



# The Maker Innovation Space Playbook

How to bring the Maker Movement to your campus

# BUILD-IT Playbook Series

## Resources for a sustainable world class model in STEM Higher Education

Since 2015 the BUILD-IT Alliance, through strategic collaborative dialogue with industry and the Vietnamese Government (MOET), has focused on creating a world class model for innovative technology and engineering higher education. The BUILD-IT public-private ecosystem is designed to produce graduates who can solve problems and engineer solutions and value for Vietnam's social and economic development. BUILD-IT leverages the vast capabilities of the implementing partner, Arizona State University, America's largest and #1-ranked university for innovation, along with diverse government, industry, and academic partners linking T&E higher education to the needs and capabilities of industry partners, building strategic leadership skills to advance university autonomy, program and instructional quality, and formal lasting

partnerships. BUILD-IT supports female empowerment and has provided leadership forums, academic initiatives, and scholarships, and has laid groundwork strengthening the universities' capacity for building technical English and 21st century professional skills.

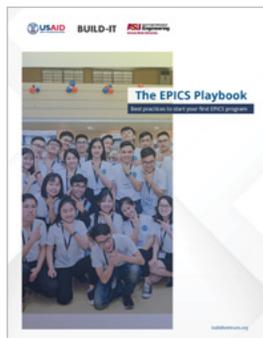
The BUILD-IT Playbook series has been developed with collaboration and input from BUILD-IT partners and is designed to provide a quick start guide and compilation of best practices that have been effectively implemented in Vietnam by our partner institutions. By leveraging these lessons learned and resources for implementation of tested and effective models, you will have resources that will help you develop a sustainable world class model in STEM Higher Education.

### Playbooks in our series include:



#### The Maker Innovation Space Playbook

Multifunctional spaces with workshops and tools to prototype innovations. Makerspaces provide critical learning spaces to the generation of problem solvers.



#### EPICS

EPICS is an internationally recognized engineering-based service learning and social innovation applied project program. Helping students build both hard and soft skills for success.



#### Women in Project-Based Learning

This playbook presents detailed instructions for creating gender-responsive programs that encourage and support women in engineering.



#### Certified Facilitator and Master Teacher Training

This playbook provides step-by-step strategies for creating a high yield of trained faculty in a short duration of time who can better drive students towards university success.



#### A Playbook for University Leaders Seeking AUN-IQA

This playbook presents recommended processes, best practices and key points of emphasis to facilitate the successful completion of AUN-IQA certification.



#### Digital Pedagogy in Higher Education

Through the digital pedagogy playbook, BUILD-IT university partners have access to proven best practices, methodologies, and approached for teaching and learning in a digital environment.



#### The Accreditation Playbook

This playbook serves as a quick start guide for leaders and officials of universities who are considering or have begun a journey to external international accreditation for programs.



#### The Industry Advisory Board Playbook

This quick start guide provides a foundation for setting up your IAB. Learn the basics of forming your board, finding participants, and setting expectations.



# Joining Vietnam's Maker Movement

In the early 2000s, the Maker Movement inspired US universities to build makerspaces; multi-functional spaces with the workshops and tools to prototype innovations. Today, makerspaces are a critical learning space for multi-disciplinary applied projects. Vietnam's early adopters struggled to meaningfully connect their spaces with Vietnam's large public education system.

USAID BUILD-IT mobilized its partners to push the maker movement into Vietnamese universities and incubation

centers. We supported the Saigon Hi-Tech Park (MIS SHTP), University of Da Nang (MIS UD), and Can Tho University (MIS CTU) to develop model Maker Innovation Spaces. BUILD-IT mentored makerspaces at Lac Hong University (LHU) and our academic partners. These partners constitute the Maker Innovation Network. This playbook was written in consultation with leaders at each space. It highlights the initial steps leaders must consider when planning their first space.

## Our contributors



The Team at MIS CTU successfully encouraged young women to use the space.



The Team at MIS UD pioneered an early space & specialized in revenue-generating programs.



The Team at MIS SHTP grew the space through competitions and industry collaborations.



