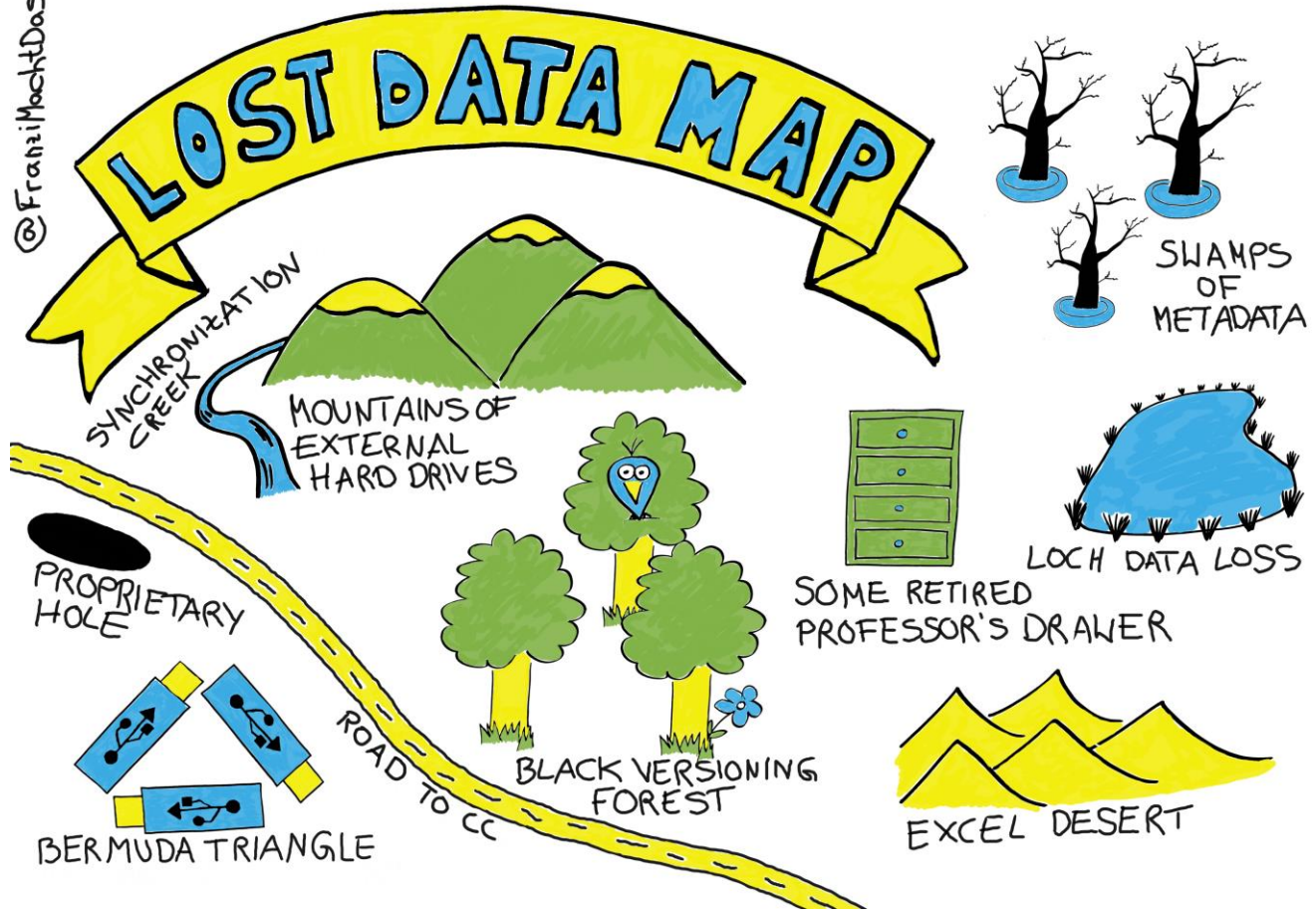# Introduction into research data management

RMU Post Doc Weeks 2023

Dr. Jörg Steinkamp (JGU), Hüseyin Uzun (GUF), Dr. Anne Vieten (JGU), and Jürgen Windeck (TUDa)
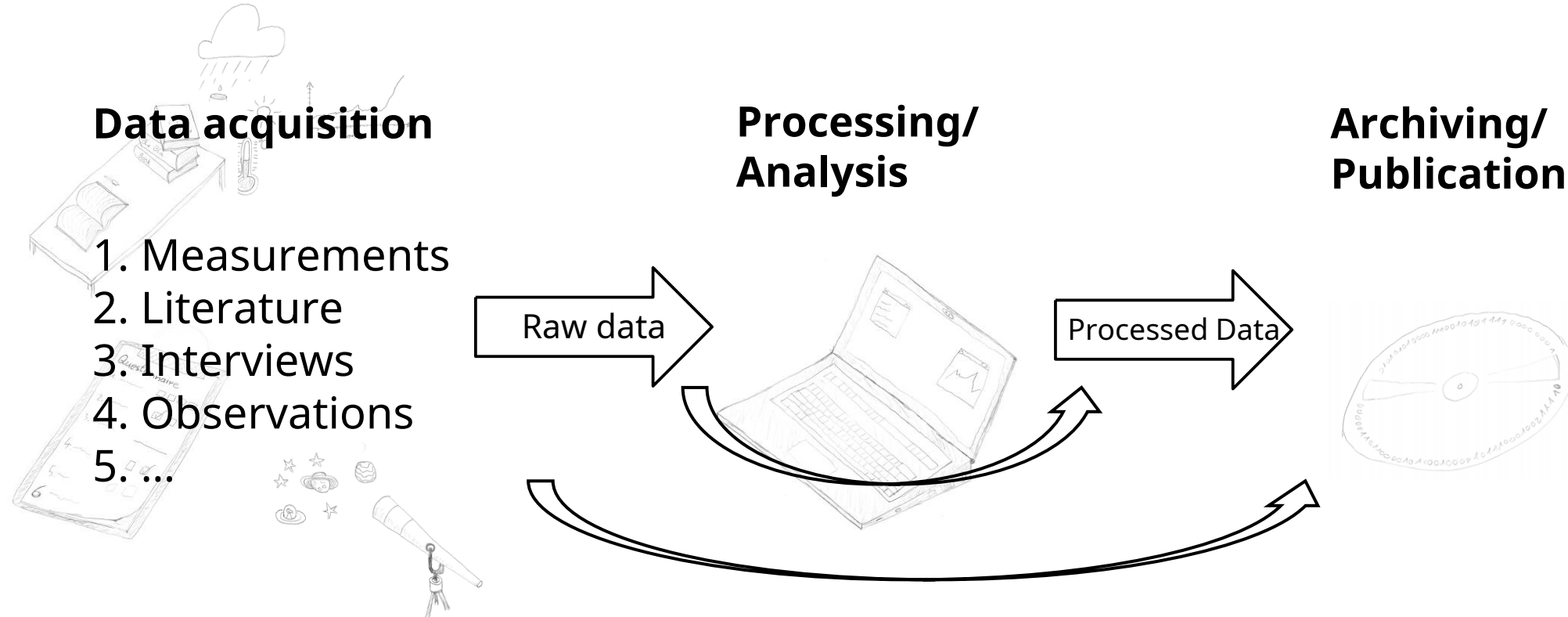
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LOST DATA MAP

