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# **Executive Summary**

## **About M-SET**

Robotics is rapidly becoming the new era of technology from the rise of artificial intelligence to personal robots. The Mechanical Science and Engineering Team serves as a platform for students of Saratoga High School to further their interest in the fields of STEM, as well as prepare them with the knowledge and experience necessary to pave the way for the robotics movement. By providing hands-on experience through interactive and competitive challenges, M-SET also fosters personal and team development.

## **Mission Statement**

Our mission is to prepare students for future success by helping them establish strong communication and technical skills through the creation of high quality robots and maintaining a student-led organization.

## **Core Values**

### **Student-driven Culture**

- Since student success is our mission, it is vital to our club that students are the ones leading and learning from each other.
- We maintain our student-driven culture by appointing student officers that manage the club and make central contributions to club operations. Officers also lead all aspects of building robots, from design to competition.

#### Individual Growth

- We focus on establishing an atmosphere where students interested in STEM can work together to build robots while developing the skills necessary for industrial-level jobs.
- Some important qualities that students gain and improve during their participation in our program are their communication, time management, and technical abilities.

## **Continuous Improvement**

- We concentrate on making decisions that benefit the long term success of the club by buying material and machinery that will improve the quality of our future robots and passing on our research and knowledge to incoming members through documentation and training.
- A majority of our mentors are parents who "graduate" with their students. This means that our club's mentors are constantly changing, requiring us to take further initiative to preserve the club's status by recording new changes so future generations of mentors and members will not need to start from scratch.

#### FIRST Ideals

- These include Gracious Professionalism<sup>®</sup> and Coopertition<sup>®</sup>. As a club that competes in both FRC and FTC, it's extremely important that we respect, understand, and exemplify these ideals in everything we do.

## Why Business Plan?

The purpose of the business plan is three-folded: fundraising tool for sponsor visits and operational plan for future generations. We hope that through the creation of the business plan that future generations will maintain the same mission and core values as our program does today.

# Why Are We Unique?

M-SET is different from other robotics programs in that our **FTC and FRC robotics programs** are not mutually exclusive. In other robotics programs, FTC members generally continue to stay in their team for the duration of their time in high school; however, in M-SET, our FTC teams are treated as a starting block for members who are new to robotics. As a result, no M-SET member has participated in a FTC team for more than 2 years, and over 90% of our FRC team are FTC alumni.

We decided to treat the FTC program as an **elevator program** to FRC so that new members who are unsure about staying in robotics can get more hands-on experience with a small scale robotics project before participating in FRC, which may seem intimidating for new members.

Another unique aspect about M-SET is the **student-driven leadership**. In many FRC and FTC programs, mentors play a large role in the decision-making process of the team, sometimes even dictating how to build the robot. However, at M-SET, while mentors are mainly resources that the students can refer to, ultimately, robot designs and team organization are managed by the students. Sometimes mentors feel obligated to "bite their tongue" when our teams ventures into the wrong direction, but this allows our team to learn from our mistakes.

Finally many of our **members are involved in more than one tasks** in the team. Our team does not have designated competition or outreach group. All of our non-technical members participate in either a hardware subsystem team or the scout app team. The members who visit sponsors and schools are the ones who know the robot the best. In this way, all of our members gain not only technical skills but also soft skills.

## **Team Summary**

Located in Saratoga High School in Saratoga, California, M-SET Fish started as a FRC team in 2001 under the name Saratoga Robotics Team. After a long hiatus, the team revived in 2009 as the Mechanical Science and Engineering Team (M-SET Fish).

Our greatest challenge throughout the years is maintaining strong communication with the school administration. Our team is not officially affiliated with the school due to lack of teacher mentors, so the team doesn't receive much funding from the school. Instead, we seek outside support from sponsors such as SanDisk, Google, and Apple for general grants and machinery. In 2015, a teacher mentor joined our team, allowing us to secure larger facilities and greater campus presence.

Ever since 2009, our team has established a flywheel approach as the cornerstone of our decision-making: instead of building our robot to incorporate the newest technology like computer vision, our team focused on continuously improving the subsystems on our robot, like flywheels and software capabilities.

As a result, our team presence has grown not only on campus but also in the FRC community.

