

SHAREbrain: Standardizing complex functional brain data for reuse

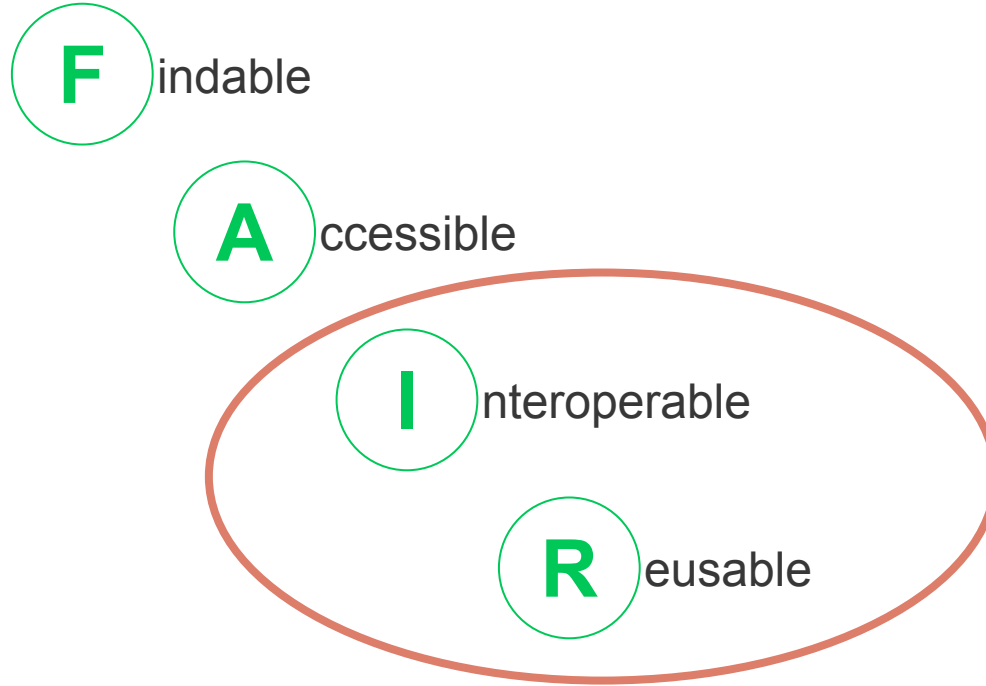
Stockholm, May 2026

Aree Witoelar & Eivind Hennestad



**UNIVERSITY
OF OSLO**

Introduction - Why standardize data?





Reminder: Data Curation Workflow

Monday 14.15-14.45

Introduction to
EBRAINS data and
knowledge services



Sophia Pieschnik



Signý Benediktsdóttir

Tuesday Track 3
EBRAINS Data and
Knowledge Services

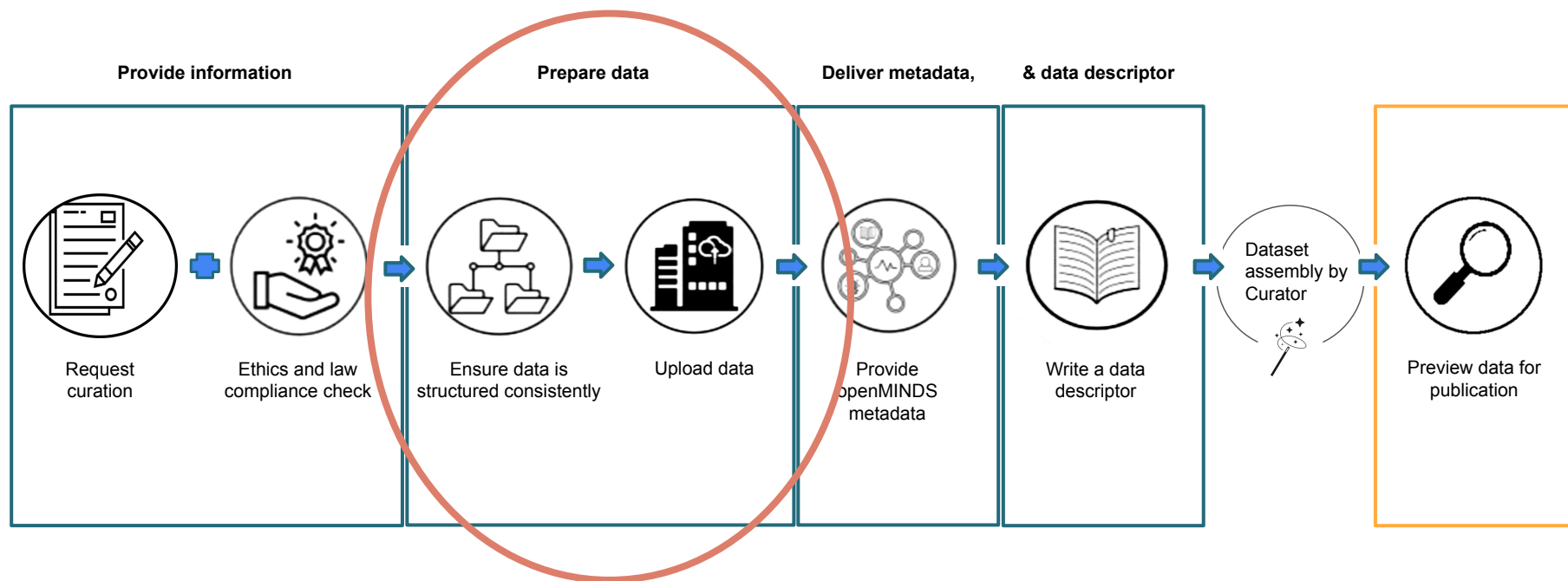


Eivind Hennestad



Aree Witoelar

Reminder: Data Curation Workflow



Introduction - Why is data not standard?

Diverse lab equipment → inconsistent formats



Heterogeneous data formats

Metadata “chaos” → poor data reuse



Ever-changing metadata requirements

Technical standards → steep learning curve

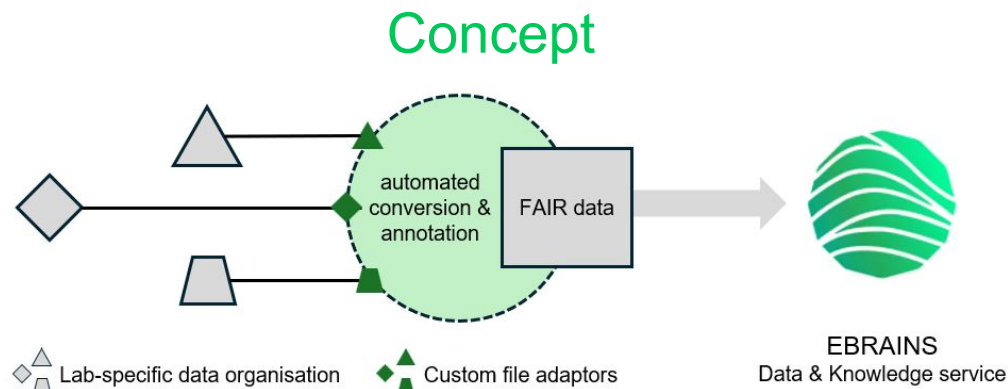


High effort to follow standardization protocols

Cartoons by ChaptGPT

Introducing SHAREbrain

SHAREbrain offers tools and technical solutions for managing, standardising and sharing of neuroscience data. This is a pilot project to be an EBRAINS Service.



Software

Neuroinformatics / Project: meta0000000 / Visualization: Session: EBRAINS													
Overview													
	Subject	Session	Date	Modality	Day	Number/Session	Description	PostTraining	Num/Train	Classification	Time	Experiment	Photo
Subject	IND127	IND127_000000	Feb-20-2024	2-Photon	1	6	CNO	162, 162	0-0-0-0-0				
	IND127	IND127_000001	Feb-20-2024	2-Photon	2	6	saline	162, 162	0-0-0-0-0				
	IND127	IND127_000002	Feb-20-2024	2-Photon	3	5	CNO	162, 162	0-0-0-0-0				
	IND127	IND127_000003	Feb-20-2024	2-Photon	4	5	saline	162, 162	0-0-0-0-0				
	IND127	IND127_000004	Feb-20-2024	2-Photon	5	6	CNO	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200015	Jun-15-2020	2-Photon	1	6	CNO	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200016	Jun-16-2020	2-Photon	2	6	saline	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200017	Jun-17-2020	2-Photon	3	2	CNO	162	0-0-0-0-0				
	KSL109	KSL109_200018	Jun-18-2020	2-Photon	4	6	saline	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200019	Jun-19-2020	2-Photon	5	5	CNO	162, 162	0-0-0-0-0				
	KSL109	KSL109_200020	Jun-20-2020	2-Photon	6	5	saline	162, 162	0-0-0-0-0				
	KSL109	KSL109_200021	Jun-23-2020	2-Photon	2	2	CNO	162	0-0-0-0-0				
	KSL109	KSL109_200024	Jun-24-2020	2-Photon	8	6	saline	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200025	Jun-25-2020	2-Photon	9	7	CNO	N/A	0-0-0-0-0				
	KSL109	KSL109_200026	Jun-26-2020	2-Photon	10	6	saline	162, 162, 162	0-0-0-0-0				
	KSL109	KSL109_200029	Jun-29-2020	2-Photon	11	6	CNO	N/A	0-0-0-0-0				
	KSL109	KSL109_200030	Jun-30-2020	2-Photon	12	6	saline	N/A	0-0-0-0-0				
	KSL109	KSL109_200032	Jul-01-2020	2-Photon	13	6	CNO	N/A	0-0-0-0-0				

SHAREbrain page

uio.no/english/services/it/research/competency-hubs/sharebrain/

(tinyurl.com/sharebrain)



SHAREbrain tools

github.com/Neural-Systems-at-UIO/SHAREbrain



Detour: BIDS and NWB



INCF best practices and standards: <https://www.incf.org/resources/sbps>



BIDS

(Neuroimaging and behavioral data)

<https://bids.neuroimaging.io/>



BIDS

ENDORSED

RRID:SCR_016124

The Brain Imaging Data Structure

(BIDS) is a standard prescribing a formal way to name and organize MRI data and metadata in a file

system that simplifies communication and collaboration between users and enables easier data validation and software... [Read more](#)



NWB

(Neurophysiology data)

<https://www.nwb.org/>



NWB:N

ENDORSED

RRID:SCR_015242

Neurodata Without Borders (NWB) is a data standard for neurophysiology, providing neuroscientists with a common standard to share, archive,

use, and build analysis tools for neurophysiology data. NWB is designed to store a variety of neurophysiology... [Read more](#)



Detour: BIDS

Brain Imaging Data Structure



Standardized Organization

BIDS provides a consistent way to organize your neuroimaging data, making it easy to understand and share across research groups and institutions.

