FIRST Strategies

Purdue First Forums
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RJ Martin

- Assistant Head Coach of FRC 10021, Golden Gears
- Mentor since 2015 (45, 7198, 5010)
- FIRST Volunteer since 2012
- Alumni of FRC 45, The TechnoKats
- Network Engineer for Allied Solutions

Outline

- Strategic Design
  - Game Analysis
  - Golden Rules
  - Trade Offs
- Match Strategies
  - Scouting
  - Coaching a Match
  - During a Match
  - Playoff Rounds

All Credit goes to Karthik Kanagasabapathy's Talk at Worlds 2025 Effective First Strategies

Strategic Design

- Designing and building a cool robot is fun
  - But designing and building a cool robot that does well in competition is more fun
- Concrete Aim
  - Priorities
  - Problem Statement
  - Secondary Objectives can still apply such as looks, elegance, etc
- Beware of the “cool factor”

Game Analysis

- Read the rules!
- Examine every way to score points, no matter how obscure
  - Full Court Shooting (2013), Passing and Fans for trap (2024)
- Examine every way to play defense or prevent opponents from scoring
  - Blockers for shooting game (ex. 2013 or 2024)
- Gotta understand the ranking system
  - 2015 Changed the Game
  - Designing for RPs
- Consider Possible Strategies
  - Leads into overall robot designs
  - Chokehold Strategies

Cost Benefit Analysis

- For each task you must compare the difficulty of accomplishment to the reward for doing so
  - High Grid vs Low Grid (2023)
  - Is Trap a trap? (2024)
- Find the tasks that are relatively easy but provide big points
  - Links are same points (2023)
- Denying 10 points from your opponents is the same as scoring 10 points in terms of Win/Loss Record
  - Blockers in 2013 and 2024

Priority Lists

- Start with Two Seperate lists
  - Desired Qualities
    - Things like Speed, agility, center of gravity, etc
  - Desired Robot Functionality
    - Things you want your robot to be able to
      - Shoot balls, intake from floor or human player station
- Combine list to see what mechanisms would fit that
  - Problem Statement/Robot in a sentence
- This should drive the direction of design for the season

Priority Lists

- What should be #1?
- What should be #2?
- What should be #3?

Priority Lists

- What should be #1?
  - Drive
- What should be #2?
  - Acquire/Release Game Piece
- What should be #3?
  - Score

Simplicity and Golden Rules

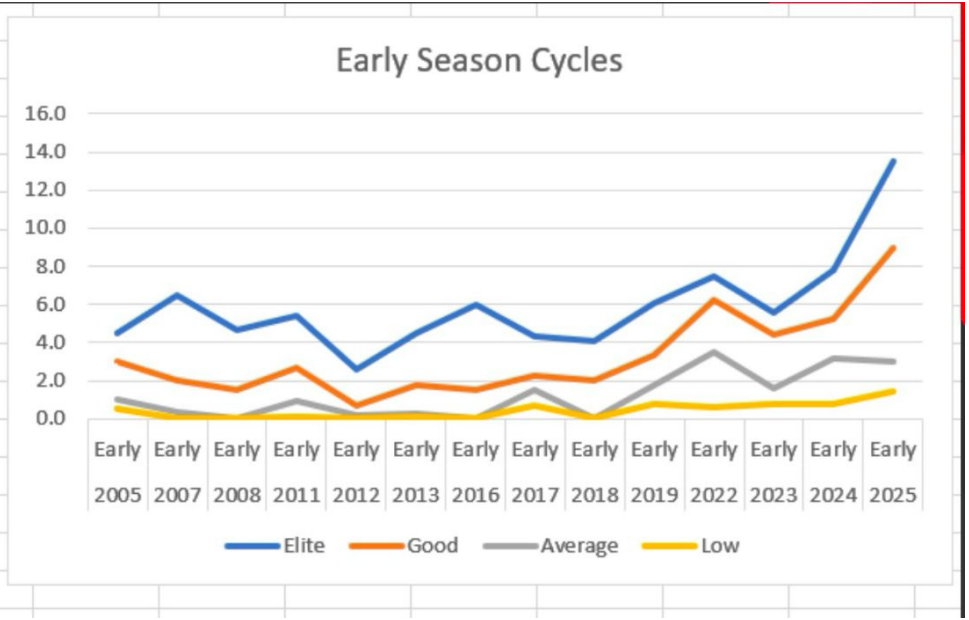
- Golden Rule #1: Always build within your team's limits
  - Evaluate your abilities and resources honestly and realistically
  - Limits are defined by people power, budget, experience, time
    - These are real!
  - Avoid unnecessary complex functions
  - On the other hand, as you get more experienced as a team, start cautionatiously pushing boundaries
- Golden rule #2: If a team has 30 units of robot and functions have maximum of 10 units, better to have 3 functions 10/10 instead of 5 at 6/10
  - Gotta define what a 10/10 function is
    - Do the thing fast, minimal lineup, in and out, automation

