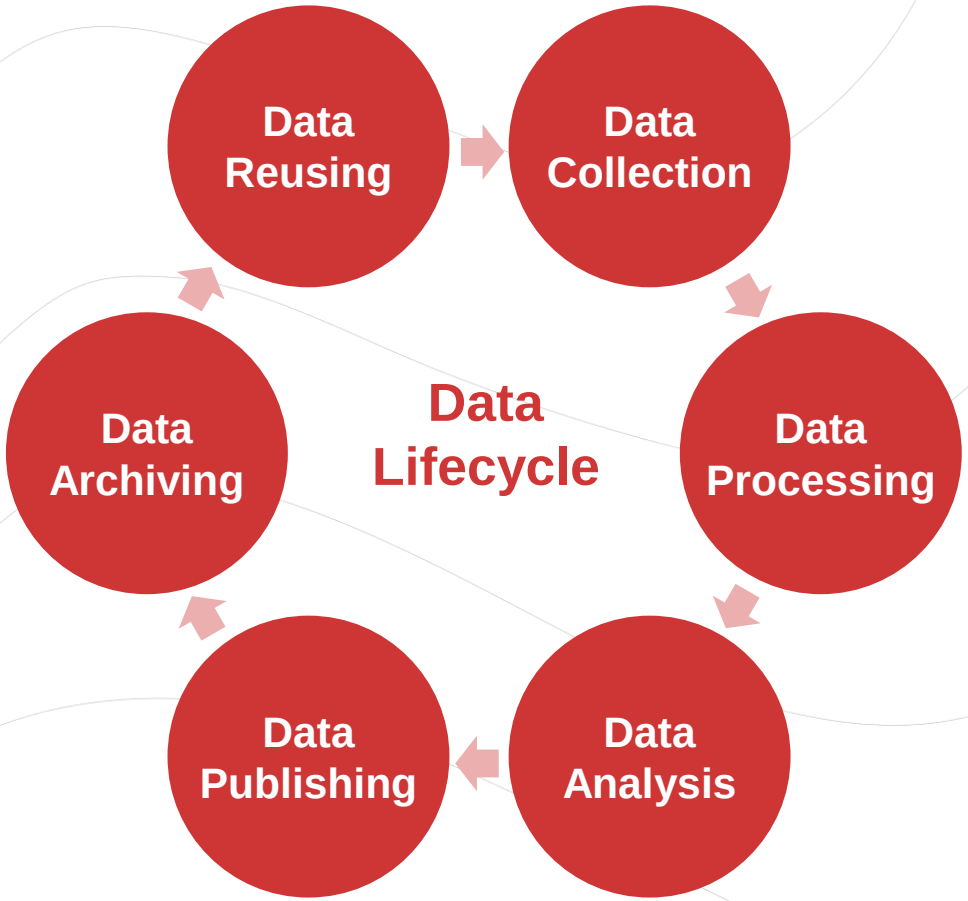
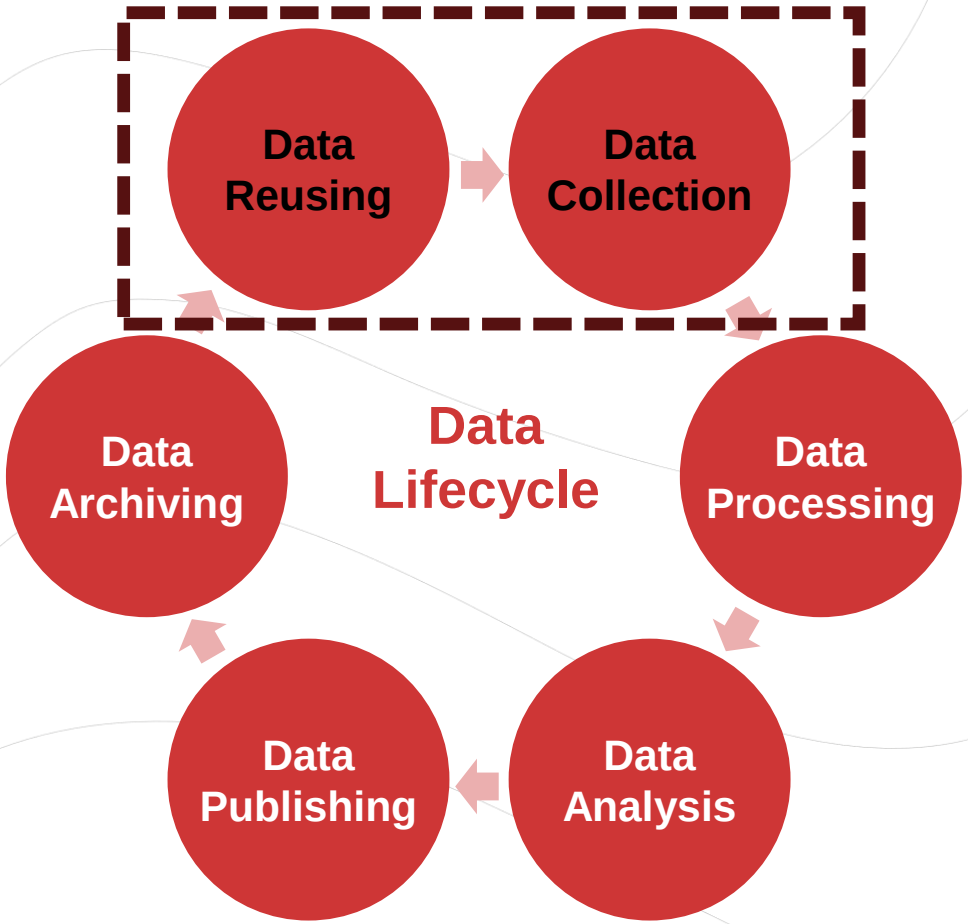
Different stages of research data lifecycle



