Building community around a student-run makerspace: Project-based social and educational events

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INTRODUCTION

Opened a little over a year and a half ago, MIT MakerWorkshop [*] is a new student-run engineering space on MIT's campus. One of the central goals of the space is to foster a student community in a hands-on learning environment where modeling, prototyping, and validation resources coexist. MIT MakerWorkshop provides space and equipment for a community of innovators that focus on deterministic designing and problem solving. In order to achieve the goal of fostering a student community in this space, MIT MakerWorkshop hosts social events, runs student-led weeklong workshop courses, and hosts shop cleanups that are social events and highlight ownership and buy-in over the space. All of these are discussed in this paper.

MIT MAKERWORKSHOP

MIT MakerWorkshop is supervised and maintained by 40+ student volunteers known as "Mentors." The student Mentors are responsible for the maintenance and operation of, and the training of Users on all machines in the space. To facilitate these tasks, Mentors are divided into teams responsible for a specific area of the shop or group of machines (e.g. Mill Team is responsible for the upkeep of and training of Users on the mill). Each team has a Machine Master, a Mentor who coordinate the other team members to ensure tasks are accomplished. Furthermore, the Mentors elect students to serve on the executive committee, who in turn make major decisions about topics such as policy, purchasing, and membership, in conjunction with the space's faculty advisor, known as the "Maker Czar." Currently, the facility has over 800 trained Users comprised of undergraduate students, graduate students, faculty, and staff.

FAB. FRIDAYS

One way in which MIT MakerWorkshop aims to strengthen the community of the space, while furthering the mission of a hands-on learning environment, is through social events known as Fab. Fridays (where "Fab." can be considered an abbreviation for "Fabrication" or "Fabulous"). These events often incorporate working on a small-scale project and are open to both Mentors and Users.

A. FAB. FRIDAY LOGISTICS

Fab. Friday events are run by a Social Chair and a Social Team. The Social Chair is a member of the executive committee and is selected based on election by the student volunteers who have supervisory and management roles as "Mentors". The Social Team is comprised of a mix of Users and Mentors. The Social Chair is responsible for arranging the event, obtaining funding, and advertising. The Social Team handles theme and idea generation, some advertising, and set up of the event.

Most Fab. Fridays events require 30 minutes of preparation. This includes time for the Social Chair to meet with the Social Team to determine activities and food offered at the event, develop flyers and announcements about the event, as well as order items to arrive for the event. The event itself runs from 1-1.5 hours, depending on the project. Finally, clean up generally requires 15-20 minutes, with extra help from the Users and Mentors who attended the event. The events are held every two to three weeks with a plan to have around five events every semester and are offered at 4PM on Fridays. The advertisement of the events is organized via emails and fliers distributed a couple of days prior to the event.

B. BUDGET

The budget for each event is approximately $200-250 for the first event of the semester (which usually has the most food and activities), and continuing with $75-100 for all other events of the semester. The budget is mainly used for food, materials required to make projects, and prizes for contests. It is controlled by the Social Chair and MIT MakerWorkshop executive committee.

C. EVENT PLANNING

Each Fab. Friday is connected to some making or building event. Thus, planning requires determining the build project, ordering either tools and materials, games, or prizes. Some themes have been:

- National Holidays (Christmas, Halloween, National Worship of Tools Day, National Dessert Day, etc.)
- Lecture/master class/learning oriented event (Office Hours, Portfolio Workshop, Flexure Lecture)
- MIT and Boston event oriented (de-stressing event after the first wave of midterms, MIT's prospective undergraduate Campus Preview Weekend, Race for Boston marathon, tours and hands-on activities for MIT 100 years in Cambridge anniversary)
- Co-sponsored events with other MIT groups (FSAE formula racecar team, Mechanical Engineering Graduate Association of Women, Lemelson-MIT Program)