Cycling Rule of Thumb

- 10-5-2-1 (used to be 8-4-2-1) Full field Cycles Per Match
  - 2025 Reefscape a little weird because of short field cycles
- Elite Teams (99th Percentile)
  - around 10 CPM in perfect conditions
- Good Team (86th Percentile)
  - Usually averages around 4-5 cpm
- Average Team (50th Percentile)
  - Usually averages around 2-3 cpm
- Below Average Team (25th Percentile)
  - Usually averages around 1 - 2 cpm

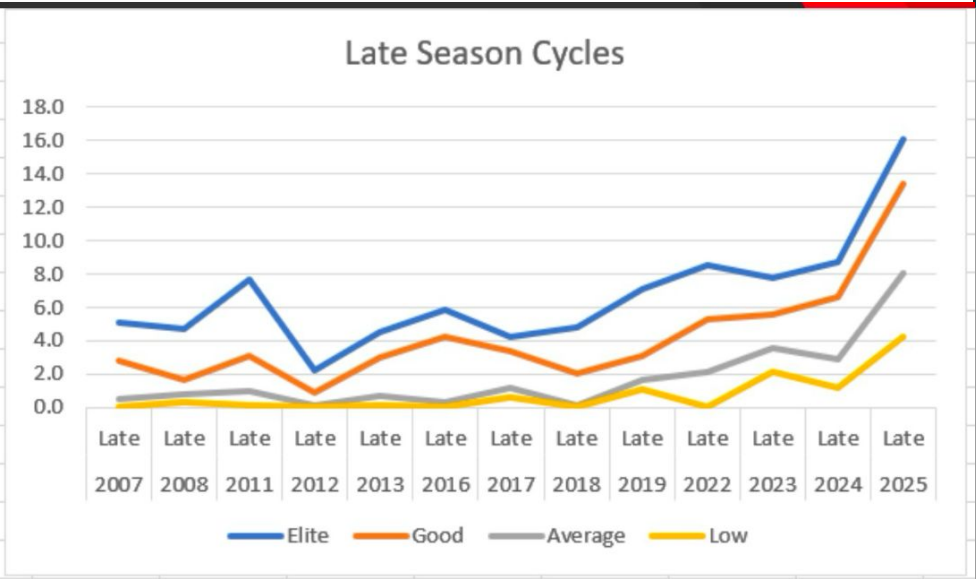
Cycling Rule of Thumb

Year	Portion	Elite	Good	Average	Low
2005	Early	4.5	3.0	1.0	0.5
2007	Early	6.5	2.0	0.4	0.0
2008	Early	4.7	1.5	0.0	0.0
2011	Early	5.4	2.7	0.9	0.1
2012	Early	2.6	0.7	0.2	0.0
2013	Early	4.5	1.8	0.3	0.1
2016	Early	6.0	1.5	0.0	0.0
2017	Early	4.3	2.3	1.5	0.7
2018	Early	4.1	2.0	0.0	0.0
2019	Early	6.1	3.3	1.8	0.8
2022	Early	7.5	6.2	3.5	0.6
2023	Early	5.6	4.4	1.6	0.8
2024	Early	7.8	5.2	3.2	0.8
2025	Early	13.5	9.0	3.0	1.4
Average	Early	5.9	3.3	1.2	0.4



