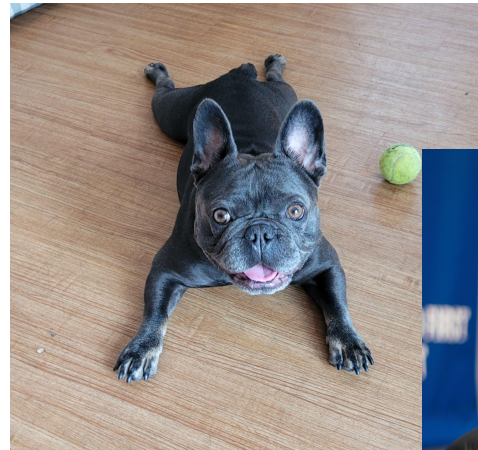


Systems. Systems! SYSTEMS!



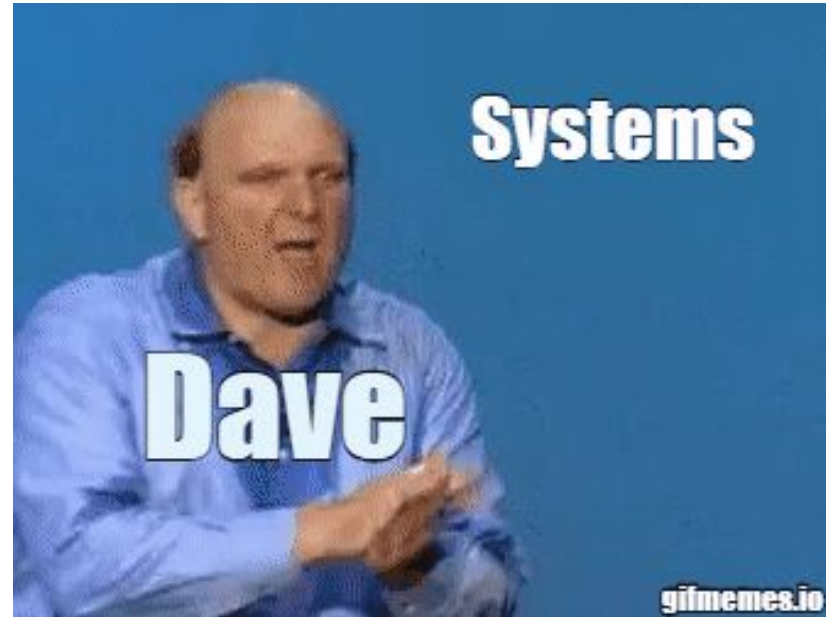
Intro

- I'm Dave
- Around FIRST since 1999
- Did FLL, FTC/VEX, FRC during childhood
- Student Alum of 228
- Mentor Alum of 2168, 1678
- Current President of the Board and Technical Mentor for 6328
- Volunteer for NEFIRST
- Went to WPI
- Senior Mechanical Engineer at Formlabs
- Love to run, cycle, F1, hang with my gfs dog Blue



Overview

- What's this all about?
 - Systems, systems, systems!
- Why, what's the point?
 - Long term sustainability
 - Little to no tribal knowledge
 - Ownership for students and mentors
 - EFFICIENCY
 - Easy onboarding of mentors/students
 - Simple training for students
- HOW DO I GET STARTED?!
 - Step by Step, my top things that make the biggest impact



