

Section 6: Build Season

By Team 1718 – The Fighting Pi
www.fightingpi.org

Build season. It's what this competition is about. Six weeks of sleepless nights, problem solving, and excitement. To have a successful build season, teams need to start preparing well before kickoff. Experienced teams know that anything that gets put off until build season probably won't get done.

I. PRE-SEASON

The pre-season for rookie teams is especially busy. A rookie team has their work cut out for them. The best idea is to start as early as possible, and get both the students and parents involved in helping.

For most teams, updating their team shirts with new sponsor names can wait until just before their first competition. For a rookie team, creating their shirts will help to instill a sense of team. In addition, wearing them to fundraisers and other important events will establish a team identity.

That means you will need a logo and name. This is a great opportunity for a rookie team to get together, have a good time, and begin some team building before the season. Remember to keep the name short and the logo simple. After all, that logo is going on shirts later, and fewer colors result in less expensive shirts. The team name and number should both be included on the shirt, as well as important team sponsors.



A number of other preseason activities will need to be completed before the team is ready to begin the build season. These include:

- Establishing a build location
- Locating sponsors
- Applying to become a team on the TIMS system
- Recruiting team members
- Collecting student dues
- Collecting student contracts
- Recruiting mentors (background checks may be required)
- Gathering tools (see the tool checklist attachment and the tools section below)
- Gathering miscellaneous materials to build a robot like wire and fasteners
- Creating a budget
- Creating the contact list
- Completing the FIRST in Michigan (FIM) Consent form, usually found on www.firstinmichigan.org (required to attend kickoff!)

It is helpful to the team if they get to know each other before they are thrown together in a high-stress build season environment. To that end, consider scheduling a team party night. Schedule the first couple activities so that team members can learn each other's names, hobbies, and generally get to know one another. Group games that the entire team can play at once are excellent. Consider games like Pictionary, or other games where they can work together to succeed.

While the team is attending the team building event have the students log into STIMS to apply for the student release. The mentor will need to access TIMS to accept them, and parents will need to approve them. You might as well get it all done at once! There is also an option to print the release forms. If the team members can't complete them all before the kickoff, print the forms out and have them sign off at the kickoff itself. You will need to continue this process if additional members join the team later in the year. Remember to invite the team's mentors through TIMS – they have to sign a release form as well.



In addition, if FIRST Choice is open, it's a good idea to pre-register. FIRST Choice is an attempt by FIRST to lower the number of unused parts in the kit of parts, and allow teams to choose additional parts that suit their needs. In the past, registration has occurred at www.andymark.com, who hosts the FIRST choice program. Be sure that once FIRST Choice is open you IMMEDIATELY go online and order what you need. In 2011 most of the useful items ran out very quickly.

TOOLS

A well stocked toolbox is essential to start the FIRST competition season. Of course, a rookie team is starting from ground level in this regard. However, utilize the most abundant resource you have as a rookie team: parents! Use the tool checklist as a starting point for what you might want to consider for the team, and give it out to the parents to see if they have any tools available for donation. Even a single pair of pliers donated can save the team \$5.



Consider talking to the managers of your local hardware stores to see if they can sponsor you. Even purchasing the tools at wholesale can be a huge savings. Our team has found that we lose far more tools than we break, so rookie teams may want to consider quantity over quality. Harbor Freight is an excellent source for very inexpensive tools. A list of tools that rookie teams should consider is provided on the team 1718 download page.

The team will also need a place to store those tools. A full-sized tool box with wheels and drawers is an excellent option, especially when it's time to take the tools

to a competition. However, if you don't have a vehicle or trailer with ramps to roll the toolbox into, consider a number of inexpensive plastic toolboxes that can be easily carried. Remember to label your toolbox drawers and toolboxes as well! If the team doesn't label drawers and containers, don't be surprised when nothing can be found. If the toolboxes are going to be kept in a public area in a school, consider purchasing something that can be locked down with cables or padlocks.

Finally, remember that team members and even mentors may not be familiar with the safe usage of many tools. Tool training, especially on power tools, can be a good idea to maintain a safe working environment for the team. A versatility matrix can also be maintained to record what power tools team members are authorized to use. A sample versatility matrix is provided on the team 1718 download page.

In addition, the team will need storage for all the odds and ends they receive at kickoff. Two large plastic totes are generally supplied at kickoff that contain items, however your inventory will quickly grow larger than the totes can handle. Consider purchasing clear plastic totes from your local big box store. Clear totes are nice because you can see inside them while they are on shelves without having to open them.



In addition, you will probably need containers for fasteners and electrical connectors. There are numerous containers on the market, but teams should remember that a large part of this competition involves traveling to venues! Don't get containers that can't be laid down or moved around easily. The team will have a large mess to clean up if a container with dozens of small drawers tips over and spills the fastener collection!



In order to make robot maintenance easier, try to keep only a few types of fasteners, and stick to using those on the robot. This will also aid the team when it's time to take inventory and order new fasteners. Some teams put a person in charge of purchasing fasteners and performing a weekly inventory to insure the team is well stocked.

II. KICKOFF

Most teams do not actually attend their regional kickoff event. They watch the kickoff live from the NASA channel at their build site, school, or other location with reliable broadband internet. The time for the kickoff event is listed on the FIRST website.

Take the time before the event to download the encrypted game manuals. Immediately following the kick off, the FIRST website has been known to be

unreachable due to the load of all the teams trying to download the manuals at once. The encryption key will be given at the end of the kickoff. Make sure you write it down! If you don't, you can usually find download mirrors and the key in the Chief Delphi forums (www.chiefdelphi.com).