The Team at LHU opened one of Vietnam's first university makerspaces.

# Link the space to your mission

## Align your space with leadership's vision for the school

### Linked with strategic goal at the University of Da Nang

Leaders at UD decided to build a makerspace to nourish a culture of innovation and help it become a research university by 2030. Supported by a high-level strategic vision, UD's university-level Research & Development Center, BUILD-IT, industry partners, and FabLab Da Nang planned the space as a public-private partnership with investment from USAID and partners. Today, the space is located at UD's downtown campus.

### Linked with public policies at Saigon Hi-Tech Park

Saigon, Hi-Tech Park is a public institution that supports Vietnam's start-up ecosystem. Firmly linked to national policies for innovation, the space receives investment from city initiatives and activities. It also serves start-ups and industries in the hi-tech park. SHTP and BUILD-IT shared initial space costs. After three years in operation, SHTP moved the space to the ground floor of their multimillion-dollar new Incubation Center. SHTP's additional investment signals the vital impact the maker movement has on entrepreneurs.

### Linked with a college at Can Tho University

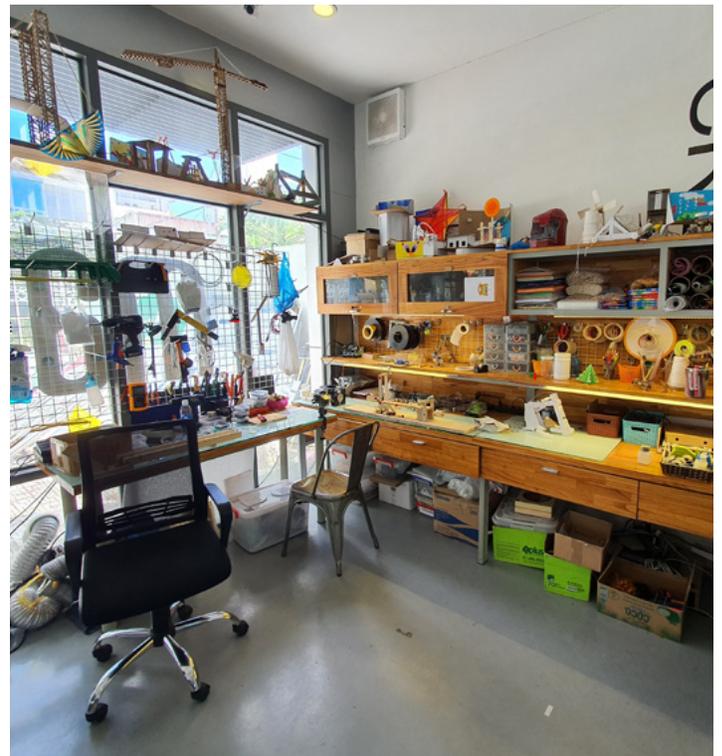
CTU's space fits into the university's strategic vision to build an on-campus innovation hub. CTU revamped their College of Information Technology & Communication with teamwork areas, a presentation stage and converted their library into a makerspace. Maintenance and management costs are covered by the college and central university's budgets. Closely supervised by faculty and situated at the heart of campus for ease of access.

### Linked with the brand at Lac Hong University

LHU's pioneering makerspace was the passion project of the school's founders. It was funded by private donations. The space allows LHU students to better compete in international innovation competitions and offers hands-on applied project programs. The space fits LHU's brand as Dong Nai's most innovative university.



*Public-private partners align the space's vision*



*The soldering station*

# Define your space

## Understand the challenges and opportunities ahead

### Understand your students' challenges

Before makerspaces, students built their prototypes in unused classrooms or at home and carried them to and from school. Inventors bought hand tools and materials from vendors around their campus. For heavy-duty tools, students paid handymen to build their ideas. Lack of design/build space, few appropriate tools and materials, the struggle of transporting their prototypes, and haggling with handymen meant few students were comfortable building out their designs. Due to these frustrations, students who did build a prototype rarely created a next iteration. These frustrations were significant for young women, who lacked tool know-how and felt uncomfortable with off-campus spaces and vendors.

