MAKE African European Maker Innovation Ecosystem

Deliverable 3.1

Open Makerspace Toolkit

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Abstract (for public dissemination only)	The Open Makerspace Toolkit (OMT) provides key stakeholders in the African and European maker movements with materials and resources for professional development in support of setting up, managing, equiping and sustaining different types of open, collaborative and innovative makerspaces. The Toolkit consists of five main parts: 1) creating a makerspace; 2) making activities; 3) good practices; 4) digital communication; and 5) business models.
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1.00	21.02.2024	Offline and online version alignment, and final editing

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List of Abbreviations

APSOHA	Association pour la Promotion de la Science Ouverte en Haïti et en Afrique
BMCC	Borough of Manhattan Community College
CA	Consortium Agreement
CAD	computer-aided design
CMIT	Centres for Maker Innovation and Technology
CNC	computer numerical control
CO	confidential
COPPA	Children's Online Privacy Protection Act
DAO	dessin assisté par ordinateur
DI	digital innovation
DIH	Digital Innovation Hub
DI	digital innovation
DIY	do-it-yourself
DMP	Data Management Plan
DoA	Description of Action
DOI	digital object identifier
DSI	digital social innovation
EC	European Commission
EGE	European Group on Ethics in Science and New Technologies
fab lab	fabrication laboratory
GA	Grant Agreement
GDPR	General Data Protection Regulation
H2020	Horizon 2020 programme of the European Union

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IDE	**Integrated development environment**
IoT	**internet of things**
IPRs	**intellectual property rights**
LED	**light-emitting diode**
LLC	**limited liability company**
MAB	**mAkE Advisory Board**
MIT	**Massachusetts Institute of Technology**
MOOC	**massive open online course**
NPO	**nonprofit organisation**
OCBM	**Open Catalogue of Business Models**
OER	**open educational resource**
OMT	**Open Makerspace Toolkit**
ORDP	**Open Research Data Pilot**
PMB	**Project Management Board**
PU	**public**
RE	**restricted**
R&D	**research and development**
R&I	**research and innovation**
SDGs	**Sustainable Development Goals**
SEO	**search engine optimisation**
SMART	**specific, measurable, achievable, relevant, and time-bound**
SSL	**secure sockets layer**
STEAM	**science, technology, engineering, arts and mathematics**
STEM	**science, technology, engineering and mathematics**

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SWOT	**strengths, weaknesses, opportunities, threats**
WP	**work package**

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Executive summary

This Open Makerspace Toolkit (OMT) is a core deliverable in support of achievement of the mAkE project's mission to catalyse innovation and sustainable growth within the African and European maker communities. Crafted under the auspices of mAkE work package 3 (WP3), the OMT is a resource aimed at supporting establishment, management, and sustainability of open, collaborative and innovative makerspaces (and other types of Digital Innovation Hubs (DIHs)). Through a methodology encompassing research, review, content creation, and peer review, stakeholders from diverse backgrounds and regions have collaboratively contributed to the Toolkit's development, ensuring its relevance and utility.

Comprising five sections, the OMT serves as a guide for key stakeholders including makers, policy makers, and funders, providing insights and resources for fostering vibrant makerspaces. From foundational aspects to advanced strategies, the Toolkit offers a holistic approach to nurturing innovation ecosystems, embodying a philosophy of openness, collaboration, and experiential learning. By empowering users to explore, experiment with, and actualise their ideas, the OMT seeks to foster intensive problem-solving, entrepreneurship, and community engagement.

As evidenced by this version of the toolkit and ongoing refinement efforts its online version will receive in year three of the mAkE project, WP3 anticipates broad-reaching influence across the maker ecosystems in Africa and Europe. Through dedicated courses, training programmes, and shared learning environments facilitated by the Toolkit, makers and innovators stand to benefit from enhanced skills, knowledge and support networks, which in turn will foster entrepreneurship, technological innovation, and job creation. Moreover, the OMT's role in facilitating knowledge exchange and collaboration between makerspaces/DIHs in Africa and Europe further promotes cross-cultural learning and collective problem-solving.

Going forward, the mAkE project is committed to ensuring broad accessibility and usability of the Toolkit, with plans to leverage public access platforms. By fostering ongoing dialogue and collaboration with stakeholders, WP3 aims to continue refining and updating the OMT to meet the evolving needs of the African and European (and global) maker communities, thereby maximising its long-term impact and sustainability. In essence, the Open Makerspace Toolkit will transcend the limitations a static resource, evolving into a dynamic force for change, innovation, and empowerment; unlocking human potential; and driving societal transformation through the power of making.

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Introduction

Makerspaces are open, shared and collaborative spaces where people with common interests (in craft, technology, design and product development, etc.) can come together to socialise and work on projects while sharing ideas, equipment and knowledge (Mboa, 2020, p. 1). They can be located in a variety of environments, such as communal, educational (schools, libraries, universities), museum, commercial venues as well as in autonomous nonprofit centres (Ahmadi et al., 2019; Irie et al., 2019; Geser et al., 2019, p. 61). Makerspaces are characterised by their ideological foundations (do-it-yourself (DIY), open source, open science, etc.), the values shared by members (openness, sharing, inclusion, accessibility, etc.), the tools found there (3D printer, laser cutter, Arduino, sewing machine, etc.) and practices (ideation, prototyping, etc.). At the heart of this dynamic is the construction, conservation, appropriation, accessibility, distribution and circulation of knowledge, which have been accelerated by the Internet. In this sense, makerspaces can be defined as Digital Innovation Hubs (DIHs) that drive local, digital innovation, learning, skill building and collaboration through digital prototyping, design, fabrication as well as smart manufacturing.

In our project (mAkE) we have chosen to work with makerspaces because of the important and growing role they play in the digital innovation ecosystem, particularly in Africa where manufacturing has been identified as a critical growth area to bring more jobs to the African economy. Indeed, makerspaces enable communities to actively shape social computing and innovation, especially marginalised groups in the so-called Global South, youth, and women (Blikstein, 2013; Cervantes & Nardi, 2010; Hook et al., 2014; Richard et al., 2015; Tanenbaum et al., 2013). As digital manufacturing technology becomes cheaper and more ubiquitous, they are offering possibilities to quickly switch from concept to prototype, then to unit and/or serial development (Bouvier-Patron, 2015). This opens up commercial opportunities for makers, in particular in countries lacking traditional industrial production facilities. Further, makerspaces provide young people and students in Africa access to digital prototyping and fabrication tools, and thereby the possibility to actively contribute to digital innovation, which they would otherwise not have access to.

The Open Makerspace Toolkit (OMT) provides key stakeholders in the African and European maker movements with materials and resources for professional development in support of setting up, managing, equiping and sustaining different types of open, collaborative and innovative makerspaces. The Toolkit consists of five main parts: 1) creating a makerspace; 2) making activities; 3) good practices; 4) digital communication; and 5) business models.

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Chapter 1: Creating a makerspace

Creating a makerspace is a multifaceted endeavour that extends beyond acquiring tools and equipment. It requires a deep understanding and embrace of the maker ideology, fostering a vibrant community where creativity, collaboration, and innovation thrive. Moreover, determining the legal status of the makerspace is crucial, setting the framework for its operation within the jurisdiction's legal system and ensuring adherence to regulations.

This chapter serves as a comprehensive guide to establishing a thriving hub for innovation, covering key steps from conceptualisation to realisation. Readers will learn how to define a clear vision that guides resource selection and community involvement, spanning from STEM education to entrepreneurial ventures. Understanding the legal framework and implications of various organisational structures, such as nonprofit organisations or for-profit entities, is also essential for ensuring compliance and accountability within the jurisdiction.

Furthermore, the chapter explores practical aspects such as space design, equipment selection, safety protocols, and accessibility measures. By optimising workflow and collaboration through strategic space layout and choosing high-quality equipment aligned with the audience's needs, makerspaces can inspire innovation and empower individuals.

Key highlights covered in this section include:

1. **Defining the vision:** Establish a clear vision that guides resource selection and community involvement, spanning from STEAM education to entrepreneurial ventures.
2. **Determining legal status:** Understand the legal framework and implications of various organisational structures, such as nonprofit organisations or for-profit entities, to ensure compliance and accountability within the jurisdiction.
3. **Designing the space:** Optimise workflow and collaboration by strategically designing the layout of the makerspace, including distinct zones for various activities and ample storage for projects in progress.
4. **Selecting equipment and supplies:** Choose high-quality equipment aligned with the audience's needs to inspire innovation.
5. **Ensuring safety and accessibility:** Prioritise safety with clear guidelines, training, and supervision, while ensuring accessibility for individuals of all abilities and backgrounds.
6. **Promoting community engagement:** Encourage community involvement from inception by soliciting input from stakeholders and hosting inclusive events to cultivate an empowering environment for exploration and skill-sharing.

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1.1. Foundations of maker ideology

Makerspaces base their ideology around : the hacker ethic, the open culture (in the sense of free software), do-it-yourself and core values (Mboa, 2017, p. 73).

1.1.1. The hacker ethic

The hacker ethic refers to the valuing of freedom of action, the importance of experimentation and verification, distrust of all forms of authority and a fundamental optimism about human capabilities. Here are the seven commandments of the Hacker ethic according to Spadaro (2014, p. 52):

- Access to computers must be unlimited and total ;
- Always give priority to the hands-on, and to personally check ;
- All information must be free ;
- Distrust authority, promoting decentralisation ;
- Hackers must be judged by their hacking ;
- It is possible to create art and beauty on a computer ;
- Computers can change your life for the better.

1.1.2. Open culture

The open culture of the maker movement borrows from the four essential freedoms that characterise free softwares:

- The freedom to run the program as you wish, for any purpose (freedom 0).
- The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help others (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3).

By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

1.1.3. Do-it-yourself

The do-it-yourself ethic is all about enthusiasm for self-manufacture, tinkering and crafts. Anderson and Le Séac'h (2012, 27) attribute the following three characteristics to DIY: digital self-manufacturing, online collaboration and the use of online files.

1.1.4. Core values

- **Openness** – makerspaces offer those who use them access to expensive and powerful tools which, under normal circumstances, would be difficult for individuals and especially the community to access.
- **Sharing** – makerspaces are niches of altruistic values of open and reciprocal sharing of knowledge. This is achieved by sharing space, machines, manufacturing plans, code, etc.

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- **Inclusion** – makerspaces are places that are open to everyone, regardless of social status or ability to commit; only the sharing of ideas and knowledge counts.

These core values should be an integral part of the operation of any makerspace that aims to be ethical and responsible. To this end, we strongly recommend adopting one or more of the following manifestos:

- OCSDNet Manifesto,
- GOSH manifesto,
- Unesco recommendations on Open Science.

1.2. Preparatory phase

Setting up a makerspace requires a preparatory phase consisting of three main steps: map your ecosystem, be aware of the maker ideology and research.

1.2.1. Map your maker ecosystem

Careful planning is one of the most important steps you can take to ensure that your project is a success. The first step is to invest time in research and development by reading and comparing what other people are doing in this area. It would be useful to ask yourself the following questions beforehand (Make App Club Team, 2018)

- Do any other makerspaces exist in your context? If they do, is this something that you can get involved in, or is it far enough away to justify a new space?
- Has a makerspace already been tried in your area? If it failed, what were some of the reasons that this happened? Is this something that can be overcome?

1.2.2. Research

Research should cover the choice of the space, technologies, types of equipment, sustainability strategy and security.