Teams must have representatives attend the kickoff event even if the whole team opts not to attend. These representatives must pick up the kit of parts. It's a good idea to bring a van or pickup truck: the totes are large and may not fit in the trunk of a car. In addition, they can be quite heavy. A dolly will make transporting the totes much easier than carrying them.



Performing a kit of parts inventory is vital! FIRST does their best to supply a complete kit of parts to each team, however every year you'll end up hearing about a team that wasn't shipped part A or widget B. Generally, teams have until Tuesday to contact FIRST and inform them that parts are missing.

Team 1718 takes the inventorying time to allow rookie students to learn what the different components are. We also label each part with a year number. Each year, parts are supplied, and sometimes they may appear the same but are not. It's good to be able to know which motor may or may not be legal that year because the internal workings have been changed. A paint pen or sharpie is a good way to mark the parts – just write the competition year in an inconspicuous place.

While the team is inventorying the kit, check to see if game pieces are included. In past years some very unique game pieces were utilized and they quickly sold out at local stores. Be on the ball, and consider sending someone out to pick up game pieces immediately if necessary. Chief Delphi (www.chiefdelphi.com) is usually a great place to check regularly in this phase of the season. Problems will quickly be posted there.



First Week of Build

Kickoff is filled with excitement. Seeing the new game always releases a flood of new ideas. This must be balanced with a thorough understanding of the rules. The team's initial focus should be to understanding how to score points, play offense, and play defense. That understanding should be utilized to create a strategy. Understand how points can be scored, and understand what portions of the game are the most important.

Keep close tabs on the FIRST choice program during the first week. Parts tend to run out quickly on FIRST choice, and there may be critical components like extra batteries that rookie teams need. They won't be around for very long.

STRATEGY SESSIONS

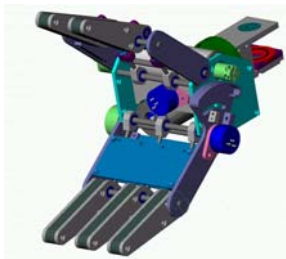
Team 1718 usually spends two or three sessions working out strategies. Initially, rookie teams want to jump right in a start building based on the first credible idea that comes up. Although spending several sessions on strategy may seem like a waste of time to some, it is important to listen to every member's ideas. As the team decides which idea or approach is the best to take, it is also important that the entire team “buys into” the strategy so that all are on the same page.

One tool that can be used to create a strategy is a weighted objective table. This is similar to a pro/con list, but it uses weights for each requirement that are determined by the team to perform an objective analysis. In the absence of an objective method, team members begin trying to ‘sell’ ideas: it’s very easy to make an idea sound good, but it’s usually much harder to execute it. Try to avoid the ‘selling’ of ideas and base decisions on factual data. A sample objective table can be downloaded at www.fightingpi.org.

TEST YOUR STRATEGY

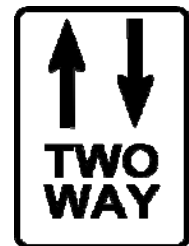
Once an overall strategy has been developed, test it! Utilize “mock” games that rely on humans to play the part of robots. Take the exercise seriously, and ask a lot of questions. Have 2 alliances of people moving around in a field size area, and pay attention to the time it takes to get to places and what impediments you might face, or how you might be forced into penalties. Is there an easy way to stop your strategy in its tracks? It may need to be reconsidered if there is.

Once the strategy has been solidified, teams move on to specific robot attributes. This is a good time to have students bring in cardboard and mock-up prototypes to provide their ideas with a three dimensional visual. Remember, as stated in an earlier chapter; “every idea that is thrown away as unworkable by a team will show up on another robot at a competition and be fully functional.” Weighted objective tables come in handy here as well. General considerations are usually items such as chassis dimensions (wide vs. long), manipulator type (claw vs. roller), and mechanism type (hi-lo system vs. arm vs. hybrid).



UTILIZE YOUR TIME – SUB TEAMS

While the team hammers out specific robot attributes, it’s a good time to start splitting team members into sub-teams to work on other tasks. Sub-teams are critical to maintaining your progress during the season. After all, the electrical team can work in parallel with the mechanical team. If one team hits a roadblock, the other team continues on and is still productive. In addition, having sub-teams allows for multiple student leaders. That helps to create a sense of ownership, and that ownership in turn creates a greater sense of responsibility.



New teams rarely have enough members to create many sub-teams, but at a minimum you should consider having a chassis team (it's always a good idea for your robot to move), and a controls team. If you are one of the lucky few rookies who have quite a few new members, consider a field-building team. FIRST supplies two sets of drawings for competition fields, an inexpensive version and the competition version. Very few teams consider building a competition field. Most build the inexpensive version of the field. If your team still has available members, there is still a robot-cart to build, spirit items to make, or you can create one of many other teams mentioned in the Team Structure portion of the rookie packet.

A cart is required for every team to move their robots around. Practical considerations for a robot cart include:

- Good working height (you'll work on your robot on the cart)
- Width that fits through doors
- Height with robot on the cart that will fit through doors
- Inverter with battery to power driver station
- Place to store tools for quick access (sometimes during eliminations you don't have time to return to the pits)
- Light (both weight and illumination!)
- Use large rubber wheels that won't catch on door frames and small pebbles
- Easy to transport (perhaps the handle should come off)



While you are considering sub-teams, it would be a good idea to appoint a safety captain. FIRST has awards directly related to safety. The safety captain should know the FIRST safety rules. They should also know safe working procedures for all the tools in the pit, basic first aid, and what to do in case of emergencies. Some teams have gone so far as to have CPR training, basic first aid classes, and a couple have even set up safety booths at competitions with fliers and instructional pamphlets.



