Date	Location	Start Time	End Time	Week #
Off Season	Various			0

Meeting Goals: Lessons Learned; Off Season Research - Drive Train, Powder Coating; Game Manual 0

Lessons Learned - Whole Team

Every year after our season ends, we sit down as a team to discuss some of the things we did right, some of the things we did wrong, what we should never do again, and how we can fix these things. This is a fantastic way for our returning members to reflect on our season and use it as a guide for what we can do better next year, and also a good learning experience for our new members to get an understanding of what goes into being a part of an FTC team.

Things We Did Right:

●Got a strong, early start:

•Generated a strategy and scoring analysis (back of the envelope at kickoff, refinements later) before anything else was done.

•Did brainstorming up front and fast (all within a week of kickoff).

•Set early goals (1 point by 1 October) and had goals and stretch goals throughout the season.

•Attended an early qualifier -- Early forcing function that provided lots of early motivation.

●Robot construction:

•The subsystem paradigm was employed more effectively this year. In general, the results were that:

▪Overall design appeared simpler than in years past.

▪Robot was easier to work on.

▪Subsystems were easier to swap out/add later in the season.

•Prioritized subsystem construction based on strategy. The subsystems needed for the early qualifier were designed and built first.

•The resulting robot was incredibly reliable. The lack of scrambling to fix the 'bot in the pit allowed the drive team to better prepare for each match and directly contributed to the fantastic competition results.

•Addressed the autonomous software early--It was not put off until the last minute.

Things We Did Right: (continued)

•Employed multiple design methods as the situation warranted: CAD, free form cardboard & duct tape, etc.

•Introduced some new materials to the robot and employed parts generated in a machine shop.

●Practice:

•Driver Practice:

■Did much more than in years past.

■Was able to practice driving from different positions and doing different jobs.

■Videos of the practice matches provided the drive team with a fresh perspective and helped identify things that needed to be improved (both on the robot and in the driving).

•Judging practice:

■Did many more run-throughs than in seasons past.

■Everyone spoke to something they knew--there was no 'winging it'. The result sounded authoritative, comfortable, and conversational.

■Brooklynn spoke louder. (Everyone who was uncomfortable speaking to the judges took it upon themselves to practice extra hard. Other teammates helped and some unique, very helpful exercises were devised.)

●Competitions:

•Attended more competitions than ever before. The team improved with each outing.

•Video recording of competition matches (of us and other teams) were used as scouting, review, and learning tools. Often yielded a fresh perspective of our own performance.

•Discussed strategy, ran autonomous, and practiced with our alliance partners prior to the match.

•Watched other teams/future opponents/partners practice. Provided insights into their capabilities and strategies.

•Scouting evolved into taking notes and recording impressions and behaviors of other teams. The drive team learned to seek out and use these impressions to set expectations and eliminate surprises.

●Pit:

•The display boards told a story.

Things We Did Right: (continued)

●Outreach:

•Did a variety of outreaches that touched different age groups.

•Communicated with and provided help to a number of other teams.

●Meetings at AvaLAN:

•"Chalk talks" - When decision points were reached, stopped and discussed the alternatives then made course corrections as a team. Often resulted in to-do lists on the whiteboard. Everyone was able to contribute and see progress. Crossing something off the list was a major accomplishment that everyone shared in.

•New shelving and much better organization of stuff.

•Occasionally took a break and did some team building (ice cream!).

Things We Did Wrong:

●Time management:

•We did really well up to the first Arkansas qualifier, but got behind through the months of November and December due to the Thanksgiving holiday and the December scrimmage. This resulted in a panic over Christmas/New Years and the month leading up to Alabama state.

●Robot:

•Experienced only one major hardware failure at competition--the ratchet failing to release during worlds. Several remedies were suggested, including periodic inspections of high stress points for wear (implies the need for checklists).

•Based on our success at the Arkansas qualifier, the lift design was set in concrete and not allowed to change. This made the subsystems developed later more complex than they perhaps could have been.

•Some CAD files were difficult to get ahold of through Dropbox. A more automatic method of saving SolidWorks files on-line, as they are being developed/revised, is being investigated.

●Engineering Notebook:

•Some got waaay behind with their write-ups. It was noted that due to the passage of time and fading of memories, write ups submitted late were generally not of the same quality as those submitted promptly.

Things We Did Wrong: (continued)

•Sometimes trivial, unhelpful engineering notebook write-ups were submitted (i.e. "I worked on the robot"). Write-ups always need some details describing the why and how. Also, any mistakes/missteps made along the way need to be captured.

●Competitions:
- •Did not bring enough hand-outs (robots, buttons) to worlds.
- •We always seem to be scrambling prior to competitions and outreach events. This may be unavoidable or it may indicate the need for some better planning.
- •Many of us got sick just after the competitions. More hand sanitizer?

Things We Should Never Do Again:

●Get so close to the weight limit.
●Write the Control Award submission on the way to a competition.
●Allow an ugly mess to develop next to the field walls.
●When speaking to visitors in the pits, we all need to be more cognizant of and careful to not interrupt, talk over, or push aside our more softly-spoken teammates.