[*] Formerly named MIT MakerWorks

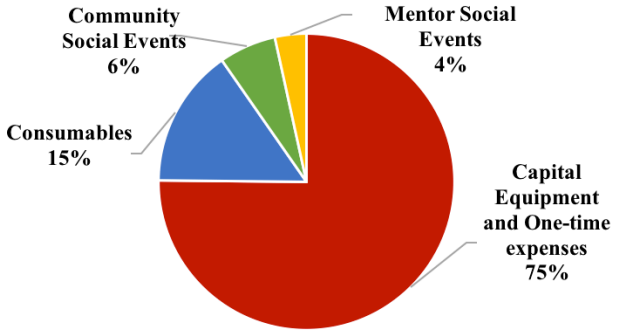

Fig. 1 The breakdown of the Y1 spending of the MIT MakerWorkshop. Note that Y1 refers to dates between July 2015 and July 2016. This demonstrates that Fab. Fridays (shown here as Community Social Events) only account for about 6% of the spending of MIT MakerWorkshop.

Fig. 2 MIT MakerWorkshop community member using a reciprocating saw to carve a pumpkin during the Halloween Fab. Friday "Pumpkins and Power Tools"

To date, our most popular events have been:

- **Make-Your-Own Cookie Cutters out of sheet metal**. At this event, people made their own cookie cutters in shapes of tools and Christmas symbols by bending aluminum sheet and fastening using rivets. It was attended by 25-30 people.
- **Pumpkin carving with Power tools**. At this event, attendees carved pumpkins using power tools such as reciprocating saws. Last year, 25 people participated in this event. When it was offered this year, approximately 15 attended.
- **Fab. Froyo Friday for National Dessert Day.** This event was an early Fall term social event at which frozen yogurt was served. Those who attended constructed their own sundae. It was attended by over 25 people.
- **Flexure Lecture**. A short lecture was offered by one of the Mentors as an introduction to the physics and applications of compliant mechanisms. The event also featured snacks such as coffee and cookies. It was extremely well received and attended by ~20 people.

Fig. 3 MIT MakerWorkshop Mentor giving the Flecture Lecture, a short introduction to the physics and applications of complaint mechanisms. It was attended by 20 people.

D. CONCLUSION

Fab. Fridays have proven to be a great way to engage with MIT MakerWorkshop community, both Mentors and Users alike. The theme and project-based events further emphasize the community focus on hands-on learning. The challenge in offering Fab. Fridays is the inability to gauge student interest prior to the event. Student attendance to these events often decreases the weeks when classes have midterms, finals, or projects due. Attendance can vary from 30 people at one event to 4 people at the following event, both of which had project-based activities or skills transfers and were further incentivized with food and/or prizes. One solution could be reaching out to the greater membership through a survey to determine the kinds of events they would like to see offered during the term. This could also be resolved by asking members to commit in advance to attending the event (reserve a spot) and comparing commitments to actual attendance.

CNC SHORT COURSE

Another way in which MIT MakerWorkshop works to build a student community focused on hands-on learning and engineering is through student-led workshops that aim to teach basic design, fabrication, and validation techniques. The first of these such courses offered was the Computer Numeric Controlled (CNC) machining short course. It was taught by MIT MakerWorkshop Mentors with the goal of going over the basics of CNC machining through the fabrication of a working centrifugal pump. On the mill, students learned to use Computer-Aided Manufacturing (CAM), with software such as HSMWorks, to generate G code, CNC program conversationally at the ProtoTrak interface (including creating conversational events from a DXF of part geometry), set up and run machining operations, and learn more advanced fixturing and locating techniques. Students fabricated additional motor interfacing and housing components using the 3D printer and laser cutter with options for customization. At

the end of the course, participants showcased their pumps and all the students were able to keep their pumps.

A. COURSE LOGISTICS

The CNC machining short course is taught by a team of Mentors including one team leader (who serves as the main point of contact), and three to six instructors.

The course is broken down into two sections of two lectures and one recitation each, two days of machining time, and a last day of assembly and a project showcase, for a total expected time of 15-17 hours of time for the weeklong course.

