OPEN HARDWARE: A KEY FOR ACCELERATING SCIENCE AND TECHNOLOGY TOWARDS THE U.N. SUSTAINABLE DEVELOPMENT GOALS (SDGS)

KEY MESSAGES

1. International organizations and governments can increase their innovation capacity towards the SDGs by adopting and promoting open hardware.

2. Open hardware can build innovation capacity in countries with low investments in science, technology and innovation, making these investments more efficient.

3. Open hardware enables new multi-stakeholder partnerships and collaborations between academia, civil society and the private sector, towards the SDGs.

4. Open hardware adoption makes science more transparent and participative, supporting global decentralised collaboration.

5. International organizations can promote open hardware expansion by incorporating open hardware (OH) in their strategies, aligning incentives and raising awareness through education and training.

OPEN HARDWARE

Open hardware or open source hardware are tangible artifacts whose design has been released to the public in such a way that anyone can make, modify, commercialize, and use them.

From the Open Source Hardware definition[1]:

> *"The hardware's source, the design from which it is made, is available in the preferred format for making modifications to it [...] Open source hardware gives people the freedom to control their technology while sharing knowledge and encouraging commerce through the open exchange of designs."*

Physical tools for science include sensors that monitor the environment, desktop 3D printers and microprocessors enabling customised equipment in university and industry labs, biomed equipment[2], experimental setups enabling fully reproducible science, amongst many others worldwide[3].

Beyond a set of tools and designs, open hardware represents "a diffuse, dynamic approach to creation" that provides a distributed alternative to centralized technology design by enabling co-creation of designs. Open hardware practitioners exchange design blueprints and other knowledge via online platforms, adapting and resharing the new designs. In this way, open hardware allows researchers to adapt technology to their own needs, instead of adapting their needs to the available solutions.

OPEN SCIENCE, TECHNOLOGY AND INNOVATION PLAY A KEY ROLE IN ACHIEVING THE SDGS

International organizations (WHO[4], UNESCO[5], FAO[6], IFRC[7], among others) recognize the key role that science, technology and innovation (STI) play in achieving the Sustainable Development Goals (SDGs). On top of defining SDG 9[8], "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation", the 2030 Agenda positioned STI as a key means of implementation of the SDGs and recognised that asymmetrical access to STI contributes to the gap between countries in terms of advancement towards the goals. In 2020 the UN Secretary-General's Roadmap for Digital Cooperation Report[9] highlighted the critical role that digital public goods ("open source software, open data, open AI models, open standards and open content") have in overcoming these asymmetries and accelerating achievement of the goals.

Open science plays a fundamental role in accelerating science and technology towards the SDGs. Moreover, in the context of the COVID-19 crisis, a recent Appeal for Open Science[10] led by the Office of the High Commissioner for Human Rights (OHCHR) and involving CERN, UNESCO and WHO, showcases the pressing relevance of open science for our societies.

To date, the open science conversation has largely omitted open hardware [Box 1], with the notable exception of the recent UNESCO Draft Recommendation on Open Science[11], which will promote a common global understanding of open science to be adopted by a range of UN member states and defines the term "open hardware". The recommendation recognizes that open science infrastructures are often the result of community-building efforts, crucial for their long-term sustainability, and highlights the need for public access. Adopting an open innovation[12] perspective, it calls for broad and effective engagement and participation in the innovation process, as well as the discovery and development of a business model for effective commercialization of new knowledge.

Furthermore, in recent years pioneering international organizations have followed the success of open source software and adopted open hardware approaches to advance their missions and accelerate their work through open collaboration e.g. the UNICEF Innovation Fund [Box 2]. These initial experiments constitute a unique opportunity for international organizations to take their learnings and support open hardware expansion worldwide, thus accelerating science and innovation towards achieving the SDGs.

This policy briefing addresses those international organizations and we argue that their **adoption of open hardware practices in science provide an opportunity to democratize and diversify science and technology, opening both the products and the process of science itself.**

BOX 1: BLACK BOXES ARE A PROBLEM FOR SCIENCE

Technological "black boxes" are systems where inputs and outputs are known, but there is limited or no information on their internal workings. Some hardware companies, partially sharing diagrams and designs, already use and recognize the value of open knowledge. However, it is by fully adopting open hardware practices that we can unleash the potential of open hardware for collaboration and co-creation in science.

