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2011 FRC Virtual Training Session 1

Task Analysis / Game Strategy

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Agenda

- **Brief Introductions**
- **Review of Last Year's FRC Game Rules**
- **General Process for Analyzing Game Rules**
- **Top Ten Mistakes**

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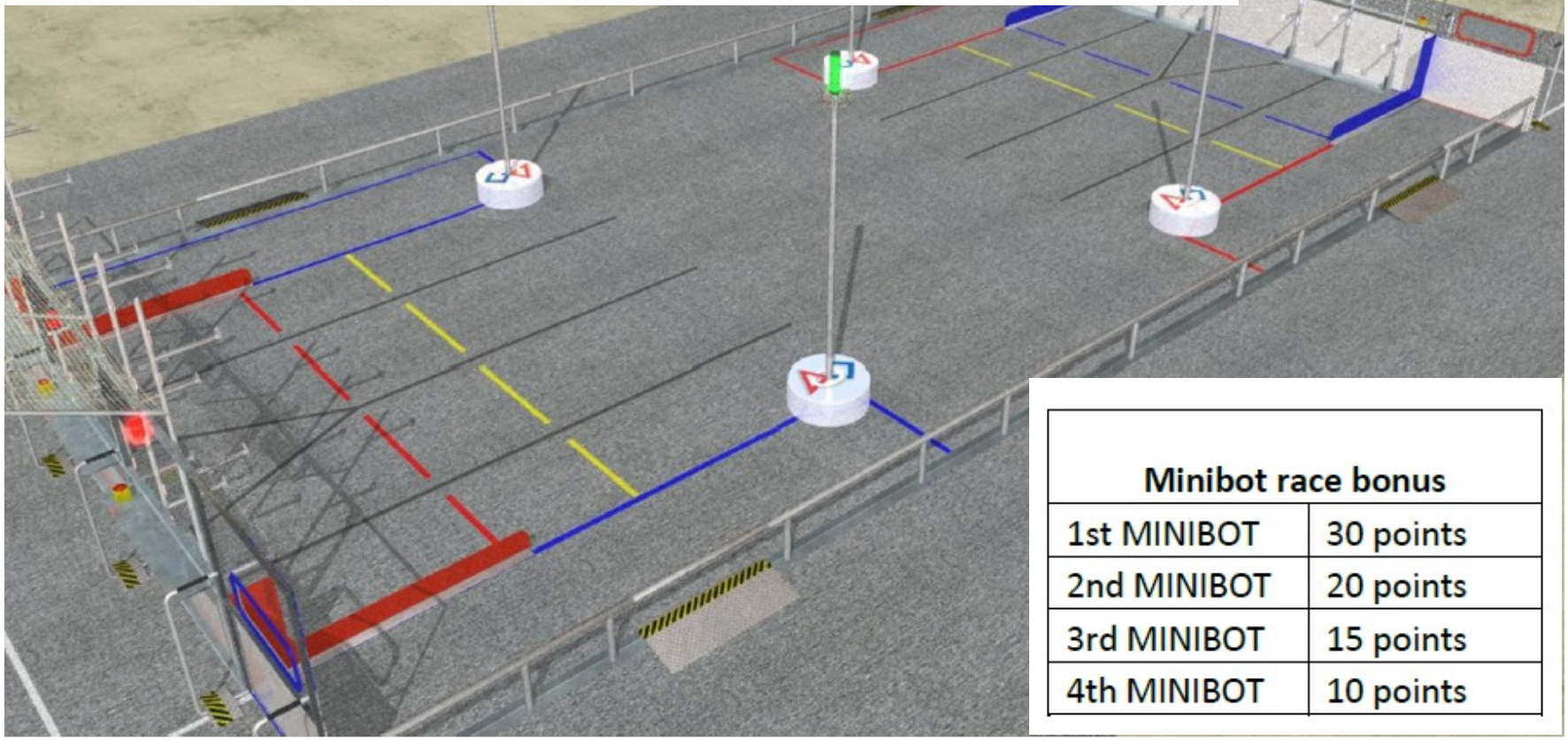
Game Rule Discussion

