The FRC Survival Guide

A compilation of resources for the FIRST Robotics Competition

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Introduction

This guide was created to be the ultimate collection of FRC resources. It was created by two alumni from FRC team 4468, Fernbank LINKS Robotics, based on resources and tutorials we found useful, both as students and as mentors. This guide is a compilation of already existing resources made available by various individuals and teams. You will notice asterisks (*) next to resources that we deemed to be especially useful and have chosen to be our “Editor’s Picks”. We want to give an extra big thank you to all of the teams and individuals that created and shared the resources included in this guide. If you have any feedback or suggestions for future editions, please feel free to email us or message us on Chief Delphi.

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General Resources

*Chief Delphi - The unofficial forum of FIRST Robotics. You will find threads on anything and everything FRC related. If you have a question about something, there is a good chance there is already a thread on it, and if not, someone will probably respond to your question within a matter of hours. Be warned that the search function is not the best so you are better off doing a Google search for *site:chiefdelphi.com [topic you want to search]* (do not include the brackets in the search).

FRC Blog - This is the official FIRST Blog. The posts tend to be interesting bits of information or opportunities related to the FRC community. All FRC Blog posts end up on Chief Delphi, so if you want to learn more about a certain post or see what others have to say about it, check out it's corresponding thread on Chief Delphi.

Rookie FIRSTs - A blog from FRC team 5526, the tCATS, with tips and tricks to help rookie teams get started in FRC. Most tips are also applicable to veteran FRC teams.

FIRST Help Now- A 24/7 helpline during build season for any technical questions you may have while working on your robot.

Advice for New FIRST Teams- A presentation from FRC team 33, the Killer Bees, that outlines everything it takes to be a successful FRC team.

FRCLinks- A page with shortcuts to get to different FIRST and FRC official websites.

Team Organization

Running a FIRST Team - A presentation by the Karthik Kanagasabapathy, former mentor of a Hall of Fame FRC team 1114, Simbotics, that highlights the organization and components of an FRC team and an overview of an average FRC season.

Team 254 Team Handbook- The team handbook of Hall of Fame team 254, the Cheesy Poof, that outlines all of the rules and responsibilities of their team members.

Team 1538 Team Handbook- The team handbook of Hall of Fame team 1538, The Holy Cows, that outlines all of the rules and responsibilities of their team members.

Team 2614 Team Handbook- The team handbook of Hall of Fame team 2614, MARS, that outlines all of the rules and responsibilities of their team members.

Team 1923 Team Handbook- The team handbook of FRC team 1923, the MidKnight Inventors, that outlines all of the rules and responsibilities of their team members.

*Slack- A great team communication platform that breaks down team communication into different channels that can be made for everything from subgroups to events. Slack also allows for easy app integrations with apps such as Google Drive and Trello. If your team is registered as a non-profit, you can qualify for slack standard which includes many additional features and tools.

Trello- An online task management platform that allows you to create different boards and to-do lists for the various aspects of your team as well as assign tasks to different team members.

Team Branding

3 Tips for Making Legit FRC Videos - Simple tips from FRC Nation on making an effective and good looking video for your team.

How to Film Your Robot - An in depth paper from FRC team 3710, the FSS Cyberfalcons, on how to effectively film and make a video about your team's robot.

FIRST Brand and Logo- The official FIRST logos and branding standards.

*254 Branding Standards - An example of the branding standards of Hall of Fame team 254, the Cheesy Poofs.

1538 Branding Standards- An example of the branding standards of Hall of Fame team 1538, The Holy Cows.

Using Social Media- A guide from Hall of Fame team 1538, The Holy Cows, on how to effectively use different social media platforms for your team.

News and Entertainment

FIRST Updates Now (FUN) - An online FRC talk show that discusses FRC community news and “hot topics,” gives recaps of FRC competitions, and hosts a Top 25 robot ranking show during the competition season.

*RoboSports Network- An FRC online talk show network with shows that focus on strategy, game play, check-ins with various FRC teams, and live commentary and coverage of both FRC championships.

FRC Nation -An FRC blog, similar to Buzzfeed, with articles ranging from cool things in the FRC community to tips for build season.

Robotics Competition News- A Youtube channel devoted to interviewing different teams and sponsors with many videos highlight different team's’ unique features and programs.

Robot in 3 Days- Teams of alumni and professional engineers who build entire FRC robots in the three days following FRC kickoff. Their Youtube page is a great resource at the beginning of the FRC season if you need inspiration on various mechanisms for the current years’ game.

*The Blue Alliance- Your one stop shop for everything game day. You will find information for almost every FRC event including the latest competition scores, live streams, team lists, award lists, elimination brackets, and match score breakdowns.

GameDay- The best place to watch live streams from all of the events going on at any given time. GameDay allows you to watch up to nine streams at once, and includes a special stream during championships from RoboSports Network that jumps between the “must watch” matches and gives insightful commentary.

