1ST MAKERSPACE
Invent. Innovate. Iterate.

Evaluation by:

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Executive Summary

Overview

1st Maker Space, LLC (1MS) was founded in 2015 in the hopes of fostering the Makerspace movement, particularly among students in the Indianapolis area. Kim Brand's self-proclaimed vision of 1MS is to create 21st century shop classes where students engage in hands-on learning activities utilizing high-end, scientific equipment such as 3D printers and laser cutters.

The business plan for 1MS calls for the organization to create partnerships with schools through which they furnish a Makerspace at no cost in the school with the understanding that they are able to run camps and enrichment classes during the off-school hours. 1MS retains the revenue from these camps and programs, which offsets the cost of the materials. Therefore, the symbiotic nature of the partnership allows schools to benefit from utilizing what is typically cost-prohibitive equipment while allowing 1MS to operate in a space that has a high likelihood of reaching students.

Evaluation Model

In order to evaluate the success of 1MS, the team from Marian University chose to utilize Stufflebeam's (year) CIPP evaluation model, focusing on Context, Inputs, Process, and Product. This model gathers data from key stakeholders, participants, research, and media to describe the position of the organization within that larger context, investments used to meet goals, methods by which the organization implements and meets goals, and outcomes associated with goals both stated and unstated. For the sake of this evaluation, specific financial information related to organizational expenditures and outside investments was not included.

Context

1st Maker Space's vision was consistent with the Makerspace movement that began in Germany and is now spreading worldwide with the key difference being its focus on education environments. 1MS designed a model through which they can create the spaces for students to be innovators and creators through engaging learning experiences utilizing equipment not commonly found in schools. 1MS is currently working with thirteen schools in various capacities. Arsenal Technical High School has a fully functioning Makerspace, and Shortridge High School's Makerspace is in development. The remaining schools partner with 1MS on a smaller scale that doesn't involve a full Makerspace in the building.

Inputs

1MS acquired the necessary equipment to build Makerspaces in schools. The spaces themselves, though, did not necessarily follow a specific design template; 1MS instead chose to remain flexible in order to accommodate the space availability in partner schools. Once 1MS completed the space in the school in accordance with the space and equipment needs of the specific school, they encouraged the

school to utilize the space during school hours. In order to better prepare teachers to accomplish this task, they hired personnel that trains school employees on the equipment and supports curriculum development to align projects to state standards. To date, 1MS has five employees, with one identified as the education director. Typically, a school will have multiple 3D printers and a laser cutter in a lab. Ultimately, the goal of Makerspace is to include additional resources such as microcontrollers, sewing machines, woodshop tools, tools for measurement and dimensioning, recycled materials, glue guns, and cardboard.

Process

Much of the operational side of the organization appeared to be flexible as 1MS learns from each new Makerspace and adapts to meet the needs of the partners. This flexibility seemed to come at the expense of standardization in the inputs and process. Each partner school with 1MS signed a Memorandum of Understanding (MOU) delineating the equipment, space, and other expectations. Some of these expectations include: identifying a site coordinator, providing adequate insurance, providing maintenance, and providing professional development for employees.

Product

The information gleaned from the interviews showed trends consistent with what the team anticipated from a start-up company. The company communicated a consistent vision that was echoed by its partners. The responses to the spaces have been positive thus far, and 1MS aspires to continue to find ways to promote the organization effectively. The interviews highlighted the strong communication between 1MS and the partners as the bedrock for the current perceived success of the partnership. The team questions whether the current prioritization of flexibility over standardization is conducive to long-term sustainability.

The data gleaned from the student surveys uncovered a consistency with 1MS usage at Arsenal Technical High School and nationwide data regarding gender inequities in Science, Technology, Engineering, and Math (STEM) related studies. Additionally a statistically significant, positive correlation (r=.38) between use of the 1MS space and student attitudes towards school. However, the lack of a true control group limited the possible statistical analyses that could be conducted.