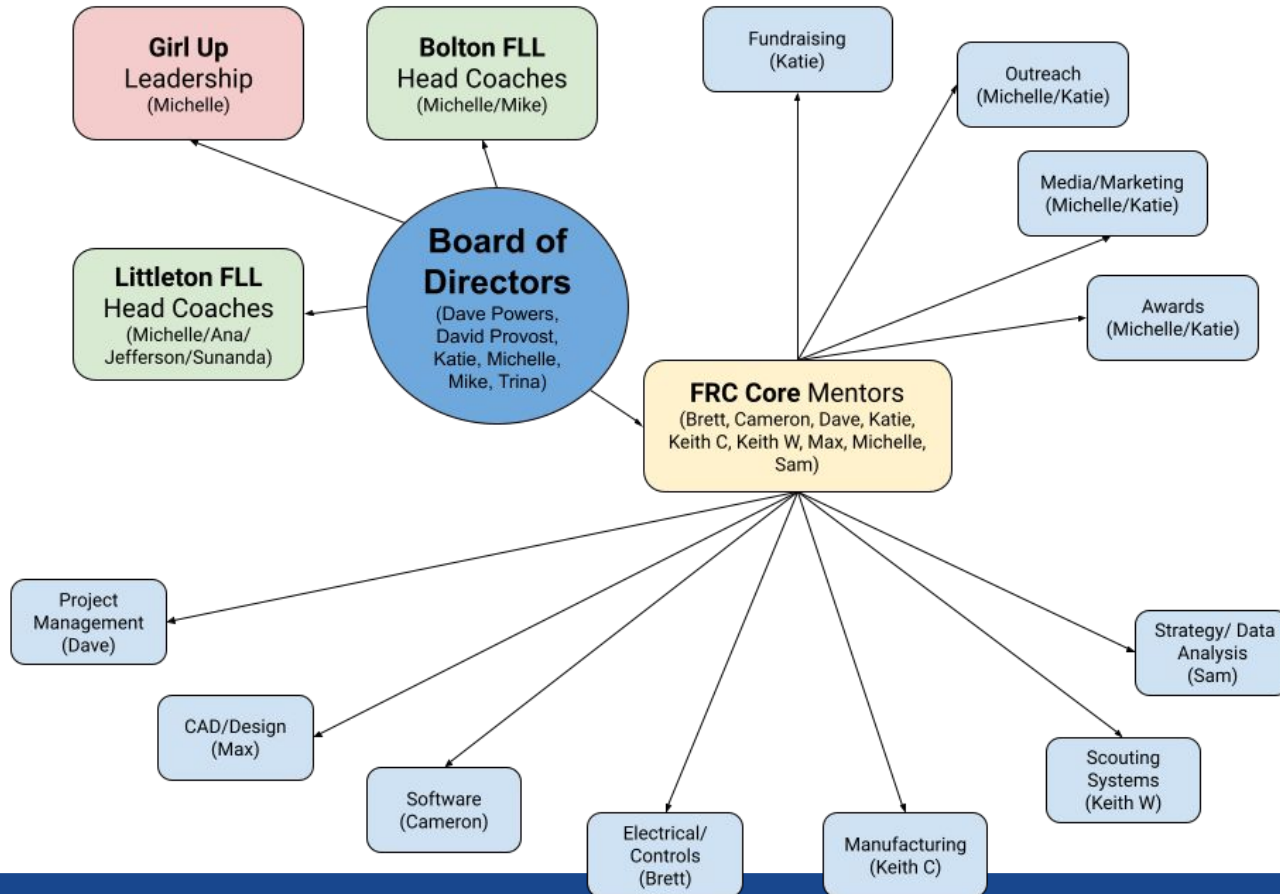
Special thanks 1678, 2168, 228, AFT, Formlabs, my old bosses, their bosses, my mentors, my parents, and my friends and family

Coaching Systems

- **Let's start at the top**
- **Coaches are a key element to every team**
 - **No matter the level of involvement, adult leadership and oversight is critical to building a robust program**
- **Lets students “do the work” and mentors focus on trainings and helping guide the boat**
- **Important to build the roles to what the team needs and not the other way around**