The chassis team has an early decision to make. A rookie kit of parts (KOP) is supplied with a modular chassis. That chassis is easy to assemble, easy to modify, and usually comes with some custom components that makes it suited to playing that year's game. Team 1718 strongly recommends that rookie teams use the KOP chassis. It is robust, and rookie teams are far better off investing their time into the game manipulator and controls systems. Remember not to try to reinvent the wheel!

The electrical team can also immediately begin building a ‘test bed’. This test bed can be very simple. All it requires is a few speed controllers, a few relays, and the pneumatics all mounted to a piece of plywood or some other substrate. The controls team can then start all their programming using this test bed, confirming simple commands like forward and backward function, and testing switches or sensors that you might be considering for use on the robot.

In order to help your sub-teams keep on task, schedule a weekly design review. That will allow each team leader to talk about what they have done, where they have struggled, and what they are currently working on. Take this design review and summarize it, and use it to help keep your sponsors informed. You can also use it to update any social media, and your website if you have one.

Make sure that your team takes pictures and video during the entire process. You’ll want to be able to look back over what you’ve done. It can also be very important if you want to go after awards! That is where the non-technical sub-teams come into play.



Parents don’t have to be engineers to head groups like public relations, media, website, community outreach, or finance. As a head mentor or team coach, think about how to pass responsibility to parents and students.

WATCH FOR UPDATES

Continue watching emails from FIRST for rules updates, and monitoring Chief Delphi for ideas. Utilize the Q&A forum at www.usfirst.org for clarification of the rules during this period as well. Many teams will ask questions on the Q&A forums that will give you insight into design concepts they may be considering. FIRST posts rules updates twice weekly, on Tuesdays and Fridays on the FIRST site. Remember that Chief Delphi comments do not represent valid rules interpretations – they’re just opinions.

ROBOT DESIGN

The middle of the first week is a good time to begin considering actual robot design. Think about some rules of thumb while starting your design.

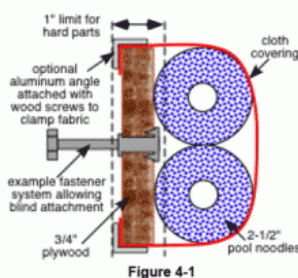


Figure 4-1

Bumpers trip up a lot of teams. The bumper rules are very strict, and very specific on fabrication and shape. The 3” tall bumpers can make it difficult to reach the floor. The bumpers also need to be very easy to remove and replace. You’ll do this numerous times during a competition because you’ll be changing colors: from blue to red or red to blue depending on your alliance.

In addition, the bumpers generally require a certain amount of coverage around the outside of your robot. In some years, you may only need to cover 3 sides of your robot. In other years you may have to have 100% of your outside perimeter covered.

The rules are also strict about the type, style, and color of lettering required on the bumpers. Usually bumpers are not allowed to weigh more than 20 pounds. The weight of the bumpers includes any fasteners you might use to connect them to the robot.



Finally, make sure your bumper shapes are legal. In the last several years, concave bumpers have not been allowed. If a string is wrapped around the frame of your robot, your bumpers should follow that string.

Make sure that when drivers practice, they also have the bumpers on the robot. Robots drive differently with and without bumpers. Bumpers add friction to any collision. It's harder to get the robot off a wall when the bumpers are rubbing against the it.

Maximum robot size is usually mandated by the rules. During some years, it is possible to trade maximum allowed weight for additional size. Read the rules carefully to determine what dimensions are allowed. As a general rule of thumb, always design and build your robots 1" smaller than the rules suggest. This includes length, width, and height. Competition can be rough on robots. The collisions are enough to deform robots, and as a result a robot built at the maximum dimensions can end up being oversized by the time elimination (and re-measurement) time comes around.

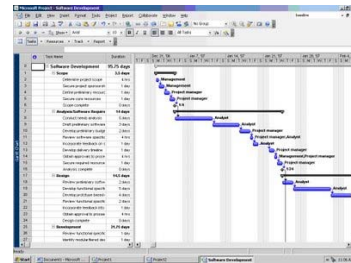
STICK TO YOUR GOALS

Set goals early in the week, and try to stick to them. Keep them up in plain view for the team members to see them. For week 1, here is a suggested list of items to try to complete:

Week 1

Build field
Modify or build cart
Purchase game pieces
Learn game rules
Develop strategies & counter strategies
Check Chief Delphi and USFirst Q&A
Determine how to function as a team
Select final strategy
Brainstorm robot characteristics
Weighted objective table to narrow choices
Autonomous programming with kitbot chassis
Teleop programming with kitbot chassis
Concept freeze
Order materials for chassis

Try to also create a season map with your team. Understand the different deadlines and when certain tasks will need to be completed. Keep this up on the wall as well so the team can see how quickly they will be approaching their deadlines. If the team has enough members, consider using project management software like Microsoft Project to track how tasks connect with each other and affect the overall deadline.



Of course, even experienced teams struggle to meet these goals, so don't be surprised if your team starts to fall behind. Make sure you look at your season time line and understand how it might affect the final product you're trying to create!

Second Week of Build

Congratulations! You've made it through your FIRST week. Now the team is off and running and it's time to start seriously looking at awards. The various awards for any given year can be found at www.usfirst.org. In addition, review section 6 of the competition manual.