The Blue Alliance Blog- A blog highlighting specific FRC teams and their robot designs as well as event predictions, event insights, and features on different aspects of The Blue Alliance.

Judging and Awards

Exploding Bacon Judges Packet- The judging packet that FRC team 1902, Exploding Bacon, gives to judges that describes their team history and outreach efforts.

*Chairman's Award Questions- A list of all of the Chairman's Award questions Hall of Fame team 27, Team RUSH, was asked from 2008 to 2014.

2014 Chairman's Submission- The full 2014 winning Chairman's submission of Hall of Fame team 27, Team RUSH.

The Complete Guide to the FRC Chairman's Award- An in depth guide developed by FRC team 2486, the CocoNuts, that describes all aspects of applying and competing for the Chairman's award.

Talking to Judges- A blog post from FRC team 3504, the Girls of Steel, with tips on what to expect during judging at competitions.

Business Plan- The full business plan from Hall of Fame team 2614, MARS, that won the Entrepreneurship award at champs in 2013.

How to Win More Awards- A presentation by Kristine Atiyeh, mentor of FRC team 125, the Neutrons, on how to go about applying for and winning more judged awards.

Strategy

*Effective FIRST Strategies - A championship conference presentation from Karthik Kanagasabapathy, former mentor of Hall of Fame team 1114, Simbotics, on effective design and competition strategies.

Spanking the Children A Brief History of Penalties in the FRC- An article by Jim Zondag, mentor of FRC team 33, the Killer Bees, highlighting the history of penalties in FRC and how they affected the different games over the years.

Weighted Objectives- A guide by John V-Neun, mentor of FRC team 148, the Robowranglers, to using weighted objective to decide on a strategy.

CAD

Simbot Solidworks Series- A series of solidworks tutorials from Hall of Fame team 1114, Simbotics, that start with the basics of CAD and go into designing a 1114-style sheet metal chassis.

*973 RAMP - Solidworks CAD videos from FRC team 973, the Greybots, that go over how to CAD FRC specific mechanisms including a West Coast Drive train.

How to Make a Bellypan- A brief tutorial by Andrew Lawrence, mentor of FRC team 1323, Madtown Robotics, and FRC team 971, Spartan Robotics, on how to CAD a belly pan with a weight reduction pattern.

Robot Weight Watcher- A tutorial from Isaac Rife, mentor of FRC team 33, the Killer Bees, on how to actively reduce weight while building FRC robots.

Designing with Belts- Youtube tutorials from WCP on designing and CADing with belts.

Gearbox Plate Tutorial- A tutorial from Hall of Fame team 254, the Cheesy Poofs, on designing a gearbox plate in solidworks.

Part Numbering and Nomenclature- Information from Hall of Fame team 254, the Cheesy Poofs, on how they name and organize their CAD files.

Mechanical Design and Build

General

Weight Budgeting Tool- A spreadsheet made by Mark Kramarczyk, mentor of FRC team 1189, the Gearheads, to help figure out how to budget weight for different robot components.

Center of Gravity Over Bumps- A presentation from FRC team 33, the Killer Bees, that illustrates how a robot's center of gravity changes while driving over bumps and gives some instructions on how to model your own robot's changing center of gravity in Powerpoint.

Parts Organization- A paper from FRC team 469, Las Guerillas, on how they organize and label their current robot and practice robot parts during the build season.

Notes on Nuts and Bolts- A explanation of the terminology used when describing nuts and bolts and what the different specifications actually mean.

Design Process

Design Tutorials- An in depth tutorial from FRC team 610, Crescent Robotics, on different design considerations when designing an FRC Robot.

Mechanical Design - A presentation from Ian Mackenzie, mentor of Hall of Fame team 1114, Simbotics, that goes into detail about design aspects of different mechanisms on FRC robots.

234 Design Process- A walkthrough of the robot design process of FRC team 234, Cyber Blue.

254 Technical Binder- A walkthrough of the strategy, design, and build process of Hall of Fame team 254, the Cheesy Poofs', 2016 robot.

Designing a FRC Robot, a Team Approach - An outline and basic timeline of how to approach an FRC season presented by Andy Baker, mentor of FRC team 45, the TechnoKats.

Engineering Design Process in Competition Robotics - An in depth paper on the engineering design process from John V-Neun, mentor of FRC team 148, the Robowranglers.

Shockwave Build Blog- The build blog of Hall of Fame team 254, the Cheesy Poofs, while they were building their T-shirt shooting robot.

118 Everybot- The build blog of FRC team 118, the Robonaut's, annual "Everybot" that is made using limited resources and a $1,000 budget.