When we do not have information on the blueprints of "black box" hardware, we cannot fully inspect them and understand how they work in detail. In particular for science, being able to inspect tools has concrete impact: users can make more informed decisions on the feasibility of experiments and expected results; others can fully review the experimental settings that led to specific results, increasing reproducibility.

Accessing the designs of tools also enables easier customization. This is particularly important for science, as researchers are users with very specific needs that may not match those of massive markets. New research questions often demand changes in the equipment used to pursue them; accessing the blueprints of hardware means that researchers could modify their tools more easily, reducing costs and delays associated with concentrated vendors in science.

By enabling access to the designs of science tools, new companies around the world can start producing them with accessible materials, increasing access to science equipment in currently neglected areas. Science equipment can be unreasonably difficult and expensive to obtain and maintain. Local production ensures tools are easier to source and repair, reducing the burden of import taxes and delays in equipment maintenance in the global South.

BLACK BOX DESIGNS SLOW DOWN OPEN SCIENCE TOWARDS THE SDGS

Under current models of innovation, technology transfer processes between industry, academia and civil society are slowed down due to uneven access to relevant information. The consequences affect knowledge production processes, inside and outside academia. In science, instruments that are proprietary black boxes can lead to less reproducibility, increased lock-in to specific vendors and significant delays for customizing or repairing tools [Box 1]. In terms of technology, unpublished hardware designs lead to duplicated efforts, with entire teams dedicating precious time and resources to "reinventing the wheel" of innovation.

Concentration of technology manufacturing and vendor lock-in processes further deepen the gap between global north and south, with concrete, problematic consequences for millions around the world. For example, proprietary diagnostic supplies turned much of Congo's medical hardware into obsolete machines[13], directly impacting the country's COVID-19 testing capacity.

OPEN HARDWARE HAS HUGE POTENTIAL FOR INTERNATIONAL ORGANIZATIONS ADVANCING THE SDGS

In contrast to centralised and proprietary knowledge production, collaborative practice and access to information in open hardware facilitates coordination efforts between multiple stakeholders, especially in contexts of crisis[14].

Open hardware for science includes opening the designs of standard lab equipment as well as auxiliary materials, such as sensors, biological reagents, and analogue and digital electronic components that can be obtained, assembled, used, studied, modified, shared and sold by anyone. As a practice, open hardware involves participants in academia, industry and civil society around the world, promoting the exchange of openly-licensed designs of tangible artifacts so anyone can make, modify, commercialize, and use them. Free circulation of designs can enable Individuals and institutions around the world to adapt them to their own needs, making currently hidden research questions visible, allowing new voices and avenues for pursuing knowledge.

BOX 2: UNICEF INNOVATION FUND: OPEN HARDWARE FOR TECHNOLOGY-ENABLED PROGRAMMES

UNICEF's Innovation Fund[15] provides funding to start-ups developing new open source solutions leveraging frontier technology for the benefits of children. The Fund, first of its kind in the UN, developed new clauses that allow for institutional contracts with vendors to keep intellectual property (IP) on open source licenses, including hardware licenses.

The initiative promotes open source as a strategic business model that facilitates community building, bringing value for both the producers and the end users of technology: Manufacturers benefit from early feedback from users, who in turn get better products. But it also identifies advantages in terms of talent acquisition, user growth, cost effectiveness and optimization.

One of the projects of the Fund is the development of open 'drone'-based technologies and services[16] for a range of applications including vaccine delivery/transport, improved connectivity in hard-to-reach communities, and aerial imaging for better preparedness and response in emergencies. In 2017, the Government of Malawi and UNICEF launched an air corridor[17] to test the use of drones for humanitarian purposes – the first in Africa and one of the first globally with a focus on humanitarian and development use.

FOLLOWING THE PATH OF LEADING INTERNATIONAL ORGANIZATIONS

International organizations and governments can increase their technological learning and innovation capacity by adopting and promoting open hardware [Box 3]. Many open hardware designs make use of digital fabrication methodologies and tools. This distributed nature of open hardware allocates work and quality control more efficiently, avoiding duplication efforts. It also facilitates higher product quality and safety at lower costs by decentralised testing and design review, as demonstrated in the success of the free open source software industry. Moreover, distributed collaboration leads to more efficient innovation, pooling scarce resources, sharing key lessons and bridging disrupted supply chains, increasing resilience[18] particularly in times of crisis. The RISC-V project[19], a global multi-stakeholder collaboration, was recently recognized as Important Project of Common European Interest (IPCEI)[20] by the European Union.