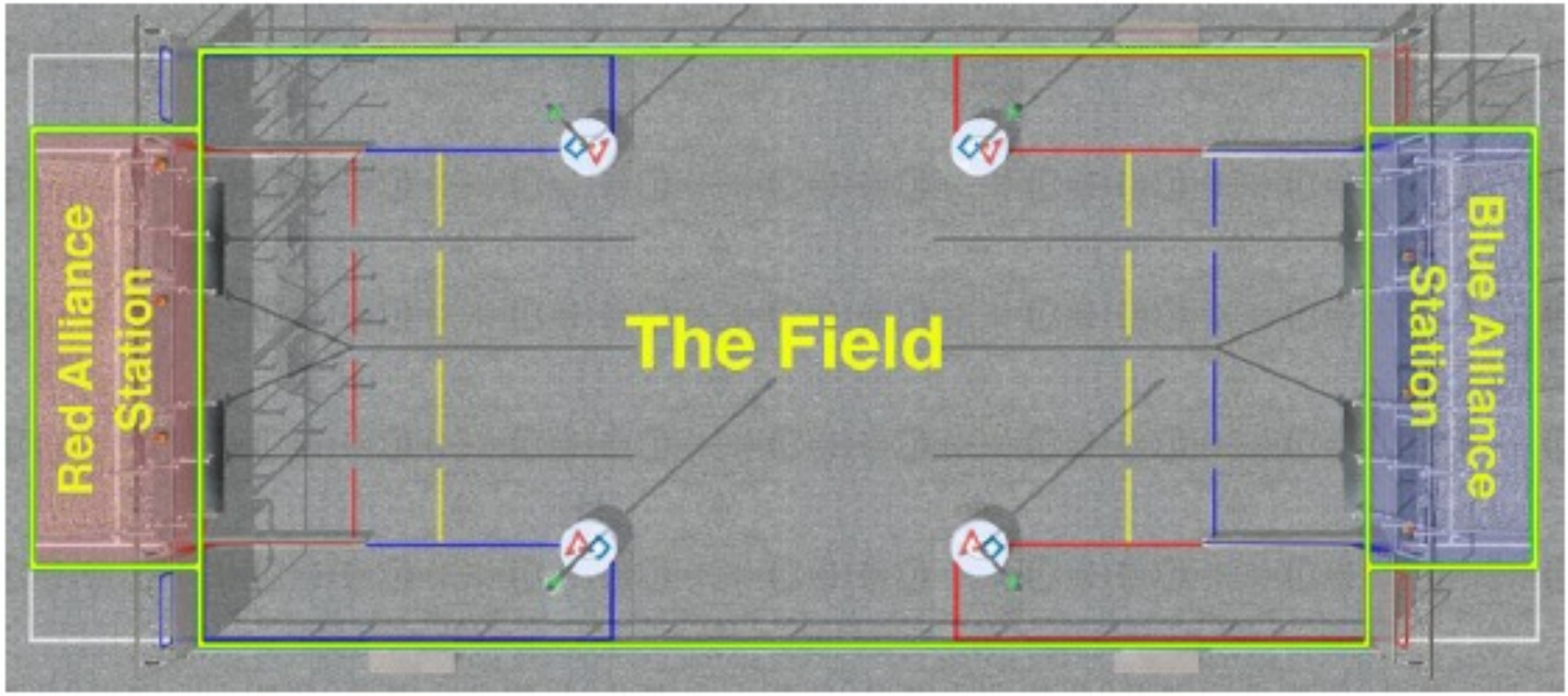
Ubertubes hung during Autonomous	
On bottom row	2 points
On middle row	4 points
On top row	6 points