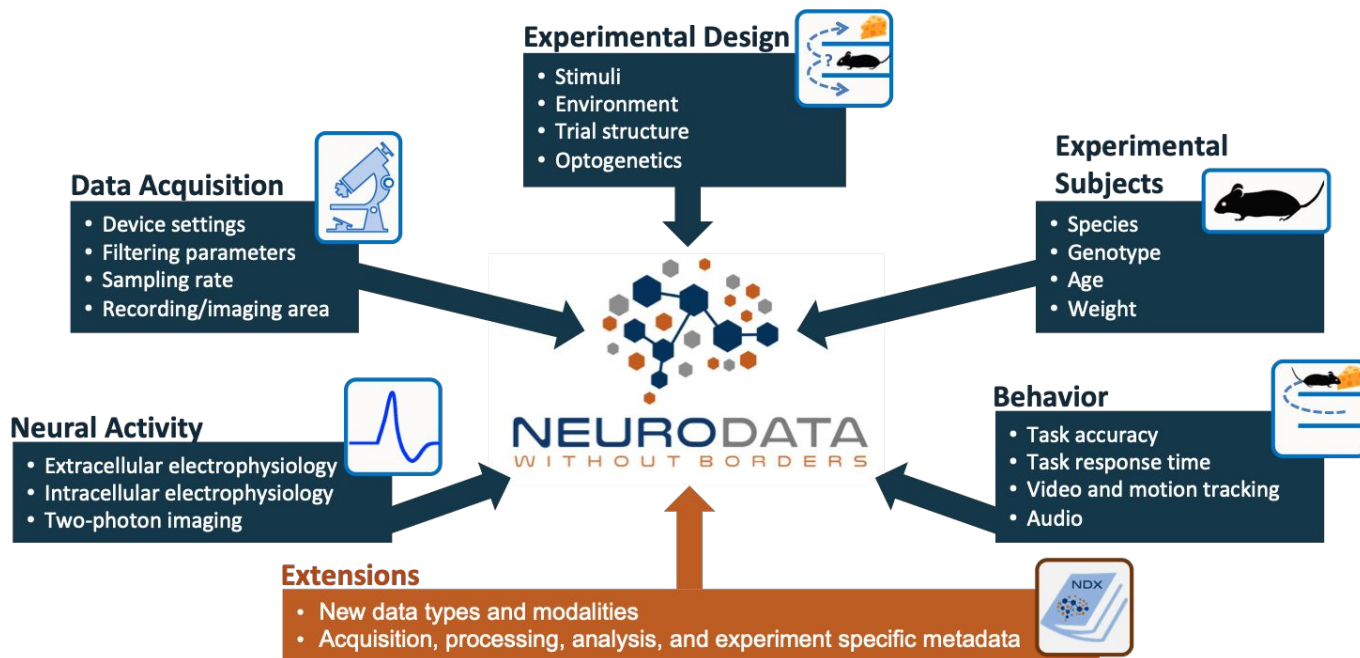
```
project/  
└─ subject  
    └─ session  
        └─ datatype
```

<https://bids.neuroimaging.io/>



Detour: NWB

Neurodata Without Borders



<https://nwb.org/>



Neurobiology



Marianne
Fyhn



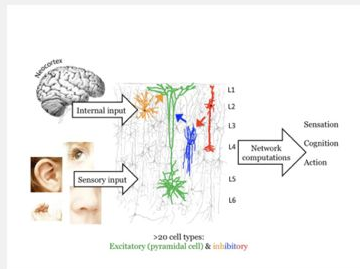
Kristian
Lensjø

extracellular recordings
2-photon microscopy



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Neural Computation



Koen
Vervaeke



Mate
Neubrandt



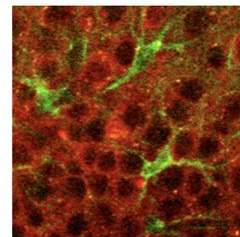
Nora
Ebbesen

2-photon mesoscopes
optogenetics



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GliaLab



Rune
Enger



Laura
Bojarskaite



Luca
Bordini

astrocytes
blood vessels

sharp wave
ripples



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Lab-specific organization

Lensjø

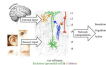


- data
 - KKL109
 - behavior
 - 200615_000.txt
 - 200615_001.txt
 - 200615_002.txt
 - 200615_003.txt
 - 200615_009.txt
 - 200615_010.txt

Project

- Subject
 - Session
 - Data Type

Ebbesen



- sData (1P & 2P)
 - DAY 1 (5HT)
 - m1581-20241015-01.mat
 - m1585-20241218-01.mat
 - m1616-20250407-01--.mat
 - m1617-20250407-01--.mat
 - DAY 1 (ACH)
 - m1582-20241015-01.mat
 - m1586-20250114-01.mat
 - m1609-20250407-01--.mat
 - m1618-20250702-01--.mat
 - m1619-20250702-01--.mat
 - m1623-20250917-01--.mat
 - DAY 1 (Control)
 - m1583-20241015-01--.mat
 - m1591-20241218-01--.mat
 - m1613-20250407-01.mat
 - m1620-20250702-01--.mat
 - m1621-20250702-01--.mat
 - DAY 1 (DA)
 - m1580-20241015-01--.mat
 - m1588-20241219-01.mat
 - m1614-20250407-01--.mat
 - m1615-20250407-01--.mat
 - m1626-20250917-01--.mat

Project

- Group
 - Session

Bojarskaite



- Data
 - Labview
 - 2024-12-04_102815
 - Log.csv
 - Preflight trial dir
 - trial_001
 - camera_time.csv
 - camera.avi
 - eeg.csv
 - frame_time.lvm
 - FrameCount.csv
 - Logpart.csv
 - Notes.txt
 - Wheel.csv
 - trial_002
 - 2024-12-05_114412
 - 2024-12-06_113130
 - Tseries
 - 20241204_normoF1
 - file_00001.tif
 - file_00002.tif
 - file_00003.tif
 - file_00004.tif
 - file_00005.tif
 - 20241205_hyperF1_TL

Equipment

- Date
 - Session
 - Data Type

BIDS

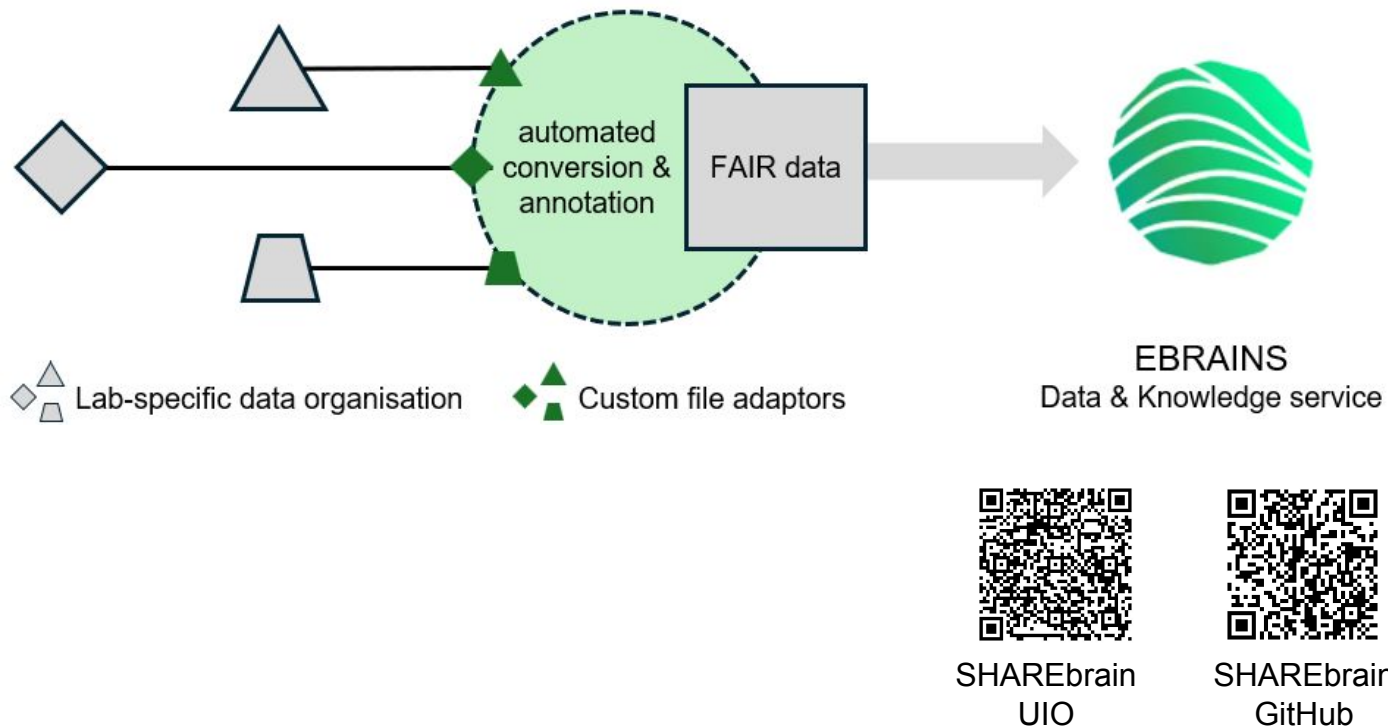
```
ds001
├── dataset_description.json
├── participants.tsv
├── sub-01
│   ├── anat
│   │   ├── sub-01_inplaneT2.nii.gz
│   │   └── sub-01_T1w.nii.gz
│   └── func
│       ├── sub-01_task-balloonanalogrisktask_run-01_bold.nii.gz
│       ├── sub-01_task-balloonanalogrisktask_run-01_events.tsv
│       ├── sub-01_task-balloonanalogrisktask_run-02_bold.nii.gz
│       ├── sub-01_task-balloonanalogrisktask_run-02_events.tsv
│       ├── sub-01_task-balloonanalogrisktask_run-03_bold.nii.gz
│       └── sub-01_task-balloonanalogrisktask_run-03_events.tsv
├── sub-02
│   ├── anat
│   │   ├── sub-02_inplaneT2.nii.gz
│   │   └── sub-02_T1w.nii.gz
│   └── func
│       ├── sub-02_task-balloonanalogrisktask_run-01_bold.nii.gz
│       ├── sub-02_task-balloonanalogrisktask_run-01_events.tsv
│       ├── sub-02_task-balloonanalogrisktask_run-02_bold.nii.gz
│       ├── sub-02_task-balloonanalogrisktask_run-02_events.tsv
│       ├── sub-02_task-balloonanalogrisktask_run-03_bold.nii.gz
│       └── sub-02_task-balloonanalogrisktask_run-03_events.tsv
├── ...
└── task-balloonanalogrisktask_bold.json
```

Project

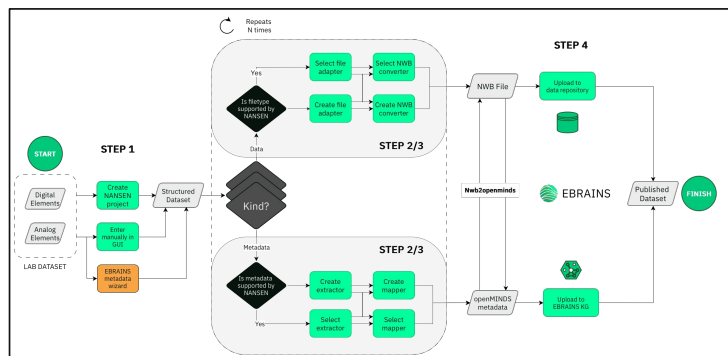
- Subject
 - Session
 - Data Type



SHAREbrain



Next: The SHAREbrain workflow



SHAREbrain
workflow

NANSEN
toolbox

Nansen | Project: lnmjo2025 | Metatable: Session (idle)

