2015 Annual Report

01 January - 31 December 2015

Mach 30
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Message from the Vice President

This past year was a rebuilding year for the Mach 30 organization, which makes it even more impressive that we also made progress on several project initiatives. While Mach 30's resource limitations have slowed us down, progress has not stopped. Using the terms from Jim Collins' book, Good to Great, we are anticipating a buildup and breakthrough process by getting our flywheel spinning with small, coordinated pushes in the direction of our "hedgehog concept" - the one big thing that we do well.

Last year, we made reference to "clearing the tower" with the excitement around the new series of Apogee and Perigee meetings. But not every rocket launch hits its full stride, accelerating up into the atmosphere. As with many of the early rocketry flights, Mach 30 has also run into hiccups that caused us to evaluate nearly every aspect of the organization, outside of our core principals. The primary issue we identified is the shortage of volunteers to help implement our plans. We have taken, and continue to take, steps to expand our volunteer base. That is my #1 priority for the Mach 30 organization.

Last year we also began consolidating the separate small teams working on many different activities, into fewer teams whose activities are directly focused on our core mission. We made great progress on two projects, the Mathematics Toolkit and the Yavin Cold Gas Thruster. There is more information about both of these projects in the "OSSHW Programs" section of this report.

This year we take another consolidation step, bringing together all volunteers into one team, focused on one project. This Integrated Product Team (IPT), includes not just engineers, but all our volunteers such as the marketers and graphics designers. While we will continue to work in other areas, it will only be in support of this one IPT project. We recognize the importance of making visible progress, and sharing that progress with the world. By having a more concentrated focus, we hope to be able to better meet these goals.

Finally, to alleviate our resource limitations, we are working to expand our volunteer base for both technical and non-technical contributors. Through a larger community, we can only expect to do more, faster. There is a seat at the table for you if you are interested in joining us. Like our motto says, "to the stars, through community."

ad astra per civitatem,

Greg Moran, Mach 30 Vice President

Open Source Spaceflight Hardware (OSSHW) Programs

Our open source spaceflight hardware (OSSHW) projects are at the center of Mach 30's mission. Every piece of spaceflight technology that we design, build, test, and publically document takes the world another step closer to becoming a spacefaring civilization. But, there is more to Mach 30's OSSHW programs than the hardware we design. As one of the first organizations developing spaceflight systems in an open and distributed fashion, we are often the first ones to demonstrate the tools and techniques required for OSSHW. Sharing these tools and techniques is every bit as important to the open source spaceflight movement as developing the hardware itself.

We make this progress both with the hardware we design and by demonstrating the tools and techniques required to design spaceflight systems in an open and distributed fashion.

This past year was a particularly successful year at Mach 30 for demonstrating our tools and techniques. 2015 was the year we first demonstrated and presented a unified approach to developing open source hardware and open source engineering tools. It was also our first year experimenting with agile methods in hardware development. Finally, 2015 was our first year of integrating our outreach and marketing efforts with our vision for open source spaceflight hardware.