Logo pieces	Alone	Over Ubertube
On bottom row	1 point	2 points
On middle row	2 points	4 points
On top row	3 points	6 points



Minibot race bonus	
1st MINIBOT	30 points
2nd MINIBOT	20 points
3rd MINIBOT	15 points
4th MINIBOT	10 points

The Field



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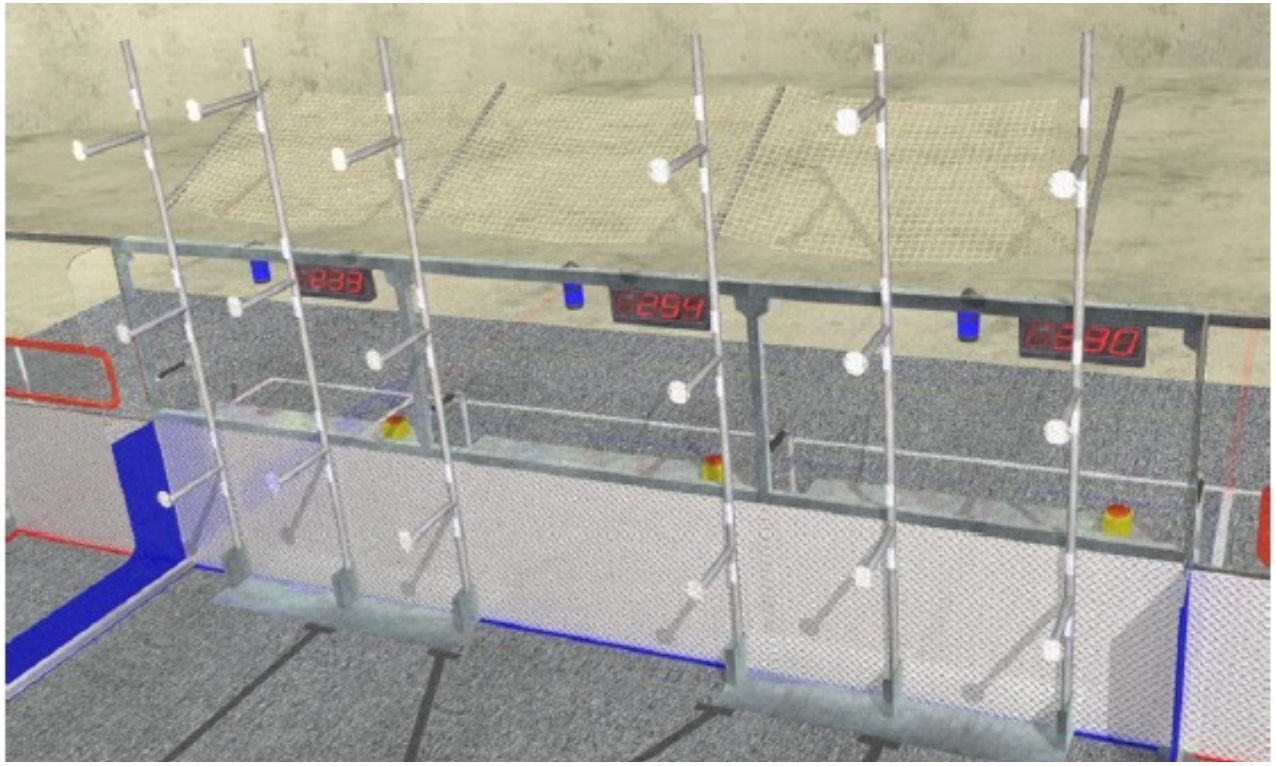
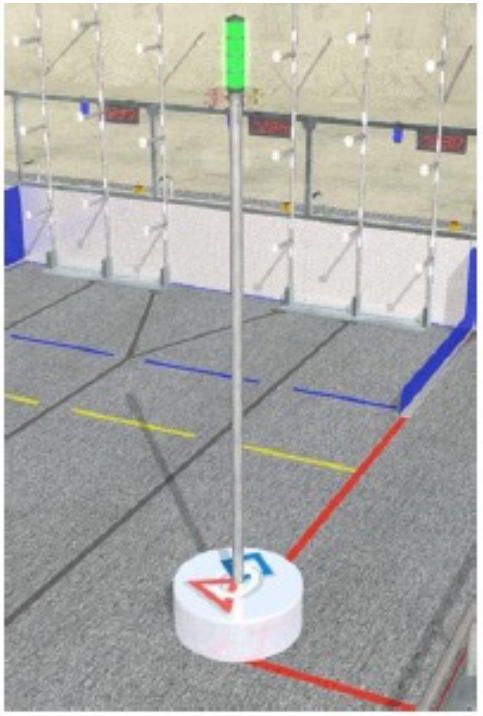
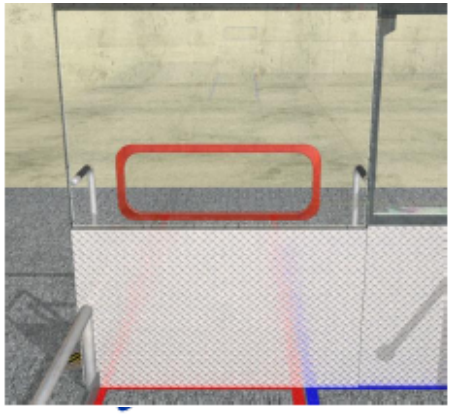
Arena Elements







