The California Community College

Makerspace Startup Guide

Preparing Students for Jobs of the Future

cccmaker.com
Acknowledgements

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—Carol Pepper-Kittredge, Statewide Project Director, CCC Maker

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Getting Started

Makerspaces come in all shapes and sizes, each a reflection of the unique needs and cultures of the communities it serves. There is no standard formula, no stock list of must-have tools and machines, no template to follow. The common denominator and fulcrum of all makerspaces, however, is community, starting with the dedicated team members who plant the seeds and radiating out to a virtual constellation of educators, students, makers, organizations, and businesses within the sphere of the space’s ecosystem.

Embarking on the journey to bring a makerspace to life is much more than creating a brick-and-mortar location with four walls and tools. Rather than merely changing the confines of a physical space, the work involves changing minds, thought patterns, preconceived notions, perspectives, and pedagogies to embrace the benefits of hands-on learning and the concomitant nurturing culture of experimentation and innovation.

While the makerspace itself is the physical manifestation, it is nothing but inanimate objects with potential without the community support. Understanding the community that creates and is served by the makerspace allows it to become more than just a physical space housing a collection of tools. If successful, the makerspace becomes an expression of the community, valued and supported by its members.

We all know the old adage, “build it and they will come,” but in the case of makerspaces, the act of building it begins long before there’s an actual physical space or a single tool within; like all successful enterprises, it begins with a well-developed, yet flexible, plan built on assessing needs and resources.
The Makerspace Startup Process

In 2016, CCC Maker (California Community College Maker) embarked on a six-month journey of guiding and shepherding 34 California community colleges through the Makerspace Startup Process: identifying the needs of their respective communities, mapping out their extended support ecosystems, analyzing their findings, piloting student and faculty engagement, and from there developing robust plans with which to go forth and realize their actual physical college-sponsored makerspaces.

This process is not unlike one that a budding startup business would go through to ensure a successful launch. While the goal of most businesses is monetary profit, the return on investment of a lucrative makerspaces is intellectual and social capital, with its primary benefactors being individuals, communities, the economy, and society as a whole.

In the case of community colleges, at the epicenter of our startup model is the student, our main “client.” The main question is: How best can the makerspace serve the learning and career needs of the student? For community college students in California, makerspaces provide skills, experiences, and connections to prepare them for entrepreneurship and innovative careers.

Though the process we developed focuses on community colleges, it can easily apply to and benefit any community considering developing a makerspace, be it another educational institution, library, museum, or a group of passionate citizens. To that end, and in the spirit of open information sharing that is prevalent throughout maker communities across the globe, we offer our process and findings through this guidebook, with the belief that makerspaces are powerful agents of positive change and the hope that others will follow suit.

CCC Maker Initiative: What and Why

The California Community College Chancellor’s Office (CCCCO), Workforce and Economic Division, led by Executive Vice Chancellor Van Ton-Quinlivan, funded the $17 million CCC Maker Initiative for three years, from July 2016 to May 2019, under the Doing What Matters for Jobs and the Economy framework. The CCCCCO holds that growing a statewide network of makerspaces linked to community colleges can help develop a much-needed workforce for what is being termed the digital or innovation economy.

At the onset of the CCC Maker Initiative, the CCCCCO commissioned the California Council on Science and Technology (CCST), a nonprofit whose mission is to improve science and technology policy and applications
in California, to develop a report providing background on the Maker Movement and to inform the creation of the CCC makerspace network. “Making” is quite a buzzword these days, but humans have been making things for as long as we’ve been on this planet. What’s new?

In their report, CCST succinctly distills some of the key hallmarks of making as part of the Maker Movement:

- Communal—Share, communicate, and cooperate.
- Empowering—Expand one’s abilities.
- Interdisciplinary—Collaborate across fields and skillsets.
- Diverse—Mix students, businesses, community members across the spectrum of science, technology, engineering, art, and mathematics (STEAM).
- Process-focused—Embrace making as a process and a personal identity.
- STEM/STEAM/entrepreneur-focused—Emphasize innovation.
- Open-ended, inquiry-based learning—Learn by experimenting and inquiring.
- Creative, fun, and playful—Innovate through play.

Further, at the fulcrum of the Maker Movement and makerspaces is the maker (notice how it’s not called a “toolspace”), the individual, inquiring, experimenting, and learning through hands-on making. In the realm of education, in particular, this is a notable pedagogical shift from teacher-driven to learner-driven.

In the light of these findings, CCCC holds that creating a makerspace network can effectively help bridge the gap between skills and jobs, becoming a crucial catalyst in strengthening California’s economy.

Solving the Skills Gap

The problem our economy is currently facing is a lack of eligible employees for “middle-skills” jobs, ones that require advanced training but not necessarily a bachelor’s degree. According to the National Skills Coalition, in the next five years, middle-skill jobs will dominate nearly half the employment market. In this digital age, technological advancements across sectors continue to create jobs that require very specific skill sets, but many of our educational institutions are not evolving fast enough to meet this need.
According to the Georgetown Center on Education and the Workforce, by 2020, 65 percent of all U.S. jobs will require either a credential or post-secondary degree, but at the current rate that colleges and universities are awarding them, we’re on track to fall roughly 5 million workers short. Though the needs of the workforce have changed rapidly over the years, our educational system has not kept pace.
In the manufacturing sector alone, despite popular misconception, according to the National Association of Manufacturers (NAM), U.S.-manufactured goods exports have quadrupled in the past 25 years. Unfortunately, though, over the next 10 years, 2 million positions are projected to go unfilled because of our skills gap. Even now, 80 percent of domestic manufacturers report a shortage of skilled and highly skilled workforce. We often hear that jobs are being taken over by robots, but the fact is that although manual labor and production jobs may be on the decline, the need for people with technical proficiency to operate the robots is on the rise.

In addition, entrepreneurship in the U.S. has been on the decline in recent years, with startup-creation at historic lows. The Great Recession, which spanned from 2008 to 2012, put a damper on the creation of new small businesses, and while the landscape was expected to bounce back after, it never quite did. According to the U.S. Census Bureau, startups were responsible for the creation of 3.5 million new jobs in 2006, but in 2014, even though the all-time lows had started to improve, that number was still only 2.5 million jobs.

![New U.S. Businesses Created Each Year](chart.png)
Aligning Education and Workforce Demand

This situation begs the question, what does it mean to be well-educated in the 21st century? How do we prepare students for success in this rapidly changing and highly challenging environment? How can we offer economic opportunity to all students, especially those who are underrepresented in high-wage STEM/STEAM careers? What can we do to shift these statistics and maintain a healthy standing in the global market, as well as keep our population gainfully employed? How can we increase the 21st-century skill sets of our society?

The answer lies in integrating hands-on making and familiarity with digital design and fabrication into our current pedagogies and curricula. Based on the key hallmarks of the Maker Movement outlined earlier in this text, the CCC Maker Initiative focuses on accomplishing just that through the creation of a network of makerspaces across community colleges in California. The California community colleges collectively comprise the largest higher education system in the country, with 72 districts and 114 colleges serving 2.1 million students every year. These colleges are also uniquely qualified to affect systemic change because they’re ubiquitous, adaptable to local needs, and more flexible than four-year universities.

California community colleges are also the largest providers of workforce training in the state and nation, offering postsecondary technical education in 175 fields, and educating more than 100,000 individuals each year in industry-specific workforce skills. However, California’s education pipeline is not keeping pace with the higher levels of skills and training required by employers. By 2025, 30 percent of all job openings in California—or a total of 1.9 million jobs—will require some form of postsecondary education short of a four-year degree.

Creating a college innovation and entrepreneurial culture will enable the most diverse student body in the nation to explore, create, and connect in new creative ways, developing 21st-century skill sets, increasing digital proficiency, empowering students through authentic learning experiences, and more effectively preparing students for meaningful careers in our current economy. By virtue of having the largest community college system in the U.S., CCCs have the potential to serve as a powerful example of what’s possible for the rest of the nation.
In support of the benefits of makerspaces within learning environments, making is inherently complementary to curriculum-driven classes and supplements learning in meaningful ways.

For example, making helps students develop:

- The “4 C’s” integral to 21st-century skills: creative thinking, critical thinking, collaboration, and communication
- The ability to experiment and to embrace failure as part of the learning process, both key to innovation
- Technology proficiency, building confidence and knowledge of digital tools, like software and desktop manufacturing machines (3D printers, CNC mills, etc.)
- 21st-century life skills, such as flexibility, initiative, productivity, persistence, and social skills

Furthermore, because of the strong emphasis on developing ecosystems around makerspaces that include local businesses, industry, and other members of the community, a door to real-world opportunity is inherently opened to the student.

The movement toward learner-driven, hands-on “maker education” has been growing for a number of years now and is well-documented, with organizations like Maker Education Initiative (Maker Ed) leading the charge by helping build maker communities, disseminate knowledge, conduct research, and spread maker education.
While Maker Ed predominantly addresses K–12 education, for post-secondary education, there is the Higher Education Makerspaces Initiatives (HEMI), a collaborative of leading universities—including MIT, Stanford, Georgia Tech, Yale, and University of California Berkeley—“focused on solving the challenges of academic makerspaces and making their combined learnings available to others.”

HEMI hosts an annual International Symposium on Academic Makerspaces (ISAM) with the purpose of encouraging networking and knowledge-sharing among the academic makerspace community. In their own words, “ISAM will gather, and make available, knowledge and best practices that may be used to form student maker communities, get students excited about using these spaces, perpetuate a culture of safe, fun and responsible use, measure/maximize educational and social impact, and to select appropriate practices, programming, safety policies, training, staffing and equipment.”

Having such notable institutions at the helm further legitimizes the movement. In 2013, when MIT announced the acceptance of maker portfolios as part of their application process, it served as a loud and clear endorsement of the value of making from one of the most reputable institutions in the country. In 2015, a conglomerate of 83 (now 113) higher education institutions became part of the Coalition for Access, Affordability and Success, a digital portfolio-building platform that lets students build their maker portfolios over the course of four years and then be able to submit them to multiple schools at once.

Now, in the realm of community colleges, there is CCC Maker. As Dale Dougherty, founder of Maker Media and chair of the CCC Maker Advisory Committee, asserts, the opportunity through California community colleges, unlike elite universities, is to “democratize making.” With the most diverse and largest student body in the country, and comparatively low barriers to entry, community colleges are well-aligned to create accessible, equitable makerspace communities. Not only will embracing maker culture inspire students to discover fulfilling and lucrative careers, it prepares them to thrive in the 21st-century marketplace and drive entrepreneurship.

Of the 34 colleges that embarked on Phase One of the CCC Makerspace Initiative, what we term the Makerspace Startup Process, of researching and planning their ideal makerspaces, as of this writing, 24 have moved forward to Phase Two, the implementation stage of realizing and maximizing their spaces and communities, with the specific intention of creating a makerspace that is responsive to and expressive of the needs of their students.
How to Use This Guidebook

On the pages of this guidebook, we offer you a deep dive into the Phase One planning stage: identifying the needs of the communities the makerspace will serve, mapping out the extended support ecosystems, analyzing the findings, engaging the community, and from there developing robust plans with which to go forth and realize the best makerspace to serve the community. We hope sharing our information makes the process accessible and empowers others to embark on a similar journey.

We begin with a brief overview of our overarching guiding principles and approach. Then, the main components of the process are presented as modules rather than steps, to encourage you to arrange them in whatever order best suits your own makerspace startup process. In the spirit of maker education, rather than outline a definitive linear path for you to follow, we offer building blocks and invite you to arrange them however you see fit.
Guiding Principles

Throughout every step of the Makerspace Startup Process, we employed the design thinking approach and were guided by a set of overarching principles, the most important of which is to always be mindful of keeping the student at the center of every decision. In our findings, the following principles emerged as being integral to the success of a community college makerspace.

