



Chapter 7

BUILD SEASON - THOSE CRAZY SIX WEEKS



For additional chapters or for more information
visit www.teamrush27.net



Table of Contents

7.1 Pre-kickoff	111
Review Your Resources	111
Pre-divide Team into Sub-groups	111
Locations	111
Material and Tools	112
Training	112
Pre-Kickoff Team Business	113
Prepare For Kickoff	113
Standards and Procedures	113
Sponsor Communication	113
Full Team Meetings	114
Contact Local Media and School Administration	114
Purchasing-Cash Advance	114
7.2 Kickoff Weekend	115
Where to view kickoff	115
Kit of Parts	115
Print the game manual	115
Playing field schematics	116
Send a parent volunteer to gather the playing field materials	116
Game breakdown	116
Identify and purchase the game piece	116
7.3 Week #1	117
Day One & Two	117
Day Three	118
Day Four	119
Day Five and Six	119
Robot Sub-groups	119
7.4 Week #2	120
Have weekly design reviews	120
Design Freeze	120
7.5 Week #3	121
Welcome to week 3	121
7.6 Week #4	122
7.7 Week #5	123
7.8 Week #6	124
7.9 Business during Build	125
DAILY Agenda:	125
What to do WEEKLY:	125
Other Business	126



7.1 PRE-KICKOFF



It is important to get your team ready before the kick-off on the first Saturday in January. We recommend you start in early December.

During this time you can:

REVIEW YOUR RESOURCES

You need to know how many mentors you will have helping during the season. This will set-up how you split-up and operate your team. Along with mentors you need to know how many machinists, welders, etc. you have.

Interview parents to see what help they can bring from time to time. It is important to have extra help when building the practice field, picking material at the hardware store or just having someone to help manage the students from time to time.

Secure machine shops or manufacturers that will make parts for you at little or no charge. This will let you know your capability for manufacturing before the start of the season.

PRE-DIVIDE TEAM INTO SUB-GROUPS

Ask the students which build season sub-group they would like to participate in (See Sub-Team Descriptions). You may have to rearrange some of the groups depending on what they choose (You can't have all the students in the business sub-group or the robot will never get finished). Make sure you mix in experienced students with new students so that there is a continued transfer of knowledge between the students as the years go by. Assign a mentor to lead each sub-group during the season. Make sure you have enough mentors for each sub-group. It is too late to be looking for mentor help after the season starts. Have the sub-teams meet a few times before kickoff to lay out group expectations.

LOCATIONS

Establish where your robot will be built and where you will be able to set up a field for testing and practice. This is usually at one of the sponsor's facilities or at the school. Most teams will have an area where a ½ field or full field can be build for practice during the season.

Also identify a location to watch the kickoff. We use the large group instruction classroom at the school which has a projector and lots of seating. The kickoff is typically broadcast on the NASA channel and on



Chapter 7: Build Season - Those Crazy Six Weeks

the web. Make sure that the location chosen has either of these options available and make sure that they work before kickoff.

TIP: *Once location is established get in there and clean and organize it. There is too much going on once the season starts.*

MATERIAL AND TOOLS

Review your material and tools that you need to build a robot and also to make prototypes. Order your material and tools in December so you hit the ground running. Some of the common materials and tools we stock are:

- 4x8 sheets of 1/8 thick aluminum
- 1"x1"x 8ft Aluminum tubing
- Sheets of cardboard (for prototyping)
- One lot of #10-24 fasteners and locknuts-all lengths
- Pop rivets
- Gas for the welder
- 2-3 hand drills
- 2-3 rivet guns
- 5-6 sets of allen wrenches, standard and metric (for motor bolts)

Contact Toolkit@teamrush27.net if you would like a more extensive list.

TRAINING

Due to the time constraints of the season, try to do as much training and team building before kickoff. Some of the training we do is:

- Safety Training – Make sure the students are aware of the safety procedures to use in the shop (safety glasses on at all times) and how to safely use machines and tools.
- Machine and Tool Training – Expose students to the machines and hand tools that are in the shop and their proper use. They must know how to use the tools safely before letting them working the shop.
- Robots 101 - We recommend you take the students thru the basics of motor selection, forces and friction calculations, how to read a drawing, etc.
- Team Training – Do team building activities with the team to establish a cohesive and comfortable atmosphere.