Overview | File Viewer | Task Processor

Session	subjectID	sessionID	Date	Modality	Day	NumBehavior...	Description	PostTraining...	NumTrainin...	Data...
ING127	ING127_240220	Feb-20-2024	2-Photon	1	5	CNO	162, 162	162, 162	162, 162	162, 162
ING127	ING127_240221	Feb-21-2024	2-Photon	2	5	saline	162, 162	162, 162	162, 162	162, 162
ING127	ING127_240222	Feb-22-2024	2-Photon	3	5	CNO	162, 162	162, 162	162, 162	162, 162
ING127	ING127_240223	Feb-23-2024	2-Photon	4	5	saline	162, 162	162, 162	162, 162	162, 162
ING127	ING127_240224	Feb-24-2024	2-Photon	5	6	CNO	162, 162, 82	162, 162, 82	162, 162, 82	162, 162, 82
KKL109	KKL109_200615	Jun-15-2020	2-Photon	1	6	CNO	162, 162, 163	162, 162, 163	162, 162, 163	162, 162, 163
KKL109	KKL109_200616	Jun-16-2020	2-Photon	2	4	saline	162, 162, 162	162, 162, 162	162, 162, 162	162, 162, 162
KKL109	KKL109_200617	Jun-17-2020	2-Photon	3	2	CNO	162	162	162	162
KKL109	KKL109_200618	Jun-18-2020	2-Photon	4	6	saline	162, 162, 162	162, 162, 162	162, 162, 162	162, 162, 162
KKL109	KKL109_200619	Jun-19-2020	2-Photon	5	3	CNO	162, 162	162, 162	162, 162	162, 162
KKL109	KKL109_200622	Jun-22-2020	2-Photon	6	3	saline	162, 162	162, 162	162, 162	162, 162
KKL109	KKL109_200623	Jun-23-2020	2-Photon	7	2	CNO	162	162	162	162
KKL109	KKL109_200624	Jun-24-2020	2-Photon	8	5	saline	162, 162, 162	162, 162, 162	162, 162, 162	162, 162, 162
KKL109	KKL109_200625	Jun-25-2020	2-Photon	9	1	CNO	N/A	N/A	N/A	N/A
KKL109	KKL109_200626	Jun-26-2020	2-Photon	10	6	saline	162, 162, 162	162, 162, 162	162, 162, 162	162, 162, 162
KKL109	KKL109_200629	Jun-29-2020	2-Photon	11	6	CNO	N/A	N/A	N/A	N/A
KKL109	KKL109_200630	Jun-30-2020	2-Photon	12	6	saline	N/A	N/A	N/A	N/A

142 sessions | Status: idle



SHAREbrain
UIO



SHAREbrain
GitHub



EBRAINS

EBRAINS 2.0

PART II

SHAREbrain Workflow



Co-funded by
the European Union

EBRAINS 2.0 has received funding from the European Union's Research and Innovation Program Horizon Europe under Grant Agreement No. 101147319.



The SHAREbrain workflow

Developed for researchers at University of Oslo, built for the world.

Provided as a collection of open source MATLAB toolboxes



Neural-Systems-at-UIO / SHAREbrain





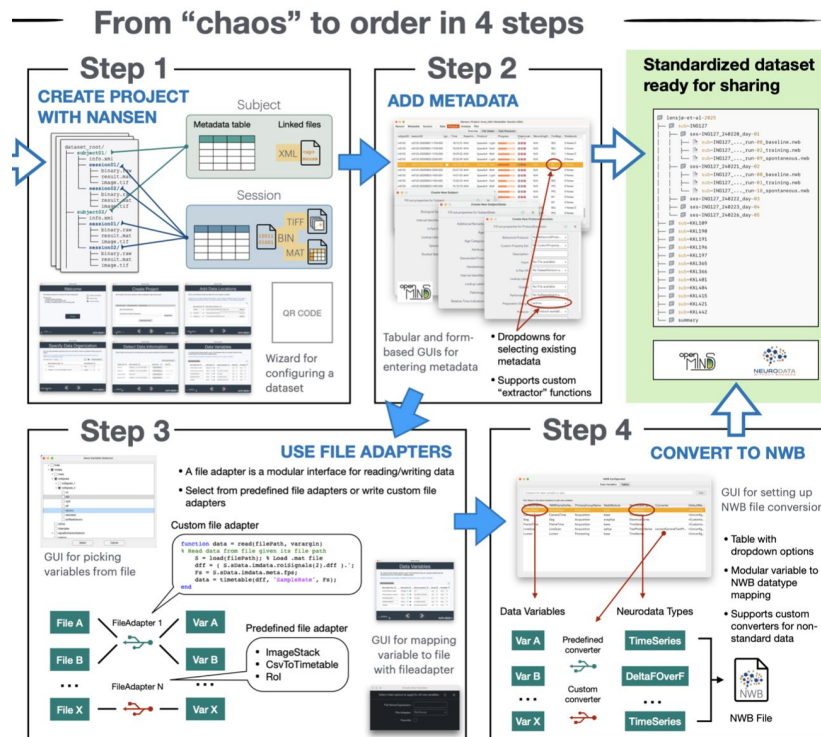
Principles

1. Automate the work **researchers should not do**
2. **Don't change** the source data
3. Use **existing** standards - NWB and openMINDS are standards with a growing community.
4. Rely on small, modular and reusable pieces

SHARebrain Workflow

Poster

Plug for FENS2026 in Barcelona

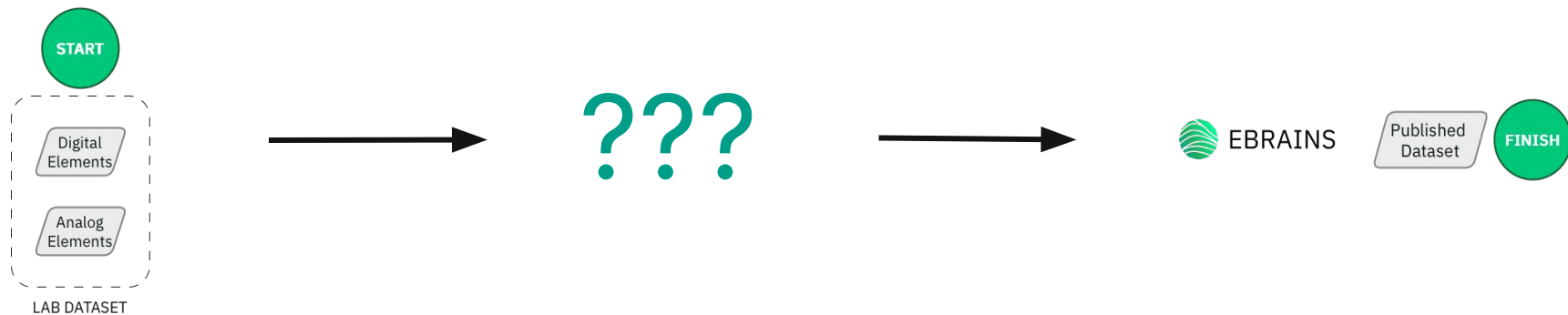


"Chaos" to order in 4 steps

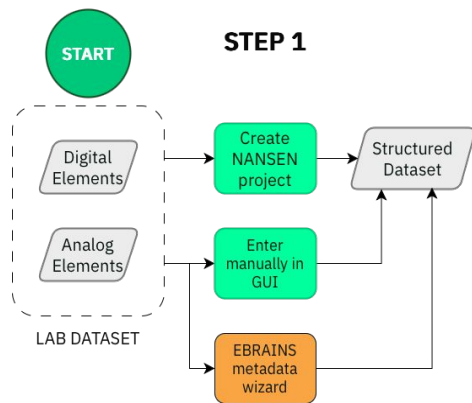
1. Dataset organization
2. Metadata extraction and mapping
3. Data conversion
4. Dataset upload and publication



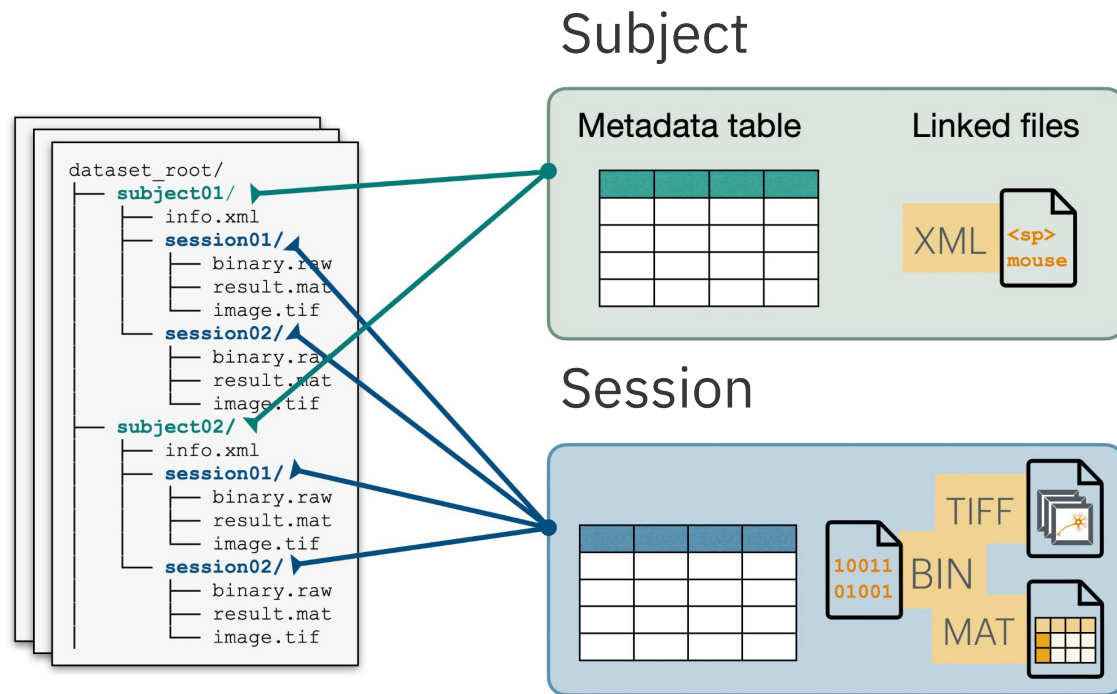
Introducing the SHAREbrain workflow



Workflow Step 1: Dataset organization



Workflow Step 1: Dataset Organization



Placeholder
Data Variables
from linked files
File adapters

Map folder organization to an entity representation (Subject/Session)

Workflow Step 1: Dataset Organization

The screenshots illustrate the following steps in the Nansen Setup workflow:

- Welcome**: The initial configuration dialog with a 'Let's go!' button.
- Create Project**: A screen to enter a project name and a local path for configuration data, with a 'Create New Project' button.
- Add Data Locations**: A screen to specify root directories for raw data, with a 'Browse...' button for each location.
- Specify Data Organization**: A screen to define subfolder organization, including a 'Select subfolder example' and a 'Set subfolder type' dropdown.
- Detect Data Information**: A screen to select folders and parts of filenames that uniquely identify data, with a table for variable names and folder names.
- Data Variables**: A screen to define data variables, including a table for variable names, data locations, filename expressions, file types, and file adapters.

