Game Analysis & Strategic Design

Team 1732

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Agenda

- Step Zero
  - Team Goals
  - Team Capabilities
- Strategic Design
  - Game Analysis
  - Design Selection
- Example Season

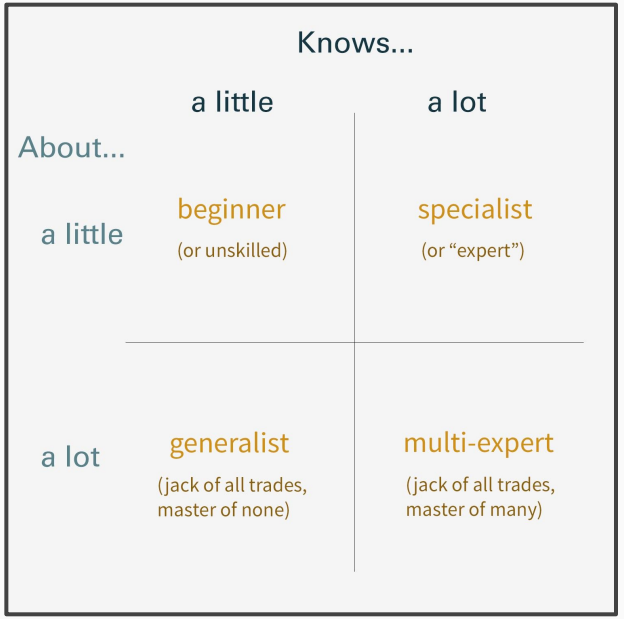
Step Zero: Team Goals

What do you want to achieve?

- Make SMART goals
- Examples:
  - Have a working robot in every match
  - Score a number of points per match
  - Play in eliminations (Be picked)
  - Be an alliance captain
  - Win a competition
- These goals will frame discussion about your robot design

Step Zero: Team Capabilities

- Assess your team capabilities and constraints honestly and realistically
  - Experience, machining access, budget, time
  - Even if you can build it, can you control it? Can you drive it?
- Jack of all trades, master of none
  - It's usually better to be great at one thing than average at everything
  - Consistency is key
- Account for scope and complexity
  - Several simple tasks will take the same or less time than a complex task

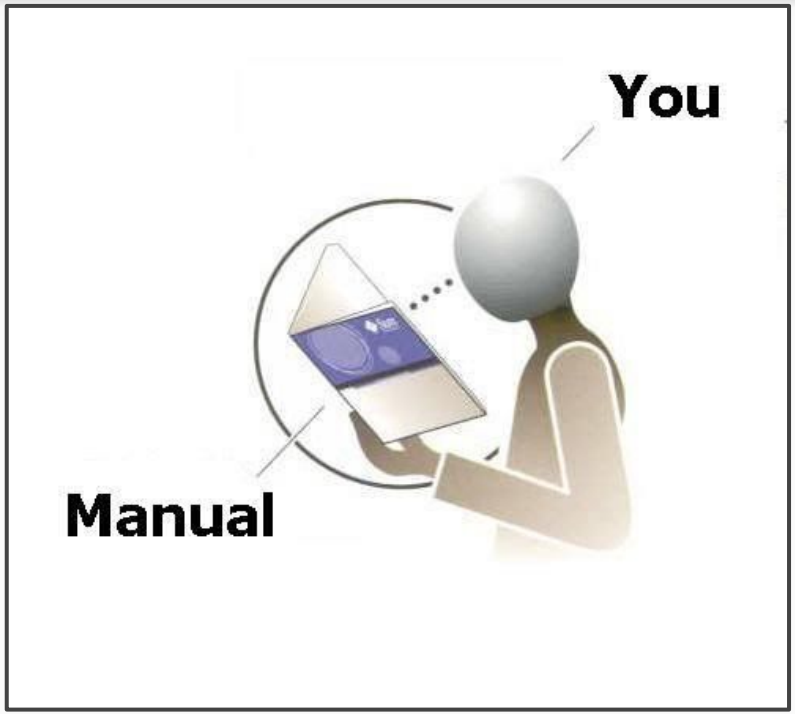


Step Zero: “Robot Points” Concept

- Let’s say each team has a number of “Robot Points” to spend
  - Higher resource teams will have more Robot Points:
    - Low resource – <20 Points
    - Moderate Resource – 21-50 Points
    - High resource – 50+ Points
- Spend points to maximize resources
  - If you have 30 Robot Points, it’s better to have 3 functions at 10/10 instead of 5 at 6/10
- Examples
  - Drivetrain
    - KoP Drive – 2
    - 6 Wheel West Coast – 6
    - Swerve – 12
  - Intake
    - Human Loaded – 2
    - Ground Pickup – 6
  - End game
    - Park - 0
    - Climb - 6
- Note:
  - These point values are made up, but you get the idea

