The Think[box] 1.0 Playbook
The History and Lessons Learned at Case Western Reserve University

A shower meter that feeds information to your smartphone.
A fuel-cell-powered bicycle.
A reusable rocket that carries payloads to the upper atmosphere for research.

All of these and more were invented by Case Western Reserve University undergraduate students within a period of six months. Ideas were generated. Prototypes were made, tested, and remade. Larger production runs were handled. Business advice was doled out. Companies were incorporated. Startups were born.

Students accomplished all this without setting foot off campus, by leveraging the university's carefully constructed and supported culture of making. By giving students access to top-of-the-line industry-quality rapid prototyping equipment, training on that equipment, access to faculty and staff to help them refine their ideas, and business and legal advice to turn inventions into market-ready innovations, students have been retooled as entrepreneurs.

All of these projects have been done not for class credit, but out of an untapped passion within the students to put their personal ideas out into the universe and see how far they can take them when they face no hurdles.

And all this has happened via a pilot project called think[box] 1.0.

<u>Think[box] Today</u>
Think[box] 1.0 is a maker-centric lab that occupies 4,500 square feet on our main campus. It is open to the entire student body as well as the community to collaborate, create, innovate, tinker, and make. There are spaces in the facility for ideation and team building—groups can use "play doh", straws, and toothpicks to get ideas brewing. They can bring those ideas to life in true maker fashion thanks to think[box]'s 3D printers, printed circuit board routers, laser cutters, digital sewing machine, a 32 sq ft ShopBot, and more.

We've made these resources available to our community, and they've responded enthusiastically.

Since opening in December 2012, think[box] has seen more than 48,000 visits, representing every school/college on campus as well as members of the Northeast Ohio community. In fact, 25 percent of our users are from the surrounding region. Those community users include other university students, art institute students, area high schools, garage tinkers, industry representatives and more. There is no cost to use the facility other than to pay for your materials,

although safety is foremost and training is required for most of the machines (at no cost). There are some projects created in think[box] that have moved beyond the physical object, toward business ideas. These teams work with our on-campus entrepreneurial programs as well as the community resources available in Cleveland to help start businesses. The most incredible part— this is just our 1.0 pilot space and use primarily has been through word of mouth. No marketing.

Think[box] Tomorrow

Our vision gets bigger. Like all well-engineered technologies, our pilot has been tested and is widely successful. That is, our prototype has been validated and we are preparing to "scale up". We will soon begin remodeling a 50,000 sq ft, seven story building on the edge of campus, and the entire building will be devoted to expanding and developing our think[box] concept. Through incredible public and private partnerships, we are raising money and raising awareness to quickly make this plan a reality. This new facility will house not only the prototyping equipment currently found in think[box] 1.0, but also our traditional non-digital fabrication workshops, all of our campus' entrepreneurial programs, and incubation space for student startups.

The building layout will allow anyone to walk in the front door with an idea, move to the next floor to collaborate on that idea, go up one flight to make that idea, if appropriate develop a business around the idea, and incubate it into a fully functional company on the top floor. You physically move up further into the facility as the concept moves to product, and added components of the think[box] ecosystem--from physical infrastructure to business development--are needed. We will continue with our 'open access' policy to make this amazing resource available not only to users on our campus, but our NEO community.

Key Plays and Lessons Learned

Building such a resource does not happen overnight. In reviewing our progress to date, there were eight key "plays" that can be identified as critical on our path to success.

Play 1, Build on Strengths & Create a Vision: We started the think[box] journey in 2008-09 asking the question, *how can we create a physical and mental space that encourages cross-disciplinary engagement, innovative thinking, making and building, and if appropriate, product development and company creation?*

This vision was moved toward reality through the efforts of a group of faculty responding to the Provost Office's call for interdisciplinary ideas based on thematic areas that represented University strengths. For this project, it fell under the theme of Culture, Creativity and Design, which had been identified in the CWRU 2008-2013 Strategic Plan. Originally, the proposal was to establish the IDEA Institute (Innovation, Design and Entrepreneurial Activity) to forward these ideas, and was seeded with a $35,000 Provost Grant. Those funds were used to hire a consultant to interview stakeholders around the campus and identify synergistic focal points for think[box] efforts. The key was to think about collaborative activities in new disciplinary areas

that had yet to come together. From the start, that vision was not limited to CWRU students or faculty alone, but rather a broader stakeholder group that included other academic, research and business institutions and leaders that could contribute.