This is where the documentation of your story will come in handy. How can you organize your story to present it to the judges? Judges are always interested in stories about challenges that you have overcome, and rookie teams usually have an abundance of those.

FIRST robotics rookie teams are eligible to win

- Spirit
- Website
- Rookie All-Star
- Controls
- Gracious Professionalism,

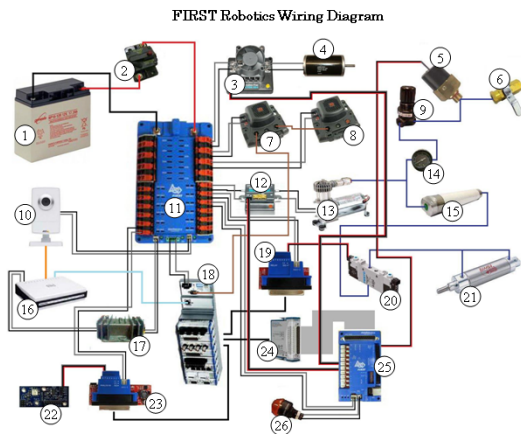
- Rookie Engineering Inspiration
- Quality
- Highest Rookie Seed
- Dean's List

In addition, the students can submit mentors for the Woodie Flowers award. It seems a bit self-serving to have the mentors pushing the students to submit, but do it anyway! It will start them on the road to submitting one yearly.

Controls and Electrical

Now it's time to get to work on the controls system (if you haven't already). The controls team should already have the programming environments installed on your programming computers and should have checked for any updates. In addition, the driver station should be up and running and updated as well.

The electrical team should have fabricated a control board using the FIRST wiring instructions. Power it up, and begin working with the default code. Work on actuating different components.



At the same time, the controls team should be considering the proposed layout of the robot and should begin trying to fit the necessary controls in place. Work on creating a layout that minimizes and simplifies the wiring as much as possible, and also allows easy access to components. Electrical components fail just like mechanical ones.

If you have the chassis ready to start moving, make sure that it's placed up on blocks when programming. In addition, always have the kill switch plugged in and a person ready to push it. The space bar on the driver station always acts to disable the robot in an emergency situation.

If you are testing actual robot motion, make sure everyone in the area knows the robot may move. People should never stand directly in front, behind, or beside the robot when you are testing it. In addition, use the wireless system or a long tether cord so no one needs to stand next to the robot.

Consider A Website

Are you working on a new website for your team? FIRST is very specific in regards to how its logo can be used. They also have requirements for a FRC team's website located on usfirst.org.

At the end of week 2, check your progress on these items:

Week 2

Prototype manipulators
Controls work:
Controls board laid out
Begin build of controls board
Chassis design completed

Third Week of Build

The third week of the build season is when you should first see your chassis come to life. If you are using a kitbot chassis, it should already be assembled. If you are creating a custom chassis, it must be done well before the end of the week so that your controls team can install the controls system. Remember to reserve room for the manipulator to attach, and for any additional electrical systems that it will require.

More Programming and Controls

Remind your controls team that they need to double check the FIRST website and download any updates for the code. Double check the code function before putting it on the robot, and make sure the robot is up on blocks before you run any new code for the first time! Updates can potentially break the software, and having an out-of-control robot is no fun at all.

Also have them review documentation on how to build (compile) and load code onto the cRio. In the past, that has been located at:

http://usfirst.org/uploadedFiles/Robotics_Programs/FRC/Game_and_Season_Info/2011_Assets/Kit_of_Parts/How_to_Build_and_Load_Programming_in_LabVIEW_W,_C,_and_Java.pdf

In addition, helpful connectivity diagrams and power distribution diagrams are provided by FIRST:

Connectivity:

http://usfirst.org/uploadedFiles/Robotics_Programs/FRC/Game_and_Season_Info/2011_Assets/Kit_of_Parts/2011%20Robot_data_power_%202011%20Data%200%28PWM%29%20%281%29.pdf

Power Distribution:

http://usfirst.org/uploadedFiles/Robotics_Programs/FRC/Game_and_Season_Info/2011_Assets/Kit_of_Parts/2011%20Robot_data_power_%20Power%20Dist%202011%20%2824V%29%20%281%29.pdf

Teams that do not have a dedicated programming computer can consider loading Labview or the other programming environments onto the classmate driver station. However, we



strongly recommend against it. The classmate, in our experience, struggles to provide the basic requirements during the competition. The processor, ram, and hard-drive space are simply not up to the task of being used as both a development computer and as the driver station.

It's time to re-check your project time line. Are you on schedule? Do you need to compress your time line to meet your goals? At the same time, check the FIRST website for important dates. Some award submittal dates are well prior to the end of the season.

At the end of week 3, review your progress:

Week 3

Compare prototypes
Build chassis
Assemble drivetrain to chassis
Freeze object manipulator design
Complete controls board

Fourth Week of Build

If you are traveling to any events, it's time to begin making arrangements for housing and transportation. Consider contacting your school and arranging transportation. In addition, insure you have all the necessary permission slips for the students, and release slips for the parents who might be driving as well.



The controls team should be working on an operator station for the events. Consider practicality above all else: making a one piece driver station that is compact will make life much easier. Having Velcro to restrain your controls is a good idea, as is fastening the control wiring down. Some teams build their control system inside a briefcase to make it easier to carry. Velcro can be placed on the bottom of the controls system to prevent it from flying off the shelves of the competition driver stations. There are usually prints or a description showing where the Velcro is located and which side you should use (loops or fuzz).