In 2011, there were only about 50 members in FRC; now there are over 100 participants. Our current female to male ratio greatly increased from 2011, from 5 female members to 37 members currently. Our team's retention rate has also increased over



the years from about 70% to almost 83%, which has greatly influenced our presence on campus. Due to the growth in membership, our team is working with the school administration to secure larger facilities for our teams.

### **Changes made in 2016-2017:**

- Added 4th FTC team, 9965 Lionfish
- Added to new officer positions: Business Lead and Scouting/Strategy Lead
- First year with student involvement in program's budget
- Created a program business plan
- Implementation of parent booster group



### Outreach

We host tournaments and open houses and bring robots to events like football games and rallies in order to demonstrate them and share information about our program. We also host sessions during the summer at a local church where we expose children to the wonders of robotics. While benefiting FIRST, these efforts promote STEM to students and the community by introducing them to exciting and valuable experiences.

### Achievements

2016-2017 Season	Las Vegas Regional (April 2017): TBD Sacramento Regional (March 2017): TBD	
2015-2016 Season	Calgames (October 2016): Finalist Alliance Captain Silicon Valley Regional (April 2016): Imagery Award in honor of Jack Kamen, Semifinalists Central Valley Regional (March 2016): Excellence in Engineering Award sponsored by Delphi, Semifinalists	
2015-2016 Season	Calgames (October 2015): Semifinalists Chezy Champs (September 2015): Quarterfinalists St. Louis World Championships (April 2015): Quarterfinalists of Curie Division Silicon Valley Regional (April 2015): Regional Finalists Central Valley Regional (March 2015): Innovation in Control Award sponsored by Rockwell Automation, Quarterfinalists	
2014-2015 Season	Colorado Regional (April 2014): Dean's List Finalist, Quarterfinalists Central Valley Regional (March 2014): Semifinalists Alliance Captain	

# **Program Information**

# **Basic Program Info**

Rookie Year	2001	
Location	Saratoga High School, Saratoga, California	
School Affiliation	Saratoga High School	
Team Demographics	109 members - 37 females and 63 males	
Mentors	31 mentors - 1 faculty, 6 technical, 24 parents	
Sponsors	SanDisk (a Western Digital brand), Apple, Brian and Monica Berkeley, Intuitive Surgical, Festo, Joyce and Howard Lorenz, Santa Clara Plating Co., M&L Precision Machining, SolidWorks, GrabCAD, Screened Images, Google, Bill Gorman	
Website	https://msetfish.weebly.com	

# **Demographics**

In 2011, there were only about 50 members in FRC; now there are over 100 participants. Our current female to male ratio greatly increased from 2011, from 5 female members to 37 members currently. Our team's retention rate has also increased over the years from about 70% to almost 83%, which has greatly influenced our presence on campus. Following this trend, our program expects to reach 135 members by 2020. Due to the growth in membership, our team is working with the school administration to secure larger facilities for our teams.



100% of our members attend college, and many of them pursue a STEM major. We hope that further growth in the team will encourage more members to pursue STEM, especially female members.

### **Member Benefits**

### For Students:

- Learn to work and communicate with other students, staff, mentors, and sponsors
- Develop the knowledge and experience to succeed in the fast-advancing technological world with industry-standard software (i.e. SolidWorks and GrabCAD) and machine-shop tools
- Progress into higher education with 97% of members pursuing STEM careers
- Participate in student-led leadership
- Give back to community with outreach events through presentations and demonstrations
- Plan and lead subteam training for new members

#### For Mentors:

- Support students in their pursuit of "real-life" learning that cannot be replicated in the classroom
- Share knowledge and experience with students to help them with areas in technology and business
- Hold tool and safety training to prepare students for build season

#### For School:

- Fosters student interest in STEM fields by being a major proponent for the creation of the Project Lead the Way (PLTW) engineering courses
- Brings recognition to the school through awards that M-SET receives
- Supports FRC team through financial support and larger facilities

## For Sponsors:

- Support the next wave of innovation for our society by developing potential employees
- Fund the goals and dreams of M-SET and its members

# **Operational Plan**

M-SET puts the most emphasis on FIRST programs. Incoming freshmen are highly encouraged to join FTC to cultivate skills, while veterans typically join FRC. **More information on these FIRST programs can be found in the FRC and FTC sections.** 

## Leadership

M-SET focuses on spreading the message of independence and self-induced learning by enforcing a student-driven infrastructure and encouraging members to take up mentorship roles. We recognize non-technical leads in addition to the traditional technical leads.

