

Competency Questions in Practice: Metadata Schema for Terahertz Research

UNIVERSITÄT
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ESSEN

Offen im Denken

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Outline

- **Introduction**

- SFB MARIE
- FAIR data

- **Methodology**

- Competency questions

- **Results**

- **Conclusion**

SFB MARIE

- Involving almost 100 people namely professors, post-docs and PhD candidates
- Collaboration between 5 universities and 2 institutes

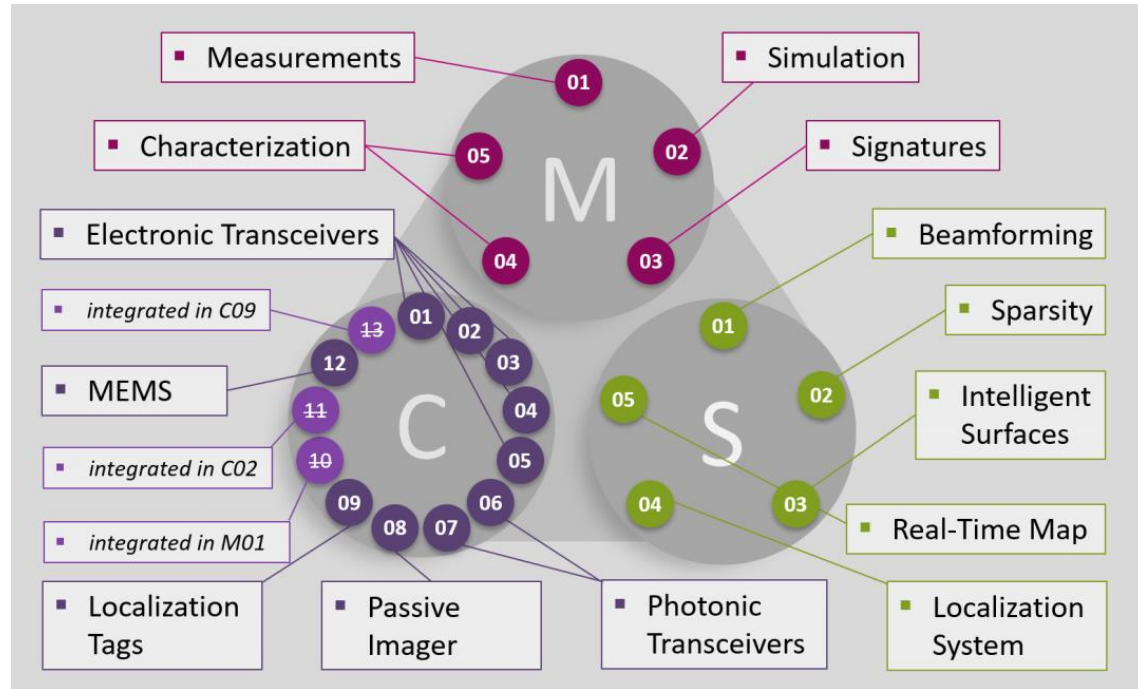


Table 2: MARIE Data types

#	Data type	Number of subprojects for which the respective data type is generated
1	Software/algorithms	15
2	Simulation data	14
3	Measurement data	13
4	Design data/circuit diagrams	10

Metadata Schema

➤ Dataverse features

- Support for FAIR Data Principles
- Versioning
- APIs for interoperability
- Preview and analysis of tabular files



Root > MARIE Dataverse 1 > Projects > S04 >

Ultra-wideband Multipath Channel Characterization at 300 GHz

Draft Unpublished



Zantah, Yamen, 2022, "Ultra-wideband Multipath Channel Characterization at 300 GHz", <https://doi.org/10.5072/FK2/BFGWSU>, Root, DRAFT VERSION

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Citation Metadata

Dataset Persistent ID	doi:10.5072/FK2/BFGWSU
Title	Ultra-wideband Multipath Channel Characterization at 300 GHz
Author	Zantah, Yamen (DSV)
Contact	Use email button above to contact. Zantah, Yamen (DSV)
Description	Conference Paper
Subject	Engineering

MARIE Metadata

Tool/Device	VNA ZVA67 Vector network Analyzer Rohde und Schwarz Transmission coefficient 105 dB 75 MHz
Processing Method	Time domain analysis
Measured Variable	Transmission coefficient S21 dB +/- 1 dB Thermal induced error
Controlled Variable	Distance D m
System Parameter	Start frequency GHz 240 Stop frequency GHz 300