Research data lifecycle



Research data lifecycle

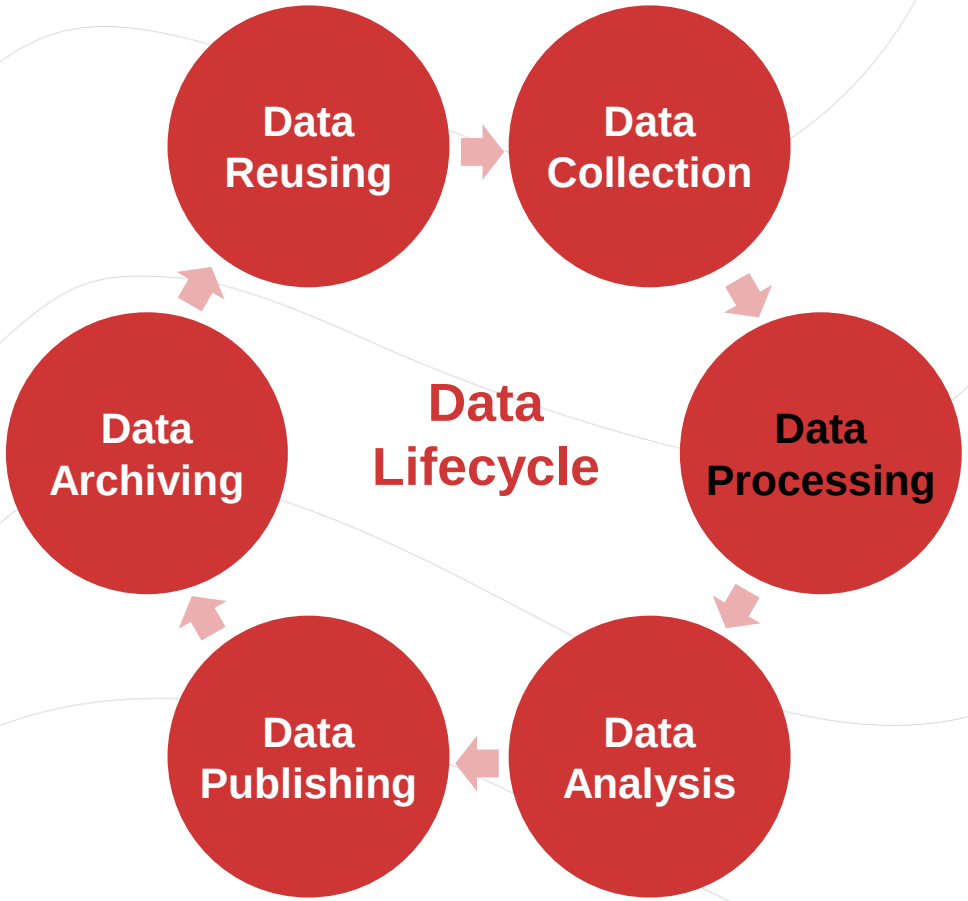


Source Data

Collected/produced “raw data“

Reused data from a database/repository

Research data lifecycle



Source Data
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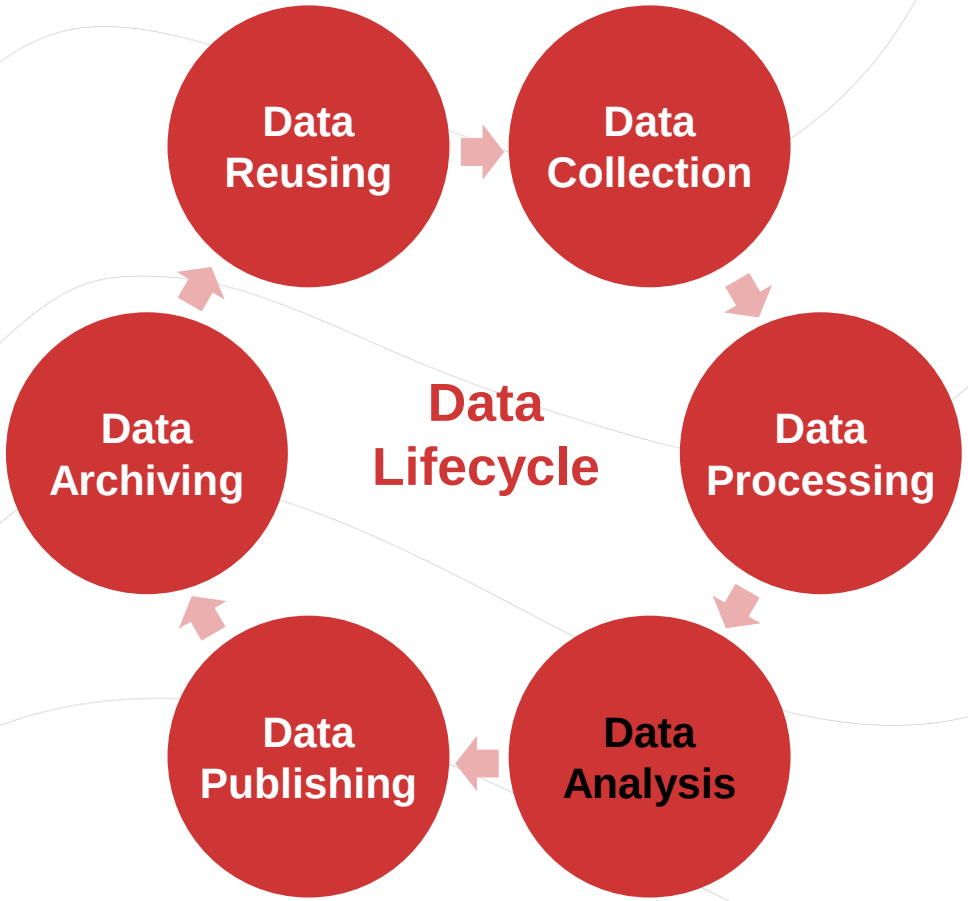
Reused data from a database/repository

Data Processing
Transformation of raw data

Research data lifecycle



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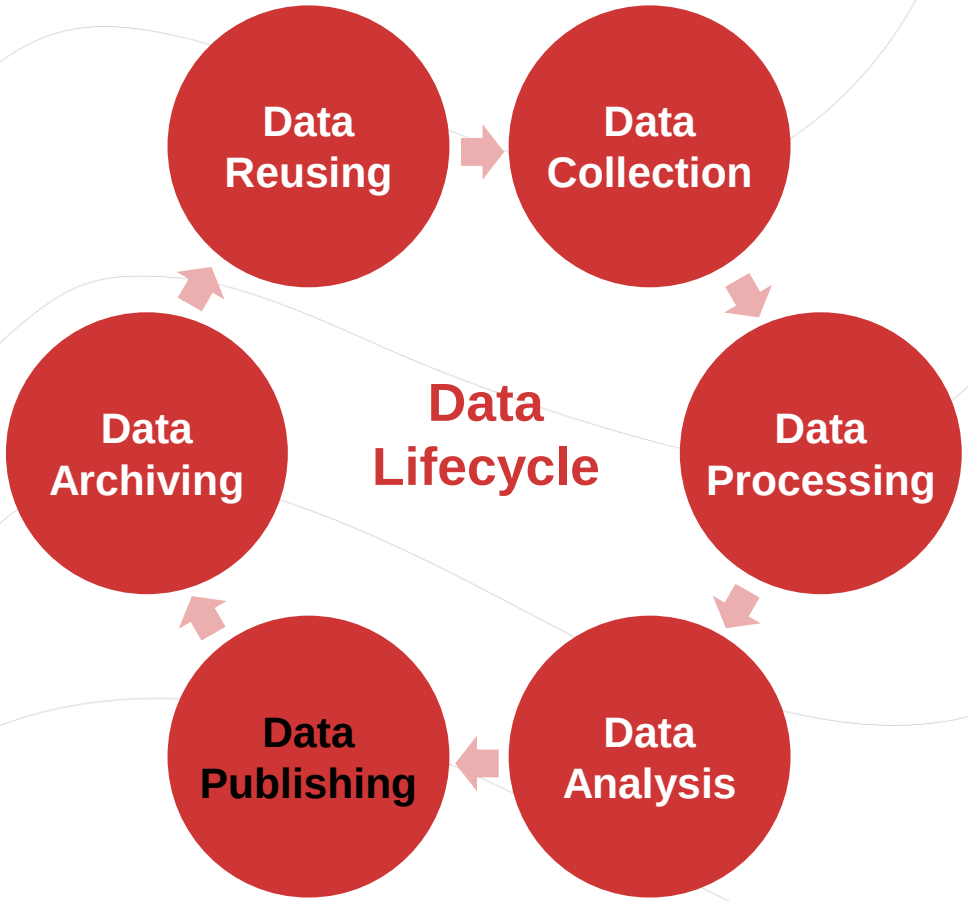
Data Processing
Transformation of raw data

Data Analysis
Data interpretation
Generation of results and outputs

Research data lifecycle



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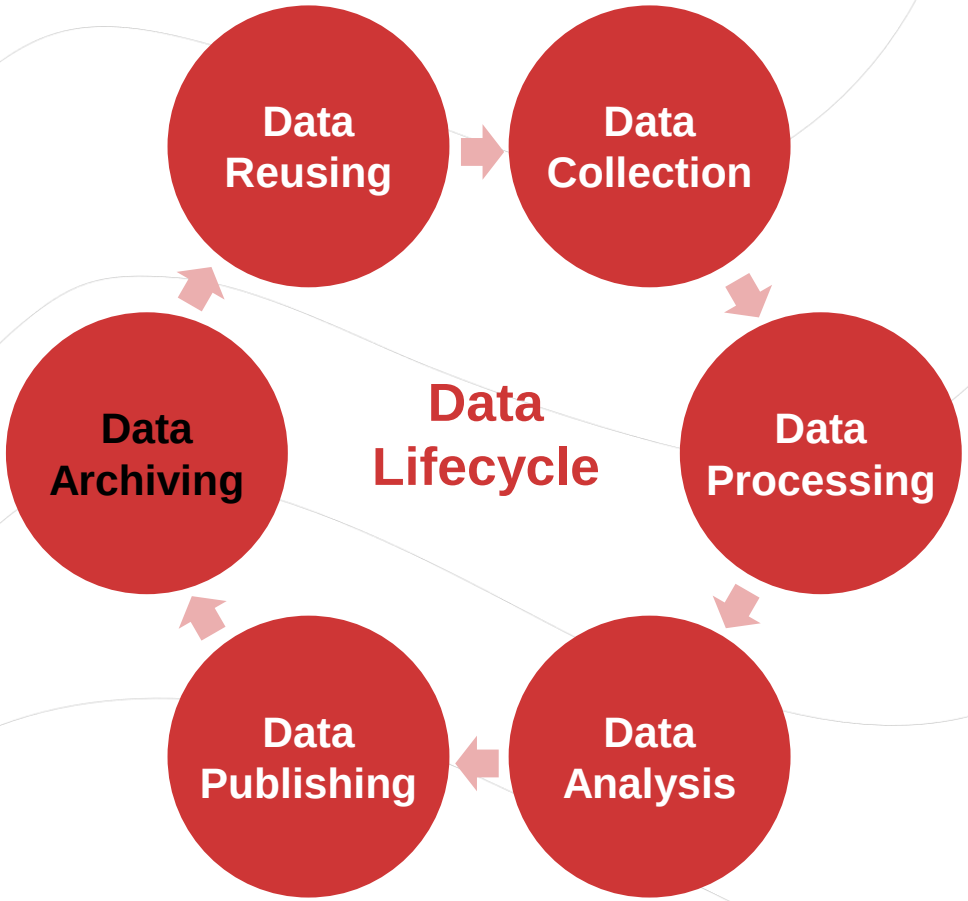
Generation of results and outputs

Data Publishing (journal article)
Manuscript + supplementary information

Research data lifecycle



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Data underlying publication
Separate datasets