You should also begin checking the weight of your robot regularly. A little creativity and a bathroom scale should make quick work of the robot weight. Continue monitoring the weight at regular intervals as you add your manipulators and controls systems to the robot. Check the rules to insure the weight limit. Remember that every scale is different! If you build your robot to exactly 120 pounds, you're going to be frantically removing components from your robot when the competition scale says that the robot weighs 122 pounds. It's also mandatory to keep your bumpers under a specific weight. Speaking of bumpers, this would be a good time to start building them and adding mounting points to your chassis.

Are your team shirts done? They should be! If they aren't, double-check that you have all your sponsors on them, and get your printer moving. It usually takes our printer two weeks to get the shirts back to us once we've placed an order, so try to allow at least that much time for yours. It's also a good idea to ask for actual dimensions for sizing. No two extra-larges are the same.

Make sure to update TIMS as well with any new sponsor information. Sponsor information is pulled out of TIMS for competition announcements, so this is your chance to make sure they get all the recognition you can give them. You can also put a thank you in your pits that the sponsors can see when they come to visit you at competition. In addition, it's time to get some emails going out to your sponsors about competition times and dates.

Week 4

Competition Robot
Drive System Assembly
Controls assembly
Test Drive System
Design guarding and bumpers
Practice Robot
Order all materials for second robot
Build controls board

Did you decide to create a website? If so, take a look at the submission date. Generally, the website award submission happens at the end of week 4 or the beginning of week 5. For more information, visit:

<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=440>

Fifth Week of Build

Week 5 has arrived. It might be time to start thinking about scouting. Scouting is useful in competitions, especially if you can tabulate real time data. There are several ways you might consider creating a scouting database.

Scouting for Rookies

First Robotics Competition (FRC) beginners might consider something very simple, like keeping track of robots' win/loss record. In addition, you might consider keeping track of all the matches' scores, and determine an average score for each team. This will give you some very basic information about teams, but there are areas where this might create problems.

Teams may appear to be excellent when, in fact, they have been the lucky recipient of some good pairings with other excellent teams due to the random seeding system. Those other teams may also have critical flaws. For instance, they may score well in autonomous or the end game, but have no way to score during the normal game. They may be one-faceted. Or they may have had breakdown issues.

Scouting for Intermediate Teams

To improve over the basic 'average score' database, consider adding additional information. For instance, have team members go from pit to pit and take pictures of the opposing teams' robots. Have them note things like drive train. For instance, if you are going up against a team that has a mechatronics drive train, it may be easier to defend them due to a lack of traction.



In addition, consider creating a weighted objective database for scouting instead of a simple averaging of final scores. Create a questionnaire style scouting sheet and have members of your team scout every robot during every match. Enter their rankings of each important factor into your sheet, including items such as rule violations and breakdowns.

Scouting for Advanced Teams

The "Holy Grail" of scouting is currently a real-time offensive-ranking-power system, combined with a weighted objective database that takes robot characteristics into account.

An offensive power database is created by recording the teams in each match and their final scores. These are then entered into a database, and a large set of simultaneous equations are used to determine a robot's contribution to their team's final score in each match.

This is a fairly complicated undertaking that utilizes matrix math and large amounts of data. The Bionic Barons, team 2834, and Simbotics, team 1114 have created definitive OPR scouting systems. They can be found on the Chief Delphi website.

They have both included real time updates from FIRST's automatically updating scoring database. This results in real time updates that can be completed prior to each match to help strategy.

In addition, a weighted objective table that measures penalties, breakdowns, and robot capabilities is important. As you try to rank the lower tier teams in a competition, OPR often has trouble distinguishing them from one another. You also might need detailed information regarding whether a particular robot can perform a particular function.

These two scouting systems combined create a robust real time system that can help you succeed. However, the time that is required to create and maintain them is extensive.

Competition Information

Start doing some research on competition venues. FIRST in Michigan's website usually has all the events listed at this point. They usually supply links to each event that contain the schedule, the address, and other pertinent information. In 2011, teams had to supply 2 volunteers for each competition that they attended. These volunteers fall under FIRST in Michigan's website, and sign-ups occur at <http://firstinmichigan.org/volunteer.html>. Get those volunteers signed up in as soon as possible.

If you plan on attending the Michigan State Championship, it's a good idea to start looking for hotel rooms now. They fill up quickly as you get closer to the event, and it's always nice to be located as close as possible to shorten the drive.

The Robot

You've also entered into the portion of the build season where you're fixing any remaining problems your robot might have. By the end of week 5 you should be testing your robot's durability and making incremental improvements. Wiring should be triple checked and locked down with zip ties, spiral wrap, split conduit, or fixed conduit to protect it against the rigors of competition.

Your robot guarding should be well on its way to completion as well. Don't leave any controls or pneumatics systems exposed. Wiring has a way of getting torn off the robot if it isn't shielded from other competitors. Some year's competitions involve manipulators that extend well outside the robot perimeter. Make sure your guarding is strong enough to survive an encounter with a robot claw. Guarding is an excellent place to position sponsor logos as well. However, make sure that the pneumatic release valve and the main breaker have extremely easy access – but don't put the main breaker in a location where another robot can turn your robot off! At competition, you'll have to put access stickers to show game officials how to quickly turn your robot off in case of an emergency.

While considering guarding, also remember that your gaming network adapter needs to be in plain site, as does your big flashing light (BFL). Normally the rules are written so that these need to be visible while standing 3 feet in front of the robot.