### Understand how Makerspaces help all students

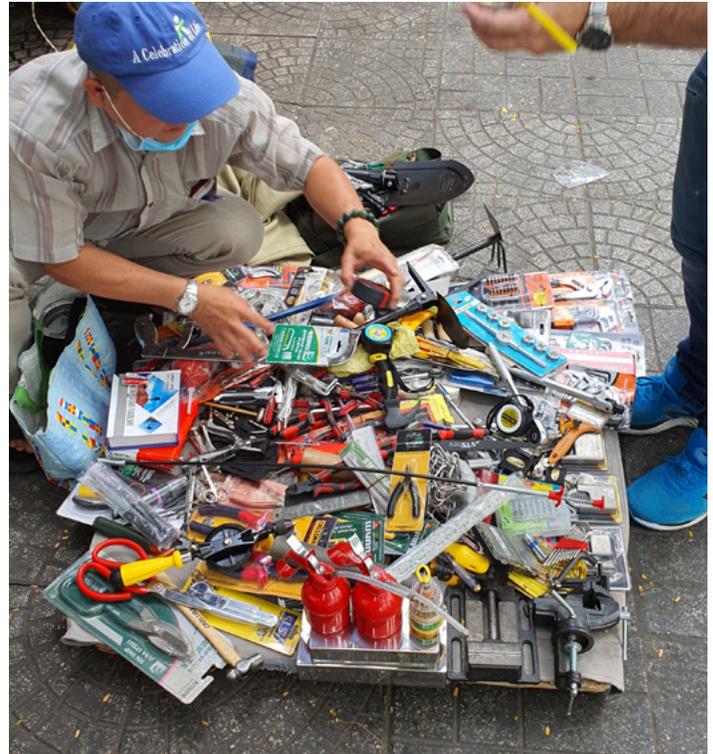
Makerspaces offer safe, clean, and inclusive spaces to design, build, and store student prototypes. Students can learn to use the tools themselves. This keeps the student intricately involved in their prototype building process. Faculty and students can reserve a space for applied learning programs and keep the entire design innovation experience in-house. The space alleviates students' apprehensions about the costs and complications of joining applied projects. Keep this in mind as you design, manage, and sustain your space.

### Understand what a makerspace is

Makerspaces are multi-disciplinary creativity spaces that tear down the figurative walls between technical, vocational, and engineering disciplines. The convergent learning space combines multiple workshops into one. Each workshop houses the essential tools needed to design and build their prototypes in one safe, clean, and welcoming place. Spaces have linked teamwork areas and building workshops so students can continuously iterate their prototypes.

### Understand what a makerspace is not

A makerspace is not a research lab. It does not have research equipment, experiments, or technical training kits. No single department's budget or courses dominate the space. It is not for campus maintenance workers to repair equipment.



*Students often buy tools from local vendors*



*The Woodshop*

# Layout

## Setting up your workshops

### Decide which workshops your projects will need

Workshops are sections of the space organized by the materials, tools and safety equipment. Imagine you set out to build a Smart Sailboat in your space. First, you would sketch and print the blueprints in the teamwork area, frame the boat in the woodshop, solder parts in the metal shop, sew the sail in the textile shop, and calibrate the smart sensors in the electronics shop. Any tools or materials you would need would be ready for you. The seamless flow between workshops is the magic of a makerspace.

### Designate your workshops as protective gear “not required” or “required”

Your workshops should be situated into two distinct sections; a “Protective Gear -Not Required” and a “Protective Gear - Required” area. The entry must lead to a “Protective Gear -Not Required” area without any dangerous tools. Situate the protective gear cabinet at the border of the “Not Required” and “Required” areas. The “Protective Gear - Required” area houses workshops where tools could inadvertently injure users. Staff and safety signs must remind users to wear protective gear. Students must never be alone in the makerspace.