Game Analysis: The Rules

- Read the manual
  - This will show the limits of what can be done in the game
- Read the manual
  - This should eliminate illegal game strategy ideas
- Read the manual
  - You may find loopholes or chokehold strategies
- Read the manual
  - The manual will be updated – some ideas may become illegal



Game Analysis: Scoring Breakdown

- Read the game summary and scoring details from the Game Manual
  - (The game video can be helpful, but is occasionally misleading)
- List every way to score points
  - High goal, low goal, drive to a zone, etc.
- What's the high score?
- How does the ranking system work?
  - FRC loves "Ranking Points" (RPs)

Example: 2020 game - Infinite Recharge

Award	Awarded for…	AUTO	TELEOP	Qual.
INITIATION LINE	exit the infinite vertical volume created by the corresponding ALLIANCE'S INITIATION LINE any time before the end of AUTO (per ROBOT)	5	-	-
POWER CELLS	scored in BOTTOM PORT	2	1	-
	scored in OUTER PORT	4	2	-
	scored in INNER PORT	6	3	-
CONTROL PANEL	ROTATION CONTROL	-	10	-
	POSITION CONTROL		20	
ENDGAME Points	HANG (per ROBOT)	-	25	-
	PARK (per ROBOT)	-	5	-
	LEVEL with 1-3 ROBOTS HANGING (per ALLIANCE)		15	
SHIELD GENERATOR OPERATIONAL	earning at least sixty-five (65) ENDGAME points			1 Ranking Point
SHIELD GENERATOR ENERGIZED	Stage 3 ACTIVATED	-	-	1 Ranking Point
Tie	Completing a MATCH with the same number of points as your opponent	-	-	1 Ranking Point
Win	Completing a MATCH with more points than your opponent	-	-	2 Ranking Point

	Auto				Tele-op					Endgame			Totals	
	Line Crossed (y/n)	Bottom PC	Outer PC	Inner PC	Bottom PC	Outer PC	Inner PC	CP Rotation (y/n)	CP Position (y/n)	Climb (y/n)	Park (y/n)	Level? (y/n)	Points	Alliance Total
Robot 1	y	3	0	0	3	6	0			n	y		56	
Robot 2	y	3	0	0	5	5	1	y	n	y	n	y	54	182
Robot 3	y	0	3	0	0	15	0			y	n		72	
Robot 4	y	0	3	0	0	15	1			y	n		120	
Robot 5	y	0	3	0	0	20	0	y	y	y	n	y	82	274
Robot 6	y	0	3	0	0	15	0			y	n		72	

Game Analysis: Robot Tasks and Skills

- List all of the skills that a robot needs to complete game tasks
- Lump these skills together as they relate to different game tasks
- This list will help to create robot concepts

	Robot Skills
1	Drive
2	Drive over Small Bump
3	Drive on ramp
4	Drive (Most Terrain)
5	Herd Boulder
6	Hold Boulder
7	Receive Boulder from Lower Wall Hole
8	Receive Boulder from Upper Wall Hole
9	Pick Up Boulder
10	Shoot Boulder
11	Relase Boulder
12	Hold Drawbridge for Others
13	Drop Drawbridge from Neutral
14	Hold Portcullis for Others
15	Lift Portcullis
16	Push Down French Ramps
17	Lift French Ramps for Others
18	Hold Sully Door for Others
19	Open Sully Door from Neutral
20	Limbo
21	Climb Tower
22	Defend
23	Dislodge Self
24	Dislodge Others
25	Hold Low Bar Flap Open

Example: 2016 game - Stronghold

Tasks	Auto	Teleop	Quals	Elims	Required Skills	Beneficial Skills
Reach Defense	2				1	
Cross Low Bar	10	5			1,3,20	
Cross French Ramps	10	5			1,3,16	17
Cross Portcullis	10	5			1,3,15	14
Cross Moat	10	5			1,3,4	
Cross Ramparts	10	5			1,3,4	
Cross Drawbridge	10	5			1,3,13	12
Cross Sally Door	10	5			1,3,19	18
Cross Rough Terrain	10	5			1,3,4	
Cross Rock Wall	10	5			1,3,4	
Boulder Top	10	5			1,6,9,10	2,3,4,5,7,8,11
Boulder Bottom	5	2			1,2,3,5	4,6,7,8,9,11
Climb Tower		15			1,2,3,21	4
Challenge Tower		5			1,2,3	4
Capture Tower			1RP	25	1,2,3	4
Breach Defenses			1RP	20	1,2,3,4,13,15,16,19,20	12,13,15,17,18