- **Choice of space:** Depending on your planning outcome and preferences (e.g., a community space, a university makerspace), choose a space that is accessible and has enough room to accommodate equipment and users. Some inspiration for spaces that can work well are: school/college classrooms or science labs, theatres and arts centres, church halls and community centres, libraries.
- **Technology:** Make sure the space has reliable internet connectivity, sufficient electrical outlets, and other technologies needed to support makers' projects.
- **Equipment and furniture:** Most commonly, equipment is related to digital fabrication, electronic/robotic, textiles, woodworking, metalworking, computers and software, general tools.
- **Security:** Select relevant safety rules and waste management best practices.

1.3. Choice of legal status

The term "legal status" refers to the recognised condition or standing of an individual, entity, organisation, or concept under the law. It signifies the rights, responsibilities, and obligations that are attributed to a particular entity based on its classification, structure, and relationship with the legal framework of a given

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jurisdiction. The legal status of a makerspace can then be defined as the recognised condition or standing of a makerspace under the laws of the jurisdiction which it operates in. This is important because it defines the framework within which makerspaces operate, ensuring order, rights protection, and accountability within a society. Every jurisdiction has its own defined legal statuses under which they operate, so it is important to understand the legalities of any jurisdiction you find in your makerspace. Makerspaces can exist as nonprofit organisations (NPOs) or for-profit organisations.

1.3.1 Nonprofit organisation (NPO)

A makerspace formed for purposes other than making a profit, such as charitable, educational, or religious activities. Nonprofits can have various legal structures, such as corporations, trusts, or associations. Such makerspaces may focus on community development, education, and fostering creativity.

Advantages

- Nonprofit makerspaces are eligible for tax-exempt status. Nonprofits are eligible for federal exemption from payment of corporate income tax. Once exempt from this tax, charitable contributions made to non profit makerspaces are tax-deductible.
- Many foundations and government agencies limit their grants to public charities. This is a huge advantage to non profit makerspaces as they can apply for grants and donations, and may attract members who support the mission. This is a legal way of raising revenue for the makerspace activities.
- Under some jurisdictions, creditors and courts are limited to the assets of the nonprofit organisation (if there are any). The founders, directors, members, and employees are not personally liable for the nonprofit's debts. However, there may be some exceptions. A person (employee, founder, board member, director, etc.) cannot use the nonprofit to shield illegal or irresponsible acts on their part. Also, directors have a fiduciary responsibility; if they do not perform their responsibilities in the nonprofit's best interests, and the nonprofit is harmed, they can be held liable.

Considerations

- Nonprofit makerspaces must meet requirements for nonprofit status (as defined by the legalities in the jurisdiction they operate), demonstrate a charitable purpose, and maintain compliance with tax regulations. It is also important to obtain certification as a nonprofit organisation in some jurisdictions, as part of the compliance procedures.
- Nonprofits sometimes do sell products or services to generate revenue, but often, they rely heavily on fundraising, public and private donations to provide services and resources. Raising funds is an ongoing challenge for nonprofits, which is especially tough when the economy of the jurisdiction iot operates in is poor. Nonprofits often have a harder marketing battle as they must motivate people to donate or volunteer when they likely get no tangible benefits in return.
- Nonprofits typically must report how they use their funds, mostly to donors and funders.as the government, funders and donors like to see most of their funds go to services and not administrative expenses.

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1.3.2. For-profit organisation

A for-profit makerspace can be organised as a limited liability company (LLC) or as a corporation.

Limited liability company (LLC)

A for-profit makerspace organised as an LLC operates with the intention of making a profit while providing services and resources to its members or community. This provision of services and resources include but not limited to renting of tools and equipment, spaces and offices, selling tangible and intangible products to the general community, etc. In this context, a for-profit makerspace would offer access to tools, equipment, and resources to community members and the general public for creative projects while operating as a profit-generating entity.

Key considerations for a for-profit makerspace organised as an LLC include:

- Founders or owners of the LLC have limited liability for the debts and obligations of the makerspace. Their personal assets are generally protected from business-related liabilities.
- A makerspace operating as an LLC allows for a flexible management structure where owners or founders can manage the makerspace themselves or appoint makerspace managers to handle day-to-day operations.
- Profits and losses of the makerspace "pass through" to the owners' or founders' individual tax returns. The makerspace itself does not pay any income tax. Instead, founders or owners report their share of the profits on their personal tax returns.
- As a makerspace operating as an LLC, owners or founders can develop an operating agreement. An operating agreement outlines the internal workings of the makerspace, including ownership percentages, management roles, decision-making processes, and more.

Corporation

A for-profit makerspace organised as a corporation is a separate legal entity from its owners (shareholders) that is formed to generate profit through the operation of the makerspace. This makerspace business structure operates as a separate and distinct legal entity. It is owned by shareholders and managed by a board of directors who appoint a manager(s) to oversee the makerspace's daily operations.

Key considerations for a for-profit makerspace organised as a corporation

- Shareholders of the corporation have limited liability for the makerspace's debts and liabilities. Their personal assets are generally shielded from business-related obligations.
- The makerspace is managed by a board of directors elected by shareholders. The board is responsible for major decision-making and oversight.
- Corporations are subject to corporate income tax, and shareholders may also face taxation on dividends received. This double taxation can impact overall profitability.
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In both cases (makerspaces as LLCs or as corporations), a for-profit makerspace would operate with the goal of generating revenue while providing community members and the general public with access to tools, equipment, and a collaborative environment. The choice between an LLC and a corporation will depend on factors such as liability protection, taxation, management preferences, and potential growth strategies.

1.3.3. Nonprofit with for-profit arm

A hybrid model in the context of makerspace business structures refers to a combination of different business or organisational structures to achieve specific goals or address unique circumstances. Hybrid models blend elements of two or more traditional business structures, allowing makerspaces to leverage the benefits of each while accommodating their specific needs and objectives. Hybrid models can be particularly effective in balancing financial sustainability, community engagement, and mission-driven goals. A nonprofit organisation with a for-profit arm is a hybrid structure where a nonprofit entity establishes a separate, for-profit subsidiary or division to generate revenue and support its charitable or social mission. This model allows the nonprofit to diversify its funding sources, increase financial sustainability, and potentially create a more stable base of resources to achieve its goals.

A makerspace could be established as a nonprofit entity to focus on community education and training, workshops, outreach, etc. At the same time, it could create a for-profit arm to offer premium services, access to specialised equipment, or commercial projects. This for-profit arm of a makerspace should be separated from the nonprofit arm of the makerspace to prevent the occurence of an identity crisis for the makerspace.

- **Nonprofit organisation (NPO):** The NPO entity remains focused on its charitable or social mission. It is dedicated to serving its community members and the general public, promoting social good, and addressing specific needs in the community. The nonprofit entity typically operates with a tax-exempt status, which means it is eligible for certain tax benefits and can receive tax-deductible donations from donors and sponsors.
- **For-profit arm (subsidiary or division):** The for-profit arm is a separate legal entity, often established as a subsidiary or division of the nonprofit. It operates with the primary goal of generating profits through commercial activities. These activities can include selling products, offering services to corporations, institutions and individuals, or engaging in other revenue-generating ventures that align with the nonprofit's mission.

Considerations

- The nonprofit status of the makerspace can attract grants and donations, while the for-profit arm generates revenue to support the overall mission.
- The for-profit arm generates revenue through its commercial activities. These profits can be used to support the nonprofit's charitable and social activities, thereby reducing the organisation's reliance on traditional fundraising methods.

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- Both the nonprofit and the for-profit arm should have a clear alignment in their missions and goals. The for-profit activities should complement and support the nonprofit's social or charitable objectives.
- By diversifying its revenue sources, the nonprofit can achieve greater financial sustainability and reduce its dependence on grants and donations
- The for-profit arm may benefit from the nonprofit's reputation, mission alignment, and established networks. In return, the nonprofit may gain access to expertise, resources, and revenue generated by the for-profit activities.
- The governance and management structures of the nonprofit and the for-profit arm may differ. There should be clear policies and procedures in place to manage potential conflicts of interest and ensure that the for-profit arm's activities do not compromise the nonprofit's tax-exempt status.
- Establishing a for-profit arm requires careful legal and regulatory considerations. Depending on the jurisdiction and the nature of the activities, there may be tax implications, reporting requirements, and compliance obligations to address.
- Open communication and transparency are essential to ensure that stakeholders understand how the for-profit arm operates, how profits are used, and how it supports the nonprofit's mission.

It is important for makerspaces to take into consideration that while this hybrid model offers potential benefits, it also requires careful planning, legal guidance, and effective management to ensure that the nonprofit's tax-exempt status is maintained and that the for-profit arm's activities align with the nonprofit's mission and values. Consulting with legal, financial, and nonprofit experts is strongly recommended when considering and implementing a nonprofit with a for-profit arm structure. Moreover, the choice of business structure will impact taxation, liability, and operational aspects.

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1.4. Layout and equipping

1.4.1. Layout

The spatial organisation of a makerspace is crucial to creating an environment conducive to creativity and learning. The makerspace needs to be adaptable, because the needs of the community can change over time. That is why the space should be zoned: divided into different zones for different types of activity. For example, have one area for electronics, another for woodwork, a collaborative workspace, and a storage area, etc.

Table 1: Zones and workstations in a makerspace

Zone	Description	Workstation
Reception	This area is used to welcome members and visitors, provide information about the makerspace and its rules, and manage registrations and tool loans.	A single workstation could be sufficient to manage registrations, tool loans and information.
Co-working space/training area	This is a multifunctional space that can be used for meetings, training courses, workshops, presentations, group work or simply computer work. It can be equipped with modular tables, chairs, whiteboards, projectors, etc.	The number of workstations can vary greatly, depending on the size of the space. You might consider having enough space to host workshops or group training sessions. For example, a space that can accommodate 10 to 20 people might be a good place to start.
Electronics/robotics area	This area includes soldering workstations, development kits for microcontrollers such as Arduino or Raspberry Pi, electronic components, robots and more.	Depending on the size of the space, you could envisage having 3 to 5 workstations, each equipped with the necessary tools for electronic and robotic work.
Digital fabrication area	This area includes 3D printers, laser cutters, vinyl cutters, thermal presses, etc. Workstations for the preparation and post-processing of 3D prints can also be located here.	The number of workstations depends on the number of machines you have. Each 3D printer, laser cutter or other machine could be considered a workstation. The preparation and post-processing area could also be considered a workstation.
Woodworking area	This area includes woodworking tools such as circular saws, drill presses, planers, etc. It would also include a space for wood storage and finishing work. It would also include space for wood storage and finishing work.	Given the size of the tools and the need for space for woodworking, 3 to 5 workstations could be a good starting point.
Metalworking area	This area includes lathes, drilling machines, welding machines and other metalworking	As with woodworking, 3 to 5 workstations could be appropriate,