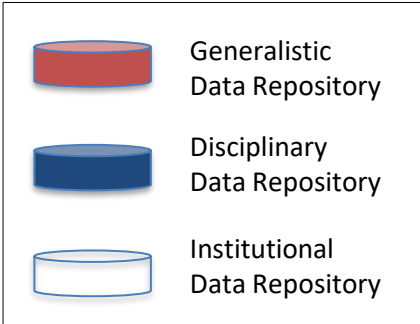
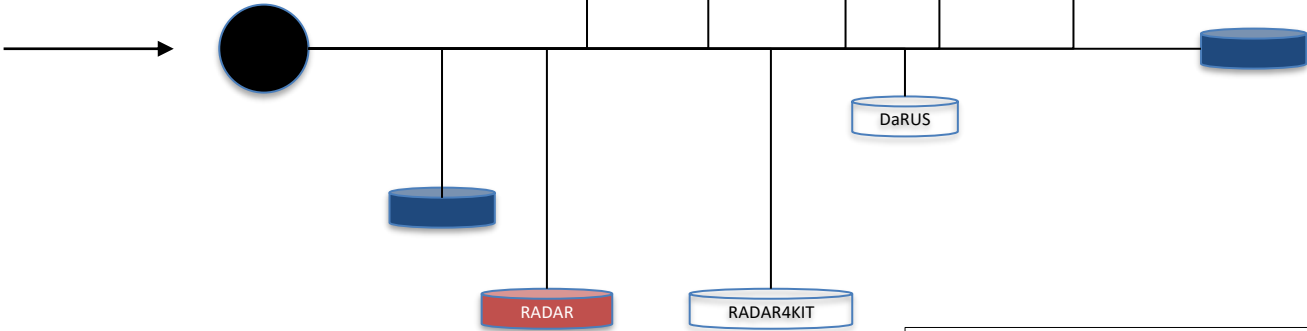
NFDI4Ing

- Aims to develop, disseminate, standardize and provide methods and services to make engineering research data FAIR.
- ✓ **Metadata4Ing (in SIG metadata & ontologies)**
 - develops a generic ontological metadata model for the engineering community.
 - uses a modular and hierarchical modelling approach that offers a high level of specificity and flexibility while maximizing reusability and interoperability.
- ✓ **CRC MARIE:**
 - Participant of Metadata4Ing
 - Bring models to practice

Metadata Schema

- Vision for the future

✓ Which cathode materials offer an optimum in terms of energy density and price?