The program has nine student leadership positions; some of the positions are specific to a certain program (i.e. FRC), while others are responsible for general M-SET operations. Each student lead is expected to attend a weekly lunch officer meeting led by the main parent mentor and the program adviser. While the mentors set the agenda for the meeting, the students are encouraged to lead the discussion and make the decisions, with the mentors having the final say.

**President:** Works closely with mentors, industry, and staff to ensure good communications, resolve conflicts, and make decisions. The President also manages communication between all the sub-teams in FRC.

**Hardware, Software, Electronics:** Lead and educate FRC members in their respective areas and ensure that the robot is complete

**Safety (FRC):** Establishes safe practices and works with mentors to plan tool training

**Marketing:** Responsible for flyers, presentations,

videos, and program apparel design

**Business:** Works with mentors on program

budget and business plan

Admin: Assists mentors with paperwork and

training or tournament signups

**Outreach:** Organizes outreach opportunities for M-SET and leads Chairman's team

**Strategy (FRC):** Organizes scouting and team strategy in FRC competitions

TARC: Leads TARC team and manages communication between TARC and M-SET

FTC: Manages communication between FTC and M-SET



### **Human Resources**

## **Off-season Training**

Our FRC officers hold trainings during the summer and beginning of the year for rookie members to prepare them for the season. Training covers topics including technical design, robot and app code, and award submissions. Members are encouraged to attend all the trainings so that they can find their niche.

# **Safety and Tool Training**

Safety training is the **only** prerequisite for members to work in the M-SET room, while basic tool trainings enables them use simple tools such as the hammer, screwdriver, and hand drill. These trainings are led by trained parent mentors and the Safety Captain.

Additional specialized tool trainings focus on more difficult shop tools, including but not limited to the chop saw, drill press, and CNC mill. Tool training must be renewed each year to ensure student safety and preservation of skill.

### **Facilities**

Our main robotics room is in an old theater set design workshop that features a smaller side room for coders, a walk-in closet and open space for robot production. In 2014, our program was allowed to install the FTC practice field at the back of the engineering woodshop. In 2017, we were given permission to use the school's storage shed for our FRC practice field.



On the days where all four FTC teams and FRC are working in the main room, members often pour into the quad outside or into the engineering woodshop. Our main workshop can only fit about 40 members, and as our program is continuously expanding, the student officers and mentors are communicating with the school administration to inherit the larger drama workshop.

# **Outreach Plan**

Because our program does not designate certain members to focus solely on outreach, we try to keep our outreach local and accessible. As a result, the members who attend outreach events are those who know the robot best. Our program's outreach focuses on two aspects: community and sponsor outreach.

# **Community Outreach**

## **Open House**

Our program hosts two open houses at the beginning of the academic year in order to recruit new members. The first open house is geared towards incoming 9th grade students while the second open house is for current high school students. We also present our program at Back to School night and Elective night in the spring.

At the open house events, M-SET shows off our FRC and FTC robots, as well as answers questions about our program. While we encourage students to join M-SET, we also remind them of the time commitment required to be an integral part of the team.

#### Summer Outreach

In the summer, we took part in the local library's summer reading kick-off program by demonstrating our FRC and FTC robots, letting younger children drive the robot and teaching them how to make craft rockets. Also in the summer, we hosted a few sessions at a local church where we helped special need children make mini LEGO robots, and even coded some through the LEGO Mindstorm.



### **Rotary Art Show**

Every year, our program displays our FRC and FTC robots at the Rotary Art Show, an event that many parents and children attend. This is one of the main ways our program notifies the local community of what we've built and how we have improved over the years.

### **Sponsor Visits**

Our team regularly visit our sponsors (mainly Festo and Intuitive Surgical) to update them on our progress for the current competition season through robot demonstrations and to thank them for their support.

### **Robot Demonstrations**

During off-season, our teams visit local elementary and middle schools to give robot demonstrations. Our purpose is two-folded: to introduce STEM early to young students and to recruit members for future years. In fact, many of our current members developed an interest for robotics due to these robot demonstrations when they were in middle school.