Recommendations

Based on the data gathered and analyzed, the recommendations focus on three general areas: standardization, alignment, and messaging. While the nature of the partnerships require a degree of customization due to varying partner interests, needs, and resources, it is recommended that the 1MS identify opportunities for standardization whenever possible. This would allow for ease of replication as the organization expands into more schools. Four areas to target for standardization include: implementation, timelines, maintenance, and evaluation.

The majority of 1MS's partners are schools, so to become a truly symbiotic partner, the 1MS programming should align to the key components of the schools they serve. Key components of a school environment include: the curriculum, training, standards, and school mission. Additionally, it appears

that 1MS has an opportunity to increase the interest in STEM related fields among students who are in underrepresented demographics according to national trends.

Finally, as a start-up company, communication with stakeholders plays a major role in the success of the company. For example, 1MS's brand can be found under several different iterations of the name, which can be confusing. Furthermore, the profitability of the company hinges on the enrollment of the camps and enrichment programs, so the messaging around those opportunities among key individual partners within the school such as teachers, parents, and administrators needs to be strong.

A Note about Data Gathering

To gather necessary information for the evaluation, the team contacted Kim Brand to compile a list of relevant constituents and their contact information. Questions were created for each constituent based on the person's specific relationship to 1MS. The evaluation team created a survey for students utilizing satisfaction questions specific to Makespace use and a validated instrument for measuring attitudes towards school, which was then distributed to students at Arsenal Technical High School by an employee of the school. Arsenal Technical High School was chosen because they have the only fully operational Makerspace that the company has built. Once all the data and information was gathered, it was disaggregated and analyzed according to the specific sections of the CIPP model.

Context

Background on Makerspaces

According to the Dartmouth College Library Research Guide, the evolution of Makerspaces began in Germany with a membership-based program that provided access to a wide variety of tools, materials, and training (Educause, 2013). A makerspace is "a physical location where people gather to share resources and knowledge, work on projects, network, and build." (Educause, 2013, p. 1). These spaces are designed to promote collaboration among a wide range of people interested in project-driven learning. Makerspaces provide both a platform for hands-on learning and the support and materials that provide the environment for innovation to flourish. The practical application of these spaces in the academic realm is not limited to one content area; Makerspaces promote multidisciplinary learning and enrich the educational value of project-based experimentation. To date, there are more than 1500 Makerspaces worldwide.

If education evolves to become more self-directed, Makerspaces could eventually be commonly used for college credit across campuses, providing the area necessary for students to engage in inquiry-based learning and assume ownership of their findings. The hope would be that students develop skillsets such as creativity and critical thinking, and then, in turn, become more marketable and successful as they emerge from programs that foster high order thinking skills. The end result would be that Makerspaces help the United States produce high-quality candidates for the science, technology, engineering, and math (STEM) careers of the future.

Background on 1st Maker Space

1st Maker Space (1MS) is an organization that partners with K-12 programs to bring the Makerspace movement into schools. Currently, thirteen schools in central Indiana serve as host sites for 1MS summer camps and enrichment programs. Parents can either pay a participation fee for a summer camp or choose a monthly subscription fee, giving their children year-round access to the Makerspaces at participating schools. 1MS after-school Maker Pass programs are aligned with Indiana After School STEM standards.

By working with schools to utilize existing space within the school building, programs that are usually offered as enrichment activities during out-of-school time can be made available to students during the school day. Arsenal Technical High School and Shortridge High School, both in Indianapolis, are 1MS school partner sites. Educators at these high schools can use the Makerspaces to reinforce formal lesson plans with the expectation that the use of the 3D printers and other tools will make the learning relevant to their students. The use of these Makerspaces moves the level of thinking of the students from simply remembering information to creating and applying what they've learned.

