

STRATEGIC DESIGN

# Strategic Design

By Mike Corsetto (1678), Austin Haddox (1678)

FALL WORKSHOPS

# Who Am I?

- Mike Corsetto
- Lead Technical Mentor of Team 1678
- Engineering Manager at Sunpower
- Going into 17th season in FRC
- Started mentoring 1678 in 2008
- I'm not that smart (Credit to Karthik, 254 and others)

# Who Am I?

- Austin Haddox
- Strategy, Scouting and Mechanical Mentor
- Sr. Analyst at NBSIA
- Going into 8th season in FRC
- Started mentoring 1678 in 2019

# Overview

- Pre-Season Prep
- Drivetrain Design
- Mechanism Design
- Electrical and Pneumatics
- Build Season
- Competition Season

# Golden Rule #1

- Keep It Simple Silly
- Build Within Your Team's Capabilities
- Simple = Robust
- Function over Form



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# Pre-Season Prep

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# Purpose of Pre-Season

- Pre-Season is not a break
  1. Trainings
  2. Try out new designs
  3. Learn and research past FRC games and designs

# Off-Season Project Ideas

- Ball Shooters
- Ball Intakes
- Elevators
- Climbers
- Kit Bot
- Bumpers



# Learn Your Game History

- Games often have repetition
- Climbing in 2010, 2013, 2016, 2018, 2020
- Tubes in 2007, 2011
- Exercise Balls in 2008, 2014
- Foam Balls in 2006, 2012, 2016, 2020
- Flat discs in 2013, 2017, 2019



# Golden Rule #2

- Steal From The Best, Invent the Rest
- Do Your Research
- Study RI3D Teams in-season
- Look at 2056, 610, 973, 330
  - Simple, effective robots



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# Drivetrain Design

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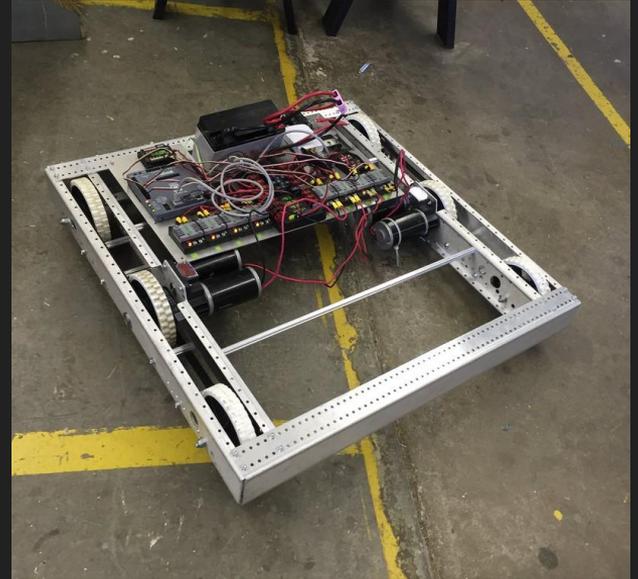
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# Golden Rule #3

- Use A Proven (for you!) Drivetrain
- Basic 4, 6, or 8-Wheel Drive
- Kitbot
- Kitbot on Steroids (Team 1114)
- Spend Time on Mechanisms
- Story of Rarecab in 2008



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# Mechanism Design

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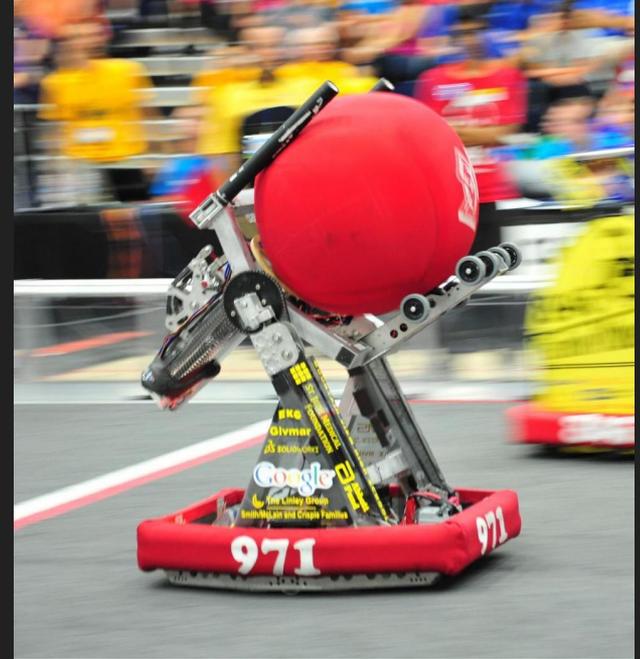
# Mechanism Geometry