Another way that organizations can support increased open hardware activity is making available space, infrastructure and tools for collaborative development and manufacturing. I.O.Me005[21] is a FabLab of the Kenya Red Cross Society located in Lamu, Kenya in operation since October 2020; the space allows researchers, innovators, technology enthusiasts and entrepreneurs to create and quickly test new concepts, products and businesses by giving them access to advanced technology, materials and production methodologies through shared knowledge and peer learning.

Open hardware can contribute to building science, technology and innovation capacity in countries with low investments in STI, making these efforts more efficient. Releasing the designs of science hardware under free/open licenses allows more people to engage in science worldwide, opening an avenue for further exploiting the results of impact-driven innovation, allowing its reuse for exploring local problems and research questions in a collaborative way. Civil society groups, who usually do not have direct access to universities and research centres, are using open hardware such as air and water quality monitors to make their needs visible and put them on the political agenda. This turns open hardware into a powerful cooperation tool for building more democratic innovation models, laying the ground for grassroots innovations and alternative development pathways[22] to emerge.

Similar to open source software, access to **open hardware designs can support the establishment of new, more participative & collaborative forms of standardisation connecting industry and communities of practice.** Open hardware can be a commercial challenge for companies as it sometimes requires rethinking standard business models, relationships with developers and consumers (who may be both) and value propositions. International organizations and well-established research institutions can encourage industry adoption by becoming early adopters and by

BOX 3: IFRC SOLFERINO ACADEMY: OPEN HARDWARE ACCELERATING HUMANITARIAN INNOVATION

The Solferino Academy is a team of experts in innovation and collaborative problem solving at the International Federation of Red Cross and Red Crescent Societies. As part of its mission, the Academy explores and supports experimentation with new and innovative approaches to humanitarian and development work.

Their role is to convene and connect global innovations at the most local level possible, by amplifying local innovation and flipping the model to support innovation in National Societies around the world. In March 2021, the organization hosted a IFRC Virtual Tour[23] with thousands of participants worldwide, to celebrate local innovation in Kenya (I.o.Me Lab[24]) and France. It is expected that this young fablab inspires many to come within the Red Cross Red Crescent network; the upcoming Youth innovation program, Limitless[25], is expected to include more innovations inspired by I.o.Me Lab.

The work of Solferino Academy helps IFRC gain fresh insights, connect innovators/ideas across the world, fast track idea-generation and decision making and inspire better outcomes.The goal is always - as local as possible. Lastly, the Academy works in partnerships with the private sector and academic institutions, entrepreneurs, start-ups, and others who share similar values.

preferentially procuring open solutions, lowering the perceived risk of open practices and opening the market to small and medium stakeholders. This preference can be justified because adopting open hardware in the supply chain can contribute to avoiding downstream constraints such as vendor lock-in. Moreover, open hardware better allows for local manufacturing and this production model is better able to rapidly adapt to market changes, incurring less delays and costs on design, research and development. In this way, open hardware fosters the emergence of 'economies of scope[26]', where the production of one good reduces the cost of producing another related good, which are crucial to small and medium manufacturers. Examples include companies providing open hardware electronics[27], computers[28], educational projects[29], 3D printers[30] and even charger stations[31] for electric cars.

Open hardware enables new multi-stakeholder partnerships and collaborations towards the SDGs. Aligned with SDG 17 aimed at partnerships towards the goals[32], public access to innovative designs fosters uptake and reuse from a diversity of actors ranging from companies to civil society, who in turn innovate by adapting the designs to their own needs. In this way, open hardware facilitates the emergence of new collaboration schemes between governments, industry, universities and civil society organizations, reducing friction in technology transfer processes. In this vein, the collaborative methods that constitute the core of open hardware best practices can facilitate the implementation of "innovation hubs". Multi-scale partnerships can build technology transfer instruments that turn knowledge into impactful innovation towards the SDGs.