@FranziMachtDas

SYNCHRONIZATION CREEK

MOUNTAINS OF EXTERNAL HARD DRIVES

PROPRIETARY HOLE

ROAD TO CC

BERMUDA TRIANGLE

BLACK VERSIONING FOREST

SOME RETIRED PROFESSOR'S DRAWER

SWAMPS OF METADATA

LOCH DATA LOSS

EXCEL DESERT

Research data, a definition

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Technische Universität Darmstadt
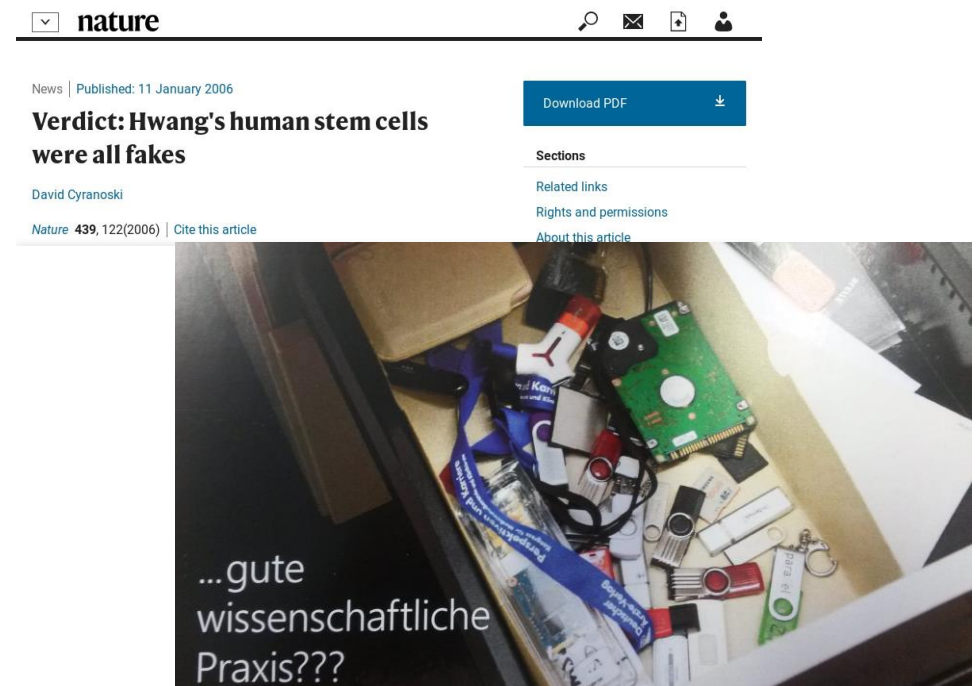**Eine strategische Allianz**

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Data acquisition

1. Measurements
2. Literature
3. Interviews
4. Observations
5. ...

**Processing/
Analysis**

**Archiving/
Publication**

Raw data

Processed Data

Why RDM is important for you?

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- Prevention of data loss

- Reproducibility, verifiability and transparency of research results

- Reduction of scientific errors

- Faster retrieval of data and information

- Long-term availability and reusability of research data
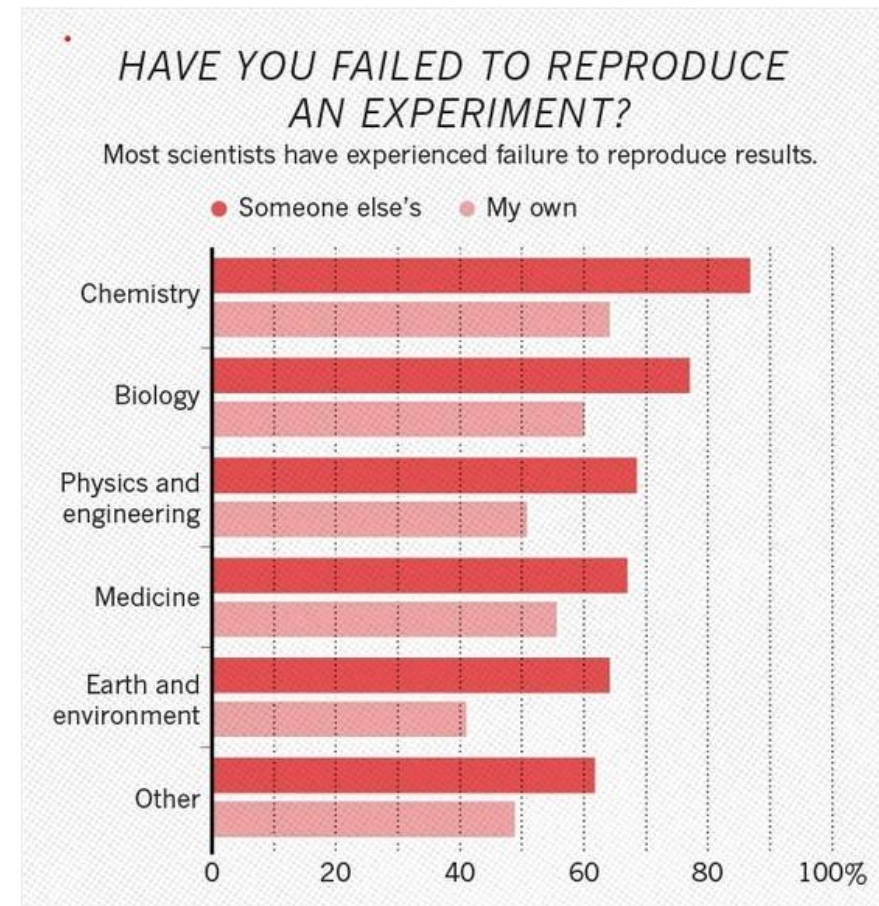
- Better scientific reputation

Postcard by:
Landesinitiative NFDI der digitalen Hochschulen NRW - Forschungsdatenmanagement

Reproducibility of research results

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…often fails

HAVE YOU FAILED TO REPRODUCE
AN EXPERIMENT?
Most scientists have experienced failure to reproduce results.

● Someone else's   ● My own

Baker, M.; Nature; May 25th 2016

Remember: Only a genius can handle Chaos ...

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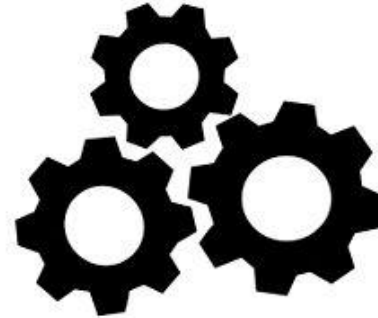
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... but what happens if the genius leaves?
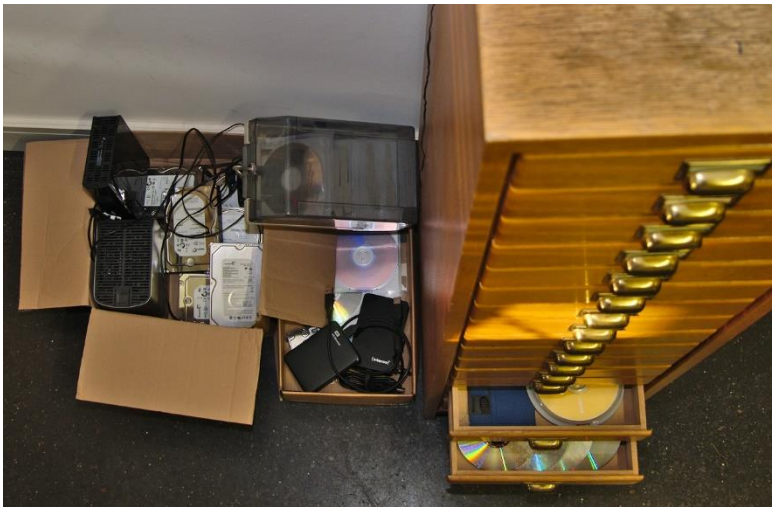
Additonal reasons for RDM

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Requirements of third party funders and science organisations:

- DFG: Good Scientific Practice

- Alliance of German Science Organisations: Principles for the Handling of Research Data

- Horizont Europa: Open Science in Horizon Europe

- BMBF: Aktionsplan Forschungsdaten – BMBF

Your research data should be fair!