Current work of 1st Maker Space

According to 1MS, the ecosystem of hands-on learning is exploding, and 1MS is looking to exploit the trend to harness imagination. By finding the balance between formal and informal educational experiences, students can benefit from combining what used to be a natural inclination to explore with an intentional learning opportunity at school. Being directly involved in the planning of their projects empowers students to take ownership of their own learning, which hopefully correlates to the deeper knowledge and retention of content that comes from working with real-world challenges. The 3D printing becomes the conduit for self-motivation because it provides tactile evidence of the learning. Developing creativity, engagement, and creative thinking skills in students could lead to an increase in positive associations with school. It could also contribute to narrowing the gap between schools and the needs of business and industry for qualified job candidates, particularly in STEM fields.

1st Maker Space Business Strategy

1MS is seizing an opportunity to have an impact on education and business by harnessing the Makerspace movement and creating a business model that is both profitable and relevant to 21st Century Learning. There are three legs to the business strategy:

1. 1MS provides the Makerspace for schools to use during school hours at minimal cost and recoups the investment through profitable camps and enrichment programs.
2. 1MS designs, consults on, and manages services to schools that want to install a Makerspace in their building.
3. 1MS offers Additive Manufacturing Certification programs to youth and young adults using STEM Engine 3D printer kits. Students receive certification upon successfully building a 3D printer, which they get to keep.

Input

Inventory

In order to actualize the benefits of a Makerspace, as delineated in the Context section, 1MS intentionally crafts its Makerspaces to meet the needs and demands of the school partners through a collaborative and adaptive process. Forgoing a one size fits all model, 1MS acquires a bevy of resources and customizes the Makerspaces accordingly. Included in their vision for future Makerspaces are: 3D printers, laser cutters, microcontrollers, sewing machines, woodshop tools, tools for measurement and dimensioning, recycled materials, glue guns, and cardboard. Currently, 1MS has three hundred 3D printers and five laser cutters. The equipment and inventory vary at each school depending on their requests and needs. The standard arrangement with schools is that 1MS provides eight 3D printers and one laser cutter; however, if a school only wants 3D printers, the site can receive between one to four printers. In addition, one roll of filament and two glass build plates are provided per printer. If the school requires additional filament or build plates, it purchases the additional supplies at its own expense.

Initial Implementation

As 1MS is incurring the cost of materials for the Makerspaces, they have a vested interest in utilizing a space that maximizes the effectiveness and impact of the equipment. The recommended requirements are: at least 1200 square feet, hard floors, exhaust to the outside, large tables, computers with an internet connection, a projector, whiteboards, and plenty of space for storage of materials. Once the room is adequately prepped for implementation of the program, 1MS furnishes the space at no cost to the school. Depending on the available space at the school, the process can take between three to six months. In the future, the goal is to pare the process down to a few weeks.

In exchange for the equipment from 1MS, each school must contribute human capital. The school must designate a site manager to monitor the operation and safety of the equipment and coordinate service maintenance requests with 1MS. Additionally, at least two staff members of the school must complete, at a minimum, two training sessions provided by 1MS on the setup, use, and operation of the equipment.

Curriculum & Training

In order to protect their investment, 1MS has two staff members who train the school and summer camp staff. The two available training courses are: (1) completion of a standard, two-session program with 1MS staff, and (2) personalized trainings that are specific to locations. The first path focuses on technical knowledge of the 3D printers and the corresponding design software. The second path familiarizes camp directors with the specific curriculum and activities. The stated objective for 1MS training is that participants with no prior experience in 3D printing can be proficient enough to practice printing their own designs by the end of the first session. 1MS has also worked with a videographer and film producer to compile training videos that can be shared online.

The aforementioned curriculum that 1MS developed focuses on 3D design and printing. It was not available as part of this program evaluation. 1MS has also developed a Creativity Training Curriculum that integrates the arts into STEM, also known as STEAM. 1MS hopes to create additional curriculum as they see an increase in their funding and interest from the market.

1MS continues to partner with educators from many organizations and schools to develop Makerspaces into an educational tool. For example, 1MS is working with Magnify Learning, an organization that specializes in project-based learning, to add project-based learning methods to Makerspace education. Currently, 1MS's projects are not tied to academic standards, but the organization has hired a new employee to help align the curriculum to standards.