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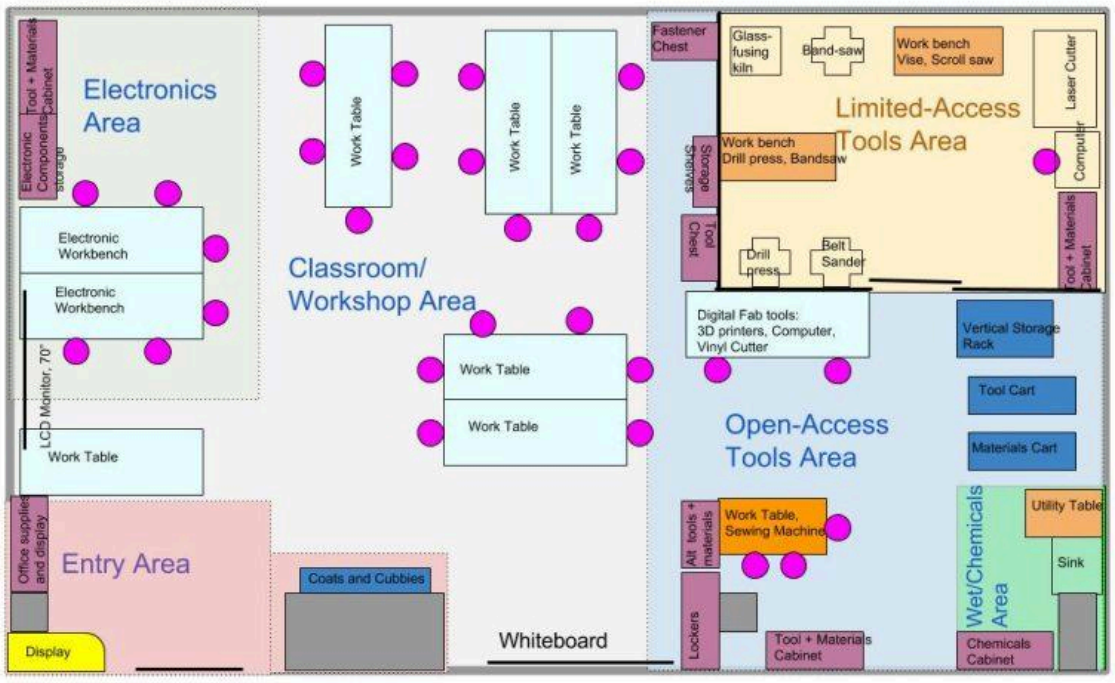
	tools. It would also include space for metal storage and finishing work.	depending on the size of the space and the equipment available.
Textile/sewing area	This area includes sewing machines, embroidery machines, mannequins, a large cutting table and other sewing and textile supplies.	Depending on the space available, you could have 2 to 4 stations, each with a sewing machine, and a cutting and preparation area.
Storage area	This space is used to store materials, tools, ongoing projects, etc.	This area does not generally require dedicated workstations, but must be large enough to store materials and ongoing projects.
Security area	This area would contain safety equipment such as fire extinguishers, first-aid kits, safety glasses, gloves, etc.	This area does not require workstations, but must be easily accessible from any part of the space.
Relaxation area	A space to relax, eat and socialise. This can help encourage collaboration and the exchange of ideas between members.	The space required will depend on the number of members, but a small corner with a table and chairs for 4 to 6 people could be a good place to start.



Picture 1: Example of space design and layout (source : Maker Resources for K-12 Educators)

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1.4.2. Equipping

Most commonly, makerspace tools and materials cover eight areas: digital fabrication, electronic/robotic, textiles, woodworking, metalworking, computers and software, furniture and security, general tools.

Table 2: Digital fabrication tools

Tool	Description
3D printer	These machines use plastic filaments or other materials to build three-dimensional objects layer by layer, based on a digital model. They are used to manufacture a wide variety of objects, from prototypes to functional parts.
Laser cutter	Laser cutters use a high-powered laser beam to cut or engrave materials. They can be used to create artwork, project components, information panels and more.
Vinyl cutter	These machines cut precise shapes from self-adhesive vinyl, which can then be applied to a variety of surfaces to create custom designs.
3D scanner	3D scanners create digital representations of real objects, using light to capture the shape and sometimes the color of the object. These digital models can then be modified, duplicated or analysed using other digital tools.
CNC machine	CNC machines are used to machine materials by removing superfluous parts to create a specific shape. These machines use a router to cut, hollow out or engrave a wide variety of materials, including wood, metal, plastic and many others. They are often used for larger projects, such as furniture making or panel cutting.

Table 3: Electronic/robotic tools

Tool	Description	Example of a model
IoT kit	These kits generally contain a variety of electronic components and sensors to facilitate the development of IoT projects.	ESP8266 IoT Development Board
Robotic kit	Robotics starter kits, such as those from LEGO Mindstorms, Makeblock or VEX Robotics, which include motors, sensors and other components.	LEGO Mindstorms EV3
Wireless modules	WiFi, Bluetooth, ZigBee, LoRa and other modules are essential for IoT and robotics projects requiring wireless communication.	ESP8266 WiFi Module
Breadboards	These tools are used to create and test prototypes of solderless electronic circuits.	Elegoo 830 points Breadboard
Motors and servos	DC motors, stepper motors, servo motors, etc., are commonly used in robotics projects.	Servo Motor SG90

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Resistors	Resistors are passive components used to resist electrical current in a circuit. They are often used to limit current, divide voltage, etc.	220 Ohm resistors (1/4 watt, 5%)
Capacitors	Capacitors are energy storage devices. They store electrical energy when a voltage is applied and release it when it is disconnected. They are often used in filtering, control and coupling circuits, etc.	100uF 25V electrolytic capacitor
Transistors	Transistors are semiconductor devices that can amplify or switch electronic signals and electrical energy. They are one of the fundamental building blocks of modern electronic circuits.	NPN 2N2222A Transistor
Diodes	Diodes are electronic components that allow current to flow in one direction only. They are often used to convert alternating current into direct current, protect circuits against overvoltage, etc.	Diode 1N4007
LEDs	LEDs (light emitting diodes) are semiconductor devices that emit light when an electric current is passed through them. They are commonly used as indicators, in lighting, in digital displays, etc.	5mm white LED
Connecting wires	Connection wires are used to make electrical connections between different components or modules in a circuit. They can be of different types, such as male-male, male-female, female-female, etc., depending on the connection requirements.	Dupont type connecting wires, male to female, 20cm

Table 4: Textiles tools

Tool	Description	Example of a model
Sewing machine	A device used to sew fabrics and other materials together with thread.	Brother CS6000i
Digital embroidery machine	These machines use design software to create complex embroidery patterns. The machines then use these designs to automatically embroider on materials such as fabric.	Brother PE800
Heat press machine	These machines use heat and pressure to transfer patterns or images onto materials such as fabric. They are commonly used to make personalised t-shirts, caps, bags and more.	Fancierstudio DG Heat Press

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Table 5: Woodworking tools

Equipments	Description	Example of a model
Circular saw	Electric tools used to make straight cuts in wood.	DeWalt DWE575SB
Jig saw	Power tool used to cut curves in wood..	Bosch JS470E
Sanding machine	Used for a smooth wood finish.	DeWalt DWE6423K
Planing machine	Used to flatten and reduce the thickness of wood.	DeWalt DW735X
Wood lathe	Used for woodturning work such as bowls, vases, balusters, etc.	JET JWL-1236
Drill press	Used to drill precise holes to defined depths.	WEN 4214
Routing machine	Used for a variety of cutting tasks, including grooves, edges and moldings.	DeWalt DW618PKB
Set of hand tools	Basic tools used for various woodworking tasks.	hammers, chisels, saws, etc.
Work bench	A stable work surface for a variety of woodworking tasks.	Seville Classics

Table 6: Metalworking tools

Equipments	Description	Example of a model
Metal band saw	A metal bandsaw is used to cut different types of metal with precision.	JET JWBS-14DXPRO
Metal lathe	A metal lathe is used to machine the metal precisely.	JET GH-1440-1
Milling machine	A milling machine is used to machine metal parts.	JET JMD-18
Metal belt sander	A metal belt sander is used to polish and finish metal parts.	JET J-41002
Anvil	An anvil is used as a hard surface on which metal can be shaped.	Grizzly G8147
Welding unit	A welding machine is used to join metal parts by fusion.	Hobart 500559 Handler 140
Hydraulic press	A hydraulic press is used to bend or shape the metal.	Sunex 5720

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Tapping arm	A tapping arm is used to tap holes in metal.	FlexArm A-32

Table 7: Computers and software tools

Area	Software	Description	Open source?
CAD (computer- aided design)/DAO (dessin assisté par ordinateur)	AutoCAD .	Used to create 2D drawings and 3D models	No
	Fusion 360	3D design software developed by Autodesk.	No
	SketchUp	Easy-to-use 3D modeling software.	No
	SolidWorks	3D design software for professionals.	No
	TinkerCAD	An excellent online 3D modeling tool for beginners.	No
Digital fabrication	Cura	3D printing software developed by Ultimaker.	Yes
	Repetier-Host	Une solution d'impression 3D complète qui permet de contrôler et de gérer les tâches d'impression.	Yes
	CAMotics	Une simulation pour les machines CNC 3 axes.	Yes
	GRBL	Un firmware pour les contrôleurs de machines CNC.	Yes
Electronic/robotic	Arduino IDE	A development environment for programming Arduino boards.	Yes
	Raspberry Pi OS	An operating system for the Raspberry Pi.	Yes
	Fritzing	Electronic circuit design software.	Yes
	KiCad	Open-source software for designing electronic schematics and printed circuits.	Yes
Design	Adobe Creative Cloud	Software suite including Photoshop, Illustrator, Premiere Pro, After Effects and more.	No
	GIMP	Free, open-source image-editing software.	Yes

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	Inkscape	Free software for designing vector graphics	Yes
Coding	Visual Studio Code	A code editor developed by Microsoft.	Yes
	PyCharm	An integrated development environment for Python	Yes
	Node.js	A runtime environment for server-side JavaScript	Yes
	Unity	A game engine for the development of 2D and 3D games	Yes
Interactive learning	Scratch	A programming platform for children.	Yes
	MakeCode	A coding environment for beginners designed by Microsoft.	Yes

1.4.3. Furniture and security

- **Furniture:** Choose furniture that is flexible and adaptable to suit different activities. Adjustable tables and chairs, storage shelves and whiteboards can be useful.
- **Security**
  - **Safety:** Put safety measures in place, including fire extinguishers, first aid kits and personal protective equipment. Make sure users are trained in safety.
  - **Waste management:** Set up waste and recycling bins, and consider waste management strategies for materials used in the makerspace.
  - **Storage:** Provide storage solutions for tools, materials and ongoing projects. Shelves, lockers and storage bins can help keep the space organised.

These are the basic tools for carrying out various projects and tasks in a makerspace. They are versatile and can be used in many different types of projects, from woodwork to metalwork, electronics and more. It is also important to train users in the correct way to use these tools and to stress the importance of following good safety practices.

Table 8: General tools

- Hammers
- Screwdrivers (slotted, Phillips, Torx, etc.)
- Spanners (flat, adjustable, Allen, etc.)
- Pliers (flat, cutting, needle nose, etc.)
- Tape measures
- Rulers and squares
- Cutter and scissors
- Cordless drill and drill bits
- Screws and nuts
- Glue, tape and other adhesives
- Files and rasps
- Clamps
- Workbench
- Work light
- Hand saw
- Sanding paper and blocks
- Markers and pencils
- Work gloves
- Safety goggles
- First aid kit
- Hot glue gun
- Tool box

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- Spirit level
- Screw extractor

Obtaining all of the equipment that you might need for your makerspace may seem like a daunting task. Here are few tricks that you can use to keep the costs as low as possible (Make App Club Team, 2018):

Tricks to keep the costs low

- First of all, you should be aware that the making you can do in your space, and therefore skills you can develop, will be determined by the equipment and resources you have available. You can start small with the basics in one particular area, and grow as your demand grows.
- Make use of used/donated items rather than buying things new. Call upon your existing network to see what might be available. You might be surprised by how generous people can be.
- Make use of auction sites like eBay to buy second-hand and to secure the best deal. Online shopping comparison sites can also point you towards some bargains.
- Particularly early on, it makes sense to borrow what you can – especially if the piece of equipment is only going to be used for a small amount of time. It also gives you the option to road test equipment before working out if it is worth purchasing.
- It is also possible to raise money for new equipment through fundraising. This could be an excuse for a group project. For example, young makers could create a Christmas gift that could be sold to raise funds.
- Whenever possible, try to work with free software. This gives people the opportunity to access that software at home and to continue to work on it for free.
- The final way to gain equipment is to bid for it through trusts and charitable institutions.