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F indable   A ccessible   I nteroperable   R eusable

Quelle: https://commons.wikimedia.org/wiki/File:FAIR_data_principles.jpg
Autor: SangyaPundir Titel: "FAIR Guiding principles for data resources" (17.11.2016)

FAIR Data

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Short Keyword – High Impact!

How to make data findable and accessible?

- Describe research datasets with **metadata**

- Metadata is indexed in a searchable directory or repository

- Publication of research data, if applicable

- Provide research data (metadata) with persistent identifiers (DOI, URN etc.)

- Metadata and/or actual data easily accessible

- Defined licensing and access conditions

- Metadata available even if actual data is not accessible

Interoperability and Reuseability

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- Data are combinable with other data sets by humans or computers.
- Use of non-proprietary, open and described or commonly used formats

- Data are in a form in which they can be used for further research and processing with computer-aided methods

Recommended formats

Tables: CSV, TSV, SPSS portable
Text: TXT, HTML, RDF, PDF/A
Image: TIFF, JPEG2000, PNG
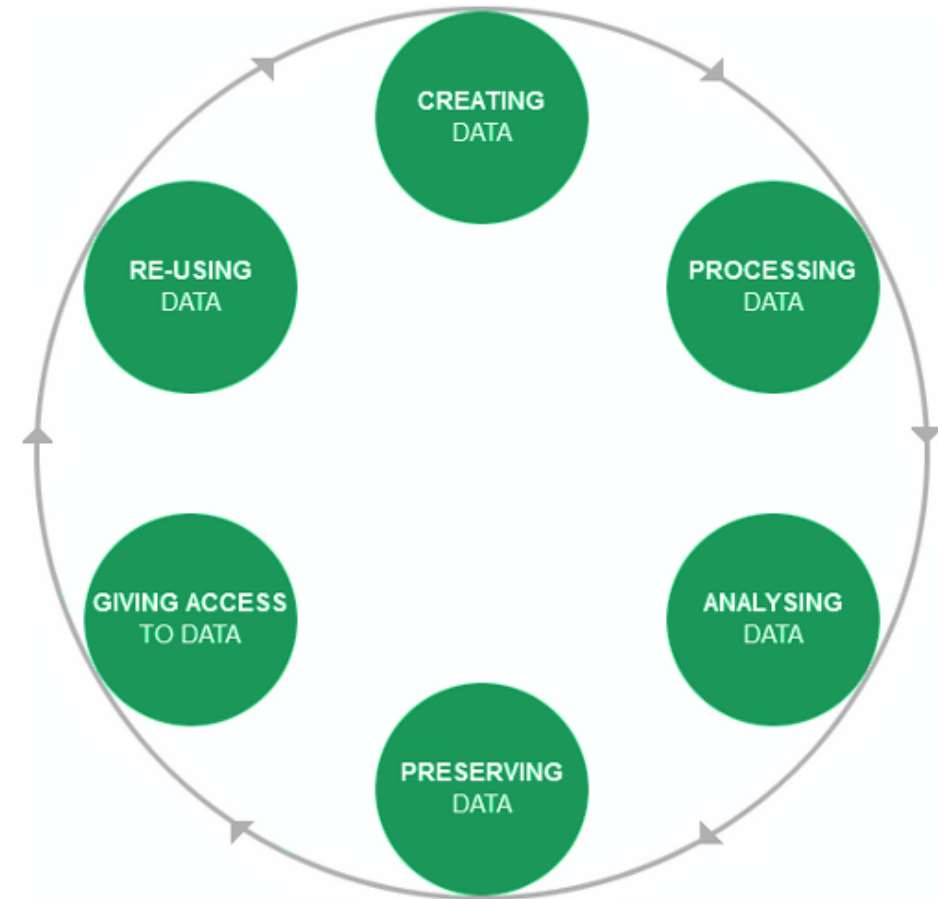Multimedia: AVI, WAV, MP4

Coverage: *Median Latitude: 47.196250 * Median Longitude: 8.468551 * South-bound Latit*

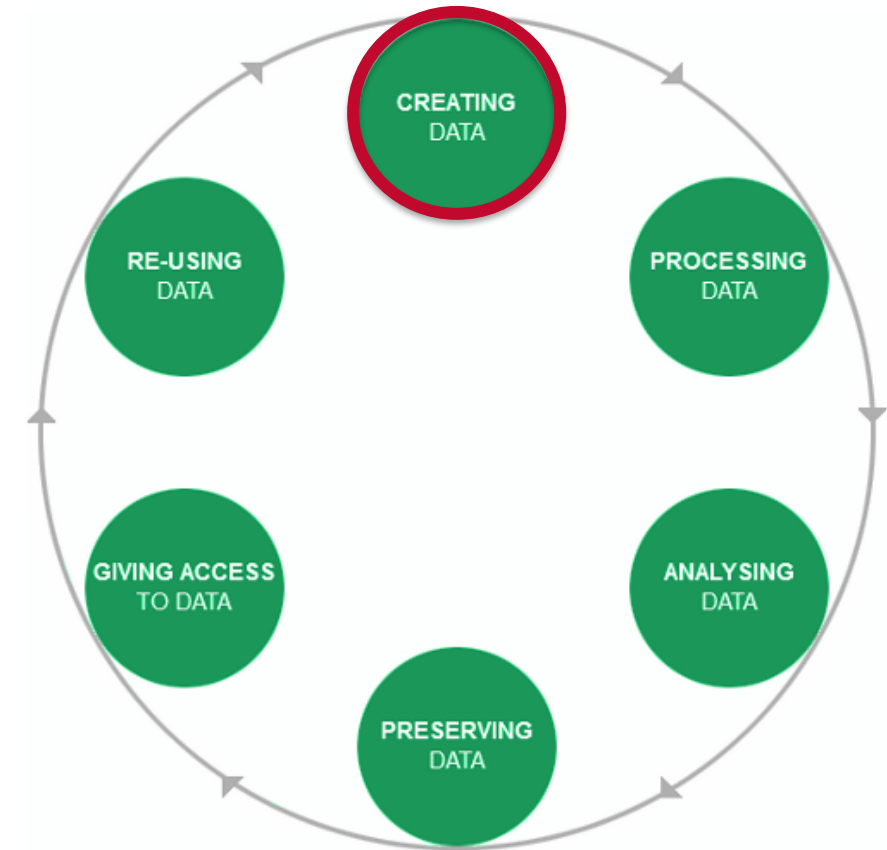License: (cc) BY Creative Commons Attribution 4.0 International (CC-BY-4.0)

Size: 73 datasets

Data Cite (Metadata) Basic Scheme
- Identifier
- Creators
- Title
- Publisher
- Publication year
- Subject
- Language
- Resource type
- Description

The Research Data Life cycle

... describes all steps of

research data management

Research data lifecycle: sub-steps

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- **Creating data:**

- design research

- plan data management (formats, storage etc.)