Marketing

As the summer camps and enrichment programs generate revenue for 1MS, they rely heavily on their school partners to promote their programs. In the memorandum of understanding (MOU) with their partner organizations, they agree to loan 3D printers to the school to use for free in exchange for summer camp referrals. 1MS markets through brochures, flyers sent home with students, a friendly online sign-up system, third party advertising, social media updates and word-of-mouth networking. 1MS also hosts school demonstrations for students to watch with their partners. Although 1MS utilizes a variety of strategies when marketing their program, no data has been collected to examine which of these strategies are most effective.

Process

Overview

As 1MS is still in the embryonic stages of development with only one operational high school space and one more in development, many of the processes are still being honed. 1MS has created a boilerplate MOU that they use for the schools with basic terms to which both parties agree. At this point, the two spaces for which 1MS has MOUs are both part of the Indianapolis Public Schools (IPS).

First, 1MS agrees to plan, develop, and build the lab for each partner school with the mutual agreement that the school will, in turn, use the space during school hours at no cost to existing students. 1MS also provides a consumables budget for the space so that day-to-day operations are not prohibited by a lack of supplies. In order to generate revenue, 1MS utilizes the space for after-school programs and camps, which includes a cost to the participants that 1MS retains. The revenue from the 1MS camps will be used to fund the installation, service, maintenance, consumables, and staffing of the Makerspace. Given the school-based location of the Makerspace, each partner school also agrees that it will maintain the upkeep of the facility within the normal use of the location.

As the Makerspace is built the school agrees to get all key staff trained to use the 1MS equipment before utilizing the space, in addition to providing a site coordinator to serve as a point of contact between the two organizations. The 1MS staff trains the employees, and once completed, the trained staff members are eligible to be employed by 1MS to work at the camps and enrichment opportunities.

Finally, 1MS sees the educational value of the program extending beyond simple access to the tools that are cost prohibitive for most schools to purchase. Teachers are encouraged to connect state standards to projects that are developed by 1MS staff including Bethany Thomas, Education Director, and the rest of the Curriculum Advisory Team.

Communication

The main point of contact for 1MS was Kim Brand, the CEO of the organization. He has negotiated MOUs with Arsenal Technical High School, whose point of contact is Ben Carter, and Shortridge High School, whose point of contact is Shane O'Day. All three parties stated that communication has been the key to success thus far in the development and operations of the space. Currently, partner schools feel that communication with 1MS is strong. Both high school contacts pointed to frequent in-person meetings, phone calls, and emails as strength of the relationship with 1MS. As partnerships with schools increase the level of communication through a single point of contact could be difficult to maintain.

Maintenance & Repairs

While space is provided by the school, and the equipment and installation is provided by 1MS, maintenance of the equipment is a bit less clear. The MOUs state that the schools must have insurance

policies, and that broken equipment will be replaced by 1MS. Carter, however, indicated that interns at the school will first try to repair any broken equipment, and if they are unable, a 1MS employee will assist in the repairs or replace any equipment. While this encourages the experimental mindset that 1MS seeks to foster, it is not clear as to how well equipped the interns are to fix the machines and what happens if they create further damage. Also, the policies regarding intentionally broken equipment were vague. Both parties seem to agree to work with a good faith understanding of who will be responsible for such broken equipment. Carter did mention that all equipment replacement has been prompt.

Terms

Currently, The MOU at the Career Technology Center (CTC) at Arsenal Technical High School is written as a five-year contract ending in 2020. They are now completing their first year as a partner with 1MS. Carter has made the Makerspace facility available for all fifteen of their career pathway programs. Of those programs, the advanced manufacturing pathway uses the Makerspace the most frequently. After teachers complete the training, how they incorporate the equipment into their lessons remains at the teachers' discretion. Oftentimes, two or three classes will cycle through the space each week to complete on-going projects that align to the specific class's curriculum. The messaging to teachers around the autonomy to utilize the space has been clear; however, it does not appear that there has been an intentional push to increase the amount of time during which the Makerspace is utilized. Additionally, ongoing support for teachers from CTC or 1MS around ways to incorporate the Makerspace into routine instruction remains ambiguous, as does the role of the 1MS Director of Education.