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Chapter 2: Making activities

Engaging in making activities within a makerspace fosters hands-on learning, creativity, and the exploration of diverse crafting techniques. From traditional craftsmanship to modern fabrication methods, these activities offer participants a chance to bring their ideas to life and develop practical skills. Makerspaces presents a diverse range of creative activities, catering to a wide array of interests and skill levels. This section provides a comprehensive overview of the various making activities that can thrive within a makerspace.

Key highlights covered in this section include:

1. **Traditional crafts:** Whether it's woodworking, metalworking, textile arts, or paper crafts, makers can immerse themselves in the art of handcrafting unique and tangible objects.
2. **Digital fabrication:** Digital fabrication technologies enable makers to turn digital designs into physical realities. 3D printing, CNC machining, laser cutting, and prototyping tools empower makers to materialise their ideas with precision and efficiency.
3. **Artistic expression:** Makerspaces provide a supportive environment for artistic experimentation and growth. Exploring different techniques, styles, and mediums, it is possible to bring creative visions to life on canvas, paper, or digital screens.
4. **Sustainable practices:** Upcycling and repurposing workshops offer makers the chance to transform discarded items into functional and aesthetically pleasing objects. Makerspaces can play a vital role in reducing waste and promoting environmental stewardship through their creative endeavors.
5. **Entrepreneurial activities:** Makerspaces provide fertile ground for aspiring entrepreneurs to develop and prototype innovative products, refine business models, and connect with mentors and collaborators.

2.1. Coding, programming and electronics

Coding and programming stand out as indispensable skills, serving as the backbone for innovation and creative expression.

2.1.1. Coding

Coding is a language for computers. It is a set of phrases, syntaxes and rules put together to give an instruction on how a computer/program operates. Like instructions on how to do quite literally everything! And like the many languages we have here on the planet, there are a myriad of programming languages used for many different purposes (BMCC's OpenLab). Through coding, makers gain the ability to manipulate and control electronic components, paving the way for the creation of interactive and intelligent systems. The integration of coding in makerspaces nurtures a collaborative and interdisciplinary environment. Makers with diverse backgrounds and skill sets can converge to collectively tackle complex challenges by leveraging their coding expertise.

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2.1.2. Programming

In makerspaces, programming plays a vital role. Visual languages like CSS and HTML are employed for website development (with Javascript offering broader functionality beyond websites). Arduino, primarily using C++, is frequently used for programming in makerspaces, alongside tools such as Processing and p5.js for visual design. Programming is best learned by doing and often requires an application to write or edit code, commonly known as an integrated development environment (IDE). IDEs, like those provided by Processing, p5.js, and Arduino, are tailored for specific languages. Alternatively, general-purpose IDEs such as Atom, Brackets, Sublime, or Visual Studio can be used.

2.1.3. Electronics

While programming languages provide the instructions, hardware and microcontrollers such as Arduino, Raspberry Pi, and ESP32 bridge the gap between code and the physical world. These tiny computers come equipped with various input and output pins, allowing code to interact with sensors, LEDs, motors, and other controllers. Free and open source software for computer programming can be downloaded, avoiding the cost of expensive software packages. Scratch by MIT is a good program to introduce programming to a novice audience, and is also useful for creating video games. These activities use breadboards and wire that is inserted to the breadboard to make electrical circuits. Microcontrollers such as the Arduino are affordable ways to add programming.

2.2. Digital fabrication and prototyping

Makerspaces help creators to turn their digital ideas into real things. It involves using special machines controlled by computers to make physical objects from digital designs.

2.2.1. Digital fabrication

Digital fabrication encompasses a diverse array of technologies, each contributing to the realisation of innovative projects. 3D printing takes center stage, allowing makers to materialise intricate three-dimensional designs layer by layer. CNC (computer numerical control) machines, including routers and mills, carve precision designs into various materials, offering a versatile approach to subtractive manufacturing. Laser cutting, utilising focused laser beams to precisely cut or engrave materials, adds another dimension to the repertoire of digital fabrication tools. Digital fabrication activities can be broadly classified into additive and subtractive (sometimes referred to as “extractive”) processes based on how material is manipulated to form the desired object.

- Additive fabrication is the process of creating objects by depositing material layer by layer, using a digital model as a blueprint (e.g., 3D printing);
- Subtractive (extractive) fabrication is the process of creating objects by removing material from a solid block or sheet, using computer-controlled machinery (e.g., laser cutter) .

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2.2.2. Prototyping

In makerspaces, makers can transform their digital designs into physical prototypes, bridging the gap between the virtual and physical worlds. 3D printers, CNC machines, and laser cutters become the artisans' instruments, enabling them to craft intricate structures, prototypes, and artistic creations.

A prototype is the first example of something, such as a machine or other industrial product, from which all later forms are developed. Prototyping is a four-stage process: construction, testing, feedback and revision, testing, feedback and revision. A prototype is developed to be tested in iteration cycles (Rieken et al., 2019, p. 106).

2.3. Handworking

The term "handworking" within makerspaces can be defined by a broad spectrum of activities involving the utilisation of hands and traditional tools for creation.

2.3.1. Interests

The age-old wisdom of woodworking can be explored, clay can be imbued with life through pottery, or intricate tapestries can be woven using yarn. The possibilities are boundless, limited only by one's imagination and the available tools. In the makerspace, handworking transcends nostalgia, serving as a crucial counterpoint to the digital age. It serves as a reminder of the power of human skill and the joy of mindful creation. A sense of community is fostered as techniques are shared and knowledge is gleaned from others, forming a network of support and inspiration. Most importantly, handworking in makerspaces embraces traditional craftsmanship, highlighting the hands-on skills that bring physical creations to life. Unlike the digital realm of coding, handworking involves manual craftsmanship, using tools, materials, and skilled techniques to shape and construct tangible objects.

Materials play a crucial role in handworking, with makers selecting and manipulating metal, fabric, and more. The tactile experience of working with these materials adds a unique dimension to the creative process. Makers learn to appreciate the characteristics and possibilities of each material, fostering a deeper connection between the creator and the crafted object.

Collaboration and shared knowledge thrive in the handworking realm of makerspaces. Makers with diverse skills, ranging from woodworking masters to textile experts, converge to share techniques and ideas. Safety practices take precedence in handworking, with makers mastering proper tool usage and safety protocols. This ensures a secure and enjoyable environment for all participants, fostering a culture of responsible making.

2.3.2. Activities

Hand Making activities encompass, but are not limited to:

- **Textile arts:** Sewing, knitting, crocheting, quilting, embroidery, weaving, macrame, basket weaving, rug making, etc.

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- **Woodworking**: Carving, furniture making, turning, joinery, wood burning, intarsia, etc.
- **Metalworking:** Jewellery making, blacksmithing, metal sculpting, enameling, etc.
- **Paper crafts:** Bookbinding, origami, papercutting, calligraphy, quilling, paper mache, etc.
- **Glassblowing:** The creation of ornaments, sculptures, vessels, etc.
- **Soapmaking:** The utilisation of natural ingredients for crafting handmade soaps.
- **Candle making:** Pouring candles into molds or creating container candles.
- **Upcycling and repurposing:** Transforming discarded materials into new and useful objects.
- **Jewellery making:** Creating unique pieces using beads, wires, clay, metal, and other materials.
- **Decorative painting:** Hand-painting furniture, murals, signs, or canvas art.
- **Drawing and sketching:** Creating traditional artwork with pencils, charcoal, pastels, etc.
- **Printmaking:** Utilising techniques like silkscreen printing, block printing, or linocut to create prints.

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Chapter 3: Good practices

Implementing good practices within makerspaces is essential for fostering a safe, inclusive, and productive environment where innovation can flourish. Just as creating a makerspace extends beyond the acquisition of tools and equipment, maintaining its functionality and effectiveness requires adherence to certain principles and practices. This section serves as a guide to ensure that your makerspace operates efficiently and responsibly, promoting the well-being of its members and the broader community.

Key highlights covered in this section include:

1. **Establishing clear policies:** Define and communicate clear policies regarding the use of equipment, space, and resources within the makerspace. Clearly outline safety protocols, code of conduct, and expectations for community engagement to create a cohesive and respectful environment.
2. **Providing ongoing training:** Offer regular training sessions and workshops to ensure that makerspace members are equipped with the necessary skills and knowledge to safely operate equipment and engage in various making activities. Training should cover safety procedures, equipment operation, and best practices for collaboration.
3. **Maintaining equipment and facilities:** Implement a maintenance schedule to regularly inspect and upkeep equipment and facilities within the makerspace. Ensure that all tools are in proper working condition, and address any issues promptly to minimise downtime and prevent accidents.
4. **Enforcing safety measures:** Enforce strict safety measures to mitigate risks and hazards within the makerspace. Provide personal protective equipment such as safety glasses, gloves, and respirators, and ensure that members adhere to safety protocols while using tools and engaging in making activities.
5. **Fostering collaboration and inclusivity:** Create opportunities for collaboration and skill-sharing among makerspace members from diverse backgrounds and skill levels. Actively engage with the broader community through outreach programs, events, and partnerships. Collaborate with local schools, organisations, and businesses to promote STEM education, entrepreneurship, and community development initiatives.

3.1. Critical making

Responsible innovation and making in grassroots practices means that those who tinker with existing technologies and develop new solutions do this critically. This has come to be known as “critical making”, which has six core values (https://criticalmaking.eu/introduction-inclusive-making/):

- **Open:** Critical making promotes open collaboration, including the sharing of skills and knowledge. It boosts creativity in the ecosystem of makers by making processes and results accessible.
- **Local and connected:** Critical making is happening locally, working on the ground and adapted to a particular socio-cultural context. Thereby, critical making implies an engagement with local communities as well as global networks–thinking globally and making locally.

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- **Social and diverse:** Critical making reflects on the social dimensions of making, the living realities of those persons involved and concerned, as well as the ethical implications of their work. Critical making thereby addresses societal challenges and needs. That's why it is so important to strive for diversity and inclusiveness.
- **Reflexive:** Critical making re-thinks and re-constructs the dominant mainstream maker culture from a critical stance, reflecting on underlying power structures and their implications.
- **Impactful:** Critical Making aspires to really make a difference. It seeks to improve life and build a sustainable future.
- **Joyful and meaningful:** Critical making is still about the joy of and in making, but adds meaning to it. What is made critically is made with a specific purpose of individual or social kind.