- plan consent for sharing

- locate existing data

- collect data (experiment, observe, measure, simulate)

- capture and create metadata

- take care about data privacy protection/legal situation

http://data-archive.ac.uk/create-manage/life-cycle

What are Metadata?

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- **Meaning:** Metadata describe and define data. They give additional Information about data.

- **Example:** Metadata of an e-book would be the author, the publisher, date of publication etc.

Data Cite Basic Scheme
- Identifier
- Creators
- Title
- Publisher
- Publication year
- Subject
- Language
- Resource type
- Descriptions

Metadata tool: https://dhvlab.gwi.uni-muenchen.de/datacite-generator/
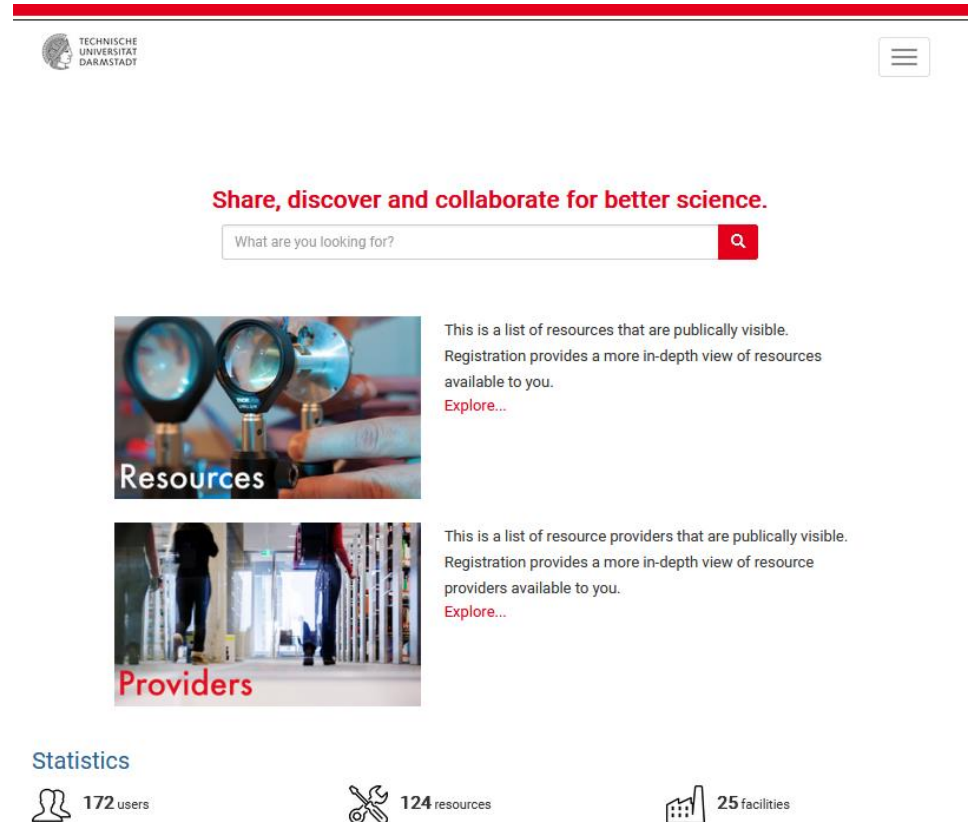
Types of metadata and documentations

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- **Descriptive/bibliographic**: title, author, keywords, year of publication, etc.

- **Administrative-legal**: rights holder, license conditions, access rules, etc.

- **Structural**: physical or logical relationships between objects (e.g. between tables in a database).

- **Administrative or preservation-related**: conversion and preservation measures, etc.

- **Technical:** information on used software or hardware, file formats, character encoding, parameters of measuring devices, experimental procedures

Electronic Lab Notebooks (ELN) TUDa: eLabFTW

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- digital tool to keep structured experimental information

- significant functional improvements over paper lab journal
  - search functions
  - collaborative features

- eLabFTW currently tested as service at TUda

Research infrastructure TUDa: TUinfra

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What is TUinfra?

- Database for TUDa research infrastructure

- Increase visibility

- Search for research equipment

- Rights management for visbility, access and booking

- Allows cross-institutional use

- Usage statistics

- https://www.tuinfra.tu-darmstadt.de

Electronic Lab Notebooks (ELN) GUF:

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- Testing two ELNs
  - in practical courses and research

- Chemotion:
  - for chemistry and related disciplines

- eLabFTW
  - generic tool for natural science and maybe more

- No solution yet for all departments

Electronic Lab Notebooks (ELN) JGU:

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- Department Biology: eLabETW is offered

- Department Chemistry: Chemotion is offered

- Other departments: diverse research groups use ELN in self organisation

What do I have to document?

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Document everything that a third person needs to understand your

datasets!

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- **Processing data:**
- enter data, digitise, transcribe, translate
- check, validate, clean data
- anonymise data where necessary
- describe data (metadata)
- manage/organise and store data
- care about versioning

CREATING
DATA

PROCESSING
DATA

RE-USING
DATA

ANALYSING
DATA

GIVING ACCESS
TO DATA

PRESERVING
DATA

http://data-archive.ac.uk/create-manage/life-cycle

Organizing Data

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...or getting completely lost?

Jorge Cham: PHD Comics: A story in file names

… better like this

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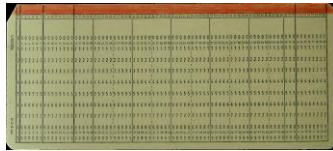**Eine strategische Allianz**