### **Sponsor Visits**

Our team regularly visit our sponsors (mainly Festo and Intuitive Surgical) to update them on our progress for the current competition season through robot demonstrations and to thank them for their support.



### **Pridebot**

During offseason, we built a spirit robot "Pridebot" for football games and rallies that can toss towels and small goodies into the stands. Afterwards, we make ourselves available to interested students, parents and community members who have questions about the robot and the M-SET program. We hope that Pridebot will help increase our program's presence on campus and in the community.

#### **FLL/FTC** tournament

Hosting back-to-back FTC and FLL tournaments is a critical part of our community outreach. While the event benefits FIRST, this effort also promotes STEM to students and the community by introducing them to the exciting and valuable experiences of robotics.

# **Sponsors**

Our program would not have been able to accomplish all our ambitious goals without the help of our sponsors. Our sponsors include professional technology and robotics companies as well as generous personal donations. Many of our sponsors not only provide us with funds necessary to build a high-quality robot, but also support our teams with free software and fabrications.

## **Sponsors List**

Sponsors that provide mainly funds for FRC and FTC	SanDisk, a Western Digital brand Apple Intuitive Surgical Festo Google Saratoga High School ASB
Sponsors that provide human capital	Santa Clara Plating Co. (free anodizing) M&L Precision Machining (free machining) SolidWorks (free software) GrabCAD (free software) Screened Images (discounted apparel)
Personal Donations	Brian and Monica Berkeley Joyce and Howard Lorenz Bill Gorman

# **Financial Plan**

# Condensed Budget for 2016-2017

Revenue	2016-2017 Actual (as of 2/15/17)	2016-2017 Anticipated	2015-2016 Actual
Known	37899.28	32000.00	36409.91
Hopeful	14272.81	17384.00	4662.00
Total	52174.09	49384.00	41071.91
Expenses	2016-2017 Actual (as of 2/15/17)	2016-2017 Anticipated	2015-2016 Actual
FRC	6091.92	19800.00	31514.55
FTC	13825.92	7670.00	8951.50
Miscellaneous	1813.08	5050.00	1965.78
FLL/FTC Tournament	2572.64	2000.00	1772.17
Staff Travel	_	3000.00	1084.00
Total	24306.56	37520.00	45288.00

#### Revenue

More than 60% of our income comes from membership donations that we request for at the beginning of the school year. As seen above, the increased amount of members made a positive increase in our program's revenue.

## **Expenses**

The high expenses in FRC is explained in the FRC section of this plan. Generally our program tries to lend more on the conservative side of finances, but we do recognize that good robots require good mechanical components, which is why we are constantly seeking new grants. The high expenses in FTC are due to the addition of a fourth FTC team, which our budget did not account for.

# **FIRST Robotics Competition**

The First Robotics Competition (FRC) is a robotics competition for 9-12th grade students. Teams compete 3 on 3, playing games that are released annually. FRC robots are almost completely custom-made, compliant with strict rules, built within an intense 6-week build season, and programmed using Java. Additionally, FRC students must analyze, strategize, raise funds, design a team "brand," and hone teamwork skills.

In the context of M-SET, FRC serves as a more challenging program for students to participate in. A vast majority of the FRC team are rookies of M-SET, having completed a year or more of FTC (See page 20 for FTC section) before joining FRC. M-SET FRC students take large leadership roles within the team and the club while also serving as mentors for younger students.

# **Program Summary**

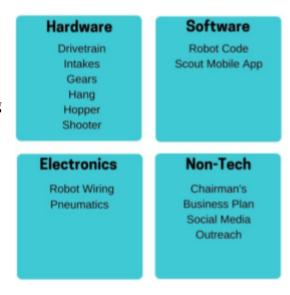
M-SET started as an FRC team in 2001 under the name Saratoga Robotics Team, and after a few years of long hiatus, the team revived in 2009 as Mechanical Science and Engineering Team (M-SET Fish). Ever since 2009, our team follows a flywheel approach as the cornerstone of our decision-making: instead of building our robot to incorporate the newest technology like computer vision, our team focused on continuously improving the subsystems on our robot, like flywheels. As a result, our team presence has grown not only on campus but also in the FRC community.