Other Discussions:

●Need to do a better job of electronic communications:
- •GroupMe, Discord, and e-mail all have shortcomings, and some team members do not have ready access. The major complaint against most of these tools appears to be either the lack of channels/threads to keep discussions organized or too much distracting noise.
- •More direct communications during meetings may be in order.
- •These communication channels require that everyone recognize they are on a two-way street. Everyone must be responsible for sharing whenever they learn anything new (to include new strategies, approaches, rule interpretations, world record videos, etc).

●Need to better document the build process next year: At the end of every (week/build session/meeting?), photograph Vera in the same orientation(s) against the same backdrop. This will enable a stop-action like video of build progress through the year. Great addition to the story boards.

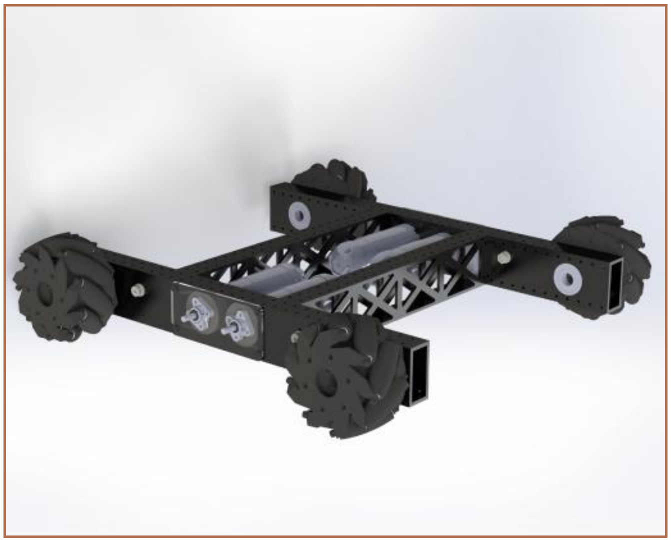
Other Discussions: (continued)

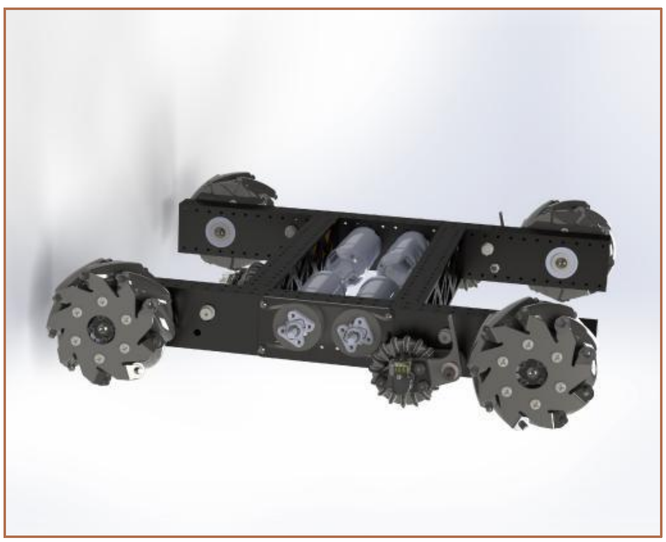
●Need more to-do lists throughout the season. E-mail does not get read by everyone, so quickly, at the beginning or end of each meeting, have a brief discussion and build/update the list of what needs to be done on a whiteboard. The downside is that this requires everyone to be present to be effective.
●To prevent getting surprised at competition by a part suddenly failing (i.e. ratchet at worlds), institute a program for the periodic assessment/replacement of high stress components. Could be a monthly maintenance checklist, a pre-competition checklist, or something else.
●Need to do more FLL volunteering! Last year, this was very rewarding (the Browncoats were even recognized with an award!), and we got the chance to do several demonstrations, so it crossed over into outreach.

Drive Train - Ian

Over the summer, I worked on multiple drive train designs in Solidworks (to varying degrees of completion). I spent the most iteration time on one drive train in particular. This drive train is a mecanum drive train (primarily because mecanum has been a very strong drive train for multiple years now) with a few key differences from our past mecanum drive trains. Firstly, the frame is built with box tube stock (two parallel “drive” beams and two beams perpendicular to the drive beams, called “cross” beams). Inside the drive beams are belts, one for each wheel (two per side). This reduces the width of the drive and more efficiently utilizes the available space. Secondly, the wheels are only supported from one side (two bearings in the box tube, which is called a cantilever) and are powered by live shafts. There are a few advantages to this style of drive train. Primarily flexibility and weight. The box tube construction reduces the amount of required components (no standoffs are required, for instance) and makes system mounting much easier, due to having a solid surface all along the top of the drive (the top face of the box tube).