Littleton STEM Educational Foundation



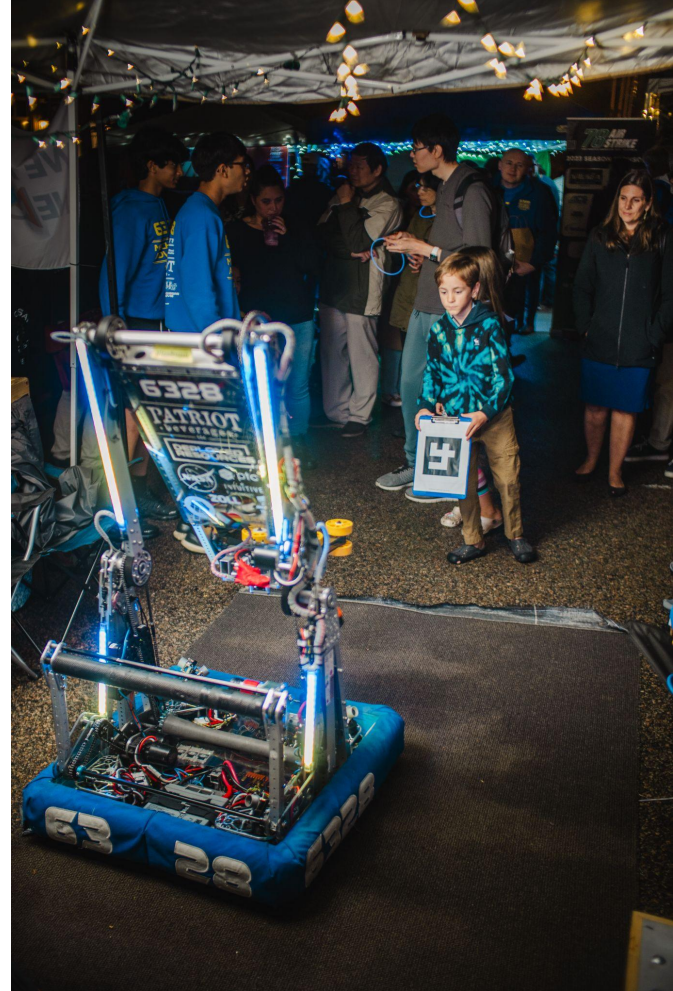
Organizational Roles

- **Nonprofit Board of Directors**
 - Drives the overall nonprofit organization, long term planning, ensures long term sustainability is taken into consideration
- **FRC Core**
 - Drives subteams and working groups for daily operations and tasks
 - Helps facilitate trainings
 - Runs individual budgets for subteams
- **FRC Mentors**
 - Ensure student experience is top notch
 - Help engage “fringe” students
 - Deliver “Subject Matter Expert” lessons
 - FEA CAD
 - Editing and Video Training
 - Grant writing
 - Assist with daily tasks



Systems Within Coaching

- Only as strong as the system
 - Once a structure is in place, it's important to build systems to support communication and continued improvement
- Set up recurring meetings, these should be frequent
 - Meeting minutes
 - One page, next agenda gets pulled and to-dos get double-checked with assigned coaches
 - 1:1s
 - Core should aim to do check-ins with coaches to evaluate and give feedback, check on their personal feelings, and help sort priority
 - When these happen is up to you
 - Do y'all only meet during the season? Start the season with a Core meeting, discuss priorities, then a full team meeting to get everyone on the same page.
 - Meet all year? Keep it going in the offseason, helps build momentum for trainings and offseason projects



Build Season Structure

- “Failing to plan is planning to fail” - Ben Frank
- Developing concrete schedule and structure for build season will allow you to properly allocate resources
- Structure makes you feel like you’re not just flailing in space



Build Season Structure

- **What could this look like?**
 - **Calendar of major milestones**
 - **Gantt Chart**
 - **To-do list for each week**
- **How do we do it?**
 - **Calendar and loose guidance to how much of the robot should be completed by what date**
 - **Week 1 Protos**
 - **Week 2 and 3 Dev Bot**
 - **Week 4 and 5 Build Comp**
 - **Week 6 Practice**
 - **Don't fall into the trap of being too granular, doesn't matter, things will change**
 - **Plan shop days**
 - **Shops open most days, not everyone meets***



BUILD SEASON

Week 1
Prototypes

Week 4&5
Build Comp

Week 7&8
PRACTICE!



Week 2&3
Dev Bot

Week 6
Software



Design Reviews

- Speed and efficiency are key to a successful build season
- Developing a system with the students and mentors to provide feedback on CAD progress is critical
- Here's how we do it!



Design Reviews

- Rely on critical tools, CAD software (Onshape) and Slack
 - Doesn't need to be slack, just some way to track
- Establish a system that helps the students build out a backlog of work to do

The screenshot displays a Trello board for '4414 Shooter Prototype'. The board is organized into columns: 'To-Do' (6 items), 'Doing' (1 item), and 'Done' (3 items). The 'To-Do' column contains the following items:

- Message: Can you double check that there is a possible fastener combination to make this work (does a nut fit here ...)
- Message: Sam: Can you double check that ther...
- Message: can you CAD the thru dead axles here?
- Message: You: can you CAD the thru dead axle...
- Assignee: Order Belts
- Message: Matthew: <https://www.vbeltguys.co...>
- Message: can you increase the side of this thru hole so there is bigger tolerance between shaft and hub?
- Message: You: can you increase the side of this ...