Throughout the year, Mach 30's OSSHW work was guided by the principle that the key to "open source hardware for all" is high quality open source engineering tools. Our primary focus was on our first propulsion system design project, the Yavin Thruster. The Yavin Thruster is a cold gas thruster, a kind of rocket engine that creates thrust just from the energy stored in a compressed gas. This project relies on engineering analyses (1) in multiple disciplines (e.g. rocket propulsion and structural analysis) driving parametric CAD models (2) that in turn are used to manufacture the thruster (3).
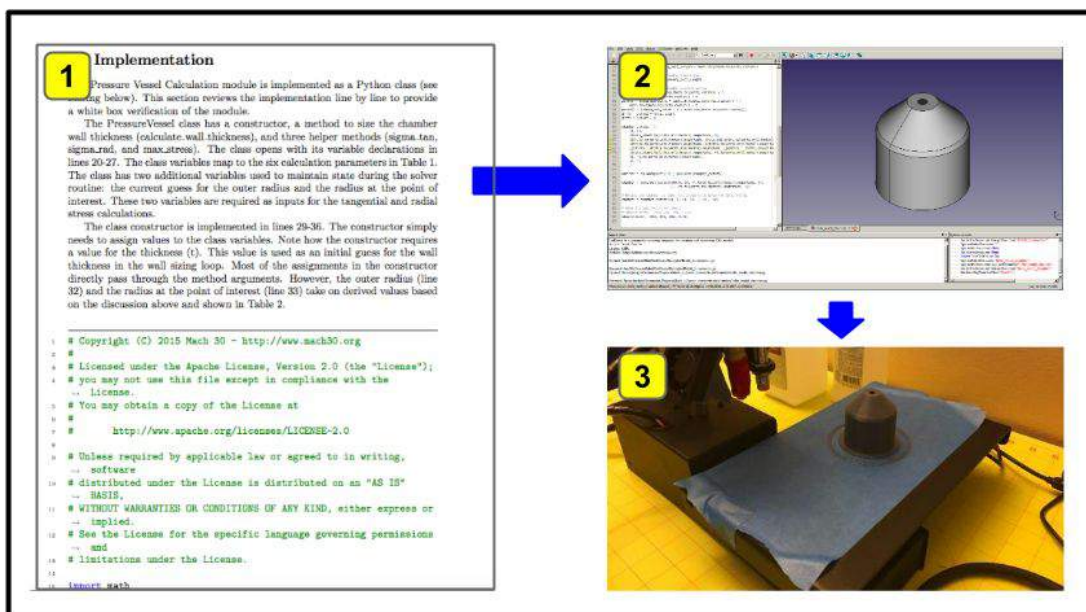
We relied exclusively on open source tools for the design and development of the Yavin Thruster. Sufficient open source tools were not available for the mathematical analysis and CAD. In response, the Mach 30 engineering team started development of the Mach 30 Mathematical Tool Kit (MTK) for analysis documentation, and contributed to CadQuery, a CAD tool that allows greater ease in collaboration on projects than many traditional CAD programs. In both cases, features developed for the software tools were tied to specific needs in the Yavin project to ensure the engineering tools had well understood and need-driven requirements. In turn, the tools were applied to Yavin to verify the tools met the needs for of our engineering team.

The results of this unified approach to developing open source hardware and open source engineering tools were so successful that Mach 30 submitted them as a presentation topic for the 2015 Open Hardware Summit. We received many compliments on our work and made several new friends, some of which have begun to work with the Mach 30 engineering team. You can check out the presentation on YouTube [1](thanks to the Open Source Hardware Association for recording the presentations).

Last year was also the first time we implemented agile processes to manage the Mach 30 engineering team. The team worked in six week sprints using our regularly scheduled #EngineerSpeak hangouts as our stand ups (regular meetings used to sync the team). We found that the self-directed nature of agile and its use of regular, personal commitments led to improved efficiency in the team's work. We also found that the project prioritization processes of agile led to early (and often surprising) results which could inform future work and be shared with the larger Mach 30 community.

Finally, 2015 was our first year of integrating our outreach and marketing efforts with our vision for open source spaceflight hardware. New marketing and business volunteers worked with members of the Mach 30 board to evaluate Mach 30's OSSHW projects for their potential to virally spread the Mach 30 message and their potential to generate revenue in the form of kit sales. The goal of this work was to provide guidance to the board about how it could best leverage Mach 30's resources in 2016 to advance open source spaceflight while also building a sustainable business model for Mach 30.

This ad hoc team concluded an ISS compatible version of 2014's Ground Sphere had the greatest potential for outreach and kit sales. An ISS compatible Ground Sphere would give users the ability to directly observe to signals from the ISS which would enable them to listen to amateur radio conversations and to download select images from the ISS. The opportunity to personally connect to spaceflight is a powerful narrative for our outreach and sales activities. And, Ground Sphere, like all space communications platforms, has educational opportunities ranging from the science of radio to orbital mechanics, making it a versatile platform for Mach 30's educational goals.