Gearing

*JVN Design Calc - A spreadsheet by John V-Neun, mentor of FRC team 148, the Robowranglers, to figure out the gear ratios and needed gears using any of the FRC motors and the main COTS gearboxes.

WCP/ VexPro Gear Calculator- A design calculator to find the gear ratio and center to center spacing of gears when designing a gear box.

Pneumatics

Pneumatics - A presentation from Ian Mackenzie, mentor of Hall of Fame team 1114, Simbotics, that goes over what pneumatics are, the different components involved, and some of their applications.

Piston Analysis- A presentation from Andrew Keisic, mentor of FRC Team 4201, the Vitruvian Bots, on the math behind mounting and controlling pneumatic cylinders.

FRC Pneumatics Manual- The official FIRST guide to pneumatics with photos and descriptions of all of the pneumatic components and how to set them up.

Manipulators

Manipulators Design in FIRST Robotics - A presentation from Andy Baker, mentor of FRC team 45, the TechnoKats, that goes over different manipulator designs and their applications using successful robots from over the years as examples.

Conveyors- A presentation from Hall of Fame team 254, the Cheesy Poofs, on the use of different types of conveyors in FRC.

Mechanisms and Manipulators- A presentation by Andrew Keisic, former mentor of FRC team 294, Beach Cities Robotics, and mentor of FRC Team 4201, the Vitruvian Bots, on the different design considerations and approaches when designing a manipulator.

Drive Systems

Omnidirectional Drive Systems - An overview from Ian Mackenzie, mentor of Hall of Fame team 1114, Simbotics, on the main types of omnidirectional drives in FRC, including some of the math behind them and highlighting teams that use the specific drive styles.

FIRST Robotics Drive Systems- Pros and cons from Ian Mackenzie, mentor of Hall of Fame team 1114, Simbotics, of the different simple drive train styles and a walkthrough of some of the design considerations.

Drivetrain Design- a comparison from Ben Bennett, mentor of Hall of Fame team 1114, Simbotics, of the different FRC drivetrain styles with the key principles behind designing a drivetrain.

Derivation of Inverse Kinematics for Swerve - Swerve drive and the vector math behind it.

Belt Driven West Coast Drive Train- A step by step guide with pictures from FRC team 4719, the Bulldogs, on how to design and build a West Coast Drive driven by belts.

Belt vs. Chain- The results of an experiment performed by FRC team 234, Cyber Blue, on the use of chain versus the use of belt for FRC drive trains.

FRC Drive Trains- A presentation by Jesse Knight, mentor of FRC team 1885, iLITE, on the important considerations when designing a drive train.

The Theory Behind 6 CIM vs. 4 CIM Drives- A paper by Anand Rajamani, mentor of FRC team 1072, Harker Robotics, that compares and contrasts a 6 CIM and 4 CIM drivetrain.

Bumpers

Flip Bumper System Using Bungee Cord- A guide from FRC team 3572, Wavelength, on how they constructed their bumpers that can easily be changed from one alliance color to the other.

Bumper Tutorials- A YouTube channel with tutorials on how to build bumpers.

Controls

Electronics

*WPI Library - The official resources and walkthroughs for the entire FRC control system, including how to wire and program it.

Advanced Robot Electrical Design - A presentation from Michael Dessingue and Al Skierkiewicz, mentor of FRC team 111, WildStang, on designing an effective electrical system.

The Book of FRC Electrical - A walkthrough from FRC team 2853, the Trobobots, of the entire FRC controls system.

Electrical Documentation- A visual guide from FRC team 868, the TechHOUNDS, on FRC electronics with a how-to guide on how to wire an FRC robot.

Battery Load Limiting- A presentation from FRC team 1736, Robot Casserole, on understanding what brownouts are, what causes them, and how to prevent them.

FRC Robot Wiring- An Instructables guide from FRC team 1477, Texas Torque, that goes through the different steps of creating an organized electronics system. While the control system used in the tutorial is outdated, everything else is still very relevant and useful.

2015 roboRio Control System- A guide from FRC team 358, the Hauppauge Robotics Eagles, on the different components of the FRC control system, advise on how to properly wire them, mounting tips, and troubleshooting advice.

2008 FRC Sensors Miller - An overview from Brad Miller, from WPI, of different sensors that can be used in FRC and their different applications.

Programing

Codecademy Java Course - An online course to learn the basics of Java.

*WPI Library - The official FRC programming guide.

*GitHub- An online platform to host and share code. Many FRC teams have public GitHub's so that you can learn from other teams' code.

PID Without a Ph.D. - A paper to learn about what PID is and how it works.

Programming Handbook- A guide to FRC programming in LabView created by Hall of Fame Team 2614, MARS.

The FRC Robot Project LabView- A step by step LabView tutorial created by FRC team 1986, Team Titanium, that goes through how to program an FRC robot.