Game Analysis: Match Strategies

- How do you actually play the game?
  - Don't talk about robot designs yet!
  - A fun activity is playing a human game to compare different strategies

Robot archetypes:

- Scorer
  - Accomplish the "main" game task
- Supporter
  - Accomplish "side goals"
- Endgame/Bonus
  - Get the "end game" or "bonus" points
- Defense
  - Prevent opponents from scoring 10 points is as good as you scoring 10 points
- Robots can be none to many of these

Typical Strategies:

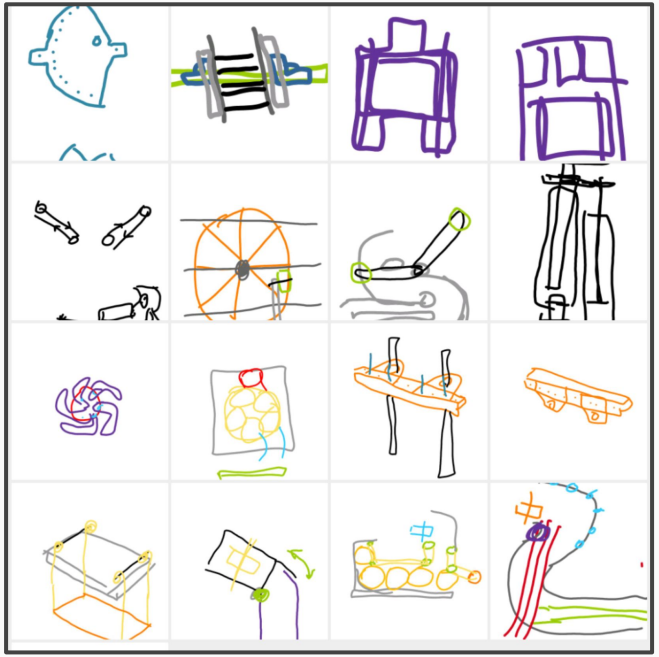
- Shootout
  - Ignore the opponents and just score
- Counterplay
  - Use one or more robots to interrupt the other alliance's game plan
- Starvation
  - Deny the opposing alliance any opportunity to score
- Chokehold
  - Accomplish some set of tasks that makes it impossible to lose control
- Think about both your scoring potential and the *differential* to your opponents

Game Analysis: Match Strategies

- You have to know what you want to do before you can figure out how to do it
- Rules of thumb
  - Elite teams can do 8 full field cycles per match in perfect conditions
    - The best teams will do this a few times a season
  - Middle tier teams can do 4 cycles per match and average maybe 2-3
- Be realistic

Game Analysis: Robot Concepts

- Start to scribble overall robot concepts
  - These should accomplish the match strategies you described
  - These should match the Robot Skills list to accomplish game tasks that you prioritized
  - Think back to “Robot Points” - how much complexity can you plan on?
  - Use anything to communicate- whiteboards, MS Paint, sketch app on your phone, the back of a placemat at a restaurant
    - The details will come eventually. Maybe.



Design Selection: Focusing Your Strat

- Narrow down robot concepts based on goals and feasibility
  - 2-3 concepts to further analyze is a good target
- Think about how these robots will play the game in an alliance
  - Can the design be successful solo?
  - Is the design reliant on Alliance partners?
- List which game tasks are required for selected concepts
  - This will help prioritize robot functions
  - Drive should almost always be a top priority (very few exceptions)

Design Selection: Tradeoffs + Priorities

- Making the right decisions will determine the fate of your season
  - Mutually exclusive tradeoffs?
    - Speed vs power
    - Complexity vs durability
    - Wide vs long frame
    - High vs low center of gravity (easier shot vs tippy robot)
  - Prioritization
    - Which mechanism do we focus on first?
    - Use your strategic priorities to decide the design process
    - Time
      - Driver practice vs. programming vs. mechanism tweaks

Design Selection: Wait and try it?