Always discuss if you need to build a practice robot or not.

Finally in order to be prepared for what is coming, you should review the past. We have all students go on-line and review games and robots of the past. This will give you and the students a peak as to what is coming and how the same game can be played many different ways.

NOTES



PRE-KICKOFF TEAM BUSINESS

In addition to being technically prepared for the season there are many things that need to be done behind the scenes to set a good foundation for the season

PREPARE FOR KICKOFF

Months before the kickoff you should have registered for the regional or district events that you plan to attend through *FIRST's* Team Information Management System (TIMS). Make sure you have the checks for registration fees taken care of prior to kickoff. TIMS is also where you enter all of your team information including team name and sponsor info. Make sure this is updated before the kickoff because this information is used to print the programs for the events and by the announcers at the competitions to introduce your team. You also can arrange for where you would like to attend kickoff and pick up your kit.

STANDARDS AND PROCEDURES

Use the time before kickoff to establish and document procedures that you will use throughout the year. Make sure the entire team is trained on the proper procedures. Some of the standards that have helped us include:

- Establish File Structure for Digital Media – Having a standard file structure set up to organize pictures, video, and documents that will be generated during the season. This will make the files easier to find when needed later in the season
- Inventory Parts – Take the time to inventory what you currently have and order what will be needed for the season (hardware, fasteners, tools, etc.)
- Part Purchasing Procedure - Identify a process for how to purchase parts during the season. It helps to have one mentor act as a purchasing agent to keep track of what has been purchased and how it affects the team budget. We have found that the best way is to setup a team credit card. The advantage of this is that purchases can be made after school hours and on-line. It also helps for record keeping because most of the transactions are made from a single source.
- Software Standards – Decide what software will be used during the season and make sure you have enough copies.

SPONSOR COMMUNICATION

Begin regular communication with your sponsors through a newsletter or e-mail blast. Let them know when the kickoff is and invite them to watch it on-line or with the team. Before kickoff is a good opportunity to ask for sponsor logos, and to being working on the artwork for uniform t-shirts.



FULL TEAM MEETINGS

Have a full team meeting with parents and students to finalize expectations for the day of kickoff and the rest of the season. Depending on the school calendar this is usually done right before or right after the holiday break. This meeting is also a good time to go over food arrangements for kickoff and the rest of the season.

CONTACT LOCAL MEDIA AND SCHOOL ADMINISTRATION

Let the local newspapers and TV stations know when kickoff will be and invite them to watch. This will help to establish a relationship for continuing communication during the season. Also make sure to let the school administration know and see if they would like to watch the kickoff with the team. We have found that this a good way to get them involved and to expose them *FIRST*.

PURCHASING-CASH ADVANCE

Try to get a cash advance before kickoff that will be used to purchase field building supplies and field objects. Cash works better in the first days because there are often multiple parents or mentors going to different stores to acquire parts in a compressed time span.



7.2 KICKOFF WEEKEND

Kickoff weekend for FRC is particularly exciting. Every team in the country will learn the game at the same moment, and you know the next six weeks will be very stressful, fun filled and rewarding.

WHERE TO VIEW KICKOFF

FIRST hosts a national kickoff event every year in Manchester, NH but it is not expected that you will use precious fundraising dollars to attend. Nowadays there are satellite kickoff events in most states, so there should be one near to you. The NASA channel typically broadcasts the event on their TV channel, and at least one webcast will be available.

You may choose to take your whole team to a kickoff event, or you may decide to send a few representatives to the kickoff and keep the rest of your broad back home watching on TV. **Team RUSH** typically chooses the latter, as this allows us to get up and running as soon as possible without wasting any time travelling.

***TIP:** Regardless of your kit pickup arrangement, make sure you bring a dolly to help move your kit from the pickup location to your car. The kit of parts can be quite heavy and tricky to maneuver without the proper equipment.*

KIT OF PARTS

After picking up the “Kit of Parts” have 2-3 team members inventory the contents. Use the inventory sheet provided in the manual. If you have not received something notify *FIRST* of the shortage. You only have a few days to notify *FIRST* of any shortages... read the rules manual carefully.