Reactions

According to Arsenal Tech High School, students were generally excited about the ability to use the space. The Makerspace ignited an interest in certain subjects that may have been previously uninspiring. The school indicated the Makerspace provided an innovative approach to challenging students to solve their own problems in new and creative ways. This approach is in alignment with the mission of the CTC, which is to prepare all students for career readiness upon graduation.

A goal of 1MS is to create a space which provides kids with an, "authentic learning environment and enrichment program designed to stimulate the type of hand-on learning that encourages creativity, inspires innovation, and stimulates interest in STEM" (1st MakerSpace, 2016). According to 1MS, perceived parental excitement for the space and the programming is high, but there is no concrete data to corroborate this claim as the parent outreach and satisfaction metrics are still in development. A 1MS representative also identified the challenges around communicating the value or importance of the Makerspace to parents because it represents more abstract concepts of learning in an unfamiliar setting for most parents. Overall, Arsenal Tech High School expressed high satisfaction with the program and intends to continue the partnership in the future.

Aspirations

1MS noted that a next step in the evolution of the programming is differentiation in the user experience based on prior knowledge and observed skill levels. Currently, this level of variance only exists in the camps and enrichment programs during the off-hours at school. 1MS also hopes to quantify how many students are enrolling in the camps based on positive class experiences.

Product

Measures

As mentioned previously, the evaluation team created a survey to gather three pieces of information: student demographic information, student satisfaction with the Makerspace, and student attitudes towards school.

To measure participant's satisfaction with the 1MS program six survey items were developed by the researchers. Respondents rated their agreement with the statements on a 5-point Likert-type scale with the following response options: 1 = *totally disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *totally agree*. A sample item is, "I feel the time I spend using the MakerSpace is time well spent."

Participants also completed Anderson's (1999) measure of Attitudes toward School which consists of 15 items. Respondents rated their agreement with the statements on a 5-point Likert-type scale with the following response options: 1 = *totally disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *totally agree*. Seven of the items of the measure were reverse-coded to reflect positive working. A sample item is, "I am learning a lot in school." In addition, the survey also included an item that asked, "I plan to attend college."

Participants

Survey completers consisted of 29 high school students at Arsenal Tech High School who were each enrolled in a course using the MakerSpace located on the Arsenal Tech campus. The age of the students ranged from 15 to 18 years old, with an average age of 16.2 years old. Regarding grade level, 66% (n=19) of the students were sophomores, 20% (n=6) were juniors, and 14% (n=4) were seniors. Ninety percent of the participants were male (n=26), with the remaining 10% being female (n=3). Lastly, a large portion of the sample identified as Hispanic or Latino (45%, n=13) or White (38%, n=11). The remaining participants identified as Black or African American (14%, n=4)) and Native American or American Indian (3%, n=1).

In response to the question, "How many times have you used the Arsenal Tech High School MakerSpace (3D Printing Equipment)," 69% of respondents said they had used the space 1-2 times while another 18% reported using the space 3-4 times. The remaining 13% had used the spaced more than 5 times. Originally, there were 33 participants who completed the survey, but four reported that they had never used the MakerSpace and thus their responses were dropped from the following data analysis as the number was too small to serve as a valid control group for comparison.

