NOTE TO AUTHORS: THIS DOCUMENT IS WRITTEN IN AMERICAN ENGLISH

Proposed Interest Group:

FAIR Principles for Research Hardware - FAIR4RH

Introduction:

Research hardware presents a physical artifact and may incorporate mechanical, electrical, and even software components. For example, laboratory equipment which is the result of scientific research presents research hardware. It is an inherent part of research, together with research data and research software. However, while the latter have been recognized as research outputs by funders and institutions (leading to for example the creation of novel career paths in academia), research hardware has not been receiving much attention so far as a research output. This is particularly visible in the absence of hardware making role in the contributor role ontology, CRediT nor DataCite Schema v4 (7.a), used widely by publishers, and the number of hardware publication platforms (two found in February 2022: hardwareX from Elsevier and the journal of open hardware from Ubiquity Press).

On the other hand, the need for appropriate guidelines for disseminating research hardware has already been recognised in the scientific community (Ezoji, Boujut, & Pinquié, 2021). Research hardware is peculiar because, (1) only its documentation can be shared digitally, while physical components are needed to make it valuable and (2) the documentation often contains both (different types of) data and software. In order to conform to open-science practices, research hardware should ideally be shared as Open Hardware (OH) under free and open-source licenses, especially in cases of publicly funded research (Bath Open Source Hardware group). The open source hardware community has also been trying to define best practices in sharing hardware documentation, in order to allow re-use and further development of the hardware, such that they have been advocating for Hardware FAIRness without using this terminology. Most research hardware adoption today follows the traditional path of intellectual property rights (IPR) protection and openness is a multi-dimensional and gradual concept. This work intends to be applicable to all research hardware.

Available good practices for research outputs disseminated as digital assets and in particular for research data are based on the adoption of FAIR principles (Wilinson *et al.*, 2016). The objectives of FAIR principles in research data are to secure findability, accessibility, interoperability, and reusability of research data by both humans and machines. Similar initiatives emphasized the importance of FAIR principles for research software. The most notable recent work of the FAIR for Research Software group (FAIR4RS WG) in collaboration with other initiatives and organization led to the definition of guidelines for dissemination of research software that conforms to the FAIR principles. In FAIR4RH "**we believe that adapting and expanding the FAIR principles for the domain of research hardware can facilitate and**

improve hardware dissemination practices ". This also includes work on the definition of research hardware, and its relation to open source hardware. Ultimately, this group wants to go beyond that and address hindernisses preventing a sustainable and inclusive adoption of hardware documentation in the scholarly commons. We also believe that technical transfer processes of research hardware towards market players, civil society and other actors may also lead to indirect wider benefits for commons beyond the scholarly community.

We believe the group's objectives align well with the RDA interest in fostering the production and publication of non-text research outputs (artifacts that are not manuscript). On the one hand, we hope to leverage the community and experience the RDA has been able to bring to the FAIR4RS WG. On the other hand, this IG will bridge open hardware communities, civic tech, as well as production engineering communities within the RDA.

User scenario(s) or use case(s) the IG wishes to address:

- *Researchers trying to build hardware used in a lab, either for performing an experiment or for reproducing experimental results at another lab (e.g. reuse of components, design improvements, etc.),*
- *Researchers who want to publish their hardware documentation and share it publicly under free and open licenses following open science practices (e.g. for free technical knowledge sharing, defense publishing, increased transparency, open collaborative development with external or joint project partners, maximized technology transfer, etc.),*
- *Funders and institutions that would want to promote quality and openness in hardware creation in academia*
- *Repositories for hardware documentation needing methodological guidance.*

Objectives and outcomes :

This group aims at the recognition of hardware as an integral part of the research process, and foster an inclusive recognition of the people contributing to the hardware design and dissemination. In order to avoid the discussion about patent strategies versus open source hardware and address both open and "close" hardware, we want to talk primarily about FAIR

research hardware. To this end, we identified several challenges, which will correspond to several outcomes we expect for this group:

- **Definition of research hardware**
- Analysis of **current practices** and gaps in research hardware lifecycle:
  - Documentation
  - Dissemination channels
  - Maintainability
- Interoperability of **hardware metadata** schemas and academic metadata
- **Definition of FAIR principles for research hardware** (see below)
- Identification of **practical means** of achieving FAIR research hardware
- Contributor **recognition** systems.

Specifically, we aim to expand previous work (Miljković, Trisovic, & Peer, 2021) towards the definition of FAIR principles for research hardware. The role model for our group will be FAIR4RS WG as we will elaborate on unique characteristics of research hardware in relation to the existing FAIR principles for data and software. Possible relationships between principles will also be explored. Moreover, we will provide a detailed analysis of current obstacles in redefinition of FAIR principles for research hardware (e.g., transferability of existing FAIR principles, value added, exhaustiveness, interdependencies of FAIR principles, and how to detail/reorient the principles accordingly). In particular, we will emphasize all important factors that influence research hardware documentation (e.g., research hardware documentation, available technology, knowledge, materials, standardized processes, and components (or lack thereof), specific demands for hardware licensing and link to the repairability of hardware). Additionally, we will focus on the complex dependencies to other hardware and/or software.

Importantly, we will put lots of energy into making our work as inclusive as possible and available to everyone. Our outcomes will also take Global South needs, achievements, and practices into account. Therefore, **involving communities from the Global South is one of the primary objectives** of this group.

Participation :

This interest group aims to collaborate with the:

- OH communities (GOSH, OSHWA, Africa OSH),
- Scientific research projects involving OH (Open.Make, OPENNEXT, Open Hardware Delft),
- Maker communities and other initiatives (Open Hardware Observatory),
- Hardware specific organization (Internet of Production Alliance),
- The RDA community to facilitate open discussions on FAIR principles for research hardware,
- Metadata producer and users (datacite, Open Hardware Observatory, Internet of Production Alliance),
- Open Science Aggregators (OpenAIRE), and
- Other interested parties.

Mechanism:

On top of asynchronous work, the group will meet online at least every four months to report on thematically distinct sub-groups' progresses.
As long as no subgroups are formed, the group will meet monthly.

Timeline (Describe draft milestones and goals for the first 12 months):

- Create a larger and more inclusive group.
- Identify issues in definition of FAIR research hardware
- Definition of research hardware
- Create subgroups to approach the question of FAIR principles for research hardware from different angles.
- Start edition of a “FAIR principles for research hardware” document

Potential Group Members (Include proposed chairs/initial leadership and all members who have expressed interest):

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