

Strategic Design

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Who Am I?

- Lead Technical Mentor and Drive Coach for 1678
- Going into my 14th Season in FRC
- Mechanical Engineer at DMG MORI in Davis
- Most Importantly: I'm not that smart!

Specialized Training

- Drivetrain Design
- Mechanism Design
- Electrical/pneumatic tips
- Programming goals



Training

Golden Rule #3

- Steal From The Best, Invent The Rest
 - Get your team familiar with past games and robots
 - Games will often be similar to past games
 - Examples:
 - 2004, 2010, and 2013 climbing
 - 2007 and 2011 tubes
 - 2006, 2012 and 2016 balls
 - Take advantage of this!
 - Ask veteran teams questions about their past

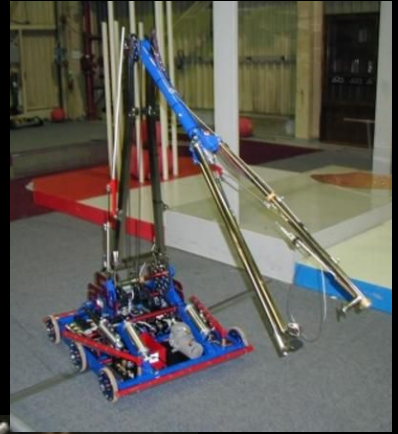


Stick to your guns

DRIVETRAIN DESIGN







Drivetrain Options

- “Tank Drive”
 - 4, 6 or 8 Wheel Drive
- Swerve
- Octanum
- **Not Mecanum**
- **Not Omni**

6 Wheel Tank

Golden Rule #1

- West Coast Drive
 - What is it?
- Why?
 - Proven design
 - Wide wheel base
 - Weight Saving
 - Room for electronics board
 - Space to mount super-structures

There's nothing that hasn't already been done

MECHANISM DESIGN



Basic Devices for Mechanisms

Motors

- Gearboxes
 - Single Speed Gearbox
 - Shifting Gearbox
 - Planetary Gearbox
- Variable Movement
- Harder to Control

Pneumatics

- Movement from point A to point B
- Very repeatable
- Non-variable
- Single or double position solenoid

Mechanism shapes

- KISS
- Minimum degrees of freedom
- Low Center of Gravity
 - Especially Motors and Battery
- Symmetry when possible
- Inside the frame perimeter when possible
- Robust when outside the frame perimeter

You Need to Move Something

- How are you going to:
 - acquire it?
 - manipulate it?
 - store it?
 - lift it?
 - position it?
 - release it?



Acquisition Zone

- The acquisition zone is the effective intake area of the robot; the larger the better.
- How will the object react to the robot, field, intake device?
- Can the driver pick up an object 50ft away without a direct line of sight?



Continuous vs. Single Intake

Golden Rule #2

- Can objects hinder intake ability or movement?
- 2012 & 2013: Picking up multiple game pieces
- **Continuous Intake = ROLLY GRABBERS**
- Single Intake = Claw/Hook







Device Alignment

- How can you guarantee proper placement?
- Are there physical objects to orient the robot?
- Quick alignment is key to scoring efficiency and on field success!



Balls



Tubes



Discs



Electrical and Pneumatic Tips

- Electrical wiring in FRC is an art
- Look at teams like 254, 973, and 1538
 - Do as they do
- Look at teams like 1678 in 2013
 - Don't do as they do
 - Cost us a match on Einstein



Programming

- Autonomous = huge points
 - 2011: autonomous = double points
 - 2013: 90 points possible, that is equivalent to a top tier robot scoring in tele-op,
 - 2013: 42 point auto and 10 point hang
better than 18 point auto and 30 point hang
 - 2014: 65 point auto from 254
 - 2015: 2826 28 point, 3 tote, 3 RC auto



Keys to Good Programming

- Precision Autonomous Driving
 - Using encoders + gyro
- Camera Alignment
 - Faster scoring
- PID Loops for arms and driving accuracy
 - Ex. 2011 Tube Rack
- Bang Bang controller for shooter wheels
 - Key in 2012 and 2013



The best 6 weeks of your life

BUILD SEASON



Build Season Overview

- Accelerated Schedule is Important
- When setting schedule: “Aim for the Moon, Land among the Stars”
- Students ALWAYS assume there is more time than there is
- Often, Mentors do too!



Week 1

- Days 1 – 3
 - Brainstorming
- Day 5
 - Strategy Freeze
- Days 5 – 14
 - Prototyping
 - Drive-base electrical layout
- Days 5 – 14
 - Build drivetrain
 - Programmers begin code for drive train



Brainstorming

- Most important weekend of your entire season
- Three Steps (in this order!)

- Read the Rules
- Answer the “What” Questions

What is our strategy? What will the robot do?

- Answer the “How” Questions

How will the robot carry out this function?



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Week 2

- Days 8 – 14
 - Robot controls
 - Finish drivetrain
 - Crucial for other mechanisms and electronics
- Days 8 – 21
 - Mechanism construction
 - Programming
 - Finish drivetrain code



Week 3

- Day 15
 - Begin testing autonomous code on drive train



Week 4

- Days 22 – 28
 - Mechanism integration
 - Wiring



Weeks 5 & 6

- Day 29
 - Robot “finished”
- Days 29 – 40
 - Testing, BREAKING, fixing, iterating
 - Driver training
 - A good driver beats a good robot



The real deal

COMPETITION SEASON



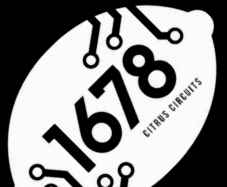
The Biggest Lie in FRC

- Myth: build season is 6 weeks
- Reality: build season never ends



Withholding allowance

- Allowed to bring < 30 lbs of parts
- Keep parts to fine tune and bring to competition
 - Last resort, do not rely on this!
 - Installation of new parts takes up precious time in the pits
- Allowed to Add Components
 - Stingers in 2012



Practice robot

- Identical to competition robot
 - If not full robot, copy of drive-base
 - Buy AM Drive Base, transfer mechanism, instant practice robot! Just add water!
- Large investment, large reward



Watch other Competitions

- Watch other regionals
 - Webcast parties (with pancakes!)
- Read Chief Delphi
- Volunteer at events
- Look at other robots for ideas
 - There is still time to re/design and add new parts



At the Competition

- Scouting
 - Qualitative and quantitative data
 - 1st Pick offensive bot, 2nd pick defensive bot
 - 1st pick: purely quantitative, who scores the most, who complements our strategy
 - 2nd pick: defense plus value added (non-tele-op score)
- Know your alliance partners and opponents. Match strategy depends on their abilities.



Pit Management

- Organization and cleanliness
 - You can't use tools that you can't find
 - Lots of metal shavings = lots of electrical failures
- Battery management
- Team member accessibility
 - Stay in contact in case we need you



“Robots don’t win competitions.
Teams do.”

Citrus Circuits
Fall Workshop Series
Questions?

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Thank You!