# **Operational Plan**

## **Team Organization**

Many of the M-SET officers' responsibilities carry over to the FRC team. These officers are expected to act as role models to incoming members and manage both their M-SET duties along their FRC ones.

During the build season, the FRC team is divided into five main groups: software, hardware, electrical, business, and strategy. Software and hardware are further divided into subgroups to organize the building process. Software has two subgroups: robot code, which programs the robot, and scout application, which creates an app every year to help with scouting. Hardware is divided differently every year based on the number of robot subsystems.



### Scheduling

After the FRC kickoff, our team goes into a six weeks build period. During this period, our team meets every day: on the weekdays, the workshop is opened typically from 3pm-9pm, and from 12pm-10pm on the weekends. As the end of six weeks nears, the team generally meets for extra hours in the room, often up to 12am - 1am.

After build season, the team continues to meet in the room regularly, usually daily from 3:30pm to 9pm, to continue improve the robot and finish non-technical work.

During off-season, each subteam (hardware, software, non-tech) create their own schedule around the training sessions. Generally, the subteams choose to meet twice a week: once on Sunday and once on a weekday.

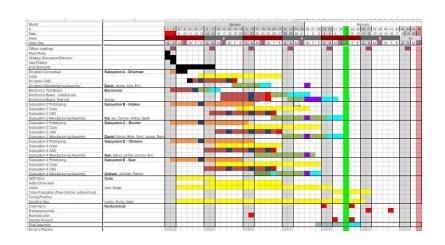
### Communication

In the past, our team has used Facebook Messenger to communicate. However, with the growth of our team, Messenger has become too crowded to use efficiently. This year, FRC made the transition to Slack, another social media platform. Not only does Slack lets users organize chats into branches (i.e. General, Hardware, Software), but the organization allows us to separate important information from spam or random messages. Although a majority of our conversations now use Slack, Messenger is still used for quick questions and reminders.

### **Project Management**

During the first week of build season, the FRC officers create a Gantt chart for all the different sub-teams so that the layout, deadlines, and important dates of the six week build season can be seen in a glance.

During the first week, hardware members are separated into teams and work together to build prototypes of their respective



subsystem. On the first Friday of build season, each team presents at a design review meeting and members decide on the subsystems that they want to incorporate into the final robot. From then, design reviews are held weekly to ensure that subteams are on track with production.

Our team makes two robots: one to bag away at the end of six weeks and one as a practice robot. Once the final robot is bagged, our team use the practice robot to make additional hardware and software changes. Because the software team cannot write code until the hardware is finalized (usually around Week 5 of build season), they rely heavily on the practice robot as a platform for writing code.

### **Documentation**

Our team documents all our hardware and software work in a technical binder so that we can pass the knowledge down to future generations of our team. The hardware section contains mathematics (especially motor calculations), geometry sketches, and CAD designs and renders of subsystems at different stages of the section. The strategy section, a subcategory of hardware, contains specific details on every subsystem and justification for our team's requirements for major design decisions.

The software section will have justifications and calculations for the sensors used on the robot. During off-season, our team is looking into including information about the scouting mobile application.