You should begin to plan your withholding allowance as well. Most years, you are allowed to keep 30 pounds of your robot un-bagged so that you can continue to work. Many teams choose to keep manipulators, turrets, or sub-systems un-bagged. Make sure that whatever you choose to keep working on is easy to install at competition. You don't want to miss matches because you couldn't install all the components in time.

It's smart to begin giving the controls team time to program an autonomous mode. Many years, even a simple autonomous mode can score points. Evaluate the

autonomous this year, and if it's important, attempt to devise a way to be productive (if you haven't already). Remember that you cannot use external alignment devices or lasers to set up your robot on the field. You can, however, use external sensors like ultrasonic sensors so the robot can determine where it is.

Update Your Sponsors

Continue to update your social media, your sponsors, your newsletters, or whatever other communication devices you use. You might also consider scheduling a 'media day' where team members can bring their parents, school faculty, and sponsors in to see your progress.

Awards



Review the team awards time-line, as the deadlines of many usually fall on or around week 5. Some awards can only be submitted by the students. In these situations, they'll submit the awards through the Student Information Management System (SIMS) on the FIRST web page. Make sure they're planning on submitting the awards at least one day in advance. Many times the FIRST servers will bog down and not allow submissions the day they are required.

Week 5 - Continue on both bots

Competition robot
Complete manipulator tweaks
Test teleoperated code
Test autonomous code
Begin driver training
Practice Robot
Build second manipulator
Build chassis and drive train

Sixth Week of Build

You're almost there. Now is the time to redouble all your efforts so that you can put a robot in that bag. Speaking of bags, make sure you keep your bag and tag paperwork in a safe place. Do not make the mistake of putting it inside the bag. Don't tape it to the outside either – all too often you'll be wheeling your robot into the competition in the rain. We use magnets to put ours on the inside lid of our toolbox.

By now, you should have hotel arrangements if you are traveling. You should also have meal arrangements for your competition. Most competitions allow you to order food in advance, but we've had fairly bad luck with that. The meals are usually cold (mass deliveries) and sometimes late. If you can, try to do a potluck in the parking lot with cold cuts, etc. You might also want to consider a cooler full of water. Some pit venues can get very warm.

Permission slips should all be signed and sent in if they are required. Volunteers should already have signed up online. Do you need release forms from the school? You may also need to request days off for the students, or they may need to bring in signed slips to give to the school administration.

Have you had a media day yet? Call your local paper, and if you can't get a representative out to do a story, offer to talk to them over the phone and email them photos of the team and robot. It's great to get the competition information out into the community, and newspaper clippings look good on the wall in the build room.



It's time to create your bill of materials (BOM). Some rules of thumb to remember are:

- Only record what you actually used (12" of bar stock, not the entire 4 foot length)
- Certain items may not need to be included in the BOM. Check the rules.
- Fasteners are not required on the BOM

Usually the BOM format can be found on the FIRST website under the Documentation section.

Week 6 - Drive practice and programming

Competition Robot
Final Programming
Driver Practice
Bag Robot
Practice Robot
Complete assembly of bot
Test practice bot

Bag Day

Bag day is the day that you take a deep breath and start working harder. Usually, your robot needs to be in the bag by Tuesday at 11:59 pm. Remember to secure a neutral third party to sign the bag and tag paperwork.

Every year, the rules change slightly regarding what needs to be bagged. Generally speaking, these items are **not** bagged:

- Batteries
- Driver station and related equipment
- Bumpers
- Your withholding allowance (usually 30 pounds)
- Commercial off-the-shelf parts (COTS)

As a final check before bagging, weigh your robot. In addition, do NOT bag the robot with the bumpers on. It can be a real chore to get the robots through doorways if the bumpers are fastened.

Now it's time to close up the robot in the bag, put on your numbered zip tie, and get your form signed off.

Between Ship and First Competition

The robot is in the bag, but the work isn't finished. Your scouting system needs to be completed. Complete all the requirements for competition: volunteers need to sign up in the Volunteer Information Management Systems (VIMS), permission slips should be complete, travel accommodations should be confirmed, and food needs to be completed.

You also need to continue work on your withholding allowance. If you had spare withholding allowance weight, you could have held back the cRio and some control components to allow you to continue programming.

Before your competition arrives, you will have 6 hours the week prior to your event to un-bag the robot and work on it. This 6 hours can be broken into multiple access windows, but they cannot be less than 2 continuous hours at a time. Prepare well in advance for your un-bag window. All the tools you need should be laid out, and a written plan should be created on what will be completed. Be realistic: you don't want to re-bag a non-working robot. After each work period is complete, the robot will need to be re-bagged and re-tagged.

You are not allowed to rotate what you keep out of the bag. Your 30 pound withholding allowance of non-off-the-shelf-parts has to be the same components (don't include motor weight, etc in your withholding if they are not bolted to the transmissions). You cannot keep pieces out of the bag if they were previously bagged.

If it's possible for your team, attend a competition. This cannot be stressed enough. Pay attention to what teams have in the pits, how they have their pits laid out, and how they are playing the game. Take the chance to practice scouting as well. How people play the game changes from week to week as teams learn the best strategy.

Driver Selection

Drivers are the core of your team. A world class robot can come in last place with poor drivers, and likewise a poor robot can be elevated to world class if your drivers have "the right stuff".

In order to select drivers, start by laying out your requirements for a driver. Traits to consider include:



- Personality – how do they work under pressure? Can they maintain their cool?
- Availability – can they make it to every competition, practice, and meeting?
- Dependability – do they hang around and take part, or wander off?
- Criticism – are they confident enough to let criticism roll off them?
- Suggestion – can they be guided by the drive coach, or do they ‘tune out’
- Change – can they change? Are they adaptable to different situations on the fly?
- Teamwork – can they work with other drivers? Are they a prima donna?