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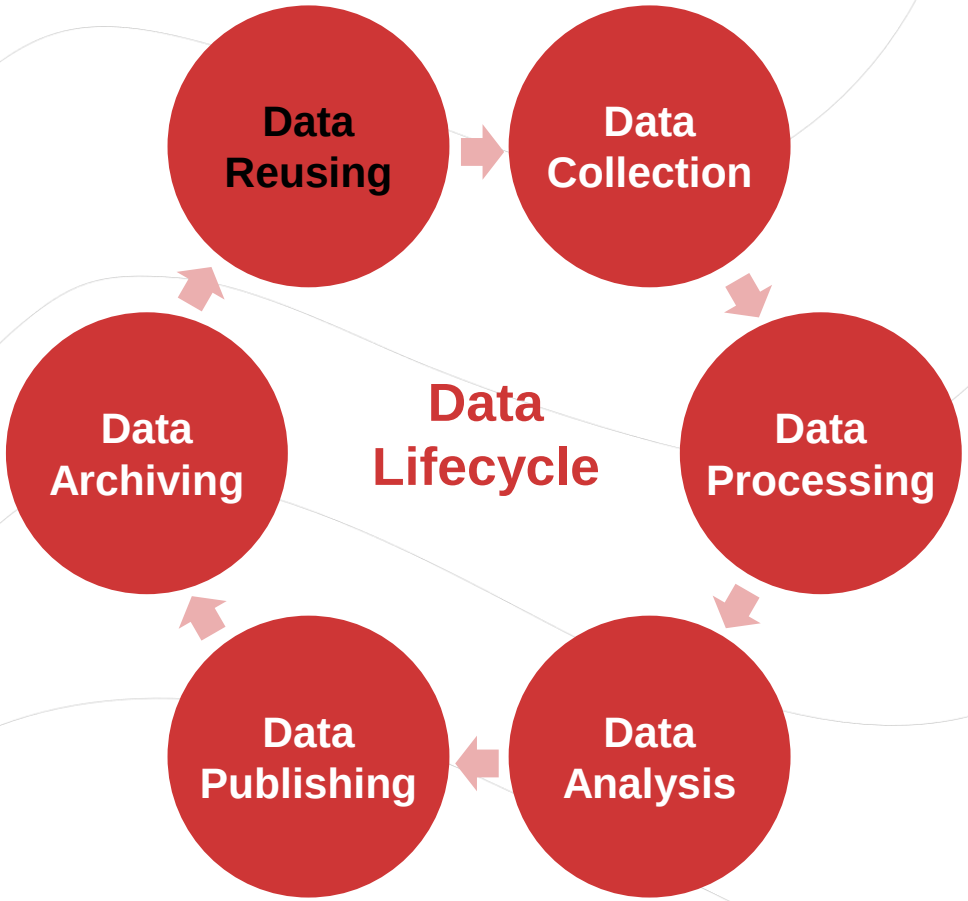

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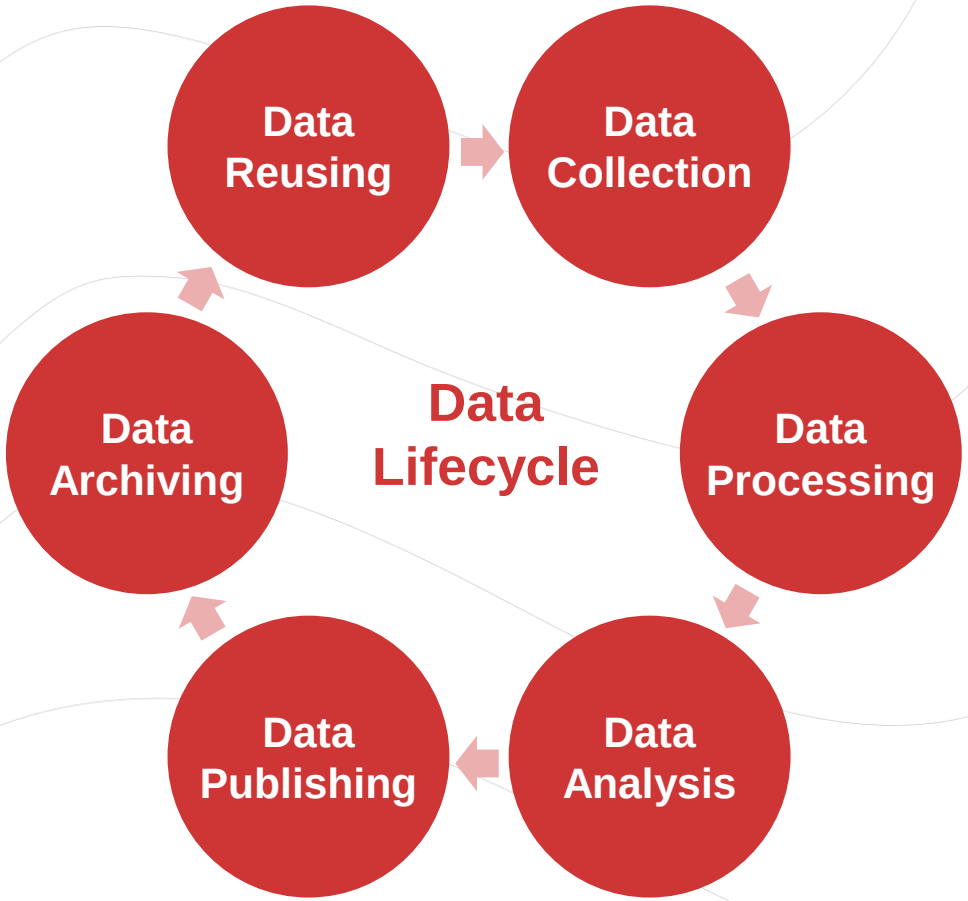
Separate datasets

Data Reusing (registries, repositories)

Research data management strategies



Organizing
- Directory structure
- Formats, names, versions

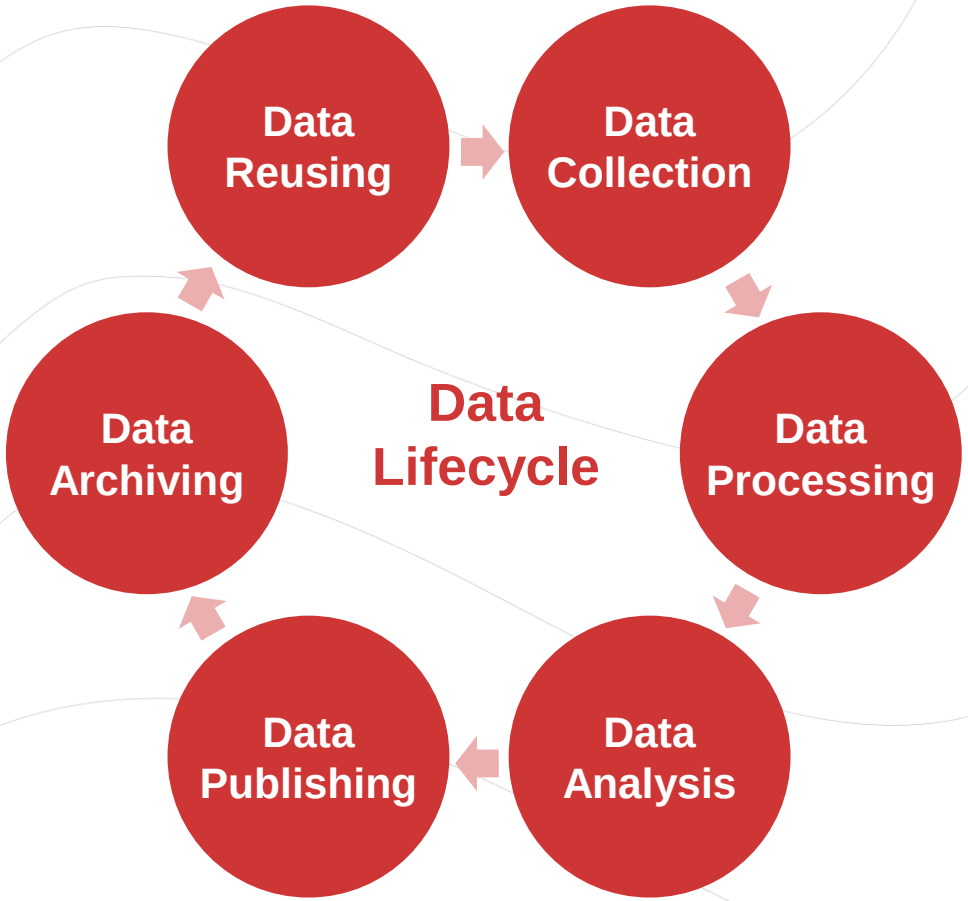
Documentation
- Data description
- Experimental details
- Decisions made
- Metadata