Cycling Rule of Thumb

Year	Portion	Elite	Good	Average	Low
2007	Late	5.1	2.8	0.5	0.0
2008	Late	4.7	1.7	0.8	0.3
2011	Late	7.7	3.1	1.0	0.1
2012	Late	2.2	0.9	0.1	0.0
2013	Late	4.5	3.0	0.7	0.1
2016	Late	5.9	4.2	0.3	0.0
2017	Late	4.2	3.4	1.2	0.6
2018	Late	4.8	2.0	0.1	0.0
2019	Late	7.1	3.1	1.7	1.1
2022	Late	8.5	5.3	2.1	0.0
2023	Late	7.8	5.6	3.6	2.1
2024	Late	8.7	6.6	2.9	1.2
2025	Late	16.1	13.4	8.1	4.2
Average	Late	6.7	4.2	1.8	0.7



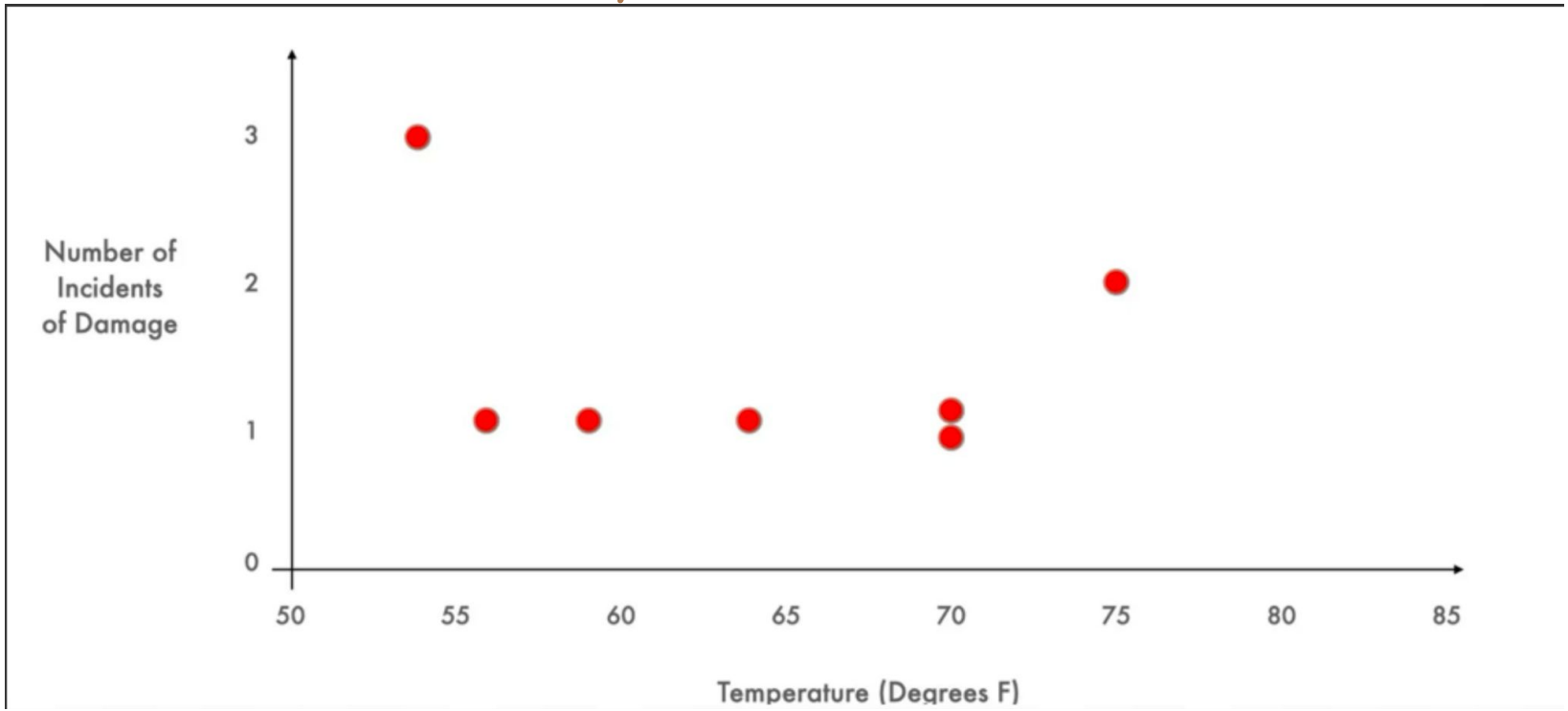
Scouting

- Only going to touch on it here
  - Go see Priyanka Koratpallikar's session on Scouting: Building a Winning Alliance next in ET 329
- Area often neglected by many teams
  - Offers a way to get a leg up in competition during Quals, Alliance Selection and Playoffs
  - Excellent way to get more students involved in competition
- Crucial in a couple way
  - Predict opponent's strategies
  - Essential for Alliance Selection
    - Especially in getting a good second-round pick