What can go right?

- **Student-centered**—Student needs, not teacher intention, must be at the center, with students being empowered to have voice and become agents, a pedagogical shift from traditional educational models.

- **Integrated**—The space cannot thrive in a silo and must be well-integrated into the community and cross-disciplinary curriculum to be fully adopted.

- **Rooted in a broader ecosystem**—Developing and growing an ecosystem that includes businesses and organizations is as important to a makerspace as tools and a physical space.

- **Clear and regular communication**—Opening regular lines of communication with the administration, faculty, students, and community is vital to success.
As well, in our process, we have the mantra, “We’re All in This Together,” a nod to our cohort of colleges, each on their own journey of realizing a makerspace but all part of a network of colleges making makerspaces. This network has served as a much-needed support system, inviting the essential elements of ideation, experimentation, and action, as well as introducing the productive element of collaborative competition. Who might comprise your own cohort?

For a more in-depth look at our findings to date, please read our 2016 and 2017 ISAM whitepapers.

Design Thinking Approach

A creative solution-based, human-centered methodology originally intended to tackle design projects, the design thinking approach to problem-solving is prevalent throughout the Maker Movement because it puts human needs first. As opposed to the scientific method, which starts with a preformed hypothesis that then gets tested and iterated upon, design thinking begins with a blank slate, and focuses on considering the needs of those the design is intended for.

As such, design thinking helps avoid predetermined solutions, confirmation bias, and self-imposed constraints. In this scenario, it also allows for the evolution of the makerspace through iteration and a continuous improvement model. In other words, it’s dynamic, responsive, and can adapt to its community’s changing needs.

As defined by the Hasso-Plattner Institute of Design at Stanford (d.school), there are five stages in the design thinking process:

- **Empathize:** Understand the way people do things and why, their physical and emotional needs, how they think about world, and what is meaningful to them.
- **Define:** Identify the challenge based on what you gleaned about your user and about the context. Focus on solving the right problem.
- **Ideate:** Generate ideas aplenty and go broad with your thinking.
- **Prototype:** Employing what you’ve learned about the end user, generate prototypes of what could work.
- **Test:** Solicit feedback about your prototypes from the end users, focusing once again on gaining empathy.

For a deeper dive into the design thinking approach, read d.school’s seminal publication, “An Introduction to Design Thinking.”
Institutional Self-Study

As writer William Arthur Ward famously wrote, “Before you speak, listen. Before you write, think. Before you spend, earn. Before you invest, investigate.” Before any makerspace start-up plan can even begin to take shape, the foundational first steps are to research, gather knowledge, and analyze your findings.

Look at student, program, and institutional data. Investigate industry, community, and regional information. Identify the institution’s strengths and weaknesses, as well as the stakeholder needs and attitudes. Talk to the college research department for insights into systemic equity and student success.

An honest self-assessment is essential to avoid predetermined outcomes. It requires you to be both highly critical of your findings and also non-judgmental, which may initially seem contradictory. We use the phrase, “meet them where they are,” meaning assess your findings at face value, then look beyond the data to the students and ask what the data is saying and why.

These valuable findings—an analysis of existing systems, resources, and data—will serve as an informed baseline for the development of your plan and help identify and define the right questions, problems, and solutions for your makerspace. As well, when you establish a baseline from which to start, then, over time, you can use these findings to assess the impact of your makerspace.
The self-study stage of our Makerspace Startup Process maps to the empathize and define stages of the design thinking process (outlined in the section on “CCC Maker Guiding Principles”). Aside from researching and collecting data about students and the college community (explained in further detail in this section), now is the time to connect with students, collect information about their needs and desires, and solicit their input. You may consider conducting a campus-wide survey or hosting an event where students can voice their thoughts.

**Self-Study Questions**

As you begin your research, bear in mind these three overarching questions. Be mindful of always keeping the student at the center.

1. Who are our students?
2. What are our students telling us?
3. How can our makerspace use public/private partnerships to help students reach their career goals in new and different ways? What partnerships can we leverage to help them?

The main takeaway here is to always make the data you collect human. Take the numbers you glean and see what they're telling you about the individuals who comprise them. Who is your typical student? What challenges do they face on a daily basis? Create a profile. Beyond the numbers, look within your student population for outliers. Who is your atypical student? Is there a student who has seemingly unusual course-taking habits? Talk to them and ask what their goals are. You’d be amazed what you’ll learn.

“I have worked as a professional in a university setting, and nine times out of ten, things are done with fiscal efficiency in mind over the needs of the students. The format of this space all but requires direct student input and participation to function as intended.”

—Erin McDowell, Sacramento City College Student
Sierra College is a three-campus institution straddling Nevada and California. They opened the doors to their first makerspace in 2015 and have since expanded to include two more, covering all three campuses. Like many of the colleges in the Makerspace Startup Process, Sierra College was looking to grow and optimize their existing makerspaces to better serve the student population.

As part of their self-study, they sent student makerspace members into classrooms to conduct a written survey that involved a random sampling of roughly 300 students. Of the questions posed, one was, “How might a makerspace help you develop professionally or gain career-related experience?” Interestingly, the top two responses were “discover a new career interest” and “learn employer-desired skills,” followed closely by “meet people to connect with employers.”

The survey also asked students to suggest ways to spread the word about the makerspaces on campus, since many didn’t know anything about it. Students are the best community members to ask such questions, as they are the primary “clients” of the makerspace and are most in touch with how best to reach other students. The responses included posters around campus, online videos, creating a Facebook page for the makerspace, class field trips, asking teachers and counselors to mention it, connecting with local clubs, and hosting networking events with local businesses.

Sierra College then used these findings to inform their ongoing plan. In their self-study conclusion, they state, “Our focus is on building connections and communities, developing student leaders, engaging faculty to integrate making into curriculum, and connecting students to employers through internships.”

Case Study: Sierra College Surveys Students for Insights
Located in Los Altos Hills, in the heart of Silicon Valley, Foothill College serves the communities of Palo Alto, Mountain View, Los Altos, Sunnyvale, and Cupertino. With a community rich in potential makerspace partners ranging from institutions to local industry, the need and potential for creating a makerspace at Foothill College was clear.

During the Makerspace Startup Process, the Krause Center for Innovation (KCI), part of the Fine Arts and Communications division, served as Foothill College’s anchor program, though their research was informed by an array of academic divisions, including Business, the IDEA (Inter-Disciplinary Electronic Arts) Lab, Theater Technology, and Physical Science, Mathematics, and Engineering (PSME). To build on the wealth of knowledge gleaned about the student population at Foothill College, they held a focus group activity to gain deeper perspective directly from students. After meeting with the focus group, they had participants answer a short survey about their personal perceptions about making, which they also put out to others who had taken KCI classes in the past.

Through the process, while initial findings were confirmed in many cases, other issues not previously considered were brought to light. For instance, many students felt the need to develop communities of practice that are more organic in nature. They preferred an environment and conditions that could facilitate networks to develop on their own.

There was also a strong interest in “just-in-time learning,” where students could drop in and either make or fix something to meet an immediate personal need. Students who were able to do this reported a sense of empowerment and a desire to take on more difficult tasks subsequently. Foothill College can now use these findings to create an environment that serves true student need rather than perceived need.

**Case Study: Foothill College Utilizes Focus Group**
Online Data Resources

There’s a plethora of information resources available online. When it comes to raw data, in general, there are three types you can collect, the first being what we just discussed:

- **Qualitative data**: Experience, observation, input from stakeholders
- **Relational data**: Ecosystem mapping, identifying larger networks, exploring how data relates to associated systems (covered in a separate module)
- **Quantitative data**: Historical data, enrollment rates, success, employment rates, etc.

For gathering statistics and data specifically in the realm of colleges, among the variety of resources available, below are the main three.

**CCC Student Success Scorecard**: As part of the Student Success Initiative, the California Community Colleges Board of Governors established this performance-measurement system to track student success at all 114 community colleges. Select a college and view data on student demographics, success milestones, completion, and transfer. The Scorecard also compares rates for college-ready and basic-skills students and tracks career technical education (CTE) and skills builder (courses taken just to build skills, not to attain degree, certificate, or transfer eligibility) stats.

**College Scorecard**: The U.S. Department of Education maintains a nationwide college data repository offering statistics on institutional characteristics. Look up any college in the U.S. and see a graphical breakdown of average annual cost, financial aid and debt statistics, graduation and retention rates, and average salary after attending, as well as student body demographics and popular programs.

**LaunchBoard**: The California Community Colleges Chancellor’s Office maintains this statewide data system hosted by Cal-PASS Plus, with the goal “to provide actionable data to help improve student success along the education-to-workforce pipeline.” LaunchBoard focuses on progress, employment, and earnings outcomes for both CTE and non-CTE pathways.
Translating Data into Action

Though we’re still gathering the vital information upon which to build our plan, it’s helpful to envision how this data can inform our decisions.

By accessing these online resources, you’ll gain insight on:

- Student demographics, including equity gaps and basic skills needs
- Socioeconomic conditions that challenge student success
- Labor market data on high-demand occupations in the region
- Career and technical education (CTE) program information with completion and graduate income statistics

Looking at the data and statistics can help identify gaps and opportunities that can be addressed through your makerspace implementation plan. Several examples of opportunities follow.

Minimize socioeconomic impact by:

- Considering affordability of materials
- Scheduling activities to align with working students
- Coordinating with public transportation
- Aligning activities with scholarships and competitions

Develop CTE programs that utilize making to:

- Offer alternative badging and credentialing for skills builders
- Accelerate completion through competency-based assessments
- Maximize student earning potential through internships

Align makerspace programs with industry demand by:

- Prioritize internships that lead to high-demand occupations
- Connect to industry mentors through entrepreneurship challenges
- Integrate 21st-century skills training with maker programs

Close equity gaps by:

- Appealing to non-traditional students through outreach activities
- Creating culturally relevant curriculum that celebrates diversity
- Integrating academic skills into real-world problem-solving
- Teaming with student support to improve completion
Folsom Lake College (FLC), which serves eastern Sacramento and western El Dorado counties, opened the doors to its 1720-square-foot Innovation Center in 2001, originally equipped as an analog-to-digital space, with tools to transform analog data (VHS, slide, etc.) to digital format. The space has since shifted its focus and expanded its offerings to better serve changing student needs, a prime example of a responsive, flexible system dedicated to serving its community.

In their self-study, they first focused on identifying the main goals they were setting out to accomplish, all centered around the student:

- Provide programs for students that will help them develop 21st-century job skills, making them more desirable candidates for employment.
- Improve student success and outcomes achievement through active and collaborative educational experiences, and through increased opportunities for student-faculty interaction, with intentional focus on disproportionately impacted students.
- Create a dynamic, authentic learning environment for students, with programs to help them meet their academic, professional, and employment goals.

They then collected data and stats from a number of sources:

- Labor market analyses from Northern California Region Centers of Excellence
- Input from faculty, staff, students, and their Modern Making Advisory Board

Case Study: FLC Uses Stats to Develop Plan
• FLC’s Office of Institutional Research, including the 2016 Community College Survey of Student Engagement (CCSSE)

• A comprehensive makerspace student survey conducted by students from their Data Science Club.

From that vantage point, they were able to put together a series of intended outcomes to work toward, with much of the work already in progress:

• Student Internship Program: Create several hundred vibrant, successful CCC Maker-funded internships for students, in collaboration with the seven sister community colleges of the Sacramento region.

• Innovation Center Makerspace V2.0: Fundraise and work toward reimagining and retooling the Innovation Center based on MIT Fab Lab 2.0 specs and student interest. The new center will support making-centered courses and activities and host workshops, professional development opportunities, college-wide activities, and student clubs, as well as be available to the college community during open lab hours.