Field Constraints

- **Slight (¼ inch) bump under carpet near towers**
- **Towers on left and right of field**
- **Line tracking lines on field**
- **Many reflectors to steer to**
- **Protected from contact:**
  - *Near posts when placing tubes*
  - *Once arrive at towers for mini-robot in end game*

Thus, no large obstacles to get in the way

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Robot Rules

- **Size and Weight Constraints**
  - *Main robot*

	Maximum Horizontal Dimensions	Maximum Height	Maximum Weight
STARTING CONFIGURATION	28” x 38” (71.12cm x 96.52cm) rectangular space	60” (152.40cm)	120 pounds (54.43Kg)
PLAYING CONFIGURATION	~~60”~~84” (213.4cm) diameter vertical right cylindrical volume	N/A	

  - *Minibot*
    - *12” x 12” x 12” volume*
    - *15 lbs maximum*
    - *FTC type components and construction rules*

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Strategy and Brainstorming

Paul Ventimiglia, Student at WPI

Example of Resources Available on the Web

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Team Consensus

- **Sense of "unity" is key**
  - *Having proud team members with an agreed upon theme*
  - *What is most important?*
    - *The engineering/build process?*
    - *Having a good time competing?*
    - *Winning awards/events?*

Team Consensus

- **Examples could include:**
  - *"Engineering Challenge"*
    - *Unusual robot strategy or design*
      - **– Will it win matches? Will teams want to play with us?**
  - *"Great Competitor"*
    - *Designed to win matches*
      - **– Is it original? Challenging to build?**
  - *"Simple and Reliable"*
    - *Safe strategy executed well, all the time*

The Game

- **Watch the video**
- **Read the rules**
  - *Re-read the rules, rinse, lather, repeat*
- **Discuss the rules as a team**
  - *Think about game objectives*
  - *Imagine playing the game as a human*
- **Wild ideas are OK here**

Build a "Field Model"

- **What is included?**
  - *The playing field*
  - *Field elements*
  - *Game objects*
  - *Lines/Boundaries*
  - *Scale robots*
    - *Make these moveable*
- **How do we make it?**
  - *Foam board*
  - *Thin plywood*
  - *Cardboard*
  - *Hot glue*
  - *Wood dowel*
  - *Poster-board*