### Lay out your utilities, workshops, and equipment

Before you begin building. Plan everything! This detailed layout includes doors, power outlets, windows, ventilation, air conditioning, fans, fire hydrants, light switches, noise separating walls, and distinct workshops. All spaces are divided into blue “protective gear - not required” and red “PROTECTIVE GEAR – REQUIRED” areas. It is ideal to have a physical barrier separate these distinct areas.



*The electronics shop*



*The spacious teamwork area*

# Tools

## Focus on the tools you need first

### Purchase tools you need first and ones you want later

First, buy space maintenance tools: vacuums, brooms, & trash cans.

Then, protective equipment: gloves, eye protection, & helmets.

Then, multi-purpose tools: scissors, tables, hammers, & grips.

Then, materials for construction: wood, sheet metal, plastic.

Then, workshop specific tools: power tools and soldering irons.

Then, equipment: 3D printers, laser cutters, & CNC machines.

### Select your workshops then your tools

A Metal Shop has welders, CNC machines, saws, grinders, and drills

A Wood Shop has drills, routers, wrenches, and carving tools

A Electronics Shop has laser-cutters, 3D printers, & soldering tools

A Textile Shop has tools for sewing & cutting fabric, leather, & plastics.

A Teamwork Area has A/V, desks, whiteboards, and project lockers.



*Tools mobilized with mounted wheels*

### Budget for tools and their care

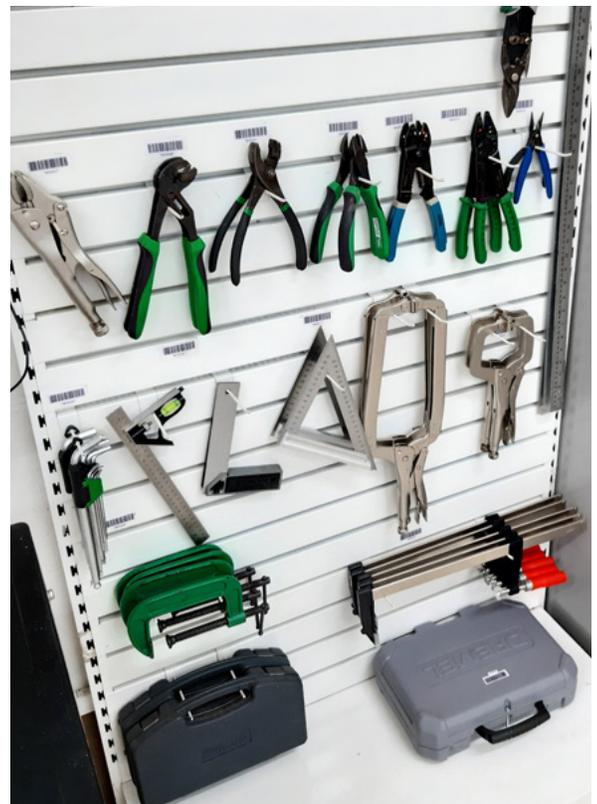
Budget for tool repairs and materials. Avoid importing specialty equipment without spare parts and materials available in Vietnam. You can rent/buy/borrow used tools. Immediately, put broken tools in storage. Sell your unpopular devices. Cabinets, desks, and lockers are essential tools. Consider a fingerprint scanner to track who rented tools.

### Track, store, and mobilize your tools

We recommend following 5S practices for standardization and safety (see references). Track your tools by mandating that students always return the tools to their place. Post a list of tools on the tool cabinets so everyone knows where to put tools. Ensure your technicians check that tools are returned. You can use a barcode system or spreadsheet to track who used which tool. Do not let students take tools home. Offer students storage to keep their prototypes at the space. Building requires students to use tools freely. The workshops cannot be crowded with chairs or large equipment. Mount heavy equipment on locking wheels. Plan and install power outlets, fans, ventilation, and fire safety equipment throughout the space.

### Train students to use the tools safely

Power tools and equipment require training to operate safely and accurately. Your team should regularly offer training seminars. For specialty equipment require that students complete training before they can use the tool. Consider labeling tools with their use and safety tips. Immediate stop students from using tools unsafely. Record your tool training videos and share them online.