Data Analysis

Due to the limited data on the 1MS program, descriptive statistics were examined to gain a sense of what this sample reported, on average, on the measures included in the aforementioned survey. Means and standard deviations for satisfaction with 1MS, attitudes toward school, and grade point average (GPA) appear in Table 1. The measures of satisfaction with 1MS program and attitudes toward school were measured on a 5-point Likert scale. On average, participants agreed with the statements measuring satisfaction with the 1MS program (M = 3.93, SD = 0.65), just below the Likert scale anchor for "agree." Thus, in general, the participants expressed satisfaction with the 1MS program. Students also completed Anderson's (1999) measure of attitudes toward school. Prior to calculating means and standard deviations for this measure, seven of the fifteen items were reverse-coded to reflect positive wording. Thus, a higher score indicates a more positive attitude toward school. Students reported that they agreed with the items on the attitudes toward school survey (M = 3.82, SD = 0.53) on average, just below the Likert scale anchor for "agree". In general, this data suggests that students expressed positive attitudes toward school. Lastly, the GPAs for this sample of students were provided to us from their school administration. The GPA mean score for this sample reflects a B-average (M = 3.18, SD = 0.76) on a traditional four point scale. Means and standard deviations for each item of the survey, specifically the satisfaction with 1MS and attitude toward school measures, can be found in Table 2.

Table 1. Means and Standard Deviations among Evaluation Variables

	M	*SD*
Satisfaction with 1MS Program	3.39	0.65
Attitudes toward School	3.82	0.53
Grade Point Average (GPA)	3.18	0.76

Table 2. Means and Standard Deviations by Survey Item

Survey Item	*M*	*SD*
I feel the 1MS program is worth the money.	4.24	0.74
I feel the 1MS program is time well spent.	4.07	0.80
I am satisfied with 1st MakerSpace.	4.17	0.76
I would recommend 1st MakerSpace to a fellow student.	4.03	0.82
All schools should have a MakerSpace.	3.76	0.99
Working in the MakerSpace has helped me in my school work.	3.28	1.10
I like my teachers.	4.00	0.65
The principal cares about students.	2.72	1.39
I am doing well in school.	4.17	0.71
I am learning a lot in school.	4.14	0.69
I try hard to get good grades.	4.10	0.86
I usually do my homework on time.	3.72	0.88
I enjoy school activities such as sports or clubs.	3.86	1.13
I plan to complete high school.	4.72	0.65
I am angry at my school.	3.59	1.05
My teachers don't care about me.	3.79	0.98
My teachers don't really understand me.	3.38	1.21
I am not interested in what my teachers have to say to me.	3.59	1.12
I am not really learning anything important in school.	3.62	1.21
I don't really care about my grades.	4.31	1.00
I do not feel a part of my school.	3.59	1.24

The item which participants expressed the most satisfaction with 1MS was "I feel the 1MS program is worth the money", indicating that, on average, students agree with this statement ($M = 4.24$). The statement which students expressed the least average satisfaction with 1MS was "Working in the MakerSpace has helped me in my school work." Although this item had the lowest mean average ($M = 3.28$), participants expressed they neither agreed nor disagreed with the statement, with the average response being slightly above average in favor of the statement.

The statement with the highest mean from the attitudes toward school measure was, "I plan to complete high school" ($M = 4.72$). The item from the attitudes toward school measure with the lowest average agreement was, "The principal cares about students", indicating that, on average, students disagreed with this statement ($M = 2.72$).

Discussion

One considerable discrepancy was in the gender of those who completed the survey. Of the 29 total responses, 26 were male and three were female. It is not known for sure if this is a representative number of the normal population of the classes that use the MakerSpace, but if so, it seems to highlight the need to focus young female students on STEM-related coursework and fields. The ethnicity of the respondents, however, appeared to be a strength of the program. A search of "minorities in STEM" in Google Scholar returns 138,000 results of academic books and articles related to this topic, with the most relevant search results at the top specifically devoted to increasing minority and female participation in STEM fields. The largest ethnic group among the participants was Hispanic with 45% (n=13), which indicates a sizeable minority group represented among 1MS users. While 38% of participants were white, 14% identified as black and 62% of the total respondents are considered minorities. This may be a product of the demographic makeup of the school itself and certainly indicates the demographic makeup of the classes using the MakerSpace, but it may also suggest a pathway for introducing minority students to making and STEM fields.