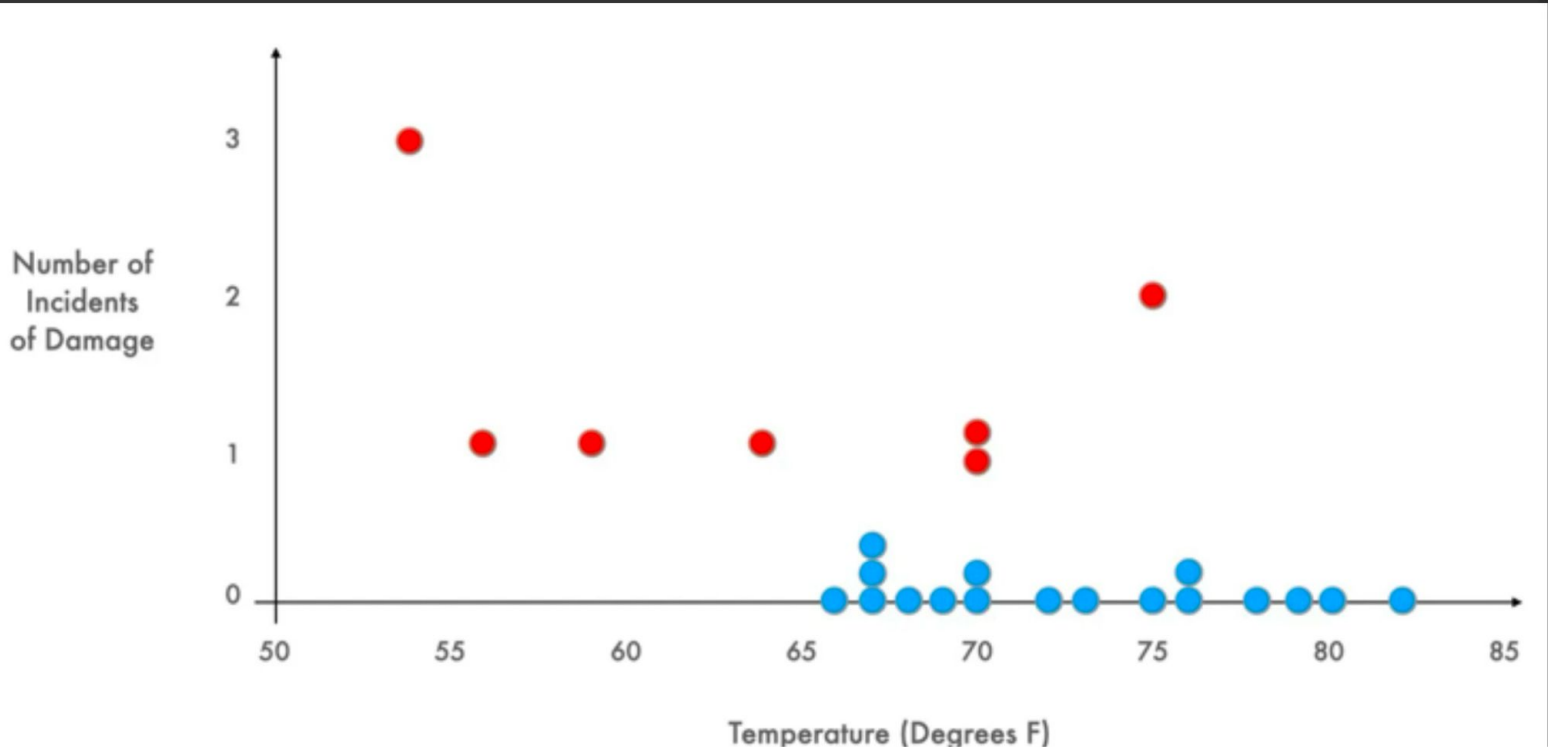
Data Case Study

- Carter Racing has a massive race in a hour in front of many sponsors on live TV
  - If they race and do well they'll pick up sponsorships to cover the team for many years
- Problem: In 7 of the last 24 races, they've had an engine blow out
  - A failure on live TV will jeopardize any future sponsorships and the future of the team
  - As well as safety risks for the driver, spectators, etc
- Team has a hunch about the failures; They might be related to cold weather
- The analysts has put together a graph to test this out

Data Case Study



Data Case Study



Data Case Study

- This isn’t a hypothetical case
- This data is from the Space Shuttle Challenger about o-ring failures
  - The First set of data was presented in a meeting prior to launch with some arguing against the lunch, but the consensus was to go ahead with the launch
  - The Shuttle broke apart 73 seconds after launch killing of seven crew members
- What's the lesson here for FIRST?
  - Be Smart about Data
  - Having Data isn’t enough, having the right data matters
  - Must ask questions about the data
  - Don’t rely on numbers without exploring context

Match Strategies

- Planning and Execution
- The most important part of the competition
- Good strategy and scouting can allow a mid robot to win majority of matches
    - 45 2012 Queen City Regional
- Good strategy and a good robot are an almost unbeatable combo

Pre-Competition

- To develop a good set of strategies, you need to know what you can do
- Analyze and be honest with your robot abilities
  - Don’t under or over estimate
- Create a playbook
  - Possible strategies that can be run
  - Different strats for difference matches
    - Defensive, high risk, safe
    - Going for win, going for RP, with different partners