Open hardware is **potentially the biggest game changer for international organizations tracking progress towards the SDGs**, **especially in resource-limited contexts.** For example, for environmental monitoring, low-cost sensors that can be deployed and maintained cheaply are essential. Open hardware provides a practical solution, given the resource constraints for SDG monitoring in most countries.

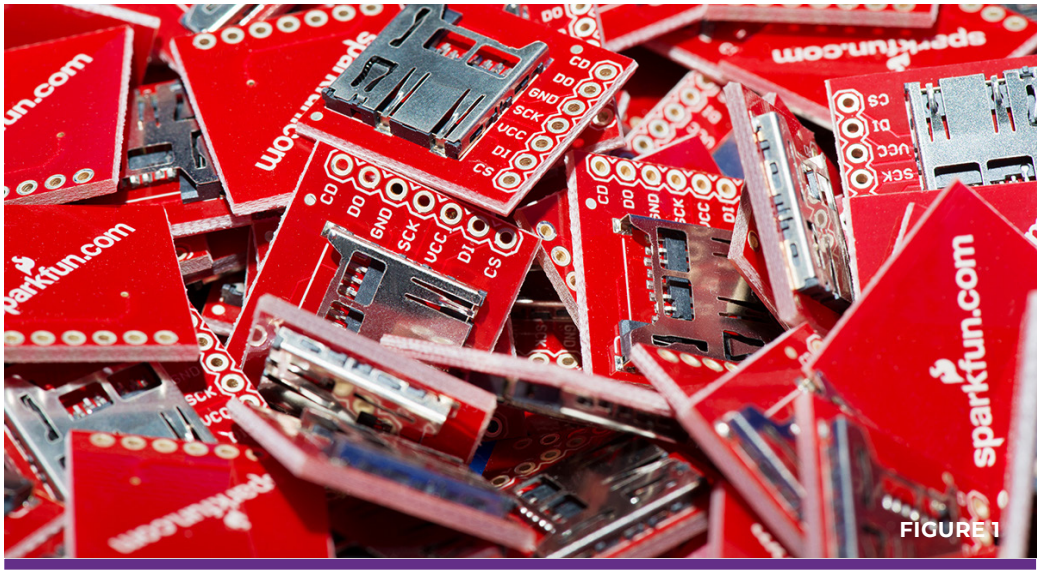

Figure 1: Image of SparkFun microSD Transflash Breakout boards. Sparkfun Electronics is an electronics company that sells open source hardware products.
Image Credit: https://www.flickr.com/photos/sparkfun/16282024335 under the CC BY 2.0 License.

Moreover, **the ability of open hardware to increase equitable access to impactful science, research and innovation globally has practical benefits for particular types of international organizations.** Examples include those involved in disaster and medical response especially in the global south where initiatives are working on using open hardware to deliver critical supplies so healthcare providers[30] and disaster response teams[31] have the means to develop their work. Another example is organizations building scientific capacity. For example, start-ups using open hardware and are working to provide accessible research tools[32] in the global south.

FIGURE 2

FIGURE 3

Figures 2 and 3: Images from the 2018 gathering for the Global Open Science Hardware community. The 2018 Gathering was held in Shenzhen, China, with 112 participants from 34 different countries coming together under a shared goal of making open science hardware ubiquitous by 2025.
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CONCRETE STEPS TOWARDS OPEN HARDWARE INTERNATIONAL ADOPTION

1. ADOPTING OPEN HARDWARE AS A PRINCIPLE OF OPEN SCIENCE AND INNOVATION PROGRAMS AND STANDARDS WITHIN INSTITUTIONS

Following the path opened by the UNESCO draft recommendation on Open Science[36], institutions already implementing open science programs can incorporate open hardware in their strategies. Ongoing programs can be widened in scope to adopt open hardware principles, in synergy with a global movement of practitioners creating and adapting open hardware tools for science.

On the other hand, learning from the experience of international organizations that are already working openly, institutions can start by incorporating open hardware as a requirement of their innovation programs. While they may not yet have explicitly "open" policies, most institutions have digital strategies in which open hardware could be endorsed to deliver benefits for existing initiatives and to promote new collaborations. For example, **universities** can use open hardware policies and initiatives to **increase the impact of academic research[37] while reducing costs in equipment**[38].