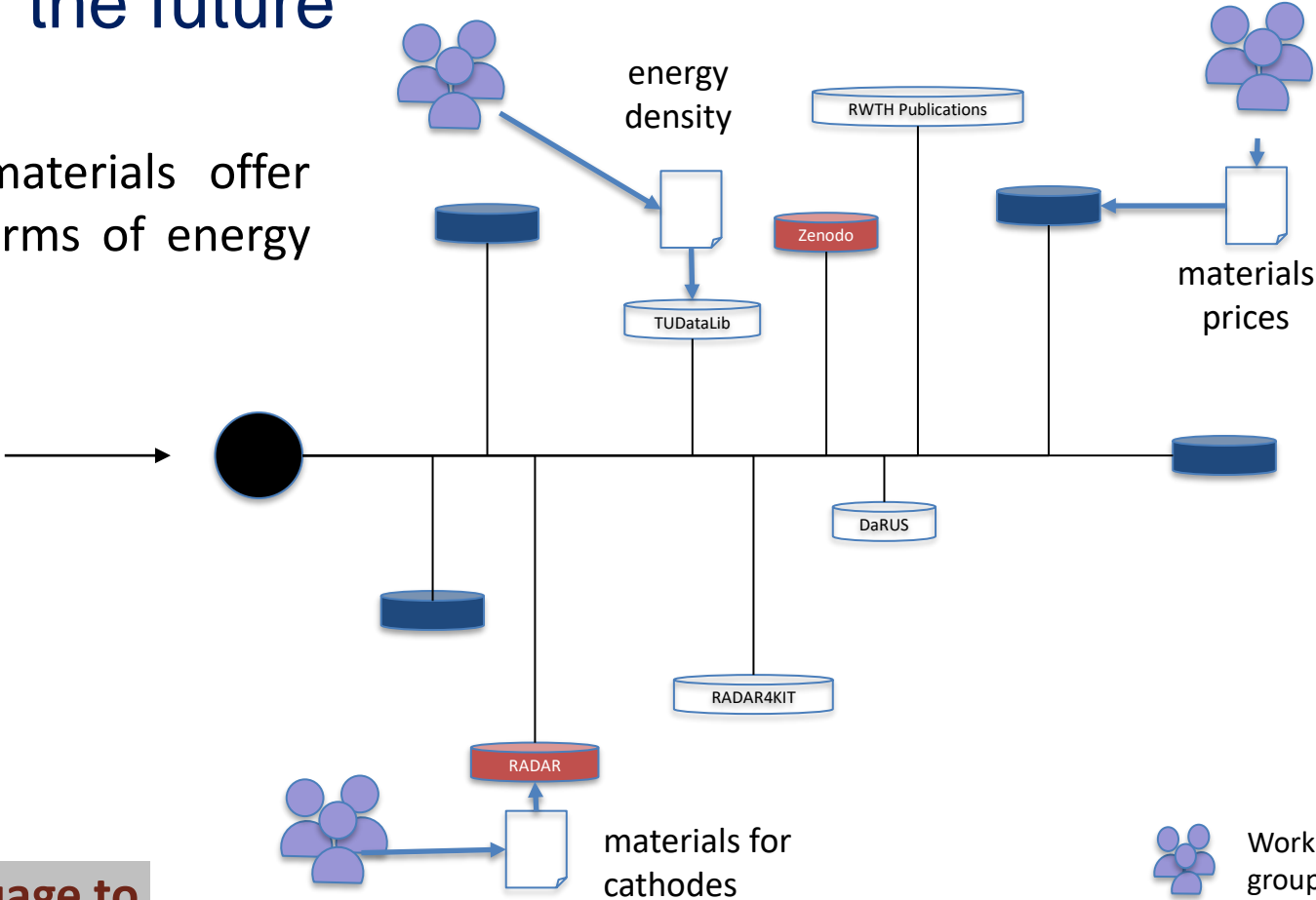


from Metadata4Ing



Metadata Schema

- Vision for the future

Which cathode materials offer an optimum in terms of energy density and price?



✓ **Common language to describe engineering data!**

 Working group
 Dataset

A bright sun in a blue sky with white clouds. The sun is in the upper right, creating a lens flare effect. A large, fluffy white cloud is in the lower center. The sky is a deep blue.