Match Plans

- Develop a match plan with your partners
  - Everyone must agree and be on board
  - How do you decide this?
    - No bullying, be cool y’all and check privilege
- This plan should outline what each robot will do for entire match
  - Draw paths and lanes out for each cycle
  - 694 Stuy Pulse IRI
- Create Time Limits on actions. If something is taking too long or match isn’t going your way, pivot
  - Reef RP vs Win

Coaching a Match

- The role of Drive coach can’t be overstated
- Drivers can only really watch their bot and the area around it
    - The coach should watch the entire field, keep track of score and other robots
- The coach should make the choice to deviate from the strategy
- Must keep drivers and other coaches of what's going on

During a Match

- You just be able to make on the fly decisions
  - Too many teams lose matches because they behave in a very static manner
- The drivers should not have to look up at the clock
  - Drive coach

After the Match

- Sit down with key members and debrief, discuss what went right and wrong
- After a couple matches, you might get rid of strategies because they didn’t work, that’s ok
- You must adapt to competition you are attending
- You often learn more in defeat than in victory

Final Comments

- Read the Rules!
- Come up with a clear, consistent strategy to how your robot will play the game
- Remember those golden rules
- Scouting is the easiest way to make your team more successful at competition
- The Role of the drive coach can’t be understated
- Each FIRST match is like a high speed game of chess, You need to have a well thought out plan, but be prepared to counter your opponents’ moves
- Remember why you are doing this
- Have fun!

Questions?

- Please watch Karthik’s Presentation!
- He does it better than me