There's only so much that you can talk about around a table

- Some decisions have to be informed by prototyping and testing
  - Which material works best for this gamepiece?
  - How hard is it to pick this up off the carpet?
- If different design paths depend on radically different mechanisms, can you use testing to focus on a better option?
  - If a game involves scoring balls in a high goal (2020, 2017, 2016, 2014…) and you're considering multiple launchers (flywheel, catapult, puncher…) maybe testing will eliminate one early on

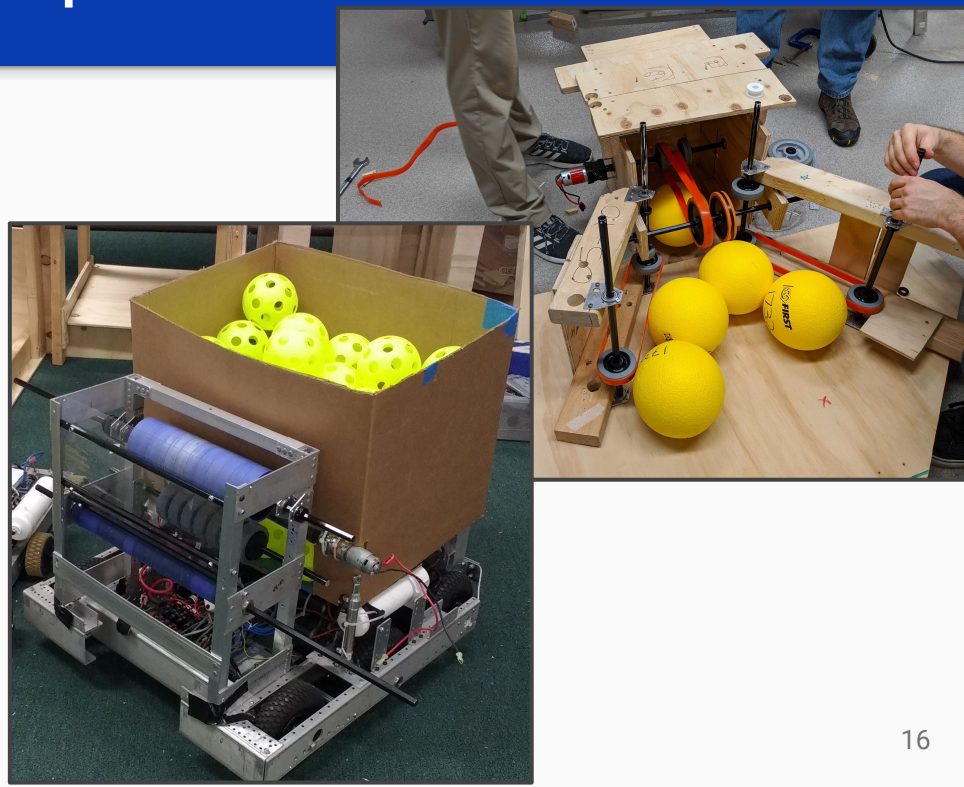
Design Selection: Wait and copy?

Steal from the best.

- Check past games!
  - If a game has a horizontal pull-up bar, what did teams do in 2020, 2018, 2016, 2013…
    - “Ok cool, telescoping or unfolding arms, not a grappling hook.”
- Are there any teams around you or online who want to work together or show ideas?
  - Teams are a different mix of “Open” or “Secret”
    - #Openalliance on Chiefdelphi
    - “Robot in 3 days”
    - Literally, just search YouTube

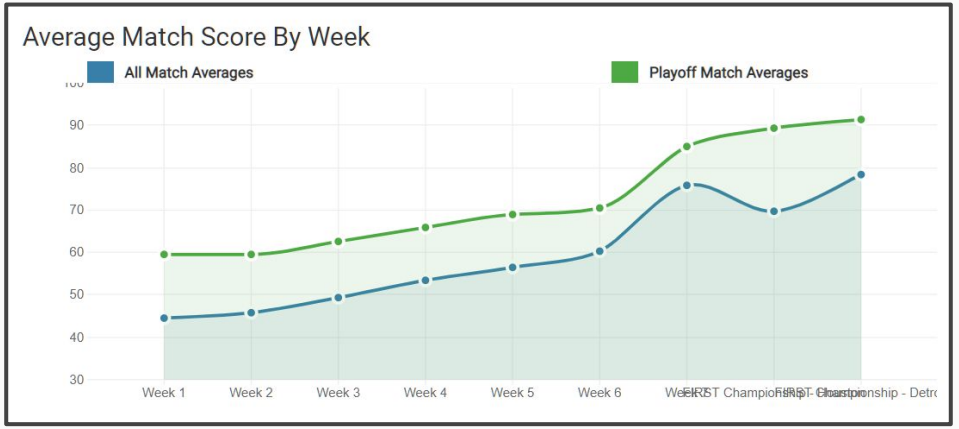
Design Selection: Gamepiece “Flow”