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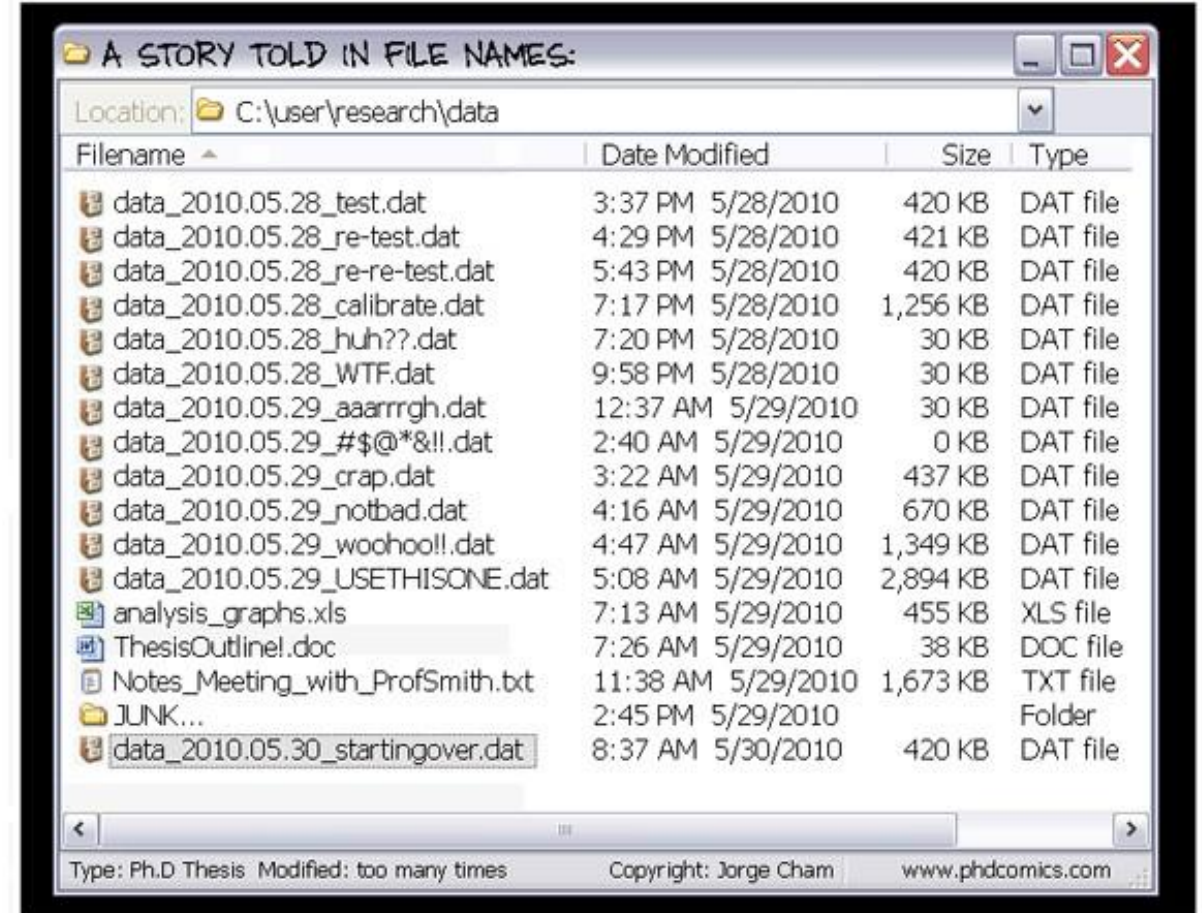
File naming:

- Develop a naming convention and document it
- Easy differentiation in the folder
- Easy identification of different versions
- Understandable for others
- Should still make sense, when files are moved
- Logically sortable
- Do not use special characters such as % or : or !

Data versioning with GitLab

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Versioning tool GitLab:

- E.g. for code, text, vector graphics

- saves and documents changes to files and their source code

- Branching

- Issue tracking

- …

- Additional feature; Mattermost for easy and quick communication

Personal Data

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- Contact the data protection officer of your institution.

- Follow the federal and state data protection laws as well as the European General Data Protection Regulation.

- In the case of surveys/interviews/patient data etc., obtain a written, informed declaration of consent from the persons concerned (right of revocation!).

- Anonymise (if necessary pseudonymise) the collected data.

- Store the raw data protected from access (e.g. encrypted) and separate from the other data (e.g. evaluations).

- Never store personal data of EU citizens on servers outside the EU!

Research data lifecycle: sub-steps

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Analysing data:

- interpret data
- derive data
- care for plausibility and reproducibility of datasets
- produce research outputs/author publications
- prepare data for preservation

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Preserving data

- Convert data to best format

- migrate data to suitable medium

- back-up and store data

- add metadata (better while planning) and documentation

- clarify the financing (better during project planning)

- give the data to preservation specialists, e.g. data repositories/archives

http://data-archive.ac.uk/create-manage/life-cycle

File formats recommended for archiving and reusability
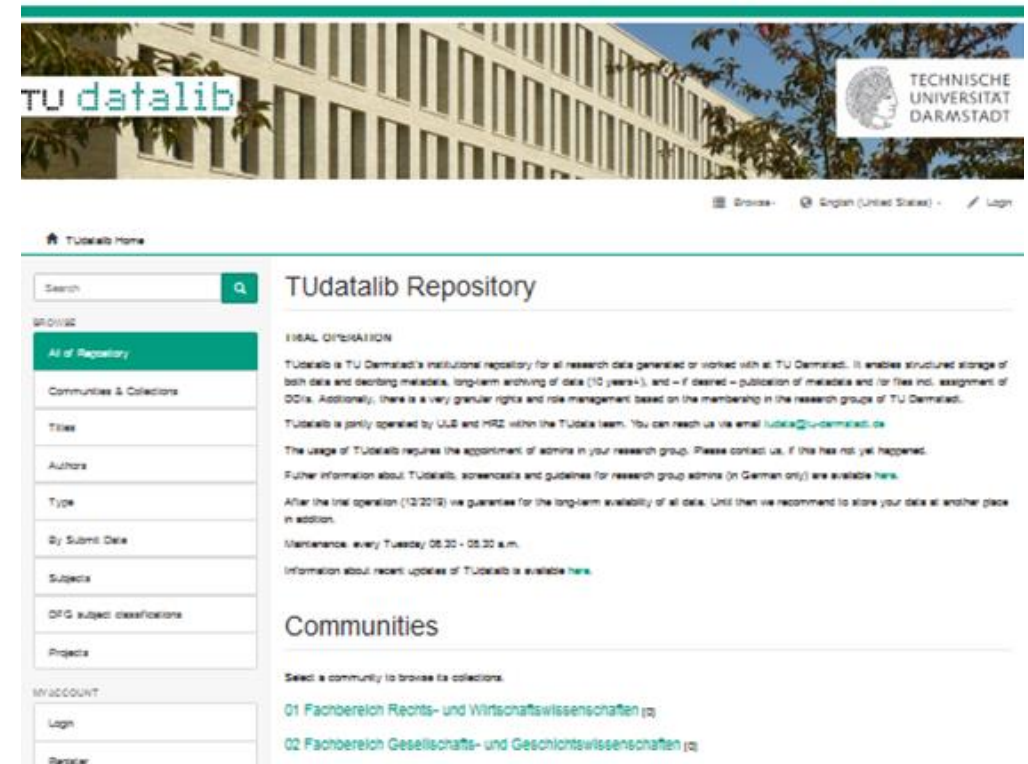
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Recommended formats	Formats to avoid
Tables: CSV, TSV, SPSS portable Text: TXT, HTML, RDF, PDF/A Image: TIFF, JPEG2000, PNG Multimedia: AVI, WAV, MP4	Tables: (Excel; xls) Text: (Word; doc), (PowerPoint; ppt) Image: JPG, GIF Multimedia: WMV (Windows Media Video)

Backup versus archiving

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	Backup	**Archiving**
Target	Active data	Final data
Purpose	Protection and recovery	Preservation of information
Timeframe	Short term	Long term
Metadata	Mainly ACL and file attributes	Data specific

Archiving data at JGU with IRODS

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What is iRODS?

- Virtual Filesystem

- Attached searchable Metadata

- Publishing

- Fine grained Access Control

- Workflow automation

- Commandline tools

Archiving data at TUDa

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What is TUdatalib?

- data sets can be
  ... archived (10 years and longer),
  ... shared with others,
  ... published including DOI and permanent storage.

- very detailed rights and role management based on
  TU-ID and affiliation to TU Darmstadt's institutes

- collaboration with non-TU researchers

- https://tudatalib.ulb.tu-darmstadt.de

Archiving data at GUF

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Backup and archive service

- IBM Spectrum Protect software
- no additional cost to users
- licence fees paid by the HRZ
- Backup for 90 days
- Archiving for 10 years

- For more Information:
- https://www.rz.uni-frankfurt.de/134715246/Backup_und_Archivservice

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5 minutes break

Research data lifecycle: sub-steps

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Giving access to data:

- distribute data

- share data/ e.g. via repositories

- control access

- establish copyright/licenses

- promote data

http://data-archive.ac.uk/create-manage/life-cycle

How to find suitable repositories?