• Community of Practice: Enhance outreach to and involvement with student clubs, plus develop a sister lab relationship with a K-5 makerspace at Georgetown School, participate in hackathon planning with local high school students, and host makerspace field trip visits from K-12 schools and community colleges. Also, strengthen relationships with regional high school CTE programs and faculty, the Sacramento Small Business Development Center, the Folsom Chamber of Commerce, and others. In collaboration with Sierra College’s Center for Applied Competitive Technologies and Sacramento Hacker Lab, they’ve even developed and implemented a two-week faculty maker educator boot camp.

• Curriculum Innovation: To address the needs of workforce development, students, and local employers, and to make their makerspace programs sustainable, they’ve developed unique courses and certificates in Modern Making, including two Certificates of Recognition in Physical Computing and the Internet of Things and Digital Fabrication, and a financial-aid-eligible Modern Making Certificate of Achievement. To ensure that their proposed courses and certificates meet the needs of students and employers, the curriculum is vetted by an advisory board consisting of students, local employers, and faculty from FLC and other colleges in the district and region.
Identify Resources and Allies

Ecosystem Mapping

In nature, an ecosystem is a community of interacting organisms and their physical environment, acting together as a unit. The animals, plants, earth, and air rely on one another in these mutually beneficial relationships. Likewise, your community college (or other makerspace community) is rich with potential partners, assets, and resources that form the life force of your endeavor and are essential to the success and sustainability of your makerspace. The key is to seek and identify who and what comprises your ecosystem. That’s where ecosystem mapping comes in.

An ecosystem map is a powerful tool to help identify and organize all the related components of your makerspace’s ecosystem in a visual way. This is particularly helpful during the assessment and planning phases. Identifying and mapping both internal and external partners can effectively guide your efforts based on assets and resources already available within your community. It can help identify areas where you may be short on contacts, so you may prioritize developing that portion of your ecosystem.

Ecosystem mapping is also valuable for planning workforce development activities, including work-based learning opportunities and internships for students. Who comprises your communities of practice, support, influence, and opportunity?
Brainstorm: Go Broad

Start by spending some time jotting down as many potential ecosystem members and elements as possible. Don't focus on any type of prioritizing of which could hold the most promise. The idea here is to go broad and list all options. It may be helpful to start with your immediate internal college ecosystem and spiral outward.

Consider key students, faculty members, on-campus clubs, and even curricula, as well as other stakeholders and partners. In other words, include individuals as well as organizations and even particular classes that may benefit from a makerspace. Then look at local businesses, economic development partners, libraries, art collectives, K–12 educational institutions and initiatives (such as Strong Workforce and the California Guided Pathways Project), nonprofits, community groups, and so on. As you build your list, ideas will naturally beget other ideas.

Here are a few questions to consider as you brainstorm:

- Are there key individuals in the community who could serve as powerful allies?
- Are there subject matter experts you could bring into the fold?
- Does someone have the potential to be an “entrepreneur in residence” at your space?
- Is there a local industry or professional association that could be involved and benefit?
- Which employers might be interested in hiring interns?
- Which workforce and economic development players are already working together?
- Are there potential partners who have expressed interests in making, innovation, entrepreneurship, and workforce development?

What Is a Community of Practice?

A community of practice (aka community of interest) is a group of people—which can include individuals, businesses, and institutions—who share an interest or passion and are invested in growing knowledge. It can develop organically based on common interest, or it can be formed intentionally with the specific aim of gaining knowledge. Information sharing and mutual support are at the core of a community of practice.
There are a variety of software systems available to use for making a visual map of the ecosystem elements you brainstormed. During our Makerspace Startup Process, we chose Kumu to create our interactive relationship maps. Kumu is free to use and offers a number of readymade templates to choose from, including system, stakeholder, and a custom option. They recommend starting with the stakeholder template.

You can even transfer your brainstorm findings to a spreadsheet with a few predefined fields and then import it into Kumu to populate your map. Kumu can also access a Google spreadsheet with multiple contributors for collaborative mapping. Kumu offers simple instructions to get you started. We worked with Kumu to create a custom CCC Maker template for our purposes.

Often, the task at hand becomes more accessible if we see examples of how others have approached it, which is certainly the case with ecosystem mapping. If you’ve never seen such a map, it may be difficult to imagine what we’re going for here, and how it can be helpful. To that end, following are examples from two colleges that participated in our Makerspace Startup Process.

“The roles of the leaders in these makerspaces is to be relentlessly looking for ways that every person they encounter, on any day, connects to the space. Successful spaces are looking out for how everyone connects.”

—Zack Dowell, Instructional Design and Development Coordinator, Folsom Lake College
Case Study: OCC Maximizes Community Connections

Founded in 1947 and situated minutes from the coast in the Costa Mesa region of Southern California’s Orange County, Orange Coast College (OCC) is one of the biggest community colleges in the U.S., with roughly 25,000 students enrolled every semester.

As part of the CCC Maker project, OCC set out to create the Orange Coast MAKERSPACE with the goal “to empower students, faculty, staff, and community members to innovate, collaborate, and share in maker culture, while leading productive and creative professional and entrepreneurial lives in the context of our region’s vibrant economy.” To that end, in the ecosystem mapping phase, they sought to maximize connections both within their college and in the broader community.

They organized the elements of their Kumu map around central hubs, including the makerspace and college itself, as well as nonprofits, education, local community, business and industry, government, philanthropy, and individuals.
Located just about an hour north of Los Angeles, College of the Canyons (COC) is part of the Santa Clarita Community College district. COC is a relatively new and small two-year institution, having first opened its doors in 1969 and now serving a student population of just under 4,000.

They took a slightly different approach to their ecosystem map by focusing heavily on internal elements, as well as those accessible through the Chancellor’s Office and CCC Maker, and then including broad elements such as industry, as well as granular elements such as specific programs, projects, safety courses, and an advisory committee.

With an eye toward workforce development opportunities, they also made sure to maximize the industries in their region.
Evaluate: Ecosystem Worksheet

Once you’ve started making your ecosystem map, what can it tell you about the assets and resources available to you? What does it tell you about potential support gaps that you have?

During our Makerspace Startup Process, we were supported by NACCE, the National Association for Community College Entrepreneurship. We co-created an ecosystem worksheet to aid in the brainstorming and evaluation processes. Here we offer questions from our worksheet for you to consider as you build out and evaluate your ecosystem.

- What are the strengths of your ecosystem?
- What are drivers behind the strengths of your college’s ecosystem?
- What are gaps in the ecosystem?
- List areas of improvement to strengthen existing ecosystem.
- Identify exceptionally engaged players in your ecosystem.
- What are some traits or practices of those people?
- How do they interact with the ecosystem? Intentionally or unintentionally?
- How do opportunities emerge?

Internal Ecosystems

One way to look at your ecosystems findings is by using inquiry-based learning. Start with a challenge that your space and institution face and then draw from knowledge or disciplines from within the ecosystem to solve the problem.

Consider the following questions:

- Given initial themes or assets of your innovation space, what challenges might emerge? What interests do your students have? What hobbies and technical interests do your students possess?
- What types of talent or expertise will you need to develop and maintain your ideal portfolio of innovation and making programs?
- Who should you engage across campus? It may be as much about willingness to play as subject matter expertise.
- Who are your partners in programming? For instance, who outside of faculty would be involved with programming, outreach, or campus-wide events? List names, titles, and departments.
• Who are your campus or regional connectors, such as Deputy Sector Navigators and Technical Assistance Providers?
• Who are your logistical support partners, such as facilities, IT, food service, etc.?

**External Ecosystem**

• How would you describe your college’s community and external ecosystem?
• What are the strengths of your external ecosystem?
• List some areas of opportunity to grow your ecosystem.

**Workforce Ecosystem**

• Who are some players who are currently in your workforce development ecosystem?
• Who is missing from your workforce ecosystem? Who shows up in the self-study that is missing from the ecosystem map? This will help reveal under-represented groups and non-traditional students.

**Entrepreneurial Ecosystem**

• Who are some players who are currently in your entrepreneurial ecosystem?
• Who is missing from your entrepreneurial ecosystem?

**Innovation Ecosystem**

• Who are some players who are currently in your innovation ecosystem?
• Who is missing from your innovation ecosystem?
And finally, we identified ways to strategize based on the elements in our ecosystem map. What actions can you take now that you’ve outlined potential partners and allies? Here are some suggestions for tangible action to grow and strengthen your ecosystem.

1. Look over your different ecosystems lists. List at least five partners with which you’d like to forge stronger relationships.

2. For each partner, describe a concrete action that you will take to foster that relationship within the next three months.

3. After a preliminary gap analysis, list at least three potential partners that you would like to connect with and action steps to make that connection.

4. In the next three months, commit to an activity you could lead or engage in to cultivate your ecosystem to meet your goals.

Out of the above actions, take a few minutes to calendar your action steps for ecosystem development.

“If you start out thinking more about community, then you’re more likely to think about the needs of people.”

—Deborah Bird, CCC Maker Technical Assistance Provider
Identify, Map, and Refine

Logic Modeling

Perhaps the most important step toward reaching any goal is to first clearly define it. What problem are you trying to solve and what pathway do you intend to use to solve it? With logic modeling, you become the cartographer of your mission, mapping out the most logical pathway with the resources and information at hand, gleaned from your institutional self-study and ecosystem map.

Simply put, a logic model is a diagrammatic map that shows how you intend to get from where you are to where you’re going. It’s also known as the theory of change model, which is exactly what it sounds like: a theory (read: flexible) of how you will affect a defined change through a series of actions.

As a visual tool, the main benefits of a logic model are two-fold: It’s both a powerful organizational tool to help plan, implement, and evaluate your mission, and it’s also an effective communication tool to share your complex vision and pathway with internal stakeholders as well as external partners and agencies before, during, and after your project has launched.

In the thick of a project as complex as creating a makerspace community, it’s easy to get lost in the trees and lose sight of the ultimate goals. Logic modeling helps define these goals and becomes a useful tool to repeatedly reference and refine as the project progresses. In the context of the design thinking process, logic modeling is the bridge between the inspiration and ideation phases.
At the core of logic modeling is a series of if-then statements, sequential steps that collectively carve out a pathway or process, constituting a larger logic model construct. If you take a particular action, then there is a logical outcome. We use logic modeling in its simplest forms just living life every day. When it comes to something as complex as forming and nurturing a makerspace community, though, the exercise of creating a logic model lends an invaluable level of clarity.

Here we offer suggestions for steps to take in drafting your project’s logic model, as well as examples of logic models from colleges that participated in our Makerspace Startup Process, but we do so with the ultimate intent of empowering you to develop your own personalized approach that serves your community best. We aim to be descriptive, rather than prescriptive, because each mission and pathway is unique.

As you work through the process, bear in mind that with logic modeling, maintaining flexibility is crucial. While it’s important and helpful to define the most logical pathways for the time being, stay open to re-evaluating and redefining your logic model as the project progresses. Over time, you’ll find that your logic model is an integral part of your project documentation, not only offering an outward-facing tool to communicate with others, but also as a tool for self-reflection.

By aiming to create and foster a makerspace community, your ultimate goal, naturally, is to affect change. Though this may sound simple and obvious, an important place to start is by asking the following basic questions:

1. Do we want change?
2. Why do we want change?
3. Why is there a need for change?
4. Who will the change benefit?

In asking these questions, you can begin to hone in on refining your mission statement and big-picture goals. Make sure all of your efforts lead to solving the right problem. What does success look like for your team and project?
For the sake of simplicity, we'll start by focusing on three general areas:

- **Intention**: Where do we want to go? Define starting point and destination.
- **Implementation**: How will we get there? List if/then sequential steps.
- **Impact**: How will we know we’ve arrived? Clearly define success goals.