- How are different Robot Skills related?
  - How do different mechanisms rely on each other?
- Gamepiece “Flow”
  - How does a gamepiece get to the goal?
  - Where is the bottleneck?
  - Put differently, it doesn’t matter if the scorer is the best in the world if nothing gets to it
  - Examples
    - An intake feeds an indexer which feeds a scorer.
    - A claw is moved on an elevator to get to the scoring height



Design Selection: Feature Ramp

- How much can you work on at a time?
  - What's most important?
    - Drivetrain > Endgame > Main Scoring > Secondary Scoring?
  - Block out space for a mechanism, ignore it, and get back to it later
- What features matter when?
  - The level of play will get better. You only have to beat the teams at your event!
- Examples:
  - 2020 color wheel
  - 2016 low goal
  - More advanced autonomous

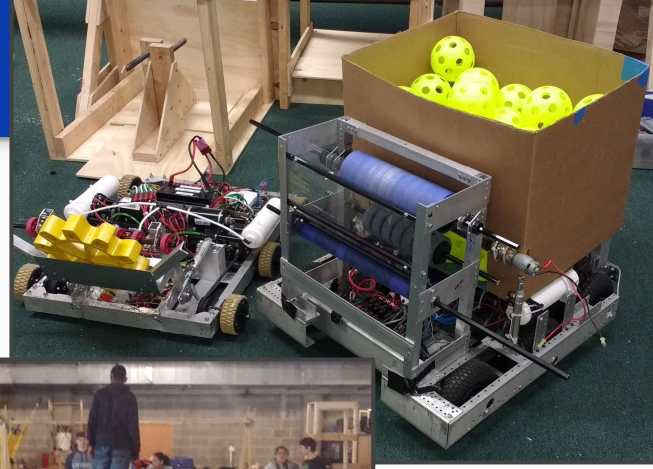


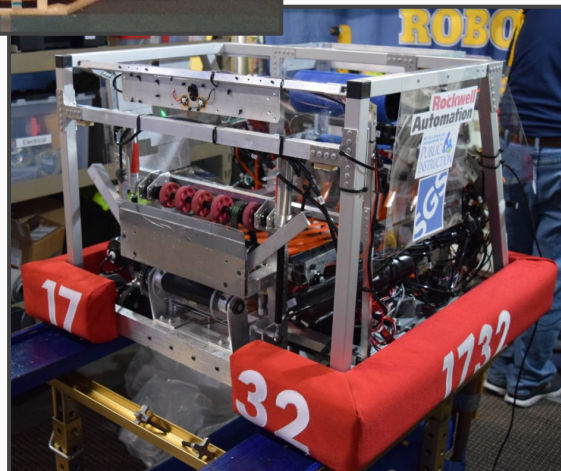
Design Selection: Making a Decision

- It shouldn't be an argument
  - Data from analysis, prototypes and other teams should make it a more objective conversation
- When things escalate:
  - Decision matrix?
  - More testing? Prove it.
  - "A good plan violently executed now is better than a perfect plan executed next week."
    - Also, it won't be perfect next week…
  - IF it comes down to voting, someone will always walk away mad.

Example: 2017 Steamworks, Team 1732

- Goals:
  - Win a Regional and be competitive at Champs
- Resources:
  - Budget for practice bot
  - Drillpress/bandsaw machining (no CNC)
  - Local practice field (Thanks Robotigers 2830!)
- Game analysis + priorities
  1. Gear scoring + Climbing
  2. Driving
  3. Better autonomous routines
  4. Ball scoring
- Feature Ramp-up:
  - Regional 1: Gear scoring, climbing
  - Regional 2: Practice ball scoring, but play to win
  - Champs: Faster climbing, faster ball scoring
  - Offseason: Moved climber up for faster climb





Homework

- Old games
  - Rules/videos
    - https://www.firstinspires.org/resource-library/frc/archived-game-documentation
  - Match footage
    - https://www.thebluealliance.com/

Questions?

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