The 'Doing' column contains one item: '+ Add Item'.

The 'Done' column contains three items:

- Message: add a little more material here
- Message: You: add a little more material here
- Message: 1 comment 25 days ago
- Message: COTs parts list needs to be complete, lets get all of this done this weekend and it be completely ...
- Assignee: [User]
- Message: You: COTs parts list needs to be ...
- Message: Untitled item
- Message: You: IMG_1864
- + Add Item

The interface includes a sidebar with 'Lists' (All lists, Starred, 4414 Shooter Prototype, Manufacturing Pipeline), a top navigation bar with 'Forms', 'Share', and a star icon, and a bottom right corner with '+ Add Item'.

Design Reviews

How does it work?

- **Pretty simple, open CAD, review, screenshot suggestion**
- **Post in dedicated Slack channel for project design reviews**
- **Make card for message**
- **Card lives in backlog for students, can be assigned to a certain student, priority, etc**



Design Reviews

Add to list

Search by list name or keyword

- 4414 Shooter Prototype**
Dave Powers · Last viewed today
- Manufacturing Pipeline**
Sean Tommasini · Last viewed today

Create New List Cancel Add

Item

Can you double check that there is a possible fastener combination to make this work (does a nut fit here or is the plate gonna be thick eno...

Add Comment Notifications on

Assignee: People
Date: Date

Message

Sam Sands
cad_leads | Jun 25th at 1:04 PM


Can you double check that there is a possible fastener combination to make this work (does a nut fit here or is the plate gonna be thick enough to be tapped). Would be nice to confirm for al... [Show more](#)

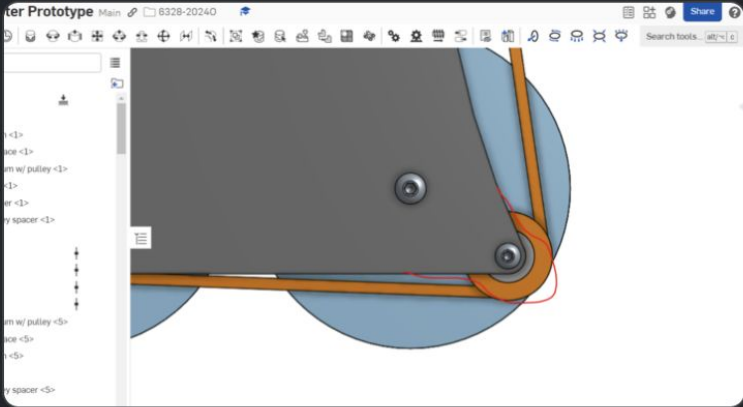
image.png

Status: Option
Material: Text
QTY: 01 Number

+ Add Field

Design Reviews

 **Dave** 1 month ago
add a little more material here
1.PNG ▾



4414 Shooter Prototype

4414 Shooter Prototype

Board 🔽 🔍 🗑️ Group by: Status ▾

- To-Do 6 items**
 - Can you double check that there is a possible fastener combination to make this work (does a nut fit here ...)
Message
Sam: Can you double check that ther...
 - can you CAD the thru dead axles here?
Message
You: can you CAD the thru dead axle...
 - Order Belts**
Assignee
Matthew: <https://www.vbeltguys.co...>
 - can you increase the side of this thru hole so there is bigger tolerance between shaft and hub?
Message
You: can you increase the side of this ...
- Doing 1 item**
 - + Add item
- Done 3 items**
 - add a little more material here
Message
You: add a little more material here
1 comment 25 days ago
 - COTs parts list needs to be complete, lets get all of this done this weekend and it be completely ...
Assignee
You: COTs parts list needs to be ...
 - Untitled item
Message
You: IMG_1864
+ Add item