Table 9: Guidelines for critical making

Statements	Recommendations
Make things that make sense: Curating a curious mind that goes beyond conventional thinking	Makerspaces should encourage individuals to cultivate the skill of adaptability to make the most of their current circumstances and available resources to foster an open mindset. Doing so allows individuals to take apart commercially made mass-produced objects, and let people learn how to modify and create something meaningful and effective for their community and the wider world. https://wikifactory.com/+criticalmaking/stories/saad-chinoy-curating-a-curious-mind-that-goes-beyond-conventional-thinking
Integrate local knowledge: Advancing empathy as a tool for commitment to care and responsible innovation	Makerspaces should promote "learning by doing and doing by learning", as these dynamics generate knowledge from various perspectives or disciplines. Individuals can reflect on their actions, evaluate their outcomes, and refine their approaches by actively making or creating something. Thus, this iterative cycle of doing, reflecting, and learning contributes to continuous growth and improvement. https://wikifactory.com/+criticalmaking/stories/georgia-nicolau-advancing-empathy-for-commitment-to-care-and-responsible-innovation
Share how you make: Cultivating the skill of documentation and transferring of knowledge	Makerspaces should encourage the dissemination of diverse perspectives and expertise, fostering a collective and collaborative approach to problem-solving. In aiming to democratise access to information, it enables individuals to share their insights, methodologies, and practical know-how with others, openly, enhancing the collective intelligence of a community.
Build for continuity: Reversing power dynamics in community	Makerspaces should organise a structure that enables individuals to understand there are a lot of opportunities for bright young people within their localities. When offering meaningful roles and responsibilities, there is a shift in power from traditional hierarchical structures to a more inclusive and equitable environment fostering authentic partnerships. https://wikifactory.com/+criticalmaking/stories/bahar-kumar-reversing-power-dynamics-in-community

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Include ecosystem services: Generating a cycle of thinking for longevity	Makerspaces should promote ideas that allow short-term solutions that have been created by society and turn them into long-term projects and have it adapt to the different timely situations. To consider present resources and anticipate future outcomes. https://wikifactory.com/+criticalmaking/stories/aravinth-panch-generating-a-cycle-of-thinking-for-longevity

Get inspired by

- Creating an inclusive and welcoming Maker Space – Critical Making
- An Introduction to Inclusive Making – Critical Making

3.2. Strengthening the community

Besides infrastructure, the main element of a makerspace is its community. Indeed, members can be a real asset to the success of your makerspace; that is why it is important to strengthen your community. This can happen at three levels:

- Individual level through e.g., capacity building
- Organisational level through e.g., collaborations and partnerships
- Large Public level through e.g., outreach activities.

3.2.1. Level 1: Capacity building

Thanks to the group dynamics occurring in makerspaces, the capacity building of members is encouraged through collaborative dynamics such as: mutual aid, peer-learning, collaborative work and peer-production. Whether it's the sharing of knowledge, information, equipment or space, or the sense of mutual support that emerges among members, these practices contribute favorably to capacity building of makerspace members on a daily basis. Through these activities, they can acquire highly technical and general skills. Below is a list of skills and attributes which are of benefit to anyone running a makerspace.

Table 10: Skills requirements

General skills and attributes (staff)	Tech and maker skills (members)
• Drive to help people build skills and confidence • Engage in own learning and exploration • Enjoy meeting new people and sharing ideas • Work with project groups to help them achieve their project visions. • Help learners to acquire skills with tools, tool safety, and other aspects of hands-on fabrication. • Track use of consumable materials, re-order as needed.	• 2D design and software knowledge • 3D design • Graphics design • Web design • Understanding of programming languages and principles. • Knowledge of programming languages, the ability to code • Electronics • Video editing and software applications • Sound production

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- Ability to run safety training for all who use the makerspace; monitor that safety is practiced at all times.
- Ability to lead workshop session
- Good level of digital awareness
- Good with hands, fault finding, and tackling problems
- Woodworking
- Metalworking

3.2.2. Level 2: Collaborations and partnerships

One of the best ways to help make your makerspace sustainable is to build your reputation by forging links with your local community, local businesses and other organisations within the STEAM (science, technology, engineering, arts and mathematics) sector. Indeed, many of the established makerspace were founded with the help and support of national, international and local community partners. Partnerships allow you to explore-in directions in which you don't have current expertise, give you built- in audiences through your partner organisations, and build on alternate strengths.

Collaboration can take the form of:

- Technical support for local universities
- Collaboration between the informal sector and makerspaces
- Collaboration with other makerspaces and startups
- Collaboration with informal sector
- International collaborations

3.2.3. Level 3: Outreach activities

- Workshops: Workshops can be a great way to build up an appetite for digital making within your area and can last as little as one or two hours. They usually focus upon one skill or task that can be completed within the time frame. If you already run a successful makerspace, you might want to start thinking about running a workshop to help get more local people into digital making.
- Conferences: Conferences work well when you have already built up a range of contacts with businesses, digital organisations and community partners within your area. They take place in one to three days and offer an opportunity to showcase the work that you are doing, to learn about the latest developments within the STEAM sector and to network. Organising or attending a conference can be a significant time commitment, so it is often best to partner up with another organisation to deliver the conference.
- Holiday events: School holidays are an ideal time to engage with children and young adults as you will find that they often have an abundance of time. Activities, events and workshops offer an opportunity to explore new things, learn new skills, and meet new people.

Get inspired by

- Guidelines for Capacity Building
  https://drive.google.com/file/d/18XpGg07pH2fhqbw6STZTvSaxq9PhH2cv/view?usp=drive_link
- Skills - Mutual Recognition
  https://drive.google.com/file/d/1Ag7WbbCefkjtmIp3G6RvPPSpjW601fHs/view?usp=drive_link

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- Working with Artisans https://www.youtube.com/watch?v=cM01htDD3zU&list=PLYSSI-cmO1bYT-9UDa1T3IR3IfKBfB6vH&index=5)
- Local Partnerships https://drive.google.com/file/d/1SpTwHJVVxt8vGrr97oEpvVQVdZbSnqDH/view?usp=drive_link
- Community Engagement https://drive.google.com/file/d/1pLrR7jg1BfvuwAU4n1qou-LkjhSTXWTW/view?usp=drive_link
- Knowledge Pill: Building a Community from the GIG Perspective https://www.youtube.com/watch?v=Ri7-hNjGs3c
- GOSH Community Events Framework https://openhardware.science/gosh-community-events-framework

3.3. Safety and waste management

Makers display, operate, or use items that may pose a danger to others, that is why their work areas should be ventilated, fire-resistant (if need be), well-lit, and conceived in a fashion that allows them to work safely on projects. Moreover, they have to explain what they will do to keep others safe. To do so, it is advised to create a written Safety Plan, which will make you and members of the makerspace, more confident that you are all aware of the foreseeable risks, consider possible consequences, and have taken all the precautions you could to ensure everyone's safety.

Safety plans typically include a description of the exhibit or demonstration, the names, qualifications and previous experience of people working the exhibit, a description of general safety precautions, and the emergency plan. If the project includes fire, the safety plan should also describe the fuel source, how much is onsite, where and how it is stored, how much is burning and in what amount of time it burns, and if the valve has an electronic propane sniffer. Here are some other more specific safety guidelines often connected to certain kinds of tools:

- **Flying objects:** Safety glasses should be worn at all times in the shop, especially while working near hammers and power tools to protect eyes from flying debris.
- **The air you breathe:** Respirators (masks) should also be worn when sanding with either a power sander or by hand. Any kind of soldering generates fumes from the rosin core of the solder so the area should be ventilated.
- **Multiple risks:** Electric saws have high-power moving blades that can quickly cause traumatic injuries. However the chance of injury is small when properly maintained and used with care and attention. In addition to safety glasses, respirators (masks) and earplugs should be worn during use of electric saws.
- **Fire:** Heat guns and handheld torches can generate fires if used without proper attention to the work and surrounding areas.
- **Burns:** Make sure there is cool running water nearby for burns. Use the lower-heat glue guns when possible.
- **Sewing:** Can cause a small prick from a needle, but sewing machines and sergers both have enough power to put a needle through a finger when used carelessly.
- **Metalwork areas:** Need welding screens or curtains to prevent eye damage in passersby. Visors should be worn while welding.

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Very important too, potential hazards reflect the tools as well as the activities in the work space. For example:

- **3D printing** is becoming more and more common in makerspaces. However, the materials that they use and their waste products may result in health hazards. Hot parts or plastic resin can cause burns. The printing process can emit toxic volatile particles that can cause respiratory irritation. Direct exposure to ultraviolet light can cause damage to your vision.
- **Laser cutters** are also potentially hazardous machines. They use a strong beam of light to cut, drill or engrave various materials. The laser light must be contained within the cutter to prevent damage to vision. Another hazard is the risk of fire caused by the hot laser beam which can be minimised by proper cleaning and maintaining the machine. The waste material produced during the cutting process needs to be removed by a filtration system meeting the specifications of the manufacturer.

Table 11: Waste management

Tasks	Operations
Apply good hygiene practices	• Clean hands in accordance with the hand-washing procedure • Clean equipment in accordance with the equipment cleaning and disinfection plan • Put equipment away
Apply good security practices	• Adopt the safety rules specific to each piece of equipment • Use personal protective equipment (gloves, goggles, helmets, safety shoes, mask, etc.) • Switch off equipment once the operation is complete • Apply general safety rules (fire extinguisher, smoke extractor, smoke detector, etc.)
Apply good sanitation practices	• Clean the workplace (inside and out) in accordance with the cleaning and disinfection procedure • Store closed waste bins • Wipe and disinfect the workroom floor and walls according to the cleaning and disinfection procedure
Collect solid waste	• Prepare solid waste collection materials and equipment • Sort solid waste • Recover biodegradable waste where necessary • Place non-biodegradable waste in an appropriate container/cover/bag depending on its nature.
Collect liquid waste	• Prepare wastewater collection equipment and materials • Place wastewater in a container • Treat the wastewater.

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3.4. Documenting

In makerspaces and other places where people make things (i.e., other kinds of DIHs, including fab labs), we call documenting the practice of publishing information so that others can remake an object, avoid mistakes or follow a method. This information can be photographs, texts, files, source code, videos, etc.

It is documentation that makes it possible not just to design something, but to allow variants or “forks” to be created, to link people and communities wishing to progress together. In fact, documentation makes it possible to ‘replay’ a pedagogical form, to re-make a complete object from digital files used by distributed manufacturing machines, and even to avoid making mistakes again when the mistakes are documented. Combined with open licenses, documentation is the key to legally enabling the replication and improvement of objects and teaching methods in networks, via information sharing, particularly on the Internet.
Documentation can relate to :

- the manufacture of an object (for example with specialised portals such as wikifab),
- the sharing of files enabling spare parts to be remanufactured to manufacture an object (for example thingiverse),
- the source code (for example Github).

Get inspired by

- Forge d’adaptations Its purpose is precisely to co-produce documentation for running workshops, based on real-life experience and supplemented by instructions for building open objects. The aim is to train people to use online files and documentation to rebuild shared solutions locally.
- Cultivating the skill of documentation & knowledge transfer by Emilio Velis

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Chapter 4: Digital communication

In the digital age, effective communication and outreach are essential components of any successful endeavor, including makerspaces. Digital communication offers a plethora of tools and strategies to connect with diverse audiences, amplify the mission, and foster community engagement. This section provides insights and best practices for leveraging digital communication channels to maximise outreach efforts and cultivate a thriving makerspace ecosystem.

Key highlights covered in this section include:

1. **Set up digital communication strategies:** Digital communication strategies encompass a wide array of platforms and techniques aimed at reaching and engaging target audiences online. From social media to email marketing, understanding the dynamics of each platform is key to crafting compelling messages and fostering interaction.
2. **Website optimisation:** A well-designed website serves as a central hub for digital communication efforts, providing visitors with essential information and resources. Optimising website content for search engines, mobile devices, and user experience is crucial for attracting and retaining visitors.
3. **Content creation and distribution:** Compelling content lies at the heart of successful digital communication strategies. From blog posts to videos and infographics, diverse formats offer unique opportunities for engaging audiences and conveying key messages. By prioritising authenticity, relevance, and quality, organisations can captivate audiences and drive meaningful interactions across digital channels.
4. **Outreach initiatives:** Outreach initiatives play a vital role in expanding reach and impact. Whether through community events, partnerships, or educational programs, proactive outreach efforts enable organisations to connect with audiences offline and foster deeper engagement.
5. **Educational programmes and resources:** Developing educational programs and resources enables organisations to empower individuals with valuable knowledge and skills. Whether through online courses, webinars, or downloadable materials, providing accessible learning opportunities fosters engagement and promotes lifelong learning within the community.
6. **Evaluation and adaptation:** Continuous evaluation and adaptation are essential for optimising digital communication and outreach efforts over time. By monitoring key metrics, soliciting feedback, and staying attuned to evolving audience needs, organisations can refine their strategies and maximise impact in an ever-changing digital landscape.