This may be another opportunity to use a weighted objective table to make a decision. You'll need more than one drive team. Sickness or other emergencies may take a key member at any time, so make sure you're training a primary and a backup team.

Consider getting them field time, as well as practice time. If your record is already 2-7, let your backup drivers in for the last 4 matches to get them experience as well. Who knows, a change of drivers may be just what you needed to change your luck.

You'll also need to pick a drive coach. Usually the drive coach is the head mentor. There are certain strategies the drive coach can use to be more effective. The first is to let the drivers drive. The drive coach should be watching the entire field, the time, and the score. It's the drive coach's responsibility to understand how the game is unfolding. If the match is half way through and your alliance is losing, does something need to be changed or does a different team need to be defended? In addition, the drive coach often sees things the drivers do not; like game pieces and where they are on the field or even game pieces that have rolled up behind game elements and can not be seen by the drivers.

Team members should spend some time familiarizing themselves with all the aspects of the robot. Even media members should understand the mechanical functioning of components. In addition, consider creating judge's packets containing highlights of your robot and explanations of novel systems or mechanisms. Safety packets, business packets, and robot packets can be created to give to the judges.

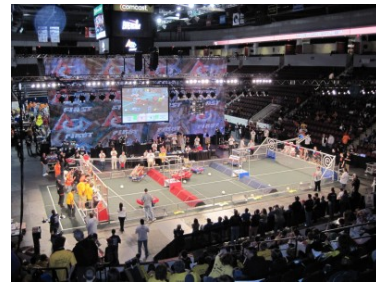
You can also start planning game strategy by watching streaming video of other events that are going on before your first event. If possible, attending one of those events can give you insight into how the game is being played and what you might need to change or plan. This can also give your scouting team a chance to try out their scouting system and touch up any problems they find.

Post Bag

Train drivers on second robot
Finish scouting system
Judge Packets
Safety Packets
Pit presentations
Watch streaming of other events

THE FIRST COMPETITION

Finally! After months of effort and preparation, the team has arrived. In Michigan FIRST utilizes a district competition system. This system is a more compact version of the old “regional” system that allows Michigan teams to spend more time competing on the field and costs less money in the process.



Competitions have a fairly generic schedule. This one applies for most Michigan qualifying events. The State Championship runs an extended format that spreads this out to account for the additional teams that compete.

- Thursday, 6PM: Load in. You may be allowed to work on your robot and set up your pits at this time.
- Friday, early morning: continue working on the robot, getting it inspected, have the field crew program your robot wireless controllers
- Friday, mid-morning: Opening ceremonies at the competition field. Make sure you attend this! There is usually a drivers meeting immediately following opening ceremonies.
- Friday, remainder of the day: Usually the competition runs until around 8 PM. It may run later if the field crew is behind on matches.
- Saturday: Qualification matches complete as soon as possible. A draft is performed where the top 8 qualification teams pick their partners for the elimination rounds. This normally occurs not more than 15 minutes after the last qualification match has ended, so be ready.
- Saturday, after lunch: Elimination rounds begin and run until they are complete. A round is best 2 matches out of 3.
- Saturday, after eliminations: Awards. Please try to keep your team at the venue. It's OK to pack up once you've been eliminated, but try to keep in mind that the teams who are still out there playing are incredibly excited. Be there when the awards are presented to cheer on your competitors. When you're in their position, you'll hope they do the same!
- Saturday, after awards: It's always friendly to offer your services to the field crew to help clean up. There are always a ton of tasks to do like breaking down the field, cleaning up the pits, etc.

Before the Competition

Teams should be organized prior to arriving at a competition. They should remember to bring:

- TIMS team member list
- Bill Of Material (BOM) in digital format on a USB drive
- Unlock Paperwork

A large number of the awards presented at the competition will be a result of how well the team members can talk to the judges in the pits. Judges will arrive at a team's pit stall at random times during the first day of the competition. Normally there will be two sets of judges. One set is interested in all aspects of the robot; controls, innovative design, mechanics, electronics, pneumatics, safety and object manipulator components; while the other set is interested in team aspects such as structure, student involvement, community service, community outreach, getting the message of FIRST out to younger students. A team should have several designated members that rotate through the pits and are ready to talk about any aspect of the team. It's best to keep these teams to 2 or 3 members.

It can help to have informational fliers about the team to hand to the judges. Many teams create a 'judging packet' that contains information on every potential award. The types of awards available and specifics on their requirements can be found at:

<http://www.usfirst.org/awards>

Practice with your presentation teams! Have knowledgeable people visit your build site and ask them questions to prepare them for the judges.

When You Arrive Thursday

Upon arrival, locate the pit administration desk. This is where you'll need to hand in your team's Consent and Release forms and sign in. This is also where you'll need to bring your robot radio to have it programmed. At some competitions they have automated kiosks that program your radio for you. In addition you'll be given competition information when you sign in, and you'll be notified of your pit area and where it is located. Most competitions have signs on each pit designating the team number as well.

Next, proceed to your pit stall. Immediately notify pit admin that your robot is in your pit and ready to be un-bagged. Do not un-bag before an official arrives to sign off on your bag-and-tag paperwork! You should have given some thought to your pit layout in advance. Some pit areas are as small as 8' wide x 10' deep. Providing easy access to tools, batteries, and the robot is key. A shelving system can be very helpful. A shelving system or roll-in work bench that contains all of your equipment can make setting up a snap. Remember to bring extension cords and power strips as well. Most pit areas only have a single power connection for each pit stall.