Design to Manufacturing

- One of the biggest ways systems can benefit teams is with Subteam to Subteam communication
- We struggled a lot with “ordering” parts from the internal machine shop, this communication helps fill the gap




Design to Manufacturing

- Similar to design review, utilize Slack Lists
- More built out cards
 - Any and all information needed to make part
 - Many students touch the cards
 - Bakes in mentor review process
 - Lets us “reorder” parts for spares
- The kids own these boards, they make cards, they push cards, mentors only interact when it’s time to send a part to fab

Needs Drawing ▾ 5 items

6328-240-2007 Main Plate

Date submitted	Machine Type
9 days ago	CNC Router
Material & Thickness	Quantity
Aluminum 3/16 Inch	2
Part Type	CAD Version
Sheet/Plate	3
Finish	Robot Type
Powder Coat - Black	Offseason Bot

 1 comment 9 days ago

Design to Manufacturing

The screenshot displays a 'Manufacturing Pipeline' interface with two main views. The left view shows a list of parts with details for '6328-240-2007 Main Plate' and '6328-240-2010 Kraken mount plate standoff'. The right view shows a sequence of manufacturing steps: 'Mentor Check', 'Ready for Lathe', 'Ready for Mill', 'Ready for CNC Mill', 'Ready for CNC Router', and 'Ready for 3D Printer'. A second, smaller view below shows a 'Manufacturing Pipeline' with steps: 'Ready for Laser Cutter', 'Done Fab Need to Powder Coat', and 'Done!'. Each step includes an '+ Add Item' button.

Manufacturing Pipeline

Status: [icon] Search: [icon] Group by: Select Hidden: 1

Needs Drawing 5 items

6328-240-2007 Main Plate

Date submitted: 9 days ago Machine Type: CNC Router

Material & Thickness: Aluminum 3/16 Inch 2

Part Type: Sheet/Plate 3 CAD Version: 3

Finish: Powder Coat - Black Robot Type: Offseason Bot

1 comment 9 days ago

Needs CAM 2 items

6328-240-2008 Kraken Standoff

Date submitted: 9 days ago Machine Type: 3D-Printing

Material & Thickness: PA6-CF Nylon 1

Part Type: Cylindrical Shaft

Link to Sub-Assembly: <https://cad.onshape.com/documents/db39bed7cdd17cab44258d7f1/w/c3facb99682d23ac57aca3ba/e/a716608fb8925b85d7a460f>

CAD Version: 3

1 comment 9 days ago

6328-240-2014 Driving Pulley

Date submitted: 9 days ago Machine Type: 3D-Printing

Material & Thickness: PA6-CF Nylon 2

Link to Sub-Assembly: <https://cad.onshape.com/documents/db39bed7cdd17cab44258d7f1/w/c3facb99682d23ac57aca3ba/e/a716608fb8925b85d7a460f>