Let’s see what that looks like, using the CCC Maker mission statement as an example:

*CCC Maker Initiative will develop a community of makerspaces that welcome non-traditional students, support faculty in embedding making into instruction and offering adaptive curriculum, and partner with businesses to produce innovation-ready graduates inspired to contribute to the creative economy.*

When we break that down into intention, implementation, and impact, it begins to look like this:

**INTENTION**
Where do we want to go?
- Develop a community of makerspaces

**IMPLEMENTATION**
How will we get there?
- Welcome non-traditional students
- Support faculty
- Embed making into instruction
- Offer adaptive curriculum
- Partner with businesses

**IMPACT**
How will we know we’ve arrived?
- Produce innovation-ready, inspired graduates
- Contribute to creative economy

What is your project’s goal or mission? How does it break down into these three categories?

**Brainstorm: Get Messy to Get Organized**

While the end goal of a logic model is to present a clean, clear vision of the pathway you intend to use to achieve your mission, it certainly doesn’t come out of the gate that way. Begin with quality—and yes, often messy—brainstorming time. Your tool array for this exercise may include sheets of paper, whiteboards, post-it notes, and writing utensils of varying colors.
You may choose to begin your brainstorming session by jotting down a number of your key goals, resources, and intended outcomes, drawing arrows between them, developing feedback loops, and looking for clues on how this can be a recursive, iterative system. Through this lens, you may start to see things as interdependent that may have previously seemed independent.
Logic Model Components

At this point, you have the knowledge gleaned from your institutional self-study, the map of your broader ecosystem, and your logic model brainstorm. Now you can begin to lay out and organize the pieces in your logic model. In our CCC Maker logic model template, we include the following five categories:

- **Resources/Inputs:** Underlying assumptions, baseline information, available resources, needed resources, problem statements
- **Activities:** Actions taken using resources and inputs
- **Outputs:** Products of the activities, metrics, data
- **Outcomes:** Beneficial results within the program
- **Impact:** Positive change to the larger system

When listing resources and inputs, we encourage you to also break out and list what you don’t have. You may consider organizing these into three subcategories: must have, nice to have, and can do without. Another way to organize resources is by what you need, in what sequence, and when.

As well, bear in mind that activities are not an end in themselves. In other words, activities are not outcomes. If you held 15 events but didn’t learn anything from them or actually achieve a goal, these are not outcomes. Rather, documentation of the event or the data and information the event produced would be the outputs that then lead to outcomes.

The four main, broad outcomes the CCC Maker Initiative focuses on are makerspace, curriculum, community of practice, and internships. Logic modeling can help identify which actions simultaneously produce more than one of these outcomes, so those actions can be prioritized.
Finally, impact is, in essence, the largest systemic change that takes place as a result of your actions. Impact is that visionary, inspiring, motivating part that moves people to participate in your project. When organizing, consistently ask, “Is this a means or an end?” Also, identify which of your elements are assumptions or external factors.

Here’s an example based on the Makerspace Startup Process to help you visualize and get started:

An alternate way to approach building out your logic model is by employing backward design, a method used by educators to design learning experiences and curriculum with the intent of achieving specific learning goals. Backward design shifts the focus from the process to the end goal. Proponents of this technique believe the goal shouldn’t be determined by the process, so it’s best to begin with the goal. Start with the intended impact goals and work your way backward.

With logic models, because they’re visual aids, seeing examples is often most useful to help you to envision your own. Following are two distinct examples.
Case Study: Allan Hancock College
Takes Simple Approach

Just because logic models are visual tools doesn’t necessarily mean they have to be highly graphical to be effective. Even just organizing the components in a neat chart, as in this example from Allan Hancock College, is helpful. Note how in this logic model, they opted to create two columns for outcomes: short term and long term. As well, even if you don’t immediately have all the details of, say, the activities you propose, plugging basic variables into the logic model offers a starting point. Remember, logic models are living documents that will evolve with the project.

Case Study: Allan Hancock College
Takes Simple Approach

Allan Hancock College Makerspace Logic Model: January 2017-June 2019

<table>
<thead>
<tr>
<th>Resources/Inputs</th>
<th>Activities</th>
<th>Outputs</th>
<th>Performance Outcomes (Thru June 2017)</th>
<th>Performance Outcomes (Thru June 2019)</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHC faculty</td>
<td>Makerspace activities and advisory board</td>
<td>Makerspace weekend internship plan plan and schedule Makerspace activities</td>
<td>develop plans for Makerspaces at AHC, SMPL and SMVDM discuss Makerspace activities in existing courses</td>
<td>embed Makerspace activities in existing courses create Makerspace credit-bearing courses, digital badges and certificates</td>
<td>establish interdisciplinary culture and foster collaborative curriculum opportunities</td>
</tr>
<tr>
<td>AHC students</td>
<td>Makerspace activities on and off campus</td>
<td>participation in the Makerspace weekend making, networking, work-based learning experiences</td>
<td>experience and engagement in Makerspace activities</td>
<td>obtain 21st century work skills, paid internships, digital badges and certificates</td>
<td>increase graduation rates, employment opportunities and entrepreneurial orientation</td>
</tr>
<tr>
<td>AHC student services</td>
<td>recruitment and orientation of student workers and interns</td>
<td>disseminate and facilitate student Makerspace opportunities</td>
<td>prepare to recruit 25 student workers and interns in 2017-2018</td>
<td>recruit and orient 25 students per year for Makerspace internships</td>
<td>new student employment and entrepreneurial opportunities</td>
</tr>
<tr>
<td>Santa Maria Public Library</td>
<td>Makerspace activities and advisory board</td>
<td>Makerspace weekend plan and schedule Makerspace activities</td>
<td>develop proposal for collaborative Makerspace at SMPL with AHC</td>
<td>expand customer base and broaden demographics through Makerspace activity</td>
<td>expand influence and role in the community</td>
</tr>
<tr>
<td>Santa Maria Valley Discovery Museum</td>
<td>Makerspace activities and advisory board</td>
<td>Makerspace weekend plan and schedule Makerspace activities</td>
<td>develop proposal for collaborative Makerspace at SMVDM with AHC</td>
<td>expand customer base and broaden demographics through Makerspace activity</td>
<td>expand influence and role in the community</td>
</tr>
<tr>
<td>High Schools</td>
<td>Makerspace activities and advisory board</td>
<td>Makerspace activities at school and on Makerspace weekend</td>
<td>increased alignment with the Makerspace movement</td>
<td>paid internships, increased graduation and matriculation rates</td>
<td>greater success in education and employment</td>
</tr>
<tr>
<td>Industry</td>
<td>Makerspace activities and advisory board</td>
<td>volunteer at Makerspace activities</td>
<td>introduced to Makerspace activities</td>
<td>provide paid internships, materials, equipment and other support</td>
<td>access to more qualified employees</td>
</tr>
</tbody>
</table>
Orange Coast College, on the other hand, opted to incorporate color coding and iconography into their logic model to aid in the visual organization. They also addressed all aspects, including assumptions, external factors, and indicators. What's more, they even offered their own definition of a logic model, with respect to their project.

**Case Study: Orange Coast College Takes Comprehensive, Graphical Approach**

- **外部因素 (External Factors)**
  - 什么我们谨慎对待？
    - 我们目前指定的设施设施需要升级（结构上的）
  - 工作室/车间的更新

- **假设 (Assumptions)**
  - 我们必须考虑的是？
    - 我们的项目将与跨学科设计/业务课程和参与者的制作资源的分享。我们有行政管理人员在我们的工作室这里定位在“中等学院”北区技术学院的夏季学期和开放期这间房。我们的新项目将与平衡预算分配/请求和参与者的制作费相似，类似于图书馆。

- **行动计划 (Implementation)**
  - 我们将如何运作？
    - 我们正在参与加利福尼亚州社区学院CCC Maker项目，该新项目将参与和推动区域创新，为教育准备学生，以满足STEM/STEAM职业领域21世纪技能。每个
  - 校区中心/社区顾问，教师和社区成员将能够加入，协作，并在Maker文化中分享，同时促进生产力和创造性的创业精神和专业生活。据我们所在地区的繁荣和创意经济。

### LOGIC MODEL: A Holistic Approach to Planning, Implementation, Evaluation, & Communication

**实施 (Implementation)**
- 我们将如何去做？
  - 我们正在参与加利福尼亚州社区学院CCC Maker项目，该新项目将参与和推动区域创新，为教育准备学生，以满足STEM/STEAM职业领域21世纪技能。每个
  - 校区中心/社区顾问，教师和社区成员将能够加入，协作，并在Maker文化中分享，同时促进生产力和创造性的创业精神和专业生活。据我们所在地区的繁荣和创意经济。

**衡量 (Evaluation)**
- 我们何时到达？
  - 通过分析我们的四个重点区域的成果和影响：

### Focus Areas

**社区 (Community)**
- 社区和自我研究
- 市场与图形

**Makerspace (Makerspace)**
- 设施和设备
- 行动运动

**Curriculum (Curriculum)**
- 从教育/技术教育项目
- 专业领域和学科

**Internships (Internships)**
- 项目和就业中心
- 业务部和俱乐部
- 制作学生和校友

**资源 (Resources)**

**活动 (Activities)**
- 我们将采取什么行动？
  - 制定徽章系统（硬技能/软技能）
  - 鼓励跨学科培训

**输出 (Outputs)**
- 什么是我们产品的结果？
  - 应届毕业生和21世纪技能
  - 共享资源和知识

**成果 (Outcomes)**
- 我们将带来什么好处？
  - 改善中产阶级生活
  - 加强地区创意经济

**影响 (Impact)**
- 什么积极的系统性变化将发生？
  - 扩展到与Strong Workforce合作
  - 与社区和校园的联系

**计划 (Planning)**
- 我们想做什么？
  - 通过分析我们的四个重点区域的成果和影响：

**实施 (Implementation)**
- 我们将如何运作？
  - 我们正在参与加利福尼亚州社区学院CCC Maker项目，该新项目将参与和推动区域创新，为教育准备学生，以满足STEM/STEAM职业领域21世纪技能。每个

**评估 (Evaluation)**
- 我们何时到达？
  - 通过分析我们的四个重点区域的成果和影响：

**信息指标 (Indicators)**
- 我们将如何衡量成功？
  - 我们正在参与加利福尼亚州社区学院CCC Maker项目，该新项目将参与和推动区域创新，为教育准备学生，以满足STEM/STEAM职业领域21世纪技能。每个

### 假设 (Assumptions)
- 我们必须考虑的是？
  - 我们的项目将与跨学科设计/业务课程和参与者的制作资源的分享。我们有行政管理人员在我们的工作室这里定位在“中等学院”北区技术学院的夏季学期和开放期这间房。我们的新项目将与平衡预算分配/请求和参与者的制作费相似，类似于图书馆。

### 外部因素 (External Factors)
- 我们必须谨慎的是？
  - 我们目前指定的设施设施需要升级（结构上的）
  - 工作室/车间的更新

### 指标 (Indicators)
- 我们将如何衡量成功？
  - 通过分析我们的四个重点区域的成果和影响：

Qualities of an Effective Logic Model

As mentioned earlier, each logic model is a unique, living document that can take whatever shape suits the project best. There are some key qualities, though, that run across effective logic models:

- Why: Clarify intentions
- Who: Define responsibility
- What: Identify essential components in the system
- How: Reveal operational needs
- When: Facilitate phasing
We began this guidebook emphasizing the most integral aspect of any makerspace: community. Without the support of a robust community, stemming out from the core team and radiating through all aspects of the home institution and surrounding industries, a makerspace is nothing but a collection of tools, a room of mere potential. Community, and the passionate individuals that comprise it, are what breathe life into a makerspace, transforming potential into promise and affecting change at the highest level.

Who will your makerspace serve? In our Makerspace Startup Process, that answer is always students, first and foremost. We aim to retain their needs as the focus of each step of the process. Through self-study, we explore. Through ecosystem mapping, we identify. Through logic modeling, we refine and plan. And naturally, the next step is to get the community involved, to invite and engage the community to adopt, maximize, and promote the space.