At the same time you inventory the parts it's a good idea to begin a “Kit of Parts weight chart”. This chart will help your team monitor your robots overall weight during the build phase.

PRINT THE GAME MANUAL

FIRST usually releases the game manual in sections with the non-critical sections coming out a few days before kickoff. It's helpful to make arrangements to print copies of the manual or to distribute digital copies immediately after kickoff so that each student can begin studying the rules.



PLAYING FIELD SCHEMATICS

We find it helpful to print or plot a copy of the playing field schematics as soon as possible. Be careful to review both the “low cost” and “actual field” drawings carefully. Many times *FIRST* will substitute different size materials in critical areas that may be important to your strategy development.

SEND A PARENT VOLUNTEER TO GATHER THE PLAYING FIELD MATERIALS

Sunday of kickoff weekend is a great day to have someone gather all the playing field construction components and get started. The sooner you have a playing field the better off you’ll be when visualizing on-field strategies.

GAME BREAKDOWN

Immediately following the kickoff presentation we start reviewing the entire set of rules. One method is to split your students and mentors into smaller groups. Have each group become an expert on their section of the manual and present back to the group.

A final group discussion with a concise breakdown of the playing field, game elements and any special rules is a nice way to wrap everything up.

TIP: *Read the rules! Read the rules! Read the rules! All too often teams miss a critical strategy of play because they didn’t thoroughly read the rules. Making assumptions about what a rule intends to achieve is also a bad idea. Should you have questions its best to write them down and submit them to the official Q&A website provided by FIRST officials.*

IDENTIFY AND PURCHASE THE GAME PIECE

The playing field objects for any particular game are usually sourced from stores that are common around the United States. Stores often run low on stock during the first 48 hours because of the massive demand from FRC teams. Sending an adult out to find game pieces immediately following their unveiling is usually a good idea.



7.3 WEEK #1

DAY ONE & TWO

Game Strategy development for Auto and Tele-Op periods

As soon as possible you should begin to formulate a strategy for how you will play the game. Students will be eager to envision their eventual robot creation, but you cannot build a truly great robot unless it is designed to satisfy a well conceived and planned strategy of play.

***TIP:** There are at least two distinct phases in any FRC match, tele-operated mode and autonomous mode. Both modes will require a strategy of play. The following focuses on the tele-operated. The same can apply to the autonomous mode strategy.*

Consider using a weighted analysis or other method to quantitatively analyze all strategies of play. *FIRST* purposely designs each game to have many small challenges that can be achieved during any particular match.

Spend the time familiarizing everyone with “The Game” and understand the following:

- Every possible way to score points
- Every possible way to prevent your opponent from scoring points
- Understand the *FIRST* ranking system (win-loss-tie, loser’s score, 3-times loser score etc.)

***TIP:** It is also important to note that there are two distinct periods at any tournament, qualification play and tournament play. Strategies and game plans can vary greatly during these periods. Styles of play that are powerful during one period may not apply to the other...this distinction is not always immediately apparent.*

Once the team is familiar with how to play the game and game scoring the team can begin defining “the robot objectives” on how your team will play the game. List/record the robot objectives for all to see. Keep in mind these are the “what the robot can do” objectives and not the “How’s” of doing the objectives.

Sample robot objective list:

- The robot should be mobile, able to drive around obstacles and over the ramp.
- The robot should be able to pick up objects from the playing field floor
- The robot should be able to shoot the objects different distances.



Chapter 7: Build Season - Those Crazy Six Weeks

NOTES

- The robot should be able to hang from the tower in the last 20 seconds of the game
- The robot should be able to hold multiple objects and shoot several rapidly.
- The robot should be safe to operate.

For each objective you must compare the difficulty of accomplishment of the objective with the reward.

- 2010 game – Suspend robot from the tower in the last 20 seconds for 2pts
- Beware of the objective reward compared to the “WOW Factor”

TIP: *Focusing on only a couple particular objectives is not necessarily a bad thing as you will always compete with partner robots as part of an alliance.*

By the end of day two you should have a “the robot objectives” list that have been reviewed and have “buy-in” from all team members. The game strategy on how your team will play the game is now complete.