*Barcode system tracks tool use*

# Manage the space

## Gather your team

### Who is on the team?

**The Director** is a university leader who focuses on procurement, layout, building approvals, curriculum integration, partnerships, and finances. They write funding proposals, oversee employees, call for sponsorship, and report to university leaders. The Director is responsible for regularly updating the space's operations manual.

**The Manager** is the chief of staff and operations. They focus on project implementation, equipment repair, safety, security, and class schedules. They have both technical and management skills.

**Staff Technicians** are tool use and safety guides. A technician is always present when the space is open. They welcome users, track attendance & tools, train people on safe tool use, and regularly clean the space. They are responsible adults with first aid training. Technicians are often a group of lecturers committed to a rotating schedule to oversee the space.

**Student Technicians** support the staff technician in training, cleaning, monitoring, and safety. They may be volunteers or employees. They create a welcoming makerspace community. Female student technicians inspire other women to venture into the makerspace. Make sure technicians are trained and competent.



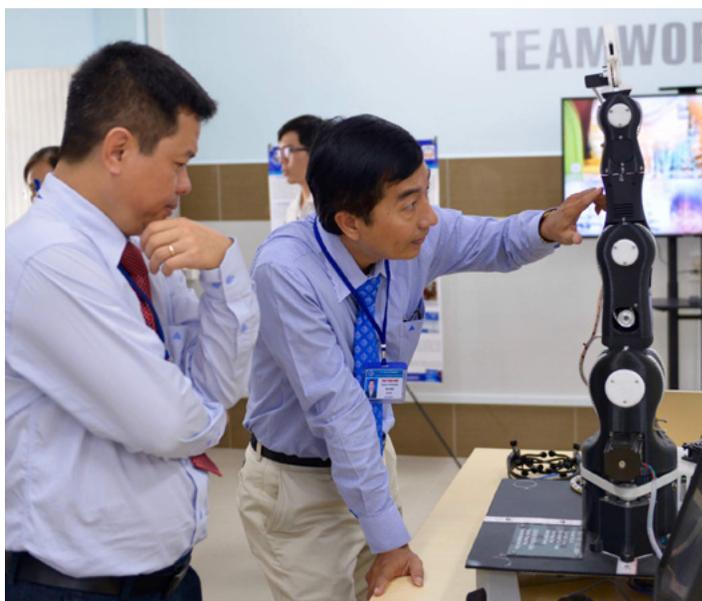
**Users** contribute to the makerspace by giving feedback, tracking any missing/broken tools, reserving the space, reporting strangers, and encouraging new users to follow the rules. A dynamic makerspace is continuously striving to meet its users' needs better.

### Write and share your makerspace operations manual

Before the makerspace opens, space leaders will write clear policies, procedures, and expectations into an Operations Manual. See the references for a starter operations manual. This manual covers daily opening/closing procedures, use & material fees, attendance tracking, safety, emergency contact information, technicians' duties, thorough checklists for cleaning & reporting, and policies for tools use. The manual should be regularly updated and available in print at the space.

### Post your emergency plan in plain sight

Although wearing gloves, safety goggles, and closed-toe shoes will protect them from the most common injuries, students will get hurt in your space. Follow international safety standards, including 5S, which limits confusion and lowers the likelihood of an accident. You must post an emergency plan in plain sight. At a minimum, the plan should have a first aid kit and the phone number for the closest ambulance/hospital. You should train and regularly retrain your staff in basic first aid (including treatment for cuts, eye washing, and burns). All technicians must demonstrate emergency response skills before starting their duties.



# Sustain the space

## Generate revenue to sustain the space

### Expand institutional funding through course integration

As project-based learning programs are integrated into the curriculum, you should work with each department that uses the space to allocate funds for their courses' utilities, materials, and space rental costs. Consider increasing program fees for courses that regularly use the space.