	person accountable	tools needed	parts involved	weight loss/addition	estimated amount of time (
remove hopper	nicole				
check solenoids	samay/basi/valen				
remove intake funnel pistons and solenoids	kai	hex key set, ziptie snips, wrench		-1	10
flash router	samay	router		0	2
remove climb	akhlesh	1/4-20 hex key		-7	6
remove agitator tubes	nicole	1/4-20 hex key, 10-32 hex key		-3	10
shooter wheel spacers	nicole	hex key that fits into collar	3d printed flywheel spacers, hex shaft collars		10
install polycarb gear flicker front panels	akhilesh	black buttonhead, 10-32 hex key	front panels	-0.1	
install gear centerer	akhilesh	10-32 hex key, who tape	centerer pieces, VHB, 10-32 bolts	0.05	
install radio	samay				5
mount autonomous selector	samay	vhb tape	autonomous selector, potentiometers		5
install polycarb gear funnel	akhilesh	drill, 10-32 hex key, rivet gun, wrench	polycarb gear furnel, rivets, 10-32 nuts and bolts		
replace compliant feeder with omni	nicole	hex key set	omni wheel		7
install battery holder	samay	rivet gun	rivets		
install topper	david	rivet gun	topper, rivets, zipties		
install axis camera	david	drill + stepper bit	3d printed axis mount		
other wiring in general and SENSORS	samay	electronics toolbox, who tape			
move wires under air tanks	samay				
install hopper gear box cover	nicole		gear box covers, 10-24 bolts	0.1	
remove old intake, install new intake	kai	collar hex keys, 10-32 hex key, ziptie snips, gentle pursuader	veloro, flanges, zipties, aluminum collars	0.5	15
driver's tape on gear flap	kyle	gaffer's tape			
install sponsor panel	akhlesh	rivets, rivet gun, who tape	sponsor panel, standoffs, polycarb strips		
install ratchet	kyle	drill, imp. hex key set, wrench	10-32 nuts and bolts		
install hopper retention brackets	nicole	drill, imp. hex key set, wrench	10-32 bolts and nuts		
put green acryllo in	kyle	adhesive	acrylic triangles		
install electronics cover	samay	10-32 hex key and wrench, rivet gun	10-32 nuts and bolts		
fit hopper	nicole	none			
fit bumpers	david	screw driver			
lights	kyle				
check solenoids	samay			0	15-45

Finally, the competition section includes our team's 8 hour plan for each regional, which breaks down exactly what will happen to our robot once the competition pits open. At the end of each regional, reflections and goals are included in the section as well.

# **Financial Plan**

Revenue	2016-2017 Actual (as of 2/15/17)	2016-2017 Anticipated	2015-2016 Actual	
Membership Donations (includes FTC and FRC)	22200.00	19,100.00	15791.00	
SanDisk Matching	3960.00	3960.00	8600.00	
Personal Donations	10424.28	3000.00	_	
Bill Gorman	1000.00	_	1000.00	
Cellular Phone Repairs	_	_	500.00	
Apple	5000.00	5825.00	5000.00	
Festo	_	500.00	500.00	
Berkeley Stock	2052.89	1500.00	1730.00	
Intuitive Surgical	1000.00	1000.00	1000.00	
Total Revenue	45639.17	34885.00	34121.00	
Expenses	2016-2017 Actual (as of 2/15/17)	2016-2017 Anticipated	2015-2016 Actual	
Registration <sup>1</sup> 5000.00		9500.00	9800.00	
Robot Manufacture	391.92	9800.00 <sup>2</sup>	12921.63	
Field, Pit, Supplies	_	800.00 <sup>3</sup>	482.57	
Food	609.77	2000.00	991.03	
Promotion (banners, buttons) 164.52		800.00	550.63	
Tools	1001.63	1500.00	8310.35 <sup>5</sup>	
Miscellaneous Supplies	37.16	250.00	194.17	
Staff Travel Expenses	_	3000.004	1084.00	
Total Expenses	7204.08	27650.00	34334.38	

### Revenue

Our main source of revenue is from membership donations. Upon registration, members are asked to pay a recommended fee of \$250.00, which, as seen in the budget table, goes a long way. Due to the increased interest in M-SET this year, our team received generous donations from parents and local businesses (under personal donations), which include Brian and Monica Berkeley, Joyce and Howard Lorenz, and Bill Gorman.

While SanDisk may not be our sponsor in future years due to recent acquisition by Western Digital, our team receives other financial support from Google, Apple, Intuitive Surgical, and Festo. Our team also receives human capital support from sponsors such as Santa Clara Plating Co., M&L Precision Machining, SolidWorks, GrabCAD, and Screened Images.

### **Expenses**

Actual expenses for FRC are minimal at the moment because our team is still in the middle of build season. Some notes of importance:

- 1. 2016-2017 FRC registration is paid for by Google.
- 2. 2016-2017 anticipated manufacturing costs cover a new control system.
- 3. Due to the complexity of the new challenge (Steamworks), our anticipated field expense is much higher.
- 4. Our team decided to participate in an out-of-state Regional, resulting in higher anticipated expenses for travel (includes transportation, hotel, and food).
- 5. 2015-2016 tool expenses were unusually high because we invested in a new band saw.