4.1. Digital platforms

Digital communication has significantly evolved with the proliferation of various platforms. Here is an overview of different digital communication platforms, their strengths and weaknesses, as well as case studies illustrating successful communication strategies. Each platform offers unique characteristics and caters to different needs and preferences of the audience. Understanding the specific dynamics, strengths, and weaknesses of each platform can aid in tailoring effective digital communication strategies.

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4.1.1. Social media

Platforms such as Facebook, Instagram, Twitter, LinkedIn, and TikTok offer vast networks for sharing content, interacting with the audience, and marketing. Their main characteristics include instant communication, strong user interaction, and multimedia content (text, images, videos).

- Strengths include extensive reach, engagement through interactive features (likes, comments, shares), and targeted advertising.
- Weaknesses involve dependence on algorithms for visibility and the potential for negative feedback.

4.1.2. Blogs

Platforms like WordPress, Blogger, and Medium allow individuals or organisations to publish articles, insights, and updates. Their main characteristics are long-form content, in-depth analyses or narratives, and opportunities for SEO.

- Strengths include content ownership, SEO benefits, and the opportunity to establish thought leadership in specific areas.
- Weaknesses involve the time-intensive nature of producing high-quality content and dependence on engaging and maintaining a readership.

4.1.3. Websites

Websites act as the official online presence for businesses, individuals, or organisations, housing a variety of content from product information to contact details. Their main characteristics are an official online presence, comprehensive information, and branding.

- Strengths include total control over content and branding, credibility enhancement, and direct monetisation opportunities.
- Weaknesses involve the need for ongoing maintenance and updates and the challenge of standing out in SEO competition.

4.1.4. Forums

Platforms like Reddit, Quora, and industry-specific forums offer spaces for community discussions, Q&As, and knowledge exchanges. Their main characteristics are community discussions, a Q&A format, and deep dives into specific topics.

- Strengths include rich environments for niche communities to engage and share, direct sources of user feedback and market research, and the opportunity to establish expertise on specific topics.
- Weaknesses involve time investment for active participation and monitoring, and reputation management challenges due to negative discussions or feedback.

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Table 12: Comparative analysis

	Social media	Blogs	Forums	Websites
Scope	Potentially vast, global audience.	Scope varies, can be significant with strong content and SEO strategy	Niche, but with dedicated and engaged users	Depends on marketing, SEO, and brand recognition
Engagement	High engagement through likes, comments, and shares.	Engagement through comments and shares; depends on content quality.	Strong engagement, in-depth discussions, and community building.	Variable; can be enhanced with interactive elements
Content type	Short, visual, ephemeral content	Long, detailed, informative content.	Conversational content, question-based or topic-specific	Diverse; can include all types of content
Audience	Broad and diverse, but can be targeted through ads.	Interest-based, often seeking in-depth information or solutions.	Niche, community-oriented, seeking discussions or expertise.	Varied, from first-time visitors to loyal customers.

Each digital communication platform offers unique advantages and challenges. By understanding their characteristics and learning from real-life examples, learners can effectively exploit these platforms to reach and engage their target audience.

4.2. Content creation

Creating engaging content and developing a strategic approach to content distribution are crucial aspects of digital marketing and audience engagement. Here's a guide on content types, strategy development, and tips for creating content that resonates with your audience.

Table 13: Content types

Types	Description	Examples
Text	Fundamental for storytelling and information sharing, essential for SEO	• Blog posts: Provide useful information, tips, or perspectives, optimised for SEO and visually appealing. • White Papers and eBooks: Offer in-depth knowledge on specific topics, great for demonstrating authority and expertise, and serve as lead magnets.

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Images	Convey complex information attractively, easier to share on social media.	• Infographics: Simplify complex information visually, easy to share, drive website traffic. • Photography: Original, high-quality images enhance content appeal and understanding.
Videos	Highly engaging, favored by social media algorithms	• Explainer Videos: Simplify complex concepts or products. • Webinars and Live Streams: Offer real-time engagement, making the audience feel closer to your brand or message.
Podcasts	Convenient for audiences preferring to listen. Perfect for in-depth discussions, interviews, or storytelling.	• Interview series: Invites experts to discuss relevant topics, adds value, attracts followers. • Educational content: Similar to blog articles but in audio form, ideal for listeners.

4.2.1. Strategies for creating relevant content

Defining goals

What is the aim with the content? It could be brand awareness, lead generation, engagement, or sales.

- Goals should be specific, measurable, achievable, relevant, and time-bound (SMART).
- The content strategy should directly support the business's overall objectives, whether increasing brand awareness, boosting sales, or establishing thought leadership.

Understanding the audience

It is crucial to know the audience, their interests, and how they consume content. Creating personas can help tailor content to meet their needs and preferences. Content should be adapted to the audience's interests, challenges, and behaviors.

- Conducting audience research through surveys, interviews, and social media listening tools is essential.
- engagement metrics should be analysed to refine the strategy for producing more of what the audience prefers.

Authenticity and quality of content

Authenticity resonates with the audience. Sharing real stories, experiences, and viewpoints can create an emotional connection.

- Incorporating narratives into content, providing behind-the-scenes looks at the brand or process, and using visuals like images, videos, and infographics can make content more engaging and understandable.
- Prioritising quality, ensuring consistency in style, voice, and publishing frequency are key.

Encouraging interaction

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Content should conclude with a call to action, prompting questions or comments.

- Strategic placement of CTAs guides the audience on what to do next, whether subscribing to a newsletter, downloading a guide, or commenting on an article.
- Encouraging user-generated content can significantly increase reach and authenticity.

Content audit
Reviewing current content to understand what works and what does not is critical for identifying gaps and opportunities.

- Analytics tools should be used to track content performance, and feedback should be regularly solicited to ensure content remains relevant and engaging.

Distribution
Distribution involves determining where and how to share your content, including selecting the right platforms and considering paid promotion to increase reach. A multichannel approach maximises reach. Engage with your audience where your content is published by responding to comments, participating in discussions, and gathering feedback.

SEO
SEO entails using keywords, meta-descriptions, and relevant tags to improve search engine visibility. Regular keyword research keeps content aligned with audience searches and trends. Technical SEO ensures your website is optimised for search engines, focusing on fast loading times, mobile-friendliness, and structured data.

Scheduling
Publication Scheduling involves planning content production and publication to maintain a consistent schedule, ensuring content is timely and relevant. Tools like Trello, Asana, or Google Calendar can help organise and schedule content effectively. Flexibility is key to adjusting your content calendar based on trending topics, audience reactions, or unforeseen events.

4.2.2. Essential digital communication tools, AI, and analytics

Content creation

- **Canva:** A user-friendly graphic design tool with templates for social media graphics, presentations, posters, documents, and other visual content.
- **Adobe Creative Cloud:** Offers a suite of software for video editing, graphic design, photography, and web development, including Photoshop, Premiere Pro, and Illustrator.
- **Grammarly:** An AI-powered writing assistant that helps improve spelling, grammar, punctuation, clarity, engagement, and delivery mistakes in English texts.

Content scheduling

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- **Hootsuite:** Allows you to schedule posts across multiple social media platforms from a single dashboard. It also offers monitoring and analytics features.
- **Buffer:** A social media management tool for scheduling posts, analysing performance, and managing all your social accounts in one place.
- **Later:** Specifically designed for visual content, Later helps plan and schedule your Instagram, Facebook, Twitter, and Pinterest posts.

Analytics

- **Google Analytics:** Provides detailed insights into website traffic, user behavior, and conversion metrics, helping businesses understand their audience.
- **SEMrush:** A comprehensive SEO tool that offers keyword research, site audits, competitor analysis, and more to improve website visibility.
- **Social Blade:** Offers detailed analytics for YouTube, Twitch, Instagram, and Twitter, providing insights into growth trends, follower counts, and engagement metrics.

AI in digital communication

- **Chatbots and virtual assistants:** AI-powered chatbots can handle customer service inquiries, provide personalised recommendations, and improve user engagement.
- **Content personalisation:** Machine learning algorithms analyse user behavior to deliver personalised content recommendations, enhancing the user experience.
- **Predictive analytics:** AI tools predict future trends based on historical data, helping businesses strategise their content and marketing efforts more effectively.

4.3. Challenges in digital communication

Digital communication, while offering immense opportunities for engagement and connectivity, also presents several challenges. Addressing these challenges is crucial for individuals and organisations alike to maintain effectiveness, credibility, and security in the digital realm. Below are some of the primary challenges, along with strategies for managing them.

4.3.1. Dealing with information overload

The sheer volume of digital content can overwhelm users, making it difficult to discern valuable information from noise. This overload can lead to decision fatigue and reduce the effectiveness of communication efforts. Strategies to address these challenges could include:

- **Prioritise quality over quantity:** Focus on producing high-quality, relevant content rather than saturating channels with frequent, low-value posts.
- **Content curation:** Use tools and strategies to filter and present content that is most relevant and valuable to your audience.

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- **Personalisation:** Employ data analytics and AI to tailor content to the interests and preferences of your audience, making it easier for them to find relevance in the information you share.

4.3.2. Managing digital reputation and dealing with negative feedback

In the digital world, feedback is immediate and visible to a wide audience. Negative comments or reviews can spread quickly and damage an organisation's or individual's reputation. Strategies to address these challenges could include:

- **Active listening:** Use social media monitoring tools to keep tabs on what is being said about your brand online.
- **Responsive and transparent communication:** Address negative feedback promptly and transparently. Offer solutions and take responsibility where applicable, demonstrating your commitment to customer satisfaction.
- **Encourage positive sharing:** Build a loyal community that is encouraged to share positive experiences, helping to counterbalance negative feedback.

4.3.3. Security concerns (data breaches, hacking)

Digital platforms are prime targets for cyber attacks, including data breaches and hacking. Such security incidents can compromise user data and trust, leading to significant reputational and financial damage. Strategies to address these challenges could include:

- **Implement robust security measures:** Use encryption, secure sockets layer (SSL) certificates, and regular security audits to protect your digital assets and user data.
- **Educate your team:** Ensure that everyone involved in your digital communication efforts is aware of best practices for digital security, including password management and recognising phishing attempts.
- **Prepare a response plan:** Have a clear, comprehensive plan in place for responding to security incidents. This should include steps for addressing the breach, communicating with stakeholders, and restoring security and trust.

4.3.4, Cross-platform consistency

Maintaining a consistent message and brand voice across multiple digital platforms can be challenging, especially as the features and audience expectations vary from one platform to another. Strategies to address these challenges could include:

- **Unified brand strategy:** Develop a clear brand strategy that includes guidelines for tone, style, and messaging, adaptable to various platforms while maintaining core brand elements.
- **Platform-specific adaptations:** Tailor content and engagement strategies to the unique characteristics and audience of each platform, while keeping the overall message consistent.
- **Regular review and adaptation**: Continuously monitor the performance and reception of your digital communications across platforms, adjusting strategies as needed to maintain consistency and relevance.