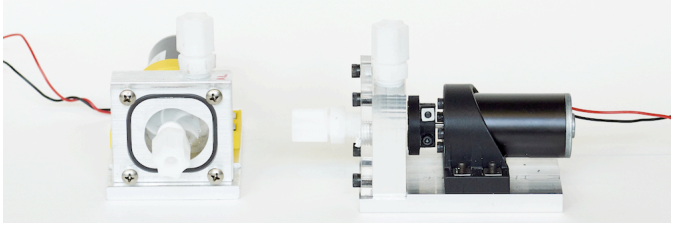

Fig. 4 Example of final centrifugal pump fabricated as part of the CNC short course.

B. BUDGET

The course was offered January 25-29, 2016 and August 15-19, 2016. The budget included paying for components and raw materials required to make the centrifugal pumps such as motors, magnets, and aluminum, as well as food for the final project showcase. Fig. 5 details the change in the budget between the two times the course was offered. All participants are asked to pay $15-25 to help cover the cost of the pump raw materials.

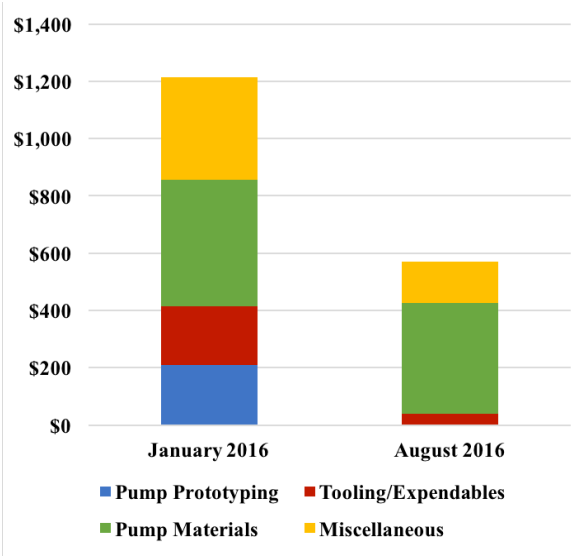

Fig. 5 CNC short course budget when offered in January 2016 and August 2016. The reduction in cost in August 2016 is due to iteration on the course material from January 2016, allowing for a more cost-effective design and hence a reduction in the pump prototyping costs as well as the tooling/expendables costs.

C. COURSE PLANNING

Preparation for the course requires approximately five meetings between the course team that take place during the month before the course is to be offered. This time is used to plan and test out design updates to the pump, make changes to the course material, ensure every member of the course team is well versed in the topics of the course, all materials are ordered in a timely fashion, and the course team has run through the fabrication of the centrifugal pump as well. Applications are solicited from MIT MakerWorkshop community (both Users and Mentors). These applications are then vetted by the course team based on whether the individual is a member of the community, has been mill trained, their availability to take part in the entire course, and their interest in the course. In total, the course offered in August 2016 required a 162 person hours for both planning and instruction.

D. CONCLUSION

The CNC short course is a valuable offering by MIT MakerWorkshop, as evidenced by the great amount of interest each time the course is offered. Costs have decreased since the first offering of the course, likely due to iteration on the pump design and fine-tuning of the pump prototyping. The first offering of the course (when the material and pump design were put together for the first time) is the most time intensive and subsequent course offerings require fewer person hours since a bulk of the course material is already complete. Unfortunately, the course still currently requires a great deal of planning, organization, and actual instruction, and can only accept a limited number of students each term. Moving forward, August is more of the "steady state" case in terms of required funding (potential further reductions in cost with additional offerings, but likely will level off). A future goal is to make the course completely free for students, and waive the $25 materials fee. The course would be an ideal candidate for corporate sponsorship, which would allow the ability to recruit more student instructors for their time, increase the offerings each term, and thereby increase the number of students who can take part in the course.