How: Interactive step-by-step configuration wizard

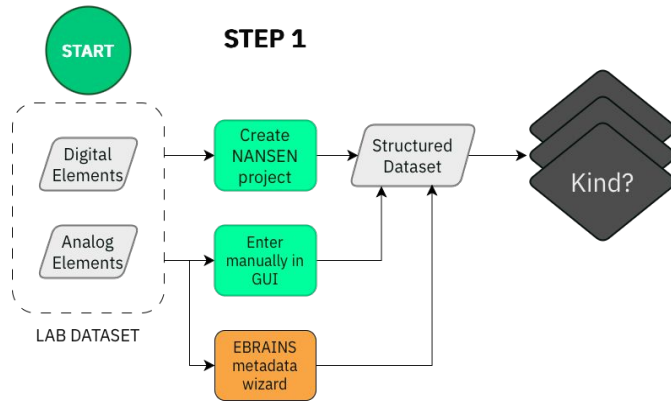
Workflow Step 1: Dataset Organization

The screenshot shows the EBRINS 2.0 dataset explorer interface. The window title is "Nansen | Project: lensjo2025 | Metatable: Session (idle)". The menu bar includes "Nansen", "Metatable", "Session", "Apps", "Tools", "Data", "Process", "Analyze", "Plot", and "Help". Below the menu bar are tabs for "Overview", "File Viewer", and "Task Processor". On the left, there is a sidebar with a "Session" button (highlighted in orange) and a "Subject" button. The main area displays a table of sessions with the following columns: subjectID, sessionID, Date, Modality, Day, NumBehavior..., Description, PostTraining..., NumTrainin..., DataLocation, Time, Experim..., and Protoc. The table contains 142 sessions, with the first 13 rows visible. The sessions are organized by subject (ING127 and KKL109) and date. The "DataLocation" column shows a series of colored dots (grey and red) representing data availability. The status bar at the bottom indicates "142 sessions | Status: Idle".

subjectID	sessionID	Date	Modality	Day	NumBehavior...	Description	PostTraining...	NumTrainin...	DataLocation	Time	Experim...	Protoc
ING127	ING127_240220	Feb-20-2024	2-Photon	1	5	CNO	162, 162	162, 162	●●●●●			
ING127	ING127_240221	Feb-21-2024	2-Photon	2	5	saline	162, 162	162, 162	●●●●●			
ING127	ING127_240222	Feb-22-2024	2-Photon	3	5	CNO	162, 162	162, 162	●●●●●			
ING127	ING127_240223	Feb-23-2024	2-Photon	4	5	saline	162, 162	162, 162	●●●●●			
ING127	ING127_240226	Feb-26-2024	2-Photon	5	6	CNO	162, 162, 82	162, 162, 82	●●●●●			
KKL109	KKL109_200615	Jun-15-2020	2-Photon	1	6	CNO	162, 162, 163	162, 162, 163	●●●●●			
KKL109	KKL109_200616	Jun-16-2020	2-Photon	2	4	saline	162, 162, 162	162, 162, 162	●●●●●			
KKL109	KKL109_200617	Jun-17-2020	2-Photon	3	2	CNO	162	162	●●●●●			
KKL109	KKL109_200618	Jun-18-2020	2-Photon	4	6	saline	162, 162, 162	162, 162, 162	●●●●●			
KKL109	KKL109_200619	Jun-19-2020	2-Photon	5	3	CNO	162, 162	162, 162	●●●●●			
KKL109	KKL109_200622	Jun-22-2020	2-Photon	6	3	saline	162, 162	162, 162	●●●●●			
KKL109	KKL109_200623	Jun-23-2020	2-Photon	7	2	CNO	162	162	●●●●●			
KKL109	KKL109_200624	Jun-24-2020	2-Photon	8	5	saline	162, 162, 162	162, 162, 162	●●●●●			
KKL109	KKL109_200625	Jun-25-2020	2-Photon	9	1	CNO	N/A	N/A	●●●●●			
KKL109	KKL109_200626	Jun-26-2020	2-Photon	10	6	saline	162, 162, 162	162, 162, 162	●●●●●			
KKL109	KKL109_200629	Jun-29-2020	2-Photon	11	6	CNO	N/A	N/A	●●●●●			
KKL109	KKL109_200630	Jun-30-2020	2-Photon	12	6	saline	N/A	N/A	●●●●●			
KKL109	KKL109_200701	Jul-01-2020	2-Photon	13	4	CNO	N/A	N/A	●●●●●			