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... use http://www.re3data.org/

Registry of Research Data Repositories

➢ About 3000 entries

Browse by subject

Graphical | Text

click to zoom into subjects or to select a bottommost subject in the hierachy as filter for the re3data search page
ctrl + click on a top subject to select it as filter

http://www.forschungsdaten.org/index.php/Datei:Re3data_icons.jpg

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JGU: Gutenberg Open Science repository

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- Institutional Open Access repository JGU

- Pre and post prints, PhD thesis,

- Research data (up to 4 gb per dataset)
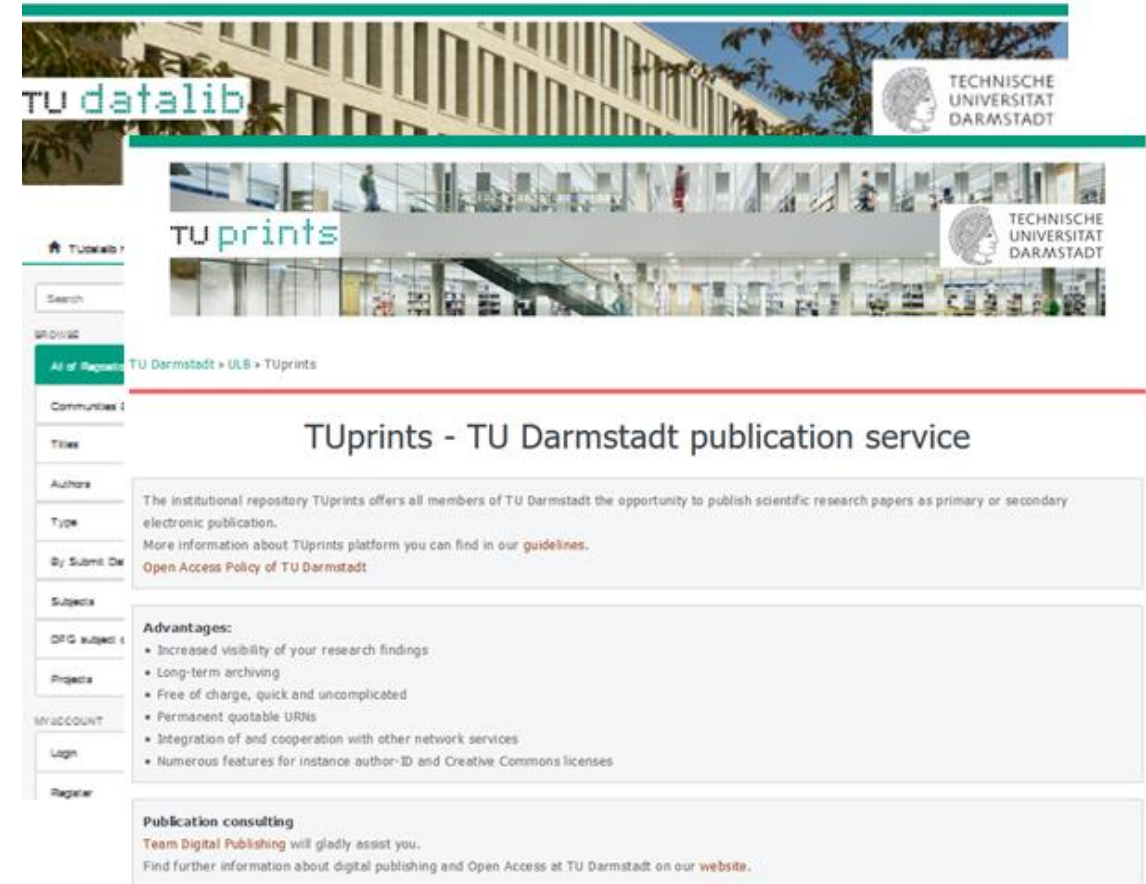
- Standardised meta data

- DOI

- https://openscience.ub.uni-mainz.de/?locale=en

TuDa: Tudatalib & TUprints

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What is TUprints?

- publish scientific **research papers** as primary or secondary electronic publication

- Long-term archiving

- Free of charge, quick and uncomplicated

- Publication consulting by Team Digital Publishing

- https://tuprints.ulb.tu-darmstadt.de/

GUF:

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Goethe University Data Repository (GUDe)

- For all members of GUF

- Permanently store research data

- (for at least 10 years)

- Accordance with FAIR criteria

- Sharing or publishing

- Operated jointly by HRZ and GUF Library

- https://gude.uni-frankfurt.de/home

Or use Zenodo a general repository

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- Open to all fields of science
- Publications and primary research data
- DOI for all uploads
- Hosted and maintained by CERN
- Flexible licensing
- Upload up to 50 GB per dataset
- Access restriction possible (limited in time)

Or other general repositories

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figshare   DRYAD

...

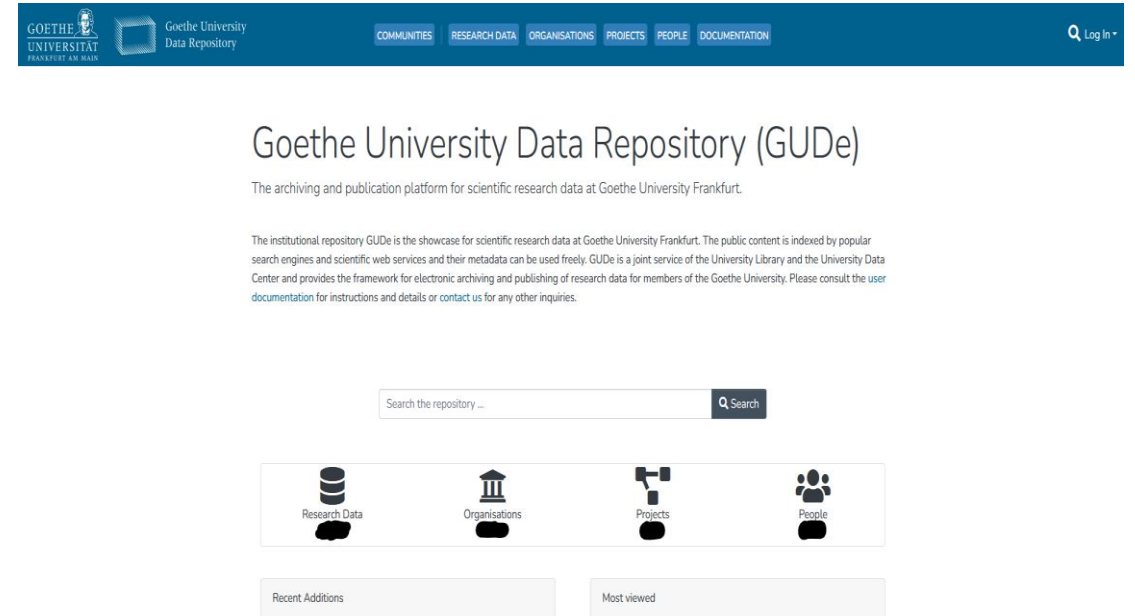# Research data lifecycle: sub-steps

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- **Reusing data:**
- follow-up research
- new research
- undertake research reviews
- standardize findings
- teach and learn

RDM requirements of the third-party funders

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RDM Regulations by third party funders

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➤ DFG: Handling of research data ; RDM Checklist

➤ Horizon Europe: Open Science in Horizon Europe (europa.eu)

➤ BMBF: Aktionsplan Forschungsdaten – BMBF

➤ Volkswagenstiftung

➤ Code of conduct: „Good Research Practice"

https://wissenschaftliche-integritaet.de/

JGU: https://forschung.uni-mainz.de/files/2023/03/00-JGU-Mainz_Ordnung-zur-Sicherung-guter-wiss-Praxis_2023-02-13.pdf

TUDa: https://www.tu-darmstadt.de/forschen/gute_wissenschaftliche_praxis/index.en.jsp

Horizon Europe - RDM

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- No opting-out from RDM anymore (data management plans required!)