Current Limiting to Prevent Brownouts- A paper from FRC team 1736, Robot Casserole, that describes how to use code to limit current going to motors to try and prevent brownouts.

Positional Motion Profiling- A paper from FRC team 900, the Zebracorns, that describes their implementation of motion profiling using LabView.

ZebraVision 4.0 Goal Detection- A paper from FRC team 900, the Zebracorns, that describes their use of vision processing for goal detection.

Integrating Computer Vision with Motion Control- A presentation from Jared Russell and Tom Bottiglieri, mentors of Hall of Fame team 254, the Cheesy Poofs, on how to use computer vision in FRC.

Competition

Drive Team

Driver Selection Criteria- A description of the criteria that Hall of Fame team 254, the Cheesy Poofs, use to select drivers and the expectations that they have of their drivers.

Drive Team Selection and Practice- A guide from FRC team 3418, RoboRiot, that has descriptions of the main drive team roles and the best practices that lead to a strong overall drive team.

Scouting

Tableau- An introduction and how- tutorials on creating a scouting program using Tableau.

Scouting Process- A guide created by Hall of Fame team 2614, MARS, that describes the process and tasks involved with scouting as well as gives examples of different types of scouting systems that teams use.

Ctrl-Z Electronic Scouting- A guide from FRC team 4096, Ctrl-Z, on how they created their electronic scouting system and an explanation of how other teams can create their own.

Citrus Circuits 2016 Scouting System- A guide from FRC team 1678, Citrus Circuits, on the development and implementation of their electronic scouting system.

Pits Space

973 Super Pit- The documentation of how FRC team 973, the Greybots, built their competition super pit.

Pit Carts- A walkthrough of how FRC team 1619, Up-A-Creek Robotics, designed and built their competition super pit.

Parts and Suppliers

Supplier Overviews

*Vex Pro- FRC products designed by FRC alumni that are easily integrated onto robots. Parts range from VersaFrame robot structure to gearboxes, including the popular VersaPlanetary gearbox.

*McMaster-Carr- A supply company that has almost everything and anything you could possibly want. McMaster has a large variety of raw materials, tools and equipment, fasteners of every kind, and if you are lucky enough to live in Atlanta, Chicago, Cleveland, Los Angeles, or New Jersey, you can benefit from their same day (sometimes same hour) in-store pickups and incredibly fast shipping.

AndyMark- FRC robot parts and kits, and the home of the FRC Kit of Parts FIRST Choice. Parts range from wheels and gears to motors and gearboxes, including the popular PG series motor gearboxes. If you opt out of the kit of parts drivetrain, you will instead receive a $450 voucher to use at AndyMark. You also get an allotted number of credits each season to use on parts from FIRST Choice.

BaneBots- FRC supplier best known for their high traction wheels.

West Coast Products- FRC products and project designs from FRC alumni. Parts range from gearboxes to sensors and sensor boards, such as the Spartan Sensor Board designed by FRC team 971, Spartan Robotics.

Automation Direct- FRC supplier that specializes in industrial controls products. Most FRC teams use them for their electrical and pneumatics components.

Bimba- FRC supplier that specializes in pneumatic, hydraulic, and electronic components. Most FRC teams use them for their pneumatic components.

Ruland- FRC supplier that specializes in shaft collars, shaft couplers, and shaft couplings.

Home Depot- A home improvements and hardware store that sells a large variety of tools and equipment, some raw materials, and random odds and ends that you may need throughout the build season.

Lowes- A home improvements and hardware store that sells a large variety of tools and equipment, some raw materials, and random odds and ends that you may need throughout the build season.

Southern Aluminum Finishing Company- An Atlanta based aluminum company that sells aluminium sheet and extrusion. They tend to have some of the lowest unit prices when you buy in large quantities, so plan what you need ahead of time and try to make larger orders.

Metal Supermarket- A metal supplier with good prices for metal sheets, bars, and common extrusions.

Gem City Steel- An Atlanta based metal supplier with good prices for metal sheets, bars, and common extrusions.

CTR Electronics- An electronics supplier that sells electronics components and tools used for FRC including Powerpole connectors, battery cables, and motor controllers.

Suppliers by Part Type

Motors and Gearboxes

- Vex Pro
- AndyMark
- BaneBots
- West Coast Products

Raw Materials

- McMaster-Carr
- Home Depot
- Lowes
- Southern Aluminum Finishing Company
- Metal Supermarket
- Gem City Steel

Electrical Components

- Vex Pro
- AndyMark
- CTR Electronics
- West Coast Products
- Automation Direct

Wheels

- Vex Pro
- AndyMark
- BaneBots
- West Coast Products
- McMaster-Carr

Penumatics

- Automation Direct
- Bimba
- McMaster-Carr

Shaft Collars and Couplers

- Ruland
- Vex Pro
- AndyMark
- McMaster-Carr