What you end up with: Interactive dataset explorer

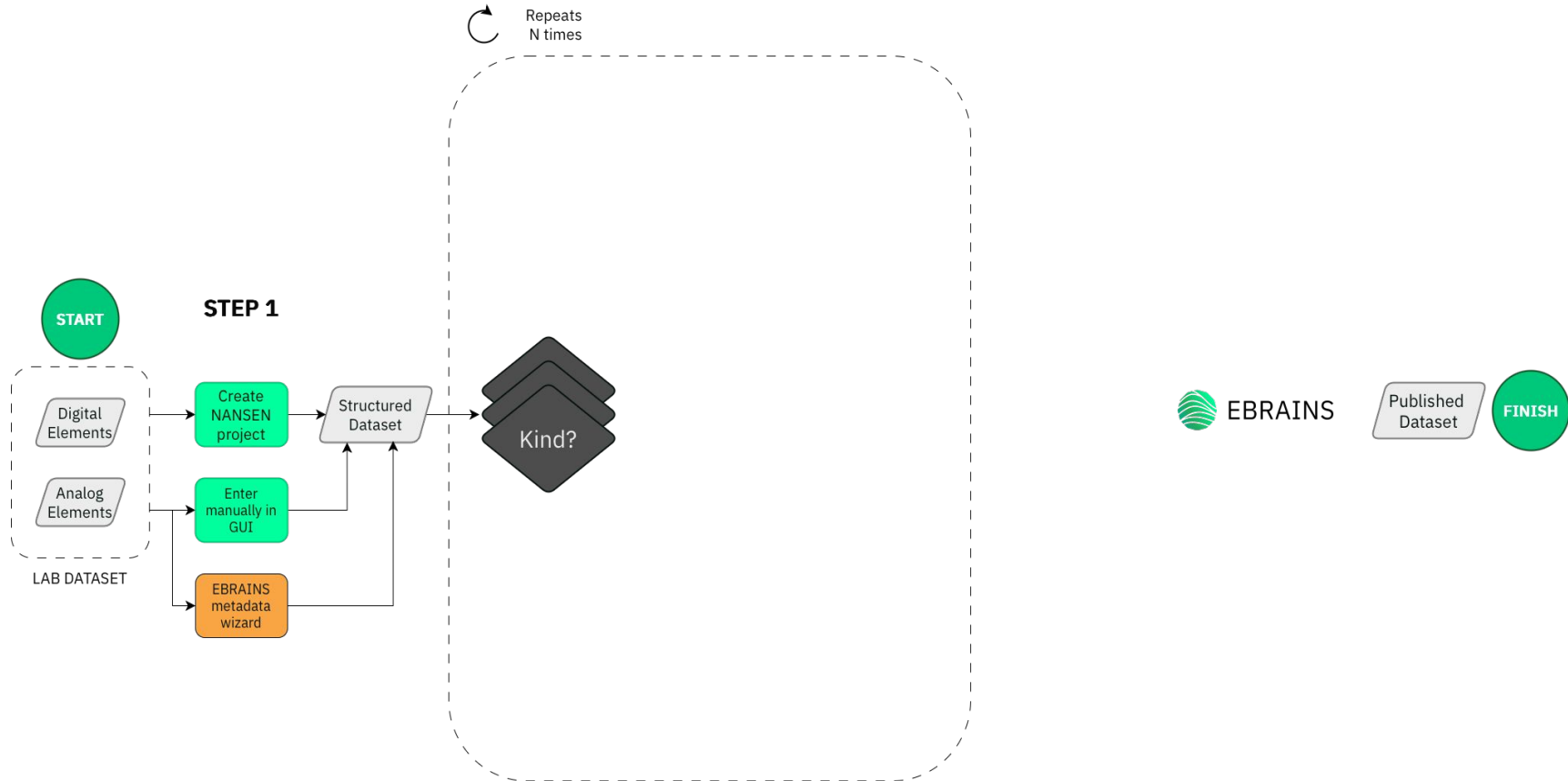
Workflow Step 2+3: Data + metadata



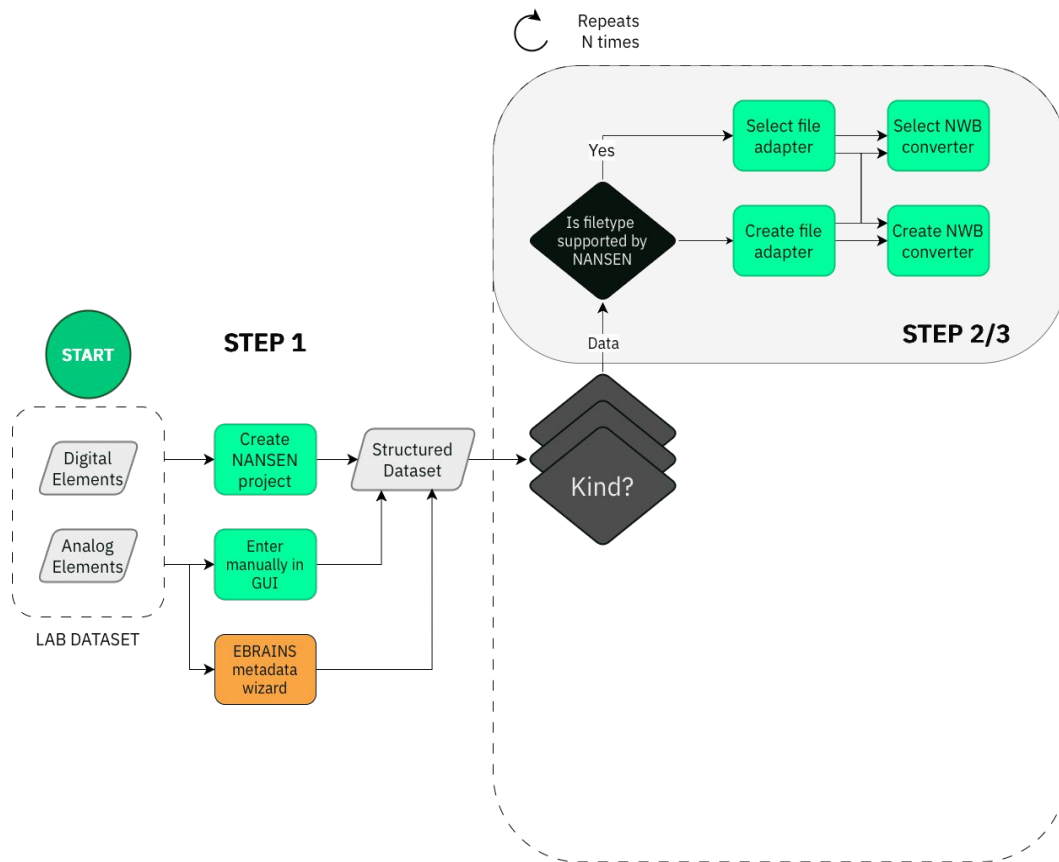
Published Dataset



Workflow Step 2+3: Data + metadata



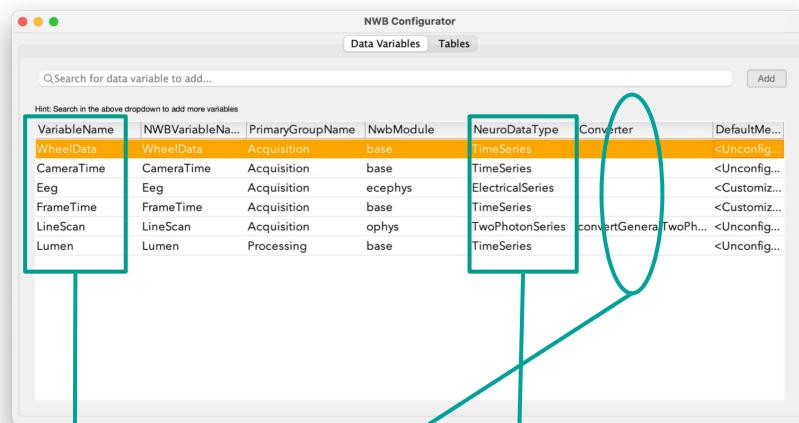
Workflow Step 2: Data



Published
Dataset

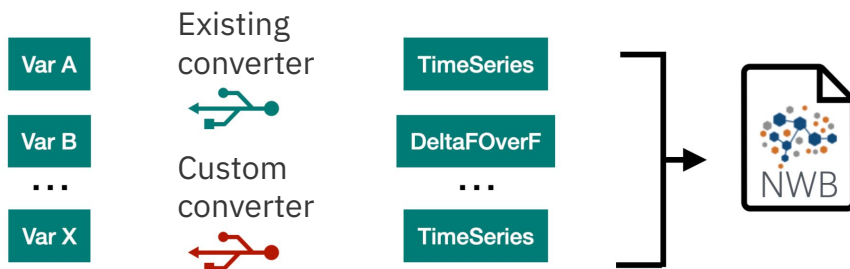


Workflow Step 2: Data conversion



Data Variables

Neurodata Types

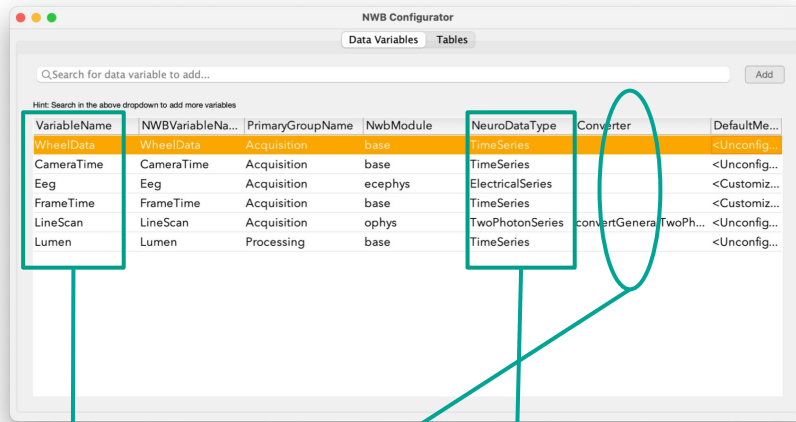


Interactive NWB file conversion

1. Select data variables
2. Select destination in NWB file
3. Select neurodata type
4. Select converter plugin (optional)
5. Add data-specific metadata

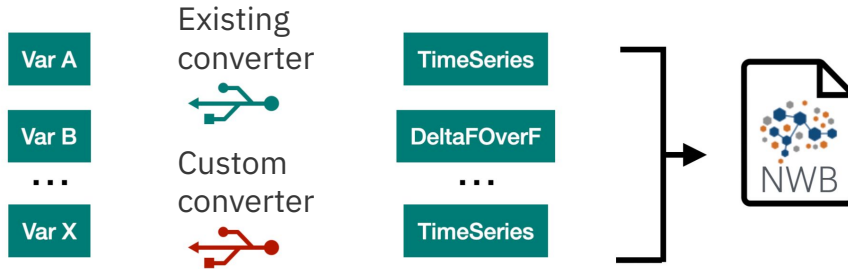
Repeat for X variables

Workflow Step 2: Data conversion



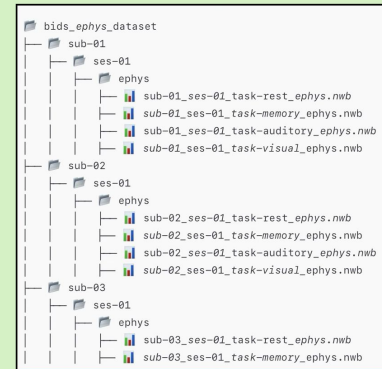
Data Variables

Neurodata Types

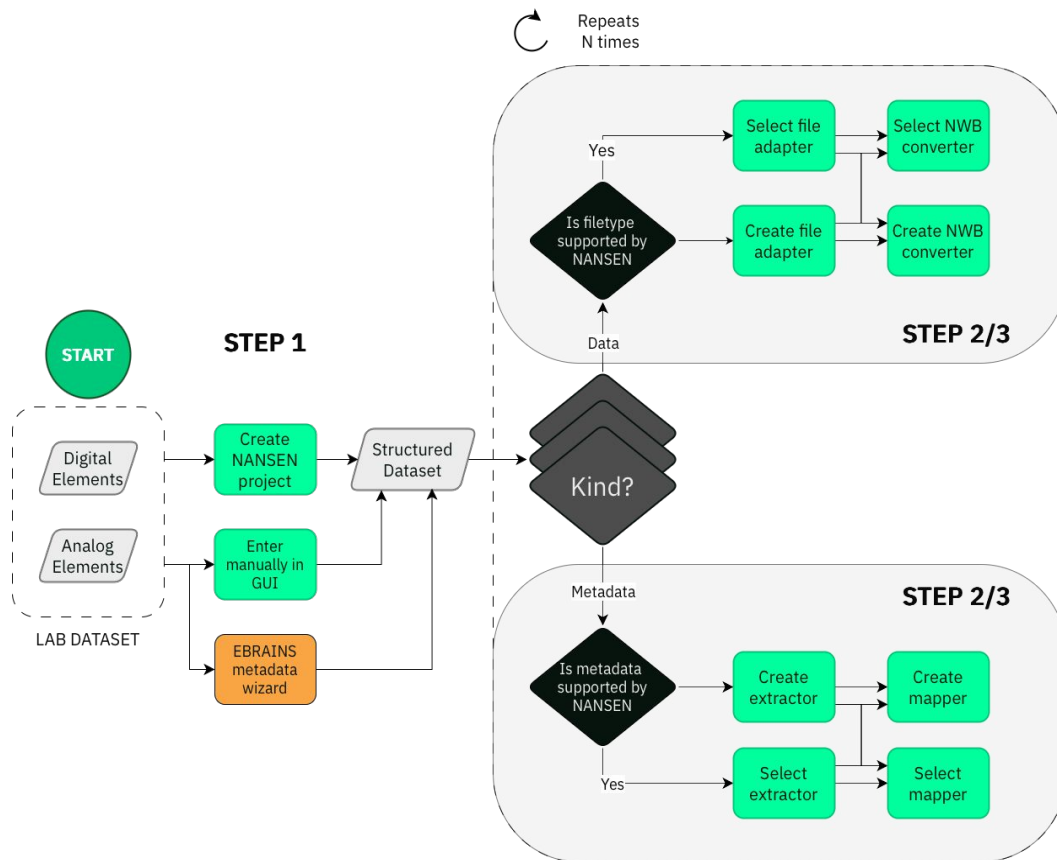


**Standardized dataset
ready for sharing**

Neurodata without
Borders (NWB)



Workflow Step 3: Metadata



EBRAINS

Published
Dataset**FINISH**

Workflow Step 3: Metadata extraction and mapping

Nansen | Project: lensjo2025 | Metatable: Session (idle)

Session | Subject

subjectID	sessionID	Date	Modality	Day	NumBehavior...	Description	PostTraining...	NumTrainin...	DataLocation	Time	Experim...	Protoc
ING127	ING127_240220	Feb-20-2024	2-Photon	1	5	CNO	162, 162					
ING127	ING127_240221											
ING127	ING127_240222											
ING127	ING127_240223											
ING127	ING127_240226											
KKL109	KKL109_200615	Jun-15-2020	2-Photon	1	6	CNO	162, 162, 163					
KKL109	KKL109_200616	Jun-16-2020	2-Photon	2	4	saline	162, 162, 162					
KKL109	KKL109_200617	Jun-17-2020	2-Photon	3	2	CNO	162					
KKL109	KKL109_200618	Jun-18-2020	2-Photon	4	6	saline	162, 162, 162					
KKL109	KKL109_200619	Jun-19-2020	2-Photon	5	3	CNO	162, 162					
KKL109	KKL109_200622	Jun-22-2020	2-Photon	6	3	saline	162, 162					
KKL109	KKL109_200623	Jun-23-2020	2-Photon	7	2	CNO	162					
KKL109	KKL109_200624	Jun-24-2020	2-Photon	8	5	saline	162, 162, 162					
KKL109	KKL109_200625	Jun-25-2020	2-Photon	9	1	CNO	N/A					
KKL109	KKL109_200626	Jun-26-2020	2-Photon	10	6	saline	162, 162, 162					
KKL109	KKL109_200629	Jun-29-2020	2-Photon	11	6	CNO	N/A					
KKL109	KKL109_200630	Jun-30-2020	2-Photon	12	6	saline	N/A					
KKL109	KKL109_200701	Jul-01-2020	2-Photon	13	4	CNO	N/A					

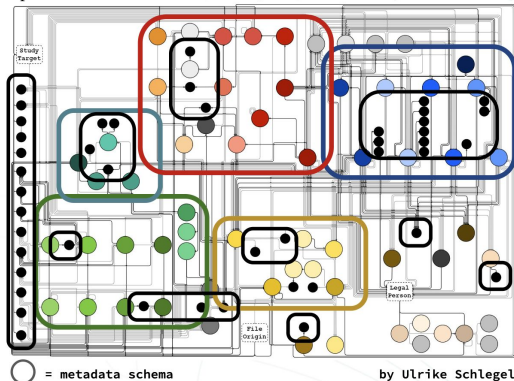
142 sessions | Status: idle

Use existing, or create custom extractors per metadata field

Workflow Step 3: Metadata extraction and mapping

- Knowing which metadata types to connect in order to form valid openMINDS metadata is expert knowledge.
- Researchers fill in domain-level templates (flat dictionaries) - automation remaps that onto subgraphs of openMINDS metadata types.

openMINDS metadata models: core, controlledTerms & SANDS



1. Flat form

Simple form used for data entry

Subject	
Subject ID:	sub-001
Species:	Mus musculus
Strain:	C57BL/6J
Subject state (before)	
Label:	before
Age category:	adult
Protocol execution	
Execution ID:	pe-001
Subject state (after)	
Label:	after
Age category:	adult
Descended from:	before
Protocol	
Name:	visual stimulation
Description:	drifting grating stimulus
Technique:	electrophysiology
Dataset version	
Version:	ds-v1.0