# **Strategic Plan**

# **Out-of-state competitions SWOT**

Strengths	Weaknesses	
<ul> <li>Able to compete with new teams</li> <li>Enrichment for members going, increased excitement for competition</li> <li>Good PR - more interested students in the following year</li> </ul>	<ul> <li>High shipping costs</li> <li>Heavy preplanning with forms, hotel assignments, transportation</li> <li>Many members have other commitments (ie band)</li> <li>Need more parent support</li> </ul>	
Opportunities	Threats	
<ul> <li>Time to relax from school and is fun</li> <li>Learn new strategies or technical skills from teams not usually around us</li> <li>Great networking experience</li> </ul>	<ul> <li>Taking funds for travel leaves fewer funds for other expenses</li> <li>Time taken out of school can lead students to fall behind</li> <li>Somebody could get injured away from familiar commodities</li> </ul>	

In 2014, M-SET Fish attended an regional in Colorado to interact with different teams. Due to that rewarding experience, in 2017, our team will be traveling to Las Vegas for another out-of-state regional. We have a record number of students attending the trip, but with our increased number of mentors and officers, we are mentally and financially prepared for the trip.

# FIRST Tech Challenge

The FIRST Tech Challenge (FTC) is a robotics challenge that allows students to build robots that solves an annual challenge. These robots are typically made of mainly TETRIX parts and run on the Android platform. Participating in FTC encourages students to gain engineering and design knowledge, as well as develop problem solving and teamwork skills throughout the season.

M-SET encourages most incoming students to join the FTC program as a way to experience the robotics dynamic before working with a larger team on a large scale project in FRC. Unlike other teams where FTC members will stay with their teams as veterans, FTC members of M-SET will generally graduate into FRC. For this reason, the four FTC teams of M-SET contain mainly first-year members.

## **Program Summary**

The M-SET program founded four FTC teams: 6165 Cuttlefish, 7390 Jellyfish, 7641 Betta Fish, and 9965 Lionfish. The FTC teams have been extremely successful, reaching regionals most years. The interest in this program grows each year due to the successes of our teams. Having four teams and over 60 people working concurrently in the M-SET room often leads to conflicts over space, lack of mechanical parts, and organization. However, cooperation and communication between the teams quickly resolve these conflicts.

The FTC teams have received much recognition for their efforts. In 2015, all three FTC teams were promoted to regionals and received awards for their outstanding performance both on the field and off. Two of our teams fought their way the semifinals, and one team won a Judges' Award for the effort they put into their robot.

# **Operational Plan**

## **Team Organization**

At the first FTC meeting, the students are asked to fill out a notecard with the sub-group (hardware or software) they are interested in, past robotics experience, and a small list of members that the students want to work with. Mentors work with the FTC Lead to create balanced teams.

The FTC Lead oversees all four FTC teams and plans basic hardware and software trainings during the summer. Each team also has a captain who leads the team. However, team structures differ between teams; teams have the freedom to create whatever structure they feel will most benefit them.

Each team consists of three student-led groups: software, hardware, and non-tech. Each group has a responsibility to help the team by finishing their tasks. Cooperation and constructive criticism between the groups ensures high-quality robots that the team is satisfied with.

### **Scheduling**

Our four FTC teams meet at least twice a week for two to four hours. The meetings are directed by students with the assistance of one parent. The teams usually meet once during the weekend and once during the weekday. Before competitions, teams will meet more frequently, sometimes from after school to late night.

## **Competitions**

The four FTC teams each choose 3-4 qualifying tournaments to attend every year. M-SET also hosts a scrimmage among the four teams to determine which team is guaranteed a spot at the regional tournament. During this scrimmage, parents and mentors analyze engineering notebooks, team dynamics, and robot construction along with the robots' performances on the field.



## **Financial Plan**

Each FTC team receives a budget from the M-SET program to buy mechanical parts or sensors. The teams must conduct research on the parts, then notify a mentor that they wish to purchase the part. The costs of the ordered parts are then deducted from the FTC budget.