Individual scores on the MakerSpace satisfaction survey and the Attitudes Towards School survey were compared using linear regression, which found a positive correlation $r(28) = .38$, $p = .03$. This correlation was statistically significant meaning that it was not likely to be a product of chance, but rather related to the two variables (attitudes toward school and satisfaction with the MakerSpace) addressed with the instruments. The positive correlation of .38 is considered moderate. In layman's terms this means that as one score increased, the other score also increased. So as students indicated higher satisfaction with the MakerSpace, they also indicated higher scores on their attitudes towards school. What we cannot conclude from these findings is what is driving the correlation. Simply stated we do not know if higher scores on attitudes toward school are driving increased scores in satisfaction with the MakerSpace or vice versa. Additionally, confounding variables are impacting attitude towards school and satisfaction with the makerspace, which is evident based on the effect size ($r2 = .15$). This tells us that 85% of the variance between these two variables is unaccounted for. Regardless, the correlation points to a relationship between satisfying experiences with the MakerSpace and a student's attitude towards school, and as such it would seem wise to continue monitoring the interaction between these two variables.

Recommendations

Based on the findings from the data gathered through surveys, instrumentation, and interviews, the Marian Evaluation Team drew some general conclusions. These conclusions are presented here as recommendations to be considered by 1MS.

Standardization

Recognizing that all schools might have vastly different needs, 1MS intentionally adapts its Makerspaces to accommodate individual sites. However, using a more standardized model would facilitate both the start-up process and the ability to run the programs smoothly for continued success. Ultimately, 1MS would position itself for its Makerspaces to be more easily replicated while still maintaining its commitment to satisfy the needs of its school partnerships.

1. Implementation

Currently the outline for recommended physical requirements of each Makerspace is concrete. However, it is unclear what systems and processes are in place to help manage and scale new growth to the spaces. Based on conversations with stakeholders, there does not appear to be clear delineations of roles and responsibilities among employees for bringing on new sites. Additionally, there may be a benefit to having a basic package that is prepared in advance like a "Makerspace in a box" that can quickly implemented and then be customized as needed. Undoubtedly certain difficulties may exist with such an approach, but this may maximize the efficiency with which 1MS is able to work with a school to develop its available space and implement the program.

2. Timeline

It is evident that 1MS is dedicated to a model that believes in adapting the needs of the school to its programs. However, the general timeline for getting a Makerspace up and running is not clearly defined. Schools operate on a schedule and calendar that is somewhat inflexible. Having a standardized timeline would help school partners plan strategically for its Makerspace with regard to physical space preparation, programming and scheduling, and any budget requests that might be necessary and require approval. Schools interested in partnering with 1MS would benefit from having an outline for a fully operational Makerspace program from start to finish, which may also assist with necessary approval from key stakeholders such as school boards and upper administration.

3. Maintenance/Usage

While space requirements are clearly defined as the school's responsibility and equipment installation of the equipment clearly provided by 1MS, maintenance of the equipment is less clear. It would be beneficial to add specific policies regarding damages. One approach could be to create online service tickets for damaged or malfunctioning equipment. This would allow 1MS to track common damages incurred in its Makerspaces, as well as costs for repair. This data could

be very valuable in modifying training sessions and/or alleviating additional costs to the school and the company.

It is also unclear who is financially responsible for specific damages. It may be beneficial to add policies on types of damage that for which 1MS is responsible (accidental) and what types of damage the school is expected to cover (intentional damage).

4. Evaluation

According to discussions with stakeholders, parent excitement about Makerspaces and the programming available is high. However, there is no concrete data to support this claim. It would be in the best interest of the company to develop a satisfaction metric for its parents and its users. Tracking data on current subscriptions and renewals could be helpful as 1 MS continues to develop its programming in schools. Additionally, creating a survey for both parents and student users would be useful data to analyze the success of each Makerspace while identifying areas for improvement.

In addition to satisfaction surveys, it would be beneficial to create an evaluation plan to investigate relationships between Makerspace usage and key school performance metrics. It is likely that 1MS already has designs on such an evaluation plan and simply doesn't have enough data to implement such a plan.