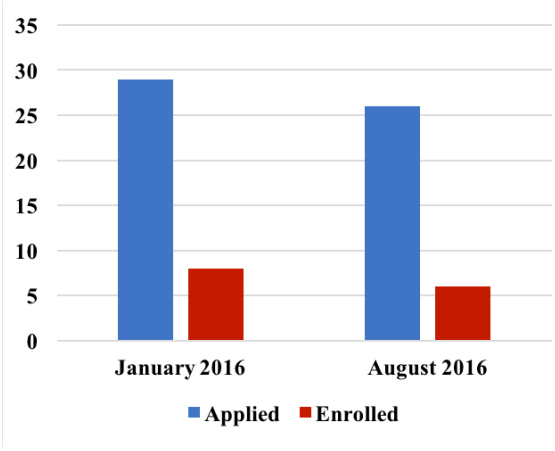

Fig. 6 CNC short course number of students who applied and were enrolled in the course. On average, for both offerings, approximately 25% of those who applied were accepted and enrolled in the course. The slight decrease in the number of students applying to the August 2016 section is likely due to the summer being a time when more students are travelling and away from campus than in the winter.

SHOP CLEANUPS

MIT MakerWorkshop also uses shop cleanups as a way to build community among the student volunteers who maintain the space. These shop cleanups are organized to include a Mentor social event (usually dinner) after the work day, while also increasing student ownership of the space through the improvement projects that students work on during the cleanups.

A. CLEANUP LOGISTICS

The cleanup team is led by the Vice President, who puts together a detailed list to determine what projects need to be accomplished by the end of the cleanup (e. g building a shelving unit, building a wall for electronics tools, etc.). The Vice President also selects a date, clearly details a project list to be accomplished, and ensures materials for the projects are available. The Vice President works with a few Mentors during the cleanup who take charge of specific projects on the list and coordinate other Mentors to help.

The cleanup itself lasts 2-3 hours, during which time Mentors are organized to help on various projects. Afterward, the Mentors helping out are treated to a dinner, usually lasting another 1-2 hours. The entire event is meant to be not only social, but a way to give back to the space.

B. BUDGET

The budget of the cleanup varies depending on the specific projects to be completed. Some projects require advanced purchase of raw materials or equipment, while others can be completed using scrap and hardware around the space. After each cleanup, the Mentors who helped out are treated to dinner, which further incentivizes participation in the cleanup. At the first cleanup, approximately 20 Mentors joined to help and dinner cost <$500.

C. CLEANUP PLANNING

Given that specific projects must be completed during the cleanup, the event must be planned ahead of time. To do so, the Vice President meets with the other members of the Executive Committee as well as the Machine Masters to determine a list of pressing projects that should be completed during the cleanup. The Vice President also asks Mentors to RSVP with their availability for the cleanup so that they can plan projects based on the number of Mentors available.

D. CONCLUSION

With specific goals for each cleanup, proper scheduling, and incentivizing using food, the shop cleanups can be extremely successful. Multiple, small, infrastructure projects around MIT MakerWorkshop can be completed in a relatively short amount of time. Furthermore, the completion of these infrastructure projects by Mentors of the space gives them a larger sense of ownership over the shop and greater buy-in over the way that the space is run and operated. However, in order for a shop cleanup to be successful, prior planning is required on the part of the Vice President to ensure there are clear, detailed tasks to be completed, there is enough notice given to the Mentors allowing them to RSVP and plan ahead, and the materials required to completed all projects are available at the time of the cleanup.

CONCLUSION

Building a community around MIT MakerWorkshop, a place run by 40+ student volunteers and home to over 800 Users is extremely challenging. It is hard to cater to the desires of all of the membership, however MIT MakerWorkshop hosts events that further project-based learning, involve skills transfers, and increase Mentor ownership of the space. Some of the activities highlighted in this paper include User and Mentor social events known as Fab. Fridays, a skills transfer CNC short course, and successful shop cleanups.

Moving forward, additional initiatives are being developed to engage with the freshman community of MIT, various departments at MIT, the larger Boston community, as well as the greater national and international makerspace movement.

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