# Strategic Plan

## **Traveling for tournaments**

Strength	Weaknesses	
<ul><li>Ability to participate in more tournaments</li><li>Compete with a wide variety of teams</li></ul>	<ul><li>Costs are much higher</li><li>Traveling may damage the robot</li><li>Important tools and parts may be forgotten</li></ul>	
Opportunities	Threats	
<ul><li>Gain new experiences</li><li>Increases awareness of our club</li><li>Network with other teams</li></ul>	<ul><li>Potentially dangerous for students</li><li>Possessions might get stolen</li><li>Unfamiliarity with area and people</li></ul>	

In 2015, the three FTC teams (Jellyfish, Betta Fish, Cuttlefish) took the opportunity to compete at a qualifying tournament in Sacramento, which required planning travel and hotel logistics. The teams found the trip to be a new and rewarding experience.

### Adding an additional FTC team

### **Strengths**

- Increases number of members we can accept
- Smaller teams = more personalized learning
- Easier to work together and brainstorm as a team
- Promotes more people to join with additional space

### Weaknesses

- Takes up additional space in the room
- Must provide funding for registration and materials for additional teams (increase budget)
- Need more mentors/parent support
- Need to plan more for logistics in terms of tournaments and travel

## **Opportunities**

- Increased M-SET presence in FTC community
- More potential budding FRC members (pipeline)
- More students with better ideas can lead to an improvement of ideas
- More students lead to growing awareness of the club

### **Threats**

- Not enough committed members to successfully run the team
- Not enough resources: money, mentors, space, tools
- Teams can become increasingly competitive and less Graciously Professional

After analyzing the strengths and weaknesses of adding an additional team, we decided to continue with our initial idea setting up our fourth team, 9965 Lionfish, in 2016. As a result, we were able to decrease the number of students we turned away.

# Strategic Plan

## **Overall M-SET SWOT**

Strengths	Weaknesses
<ul> <li>Unique branding/image</li> <li>Student-run program (sideline mentors)</li> <li>Inner-team rapport</li> <li>Strong financial support</li> <li>Good relationship with school faculty</li> <li>Veteran members leading workshops</li> <li>Emphasis on both technical and nontechnical aspects</li> </ul>	<ul> <li>Small team of core members</li> <li>Time management</li> </ul>
Opportunities	Threats
<ul> <li>Increasing number of interested members</li> <li>New facilities for practice field</li> <li>Outreach to various schools and programs</li> <li>School faculty mentor</li> <li>New parent booster group</li> </ul>	<ul> <li>Loss of nearly half the team and core mentors (graduating seniors and their parents)</li> <li>Potential loss of major sponsors (ie SanDisk)</li> <li>Loss of facilities</li> <li>Not enough resources to support amount of interested members</li> </ul>

While our program excels with emphasizing student leadership and participating in more than one aspect of the team, we have problems with maintaining a steady pipeline of members and having enough resources to support the amount of interested members.

# **Risk Management**

Our teams have analyzed and categorized potential risks into categories of high, medium, and low categories, and created a plan of action for each risk. Some of the risks with a higher potential of occurring include a surplus of potential members and loss of human capital, while risks with lower possibilities are low budget and loss of facilities.

Probability Key: Low, Medium, High

Risk	Туре	Mitigation	Prevention
Low income		Search for new grant opportunities, plan for a surplus of money in budget	Monthly budget review meetings Cut down on expensive FRC parts

Too many costs	finances	Switch focus to FTC only, FTC uses less funds than FRC	Require mentor approval for purchases
Too many people want to join	membership	Make membership on first come, first serve basis. Officers and most active veterans guaranteed membership	Create more FTC teams or put more people in each team
Empty pipeline	membership	Give demos at middle and elementary schools to foster interest in STEM Promote M-SET in Computer Science and Engineering classes	Present and promote, do outreach Design M-SET apparel to increase awareness
Serious Injuries	safety	Call 911 if necessary	Basic safety training, safety rules for using machines and tools
Loss of veterans	human capital	Contact veterans for assistance or create a veteran network	Creating documentation of different hardware, software, electrical training so that knowledge can be passed down
No more mentors	human capital	Reach out to community through weekly email sent by principle	Create a Parent Booster Group that recruits more parent mentors
Loss of building	facilities	Move into back of engineering lab or share classroom with one of our teachers	Attend school board meetings and persuade school administration to move us to a larger building
Member misconduct	public relations	Expel student from M-SET	Members sign behavior conduct agreement at time of membership