### Leverage sponsored programs for revenue

Industry-sponsored programs and competitions should be budgeted to cover costs for using and sustaining the makerspace. When you negotiate an industry-sponsored program, account for utilities, materials, and tools use in your budget. Industry partners can also sponsor tools and pay to advertise in the space. Grant-funded projects can bring in revenue from organizations supporting STEM, innovation, and entrepreneurship. Host innovative programs at your makerspace and include related space costs into your budget.

### Charge users for entry, rental fees, and materials

You can earn revenue from charging users daily entry fees, space rental fees to outside groups, and selling raw materials like metal, wood, and plastic to users at a mark-up to cover space costs. Not all tools should be free! Extensive time on a laser cutter or 3D printer shouldn't be free. Snack vending machines may earn limited revenue.

### Offer public programs for children and makers

Children's STEM programs can be a consistent source of revenue because demand is high and their positive impact is significant. Connect with local schools to rent the space or run custom programs. Specialty trainings are evening or weekend classes for adults to learn to use popular tools like CNC machines and 3D printers.

### Start young – start now!

Changing attitudes about women and girls in STEM should start before boys and girls have absorbed pre-conceived notions about gender and ability. Inspiring an attitude shift means starting today with students at all levels in their STEM pathways. Focus on shifting both parents' and students' attitudes.



*Materials are costly and can be a source of revenue.*



*Course fees can support the space and students*

# Make her space

## Makerspaces encourage women

### Showcase women in the makerspace

The first impression of your makerspace is critical! Online and off, young men & women need to see images of women using tools, in safety signs, and working in the space. Makerspaces should position this imagery on website banners, public-facing signs, and near the tools to normalize women building prototypes.

### Hire women technicians

The most powerful signal to a young woman that she belongs in the makerspace is seeing a female technician working with equal duties to her male colleagues. An active female technician supporting tool training is critical to helping women overcome hesitation around using tools. A female technician will combat stereotypes and inspire women to use all the space's resources.

### Tool training for women

Since women are less likely to have experience using tools, men may discourage women from building the prototype. Host tool training events for and by women. Host these sessions regularly and offer them to women from all majors. Link them to new student orientations and high school visits. Include women in any tool training videos that you develop.

### Make it her space

Introduce the space to women by connecting with women's clubs and hosting women-focused events. Start young with children's classes, soft skills programs, and career seminars. As a multi-disciplinary platform, the makerspace is ideal for hosting a women's STEM club. Incentivize women to use the space with membership discounts & reserved lockers.

### Respect her space

Location, lighting, hygiene, and the presence of strangers are critical to women's engagement. Build your space in a highly visible part of campus, near private restrooms, with trusted adults present. Students should never be alone, especially with public members, mentors, or maintenance workers. The space is not one clique or department's clubhouse. Students must put tools back and take their belongings. Allow students to share anonymous feedback with space managers.



*Poster of woman building on display at the space*



*Welcoming spaces can break gender bias in STEM*

# References

Dougherty, et. al. (2013) Makerspace Playbook school edition. Retrieved from <http://makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf>

The University of Danang, (2020) Operations Manual, Operations Manual for University of Danang Maker Innovation Space. <https://drive.google.com/drive/folders/1Wm45nguEpf5zJD0lpzCEJndDYoc6Snt>

Can Tho University, (2020) Makerspace Tools Training video samples. Retrieved from [https://youtube.com/playlist?list=PLQrbvBNZgc\\_Wf3sxmT8NuQ-iyIveVgE7w](https://youtube.com/playlist?list=PLQrbvBNZgc_Wf3sxmT8NuQ-iyIveVgE7w)

Brian McFadden, What is 5s, Retrieved from <https://www.graphicproducts.com/articles/what-is-5s/>



## Let us know...

Thank you for your interest in the BUILD-IT playbooks, these useful guidelines will help you develop a sustainable world class model in STEM Higher Education. Make sure to share your input on implementing our playbooks and how you used them.

Additionally, we would like for you to share them with your colleagues, not only in your university but also in your network.

Reach out to [builditvietnam@asu.edu](mailto:builditvietnam@asu.edu) to let us know about your successes and any lessons or suggestions you would like to send as feedback.