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[1]Mach 30's presentation at the Open Hardware Summit, 2015: https://www.youtube.com/watch?v=oQJY-_c7Fg8

Highlights of 2015 Accomplishments

Presentation at the Open Hardware Summit

As discussed above, Mach 30 was accepted as a presenter at the 2015 Open Hardware Summit (OHS), and this was one of the biggest highlights of the year! Our President, J. Simmons, did a great job conveying one of our main themes from 2015, namely, the need for "high-quality open source engineering tools" as a prerequisite to "open source hardware for all!" This was a means to introduce the audience to all the open source software work that Mach 30 has been doing in 2015, such as the Mathematics Tool Kit (MTK) and CadQuery. Mach 30's message was well received, with many members of the audience coming up to J. to express their support and interest in these projects.

Apogee 2 Presentations

In combination with the second annual Apogee, Mach 30 held a public outreach event at a local makerspace, Nova Labs in Reston, VA, continuing the tradition started at Apogee I. We changed the format this year, holding a series of three TEDx-style presentations, one from each of the Mach 30 board members. We talked directly to our three groups of fans (space enthusiasts, makers, and open source hardware developers). Between talks we showed off the open source spaceflight hardware projects that we've been working on over the past couple years. It was a great event bringing in a larger audience than Apogee I and engaging with our community in person.

Mach 30's DC Happy Hour Meetups

This year, our Vice President, Greg, started a new initiative in the Washington DC area to engage more in person. This resulted in happy hour get togethers for folks that could meet up in real life. The organization has gotten a number of benefits from the format, beyond just being able to meet in person. It has given the organization a venue to introduce new people to the organization, as well as a forum for holding more non-technical conversations. The greatest value though was in how conversations at these happy hours has formed much of the foundation for the direction of the IPT.

Envisioning Mach 30's Future

The focus at Mach 30 over the last few years has been heavily geared towards growing our ability to develop open source spaceflight hardware. Past projects have included software development to build our software infrastructure including launching Open Design Engine, our open source hardware project hosting platform, contributing to CadQuery as mentioned earlier, and starting the Mathematics Tool Kit project (also discussed earlier). We have also refined our approach to distributed collaboration as we worked on the Shepard Test Stand, Ground Sphere, and the Yavin Cold Gas Thruster.

To truly fulfill our mission of hastening the advancement of humanity into a spacefaring civilization we need to do more than just design and build spaceflight hardware. We need to build a sustainable business model to support the material costs of our programs. We need to spread word of our work and mission to a wider audience. And we need to grow our volunteer base to support more and larger projects.

To these ends, and based on the groundwork laid by the Mach 30 Happy Hour community, beginning in 2016 Mach 30 is unifying its technical and non-technical volunteers to form a single Integrated Product Team (IPT). This team will be composed of the technical team members from the #EngineerSpeak community and our business, marketing, and social media volunteers who have been been, until now, working independently from the technical team.

The IPT's focus will be on implementing Mach 30's mission one project at a time, while the board (volunteer and contractor assistance) will handle the administrative work. The IPT's focus will concentrate our resources on the most important work and give the IPT members the opportunity to do what they love - work on open source spaceflight projects. For 2016 the primary project will be an updated Ground Sphere satellite receiving station, tuned to receive signals from the ISS, with the goal of using it to support market research for a kit or other Ground Sphere products.

The selection of this goal and project comes directly from the research done by the Happy Hour community and will start Mach 30 down a path toward unifying business, outreach, and engineering needs. Watch the Mach 30 blog and social media channels for updates throughout 2016.

2015 Hall of Donors

We are able to do the things that we do because of generous donations of both time and money from you, our supporters and community. This year, the generosity of our donors and the efforts of our volunteers enabled us to host the second Apogee conference. This included a set of presentations and multiple opportunities to directly engage with those outside of Mach 30 about open source spaceflight. Our hardware projects have continued to grow and develop with an inflow of revenue and time. This year's project focus was the Yavin cold gas thruster. This project has not only allowed Mach 30 to develop the hardware itself, it has also allowed us to create new tools that will keep Mach 30 on the cutting edge of spaceflight design for many years to come.