Standards are also an area where international organizations can make policy changes to support open hardware. Standardization efforts in open hardware are relatively young, and mostly oriented towards hardware documentation practices, including the development of the DIN SPEC 3105 which defines the technology-specific "source" of Open Source Hardware. To foster open hardware adoption, it is important for stakeholders in international standards setting to **make current hardware standards on quality, safety or risk feasible to adopt for open and distributed manufacturing**, such as considering affordability and accessibility to broader audiences.

In particular, **open hardware provides a powerful opportunity for impact in the aid sector**, where sharing designs can benefit agencies, hospitals, and university labs making work more efficient but adherence to quality standards is essential. For **organizations working on development programs and advancing the SDGs**, open hardware can become a tool to shortcut supply chains in countries where import restrictions are prohibitive, for example by fostering science equipment production by small businesses.

Specific activities to support this comprise:

- Including open science hardware as one of the fundamental elements of open science policy, as pioneered by the UNESCO Draft recommendation on Open Science[39], e.g. incorporating open hardware in initiatives like the European Open Science Cloud[40] (EOSC) providing critical infrastructure for research, Nationale Forschungsdateninfrastruktur (NFDI) or GAIA-X[41], the european federated data infrastructure;
- Including open hardware as a pillar of practice in science diplomacy roadmaps and development programs led by multilateral organizations, for instance, the programme recently proposed by the UNDP Accelerator Labs[42];

- Developing programmes that help turning open hardware prototypes into certified products, e.g. lowering market entrance barriers for open hardware products by establishing a network of institutes to support the process of meeting safety, technical and environmental standards. For example, CE testing for meeting European safety standards or Federal Communication Commission (FCC) compliance testing for ensuring the level of electromagnetic radiation from the device is acceptable by US standards;
- Large standardization organizations (like the International Organization for Standardization, or IEEE Standards Organization[43]) can develop open hardware standards and also incorporate open hardware in their current standards or issue guidance on compliance of open hardware initiatives with ISO-certified activities;
- Digital strategies at international organizations and national governments should include open hardware as a principle, in particular if funded by large donors such as the Foreign, Commonwealth & Development Office (FCDO), the United States Agency for International Development (USAID), the European Civil Protection and Humanitarian Aid Operations (ECHO) or other public funds; this can be inspired by recent strategies such as IFRC Strategy 2030[44], IFRC Digital strategy[45], and UN digital cooperation[46];
- National and intergovernmental commissions should start addressing product liability regimes for open hardware stakeholders, including designers, manufacturers, resellers, investors and service providers. Lack of clarity slows down adoption, for example when designers who release their creations openly, or their host institutions such as universities or research centers, are unsure on where lies the responsibility for damages derived from the manufacturing process by third parties.

2. ALIGNING FUNDING AND INCENTIVES TO PROMOTE OPEN HARDWARE

Although more and more funding initiatives incorporate open data or open access clauses to their requirements, only a few do the same with open hardware. Aligning the incentives for developing and maintaining open hardware is crucial not only for promoting but also for sustaining innovation.

For most countries where STI is publicly-funded, adopting open hardware clauses can guarantee that the products of public investment remain accessible to all, as one component of a balanced approach to technology transfer and commercialisation[47].

Specific activities to support this comprise:

- Including open hardware in procurement policies within institutions;
- Defining concrete steps for funding agencies and institutions to adopt open hardware, e.g. developing disclosure agreements to distribute the results of collaborative projects as open hardware;
- Incentivizing open hardware adoption in research grants, Prize & Challenge competitions (US), and start-ups;
- Creating dedicated funds and platform cooperatives to support long-term open hardware research, development and maintenance, including community support as it happens in open source software[48];
- Institutions can support open hardware development by backing crowdfunding campaigns of open hardware equipment;
- Universities and research institutions should set up incentives for hardware developers and maintainers, so they obtain career recognition for their work within academia.

3. RAISING AWARENESS OF OPEN HARDWARE THROUGH RESEARCH, EDUCATION AND TRAINING INITIATIVES

International organizations and governments can boost the impact of research and education towards the SDGs by incorporating open hardware into education and training curricula. A significant part of open hardware designs have their origins in academic contexts, however open hardware is not yet part of most academic programs.

By promoting open hardware amongst students, researchers and educators, universities, research institutions and professional associations can foster STEAM education and build innovation capacity towards the SDGs.