- Minimum Degrees of Freedom
- Low C.O.G. (Motors and Battery)
- Symmetry When Possible
- Inside Frame Perimeter If Possible
- Robust When Outside Frame Perimeter



# Movement- Motors

- Range of Motor Choices
- Single Speed or Shifting Gearboxes
- Allow Variable Movement
- Harder to Control (Need Sensors for precision motion)



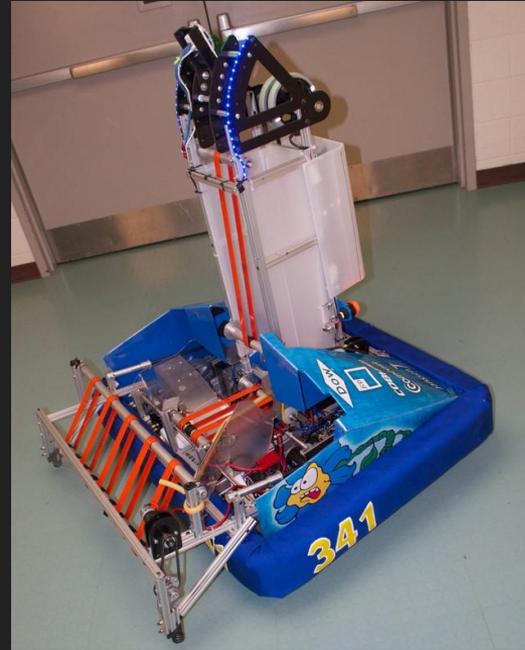
# Movement- Pneumatics

- Movement From Point A to Point B
- Very Repeatable and Precise
- Non-Variable
- Requires Compressor and/or Storage
- Usually lighter than motors
- Be careful, can run out of air!



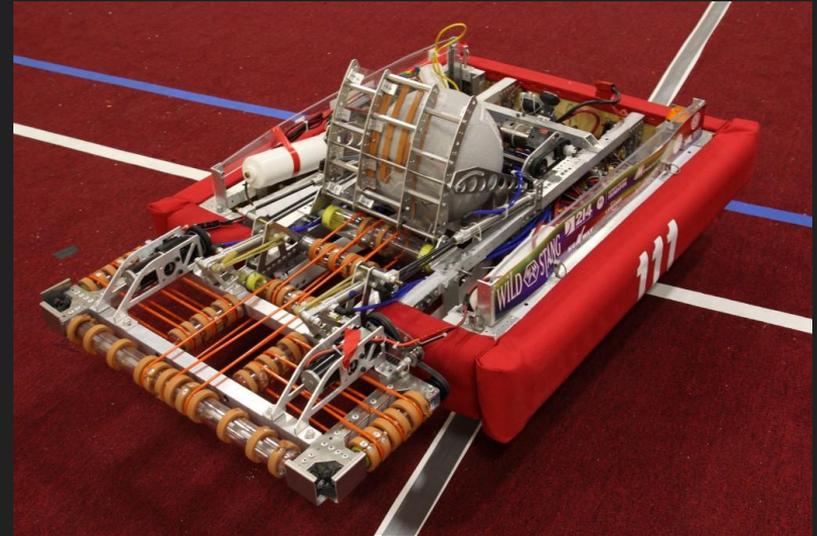
# Acquisition Zone

- Effective Intake Area
- Object/Intake Interaction
- Make the Driver's Job Easy
- Stress The Prototype



# Golden Rule #4

- Rolly-Grabbers
- Continuous Intake
- Increases Acquisition Zone
- Compare to Single Intake  
(claw, hook, scoop)