Storage
- Backup
- Long-term preservation

Data access
- Access rights (open, restricted)
- Licenses

Research data management strategies

Plan
Generate ideas
Design research
Funding proposal



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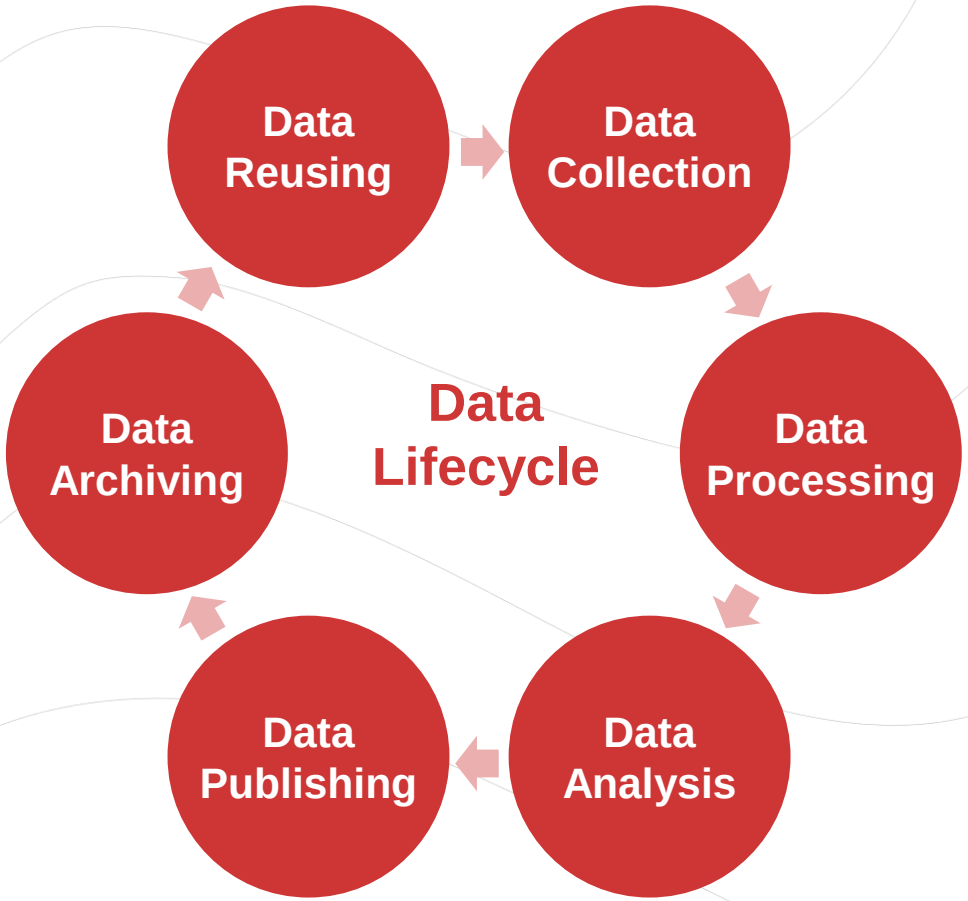
Research data requirements and policies

Plan
Generate ideas
Design research
Funding proposal



Adapted from "Research Data Lifecycle" by UK Data Service, used under Creative Commons Attribution license (CC BY)

Funding agency policies

Open Access policy
Data management plan

Legal and ethical requirements

National and European legislation
Ethical framework for researchers
Personal data protection
Intellectual property rights
Commercial use of data

Institutional policies

RDM policy
Codes of conduct and ethics
Data protection
Partnership agreement (for collaboration)

Journal & Publisher policies

Data sharing policy

How to approach Research Data Management

What is data?

Anything containing information

Some might be self-explanatory

- Text
- Tables

Other might not

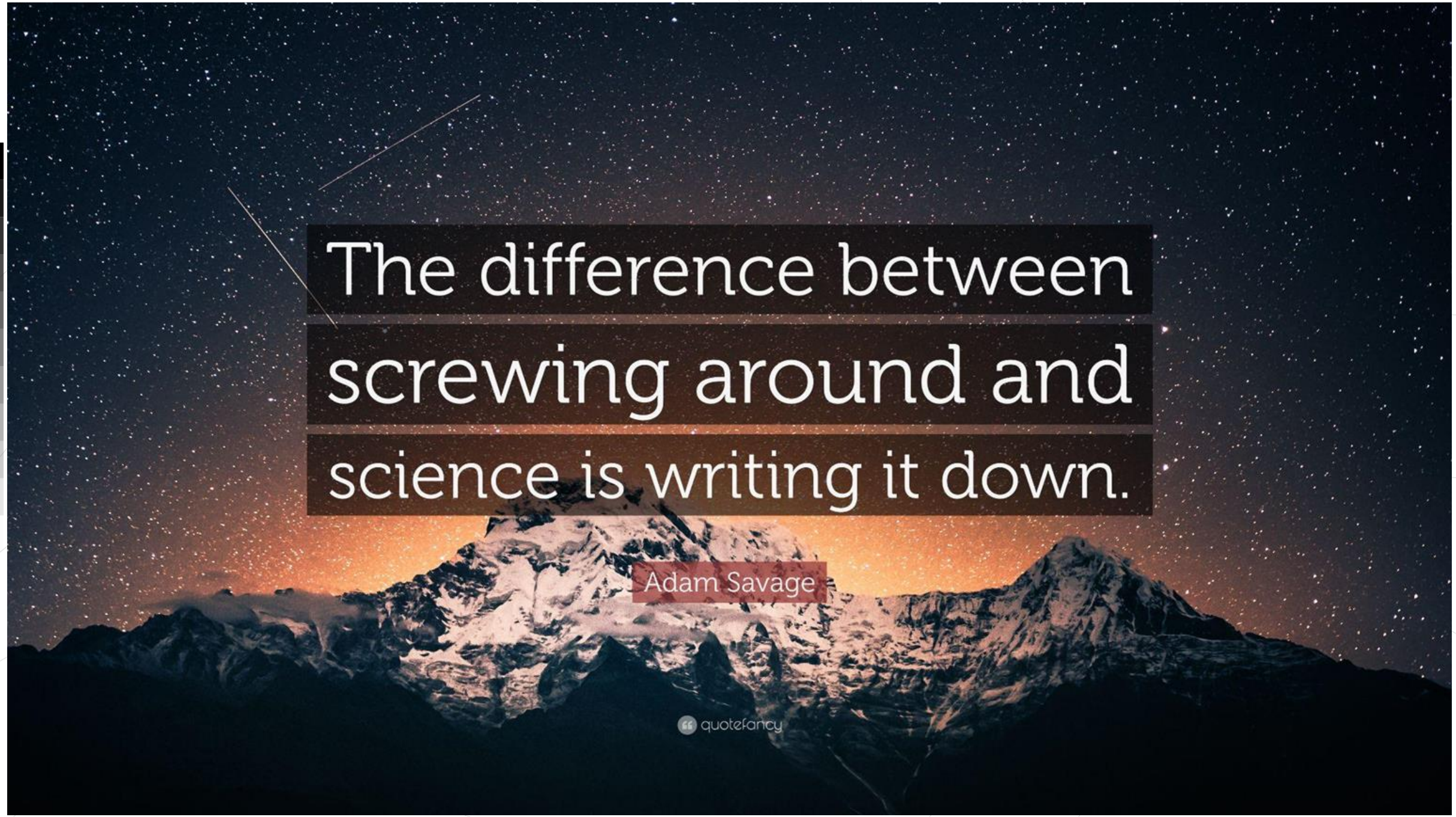
- Measurement results
- Images

Some might not be shared

- Personal information
- Medical diagnoses

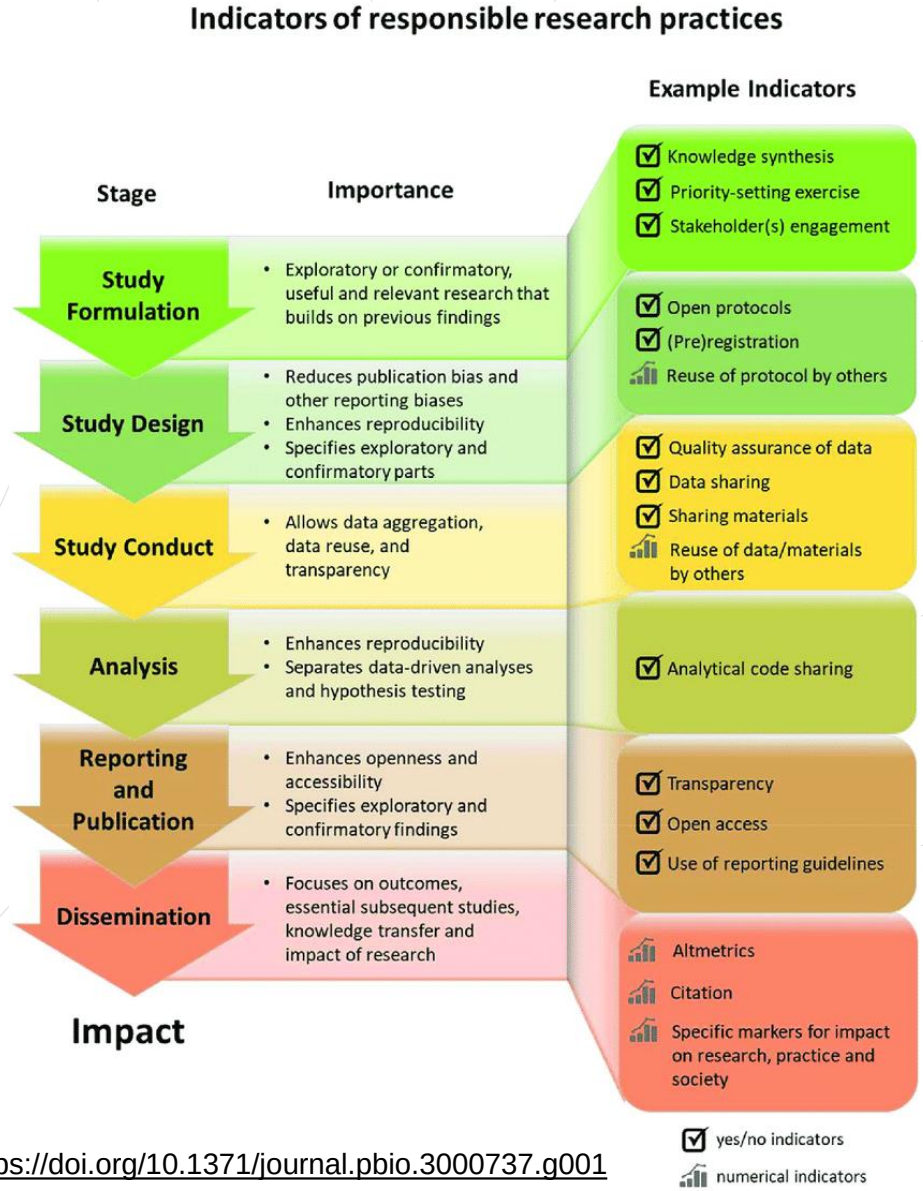
But there is **metadata:** information (data) about data.