Lessons Learned:
- Take the time to build out the original vision into one that is robust, dynamic, and shared among others. Develop PowerPoints. Develop key talking points. Ask for ideas. Ask for opinions.
- Recognize that support may not come the first time the idea is shared. It may need to incubate and you may need to share the thoughts numerous times. This is okay; support from a diverse field of thinkers will take differing amounts of time to become internalized. Patience is okay.
- Listen carefully to questions and critiques. Iterate based on valid feedback consistent with the vision and have the confidence to not compromise too much.
- Be honest, forthcoming, and genuine. Playing the "system" does not work with big initiatives such as this.

Play 2, Support Faculty Champions: A core group of faculty champions had a vision to break down boundaries on and off campus, and wanted to celebrate a culture of creating, making and innovating within a region that has making and manufacturing as part of its DNA. If it were not for the key faculty, this project would have faltered many times. In particular, there was one individual so passionate about the idea, he carried the effort on his back and sheer will to see the idea come to light. It truly originated from the appropriate point—not administrative, not staff— but from academic minds. This added legitimacy to the effort not only because it was faculty initiated, but also because the faculty had the pulse of the students, which helped guide the vision.

Lessons Learned:
- Identify faculty champions from a wide range of departments to join the effort.
- Expect some faculty to dismiss the idea and accept that it is okay. Not everyone will be supportive. While they may start as skeptics, they will join the bandwagon when victory is evident (or remain silent in their past skepticism). Be fearless.
- When you do have a core group of supporters, maintain constant communication on all of the nuances. Silence can easily be mistaken for secrecy and game-playing.

Play 3, Find Alumni Champions: One of the key activities that occurred early in the development of this project was encouraging active involvement of alumni who were also passionate about this topic. Tapping individuals early to join in the development of the idea allows for a shared sense of commitment and buy-in. We were able to kick-start fundraising efforts more quickly because of this early involvement as well as tap into ideas that would not have been explored if additional great minds were not around the table. This included the identification of our permanent building—an idea that came straight from an alum who knew much about the history and physical layout of the campus infrastructure.

Lessons Learned:
- When involving alumni, there often is the learning curve of helping indoctrinate around university processes and politics. Most successful alumni are such because they have built businesses or managed complex organizations, thus expecting different operational procedures and vastly different implementation timelines.
- Be true about including alumni on your team. If they are only figureheads yet expected to be intimately involved in the planning, bad feelings arise. Make expectations on both sides clear.

Play 4, Engage *all* University Players: To introduce an idea that will impact the entire university community not only requires steep commitment from faculty, but also understanding and commitment from the administrative ecosystem of any university. From the Development Office to Corporate Relations, Foundation Relations, Media Relations, Government Relations, the Provost and Student Life, including the internal administrative ecosystem is critical. Time must be spent educating about the benefits of the idea, the wide-ranging potential for impact (beyond one particular school/department), and specifically how each office can engage and support the idea. This engagement should happen at all levels—from the Dean's Office across to all staff levels.

Lessons Learned:
- Find trusted staff from the various departments so they can help you craft the appropriate messages for "their audiences".
- Describe the impact on students. How will the student experience change and make the products we make, i.e., graduates, better for the world as it will exist in the future (not just today)?
- When engaging the internal ecosystem, this is where honing the elevator speech becomes critical. It was around this time in engagement that the name of the IDEA Institute was transferred to think[box], the word "think" sitting outside a box, as proposed by a marketing professional to help us more quickly explain the "mental and physical space" we were envisioning. Once this transition was made, it became slightly easier to quickly communicate the idea.

Play 5, Engage External Partners: When you are developing a new idea that is community focused, there is often the confusion about how it "fits" with the external ecosystem. Because think[box] includes many pieces that do connect to the community—from points of intersection to other maker spaces, to the handoff to the entrepreneurial ecosystem—there becomes a concern about how a giant like CWRU would fit with the little programs.

A key set of activities that occurred to help this was having our faculty leaders engage frequently with key external organizations. One faculty member in particular often went to lunch, offered presentations, and engaged and listened to the community to figure out how to tie into our vision and bring those players to the table. He was able to find strong champions in this process, such as Lorain County Community College, JumpStart, and the Cleveland Institute of Art, among others. Those community champions proved incredibly valuable when we opened think[box] 1.0 and as we worked to obtain additional public and private investment in our idea.