DAY THREE

Brainstorm Robot Concepts

Once you have a team approved game strategy the next step is to begin brainstorming generic robot concepts. Divide the team into 2-3 student/mentor groups. Require each group to “sketch” 2 robot concepts which fulfill the team’s robot objectives. Use large paper or white marked boards for each group to present their concepts to the whole team. Allow enough time for all groups to present and address questions from the team.

After all the groups have presented, the team needs to begin discussing common concepts, unique concepts and weed out wacky concepts.

TIP: *The critical focus at this point for the mentor leaders is to guide the team down to 4-6 feasible/serious robot concepts. As you are funneling down the concepts you must consider your team’s capabilities:*

- Understand your teams abilities and resources realistically
- Understand your teams manpower and know your budget constraints
- Beware of complex systems or “WOW Factors” which tax manpower and resources

You should be closing day three of week #1 with 4-6 robot concepts... keep moving forward!



DAY FOUR

Take Five - R&R

Schedule a day off after your robot concepts have been defined. This allows all for a day to think about the robot concepts outside of the team atmosphere.

DAY FIVE AND SIX

Robot Concepts

Once your team has 4-6 final robot concepts, the team can now begin defining the different robot subsystems. Sample robot subsystems are as follow:

- Chassis
- Above Chassis
- Object collection
- Robot lift
- Programming
- Electrical

Divide the team into robot sub-groups to begin the design and development phase of each of the robot subsystems.

ROBOT SUB-GROUPS

This is the beginning of “How to” phase for fulfilling the robot strategy objectives. Each sub-group is to review the 4-6 robot concepts and develop their subsystem concepts down to one feasible concept direction which aligns with the robot strategy objectives.

Sample Robot sub-group “how to”:

- Chassis – 6 Wheel Drive mobile platform utilizing sprockets and chain.

At the end of day six all the robot Sub-groups need to present to the team their concept design direction, which includes the how’s and why’s of their decisions.

Congratulations, at the close of week one your team has one complete robot design concept direction keep moving forward!



7.4 WEEK #2

Week two is a lot like week one, you are going as fast as you can. There are many sub-group and team meeting during the time. You need to:

- Have a weight review meeting to make sure how much weight each group is allotted.
- Have the initial controls discussion. Each sub-group will explain what controls hardware they expect to use.

HAVE WEEKLY DESIGN REVIEWS

Sub-groups must plan and package the robot. Each sub-group will present to all team members. This is the time for people in other groups to learn what you are working on and give input to the sub-team.

You are validating your concepts to make sure they will work as planned.

The sub-groups can now start working on the design on the computer. CAD designs first, lots of pre-planning give you the best chance for a great design. Remember, making a mistake in CAD is easy to fix, once you have machined a part that doesn't work you are starting over again and there is no time for this.

Controls people are using their breadboard and getting the system online...maybe using old robots to help understand the controls systems.

You must decide what items if any, you using items from the kit. You would also isolate these items if you have kits previous years. We don't usually use much from the kit but the motor and controllers.

You can start ordering some parts and material you may need, i.e. belts, pulleys, paint, etc.

DESIGN FREEZE

The goal of week two is to have a design freeze by the end of the week. This means you know what each sub system will generally look like, what motor it will use, sensors, etc.

The Chassis sub-group should be out in front...a moving robot is priority. The Chassis should be done by the end of the next week.



7.5 WEEK #3

Welcome to week 3

By now the design of your robot should be mostly complete. This includes planning for electronics, a battery, bumpers, graphics and all the details that you pushed off during the first two weeks. Don't forget to leave some room for maintenance and clearance for removing damaged items. FRC competition is rough...you will replace components during the season.

Keep tabs on these tasks and items during this week:

- Final robot components are being fabricated
- Final robot assemblies are taking shape
- Your chassis or main mobility mechanism should be complete and driving around

***TIP:** Your chassis or main mobility mechanism should be complete and driving around. Upwards of 80% of any FIRST match will be decided by your robots chassis and ability to robustly navigate the playing field. Make sure you have your system up and running as soon as possible.*

- Your programming team should have access to the robot at this time to start early development. Autonomous programming should also begin.
- Now is a good time to get your prospective drivers some early practice.
- Design reviews during this week are critical. Make sure to check your weights and check to see if you're currently in compliance with the inspection checklist.