In our process, we have what we call the Curriculum Innovation Project. The idea is to plan, execute, document, share, and evaluate a student activity utilizing maker principles to directly engage stakeholders in the ecosystem. We advised colleges to use this activity to explore a particular issue revealed through their self-study.

Here’s the prompt that participating colleges received from CCC Maker:

*Colleges will adapt an existing project or create a new event to test with their students and share with their maker community. It may involve a public presentation of student work, an interdisciplinary project involving*
community or employers, participation in a competition, or holding a community-based event. This experience will build community and support the ongoing planning and implementation proposal process.

The prompt we provided was intentionally open and flexible, acknowledging the limitless options available and giving a green light to pursue community engagement in whatever way may be most effective for the needs of the unique communities. As well, some colleges we worked with had makerspaces at the time while others did not, so we aimed to provide a broad, equal-opportunity prompt.

In short, there’s no universal “right way” to go about engaging the community, and colleges took a variety of different routes. Outreach can take many forms and may be analog or digital, but ultimately, all roads ideally lead to face-to-face human interaction. Examples speak louder than explanation, so here we present three unique cases.

“The biggest fear that schools have in the beginning is that they think we’re going to silo this space and keep people away or that it’s strictly for STEM or STEAM students. Set the tone right away that this is an inclusive space for everyone, and that includes faculty, staff, students, and the community.”

—Tom Cappelletti, Director of Sacramento City College Makerspace
Case Study: Sacramento City College’s Analog Graphical Approach

One of the simplest and yet most powerful approaches was taken by Sacramento City College. This team opted to create a series of graphical posters to put up all around campus. The main focus of their poster series was to introduce the college community to the concept of a makerspace and to encourage everyone to see themselves as makers. Notably, the series was created by a student, Graphical Communications major Sam Liff, and is a great example of how student input and creativity can be encouraged and included in the planning and execution phases.

The series included a number of styles. For starters, there was a very simple poster that just offered a basic definition of a makerspace in bold text on a white background, with a link to the makerspace’s website:

_Makerspace (noun): A place in which people with shared interests can gather to work on projects while sharing ideas, equipment, and knowledge._

Coming soon to SCC

scc.losrios.edu/maker
Then there were a few styles where the main text was “YOU ARE A MAKER,” capitalized, with the word maker in red. Each had a different stylistic image of a person doing something, including a man playing synthesizers, a woman painting, a gender-neutral person taking a picture, and a man sewing. This series effectively helped the community see that “making” is for everyone, there are many modes of making, and even commonplace, recognizable modes are included.

There was another series that showed various mixed-gender groups of people working on a project together, with bold text that reads, “WE MAKE,” stressing the collaborative nature of making and reinforcing their previously mentioned definition.

Finally, there was a poster that simply read, “SAC CITY MAKES.” These posters were hung all throughout the campus (poster-bombed, as they refer to it) at various kiosks and bulletin boards, clearly conveying what a makerspace is and that everyone is invited to participate.

Then they hosted an open meeting attended by a large number of faculty, effectively leveraging multiple campus communities simultaneously. The posters had reminded the faculty of their interest
followed up by a series of meet-ups (promoted again via posters) centered around a collaborative student build of a giant inflatable brain to be featured at Maker Faire Bay Area. Their first meet-up drew an impressive 30 students and six faculty members from across disciplines. Providing a project to focus on and a deadline to work toward set the scene for collaborative action straight out of the gate.

The posters are freely available for anyone who wants to use them.
Moorpark College’s Pop-Up Makerspaces

Introducing the college community to the concept of makerspaces can seem difficult in the planning phase if there’s no physical location, but Moorpark College addressed this by hosting pop-up makerspaces, using whatever space was available. They drew students in by offering the use of tools they may not regularly have access to, and this proved to be an effective approach. For example, one pop-up makerspace event was held in the Campus Center and centered around the MakerBot Mini 3D printer.

Students were encouraged to bring 3D printer projects to print out, and the pop-up also offered supplemental materials such as LEDs, batteries, construction materials, and hot glue guns, to promote further making opportunities. This particular pop-up, one of many, was open for three days total, during a specified two-hour period each day, with facilitators on hand. The idea is that the tools draw the students in, but the sense of community and collaboration inspires them to get and stay involved.

Validate anything that people want to make, no matter how small. It doesn’t have to be a huge ambitious project. That’s why we have a button machine. They can come in and make a button. And when you see that look on their faces that they’ve made something—even though they cut a picture out of a magazine and stuck it in the button machine—that’s what gets them in and keeps them coming.

—Clare Sadnik, Art Professor and Liaison for Moorpark Makerspace
Case Study:
Sierra College’s Rocklin Mini Maker Faire

Sierra College has a unique model for their makerspaces: instead of building dedicated makerspaces for each of their three campuses (Rocklin, Grass Valley, and Truckee), they’ve made the conscious decision to partner with pre-existing community makerspaces close to each campus: Hacker Lab in Rocklin, Curious Forge in Grass Valley, and Truckee Roundhouse in Truckee.

With local entrepreneurs, businesses, and other community members using the same facilities afforded students, the parameters of the makerspace community broaden, as do the opportunities presented to students and the shape of the outreach efforts. Each campus supports and promotes various makerspace community events—including Boot Camps, Design Challenges, and Mini Maker Faires—that engage students and faculty in the practices of ideation, prototyping, and iteration.

The Rocklin Mini Maker Faire is a prime example. Held annually at the Sierra College Rocklin campus since 2015, the event is co-produced by the City of Rocklin and Sierra College. Maker Faires follow the science-fair model of sharing projects and knowledge, with an emphasis on learning hands-on skills, providing essentially a physical incarnation of the maker spirit.

The 2017 Rocklin Mini Maker Faire drew 8,000 attendees, community members of all stripes, including Sierra College students, staff, and faculty. This showcase, when hosted on the college campus, serves both as an optimal bridge between students and the surrounding communities and a powerful promotional tool for the three partner makerspaces.
There were faculty and student demonstrations from Career Technical Education programs, as well as the college’s three makerspace partners. The Sierra Makerspaces project was also represented by a student-run exhibit that offered simple tools to express creativity through 3D modeling, alongside an “open sewing lab” that encouraged attendees to fabricate useful objects on sewing machines.

Additionally, it provides an excellent platform for students to share projects with and receive feedback from the greater community. The event also featured a student-curated art show featuring local maker works, including a high school student’s remade shoes with laser cut heels and inlaid mermaid art.
All three examples—Sacramento City, Moorpark, and Sierra—show effective methods a college can use to engage the community and promote the makerspace. In each case, there was also accompanying promotion online and through social media platforms, which is expected in today's digital environment.

What outreach methods would work best for your community? How best can you share the excitement and benefit of a makerspace? While these examples worked well for the respective colleges, we encourage you to use them as a springboard to develop your own methods.
Internships

At CCC Maker, our entire mission is intrinsically hinged on preparing students to succeed in the 21st-century job market and workplace. Two of the most crucial elements are partnerships with area businesses and a robust internship program, together effectively bridging the gap between education and employment. Internships are so important that they are one of four key outcomes of the entire CCC Maker project, alongside makerspace, curriculum, and community of practice.

This emphasis is also directly in line with our mission statement:

*The California Community College (CCC) Maker Initiative will build a community of college makerspaces that welcome non-traditional students, support faculty in embedding making into instruction and offering adaptive curriculum, and partner with businesses to produce innovation-ready graduates inspired to contribute to the creative economy.*
The CCC Maker Initiative set out with the goal to place 800 students in internships or work-based learning experiences between July 2017 and May 2019, with a firm belief in the benefits of experiential learning and the power of making industry connections. There’s a wealth of research supporting the virtues of experiential learning, much of it based on American educational theorist David A. Kolb’s experiential learning theory (ELT), summarized in the graphic below.

As part of our Makerspace Startup Process, each participating college was tasked with creating an internship plan “to develop entrepreneurship and soft skills to prepare for and place students in CCC Maker-funded internships.” In this module, we provide you with an overview of considerations and share selected examples. Intentionally, there are a good number of open-ended questions included throughout to guide you in developing a program specifically suited to your institution and ecosystem, as each internship program will be unique depending on the institution, businesses, and students served.
One of the greatest benefits that a makerspace offers to students is the opportunity to learn real world experiences in a community environment. Students from all backgrounds can come to one location to work together as a team to create an idea or thought into something tangible.

—Kimberly Glaster, Sacramento City College Student
Develop a Process

Ensuring successful internships requires strategic planning from beginning to end, starting with the development of an overall process and financing model. Some of the groundwork for this task is laid through the ecosystem mapping exercise and institutional self-study. Identifying key industries and businesses in the local landscape, as well as other partnership opportunities, and considering those in relation to student interest and needs, is a solid place to begin.

Equally as important as identifying potential partners and building working relationships is preparing students with the proper skill sets needed to succeed in their internships. One of the keys to maintaining a positive relationship with employers is making sure students are prepared for their internships.

The basic parts of the process are:

1. Outreach – Employers, students, faculty
2. Selection – Application process, makerspace project
3. Preparation – Soft skills, 21st-century skills, setting expectations
4. Operation – Employers, students, procedures
5. Evaluation – Employer feedback, student reflection

This flowchart gives a broad overview of what a potential process may look like.
**What Are Soft Skills?**

Hard skills are technical skills that are generally measurable based on educational background and work experience. Soft skills, on the other hand, are essentially a collection of personal attributes that facilitate effective interpersonal connections and interactions. Soft skills include empathy, collaboration, ability to communicate, problem-solving, self-awareness, adaptability, and leadership. They can basically be broken down into people skills, social skills, and personal career attributes.

**NWoW’s Top 10 Soft Skills**

In the 21st-century workplace, soft skills are as desirable, if not more so, than hard skills. The two complement one another. With equipment and technology changing so rapidly, it’s often more valuable for an employee to be adaptable and persistent (two soft skills) than adept at a particular hard skill that may be obsolete in a year or two.

The New World of Work (NWoW) initiative, in collaboration the Foundation for California Community Colleges (FCCC), created the “Top 10” 21st Century Skills list, along with corresponding badges, as part of the 21st Century Skills Digital Badging project.

The top 10 soft skills, as defined by NWoW:

1. Adaptability
2. Analysis/solution mindset
3. Collaboration
4. Communication
5. Digital fluency
6. Entrepreneurial mindset
7. Empathy
8. Resilience
9. Self-awareness
10. Social/diversity awareness

“A makerspace can act as a hub where students can grow intellectually by learning different skills and collaborating with other people. Most of these skills are not taught in classrooms, so the makerspace offers a unique dimension to a student’s education.”

—Pouyan Kiani, Sacramento City College Student
NWoW has also developed curriculum tailored to California community colleges and trained at colleges all over the state. The NWoW program, which includes both free and for-pay offerings, is comprised of three key components:

- Curriculum designed to be taught in the classroom
- Work-based learning component
- Credentialing system

These three components have the potential to improve students’ 21st-century skills, which in turn could help educational outcomes, such as college completion and the likelihood of finding and keeping a job with sustainable wages.

Helpful Resource: National nonprofit Jobs for the Future, in collaboration with Harvard Graduate School of Education Initiative, compiled an “Annotated Guide to Employability Skills Curricula and Resources” detailing helpful curricula resources, many of which are freely available, for teaching soft skills.

Ask Preliminary Questions

At the onset of your internship program development, asking the right questions can ensure success throughout the various stages of the program. Involving the voices of many—including your advisory committee, faculty, and students—will empower you to ensure all stakeholder needs are served.

1. *How is your college preparing and onboarding students to the internship process?* Is there a formal process that leads to becoming an intern? Outreach? Meetings? Forms?

2. *How will you recruit from a variety of demographics and disciplines?* How will you reach students who wouldn’t normally take advantage of a program like this?