Specific activities to support raising awareness include:

- Developing and maintaining open educational resources on open hardware, and incorporating them in official university programs;
- Developing specific talking points and guidelines for advocacy on open hardware, for advocates inside organizations;
- Developing use cases of open hardware initiatives that support the association between open hardware and high quality standards to support cultural change;
- Developing systems for educators and researchers to easily access information on available open hardware designs;
- Creating and maintaining updated communication materials on open licenses for hardware, in a way that becomes easy to address non-technical audiences and decision-makers;
- Making open-source licensing a default for the hardware outputs of student research projects at university, building on the increase in dissertations and theses being published in open access repositories and raising awareness amongst students to enable further innovations.

As demonstrated by the experience of early adopters, open hardware has the potential for fostering mission-oriented, impactful multi-scale collaborations between academia, civil society, governments and industry. As discussed in this brief, international organizations, national governments, intergovernmental organizations and other multilateral initiatives have the power to shape the future of the open hardware ecosystem.

Previous work on open hardware and policy[49] discusses key implementation benefits and challenges for nation-wide adoption, in particular for a US audience. Now addressing a global audience, the contents of the present policy brief aim to orientate action towards the promotion and growth of open hardware in international policy discussions. Including open hardware as a principle of innovation programs and standards, aligning funding and incentives, and raising awareness through research, education and training initiatives are concrete steps that can turn open hardware into a critical tool to achieve the SDGs.

FAQS: WHY OPEN HARDWARE?

For more FAQs on open hardware licensing and technology transfer strategies, see "Open Hardware is ready to help Technology Transfer Offices (TTOs) maximise the impact of academic research[50]"

WHAT IS OPEN HARDWARE?

Open hardware, sometimes referred to as open source hardware, is one model of technology transfer whereby designs for hardware are shared openly online for anyone to freely use, modify and commercialise.

From the Open Source Hardware definition[51]:

> *"The hardware's source, the design from which it is made, is available in the preferred format for making modifications to it [...] Open source hardware gives people the freedom to control their technology while sharing knowledge and encouraging commerce through the open exchange of designs".*

In particular, open hardware for science refers to any piece of hardware used for scientific investigations that can be obtained, assembled, used, studied, modified, shared and sold by anyone. It includes standard lab equipment as well as auxiliary materials, such as sensors, biological reagents, and analogue and digital electronic components.

ARE OPEN LICENSING AND PATENTING INCOMPATIBLE?

No. Open source licences are applied to patented technologies in both the software and hardware industries and most of the licences include a patent grant. Although counterintuitive, patents are not only used for the purposes of excluding others from practicing an invention.

Some reasons[52] why a patent might be given away for free via open licensing include:

- Increasing profit: a usual situation in open source software that can apply to hardware is that in some cases open licensing enables the patent holder to benefit from community activities such as know-how, novel ideas and development which enhance the products and in turn the market position and profits.
- Catalysing innovation and opening up new fields of business: particularly if the firm lacks the business alignment and know-how, or a firm is generating more technologies than they could finalise into a product.
- Technology provision: a combination of creating goodwill and serving society.

On the other hand, due to the requirement for non-disclosure prior to submitting a patent application, it is not typically possible to patent a technology that is already openly licensed as this implies that it has already been made publicly available.

HOW CAN OPEN HARDWARE GENERATE REVENUE?

Business models for open hardware[53] can generate revenue based on design-centric, manufacturing-centric, services-centric or standardisation-centric approaches.

In the first case, the model is based on product design and R&D (e.g. Arduino[54]), while manufacturing is handled by another party. Suppliers can provide parts that the designer sells assembled or as a kit. In other cases, finished products are manufactured by a third party and distributed under the brand of the project.

Within this model, open hardware is particularly successful when targeting higher-end, non-commodity markets. If designs are technically complex to manufacture or calibrate, even if competitors are able to access the schematics and technical information about a hardware project, few are likely to occupy the same niche.

In a manufacturing-centric model (Sparkfun[55], Adafruit Industries[56]), the organisation's core value proposition is to manufacture and distribute open hardware products for an affordable price. In addition to the brand and community, industrial efficiency is a key asset, and depending on the industry, the diversity and renewal of the product catalog can also be a key differentiator.