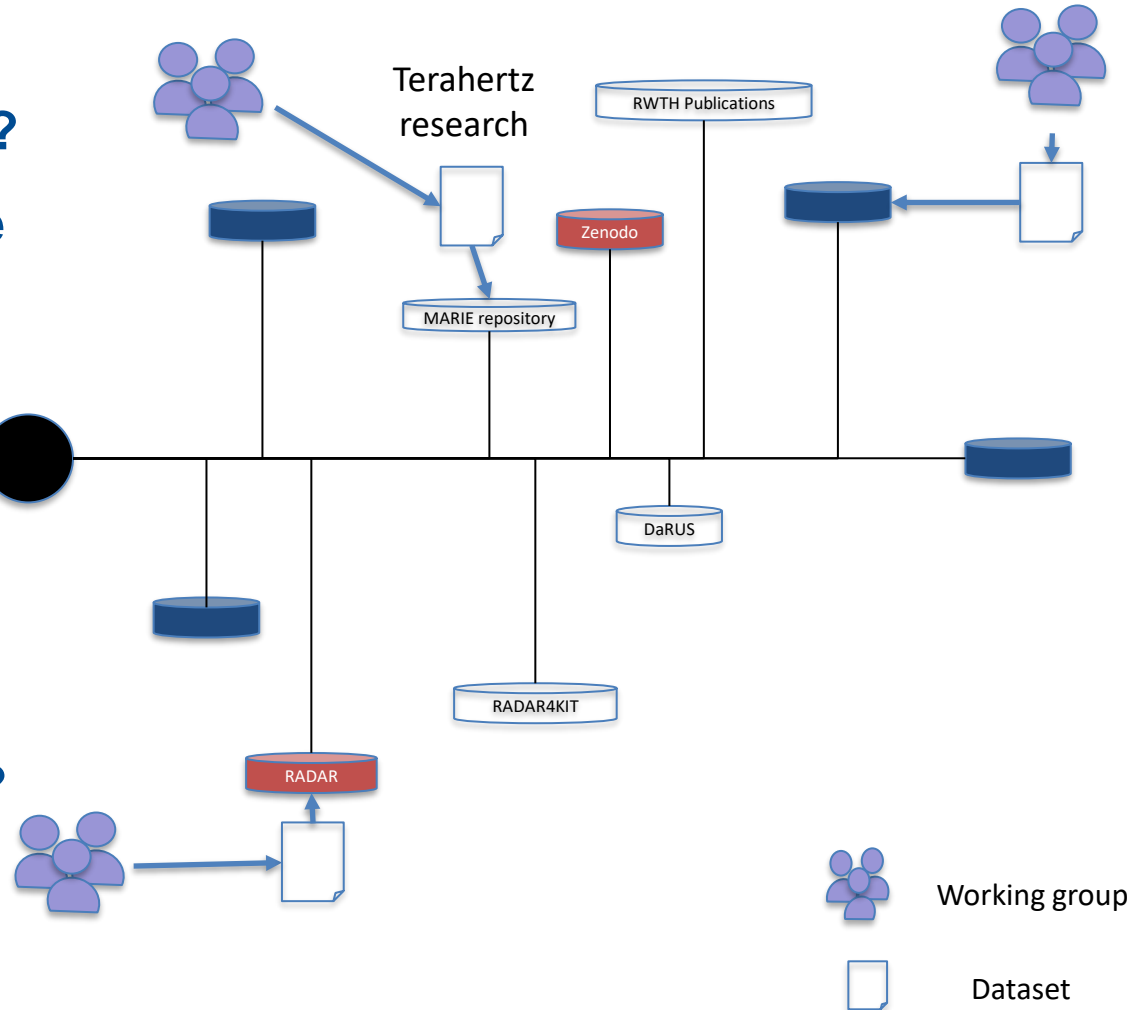
Methodology: Competency Questions

Concept of Competency Questions:

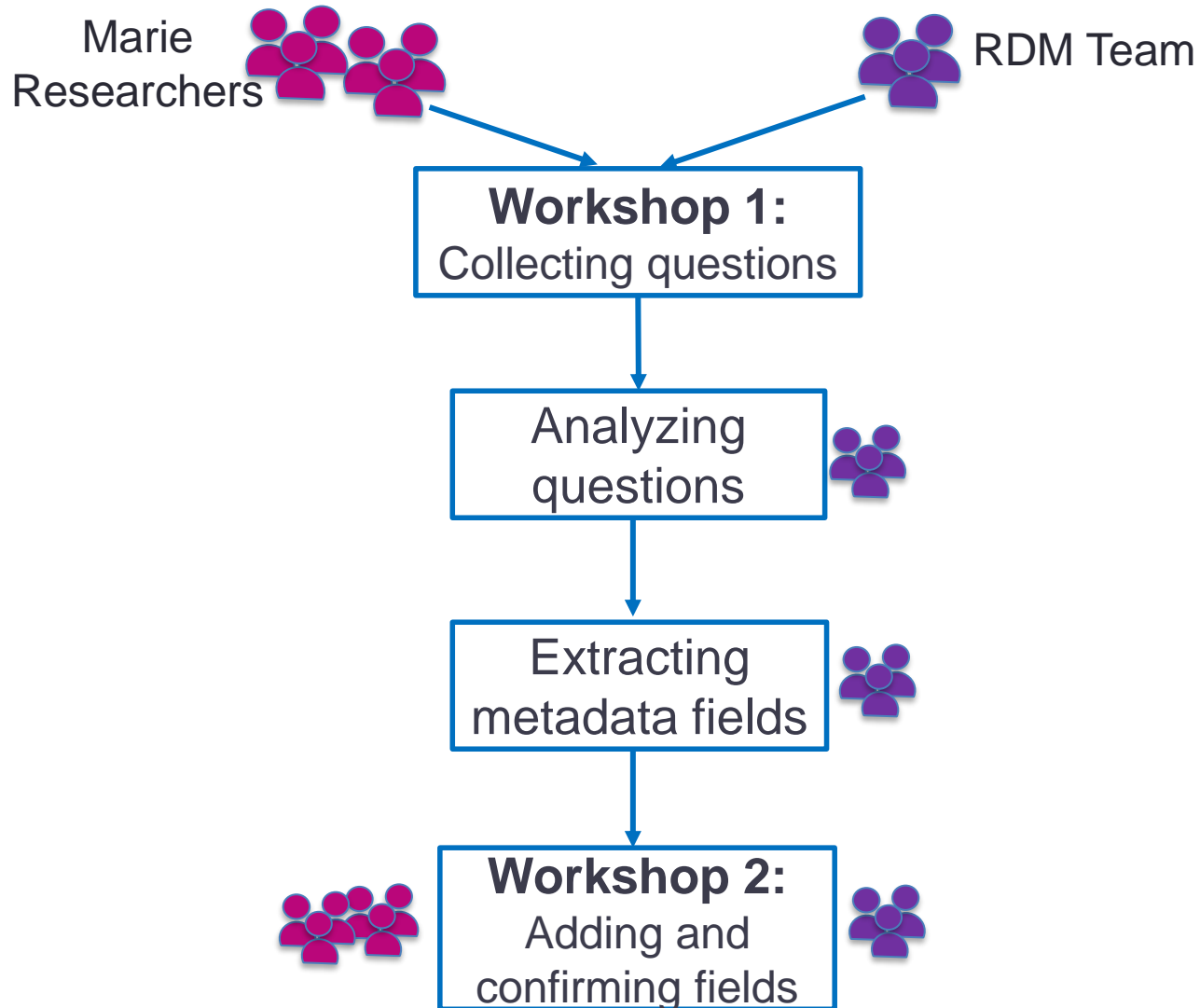
- ✓ What do you want to ask?
- ✓ Which concepts describe your research?