- Projects generating research data MUST manage their data responsibly and in accordance with the **FAIR** principles

➢ Open access to research data. "as open as possible, as closed as necessary", i.e. there may be exceptions to open access to research data. (personal data protection, patenting etc.)

DFG: RDM Checklist

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1. Data description

2. Documentation and data quality

3. Storage and technical archiving

4. Legal obligations and conditions

5. Data exchange and long-term data accessibility

6. Responsibilities and resources

DFG Checklist in Detail

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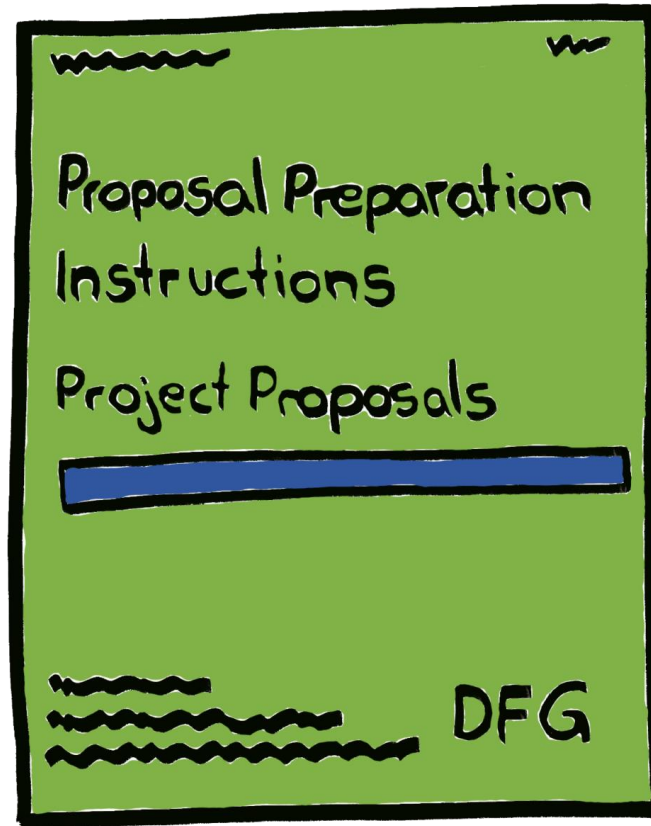**Eine strategische Allianz**

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1. Data description

- Process of data creation

- Data formats (e.g. image data, text data or measurement data)

- Type of data processing

- Expected data volume

2. Documentation and data quality

- Metadata or documentation standards or ontologies

- Quality assurance/control measures

- Necessary methods and tools (software) for data use

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3. Storage and technical backup during the course of the project

- Storage location

- Data protection/backup

- Access and usage management for sensitive data

4. Legal obligations and framework conditions

- Legal specifics in the project

- Impact of specifics on publication/accessibility

- How to take into account ownership and copyright issues

- Existing scientific codes or professional standards

DFG Checklist in Detail

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5. Data exchange and permanent accessibility of the data

- Data suitability for re-use (other context)

- Criteria for data selection for publication

- Archiving data in suitable infrastructure, where?

- Time of publication

- Embargo periods for data publications

6. Responsibilities and resources

- Responsibility for adequate handling of research data

- Resource requirements (costs, time or other)

- Responsibility for data after the end of the project

DFG funding for RDM

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Eligible costs:

- Costs for the preparation of data for subsequent use or for the transfer to existing infrastructures can be raised.

- Costs for the use of relevant infrastructures (e.g. external repositories)

- Funding for personnel costs, user fees

- CRC: INF project, data stewards

Organise your RDM - data mangement plans (DMP)

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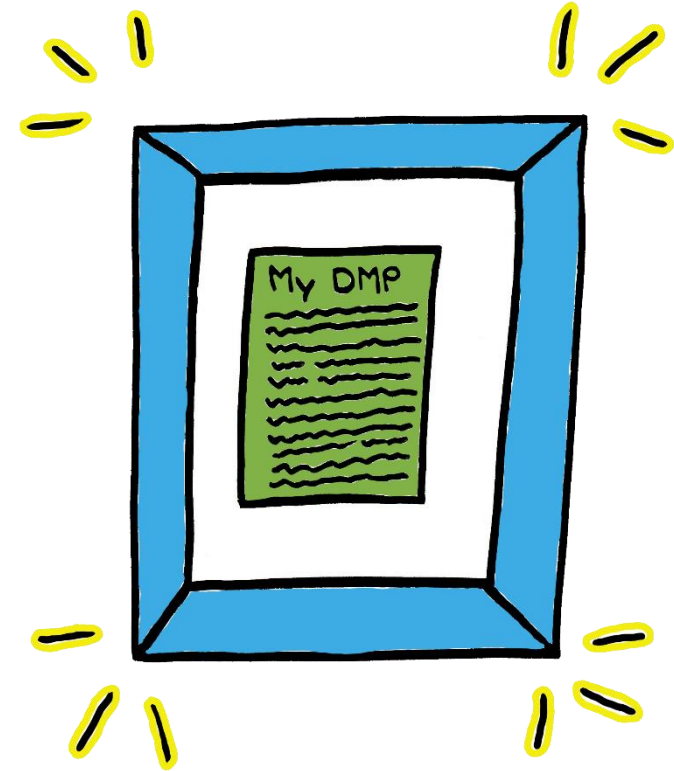**Eine strategische Allianz**

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- describes data handling in a research project
- Divided into different sections
- Obligation of some third-party funders
- formal but dynamic document
- ➢ Make adaptions in the course of the project!

DMP

00001011110
01000101001
0011000011010101000110101
1000101
0101110101

What use has a DMP to me?