3. *How are you implementing NWoW 21st-Century Skills training to increase success for employers and students?* Will the training be embedded in curriculum such as makerspace courses? Will it be relayed in dedicated workshops such as the ones offered by NWoW?

4. *Which badges are you developing to communicate student preparedness to employers?* How will the badges be implemented? How will they be explained and shared with employers?

5. *How will you evaluate career readiness and makerspace effectiveness using the employer’s evaluation process?* Will there be an exit interview for the internship program? Did students have adequate soft skills? Were they prepared professionally to interface with employers?
Training sessions come in all shapes and sizes. Here Dominic Gutierrez, Project Director of Sierra Makerspaces shares details of one of their action-packed intern training days.

Today we had our first intern training with a cohort of nine Sierra Students from our Nevada County Campus. The day started with a hands-on workshop covering three different New World of Work (NWoW) modules delivered by Aleda Vaughn, Sierra College welding faculty and NWoW facilitator. The modules covered were Communication, Analysis/Solution Mindset, and Entrepreneurial Mindset.

After completing the NWoW modules, students registered on LaunchPath so that they could receive digital badges. All of the students were also registered on Career Catalyst so that we can begin to place them in internships.

We finished the day off with a workshop on resumes, portfolios, and LinkedIn facilitated by Janna Evans, who is a Reentry Transition Specialist for the Contra Costa County Office of Education.

In a later post, Gutierrez shares:

Sierra Makerspaces held our second internship training at Hacker Lab Powered by Sierra College. Twenty-five students attended the trainings, which consisted of three New World of Work modules; a resume, LinkedIn, and portfolio workshop; on-boarding into the career catalyst system; introduction to CorelDraw for laser; safety and basic use of our Universal Laser System; introduction to Cura; and safety and basic use of the Ultimaker 2+ and 3.

In order to elevate the LinkedIn profiles of our interns, we worked with our photography department and Professor Kirkman Amyx to ensure that every student has a professional headshot. This provided a great opportunity for Kirkman’s students to practice the skills he’s been teaching them all semester. We’re now working on placing each student in a relevant internship.
The Basics of Badges

In a nutshell, digital badges are the most effective way to communicate a broad range of skill sets to potential employers and internships. Just as physical badges, such as the classic ones sewn onto Boy Scout and Girl Scout uniforms, have traditionally been used to provide an at-a-glance overview of skills attained through training, digital badges serve the same function in the 21st century. Their digital nature makes them easy to share on a variety of online platforms and portfolios.

The Mozilla Foundation’s Open Badges have been working to set the standard since 2012, and it’s a great place to start, whether you choose to employ their badges or use them as a springboard to develop your own customs. Their graphic denotes the basic badge ecosystem:

![Diagram of badge ecosystem](image)

Eric Ullrich, co-founder of Hacker Lab and the Digital Badges Service Provider for CCC Maker, presents a helpful overview of badges in his webinar “Getting Started with Digital Badges.” Badges may be earned, for example, for completing a course, taking a test, creating a portfolio, presenting at an event, or joining a club, as well as for soft skills gained, as shown in the sample NWoW badges below. The possibilities are really endless.

![Sample NWoW badges](image)
Sacramento City College (SCC) has developed a robust approach to badging for students. Here, SCC makerspace student lead Michelle Zamora shares insight into their system.

We met with SCC administrators and instructors to see how we can incorporate and accredit a badging system throughout the entire campus. We landed on having “houses” such as Makerspace House or SESI (STEM Equity and Success Initiative) House. Within each house there would be specific badges that can be earned. For example: Within Makerspace House, a student can earn a badge in 3D printing. Each badge is tiered—having a beginner, intermediate, or advanced level. Once the student has earned enough advanced level badges, he or she can apply for an internship.

We will be using Badgr, a free and open-source achievement recognition and tracking system used to issue, organize, and share Open Badges. We are also able to link Badgr with Canvas, so students can store and share their badges on platforms like LinkedIn or Portfolium.

We are currently defining the badges for Makerspace House, including but not limited to: Safety, Laser Cutter, 3D Printer, Design Thinking, CNC, Router, GCOM Digital Suite, EDT (CAD, CAM), Power Tools, Saw Stop, Vinyl Printer, and Soft Skills Course. Makerspace staff will then design the graphics for all badges, ensuring they represent a consistent brand across campus.

Case Study: Badges at Sacramento City College

*Sacramento City College (SCC) has developed a robust approach to badging for students. Here, SCC makerspace student lead Michelle Zamora shares insight into their system.*

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Forging healthy partnerships with area employers, like any relationship, takes time, collaboration, and mutual respect. Successful internship programs are built on a foundation of clear communication, assessing needs, and managing expectations early on and continuously. Notably, having an intermediary to serve as the employer of record is often an important factor for small businesses. For example, the FCCC’s Career Catalyst program offers services for organizations who are seeking to offer paid work experience.

Here are three key ways to foster a long-lasting partnership:

1. **Reach out with a broad-enough strategy** so that the employer decides which work-based learning activity they want to engage in. Some may just want to do visits while others may want to take on full-fledged internships. Remember that building relationships with employers is a developmental skill. It’s important to present a variety of options so that they can engage at the level they feel most comfortable and equipped to handle.

2. **Collaborate on requirements/skill sets, internship outcomes, and timelines.** By working together, needs are heard and expectations are managed. The employer gets a qualified student, and you develop the right training to get them there. Note: Be sure to always emphasize that the internship is, by legal definition, a learning opportunity for the student, not just free labor for the employer.

3. **Filter students who you know won’t fulfill the requirements** and plan a program to increase their selection success for the next round of internships. If you feel students aren’t ready, help them get to a place where they can reapply for the next round, rather than jeopardizing the relationship with the employer and setting the student up to fail. Plan a methodology that includes a scaffolded learning process and a test for career readiness.

Use a continuous improvement model where feedback and information on why certain students aren’t ready can be used to improve the system. Look at it through the design thinking approach: What are the issues? Gain insights and use them to strengthen the process.
Situated in Costa Mesa, 40 miles south of Los Angeles in the heart of Orange County, Orange Coast College (OCC) is surrounded by much of the action sports (e.g. surfing, skateboarding, snowboarding) and autonomous vehicles industries that defines the region. Professor Steve Fuchs explains how they capitalize on that proximity to form intersections for internships.

In the spirit of sharing regional expertise, the City of Costa Mesa and our surrounding cities are known as a hotbed of innovation and world leader in the design and manufacturing of action sports equipment and lifestyle. From local makers to large employers, Orange Coast College is actively engaging with our creative economy. Led by Tim Peters, Professor of Fine Woodworking, and Professor Fuchs, we are currently developing curriculum and facilities to enable programs to teach the fundamentals of designing, engineering, and making performance objects, such as skateboards, skimboards, handplanes, surfboards, standup paddleboards, and small boats. OCC is also exploring the development of non-credit workshops, a skill-based badging system, additional for-credit certificates, and a 2-year multidisciplinary degree in Applied Design (with a possible 4-year option).

Along with the design and engineering of performance objects, Orange Coast College was recently funded to be a regional lead in the design and development of autonomous systems to control drones and robots in the air, land, sea, and space. Lead by Dr. Stanley Harriman, Professor of Aviation Science, and Rodney Foster, Professor of Aviation Maintenance, we have partnered with Base 11, a non-profit STEM-based local workforce and entrepreneurship development company, and Dassault Systems, an industry leader in advanced 3D design and product lifecycle management, to aid in revitalizing our region’s tech and aerospace sectors. By integrating applied design and engineering into our current Technology Division and campus offerings, OCC hopes to expand our regional support of students and employers in these specific regional industries and within our already vibrant, creative and entrepreneurial economy.
In a makerspace community, members teach each other and collaborate on projects. Students may teach faculty and business owners skills, and they, in turn, may mentor students. There is a natural comradery when people are working in a shared work space.

—Dominic Gutierrez, Director, Sierra Makerspaces

Internship Success Factors

Though each internship program is unique, collaboration, communication, education, preparedness, and incorporating feedback into future iterations are the cornerstones of successful programs. Below is an overview of what a program workflow may look like.

1. How are you supporting students as they fulfill the required hours or badges before application to an internship? Have you considered using advanced students in your program to assist or develop NWoW workshops?

2. Are you partnering with a career center or business intermediary to help prepare students to apply? Who is your ally in helping to prepare the students?

3. Are you cultivating relationships with employers for awareness and exploration before internship? How are you assessing need and setting expectations?

4. How are the evaluations of employers and students helping improve your program review? Are you using gleaned insights to improve the process and better serve students and facilitators?

What does your successful internship program look like?
More Than Just Physical Space

Makerspace Design Considerations

When you think of designing a physical space, it’s only natural that the first thing that comes to mind is how physical objects will be arranged within the constraints of the physical space. But before you start deciding which tools go where, let’s take a step back and again consider the space beyond the obvious physicality of it. After all, this isn’t just any space we’re designing, it’s a makerspace, the heart and soul of which is the community it serves.

If we’re to approach makerspace design through the same design thinking lens we’ve applied to the other steps of the planning process, we first empathize, then we define, ideate, prototype, and test, only to empathize once more. Empathizing with the end user means considering all aspects of the makerspace (inside, outside, online) from the perspectives of not only the people who are most likely to use it, but also the people who you’d like to invite and encourage. Inclusive makerspaces mindfully welcome all students and faculty (and sometimes even greater community), democratizing learning by ensuring equal access.

At the onset, flexibility is key, and the most important operating system is a culture of inclusivity. Planning the layout of the physical makerspace, like all other aspects, should be a collaborative effort with input from the community. Ideally, as the community invests time and gains a sense of ownership about the space, they’ll help further shape and refine it. When you’re first preparing to set up the space, be sure to allow room in the design for it to develop organically as a reflection of the community.
In this section, we won’t be discussing the number of power outlets needed for each piece of machinery, what the ideal arsenal of tools is, how to consider ventilation, or what raw materials should be available in your space. There are plenty of other readily available publications that have addressed these topics and more. From our perspective, there is no one standard set of tools or way to organize a makerspace that works for everyone. What we aim to do here is touch on a number of important considerations as you begin planning the design of your space.

Before You Buy Any Tools

1. Go to other makerspaces. Take field trips to other makerspaces in your area (and beyond if you can). Note how the design of the space makes you feel, from outside the space approaching the door to inside walking around. How is the space being used? What strikes you as particularly inviting? What did you like? What would you do differently?

2. Talk to other makerspace folks. Before taking your field trip, get in touch with the people who run the space and see if you can have a few minutes of their time. Reach out to other makerspace organizers and managers outside of your immediate area. Makerspace folks are generally empathetic and generous with their knowledge. After all, knowledge-sharing is an integral part of the maker ethos. Getting in touch in advance is recommended since makerspace organizers are also generally really busy, as you can now attest.

3. Survey your makerspace community. What kinds of tools are they most interested in having access to? How would they like to see the space used? What would make them feel invited? What would get them through the door? What would make them want to stay? Be sure to cast a wide net to all corners of the community, including local employers and industry. Why guess what they need and want when you can ask?

4. Assess what you have and prioritize what you need. What kinds of space do you have available to you? Any tools and materials? Then, based on your findings in the three previous steps above, start making a list of things your makerspace needs. Does your tools list serve constituents in a balanced way, representing the gender, age, and other needs of your diverse community? Divide the list into three: must-have, helpful to have, and wish list.
Create a Culture of Inclusivity

The planning phase, before the doors have even been opened, is a perfect time to begin cultivating a culture of inclusivity. This is an ongoing effort that needs to be reinforced and nurtured indefinitely. Consider reaching out to a variety of student clubs or organizations to invite them to offer their perspectives and input. If you do have a space already, even if it's not fully set up, you may invite clubs to host their meetings there to familiarize themselves with the location and feel included in the development process.