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4.3.5. Legal and ethical considerations in digital communication

Digital communication operates within a global context, where laws and regulations regarding privacy, copyright, and content can vary significantly. Ethical considerations, such as respecting user privacy, consent, and the responsible use of data, are also paramount. Navigating these legal landscapes and ethical dilemmas can be challenging, especially when trying to engage audiences across different jurisdictions. Strategies to address these challenges could include:

- **Stay informed on laws and regulations:** Regularly update your knowledge of relevant laws, such as the General Data Protection Regulation (GDPR) in the EU, the Children's Online Privacy Protection Act (COPPA) in the US, and other local data protection laws. This includes understanding copyright laws related to the use of images, videos, and written content.
- **Implement data protection measures:** Ensure your digital communication practices comply with privacy laws by securing user data, obtaining necessary consents for data collection and use, and being transparent about your data practices through privacy policies.
- **Ethical content creation and distribution:** Avoid deceptive practices such as clickbait, misrepresentation of information, or the manipulation of digital content in ways that could mislead or harm the audience. Ethical considerations also include respecting the intellectual property of others by ensuring all content is either original, licensed, or properly attributed.
- **Accessibility:** Ensure digital content is accessible to all users, including those with disabilities. This not only broadens your audience but also complies with legal requirements in many regions, reinforcing ethical commitments to inclusivity.
- **Respond ethically to negative feedback:** Handle criticism and negative feedback in a manner that is respectful and constructive, without resorting to censorship or retaliation, which can have legal and reputational repercussions.
- **Advertising and promotions:** Adhere to regulations governing advertising, such as disclosing endorsements and partnerships, to maintain transparency and trust with your audience. This includes being clear about sponsored content or when influencers are promoting products on your behalf.

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Chapter 5: Business models for building sustainable impact economies

Building sustainable impact economies within makerspaces involves establishing business models aimed at fostering social, environmental, and economic well-being within these creative hubs. These models focus on creating positive impacts while generating revenue and supporting local communities. Choices include offering services, supporting startups, and providing training to empower individuals and businesses within the makerspace ecosystem. The mAkE project, through which this Open Makerspace Toolkit (OMT) has been developed, has (in its work package 1 (WP1)) developed an Open Catalogue of Business Models (OCBM). This OCBM, developed through extensive stakeholder engagement and intervriews, provides insights into business models for building sustainable impact economies within makerspaces, and highlights each business model's potential impacts, advantages, challenges, and complementary models.

Key elements covered in the OCBM include:

1. **Product manufacturing:** Makerspaces engage in product manufacturing, creating items under their own brand or in response to specific market demands. By producing locally, makerspaces cater to unique needs, reduce transportation emissions, and bolster the local economy.
2. **Manufacturing as a service:** Offering manufacturing services to external clients enables makerspaces to leverage their existing assets and expertise. By providing advanced manufacturing technologies on-demand, makerspaces contribute to local economic development and industry competitiveness.
3. **Repair and recycling:** Repairing broken items and recycling waste materials are integral aspects of sustainable practices within makerspaces.
4. **Asset sharing:** Asset sharing models, including membership and machine access, democratise access to space, tools, and equipment within makerspaces. By providing affordable access to resources, makerspaces empower individuals and businesses to innovate, reduce startup costs, and improve product quality.
5. **Expertise sharing:** Training and consultancy services enable makerspaces to share knowledge and skills with their community. By offering hands-on training and expert guidance, makerspaces enhance skill development, support local businesses, and attract investment.

Click here to access the mAkE Open Catalogue of Business Models (OCBM).

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Conclusion

This Open Makerspace Toolkit (OMT) ains to be a powerful resource, through democratising access to tools and knowledge for fostering innovation across diverse communities. Empowering individuals and groups to explore, experiment, and create unlocks a vast potential for problem-solving, entrepreneurship, and community engagement. This Toolkit is not merely a collection of information and resources. It represents a philosophy of open access, collaboration, and learning-by-doing; it recognises the inherent creativity and ingenuity within individuals and communities; and it provides the platform and tools to bring individuals' and communities' ideas to life. The true success of this Toolkit will lie not in its features and functionalities, but rather in its ability to spark a movement. It seeks to catalyse the building of vibrant maker communities in Africa and Europe, and vibrant linkages between African and European maker communities—through which individuals and communities of all backgrounds can learn, share, and create together. The Toolkit is not a static resource, but rather a launchpad for continuous growth and innovation. It will thrive on ongoing improvement, collaboration, and user feedback. Embracing these collaborative principles will ensure the Toolkit's relevance, effectiveness, and long-term impact.

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Additional resources

Set-up, organisation and equipment

Table 14: Set-up, organisation and equipment					
Name of resource	**Type of resource**	**Subject/topic**	**Developed by**	**Link**	**Language**
Social Innovation in Action through Makerspaces	Blog	Definition of makerspaces, interactions between makerspaces and social innovation	Future Learn	link	English
Makerspaces for Economic Development and Social Cohesion	Blog	Maker movement, importance of makerspaces in education, makerspaces as a continuous source of knowledge	Esther Fuldauer	link	English
Social Innovation, Democracy and Makerspaces	Article	Etymology of makerspaces, definition of makerspaces, makerspace possibilities	Adrian Smith	Link	English
Why Makerspaces are the Key to Innovation	Blog	Location of makerspaces, where one finds a range of activities	Matthew Lynch	link	English
Creation Crate Blog resources	Blog	How to start, run, and be involved in a makerspace	Creation Crate Blog	Link	English
Creating a Makerspace that Works	Research article	How to set up a makerspace	Jamie Back	Link	English
Starting a Makerspace: 5 Things Every Administrator Needs to Know	Blog	How to set up a makerspace	Dr. Jacie Maslyk	Link	English
Sustainable in Action: From Intention to Environmentally Friendly Practices in Makerspaces Based on the Theory of Reasoned Action	Article	How to set up a makerspace	Antje Klemichen Ina Peters* Rainer Stark	Link	English
State of the Art of Makerspaces – Success Criteria when Designing Makerspaces	Article	How to set up a makerspace	ScienceDirect	Link	English

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Makerspace Resources	Blog	Makerspace design and set-up	Diana Rendina	Link	English
How to Start a Makerspace	Article	How to set up a makerspace	Brilliant Labs and Labo Creatif	Link	English
Establishing a Maker Culture Beyond the Makerspace	Article	How to set up a makerspace	Karen Beavers, Jennifer Esteron Cady, Amy Jiang and Liberty McCoy	Link	English
How to Start a Makerspace Planning and Resource Guide	Article	Starting a makerspace	Diana Rendina	Link	English
How to Develop a Makerspace: From Proposal to Production	Article	How to set up a makerspace	Reid Fuente, Suzy Dorsey, Devin Spatz, Cameron Crasto and Zach Patterson	Link	English
Des communs informationnels aux communs éducationnels	Article	Makerspace definition	Stéphanie Leyronas,	Link	French
Innovation numérique et transformation structurelle des économies africaines francophones	Article	Makerspace definition and opportunities	Kako Nubukpo	Link	French
Technology-transfer Offices and Academic Open Labs as Different Types of Organisational Intermediaries In Science-society Relationships	Article	Makerspace definition	Valérie Mérindol, Emilie Pauline Gallié, Ignasi Capdevila	Link	English
The Essentials You Need to Build Your Makerspace	Website	How to build a makerspace	OfficeMax	Link	English
How to Set Up and Run a Makerspace	Blog	Makerspace design and set-up	Moritz Walter	Link	English
How to Build a Safe Makerspace	Article	Makerspace design and set-up	Future Learn	Link	English

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How to choose the Best Management Software for Makerspaces	Blog	Makerspace design and set-up	L Walker	Link	English
Makerspace Collaborating on Sustainability Projects	Blog	Examples of running makerspaces	Williams	Link	English
Science 3D: Discovery, Design and Development through Makerspaces	Book	Pedagogical aspects of makerspaces	Dr. Janette Hughes	Link	English
How to Set Up a Digital Makerspace	Video	How to set up a digital makerspace	Youthlink Scotland	Link	English
How to Level Up Your Library Makerspace	Blog	How to set up and organise a makerspace library	Artefacto	Link	English
Incentives and Ingredients for Building a Makerspace	Blog	How to set up a makerspace	FormLabs	Link	English
Tips to Start your New MakerSpace	Blog	How to start a makerspace	S&S Blog	Link	English
Equipment and Tools in the Makerspace at Hub and Spoke: Implements For Innovation	Blog	Case study example of a makerspace	Stephanie Decker	Link	English
Equipment in the Innevation Center Makerspace	Website	Case study example of a makerspace	University of Nevada, Reno Innevation Center	Link	English
DWA Training	Website	Woodworking and social innovation	Digital wood artisan	Link	English

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Management, Human resource, Safety and regulation

Table 15: Management, Human resource, safety and regulation					
Name of the ressource	**Type of Resource**	**Subject/Topic**	**Developed by**	**Link**	**Language**
Circular Makerspaces	Article	Makerspace definition and opportunities	Sharon Prendeville ORCID Icon,Grit Hartung,Clare Brass,Erica Purvis &Ashley Hall	Link	English
Makerspace Projects	Blog	Projects to run in makerspaces	Makezine	Link	English
The Exploratorium Projects	Website	Open source activities for makerspace	The Exploratorium	Link	English
Makerspace: Policies and Procedures	Blog	Policies and procedures for makerspaces	Miami University Libraries	Link	English
Phrase: Makerspace Tips	Website	Case studies and tips on design and management of makerspaces	Amtek Company, Inc.	Link	English
Innovation Junction: A Guide to Makerspaces in Coworking Environments	Blog	Collaborative nature of makerspaces	Helga Moreno	Link	English
3d Printing, Makerspaces and Innovation: A Bricolage Perspective	Article	Makerspace definition	Ahmad Beltagui1 , Achilleas Sesis1 , Nikolaos Stylos2	Link	English
Defining and Differentiating the Makerspace	Book	Makerspace definition	Tonia A. Dousay	Link	English
Makerspaces as Social Innovation and Entrepreneurship Learning Environments: The DOIT Learning Program	Article	Role of a makerspace in education	Eva-Maria Hollauf, Veronika Hornung-Prähauser, Sandra Schön	link	English
Educating Young Social Innovators from 6 to 16	Presentation	Role of makerspaces in education	Eva-Maria Hollauf BA	link	English

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in Makerspace Settings: Case Studies of Existing Approaches and their Implications dor the European Initiative DOIT					
Makerspaces as Social and Technological Innovation Platforms	Blog	Makerspace definition	Digital wood artisan	link	English
Makerspaces: A Catalyst for Africa's Creativity, Innovation, Hands-on Learning	Blog	Development of makerspaces in Africa, success and impact rate	By Edugist	link	English
Social Innovation: What It Is, Why It Matters and How It Can Be Accelerated	Paper	Growing importance of social innovation	Geoff Mulgan with Simon Tucker, Rushanara Ali and Ben Sanders	Link	English
Key Elements of Social Innovation	Blog	Key elements of social innovation	Allyson Hewitt	Link	English
Social Vouchers: Innovative Tools for Social Inclusion and Local Development	Article	Role of social vouchers as a tool for social inclusion and local development	OECD	Link	English
Building Local Ecosystems for Social Innovation	Article	Famework for analysing social innovation ecosystems at local level	OECD Local Employment and Economic Development (LEED) Papers	Link	English
The Guide to the Seven Key Questions All Social Entrepreneurs Must Ask Themselves	Article	Ideas and tools to develop projects and maximise the social impact	ASHOKA	Link	English
ASHOKA (NGO focussing on social innovation)	Website	How to build and amplify the global social innovation movement	ASHOKA	Link	English
Social Innovation Toolkit	Article	How to support social innovation and social entrepreneurship initiatives	Simón Peña-Fernández	link	English