Manufacturing Pipeline

Status: [icon] Search: [icon] Group by: Select Hidden: 1

Mentor Check + Add Item

Ready for Lathe + Add Item

Ready for Mill + Add Item

Ready for CNC Mill + Add Item

Ready for CNC Router + Add Item

Ready for 3D Printer + Add Item

Manufacturing Pipeline

Status: [icon] Search: [icon] Group by: Select Hidden: 1

Ready for Laser Cutter + Add Item

Done Fab Need to Powder Coat + Add Item

Done! + Add Item

+ Add Item



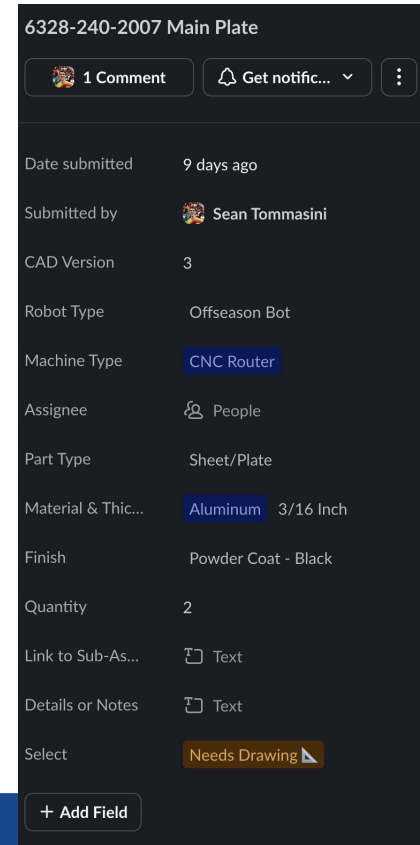
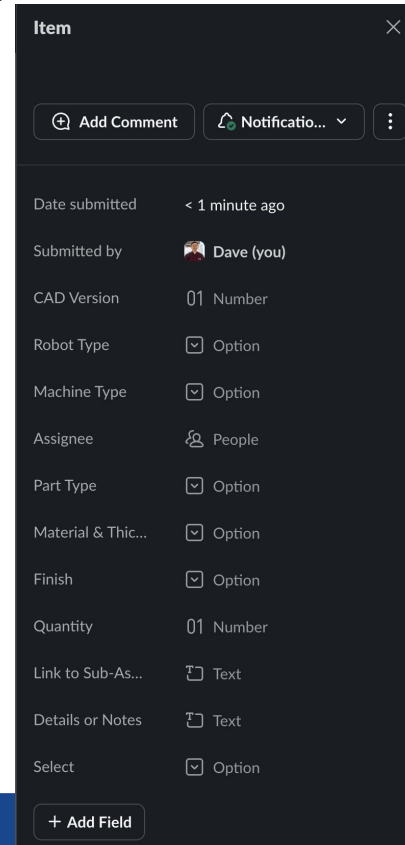
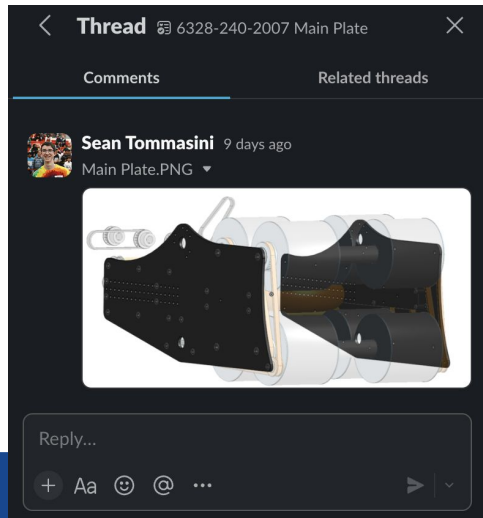
Drawing->CAM->Mentor Check->Lathe->Mill->CNC Mill->Omio->3DP->Laser->Powder->DONE!

Design to Manufacturing

- Student has part ready for fab
- Student makes card
- Card gets shuffled into the pipeline of ready to work students who specialize

What's on the card?

- *Ideally, everything*
- *In reality, just enough, nothing more*
- **Picture (important)**



Design to Manufacturing

Weird bits

- Some parts get outsourced
 - Go into separate group
- 3DP parts no drawing
- “Ordering” spares is just redragging the card into the ready for fab group

What does each step look like?

- Drawings posted as PDF in comments like pics
- CAM files into specific folders in cloud
- Parts come off machines and sit on certain shelf for that color powder that helps batching

Future Additions

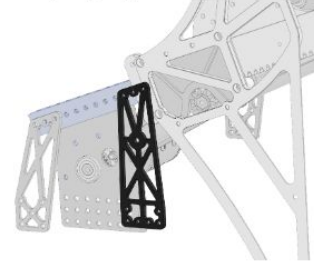
- Less mentor checking, super students with approval power
- Canceled group
- We’ll see how this build season goes, systems tend to break down in high pressure times, what do we need to change?

Design to Manufacturing

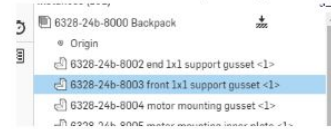
- **Build SOPs**
 - Helps transfer knowledge
 - Easy to iterate
 - Long term sustainability
- **USE SOPs**
 - **Actually use them (this is true for everything really)**

Creating a Card Full Version

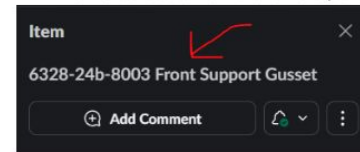
1. Find part you plan to create a card for