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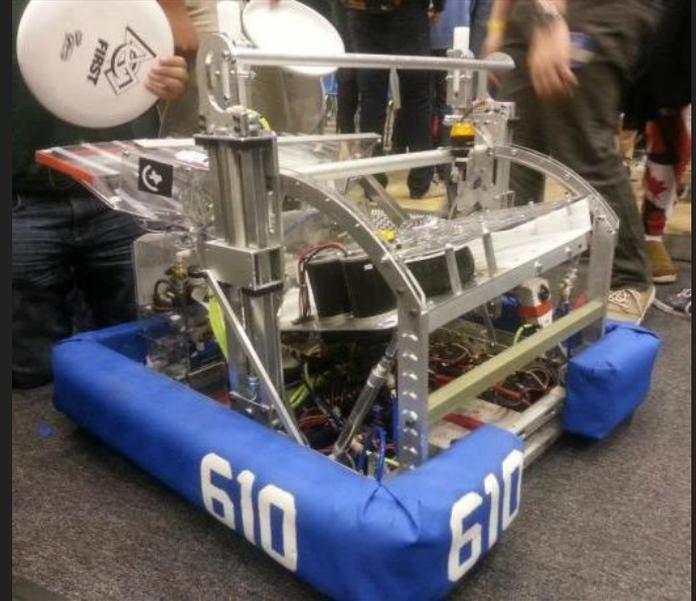
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# Device/Robot Alignment

- How can you guarantee proper placement?
- Are there physical objects for orient the robot?
- Quick Alignment = Efficient Scoring and Simpler Code



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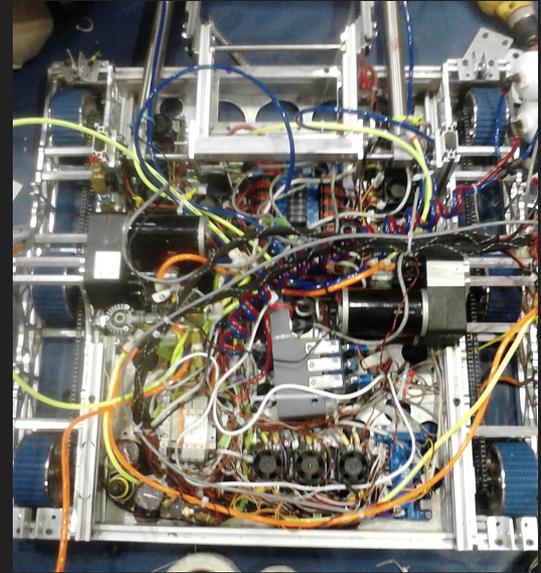
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# Electrical, Pneumatics, and Programming

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# Electrical and Pneumatics

- So Much Can Go Wrong (Power, Signal, Radio, Leaks, etc)
- Spend time to do it right
- 1678 On Einstein in 2013
- 1678 2019



# Programming “Toolkit”

- Precision Autonomous Driving
  - Using encoders + gyro
- Vision Alignment
  - Limelight
- PID for arms and elevators
  - Talon + Mag Encoder
- Bang Bang controller for Shooter
  - Talon + Mag Encoder



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# Build Season

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# 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 3
  - Design Drivetrain
- Days 4 – 14
  - Prototyping Mechanisms
  - Drive-base electrical layout
  - Fabricate/Assemble Drivetrain
  - Begin writing code for expected mechanisms



# Brainstorming

- Most important weekend of your entire season
- Three Steps (in this order!)
  1. Read the Rules
  2. Answer the “What” Questions
    - a. What is our strategy? What will the robot do?
  3. Answer the “How” Questions
    - a. How will the robot carry out this function?

# The “Whats”

- What are the ways to score?
  - a. What is each task worth (Points/RP)?
  - b. What is the difficulty of the task?
    - In game
    - To build during build season
- Design Points
  - a. Specialization is a goal not compromise!
  - b. Just because another team is doing it, doesn't mean you should.

# The “Hows”

- How will the robot carry out this function?
  - a. Do you have experience with a design like this?
  - b. Passive vs Active
  - c. Processing a game piece
- Typically through hand drawings.
  - a. No need to make it complicated.
  - b. Show basic mechanism ideas with correct scale.