2. Metadata graph

The filled form is mapped into linked metadata types

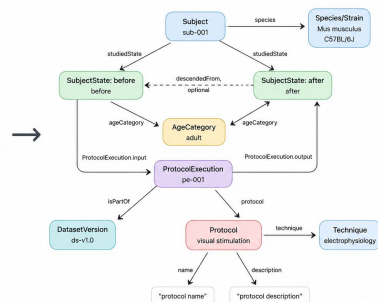
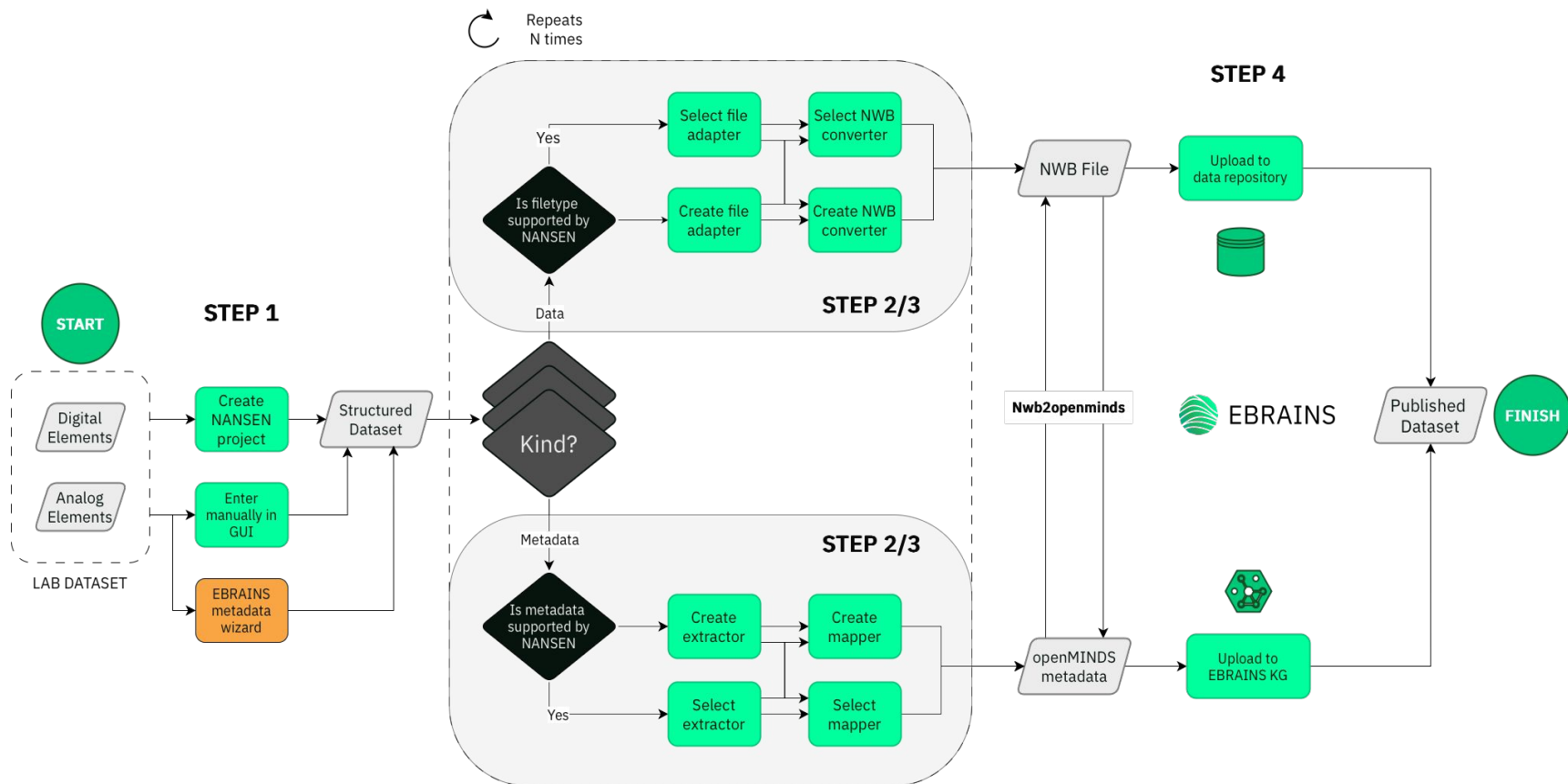


Illustration by chatGPT

Workflow Step 4: Export and upload



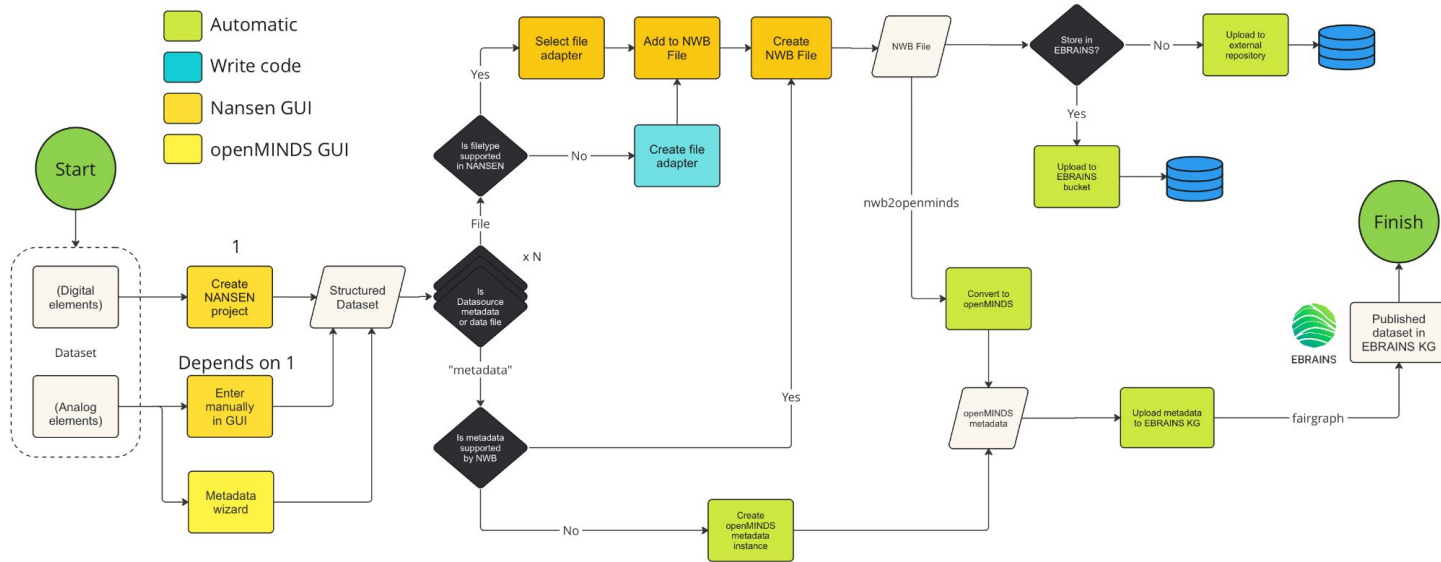


Workflow Step 4: Dataset upload

SHAREbrain provides methods that

1. Automates file upload to dataset buckets
2. Uploads openMINDS json-ld files directly to the EBRAINS Knowledge Graph

Old workflow diagram





Outlook @Eivind

- Uplifting comments about AI taking over:
 - AI to help with data conversion
 - AI to extract metadata
- Working with researchers and curators is key
- Stuff from the proposal
- Agent skills:
 - Create NANSEN project - scan folders and files, create DataLocationModel
 - Create FileAdapters - How to read data from files
 - Create NWB converters
 - Extract Metadata



Enter AI Agents - Two emerging concepts

AGENT = Harness + model

HARNESS - Everything that is not the model?

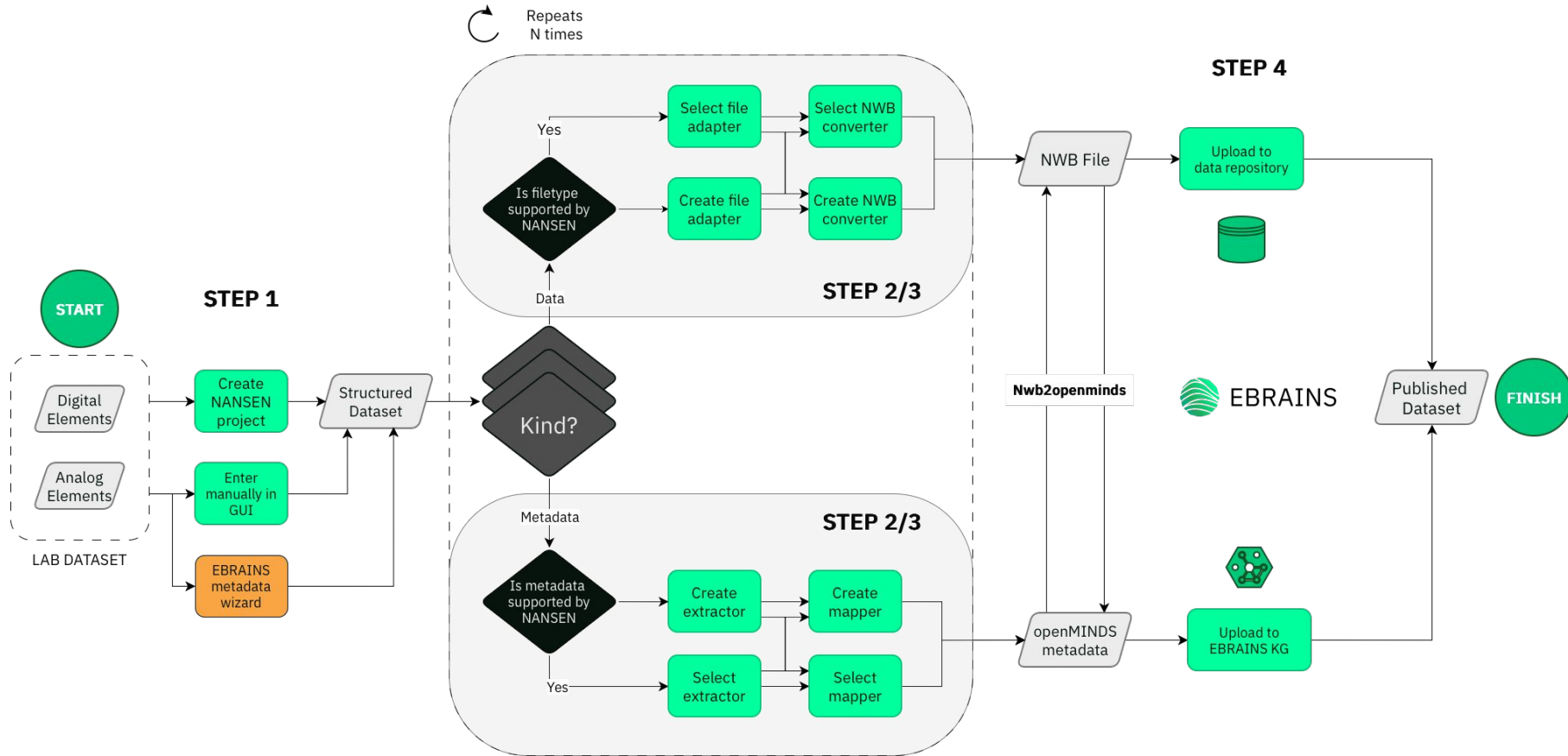
- Skills
- Software tools, e.g CLIs and APIs
- Checks and verifications (automatic, or involving human feedback)

SKILL - A standardized way of defining a set of instructions and reference materials that lets an agent solve a specific problem.