- ✓ What do others need to know to reuse your data?



Competency questions workflow:



Analyzing questions:

- Questions were sorted:
 - ✓ 84 acceptable, 16 out of scope

Categories for sorting	Values
Complexity	simple/complicated
Administrative	administrative
Out of scope	out of scope
Type of data	measurement/simulation/software/design/multiple
Sub-classes	method, instrument, software, variable, material
Instruments/tools	type, name, description, version
Material	type, name, description (e.g. composition), e.g. Optical material properties
Method	Type (generation, processing, analysis, others), name, description
Software	name, version, description, open-source, programming language, Operating system?
Variable	name, constant (value) if not: measured minimum value, measured maximum value

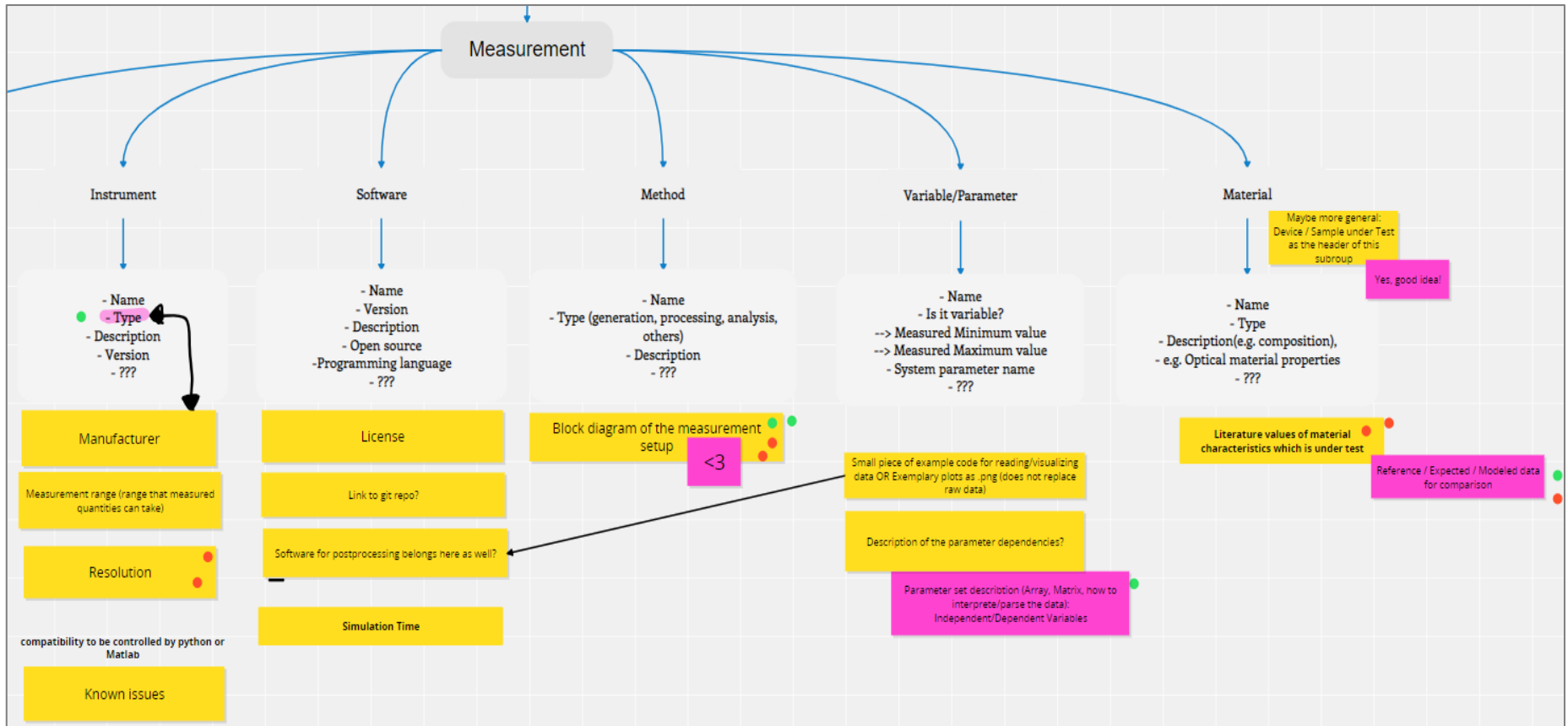
Analyzing questions:

➤ Questions and sorting: examples

	Questions	Complexity	administrative	Type of data	Sub-classes
1.	What algorithm has been used for post processing, what were the parameters ?	simple		software	Software, parameters
2.	How does this measurement compare to [insert golden standard here]?	complicated		measurement	method
3.	Give me all details about the sample (composition, geometry, reference measurements, other groups measurement , photos)	simple	administrative	multiple	material, parameter
4.	Circuit data: Does the simulation results include layout effects (using EM simulation, parasitic extraction, ...)	simple		simulation	method, tool
5.	Is there a simulation for this experiment? Is there an experiment for this simulation?	simple		multiple	method
6.	How easy are the measurements to reproduce / replicate i.e., how difficult were they to perform	complicated		measurement	method
7.	What are the dielectric properties of 3D printable dielectrics (e.g. HiPs) at a frequency range of 100 GHz to 1.3 THz? (Comment / Additions: relative refractive index / complex refractive index / attenuation.	simple		design	parameter
8.	Which samples show similar results? What is similar?	complicated		Measurement	parameter, material
9.	Which calibration method has been used?	simple		multiple	method

Workshop 2: Enhancing metadata

- Asking researchers to check and enhance the fields
- Breakout sessions with people in similar fields
- Receiving feedbacks and suggestions





Metadata Schema Evaluation:


➤ Implemented in Dataverse


Root > MARIE Dataverse 1 > Projects > S01 >

Measured radiation pattern of four static reflectarrays using a terahertz TDS system


Draft **Unpublished**

 Liu, Xuan, 2022, "Measured radiation pattern of four static reflectarrays using a terahertz TDS system", <https://doi.org/10.5072/FK2/PETY1W>, Root, DRAFT VERSION 

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MARIE Metadata

Tool/Device 	All fiber-coupled terahertz spectrometer TERA K15 MenloSystems terahertz bandwidth 5.5THz spectral resolution < 0.7GHz
Processing Method 	zero padding time-domain windowing
Controlled Variable 	angle φ degree 35 65
System Parameter 	scan wondow of the delay line τ ps 200
Research Object (Samples) 	static reflectarray

Developed Metadata Schema

Tool/Device ?	Name ?	Model ?
Processing Method ?	Name ?	Method Type ?
Measured Variable ?	Name ?	Symbol ?
Software ?	Name ?	Version ?
Research Object (Samples) ?	Name ?	Description ?
	Optical Properties ?	Other Properties ?
	Related Literatures ?	
	Central Requirements ?	Operating System ?

Conclusion

- ✓ The collection of competency questions has proven to be a good tool to develop a metadata schema.
 - ✓ The Terahertz metadata schema effectively covers the researchers needs.
- ❖ We thank **Metadata4Ing** for providing the slides and the workshop concept!

Thank you for your attention!