Lessons Learned:
- Never assume that once you share your vision that it will take hold. We needed to share that vision again and again. A "no" is not a no; it is often a "not yet."
- Continuous and honest communication was highly important. When we grew quiet, the community seemed to think that we moved on to other projects.
- There was always a bit of disbelief in the vision of being open to the community. To this day, mouths fall open when they walk through think[box] 1.0 and realize that we were very serious about being a strong community partner. They see this commitment when they see the diversity of those using the physical and intellectual resources.
- Not every external partner should be brought into the planning circle. There are decisions that need to be made about who adds value to the process and who needs only to be kept informed.

Play 6, Find a New Starting Space: This play was probably the MOST IMPORTANT outside of the original vision. We had a vision. We had a new name. But we still hadn't fully captured the attention and imagination of all. By tapping into a gift of one of those early alumni supporters, we decided to begin a pilot version of the think[box] vision. What started out as a 3,000-square-foot location—and expanded to 4,500—became the turning point we needed to really sell the idea to a wide set of constituencies. We also hired at this time an executive director and an operations director to help us operationalize the idea, which was also a key piece to ensuring that the space was piloted appropriately.

It is also important to note that we did not just rename an existing workshop—we identified a poorly utilized laboratory, negotiated for the space on campus, and started anew. Renaming existing resources does not have the same feel as starting something new. The excitement grows fast.

Lessons Learned:
- Any internal contribution is an important one, particularly one like space. Say thanks publically and frequently.
- Measure key performance indicators- KPI's, like number of visits per month, diversity of users from the institution and community, etc. Share those numbers with those with vested interest in the space.
- Even with under-utilized spaces, costs are incurred to move equipment or clean a space. Keep in mind that nothings comes for free! Balance cost with future impact. Make these decisions quickly and deliberately but ensure they are conscious decisions.

Play 7, Important Operational Decisions: Operationally, you can find "how to equip maker spaces" on the web. But as a university, there are a few things we did that made a difference. Not only did we hire a young, enthusiastic, visionary alum who understood the existing maker spaces and resources throughout the country, but we also sent him to various sites to determine what pieces of equipment would be important to include in our pilot space. In addition, a faculty member also became engaged who had deep experience in managing traditional fabrication spaces. That set of expertise proved invaluable to setting up this space, particularly as it has become the beacon for the vision as well as the starting point for many fundraising discussions

and tours. Some of the key features of the operational plan (which are being tested for when we move to the larger space) include:

- The "counter": Shortly after the facility opened on December 12, 2012, a digital counter was installed above the doorway. It counts only one entry/exit so that we could ensure an accurate representation of use. As visitors, investors, administrators, faculty, etc. come to think[box] 1.0 and they see the ever increasing number, they know instinctively that this isn't just a facility with a name plate, but a highly used location. To supplement the counter, we recently began a sign-in system that allows us to track users more directly, both internal campus users (to show the interdisciplinary mix) as well as community users.

- The TA's: Teaching Assistants were hired (currently 25 this semester) to provide support and service to all who enter the space. This had numerous benefits beyond the obvious need for a solution of how to service 3,000 visits per month with only two (originally only one) full-time staff. The individuals hired were chosen primarily for their communication skills and friendliness, but secondarily they were chosen to represent a wide slice of the university community. Students of different genders, races, backgrounds, and social circles spread the word about think[box] through their social networks. Some students from the neighboring Cleveland Institute of Art were hired, who quickly spread the word through their social networks, without any effort on the part of the staff. Soon industrial design students from the art school would be working together with our students in engineering, management, and law. The first big hurdle was just to get that foot traffic, and the teaching assistants really spread the word for us.

- Safety: Safety has been a top concern for all involved with think[box], particularly as it becomes more of a public use facility. As such, comprehensive safety and access policies were developed, which are available to the public on the think[box] website. Machines of varying skill level and danger were separated physically into different rooms, and policy-wise by differing access and safety policies. An "Ability Badge" system was developed to visibly display which machines a user had been certified on, which improved the staff's ability to quickly scan the shop and make sure users are only using equipment they have been trained on.