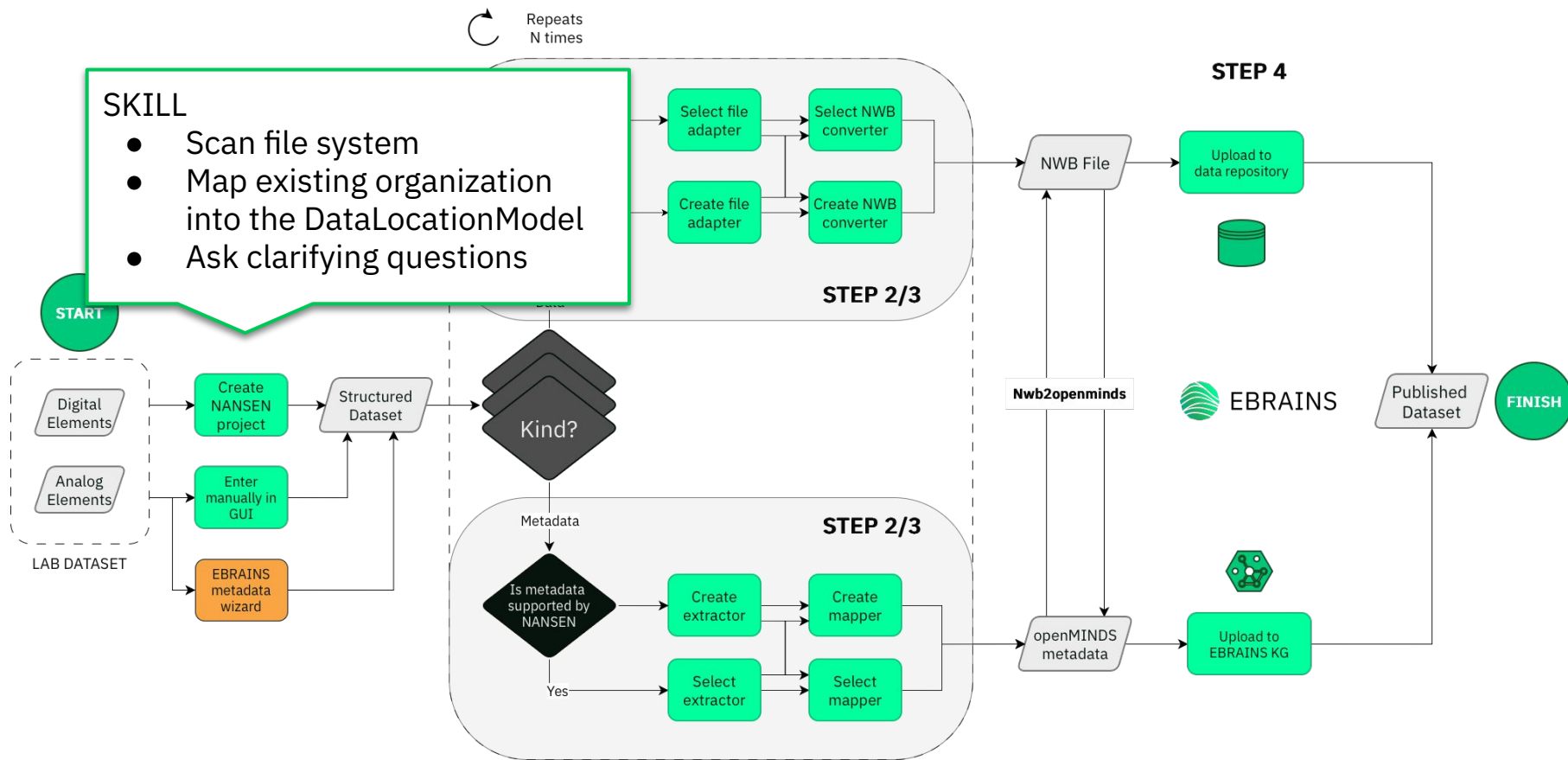
Example:

- Use pdf-reader to extract metadata from this pdf-file
- Map this metadata onto openMINDS
- Refer to the openMINDS documentation for specific metadata types and their relationships
- Refer to openMINDS_MATLAB/openMINDS_Python for details on how to produce valid json_ld documents

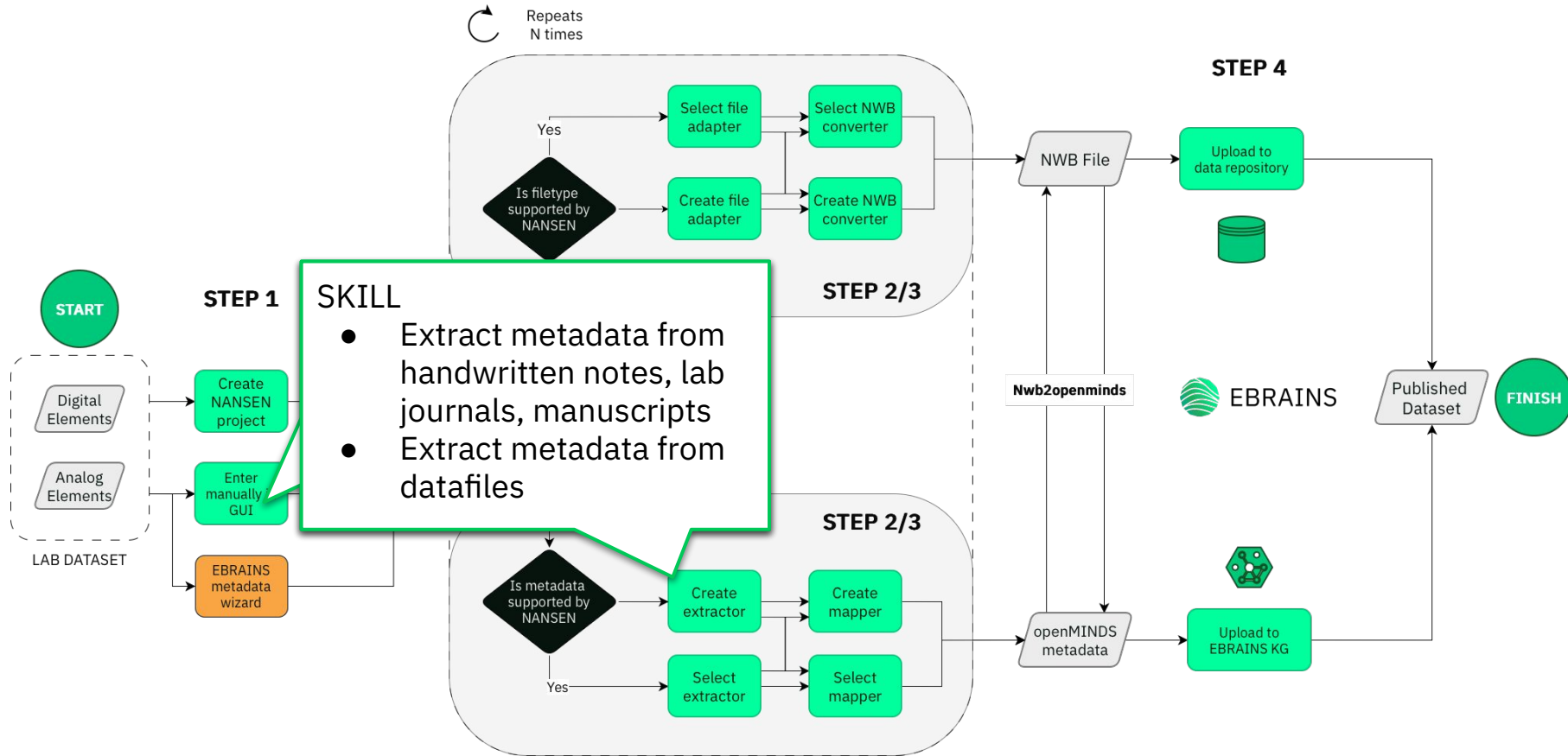
SHAREbrain workflow diagram as an AI harness



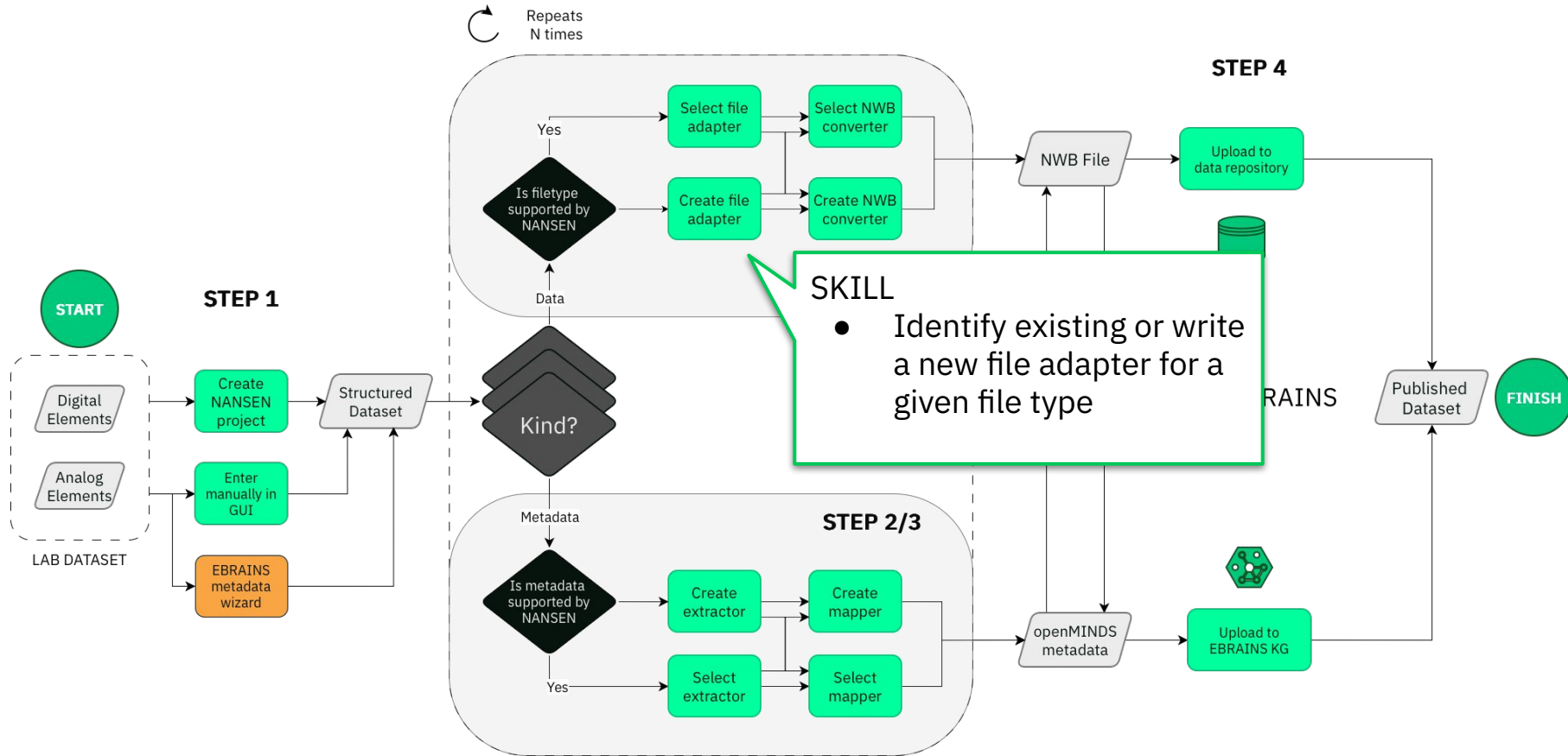
SHAREbrain workflow diagram as an AI harness