This drive train went through three primary revisions (as well as multiple smaller revisions). The first was primarily an experimental concept check. It lacked many key components such as mounting holes and hardware. In the second revision, I decided to use c-channel instead of box tube for the drive tubes, primarily to aid in mounting component (the first revision made mounting components difficult due to the lack of inner tube access preventing the use of locknuts). However, this also proved suboptimal, primarily due to machining. Machining c-channel in a vise is far more difficult than box tube since the channel is more likely to deform. Additionally, c-channel is not as rigid as box tube is in general. For the third revision, this problem was solved by using 0.125” wall box tube (instead of 1/16” wall box tube). This will allow us to tap the walls of the tube (1/8” is slightly above the minimum thread engagement for 6-32 bolts, which is our standard thread size). We had also discussed using rivet nuts (threaded inserts that are installed using a rivet tool), but we decided that requiring more hardware would be expensive and inefficient. However, this solution introduced another problem: weight. 0.125” wall tubing is significantly heavier than 1/16” wall tubing. To solve this, we aggressively pocketed the cross tubes (reducing the weight from 0.75lbs to 0.4lbs), which brought the weight estimate to approximately 11lbs.

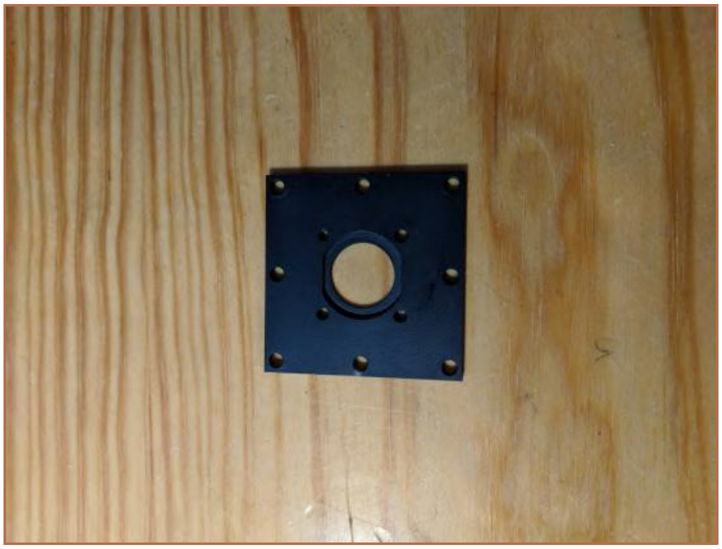




Powder Coating - Ian

Throughout the offseason, the team discussed our plans for the Skystone robot's color scheme. Shortly after the Rover Ruckus season, we decided that we wanted to adhere to a consistent aesthetic for the next robot. This would include reducing the number of filament colors for 3D printed parts, and potentially coloring the metal parts on the robot. In pursuit of this, Ian researched multiple methods for coloring metal. By talking to other teams and doing independent research, he found three different options for coloring the parts, each with their own drawbacks and benefits. The first method was spray painting the parts. The primary benefit of spray painting is the cost and experience. It wouldn't require any additional research or equipment, and all that's required are cans of paint. However, spray paint is prone to scratching or chipping from impacts, which would be common in a competition robotics setting. Additionally, spray paint is applied in fairly thick layers, which would require significant masking or filing to combat. Finally, we'd be limited by the weather outside, because spray painting must be done in relatively warm weather. The second option was anodizing the parts. This would provide a very durable finish with virtually no added thickness to the part, but it's a very time consuming and complex process, and requires harsh chemicals. Anodization is done with very alkaline and acidic chemicals, which the part is bathed in. The part must also be thoroughly cleaned because any oil, smudges, or scratches on the part would result in a splotchy finish. The final method is powder coating. This process involves using a dry, colored powder, which is sprayed via a powder coating gun connected to an air compressor. The end of the gun has a metal rod, which is very highly charged, and the part is grounded to the gun. This charges the powder particles as they exit the gun, causing them to cling to the part. After being coated in powder, the part is cured in an oven. The main benefits of powder coating are the simplicity and flexibility. Powder coating can be done in colder weather (because the powder is cured by an oven), and it's a much cleaner process than spray paint or anodization, because the powder can simply be swept up when finished. However, it also poses a higher risk of injury than spray paint, due to the high voltages. Finally, powder coating results in a much more durable finish than spray paint (though not as durable as anodization), and the thickness of a coat of powder is thinner.

Because of the relative danger of anodization and the restrictiveness of spray painting, we decided to powder coat our metal parts this year. Ian is researching more economical, DIY friendly ways to powder coat, which would allow us to coat our own parts, rather than rely on a professional shop (which would necessitate a longer return time).



{Game Manual 0 - Ian}

Game Manual 0 is a guide written by FTC alumni and veterans, including myself! The full version contains nearly 250 pages of information about a variety of topics related to FTC, including an enormous number of mechanical topics (drive trains, kit options, linear slides, intakes, and more), as well as a very in depth wiring guide and an overview of software topics. There's an absolute wealth of information here, which has been formed by our dozens of years of combined experience (we made mistakes to prevent you from making the same ones!) Our goal with this guide was to provide a comprehensive source of information for FTC rookie teams. We all learned through mistakes, conversing with others, and searching for scattered bits and pieces of information. Thus, we decided to write this guide to help more students get a grasp on the program, allowing them to focus more on building robots. It's been in the works since shortly after the Houston and Detroit Championships of this year, and it was only recently finished (shortly before kickoff). I'd recommend everyone to read through this, because there's so much valuable information within.

http://gm0.copperforge.cc/