- Equipment Selection: We chose to offer a wide variety of both traditional and digital fabrication technologies. We have traditional hands-on processes like the wood shop and metal shop, but also digital processes such as laser-cutters, vinyl cutters, 3D printers, circuit board routers, and even computerized sewing. Digital processes such as 3D printers can produce a great looking final product, and also provide a very low learning curve for the novice to enter the world of making. In terms of which manufacturers to choose, the best advice is to visit other shops and learn from their lessons. During the course of building think[box] 1.0, we toured several dozen makerspaces around the country, from the MIT Fab Lab to the Stanford d.School, and everything in between. Machines with a low price tag sometimes come with dozens of hours of unexpected maintenance. Talking with other lab managers, and not sales people, is the best way to determine the real value of a certain machine.

- Hours: Our initial offering of 20 hours a week built up to 63 hours a week over the course of our first two years of operation. In the beginning it was important to start small so as not to overwhelm staff, as hundreds of lab logistics were still under development. Later

we were able to implement some evening and weekend hours, to more closely match student schedules.
- This is not a teaching lab where theoretical principles are demonstrated and learned. We have those labs on campus for conventional hands on curricular activities.
- Student IP: As soon as the doors were to open on think[box] 1.0, the question of student ownership of IP came calling. Working with the University's Technology Transfer Office, a policy was created and posted on the think[box] website. Students own their IP, and by making that explicit from the beginning, all hesitancy was gone.

Lessons Learned:
- Do not underestimate the time needed to create the necessary documentation and operating procedures to cover safety and use of machines and equipment
- Provide as much safety and equipment operating tutorial documentation as possible on-line; there is no compromise on this
- Implement a robust, visible, and efficient scheduling and booking system
- Clear, accurate and efficient communication is essential
- Be flexible, prototype ideas and do not be afraid to radically change the operating parameters of the system, whether that is equipment, procedures and/or staffing
- Listen to the users to understand what is working well and what needs fixing – if it needs fixing, fix it quickly; fail often and early and develop unflinching sense that we'll get it right next time.
- Absolutely essential to select and nurture a dedicated, innovative team to manage and guide development
- Respond professionally to requests to showcase and promote the think[box] concept; one needs to win the hearts and obtain strong support from the community
- Do not underestimate the level of administrative support needed

Play 8, Tie to the Curriculum & Students: Once the space was developed, we were able to further the vision by linking recently redesigned curriculum to the functionality of the pilot space. From the new SAGES courses (Engineering developed 19 new introductory first-year student seminars that included hands-on components that could take advantage of maker spaces) to our senior design classes, there was a great opportunity to tie immediate needs of students and faculty to the think[box] project. This proved invaluable to bringing other faculty into the conversation and helping them see the value of the effort. That is, school's curriculum began emphasizing the need for broader "hands on"/making experiences and new courses were created and others were redesigned to emphasize this. Think[box] was a resource to support these revisions but not a scheduled home for curricular delivery.

Lessons Learned:
- Arrange information and tour sessions for faculty.   It is essential that they understand what is possible and what is outside the scope of the facility when setting their students design/build assignments
- Encourage faculty and students to plan their activities in a timely manner; rapid prototyping a large 3D printed part is anything but rapid.

- Implement a reliable scheduling system that is easy to use by the TAs (we use a system called Trello – if you don't need to make it, don't. There is many good resources and tools already available. Focus your time on those things that provide greatest impact)
- Use of the facility will be cyclical, so arrange access and support accordingly, very little demand at 8:30 – 10:00 am, however, huge demand between 4:00 - 9:00 pm.

The Touchdown Play, Be Comfortable with Chaos: While this playbook has been presented sequentially, it was anything but. Chaos has been more of the norm than the exception, particularly when you are trying to engage both internal and external partners. Communication becomes the key, as does providing frequent examples of "wins" to the stakeholders. Expect the communication to be "noisy" and "lousy" at the beginning. Maintaining the vision, aligning it to internal and external priorities/messages, and continuing to persevere are the primary ingredients that have allowed us to be at the success point we have reached today. The message becomes clearer as the message and data provide demonstrable evidence of success

We are excited about sharing this playbook with the higher education community, and we welcome one and all to come for a visit or contact us with additional questions. All policies (IP, K-12 use, safety, access, etc.) can be reviewed on our website: thinkbox.case.edu. For additional information, please feel free to contact us!

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