United Nations Conference on Trade and Development

Note on a proposed

UN CENTRALISED DATABASE OF OPEN-SOURCE APPROPRIATE TECHNOLOGIES

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NOTE

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EXECUTIVE SUMMARY

Open source allows users the freedom to control their technology while sharing knowledge and encouraging commerce through open exchange of designs. Open licenses contain a viral restriction and changing existing designs requires re-sharing the new design within the same license. This well-established method encourages rapid innovation and is regarded as a mainstay in software development. The same concept is now used for physical products and the open-source technical development method is in exponential growth in hardware development. Millions of open-source products are shared by the global community from consumer goods to scientific and medical equipment. New digital manufacturing and recycling techniques enable individuals and communities to fabricate their own products for less than the price of purchasing them. This model has been proven to be effective for emergency manufacturing during the COVID-19 pandemic.

One area particularly ripe for open-source development and knowledge sharing is "appropriate technology". Appropriate technologies encompass technological choices and applications that are small-scale, economically affordable, decentralised, energy-efficient, environmentally sound and easily utilized by local communities to meet their needs. Therefore, the trend in appropriate technologies is towards relatively simple and non-complex technologies, such as solar cookers.

One way the appropriate technology movement is modernizing to overcome intellectual property (IP) barriers is to blend with the open-source approach to technology development in order to overcome many of appropriate technologies' shortcomings as a technology change model and completely breaking away from IP restrictions. Open-source appropriate technology (OSAT) is an appropriate technology that contributes to the achievement of sustainable development goals (SDGs) while being designed in ways synonymous with free and open-source software (FOSS) and free and open-source hardware (FOSH).

Free and open-source software (FOSS) is software that is both free software and open-source software. Unlike proprietary software, FOSS is available in source code (open-source) form, and can be used, studied, copied, modified and redistributed without restriction, or with restrictions that only ensure that further recipients have the same rights as those under which it was obtained. Today free and open-source software (FOSS) plays the dominant role in software development globally and there is burgeoning rise in digital manufacturing, which make free and open-source hardware (FOSH) not only physically possible, but economically advantageous. The innovation cycle in open-source technology is much more rapid than the conventional intellectual property (IP)-focused process.

Both FOSS and FOSH go beyond open access, granting users substantial freedoms to build on the intellectual work of others. FOSH provides the "source code" for physical hardware including the bill of materials, schematics, computer aided designs (CAD), and other information such as detailed instructions needed to recreate a physical item.

The OSAT approach, even in areas such as medical research, radically reduces the costs even in the upfront investment and can be funded publicly, while earning a high return on investment.

Examples of how open-source can contribute to SDGs

To meet the SDGs, it is imperative that developing countries have access to a broad knowledge base. Access to relevant knowledge can significantly improve the quality of life in developing communities and solve the challenge of sustainable development. Examples of how open-source including FOSS and FOSH can contribute to SDGs include:

- **SDG 2.** An automatable, field camera track system for phenotyping crop lodging and crop movement **SDG 3.** Osmar, an open-source autosampler. Commercial microsyringe manipulation is common for automated sampling of liquids or gases and normally costs over $30,000. Osmar is a viable technically-accessible alternative that can be adapted and expanded for more general liquid handling tasks and be built for under $1,000. Loss of life could be prevented by known technologies whose

availability is restricted by causes such as paywalls on articles under copyright, which restrict the free flow of information or companies leveraging patents to restrict the manufacturing of medical products (e.g. restricting the sale of antiretroviral drugs to treat HIV).

- **SDG 4.** The OpenFlexure Microscope is a 3-D-printed laboratory-grade motorized microscope, which was co-developed between the University of Bath, UK and the Tanzanian engineering company STICLab. It replaces commercial tools that cost over $30,000 for under $100.

- **SDG 6**. An open-source, programmable pneumatic setup for operation and automated control of single- and multi-layer microfluidic devices.

- **SDG 7, SDG 2**. Sharing technology of solar cookers or solar bakeries can be advantageous in terms of having no recurring costs, the potential to reduce drudgery, the improvement of indoor air quality, the high nutritional value of food they produce, and high durability.