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Social innovation: Comparative Perspectives	Book	Social innovation understood as organisations' capacity to generate novel ideas, ways and means of doing things and of addressing public and social problems	Helmut Anheier, Gorgi Krlev, Georg Mildenberger	link	English
Social Innovation for Creating a Smart Future	Article	Social innovation classification, evolution, organisation	Sang M. Leea, Silvana Trimib,	link	English
Social Innovation in the Built Environment: The Challenges Presented by the Politics of Space	Article	Social innovation systems for building resilient communities within different social and political contexts across four continents	Donagh Horgan and Branka Dimitrijević	Link	English
Standford Social Innovation Review	Journal	How recognising trauma in ourselves, other people, and the systems around us can open up new pathways to solving social problems	SSIR	link	English
What Is Social Entrepreneurship? A Guide	Blog	Definition of social entrepreneurship; entrepreneurship v. social entrepreneurship	Coursera staff	link	English
6 Social Entrepreneurship Examples and How to Set Up a Social Enterprise	Blog	Definition of social entrepreneurship and information on how to set up a social enterprise	Futurize: Moritz Gripp	link	English
Social Entrepreneurship: Creating New Business Models to Serve the Poor	Article	Social entrepreneurship as a new phenomenon, in support of UN Sustainable Development Goals (SDGs)	Christian Seelos and Johanna Mair	link	English
Social Innovation Academy	Website	Course on how to create social impact and systemic change	Social innovation Academy team	link	English
Social Innovation – the What, Why and How	Blog	Definition of social innovation, importance of social innovation	Diana Porumboiu	link	English
Social Innovation: Blending Business with Impact	Blog	How business can be a vessel for positive change	Lindsey Hayden, Silvia Mah, Emily Seeba	link	English

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Social Innovation Lab	Website	Details of Social Innovation Lab	Pune international center	link	English
Reinventing Social Innovation	Blog	Presentations on innovation mindset	Project innovation:	link	English
Social Innovation for Public Service Excellence	Document	Social innovation as a response to public service challenges	Simon Tucker	link	English
Social Innovation: 7 Practical Steps to Promote It at Regional Level	Blog	Steps to promote social innovation	Guadalupe de la Mata	link	English
Innovation frugale, effectuation et Fablabs : des pratiques à croiser pour penser l'innovation différemment	Article	L'article contient : définition de l'innovation frugale, les points convergents entre l'innovation frugale et l'entrepreneuriat effectual, Innovation frugale, fablab et développement durable	Sandra Fagbohoun	link	French
Making Maker Space: An Exploration of Lively Things, Urban Placemaking and Organisation	Article	How makerspaces can interact with local environments	Abigail Schoneboom	Link	English
Schwab Foundation for Social Entrepreneurship	Website	Social innovation	SCHWAB foundation	link	English
What Is Social Innovation?	Article	Definition of social innovation	Sol Price center for social innovation	link	English
11 Blogs Every Social Innovator Should Be Reading	Blog	Social innovation	Kayla Kurin	link	English
Three Strategies to Boost Social Innovation	Blog	Social innovation	David Murillo	link	English
NESTA Toolkits	Website	Collection of toolkits	NESTA	Link	English

Sustainability

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Table 16: Sustainability					
Name of the ressource	**Type of Resource**	**Subject/Topic**	**Developed by**	**Link**	**Language**
Making, Hacking, Coding: Fablabs as Intermediary Platforms for Modes of Social Manufacturing	Article	Social, open and inclusive nature of makerspaces for sustainability	Constance Garnier, Ignasi Capdevila	Link	English
Social innovation for Sustainable Living	Article	Role of social innovation in sustainable living	Aeiforia	link	English
Novel ways in which Social Innovation Can Tackle Biodiversity Loss	Article	Sustainability action and tackling biodiversity loss	Fergus Lyon	link	English
Social Innovation for Biodiversity: A Literature Review and Research Challenges	Article	Social innovation tackling main drivers of biodiversity loss, civic action for changing practices	Rafael Ziegler et al.	link	English
Social Innovation as a Driver for New Educational Practices: Modernising, Repairing and Transforming the Education System	Article	Article recommending that the SI-DRIVE project concerning education and lifelong learning reveal the potential social innovation could have for innovating this policy field and its systems	Antonius Schröder, Daniel Krüger	link	English
Cultivating Sustainable Developments with Makerspaces	Article	How to sustain a makerspace	Adrian Smith, Ann Light	Link	English
Sustaining a Makerspace	Article	How to sustain a makerspace	Kristin Fontichiaro	Link	English
Design Principles for Teaching Sustainability Within Makerspaces	Article	How to sustain a makerspace	Paula Macdowell	Link	English
Sustainability at the MakerSpace	Blog	How to sustain a makerspace	Makerspace	Link	English
How to Cultivate Sustainable Developments in Makerspaces	Article	How to sustain a makerspace	Adrian Smith, Ann Light	Link	English

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Makerspace for Sustainability: University-community Learning Collaborations with RCE Severn	Presentation	How to sustain a makerspace	Alex Ryan, Miriam Webb	Link	English
Sustainability Considerations in Digital Fabrication Design Education	Article	How to sustain a makerspace	Georgi V. Georgiev, Vijayakumar Nanjappan	Link	English
Co-creating Social and Sustainable Innovation in Makerspaces and Fab Labs	Article	Makerspace sustainability	Carla Sedini, Asger Nørregård Rasmussen, Marion Real, Laura Cipriani	Link	English

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Handworking

Table 17: Handworking					
Name of the ressource	**Type of Resource**	**Subject/Topic**	**Developed by**	**Link**	**Language**
The DWA project Manual	Manual/book	Comparative study in Europe on old and new woodworking techniques		Link	English
Co-creating Social and Sustainable Innovation in Makerspaces and Fab Labs: Lessons Learnt From The SISCODE European Project	Document	Cultural role of makerspaces and fab lab	Carla Sedini, Asger Nørregård Rasmussen, Marion Real, Laura Cipriani	link	English
Moving from Makerspace to Dynamic Innovation Space	Blog	Using tech to support collaborations, making the transformation	Nick Swayne	link	English
The Role of Makerspaces in Innovation Processes: An Exploratory Study	Article	Evolution of makerspaces, innovation processes, makerspaces as facilitators	David Zakoth, Oliver Mauroner, Jutta Emes	link	English
A Makerspace Network as Part of a Regional Innovation Ecosystem, the Case of Emilia-Romagna	Article	Makerspaces and their networks	Andrea Cattabriga	link	English
Innovation Junction: a Guide to Makerspaces in Coworking Environments Helga Moreno	Blog	Makerspace users, design, ecosystem	Helga Moreno	link	English
Open Social Innovations Dynamics and Impact: Exploratory Study of FabLab Network	Document	Study of Centres for Maker Innovation and Technology (CMIT)	Thierry Rayna, Ludmila Striukova	link	English
Organisation for Economic Co-operation and Development	Online Library	Projects and workshops on social innovation	OECD	Link	English

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(OECD): Social Innovation					
Social Innovation Toolkit	Book	Toolkit designed to help cities integrate social innovation in path towards climate neutrality	Net Zero Cities	Link	English
Social Innovation Toolkit	Book	Links between big issues and the smaller actions that Europeans can initiate as social innovators	European social innovation competition	link	English
Digital Social Innovation: An Overview and Research Framework	Article	Use of digital technologies in development and implementation of innovative products, services, processes and business models	Israr Qureshi, Shan L. Pan, Yingqin Zheng	link	English
A Spectrum of Open Social Innovation Within Social Enterprise	Article	Use of open social innovation to achieve social change	Lauren Tuckerman, Julie Roberts and Geoff Whittam	link	English
Theoretical Approaches to Social Innovation	Article	Theories of social change, social innovation studies, and innovation and management studies	Anna Butzin et al.	link	English
Digital Technologies for Social Innovation: An Empirical Recognition on the New Enablers	Article	Empirical recognition of social innovation	Donagh Horgan, Branka Dimitrijevic	link	English
The open book of social innovation	Book	Process of social innovation, ways of supporting social innovation	Robin Murray, Julie Caulier-Grice, Geoff Mulgan	link	English
Toward a Theory of Social Innovation	Book	Definition of social innovation and social innovation process	Kristen Pue, Christian Vandergeest, and Dan Breznitz	link	English
Social Innovation: Field Analysis and Gaps for Future Research	Article	Advances in social innovation	Jaiarys Capa Bataglin, Isak Kruglianskam	link	English
The history of social innovation	Article	History of social innovation	Ola Tjornbo	link	English

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Investing in the Future: Why Social Innovation Startups Are Attracting Funding	Article	Funding of social innovation	FasterCapital	link	English
Toolkit of All Toolkits for Social Innovation	Blog	How to invent, adopt, or adapt ideas that can deliver better results	Guadalupe de la Manta	link	English
Design strategy for social innovation	Toolkit	Guidance for social innovation educators	Penny Herscovitch, Dan Gottlieb	link	English
Social innovation guide for practitioners	Article	Guide to develop social innovation	SIMRA (Social Innovation in Marginalised Rural Areas)	link	English
Contributions et coordination des makers face à la crise du Covid-19	Article	L'article contient des informations sur les makers face au Covid-19: cadre théoriques, résultats préliminaires	Robert Viseur, Amel Charleux	Link	French
Co-création de valeur et innovation sociale : l'exemple des living labs	Article	L'article a pour résultat: Compréhension du processus de co-création de valeurs d'usage, d'échange et sociale par les living labs Dévoilement de la fragilité de la co-innovation multi-parties prenantes des living labs	Ingrid Fasshauer	Link	French
La performance des lieux de co création de connaissances Le cas des FabLabs	Article	L'article contient des points tels que: FabLab, tiers lieux et cocréation de connaissances et Une analyse empirique de la performance des FabLabs	Raphaël Suire	Link	French
Le déploiement des innovations sociales numériques dans les fablabs	Article	L'article propose d'approfondir la notion d'innovation sociale numérique, domaine de recherche en gestation, au travers d'une étude circonscrite à l'un de ses champs d'application	Maud Pélissier	Link	French
Retour sur l'atelier "Communs services de	Article	L'article présente l'atelier dans son ensemble	Michel Briand	Link	French

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Digital fabrication

Table 18: Digital fabrication					
Name of the ressource	**Type of Resource**	**Subject/Topic**	**Developed by**	**Link**	**Language**
Printable	Website	Open 3D design for 3D printing projects	Printable	Link	English
Makerspace MekTro	Training resources	Information on rules and regulations, training content, instructions and manuals, opening hours and reservations, and a forum for DIY prototypes.3D printing, laser cutting, electronics and soldering	University of Rennes (France)	Link	French
Creation Crate Blog resources	Blog	Electronics tutorials, videos, and courses.	Creation Crate Blog	Link	English
Careables Training Kit: Design and 3D Technologies for Healthcare	Website	Online course on 3D technologies for health	Careables	Link	English
DIY PROJECTS	Tutorials	Electronics projects for makerspaces	Sew Electric	Link	English
OBRARY: Library of Open Designs	Website	Ebooks and free designs for CNC router and laser cutter	Scott Austin and Eric Schleiche	Link	English
Maker Pro	Website	Electronics projects and tutorials makerspaces	EETech Media, LLC	Link	English
Amtek Company, Inc. Sample files	Website	Open source STL sample files for 3D printing projects	Amtek Company, Inc.	Link	English

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