2. Then find corresponding name in Onshape



3. Then open the Project Pipeline list in Slack and click add item in the bottom right corner
4. Now add a title from the Onshape CAD, and shorten if needed



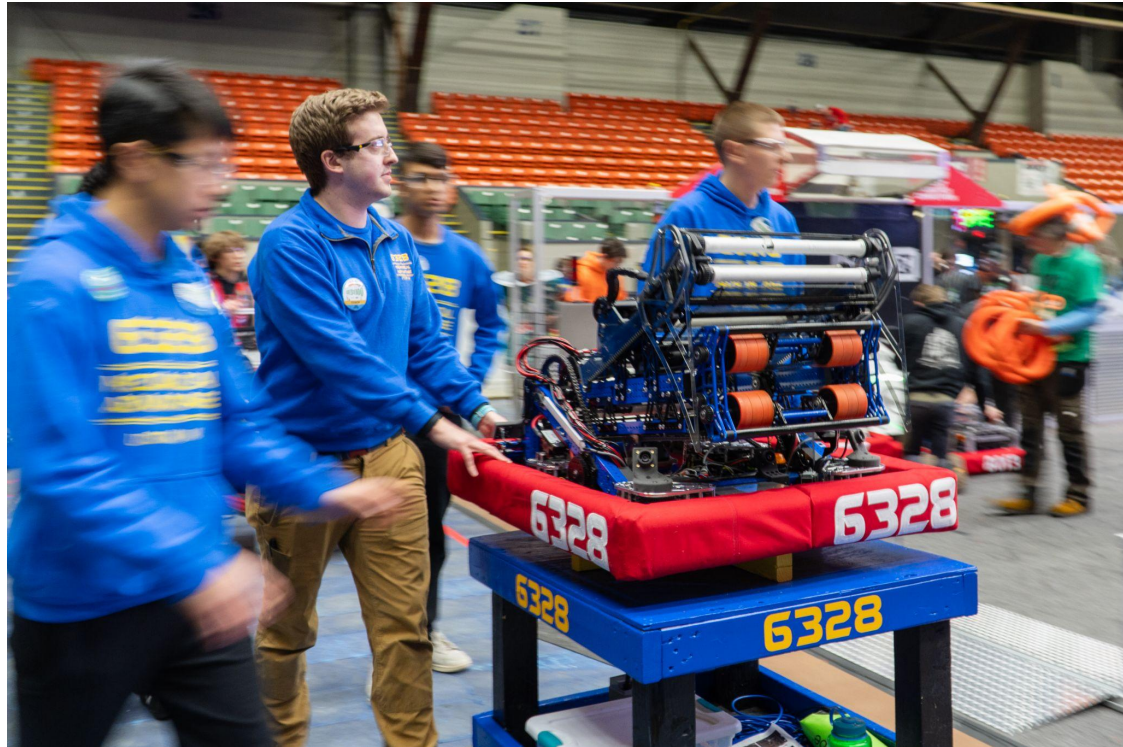
Competition Roles

- Mildly random but important
- Not always thought about but can be critical
- Worth the effort to make a plan!



Competition Roles

- Instead of dedicating all time to building, why not think about how to better prepare for in-person events?
- Spend time writing out list of roles that you think you need
 - Assign specific people for each with ownership
- Get granular
 - Ex. who helps bring the lunch from the car



Competition Roles

Examples of 6328 event roles

- **Pit**
 - Driveteam
 - Humanplayer(s)
 - Electrical
 - Software
 - Hardware
- **Scouting**
 - System operations
 - Student wrangler
 - Scouts
- **AAA**
 - Electrical
 - Software
 - Hardware
- **Parents**
 - Lunches
 - Rides
 - Support!
- **Many many more!**



What else can you make a system for?

Everything

- Where you order lunch from at events
- Planning rides
- Pick list meetings
- Match strategy
- System for building systems
- Shop cleaning
- Parts organization
- Purchasing
- Onboarding Mentors
- Pre-match robot check
- Offboarding Mentors
- New student orientation
- Connecting with Sponsors
- Media at events
- Media not at events
- Getting student feedback
- Summer trainings
- Long term goal setting
- Evaluating long term goal setting
- Robot Battery Check



Questions?