To our Volunteers:
All of Mach 30's work is supported by volunteers like you. All efforts are important, whether you work on a specific hardware design team, a policy task force, marketing project, or a board membership position. It has taken a great deal of effort to figure out how to market Mach 30 effectively to the public, and we have had a great team step up to help us do that. Volunteers: we greatly appreciate all the hours and energy that you spend on Mach 30's behalf. Thank you!

To our Donors:
Monetary contributions are the lifeblood of any organization, without which there would be little progress on our mission. Hardware in particular can be expensive to develop, and as time goes on Mach 30 will have bigger hardware projects to undertake. To our core community of financial backers we say a hearty and sincere thank you.

Financial Data

Thanks to the support of donors and the work of our volunteers, Mach 30 was able to cover approximately $3,000 in expenses during 2015, and will start 2016 with over $6,200 available to continue operations. Our largest single expense during the year was Apogee II at around $1000, with the event generating an income of around $700.00. Operating expenses made up the rest of Mach 30's expenditures at around $2200.00. No money was spent on hardware projects in 2015.

Donors were the source of approximately 90% of the income for Mach 30 during 2015. In total, donors gave $5,000, $560 of which were one time donations. We greatly appreciate our donors' willingness to back Mach 30, and as always we will handle our finances in a transparent and careful manner.
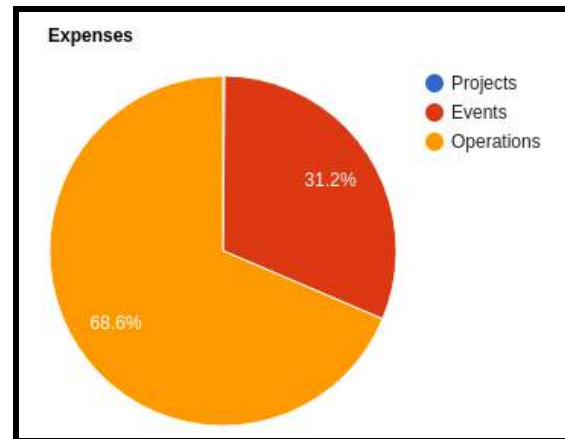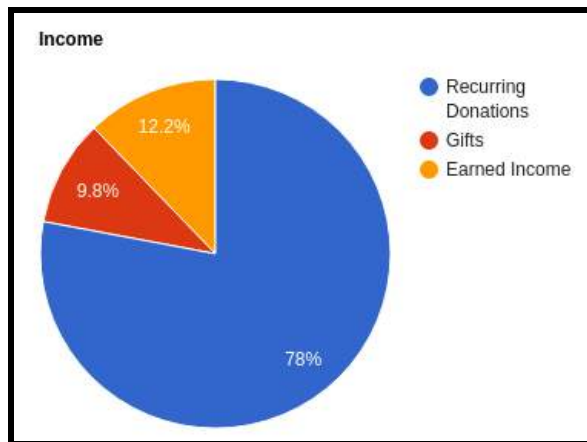
Mach 30's 2015 expenses had a different set of ratios than in previous years. The chart above highlights two of these differences. First, our project expenses did not register on our financial reporting in 2015 due to a heavy focus on software development (bits are free, atoms cost money). Second, operations expenses grew in 2015, reflecting our use of contractors to supplement volunteer capabilities.

Thank you again to all of our 2015 donors. You directly enable the operations of Mach 30 by your generous contributions, and we greatly appreciate your support.

Mach 30 Volunteers

We greatly appreciate the support of our volunteers, and would like to acknowledge their contribution to the organization. Below is a list of all of the people that helped continue the Mach 30 mission in 2015.

Carl Barbour
Charlie Bellows - Board Advisor
Jason Daniel
Brad Feddersen
Juli Fowler
Aaron Harper
Brian Lorelle
Ray McCauley
Ryan McKnight
Rebekah McGrady
Matt Maier - Board Advisor
Greg Moran - Vice President/Secretary and Director
Josh Sharpe
Chris Sigman - Board Advisor
J. Simmons - President and Director
Ingrid Velasquez
Jeremy Wright - Treasurer and Director

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Mission Statement: *To advance humanity into a spacefairing civilization through open design practices, sustainable leadership and a bias towards mature technology.*