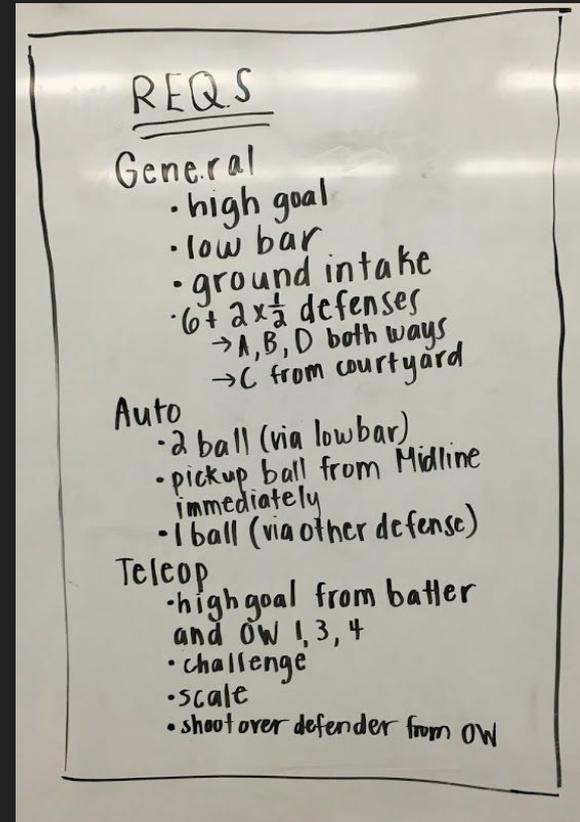
# Game Object Processing

- Acquisition
- Manipulation
- Storage
- Elevation
- Positioning
- Release



# Week 1

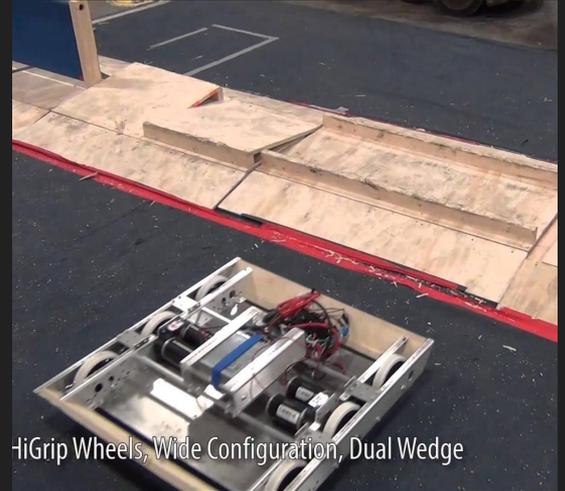
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- Day 14
  - Finish Drivetrain
- Days 15-16
  - Wire up entire drive base, test functionality
- Days 8 – 21
  - Build Mechanisms
  - Program Mechanisms
- Days 22-28
  - Mechanism Integration/Wiring
  - Test code with assembled robot

# Golden Rule #5

- Day 29
  - Robot “finished”
- Days 29 – 45
  - Testing, BREAKING, fixing, iterating
  - #5: Fail Faster!
  - Driver Practice
  - A Good Driver Beats a Good Robot



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# Competition Season

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# No Bag

- Working through competition season is more important than ever!
  - a. Be careful
    - Keep a tight schedule
    - Don't be overly ambitious
  - b. Other teams won't stop

# Watch Other Competitions

- Watch other regionals
- Webcast parties
- Read Chief Delphi
- Watch FUN and Gamesense
- Volunteer at events
- Look at other robots for ideas



# Summary

- Pre-Season Prep – Golden Rules #1 and #2
- Drivetrain Design – Golden Rule #3
- Mechanism Design – Golden Rule #4
- Electrical and Pneumatics – Keep It Neat
- Build Season – Golden Rule #5
- Competition Season – Time to Improve

# Resources

- Chief Delphi – [chiefdelphi.com](http://chiefdelphi.com)
- TCA - [thecompassalliance.org](http://thecompassalliance.org)

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**Thank You! Questions?**

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