In addition, consider bringing a small piece of carpet to set down in your pits if you want to program and work on autonomous or turning. Most venues will have practice areas, but they can have long lines as other teams try to work out their problems.

It may seem like a neat idea to set up a wireless network in your pit. Please don't! The field systems work on a wireless network. FIRST generally has rules against teams running wireless networks or walkie-talkies that might interfere with the competition.

Entry into the pit area or the competition floor at any FIRST competition requires safety glasses. Make sure the safety glasses your team is going to wear meet the requirements for FIRST. Tinting is heavily restricted, and things like paint ball masks and goggles are not allowed.

Finally, decorate your pits! Hang up banners and signs that show your team name and number, your sponsors, and any other information you want people to readily see. You are allowed to extend up to 10 feet in the air, so don't be shy about putting together some framework to hang your signs from. PVC is commonly used for signage framework. Just make sure you don't intrude into your neighbors pit.

It can be a good idea to discuss in advance who is going to be allowed in the pit on a regular basis. The lack of space necessitates that only key members be allowed in: any more than 3-5 people makes it impossible to work in the pits. Your pit crew should generally be chosen based on mechanical and electrical ability, as well as the ability to speak to the judges about topics like safety and business.

The time-line for a district event is uniform. Teams are expected to arrive and bring in their robots (still bagged) and get their pit setup. It's best to treat this part of the competition is a competition in itself. Try to arrive just before or right at 6:00 PM. Teams should unload and clear the loading dock quickly, as there will many other teams coming in after them.

The next step once a team has arrived is to find an official to un-bag the robot. Do not un-bag the robot without an official present to witness and sign off on the bagging documentation.

With any luck, the team's robot will be ready to perform. Immediately take the robot to be inspected. Inspection consists of a size check, a weight check of the robot, and a weight check of the bumpers. The size check is performed by placing the robot in its starting configuration and then sliding it into a box that has been made at the competition-legal maximum dimensions. The robot will then be placed on a scale and weighed, then the bumpers will be weighed. After that, the team can

return to the pits. Make sure to request an electrical inspection as well from the Pit Administrator.

The electrical inspection of the robot will take anywhere from 10 to 45 minutes. It's good practice to have already printed out the inspection check sheets (available at usfirst.com). Use the check sheets to go through the robot and perform a self-check prior to coming to the competition. Also, be ready to power-up the robot and enable it so that the inspector can check various functions.

If you have extra team members, have them go offer to help set up the practice field. Get them out of the pits while the inspectors are there. You'll need a key mechanical and electrical member to ask questions, but otherwise fewer people is better at this point to minimize noise and confusion. If the practice field is set up already, see if you can sign-in there for specific time slots, based on when you think your robot will be ready to go.

Keep a whiteboard in the pits so that you can keep track of your matches and the scores of each match. Write the scheduled times for each match on the board as well. Team members should be expected to be in the stands cheering when you're on the field. Also remember that the FIRST field crew doesn't always follow the schedule. If they are ahead, they won't slow down, and if they fall behind, they're going to push hard to get robots on and off the field as quickly as possible.

The Match

Hopefully you've received your match schedule well prior to opening ceremonies. If you are one of the first two matches of the day, the field crew will expect you to have your robots at the field prior to the beginning of opening ceremonies.

Your coach and your drive team should contact your alliance teams well before each match. Discuss who is good at what. Do NOT overstate your abilities. If you can score 10 times on the practice field, it's very likely that you're only going to score 2 or 3 times when other robots are on the competition field trying to stop you. Give a fair assessment of your abilities, and your weaknesses. Discuss who is going to do what on the field. Usually a team will be assigned to play defense. It's their responsibility to understand HOW to play defense. Drawing penalties is never a good idea.

It's also necessary to have some information on the teams you are competing against. Figuring out which robot is the best offensive robot on the other team and shutting them down with a solid defense will often allow an alliance to win a match that they otherwise might not.

Once you reach the field for your first competition, events will usually follow a regular pattern.

Before The Match:

1. A student will wheel the robot cart up to the field entrance.
2. Two students will lift the robot into place on the field and turn on the power.
3. Another student will take the controls system to their assigned position and begin preparing it. (Your driver station should be powered on before arriving at the field. Some teams use 12 volt batteries through an inverter so their driver station is always being charged).
 - a. Connect power to the driver station
 - b. Connect ethernet to the driver station
 - c. Connect controllers to the driver station
 - d. Go to the diagnostic tab in the driver station and confirm that the controllers are working and that you know which is the driver and which is the operator controller. When a button is pushed on a controller, you will see the controller's name highlight on the diagnostic tab.
 - e. Check that the driver station has the correct team number.
4. Make sure you have set your autonomous mode if you are using one
5. Have the students move to their positions. There is usually a starting position behind a white line – students and coaches can not step over that line while the robot is in autonomous.

After the Match:

1. After the match, it's important to get off the field as soon as possible.
2. One student should pack up the controls and get the cart to the field exit
3. The other students should retrieve the robot. The first step is to make sure you turn the robot off!
4. Do a quick check to make sure you are leaving the field with all the parts that you started with. FIRST usually has a lost-and-found box on the competition table.
5. Once you arrive back at the pits, immediately pull the robot battery and get it charging.
6. Above all, remember to have fun! Meet and mingle with other teams and don't be afraid to ask questions about their robot. Don't get in the way, but most teams have students willing to expound on their robot's design and capabilities. And who knows, you may just take away some ideas for next year.