In designing the space, be sure to consider the needs of community members with disabilities. Is your space set up in a way that grants them access and mobility? Can folks move around the space in a wheelchair or walker? Can tools be reached from a seated position? Is there clear signage? The DO-IT (Disabilities, Opportunities, Internetworking, and Technology) Center, a government organization dedicated to empowering people with disabilities through technology and education, offers a great set of guidelines for accessibility and universal design specifically for makerspaces.

As well, does your community include a population that may have limited English-language proficiency? How do you make sure they also feel invited? Signage is an obvious way, but you may also consider including programming that celebrates all cultures and ethnicities and highlights the traditional modes of making within each. Indeed, we are all makers.
A common issue within many an existing makerspace is gender imbalance. Often, women are outnumbered among makerspace members and may not feel as comfortable in the space. Be sure that you consider the input of all genders as you plan the layout of your space, as well as the programming available. You may consider hosting programs specifically geared toward women (e.g., an all-female welding workshop) to encourage feeling comfortable in the space.

Further, beyond the physical space, show women making in your marketing materials and on your website. Recruit female instructors as role models. Coach instructors to be encouraging and create an environment where community members feel free to ask questions and get advice. The California Community College Special Populations Initiative has a dedicated guide on the topic.
Consider details like the color of the walls and the furniture. Color is a powerful tool that can either make the space feel cold and industrial or warm and welcoming. Little maker-made touches around the space can help it seem less institutional and more like home, a place to learn and grow, a place where students would want to invest time and effort.

As much as a makerspace should be fluid and allowed to organically grow, establishing a clearly stated no-tolerance policy against discrimination and harassment from the get-go establishes the important ethos that “All Are Welcome Here.”
Case Study: Folsom Lake College’s Invitations

“The wider you can throw the door open and the softer you can make the space up front, so that people don’t bounce off, they can find themselves going deeper and deeper in the space and taking ownership,” advises Folsom Lake College’s Zack Dowell. To that end, the front of their makerspace is a casual gaming area that draws in many new members. The familiarity and appeal of gaming draws students into the space, helping them feel like they belong, that this is their space, too. Once inside, they can begin to explore all the other modes of making available to them.

The makerspace has also set up a freely available studio space for music production, which includes an audio booth, outboard gear, and a high-end subwoofer. This area has become a locus for male African-American students, who have been deputized to be responsible for the space. Not only has this led to entrepreneurship opportunities for these students, but the makerspace now has an in-house band for events.
Design a Multi-Purpose Space

Will community members be using the space to design or fabricate or a bit of both? What types of projects are going to be made here? How many people does the space need to accommodate at any given time? These questions may seem daunting when you’re first starting out, and you may never have definitive answers, even as time goes on, because of the fluid nature of makerspaces.

Pace yourself and don’t be afraid to start small. You don’t have to try to do everything at once. In fact, we’d advise against being in a hurry. You may opt to knock down that wall at the get-go but realize six months later that you wish you’d kept it, as it would’ve been perfect for how the space ended up getting used.

The best approach is to design the space to be as modular and multipurpose as possible. For example, putting locking wheels on benches and tables allows them to be moved about easily. Choose tables that can be used individually or grouped together to accommodate a larger group of people working collaboratively. Create partition walls that can be popped up to subdivide the room and can fold to be stored.

“Our 2D room will house most of our digital art machinery. We are also bringing in a hydroponics station, podcasting equipment, and bean bags—lots and lots of bean bags. As a collaborative work environment, all benches and work stations are moveable, either on wheels or sliders, to accommodate group meetings or spaces that require a lot of surface area.”

— Michelle Zamora, Makerspace Creative Director and Former Student, Sacramento City College

Consider the dichotomy of spaces that can coexist harmoniously with the right layout. Not only are there “messy” modes of making, like woodworking, that create a good amount of project debris, there are, conversely, “clean” modes, such as digital design. Computers and sawdust don’t mix. Likewise, there are loud and quiet modes of making. How can your layout accommodate all?
Bear in mind that the way the space is set up, if it’s rigid, may end up dictating what types of interactions the space can support. For instance, an open setup with workbenches that are not too far away from one another may encourage cross-pollination of ideas and collaboration, just as the opposite may be true. Do your best to provide a malleable pallet where creativity can flourish.

“It’s crucially important to consider project space. In space-constrained environments, big gear takes up a lot of space. Where are people going to actually assemble the seven parts they cut on the jigsaw? Having configurable working space is crucially important. Look at devoting much more floor plan to people sitting around and cutting and gluing.”

—Zachary Dowell, Instructional Design and Development Coordinator, Folsom Lake College

Celebrate Limitations and Failures

Maybe you don’t have the budget for a 10,000-square-foot workshop or shiny rows of 3D printers or a much-coveted CNC mill. Don’t let that stop you. Remember, you are also makers, making a makerspace. Approach the space with the maker mindset, and anything is possible. Don’t have the budget to buy expensive workbenches? Look for sources of salvaged materials and assemble a crew to make them yourselves. Celebrate limitations as invitations to innovate.

In doing so, you won’t only demonstrate that the maker ethos is alive and well in the space, you’ll also invite others to do the same. When things are too perfect and sterile, there’s no room for experimentation, play, iteration, and failure. Strive to create an environment that celebrates trying, failing, and trying again. After all, these are potent ways to learn.
The Role of Those Who Kick-Start Change

Facilitators

Change-maker, facilitator, agent of change, catalyst: Whatever verbiage you use to identify the movers and shakers, those who are bold and charge ahead (often despite the odds), no makerspace would be possible without at least one, if not an entire team of them. We’re talking about you, if you’re considering accepting the challenge of embarking on the journey to creating a makerspace. This module is an honest pep talk from folks who’ve been there and have helped others get there.

If there’s an overarching quote we can kick off with, it’s one well-known in maker circles, by Zen Buddhist monk Shunryu Suzuki: “In the beginner’s mind there are many possibilities, but in the expert’s, there are few.” Be bold, be empathetic, but always strive to retain a beginner’s mind throughout the process. Beginner’s mind is the key to original solutions.

Up until now, reading through the pages of this guidebook, you may be under the impression that the process from zero to makerspace, albeit the result of a great deal of work, has the potential to be neat, organized, and systematic. Not really. While it certainly does entail a lot work and dedication, it’s also often messy. Know that wherever there are a variety of people and systems at play, it’s bound to get messy.

Throughout our CCC Makerspace Startup Process, our technical assistance providers (TAP) were Deborah Bird and Salomon Davila. Both came to CCC Maker armed with wisdom gleaned from having gone through the process of kick-starting a makerspace at their own home institution of Pasadena City College, as well as a wealth of other relevant
knowledge. They guided our participating CCC Maker colleges through all the processes you’ve read about in this guidebook, and they offer their sage advice in this module.

To lead the charge, to be at the helm, steering the ship through uncertain and sometimes choppy waters, is the toughest (and perhaps most rewarding) job. Simply put, it takes guts. It’s not for the faint of heart. After all, the change that the change-maker is kick-starting is so much more than four walls filled with tools. Especially in an educational setting, it has the potential to get political really fast.

“**The more you understand the implications of the Maker Movement in education, the more threatening it becomes to a lot of people. When they just think of it as toys in a room, it doesn’t bother them so much. But when they start to realize that it’s student-directed learning, that it empowers students, that it demands that curriculum be updated, and that it requires flexibility, that’s when it starts to freak people out a little bit.**”

—Deborah Bird, Technical Assistance Provider, CCC Maker

### Assemble a Core Team

At the onset of the CCC Makerspace Startup Process, some college teams were hung up on preconceived ideas, others thought they could simply buy a makerspace in a box, and some had no idea where to even start. One of the most important steps for them all was to establish a point person or pair of point people and to develop a core team around them. Most often, there’s a single, enthusiastic faculty member ready and willing to organize the troops. Sometimes there are two people with different, complementary skill sets, who both have an understanding of their strengths and specific roles. This type of partnership can also be powerful.

Bear in mind when assembling a core team that because the process is intensive, it may not be easy to find people who are willing to put in the amount of work necessary, and you may be working with varying levels of commitment. Look within your ecosystem for the early adopters, natural innovators, and like minds. Be sure to cast the net in all departments and divisions.

If you know of folks who could be a good fit but need a little nudge, organizing visits to other makerspaces is a great place to start. Walking into an active makerspace can be eye-opening and inspiring, especially if you’ve never experienced one before.
Another idea is to encourage a trip to a local Maker Faire, which does wonders for making visible the power and potential of the Maker Movement. Sierra College did just that with their faculty members. Now Sierra College is a partner in producing the Rocklin Mini Maker Faire, which attracted 8,000 attendees in 2017.

“The Maker Faire brings people together in real time and space to validate interest, skill, and passion for the Maker Movement. Faculty and students attending a Maker Faire can see that they’re part of the whole, and that their academic makerspace can address community needs and serve generations of learners in new ways. Maker Faire gives faculty and students confidence to continue their work, knowing that there’s a national and international community behind them.”

— Sierra College’s Carol Pepper-Kittredge, Statewide Project Director, CCC Maker
When assembling a team, strive to include:

- Members from all echelons of the system within which you’re operating
- Students—and bring them in as equals
- Interdisciplinary faculty, to ensure broad reach
- Administrative and facilities folks
- The arts, which are integral

Simply put, if the makerspace initiative is coming from the administration with no faculty buy-in, it won’t work. If the initiative begins with faculty members, there needs to be an administrator on board and then students must be quickly involved. The purpose of the educational makerspace is to serve, prepare, and inspire students, so it’s essential to invite and engage students from the beginning, during the planning stage.

On the topic of creating an interdisciplinary team, broaden your ideas of which departments may be able to lend a hand. For example, Sacramento City College Makerspace’s Tom Cappelletti unexpectedly found support in the Athletics and Theater departments. The wrestling coach had come into their makerspace looking for a way to build wooden stands to use on the sidelines of games for their concessions. The Athletics department is well versed in dealing with funds, how to handle money on campus, and a myriad of administrative tasks. The makerspace was able to help out with the build, and the coach shared invaluable insight into college systems of funding. As well, the Theater department shared knowledge on dealing with ordering materials and supplies, as well as shop safety procedures.

And finally, it may go without saying, but employ basic organizational theory, information on which is abundant on the web. There are essential frameworks that apply to how any organization operates, no matter how small or large. For instance, all are based on a division of labor, decision-making structure, and rules and policies. Of the team you gather, it’s helpful to bring in folks who understand leadership.
Establish a Timeframe and Structure

We purposely set up our CCC Maker Startup Process to feel like a professional development course. It ran over the length of a semester; there were 34 colleges involved (similar to the number of students in an average class); there were regular milestones (assignments), meet-ups, and communication; and the work culminated in a final gathering and a unique proposal. In other words, it used a familiar structure to explore new territory. In general, we suggest facilitators think about this work within a timeframe and structure (preferably something familiar) right from the get-go.

Qualities of an Effective Change-Maker

While the qualities of effective change-makers and facilitators are as wonderfully varied as the humans themselves, there are a number of qualities we’ve identified as being useful and productive across the board.

- Be bold but empathetic.
- Retain beginner’s mind.
- Know and understand your role.
- Be prepared to fail and embrace it as a way of learning.
- Realize that the implications of makerspace innovation can be scary to some.
- Be prepared to jump in and say what you know to be true.
- Be relentlessly positive and encouraging.
- Embrace the benefits of starting small.
- Know that there is no right answer.
- Embrace experimentation and taking risks.
- Allow people to feel comfortable making mistakes in front of you.
- Avoid being critical or all-knowing.
- Avoid being identified as “the other.” Focus on commonalities.
- Develop a vision everyone can rally around.
- Be student-centric.
Again, there are countless actions a change-maker can take to help the immediate team and broader mission. Here are a few we’ve identified.