- Date of creation
- Author
- License
- Measurement device


The difference between
screwing around and
science is writing it down.
Adam Savage
quotefancy

Responsible Research Practice

- For knowledge to benefit research and society, it must be trustworthy.
- Trustworthy research is robust, rigorous, and transparent at all stages of design, execution, and reporting.
- Assessment of researchers still rarely includes considerations related to trustworthiness, rigor, and transparency.



We need to plan in advance

- Instruments
  - Can we properly document what we are doing, and how?
- Size
  - Do we have enough storage?
- Software
  - Do we have workflow for processing of data?
  - Do we have access to proper software?
  - Can we use open file formats?
- Ethics
  - Are there any set procedures for data processing?
  - Collaboration and services!

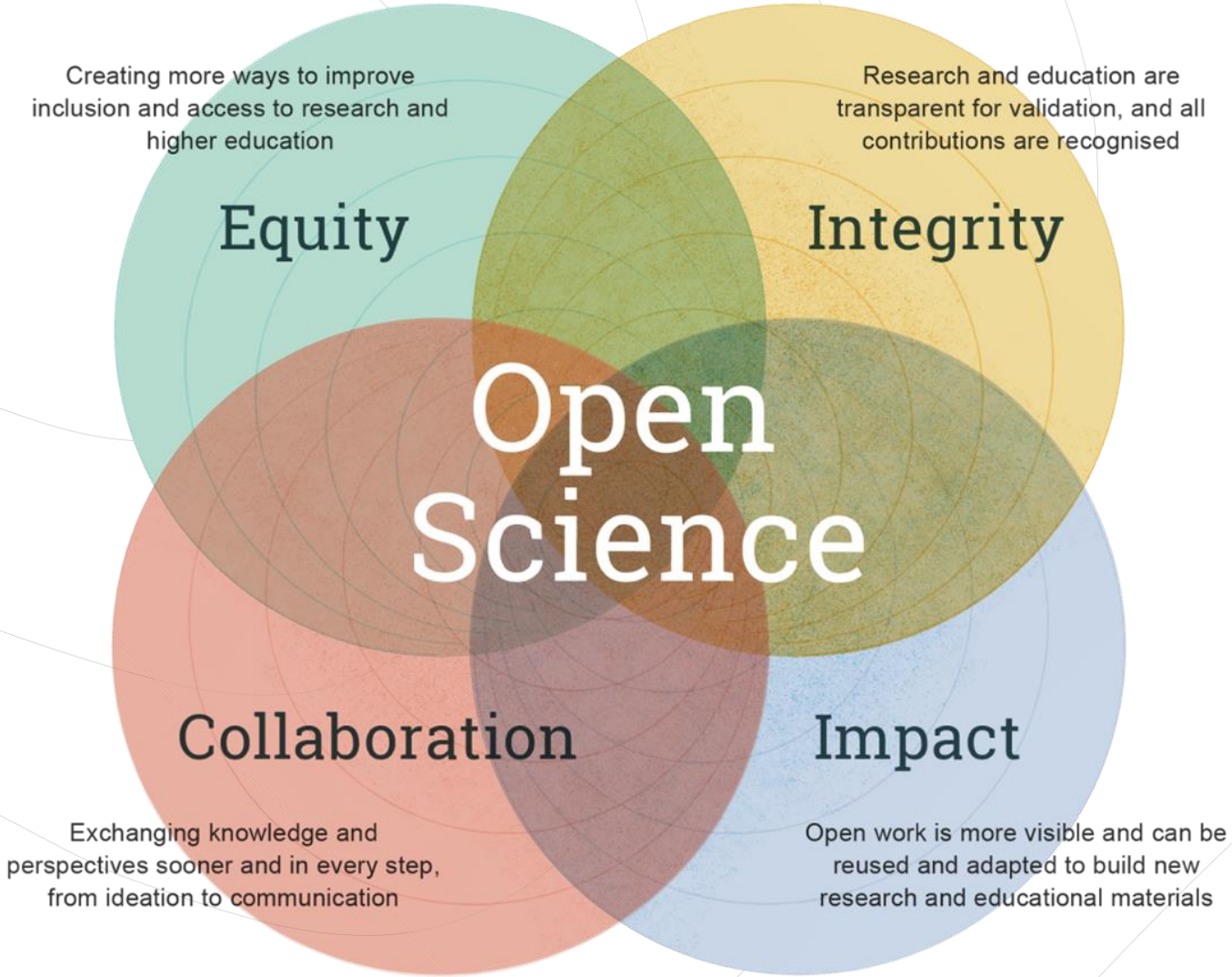
We need to plan in advance

- Backup
  - How and where?
  - Do we need encryption and access control?
- Copyright License
  - How are we legally bound?
  - How do we want to license our results?
- Publishing
  - Can we publish data?
  - Is there any domain-specific repository?
- Archiving
  - What data to archive?
  - How long?

Open Science

Revolution or evolution?

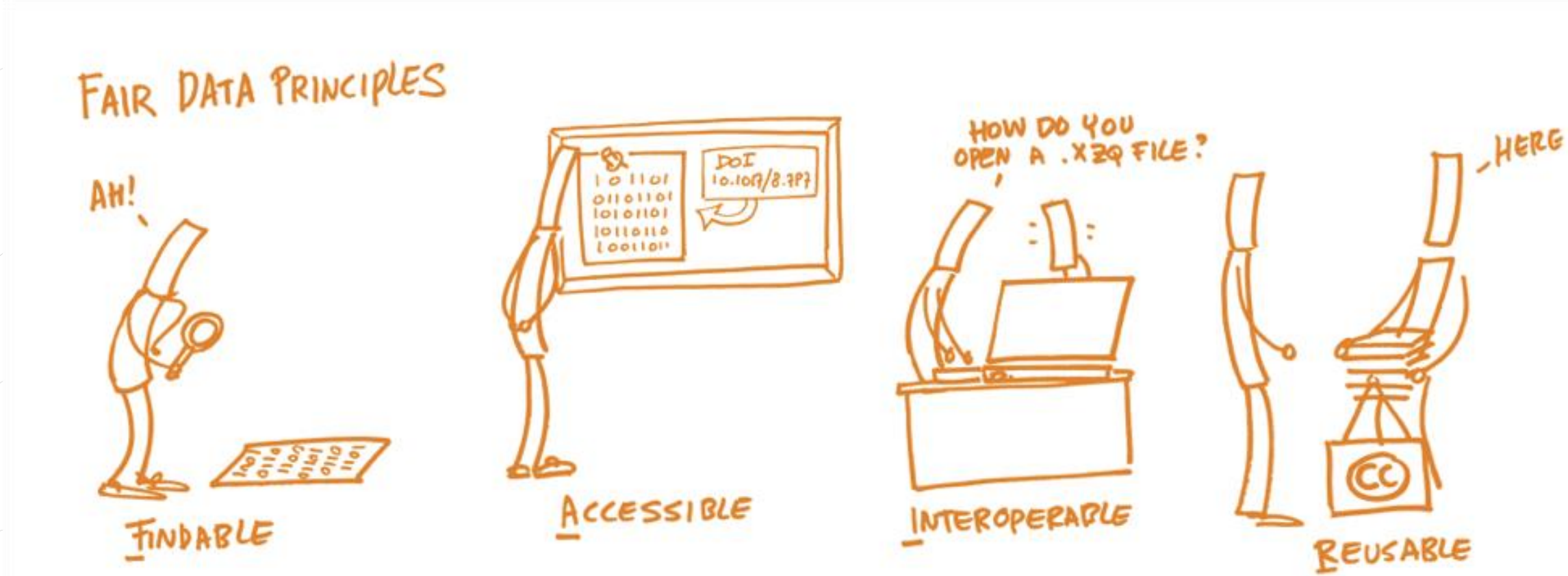
source: Vers une science ouverte. Gabriela Montors, MA, PhD. Scientific Infographics, April 2021



What we will focus on next:

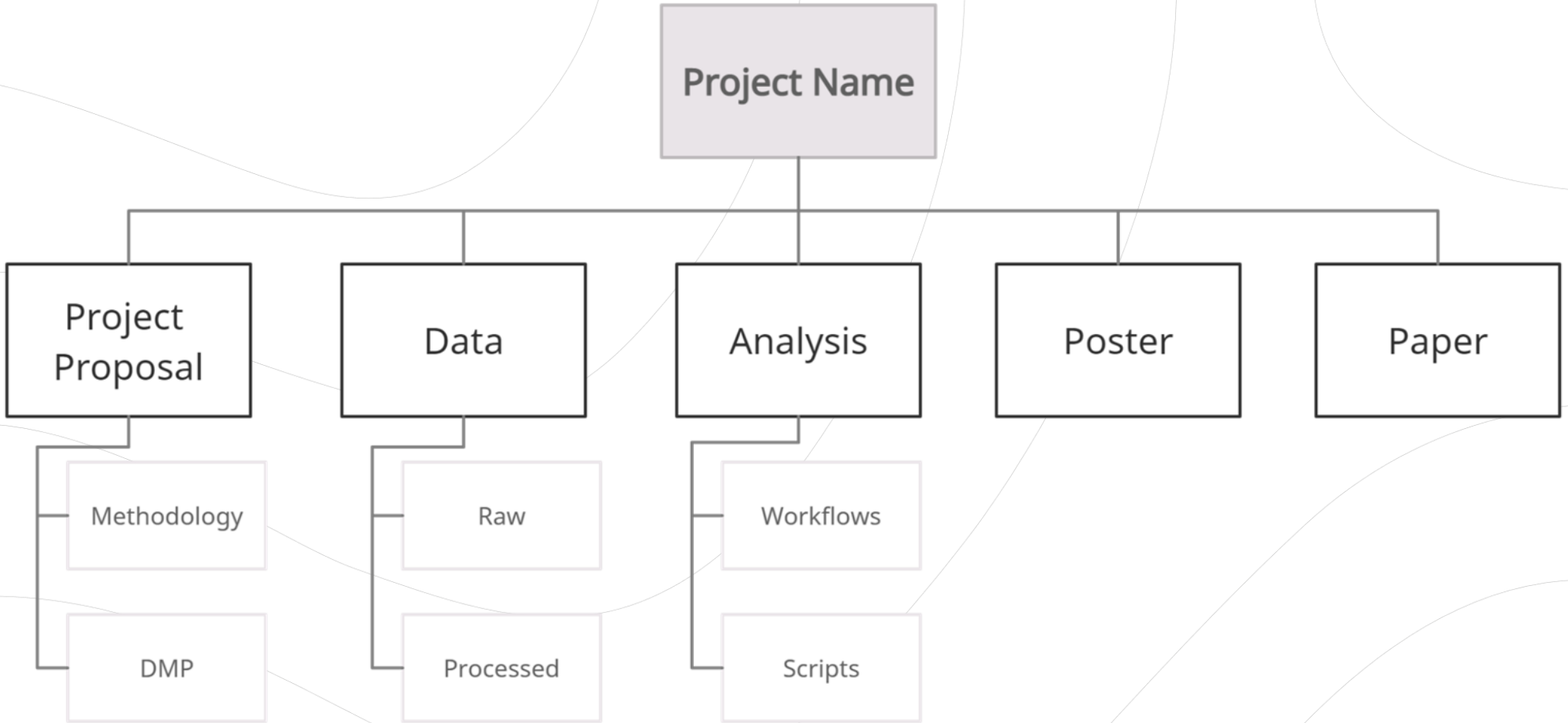
- FAIR principles
- Data naming conventions
- File formats
- Metadata
- Licensing
- Repositories
- Electronic Laboratory notebook

FAIR - the ultimate goal



Source: https://www.fosteropenscience.eu/learning/assessing-the-fairness-of-data

Organizing your data



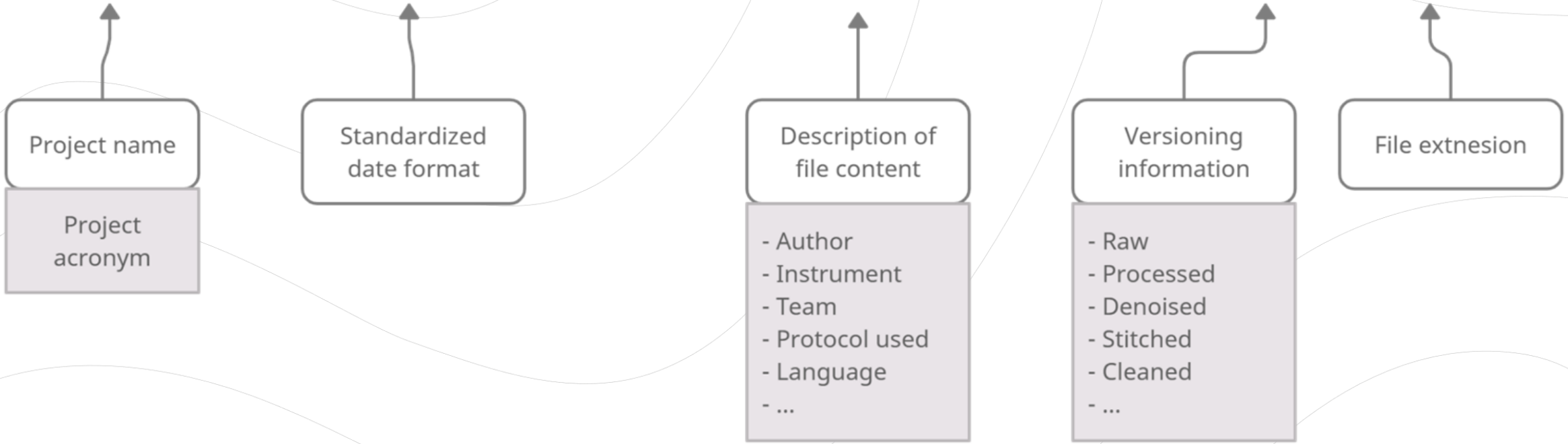
source:https://biblio.uottawa.ca/en/services/faculty/research-data-management/file-naming-and-organization-data

Organizing your data

- Restrict level of folders to three or four deep
- Consider limiting the number of folders within each folder, to ten
- Include a folder within the folder structure for “documentation”. This might include:
  - Project proposals/protocols
  - Consent and approval forms
  - Methodology documents
  - Data management plan
  - Code used for recodes, analysis, and outputs
  - Readme files with transformation information
  - Readme files with the full names or titles for any abbreviations used in file names
  - Codebooks or guides

Setup naming convention

Project_YYYYMMDD_ContentDescription_Version.ext



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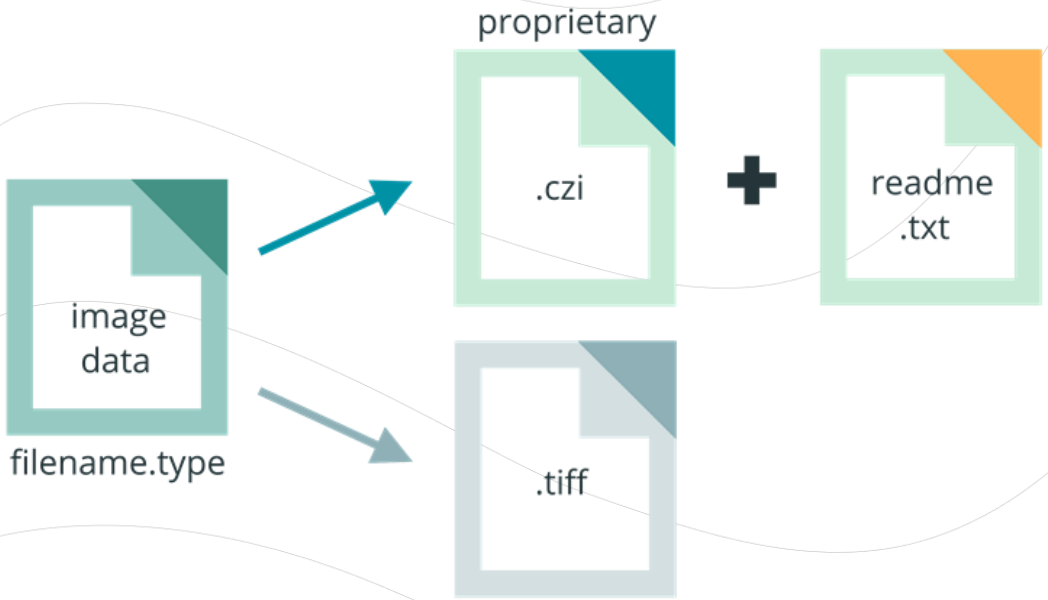
Setup naming convention

- Avoid using spaces, dots and special characters (& or ? or !)
- Use hyphens (-), underscores (_), or capitalization (C) to separate elements in a file name
- Include an abbreviation in the file name to identify
  - The instrument used
  - The phase (if research has multiple phases)
  - The transformation phase (i.e., original, raw, compressed, digitized, recoded, restructured, cleaned)
  - The source of third-party data (data provider or principal investigator)
  - The team (if working with multiple teams)
  - The language (if working with multiple languages)
- Include versioning within file names as appropriate

File formats



When it is necessary to save files in a proprietary format, consider including a readme.txt file in your directory that documents the name and version of the software used to generate the file, as well as the company that made the software. This could help you down the road, if you need to figure out how to open these files again.

source: https://www.howtofair.dk/how-to-fair/file-formats/

Specific file types

Here are some examples of preferred FAIR file formats for preservation:

- **Images**: TIFF, JPEG 2000, PDF, PNG, GIF, BMP, SVG
- **Tabular data**: CSV, TXT
- **Text**: XML, PDF/A, HTML, JSON, TXT, RTF
- Containers: TAR, GZIP, ZIP
- Databases: XML, CSV, JSON
- Geospatial: SHP, DBF, GeoTIFF, NetCDF
- Video: MPEG, AVI, MXF, MKV
- Sounds: WAVE, AIFF, MP3, MXF, FLAC
- Statistics: DTA, POR, SAS, SAV

Sooo… what are the metadata?