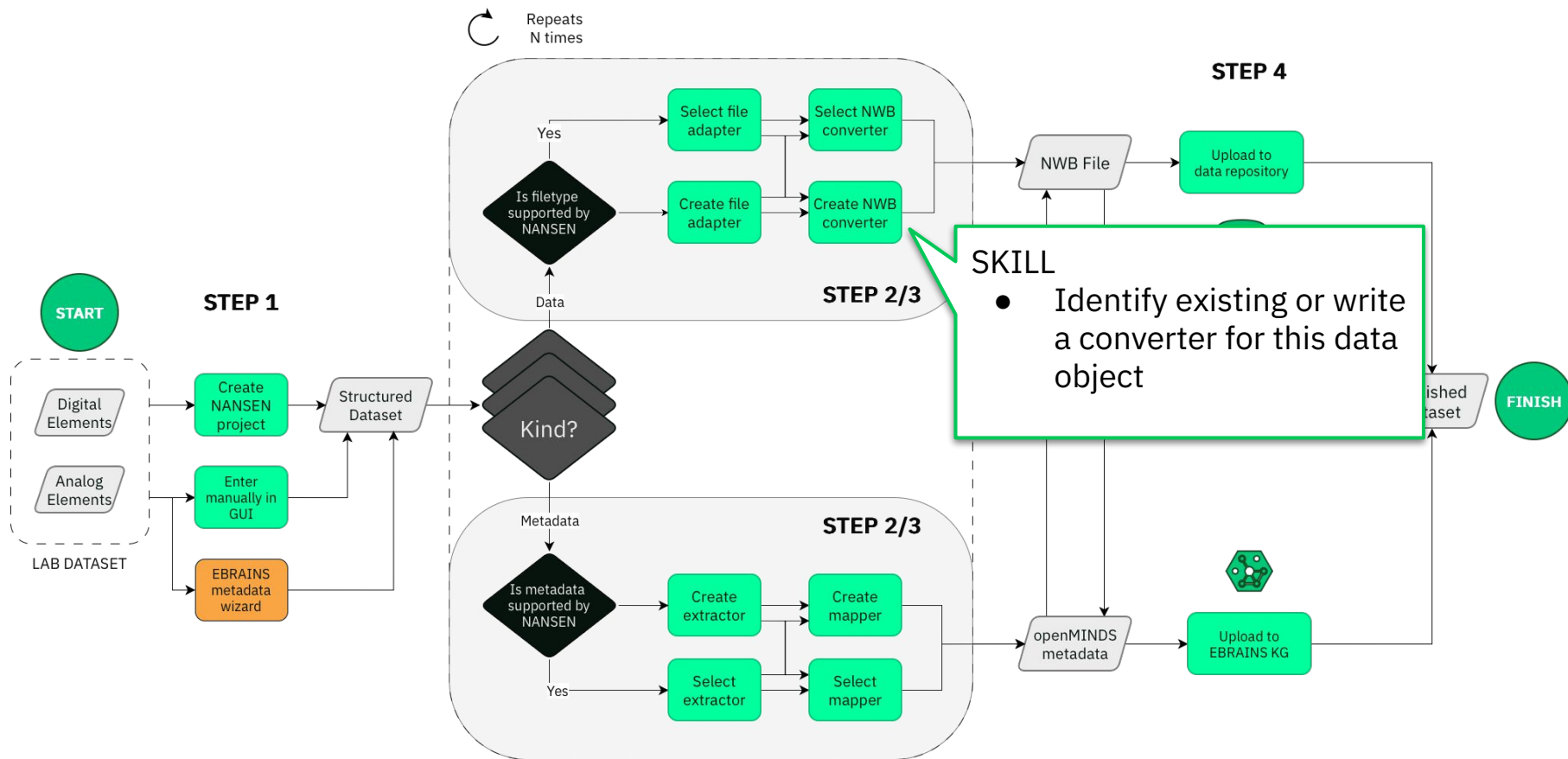
SHAREbrain workflow diagram as an AI harness



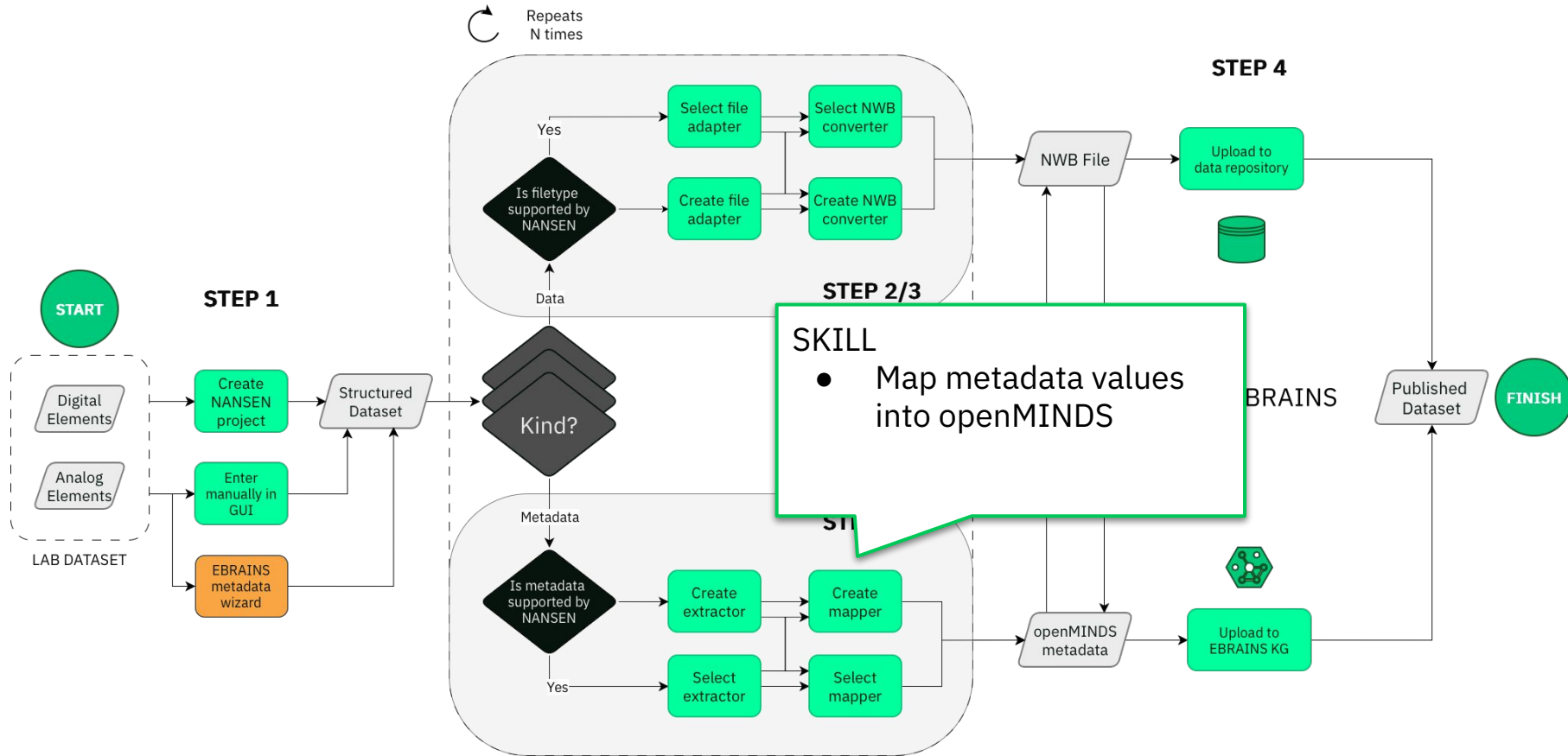
SHAREbrain workflow diagram as an AI harness



SHAREbrain workflow diagram as an AI harness



SHAREbrain workflow diagram as an AI harness



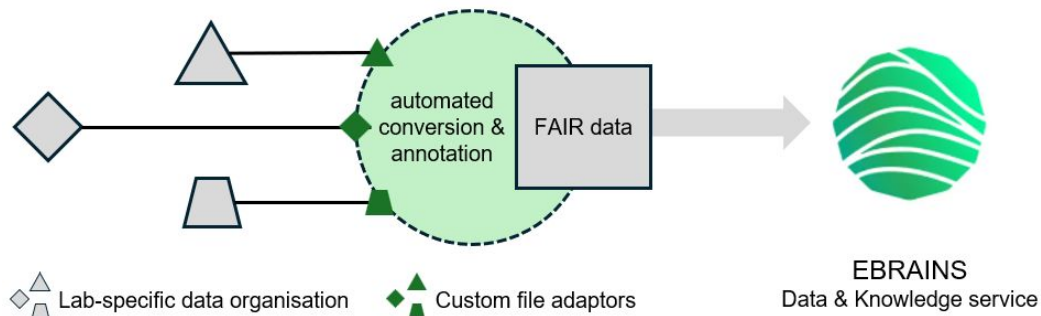


Example of Agentic workflow

- Follow each step of the SHAREbrain workflow and use appropriate skills
- For each step, check in with user.
 - Ask clarifying questions (conversational)
 - Present a summary for review and verification (list of elements to verify)
- Use existing tools (e.g NANSEN, openMINDS_Python, openMINDS_MATLAB, MatNWB, PyNWB, neuroconv) to produce and upload a standardized dataset for final review

Summary

- SHAREbrain Workflow:



- Works with your existing data organization (lab-specific)
 - Interactive GUI-tools and customizable standardization
 - Data ready for EBRAINS (public)
-
- Future developments for automation e.g. with AI



Track 3: EBRAINS Data and Knowledge Services

10.00 - 12.00

Impactful data sharing via
EBRAINS



Sophia Pieschnik



Signý Benediktsdóttir

13.00 - 15.00

The SHAREbrain workflow -
Automated standardization of
functional data



Eivind Hennestad



Aree Witoelar

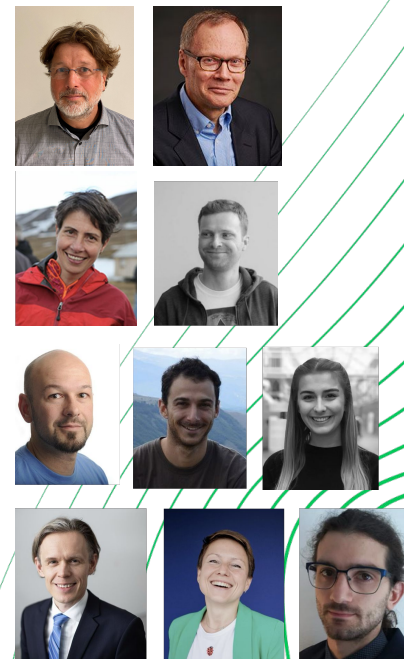


EBRAINS

EBRAINS 2.0

Thank you!

For Questions, Feedback and Discussions:
17:00 - 19:00 Drop-in Consultation Sessions



Co-funded by
the European Union

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