7.6 WEEK #4

Past the halfway point, good time to begin drinking coffee

Keep tabs on these items during this week:

- A drivable chassis platform should driving around
- Student Drive team tryouts can begin
- Verify Chassis overall dimensions, meaning does it fit in the inspection box
- Chassis Autonomous mode development should begin
- Continued fabrication and assembly of above chassis systems
- If so choose some parts out for paint & finish
- Bumper construction completed and assembled to the chassis
- Bumpers, verify bumper weight is within the rules limit and can be removed from the robot within the rules time limit
- Begin monitoring the robot's overall weight and overall size dimensions ... DAILY.
- Continue design reviews, things are heating up and changes happening in all the sub-groups.

Begin considering the following:

- Begin construction of a shipping crate if you are not part of the "Bag & Tag" process. Read the rules regarding this section many steps that need to be fully understood.
- Begin considering Robot cart. How will you move it around?
- Robot Graphics, don't forget you are required to have sponsor, team numbers on 4 sides of the robot and school name on one side. Again read the rules.

***TIP: Graphic panels are part on the overall robot weight!!!!
Don't build a robot that makes weight but with no extra
weight capacity for required graphics.***

- Construction of a portable, robust and organized Operator Interface to hold the driver controls

Finally... don't give up... Keep moving forward



7.7 WEEK #5

Congratulations, you should be looking at a robot right now!

If your machine doesn't at least have a representation of every feature and mechanism that you planned then you're behind schedule! Get ready for the long nights and fun times that will keep you coming back year after year.

Keep tabs on these tasks and items during this week:

- Final assembly of your robot sub-systems
- You should be bringing your complete system online
- Mechanical, electrical and programming sub-groups should be well into the debugging phase
- Check your center of gravity if climbing or navigating uneven playing surfaces. Now is the time to re-arrange weight if needed. A robot on its back is not a competitive robot.
- Continue your drive practice. Your drivers should be getting at least one hour of uninterrupted drive practice every night. If you cannot keep your robot together and running for this amount of time with a breakdown then you need to consider beefing up your failing assembly.
- Now is the time to see where you are weak. FRC is a rough and tumble competition environment. Break your robot now, not at your first competition.

***TIP:** Check to see if any scrimmages are being held in your area. Many veteran teams will host pre-ship scrimmages. Even if you are not up running consider attending to see what other teams are doing and how the game will play out.*

- Do a final design review.
- Check that you fit in the box, are in weight and can pass the inspection checklist
- Get student drivers driving as much as you can but don't hold up the robot assembly.
- If you don't have any graphics or team numbers, GET SOME!



7.8 WEEK #6

Week 6 is finally here (already, are you kidding?). This is your last week before shipping the robot to a competition or bagging it until the first fix it window. You will need to finish implementing all design improvements (fixes) both mechanically and software wise.

Keep tabs on these tasks and items during this week:

- Finish painting and polishing the robot.
- Make sure you have a Robot Bill Of Material (BOM) ready. Read the rules for the details of this requirement.
- Have software backed up on another computer.
- Have student drive practice every day, you cannot practice too much at this point.

Do a safety inspection on the robot

- Do you have any sharp corner?
- Can someone get a finger pinched or cut around and moving part?
- Can you damage the playing field?

Print out an *FIRST* inspection checklist and inspect your robot.

TIP: Get the final weight. It is too hard to make weight changes once you get to a competition.

Make shipping arrangements setup with the donated shipping from FedEx. Read the rules pertaining to robot transportation in the manual. If you are part of a “Bag & Tag” competition then you will need to make arrangements for someone (not on your team) to witness the bag and tag of your robot.

You should be almost complete, but you’ll probably be pulling all nighters at this point. 😊



7.9 BUSINESS DURING BUILD

NOTES

During the build season we have daily and weekly procedures that we follow.