Metadata is documentation that describes data. Properly describing and documenting data allows you to understand and track important details of the work. Having metadata about the data also facilitates search and retrieval of the data when deposited in a data repository.

Metadata: the who, what, when, where, why, how of your research.

Dublin Core (1999, Dublin, Ohio)

A set of 15 metadata tags:

Creator
Publisher
Date
Format
Description
Relation
Type
Rights
Contributor
Title
Language
Subject
Identifier
Source
Coverage

Element	Definition
Title	A name given to a resource
Creator	An entity primarily responsible for making the content of a resource
Subject	A topic of the content of a resource
Description	An account of the content of the resource
Publisher	An entity responsible for making the resource available
Contributor	An entity responsible for making contributions to the content of a resource
Date	A data of an event in the lifecycle of a resource
Type	The nature or genre of the content of a resource
Format	The physical or digital format of a resource
Identifier	An unambiguous reference to the resource within a given context
Source	A reference to an another resource from which a resource is derived
Language	A language of the content of a resource
Relation	A reference to a related resource
Coverage	The extent or scope of the content of a resource
Rights	Information about rights held in and over a resource

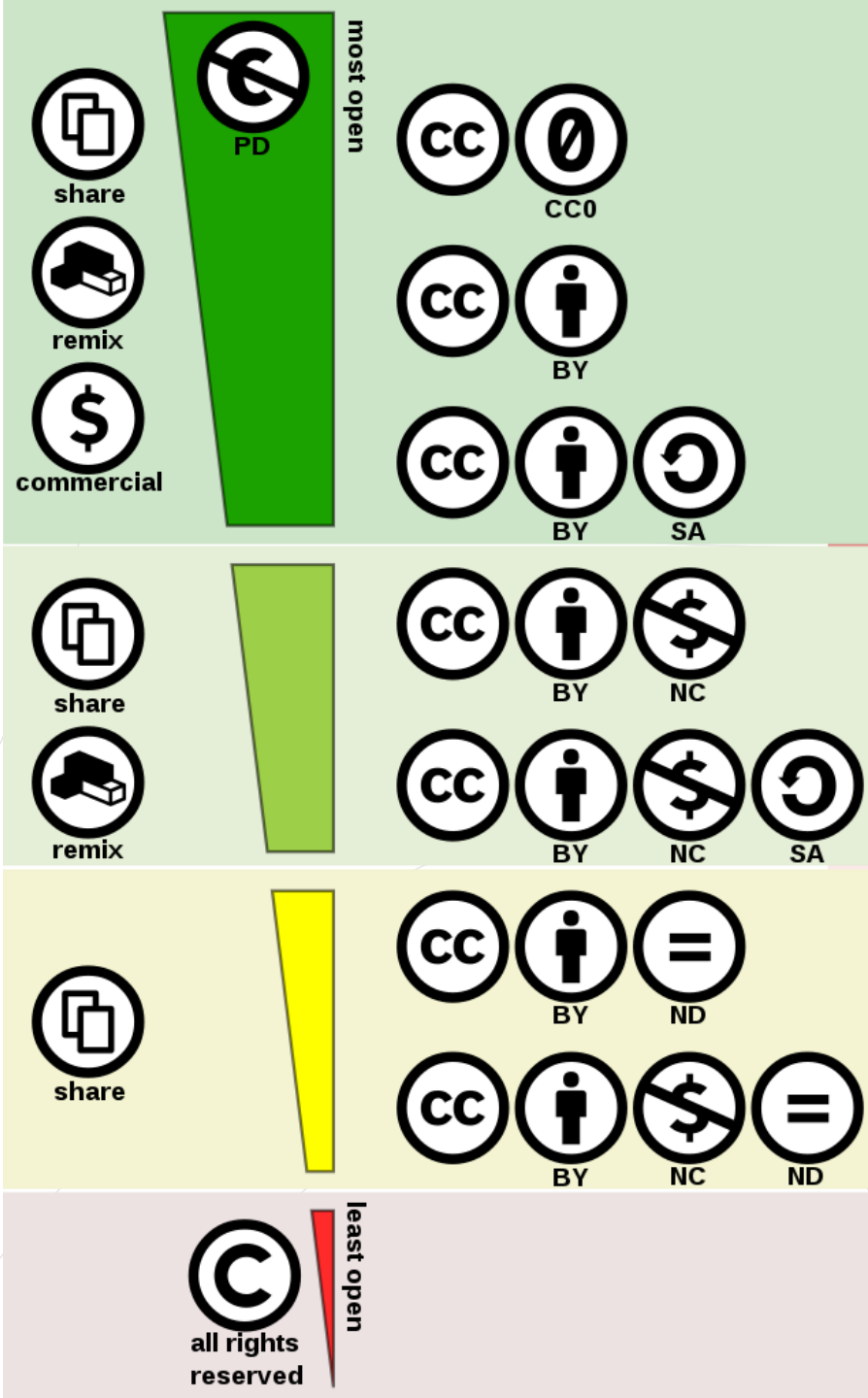
Creative Commons licence

Easy to understand/easy to use

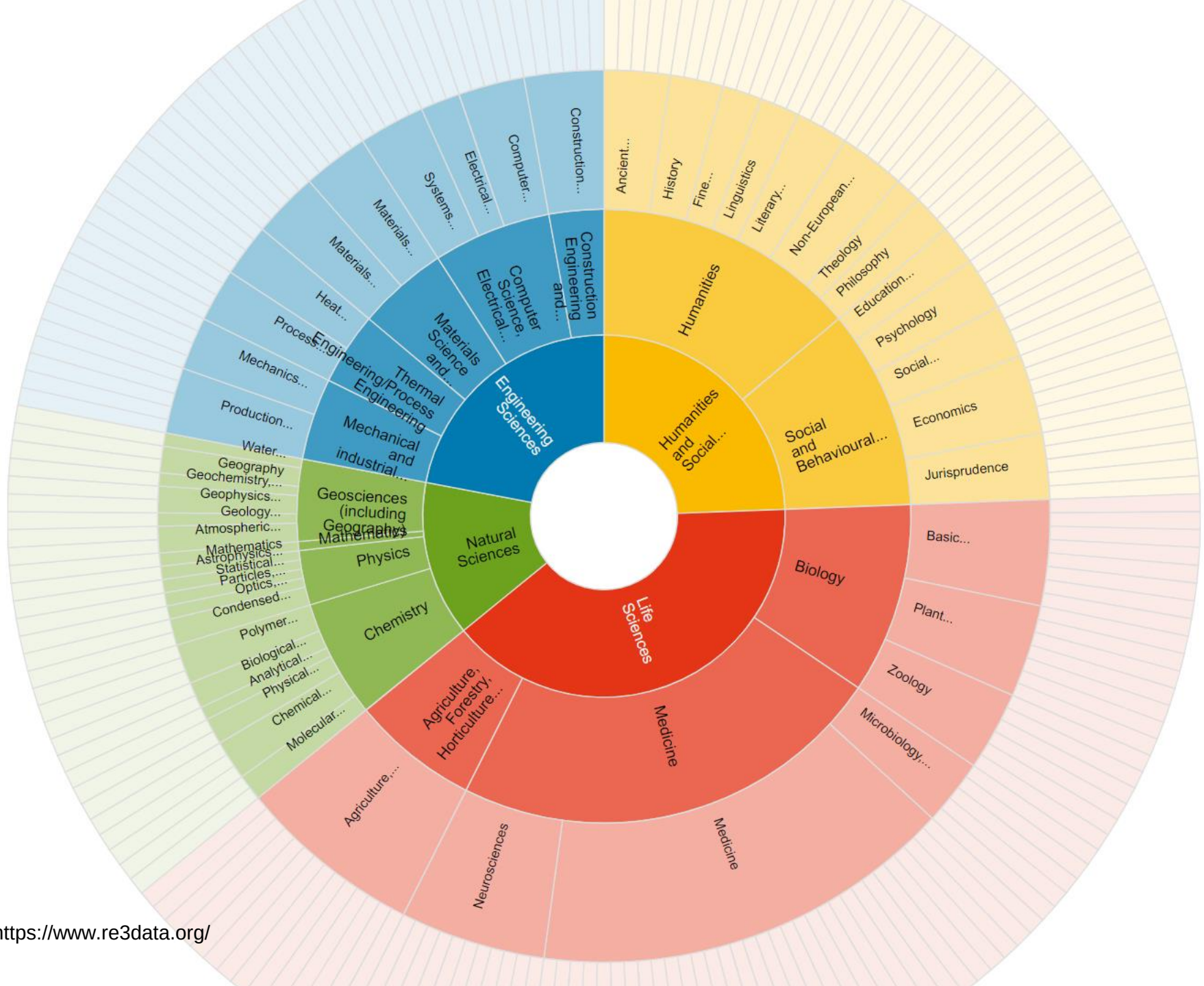
Meaning of **CC** suffix:

0 - Public domain
BY - By Attribution
ND - No Derivatives
NC - Non-Commercial
SA - Share Alike

source:https://creativecommons.org/



Source: https://www.re3data.org/



Source: https://www.re3data.org/

Price of storage (AWS)

Standard

First 50 TB/Month	$0.023 per GB →	13,517$ per year
Next 450 TB/Month	$0.022 per GB →	121,651$ per year
Over 500 TB/Month	$0.021 per GB →	129,024$ per year

Archive

Archive Access Tier	All Storage/Month	$0.0036 per GB

100TB → 4,424$ per year

Deep Archive Access Tier	All Storage/Month	$0.00099 per GB

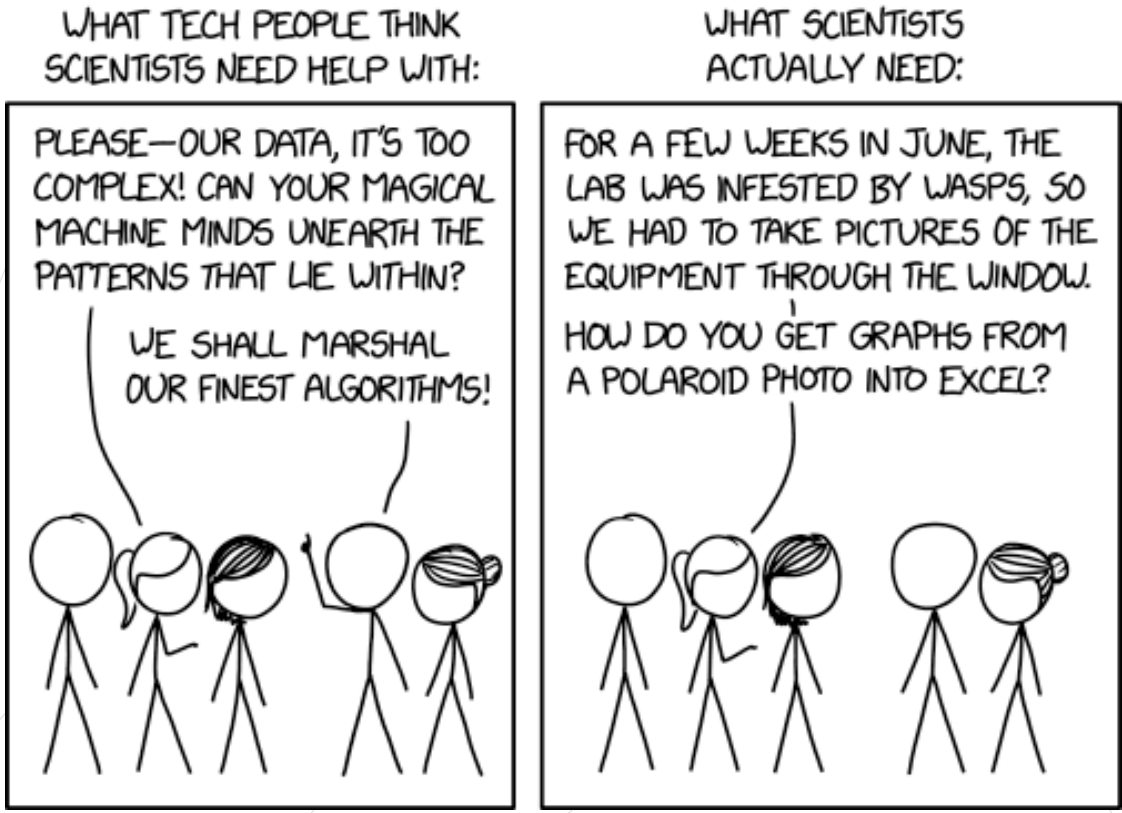
100TB → 1,217$ per year

Electronic laboratory notebook

The missing infrastructure for data recording, retrieval, and integrity.

There are many options, from utilizing Google Colaboratory up to all-in-one solutions:

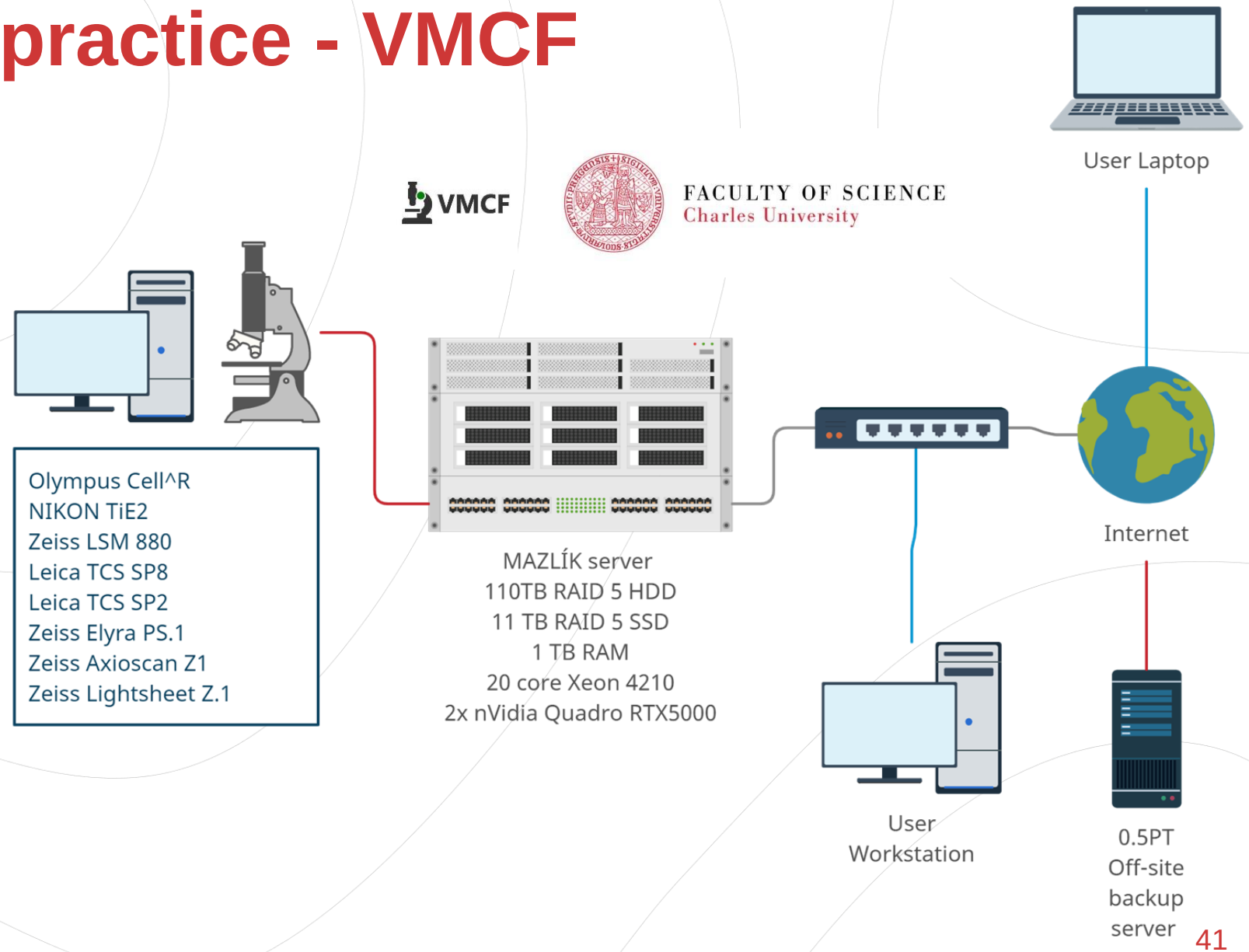
https://www.labfolder.com/electronic-lab-notebook-eln-research-guide/



How it looks in practice - VMCF

Many limitations:

- RDM
- Length of experiments
- Data ownership
- Documenting
- **Ethics**
- Access planning
- Cost management



Research data management resources

Course: Data Stewardship: module 1, DocEnhance (2021)

https://moodle.techlib.cz/course/view.php?id=179

- Developed as part of the DocEnhance project
- The Data Stewardship course was piloted in Norway and Czech republic
- Course was developed for early-career researchers
- Entry level self-guided open course to data stewardship
- 11 modules on various aspects of data management
- Ended by self examination with certificate

What to take home?

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- Open Science is evolution.
- Managing data is good scientific practice.
- Managing and sharing data can save time, money, and create impact.
- Communities of researchers worldwide define standards, usually they are open to others joining their efforts. The same is happening at the national level.
- There is already huge amount of resources online to learn from.
- Research data management is a helpful tool, not just an administrative task.
- Funding agency will, in time demand (or already are demanding) Data Management Plans, and support RDM tasks financially.

Get Assistance

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1) Schedule a **consultation**

- Please don't be shy; our team includes doctoral students who know the issues you face
- LaTeX support, Bibliometric services

2) Attend other **webinars**

3) Explore by yourself

- STEMskiller: comprehensive skills set map for early career researchers
- Tutorials: NTK instructional materials and recordings and links to more information
- Subject guides

Contacts

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Thank you

Questions?