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Benefits of a Field Model

- **Visualizing the game**
  - *Some things are easier to picture*
  - *New ideas are fostered*
    - *Appeals to hands-on and visual learners*
  - *Essential for game strategy*
    - *"Robot Role-playing"*

Game Strategy

- **Select a meeting facilitator**
  - *Impartial and able to control the room*
    - *Makes sure everyone is included*
- **Forget about robots; no robot thoughts!**
  - *Instead, focus on tasks*
    - *Capping, hanging, herding, moving a goal, etc*
- **Create a "list of game tasks"**
  - *Include point values*

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Game Strategy

- **Play the game!**
  - *Use your model*
  - *Assign a person to control a robot*
    - *Give arbitrary abilities*
      - **"This robot can pick up small balls and deliver them"**
      - **"This robot only plays defense and hangs"**
      - **"This robot can move the goals and cap goals"**
  - *Use a timer, and watch what happens*
  - *Repeat with different robot abilities*

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Game Strategy

- **Prioritize your "list of tasks"**
  - *Adjust the list until you are satisfied*
    - *This is challenging!*
      - **Remember to avoid robot designs**
      - **People will tend to argue, facilitator be wary**
  - ***<u>This list should be used all season</u>***
    - *Where is weight allocated first?*
    - *What should we build first?*
  - *Even if only priority 1 is complete, your team will still feel successful*

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Robot Design

- **Brainstorming should be fun**
  - *Every idea is useful*
    - *Experience is not needed*
    - *New people offer a unique perspective*
- **Include everyone**
  - *Anonymous drawings/ideas?*
  - *Get into small groups*
  - *Watch out for the "know-it-alls"*

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Robot Design

- **Three example techniques**
  - *Anonymous Large Group*
  - *Small Sub Groups*
  - *Small Scale Prototyping*
- **Every team has a design process that fits them best**
  - *Consider the size of your team*
  - *Do you have people who can lead?*

Anonymous Large Group

- **Post it notes**
  - *Anonymous ideas*
  - *Grouped and discussed*
- **Lots of quick prototyping**
  - *Plywood and plastic mechanisms*
  - *Immediate feedback*
    - *This is feasible, or this is impossible*
    - *Look at how simple this is, etc*

Small Sub Groups

- **Small groups design separately**
  - *moderated by a veteran*
  - *Less "chefs" in the big kitchen*
- **Drawings of a complete robot**
  - *Takes several days, hard work*
  - *A presentation is made*
    - *Presented to the entire team*
- **One main design is selected**

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Small Scale Prototyping

- **Small groups build model robots**
  - *Robotics kits can be used*
  - *A scale field is made*
  - *Robots actually play the game*
    - *This is a more realistic approach to the scale model role-playing*
  - *Winning robot is selected*
  - *This requires some student skill and kit materials*

Design Matrix

- **How do you compare designs?**
- **Create a design matrix!**
- **How to make one:**
  - *Designs being compared go across the top*
  - *Design attributes go on the side*
  - *Assign "weights" to the attributes*
  - *Rate the various designs*

Design Matrix

- **What does the outcome mean?**
  - *Can be misleading*
  - *You may need to adjust your weights*
  - *Include new criteria to compare?*
- **Include these attributes also:**
  - *Cost, build time, skill, reparability, etc*
    - *Fun? "WOW" factor?*

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Top Ten

Things NOT To Do When Designing Your FRC Team's Robot

Richard's Top Ten Boneheaded Mistakes
and suggestions for avoiding them

St. Louis Regional Fall 2007 Robotics Training Camp
Hosted by FRC 931 Perpetual Chaos, Gateway High School