DAILY AGENDA:

After School – 4:00	Students study time
4:00	Check In
4:00 – 5:00	Meeting Start – Establish goals for the meeting
5:00	Mentors Arrive
5:00 – 6:00	Working in small groups to design, prototype and build
6:00 – 6:30	Dinner
6:30 – 7:45	Continue working in small groups
7:45 – 8:00	Full team Pluses and Deltas – See Chapter 2: Business page 25 item 9
8:00	Check Out

Other daily activities include checking for rules updates from *FIRST* (through website or Twitter), and checking the discussion forums on ChiefDelphi (www.chiefdelphi.com).

WHAT TO DO WEEKLY:

Weekly Design Review

Each sub-group presents what they completed during the week and what the goals are for the next week. This gives the other groups opportunity to collaborate and express their needs.

Breakfast Club - Saturday Mentor Meetings

Every Saturday morning during the 6 weeks the mentors and student captains meet to discuss team progress and establish the schedule for the week. The meeting is held at a local coffee shop to get us away from the school.

Weekly Newsletters

A newsletter is created and distributed to the students, sponsors, parents, school administrators. Students and mentors work together to create the layout and write the articles including updates from each subgroup. We also have a Student of the Week and Captain's Choice award which students are nominated for by other students and mentors.



Academic Progress Reports

Students have to submit a weekly progress reports signed by all of their teachers. Students must keep a C average to be eligible to participate on the team.

Update Social Media and Website

Update team progress on social media sites and on the website

OTHER BUSINESS

In addition to the common daily and weekly activities there are many things that have to happen continuously throughout the season.

Media

The media team takes pictures and video of the entire build process (See Business page 37). They are responsible for downloading and organizing the files, keeping batteries charges, and providing media for the other sub-teams to use in their weekly design review presentations. In addition, our media team creates a weekly video that documents the activities of the week.

Purchasing

Purchasing is responsible for processing part orders, outsourcing part manufacturing, and making runs to the hardware store to purchase parts.

Parent Meetings

Every other week we have a parent meeting to keep the parents aware of upcoming events and team progress.

Open House

The week before ship we have an Open House for the parents and sponsors where we explain the game and demonstrate our robot. Planning for the Open House starts after kickoff and continues through the season.

Driver Tryouts/Training

When the robot is close to completion we conduct try-outs for drivers and training. We also look for opportunities to scrimmage and practice with other teams.

Awards

FIRST offers many awards that need to be submitted prior to competition. For a complete list see www.usfirst.org or look in the Awards section of the manual.



Chapter 7: Build Season - Those Crazy Six Weeks

NOTES

There are many items that need to be taken care of prior to going to competitions. These items include:

Arrange for robot shipment (Read the Rules Manual)

Arrange for FedEx or UPS to pick up your robot on the day of ship and make sure that everything is documented properly.

Prepare for Competition Scouting

At competitions it is important to collect information on other teams to help establish strategies for matches. To do this we come up with a scouting sheet for each match where the students document the performance of each team. This data is entered into a computer database which is used to help in the selection process.

Competition Giveaways

At competitions teams exchange giveaway items such as buttons, binky lights, key chains, etc. These items need to be decided on or manufactured before the competition season begins. Teams also give other teams awards. For example, we give out **RUSHies** for teams that best demonstrate Respect, Unity, Spirit, and Heart. During the build season we manufacture and pre-assemble some of the awards.

Uniform Finalization and Ordering

Create a spreadsheet with each team member's sizes, finalize the art work for the t-shirts and place the order. We try to order the T-shirts before the Open House.

Create Travel Arrangements for Competitions

Find and reserve hotels for competitions and determine transportations to the events. For local competitions we try to set up parent car pools. For the Championship we usually rent a bus.

Arrange Food at Competitions

We usually work with parents to provide food at the competitions. We have done tailgates in the parking lot with hamburgers and hot dogs or sandwiches. Many teams also arrange for pizza to be delivered from local stores. For dinners we will bring in food to the hotel, or set reservations at a nearby restaurant

School Preparation for Competition

Before the events check how the travel schedule will affect the students. Many times travel will coincide with exams. Sometimes teachers will allow the mentors to proctor exams for the students so they will not be behind when they return. Also make sure to get permission and medical forms signed and notarized before the competitions.



NOTES