Alignment

1MS partners with schools and educators to develop Makerspaces as educational tools. By aligning the training of its staff members and the development of its programming to the areas of curriculum, academic standards, national trends and school mission, 1MS would ensure that a partner school was able to maximize the effectiveness of having a Makerspace in its building.

1. Curriculum/Training

1MS has two available training courses. One focuses on technical knowledge of the equipment and another is outlined for specific locations and its curriculum needs. It is not evident that there is ongoing training or support for teachers in partnering schools to facilitate ways to incorporate the use of the Makerspace with routine instruction. It would be helpful for teachers to be clear on what ongoing access to resources they have to ensure that the use of the space is incorporated effectively into the curriculum. Lesson examples from a variety of disciplines and the creation of an online lesson exchange are two examples of resources that could be valuable to teachers.

2. Standards

According to the 1MS website, the Makerspace areas can be used to meet STEM standards through school use and afterschool programs, there seems to be a lack of concrete examples of how this can be accomplished. It may be beneficial for 1MS to highlight the STEM standards and common core standards that directly relate to the use of Makerspaces. It may also be helpful to highlight these standards in lesson plans that can be shared during 1MS training. Providing

resources that are standards related would likely increase the likelihood that teachers will use the space during the school day.

3. National Trends

Nationally there are a lack of females, black and Hispanic employees in the STEM workforce. According to National Science Foundation (2014), women remain underrepresented in the science and engineering workforce with the biggest disparities in engineering, computer sciences and physical sciences. Of the 29 students surveyed, three of the students were women. Additionally, the NSF (2014), states Hispanics, blacks, and American Indians/Alaska Natives make up a smaller share of the science and engineering workforce than whites and Asian/Pacific islanders. Of the students surveyed, 18 out of 29 were black or Hispanic. The demographics of the students completing the survey seems to support the disparity in female participation in STEM pursuits, thus it could be very beneficial for 1MS to set goals to increase the number of women enrolled in its programming. The strength of the numbers of black and Hispanic students using the Arsenal Makerspace exceeds the expectations for these underrepresented populations and would seem to be a marketing opportunity for 1MS. Tracking this data as the program progresses will aid in working to address this gap in the workforce.

4. School Mission

According to stakeholders, 1MS claims to be a very mission and values driven company. Developing a process that aligns the missions of both 1MS and the prospective partner school to ensure compatibility would help predict the success of the program in the partner school. As the school Makerspace does not function independently of 1MS, it is imperative that the mission of the company and the mission of the school are aligned.

Messaging

When establishing a new program like 1MS, the communication and messaging to the stakeholders needs to be consistent and targeted. If the message to the students, families, community, and staff members is clear and concise, they will be more likely to spread the word to others effectively.

1. Standardization of Name

When looking through 1MS documents there were several different variations of the organization name. The marketing flyers, website, MOU, emails and other documents use different variations including: 1MS, FMS, First Maker Space, First Makerspace, 1st Makerspace and 1st Maker Space. We suggest standardizing the name and branding to increase clarity.

2. Marketing

1MS uses partner organizations to market summer camps and does so through brochures; flyers sent home with students, an online sign-up system, third party advertising, social media updates and word-of-mouth networking. It also hosts school demonstrations for students to watch with their partners. We suggest collecting data on what schools have been marketed to and surveying the students to see how they heard about the program. From this data 1MS can create a plan

targeting specific schools for whom they will provide marketing materials and determine the most effective marketing tool to use. It may also be beneficial to be deliberate in marketing the program to teachers to use with their classrooms and unit of study and continuing marketing within the school after implementation. Adding the teacher as stakeholder should aid in the communication and messaging to students and families. Many parents and students ask teachers for opportunities outside of school to continue learning and attuned teachers will be able to direct students 1MS.

References

7 things you should know about makerspaces (2013, April). In Educause. Retrieved from http://net.educause.edu/ir/library/pdf/eli7095.pdf