- Make the process fun.
- Model the maker experience: work in teams, prototype, iterate.
- Focus on and develop empathy for the needs of all students.
- Reinforce the idea that we’re all lifelong learners.
- Bring in the influencers and unifiers.
- Anticipate objections and naysayers and recognize objections as fear of change.
- Draw on positive participants to offset naysayers.
- Meet the teams where they are, and don’t assume experience or knowledge.
- Employ the design thinking lens to define and solve the right problem.
- Include students in the process and empower them to do outreach.
- Try to never stop the conversation. Guide it gently and focus on the positive.
- Identify external ecosystem members and build relationships with them.
Find a Cohort, Evaluator, or Coach

Of note, the college teams that went through our Makerspace Startup Process had the advantage of access to the cohort of colleges in the program and the TAP (technical assistance provider). Having this readily accessible support and sounding board was so important, and we recognize that folks reading this guide may not have similar access. As well, gaining perspective through an independent source, such as an evaluator or a coach, who works one-on-one with the team, is invaluable. We highly recommend identifying and engaging similar support.

An evaluator is an independent person who gathers information (qualitative and quantitative) about the project, in collaboration with the project team, then analyzes and measures the success of the project from an objective perspective. Admittedly, this doesn’t always seem valuable because they’re often telling you what you already know, but sometimes it can be extremely useful because they offer a different point of view, they have research skills, and their independence allows them to collect honest feedback through interviews and focus groups.

A coach is also independent but is more focused on leadership issues, goal setting, forward thinking, and prioritizing. Like the evaluator, the coach is an independent specialist, but the evaluator tends to look backward at what has been done, while the coach looks forward to helping the project reach a successful conclusion.

An alternative is to seek out a makerspace mentor, someone who has already gone through the process. Though folks who run makerspaces are generally pretty busy, they’re also dedicated to the open source ethos of the Maker Movement and are willing to share insight.

You can also connect with communities of like-minded educators online through the websites and social media pages of Maker Ed, CCC Maker, and other makerspaces, or by following hashtags such as #makerspaces, #makered, or #making on social media.

“Those of us who are driving the spaces from the administrative and faculty sides really need to, with intentionality, think about the culture: everything from how the space is set up to how the messaging looks to how the programming looks to the feelings of empowerment we give to the students.

—Tom Cappelletti, Project Director, SCC Makerspace”
Why Bother?

With all the hardships and pitfalls, why would anyone accept the challenge of creating a makerspace? To transform the lives of students, and by proxy, that of our society and economy. This is no small feat, but certainly one that has reverberations for generations to come.

In one college’s case, they were looking at their own system and realizing it wasn’t doing what it purported to do for students. Their makerspace was ultimately the manifestation of the design thinking process they employed to approach the problems they identified. Students were underprepared in academics, unaware of career options, and not privy to the changing landscape of careers. The makerspace ended up being the solution that solved a lot of these problems.

For example, to give instructors more time to teach higher-level thinking, general-purpose technologies, such as basic CAD programs, could be taught in workshops at the makerspace. Plus, learning the basics in a hands-on environment sets the stage for active, engaged learning as opposed to passive consumption of information. The makerspace enables class time with the instructor to thus be maximized, and students benefit, which is the ultimate goal. As SCC Makerspace’s Tom Cappelletti notes, “I never lose sight of the fact that I’m here for the students.”
Welcome! The journey has actually just begun—both your team’s own journey to realizing a makerspace community and the broader journey of makerspace evolution as a whole. Just as the design thinking process we’ve used all along the way is perpetual and recursive, we conclude by inviting you to get started. The CCC Maker team went into the Makerspace Startup Process knowing we would glean as much, if not more, than we imparted. In the open-source spirit of the Maker Movement, we hope to have effectively shared what we’ve learned so far, here on the pages of this guide.

This is a living conversation. It didn’t originate here, and it will certainly continue far past this guide. Our hope is that you’ll add your own voice, experience, and findings. After all, as our mission notes, “We’re All in This Together.” Beyond your immediate makerspace community, there’s an ever-expanding community of makerspaces across the globe, supporting, informing, growing, and encouraging one another.

Even though each of the colleges we worked with during the Makerspace Startup Process is distinctly unique, the common denominator across them—and indeed across all successful makerspaces—is a rich, vibrant, and engaged makerspace community. If there’s one thing we hope to have imparted in this guide, it’s that nothing is more important than fostering, nurturing, and growing this community. As CCC Maker Project Manager Carol Pepper-Kittredge puts it, “If we did this initiative and everyone just ended up with a room full of tools, we would’ve failed. We came out really strongly and purposefully saying that this is about community, not about tools.”
It’s not by accident that “unity” comprises half of the word “community.” Powerful things happen when like-minded people come together under a common goal. When we harness this energy toward supporting hands-on learning, the benefits are far-reaching in our society and economy. With every makerspace community formed and every makerspace forged, we take one step closer to improving lives and career prospects, as well as closing the foreboding skills gap.

On these pages, we’ve offered you a framework to identify the needs of your community, map out your extended support ecosystems, analyze your findings, pilot student and faculty engagement, and from there develop a robust plan with which to move forth. How you approach each step of the way is up to you, but remember, you’re not alone.

**CCC Maker Outcomes Thus Far**

To recap, the CCC Maker initiative is a three-year statewide action strategy to prepare students for the innovation economy through the integration of makerspaces into academic environments. In the first year of the project (2016-2017), 34 colleges received $1.4 million in startup funding and customized technical assistance to develop implementation plans. Through competitive review and a detailed scoring rubric, 24 colleges were selected for continued funding on a tiered-basis.

We’re proud to report our project outcomes during the first year of implementation (2017-2018), in the table below, both cumulative and broken down into each quarter of the project thus far. You can read the full details in our latest 2018 ISAM paper (check cccmaker.com for link).
In due time, we’ll undoubtedly begin to see the positive effects of this network of community college makerspaces ripple out through individual student career paths to the economy of the state of California and beyond.

Maker Value Statements

Through the work we’ve done so far, we’ve also identified a set of five overarching value statements to guide the makerspace network as it emerges and grows. Through the CCC Maker Initiative, and the creation of a network of California Community College makerspaces, we aim to:

1. Create a culture that evolves by embracing risk and failure, open source, and reinvention.

2. Build connections within and beyond the CCC Maker network to accelerate the adoption of makerspace culture and educational integration.

3. Tell our story to share knowledge and inspire innovation.

4. Improve makerspace access for underserved and underrepresented populations to empower all students to achieve educational, career, and entrepreneurial goals.

5. Redefine what it means to be “well educated.”
Maslow’s Hierarchy of Needs Hack

One new gem we recently created and want to share is our hack of Maslow’s hierarchy of needs, as reimagined through the lenses of maker, community, makerspace, and curriculum. The original Maslow’s hierarchy, for those who aren’t familiar with it, is a popular theory in psychology proposed by Abraham Maslow in 1943. The hierarchy posits that there are five distinct levels of basic human needs, or motivators, that must be satisfied in sequential order, starting from the bottom up: psychological, safety, belongingness and love, esteem, and self-actualization. We hope that this perspective can help contextualize and focus your efforts on the inherent needs of the people involved in and affected by the makerspace.

Maslow’s Hierarchy Hack

<table>
<thead>
<tr>
<th>Self Transcendence</th>
<th>Giving back to community</th>
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<tbody>
<tr>
<td>Maker: Transformational Leadership, Mentorship, Advocacy, Empowerment</td>
<td></td>
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<tr>
<td>Community: Social Justice Alliances, Generational Skills and Cultural Transmission, Scholarships + Internship Funding</td>
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<tr>
<td>Makerspace: Regional and Statewide Network, Association Memberships, Conference Presentations, Publications</td>
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<tr>
<td>Curriculum: Advisory and Student Driven, Ongoing Project Commitments, New Technologies + Research</td>
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<tr>
<th>Self Actualization</th>
<th>Achieving Personal Goals</th>
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<tbody>
<tr>
<td>Maker: Self Agency, Entrepreneurship, Internship completion, Employment, Continuing Education</td>
<td></td>
</tr>
<tr>
<td>Community: Sustainable, Employer and Community Partnerships, K-12 + 4 Year Partnerships</td>
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<tr>
<td>Makerspace: Maker in Residence, Digital Badging, In house Team Internships</td>
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<tr>
<td>Curriculum: Real World Problems, Micro-enterprise, Ethics, Authentic Assessment, Portfolio</td>
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<tr>
<th>Esteem, Self Respect</th>
<th>Mutual Respect, Intellectual and Aesthetic Appreciation</th>
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<tbody>
<tr>
<td>Maker: Growth Mindset, Experimentation, Internship Onboarding, Up-skilling</td>
<td></td>
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<tr>
<td>Community: Collaboration, Teams, Shared Experience, Ecosystem Mapping, Employer Outreach</td>
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<tr>
<td>Makerspace: Branding + Messaging, Website, Workplace, Social Media, Community Events</td>
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<tr>
<td>Curriculum: Interdisciplinary, Project Based, Design Thinking, Learning Made Visible</td>
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<tr>
<th>Belonging/Love</th>
<th>Membership in a Community</th>
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<tr>
<td>Maker: Standards of Conduct, Situational Awareness, Trust, Resilience to Risk + Failure</td>
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<tr>
<td>Community: Group Identity, Diversity, Inclusion, Onboarding, Guided Support, Outreach</td>
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<tr>
<td>Makerspace: Welcoming Entrance, Membership System (badges), Shared Project Space</td>
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<tr>
<td>Curriculum: Career Exploration, Collaboration + Communication Skills</td>
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<tr>
<th>Safety</th>
<th>Personal Physical Security</th>
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<tbody>
<tr>
<td>Maker: Equipment Training, Protective Apparel, Emergency Contact, Secure Storage</td>
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<tr>
<td>Curriculum: Orientation, Basic Operating Skills, Safety Training</td>
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<tr>
<th>Physiological</th>
<th>Air, Water, Food, Shelter</th>
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<tr>
<td>Maker: Hydration, Food, Clothing</td>
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<tr>
<td>Makerspace: Ventilation, Lighting, Restrooms, Kitchen</td>
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Guiding Questions for Implementation Plan

Last but not least, we want to leave you with an action item. Below is the set of questions posed to the 24 colleges who completed the Makerspace Startup Process. May they serve as a springboard to help guide you to taking the first step.

• What is the overarching problem that your institution seeks to solve?
• How did your institutional self-study inform your understanding of the problem in the context of student experience?
• How well-prepared is your college to solve this problem in terms of the specific resources, programs, and experience needed to drive the success of this project?
• Given the current extent of your ecosystem (as revealed by your Kumu mapping), what strengths, weaknesses, challenges, and opportunities could be addressed?
• If you were funded today, how prepared are you for immediate implementation of this plan? What barriers exist that would delay implementation?
• How did your thinking about the project evolve as your team worked through the start-up process? How did the process inform your approach to the plan?
• What is your overall strategy to create an inclusive, student-oriented makerspace culture that supports internships and is aligned with the key CCC Maker Project outcomes?
• What’s your strategy to embed making into the student learning experience through innovative curriculum?
• What’s your strategy to develop, strengthen, and grow your maker-based community of practice within your regional educational institutions, the CCC Maker state-wide community of practice, industry partners, community, and students?
• What’s your strategy to develop a work-based learning system through your makerspace that leads to 50 internships over 2 years and 1:3 funding match?
• What is your strategy to create, develop, or expand a makerspace for your college?
• How will you measure and report the outcomes of your implementation plan and utilize feedback to improve your outcomes?
• How will you leverage other funding resources to achieve project outcomes?
• How will your college sustain the makerspace and related programs and activities?
• How will you measure the long-term success of your project over a 5-year period?

Add your voice to the conversation. Connect with CCC Maker online.

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