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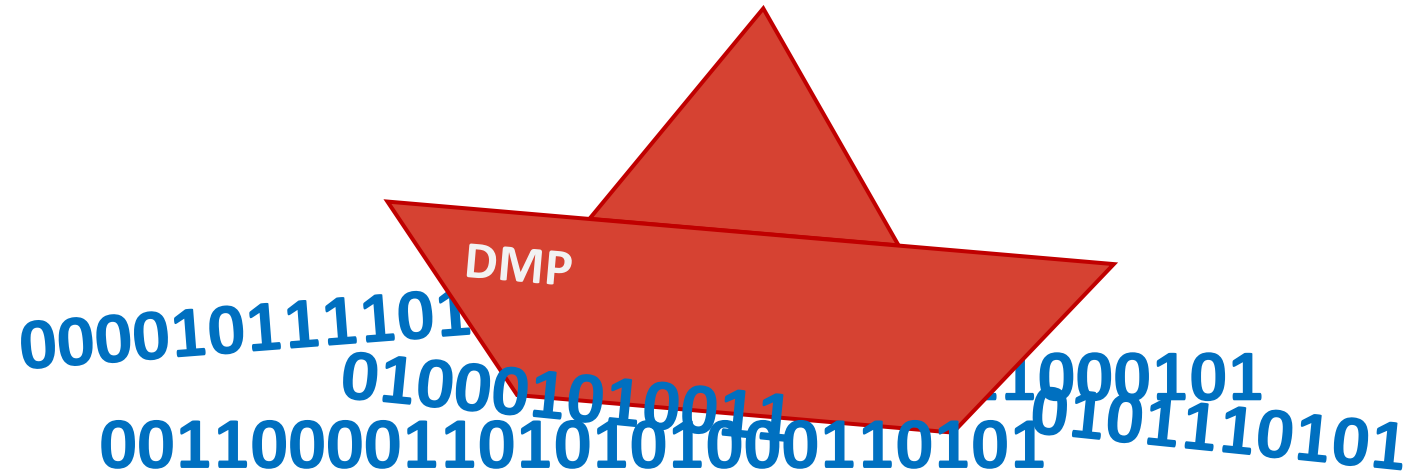
- Saves time in the long run!

- Avoidance of data handling problems by explicit RDM-planning

- Improved data retrival in the final phase of your project

- Facilitates long term preservation of your data and data reuse

Contents of a DMP

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Information about:

- Administrative information

- Documentation and metadata

- Ethical and legal issues

- Storage and back-up

- Data selection and preservation

- Data sharing/publication

- Responsibilities and resources

FARSYD - FArming SYstems as tool to support policies for effective conservation and management of high nature value farmlanDs

A Data Management Plan created using DMPonline

Creators: Ângela Lomba, Yulia Karimova

Affiliation: Other

Funder: European Regional Development Fund (FEDER) & the Portuguese Science Foundation (FCT)

Template: DCC Template

ORCID iD: 0000-0003-3748-8751

Grant number: POCI-01-0145-FEDER-016664- PTDC/AAG-EC/5007/2014

Project abstract:
FARSYD (2016-2019) aims to tackle the relation between farming systems and biodiversity and ecosystem services (BES) in High Nature Value farmlands (HNVf), whilst assessing trade-offs between driving forces behind land-use change, and the safeguard of the natural ad social capital underlying such farmlands.

Last modified: 19-11-2019

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From: https://dmponline.dcc.ac.uk/public_plans

DMP tools

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Lokal tools

- JGU: **RDMO** https://rdmo-01.zdv.Uni-Mainz.de

- TUDa: **TUdmo** https://tudmo.ulb.tu-darmstadt.de

- GUF: **RDMO** https://rdmo.server.uni-frankfurt.de/

External tools:

- **GFBio Data Management Plan Tool:** https://www.gfbio.org/de/plan

- **DMPonline:** https://www.dcc.ac.uk/dmponline

DMP tools: RDMO

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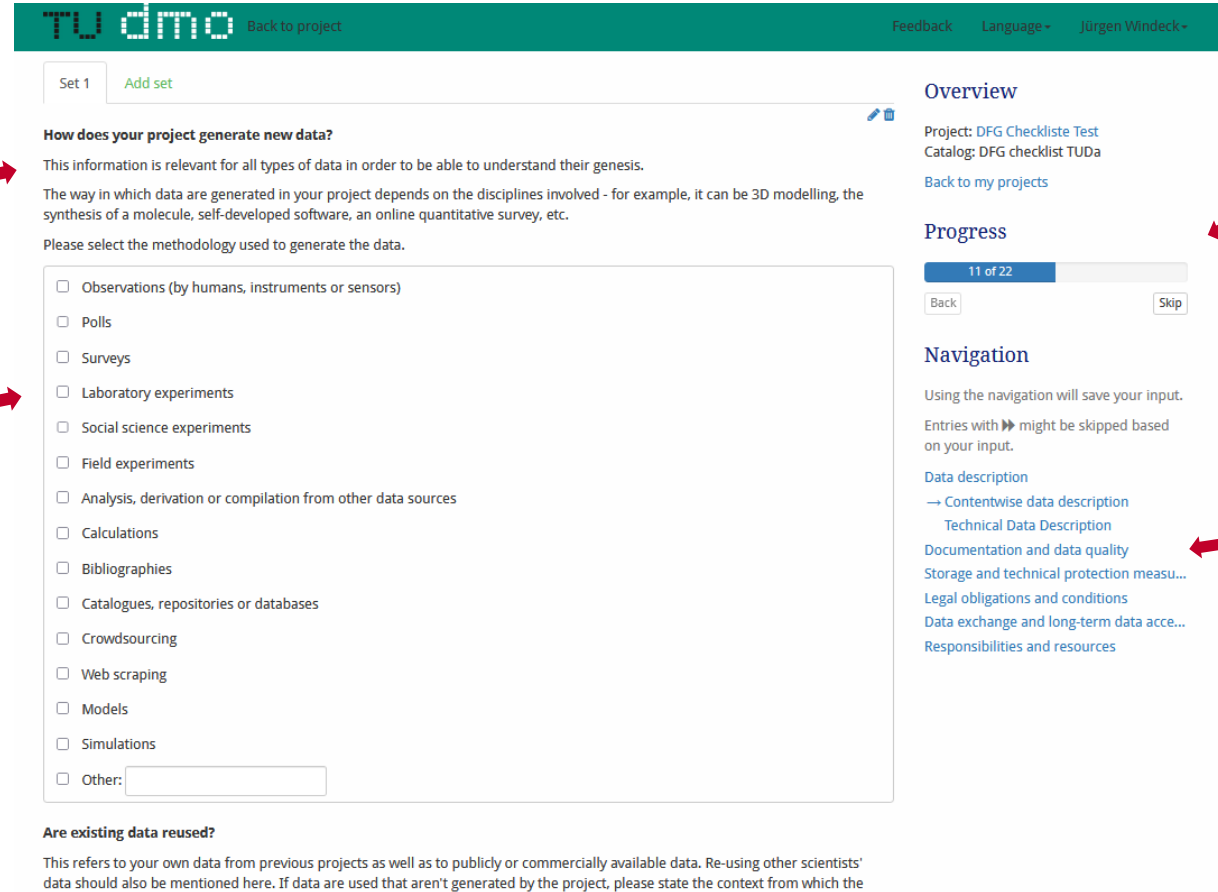
Log in with your university account

https://rdmo.zdv.uni-mainz.de/

DMP tools: RDMO

Questions and information

Answer questions

Completion status

Navigate through different parts of your DMP

RDM services at JGU

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Your Team of Experts Research Data: forschungsdaten@uni-mainz.de

- **Dr. Anne Vieten** (Research and Technology Transfer – general RDM aspects, requirements of funders, DMPs, data publication…)
- **Dr. Jörg Steinkamp** (Data Center – technical RDM aspects, GitLab, data archiving and publication …)
- **Karin Eckert** (University library - Metadata, Gutenberg Open Science, data publication, …)
- **Tina Rotzal and Esther Reinecke** (University library – good scientific practice, academic integrity)

https://www.forschungsdaten.uni-mainz.de/

RDM service at TUDa

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TU data

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tudata@tu-darmstadt.de

RDM service at GUF

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  - eln@ub.uni-frankfurt.de

Thank you for your attention!

Questions?