- **SDG 8.** OpenDesk which is a global platform for local making, uses a business model for open-source furniture made with distributed on-demand manufacturing. Anyone can download the design files and cut it out on their own open-source CNC (computer numeric controlled) mill. Local economic development occurs because of local manufacturing and sales.

- **SDG 15**. ImageJ which is an open-source image processing and analysis software package originally developed to look at microscopic organisms. Because it is open source and highly adaptable, it is even being used for remote sensing work carried out by aerial drones over enormous land areas.

- **SDGs 1, 2, 3, 4, 11**. OSAT development has already reached sophisticated devices such as open-source 3-D printers used for both the design, but also the production of OSAT in a wide range of areas. For example, RepRaps can be used for manufacturing tools for organic farming, to make microscopes for medical clinics or for full optical labs in schools and research facilities in developing communities for far less cost than conventional means. Open-source 3-D printers are used to create thousands of free 3-D printed hands and arms for those in need of an upper limb assistive device from open-source designs, with significant cost reduction.

The need for a centralised open-source database

A database of OSAT could have potential to accelerate discovery and innovation across all sectors associated with the SDGs, while minimizing legal or financial impediments. Technical information made available via open-source methods can overcome barriers to the building and dissemination of the global stock of knowledge, particularly in developing countries.

Currently, there is no comprehensive repository or central database of OSAT, including technologies with expired patents, patented technologies that are freely licensed (with conditional or unconditional use), and free and open-source technologies. Many organizations, non-profits and for-profit companies are developing OSAT and maintaining existing small-scale databases. While many OSAT are available, they are scattered in various databases for particular technologies. Meanwhile, there remains a distinct need for increasing the use rate of OSAT. Therefore, there is an urgent need for a trusted, global centralised open-source database (COSD).

Being global in scope, a COSD repository would provide a one-stop-shop that everyone can access to solve local challenges. Appropriate technologies that are relevant to the SDGs would be expected to make up the core of the COSD. COSD would thus cover all technical areas. In addition, the COSD will not be limited to specific sectors or applications, as open-source technologies can often solve problems far outside the scope of their intended use. For example, ImageJ is an open-source image processing and analysis software package originally developed to look at microscopic organisms. Because it was open source and highly adaptable, now it is being used for remote

sensing work carried out by aerial drones over enormous land areas. In the COSD, all information, data, plans, full digital design and manufacturing files, instructions for assembly and use, etc. are available and free.

UN is rightly positioned to host the COSD

The United Nations (UN) is well placed to take a lead in the establishment of a COSD given its well established role in advocating open-source technology through various intergovernmental forums and publications. In particular, the 2030 Connect is a UN online technology platform that was developed as part of the work of the UN Inter-Agency Task Team. The COSD could enhance it by being incorporated into the 2030 Connect. The success of the COSD depends on support from the UN Member States as well as collaboration and cooperation among UN agencies including United Nations Conference on Trade and Development (UNCTAD), UN Department of Economic and Social Affairs (DESA), United Nations Development Programme (UNDP) and UN regional commissions. Private sector engagement in COSD is equally important. For example, companies that already belonging to organizations like Open-Source Hardware Association may find it beneficial to share their own designs with the COSD.

ABBREVIATIONS & ACRONYMS

ASME	American Society of Mechanical Engineers
CAD	Computer aided designs
CNC	Computer numeric controlled
COSD	Centralised Open-source Database
DESA	Department of Economic and Social Affairs
DIY	Do-it-Yourself
DRAM	Distributed Recycling and Manufacturing
E4C	Engineering for Change
FDA	Food and Drug Administration
FOSH	Free and open-source hardware
FOSS	Free and open-source software
FPF	Fused Particle Fabrication
GIAN	Grassroots Innovation Augmentation Network
ICT	Information and Communication Technology
IEEE	Electrical and Electronics Engineers
IP	Intellectual Property
NIH	National Institutes of Health
OSAT	Open-source appropriate technology
OSE	Open-source Ecology
OSHWA	Open-source Hardware Association
PPE	Personal Protective Equipment
ROI	Return on Investment
SDGs	sustainable development goals
TAP	Tech Access Partnership
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
WHO	World Health Organization

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