How This List Was Made In Three Easy Steps

- **Step One: Asked The Experts Online**
  - *Requested help (discreetly) from a community of respected FRC mentors*
    - *Responders include many people whose contributions to FIRST have been previously recognized; they represent several teams with strong records of FRC accomplishment*
  - *Received responses from across the US*
    - *Northeast, Southeast, Midwest, Texas, and West Coast*
    - *Fifteen mentors provided more than seventy suggestions*
  - *Edited, paraphrased, and added some items of my own*
    - *Omitted names to protect the innocent*
- **Step Two: Asked The Experts Locally**
  - *Met with regional group of FRC mentors and FRC event organizers*
  - *Presented summary of online responses and requested advice on how to prioritize each*
- **Step Three: Selected the Top Ten (and a few more)**

Format of the Presentation

- **Top level bullets describe the mistakes**
  - *Sub-bullets describe ways to avoid them*

- Fair warnings:
  - Some boneheaded mistakes may have been left off this list! (doh!)
  - Reasonable (and unreasonable) people may disagree.
  - Your mileage may vary.

- Please, add to the list by telling us about mistakes your team has made or observed. And how they were corrected.
  - Easiest contact: Richard on the Chief Delphi Forum

The Top Ten

10. Bigger is better.

- *You will find reasons to add things to your robot design, even one that seemed perfect before you started testing it. Leave some room to attach things that will be needed to solve the problems you haven't found yet. Little things will stick out. Frantic sawing and filing to pass inspection is not much fun.*
- *Rookie tip: if the maximum footprint is 38" x 28", design your chassis to be 37" x 27".*

It has to fit.

The Top Ten (continued)

9. Decorations are for sissies.

- *The robot is the most visible expression of your team's identity. Spectators, officials, judges, VIPs, and your fellow competitors will all form FIRST impressions of your team based on the appearance of your robot. Make it a good one.*
- *Coordinate your robot's markings to tie-in visually with team shirts, crate decoration, pit signage, and spirit items such as banners and mascots.*
- *Rookie tip: make your team number the largest, most eye-catching feature of your tee-shirt design, and of the robot's markings.*

Let your colors fly.

The Top Ten (continued) Maintainability

8. A good design never breaks.

- *Murphy's law dictates otherwise. Design for maintainability; that means knowing where break points will be and making those easy to access in the pit. Have the right tools and spare parts to minimize downtime.*
- *Rookie tip: have a back-up plan that will help your alliance even if your robot is not able to perform all of its designed functions.*

OUCH !

The Top Ten (continued)

7. Just stick the control system wherever it will fit.

- *Electrical and pneumatic systems require clean, accessible layout to avoid delays when things go wrong. Problems will occur; make it easy to find them so you won't have to miss matches waiting for them to get fixed. Your pit crew, your alliance partners, and your robot inspector will thank you.*
- *Design the electrical and pneumatic systems with the respect they deserve. Identify all the needed components based on your robot's functions early so you can prototype and/or CAD them along with other critical systems.*
- *Rookie tip: lay out electrical components so that fatter wires run shorter distances.*

The Top Ten (continued)

6. My way or the highway.

- *Anyone can come up with a great idea. Don't forget to listen to everyone on the team. When mentors and veteran students listen and encourage, great ideas spring from new or unexpected sources.*
- *Every team needs one person with the responsibility of making a final decision when differences of opinion lead to an impasse – that person must be able to consider all the facts and opinions of all team members, and then make the decision.*

Communicate.

5. Weight? No problem!

- *Take charge of robot weight on Day One. Make one student the weight czar. Know or model the weight of everything that goes onboard. Don't leave anything out: common omissions are chains, fasteners, and wiring. Check component and total systems weights frequently and update the budget.*
- *Rookie tip: make the whole team aware of the robot's weight margin at least one week before ship day.*

No Margin !

Have you ever watched a dozen people holding their breath?

And then exhaling all at once?