A services-centric model monetises expertise and service, a common model for open source software. In open hardware this can include the development of DIY workshops to teach how to build or use a product, selling the "experience" of building it yourself, providing consulting services for third parties to build derivatives or learn specific aspects of a process.

Business models based on standardisation consist of opening a key product whose openness serves mostly to make the associated technology a de facto standard in the industry. This enables the organisation to leverage other capabilities adapted to that standard. Open source hardware is well-positioned to define a standard because everyone involved has equal control of it into the future. As an example, the USB to RS232 converter cables or FTDI Cable Pinout[57] provides a simple communication method between serial devices with RS232 to modern USB supported devices, adopted by all major hardware providers.

IS THE QUALITY OF OPEN SOURCE HARDWARE COMPARABLE TO TRADITIONAL TOOLS?

Due to the wide adoption of rapid prototyping techniques in the open source hardware world, it is not uncommon to hear that open hardware tools are "low quality", or "just prototypes". Even if they start as prototypes, many open hardware projects are available today as off-the-shelf products, with the same certifications obtained by proprietary alternatives. OpenQCM[58] is a company providing scientific devices capable of measuring phenomena at molecular scale; they collaborated on calibration of QCMs onboard the ESA-ROSETTA space mission.

IF ONE PERSON DESIGNS A PIECE OF HARDWARE, A DIFFERENT PERSON MANUFACTURES IT, AND SOMETHING GOES WRONG, WHO IS LIABLE?

Murillo et al (2019)[59] identify that as in Free and Open Source Software (FOSS) licensing, OH licences attempt to exempt licensors from liability by describing that the open design documentation is offered with no warranties and guarantees for any particular use or "fitness" for any kind of purpose. The TAPR Open Hardware License constitutes an exception with an indemnification provision. The rationale for including this exception has to do with the possibility of harm induced by a particular OH product should be fairly placed on the manufacturer (who receives payment) as opposed to the original designer (who does not). In other words, the cost of testing that the product is safe and fit for sale (and of appropriate insurance and, ultimately, the acceptance of liability) should lie with the manufacturer, and not the original designer. Please note that the contents of this policy brief do not constitute legal advice and are provided for general information purposes only; if you require specific legal advice you should contact a specialist lawyer within your institution.

SOURCES

This policy brief is the result of discussions that took place during an online workshop organised by the Global Open Science Hardware community[60] in May 2021. The session gathered 23 key participants to explore how international organizations can benefit from and support open hardware expansion.

PARTICIPANTS

Alexandra Novak, Wilson Center, US

Allen Gunn, Aspiration

Andrew Katz, Moorcrofts LLP, UK

Andrew Lamb, Field Ready

Anne Bowser, Wilson Center, US

Calum Handforth, United Nations University International Institute for Global Health

Clovis Freire, United Nations Conference on Trade and Development (UNCTAD)

David Li, Shenzhen Lab, China

Elena Proden, United Nations Institute for Training and Research (UNITAR)

Eric Pan, Seeed Studio, China

Eva Gousiou, European Organization for Nuclear Research (CERN), Switzerland

Fernan Federici, Pontificia Universidad Católica de Chile (PUC), Chile

Francois Grey, University of Geneva, Switzerland

Guillermo Anllo, United Nations Educational, Scientific and Cultural Organization (UNESCO)

Heather Leson, International Federation of Red Cross Red Crescent Societies (IFRC)

Ji Li, Tsinghua University, China

Jorge Appiah, Kumasi Hive, Ghana

Lukas Winter, Physikalisch-Technische Bundesanstalt (PTB), Berlin and Braunschweig, Germany; OpenSourceImaging.org

Martin Häuer, Fraunhofer Institute for Production Systems and Design Technology IPK, Germany; Open Source Ecology Germany e.V. (non-profit)

Matias Acosta, United Nations Development Programme (UNDP)

Paul Jerchel, Helmholtz Association, Germany

Shannon Dosemagen, Open Environmental Data Project, US

Subir Bhadur, Freelancer, smalldesign.in[61], India

Tarunima Prabhakar, Tattle Civic Tech and Carnegie India, India

Tom Igoe, New York University, US; Arduino, US

This document was written by Julieta Arancio with editorial support from Shannon Dosemagen and Jenny Molloy. Template by Maria Lamadrid and layout by Brianna Johns. It is licensed under CC-BY 4.0.

ENDNOTES

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