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The Top Ten (continued)

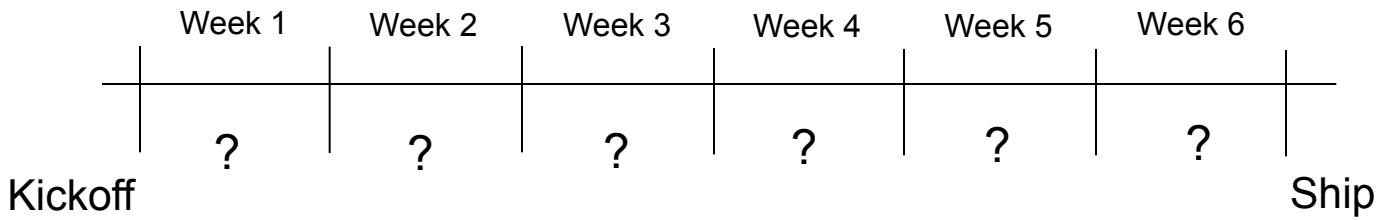
Stay on target.

4. Darn the schedule! Creativity happens when it happens.

- *Six weeks can slip by faster than you think.*

  Decisions your team doesn't make in the first and second week
  will lead to extra work, unplanned costs, frustration,
  a poorly functioning or non-functioning robot,
  and maybe some burned-out team members
  in the sixth week.

- *Schedule your build season activities and milestones. Then stick to the schedule even if it means eliminating some goals.*



Good reference: MOEmentum from FRC 365 (MOE, 2007 Chairman's Award)

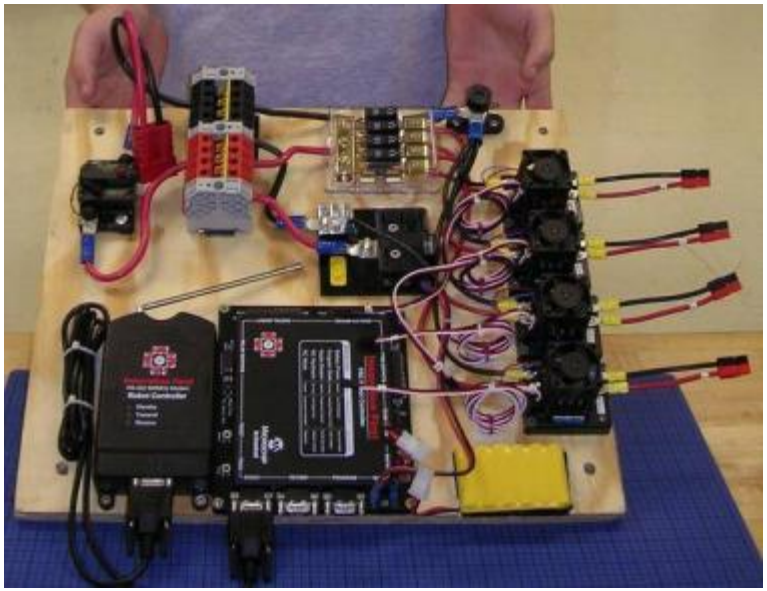
http://www.fsrobotics.org/moe365//moementum.php

The Top Ten (continu Test it, again.

3. Software can wait.

- *Remember the old saying about strength of chains: your robot will only be as reliable as its worst system. Delays in prototyping the control system will almost guarantee that your software gets little or no test/debug time – so it will be the weakest link.*
- *Early in the build season (or sooner!) provide a "mule-bot" that your programmers can use to test ideas.*

Example: A complete electrical system prototyped during Week 1 of the 2007 build season.



The Top Ten (continued) Strategy

2. We finally got last year's robot to work; let's build it again.

- *Let the form of your robot follow the functions you want it to perform.*
  - *Reference: MIT 2.007 Open Courseware (Alex Slocum, 2005)*
    - http://ocw.mit.edu/OcwWeb/Mechanical-Engineering/2-007Spring-2005/LectureNotes/index.htm
  - *Process: steps to take your team from Kickoff to Design*
    - **One: Take stock of available resources.**
      - **Kit of Parts, funding, knowledge, tools, skills, facilities**
    - **Two: Understand the rules and the physics of the game challenge.**
      - **READ THE MANUAL. All of it. Frequently.**
    - **Three: Create game strategies. Use words and diagrams.**
      - **Imagine the flow of robots, field elements, and game pieces.**
      - **Keep asking questions: who, what, when, where, why, how**
      - **Experiment. Play the game using students as robots.**
      - **Think about how defenders are likely to respond.**
- *Rookie tip: Base your design on a limited number of strategies. Robots that do one or two tasks well are more successful.*

The Top Ten (continued) Solutions win.

1. It's a learning experience. We'll figure out what to do on our own.

- *Your team doesn't have to reinvent everything.*
  - *FIRST and the FIRST community provide many excellent resources.*
    - **FRC Manual: Tips and Good Practices.**
      - http://www2.usfirst.org/2007comp/other/2007%20Guidelines_Tips_Good%20Practices_RevC.pdf
    - **Chief Delphi discussion forum**
      - http://www.chiefdelphi.com/forums/portal.php
      - **Many helpful White Papers on topics of interest.**
  - *"Steal from the best, then invent the rest." -- Dave Lavery, NASA*
- *Local veteran FRC teams are often eager to help you avoid mistakes they have already made.*
  - *"The biggest fallacy in FIRST is the belief we are just a bunch of different teams. We are ONE BIG TEAM with a lot of sub teams for the purpose of competition.*

  … Gracious professionalism dictates that if you come to play, I must help you."
  -- Al Skierkiewicz, FRC 111 (WildStang, 2006 Chairman's Award)

The Contenders

- **Let's put casters on one end, that will make the robot easy to turn.**
  - *Casters will make your robot easy for defenders to turn, too. And make it difficult (or impossible!) to surmount obstacles, climb ramps, etc.*
  - *Check out Chris Hibner's whitepaper on Drive Train Basics.*
    http://www.chiefdelphi.com/media/papers/1443
- **Oops! There went the battery!**
  - *Secure that battery, so that it cannot fall out when the robot is on its side or upside-down!*
- **Tank treads will make our robot unstoppable!**
  - *Well executed high-traction systems have succeeded in some FRC games. More often, the extra demand they put on your batteries is not worth the benefit.*
- **An exotic drivetrain (holonomic, swerve, mecanum, etc.) will let us outmaneuver the opposition.**
  - *Only if you have developed and tested it thoroughly, long before build season begins.*

The Contenders

- **We'll make that cantilevered axle out of drill rod, then heat treat it for added strength.**
  - *It'll snap when shock-loaded. Use 4130 or 4340 instead.*
- **Hurry up and cut that part we need, right now!**
  - *Measure thrice, then cut once. It's much better than cutting thrice.*
- **But my design looked great in Inventor!**
  - *Beauty and frustration – both reside in the details. CAD can be a great tool, but its results are only as good as the details you include. Oversimplifying can leave a big disconnect between design and build.*
- **Screw that tether on good and tight!**
  - *No, don't. Remove tether screws from the robot end, so it will self-protect by pulling loose if the robot gets away while you are testing.*

The Contenders

- **Our wiring doesn't need to be pretty, it just needs to work.**
  - *Take the time to organize your motor, PWM, digital, and analog wiring so that it is easy to trace, and mark each circuit on both ends with an identifying label. This will make it easier to reconnect things that come loose or need to be removed while something else gets serviced. And it will make life much easier for your programmers if the labels match up with your software I/O map.*
- **Auto mode is just like driver control, but without the driver.**
  - *PWM commands in auto mode should be set to an initial null value of 127. Driver controls can be tweaked to correct for other null values, resulting in predictable response in teleo mode and unpredictable results in auto mode.*
- **To protect the radio we'll put it inside the robot's metal skin.**
  - *Recall those pesky details known as Maxwell's Equations? Radios are much less effective when their signals are boxed in!*