A Brief Foray into Kickoff Analysis

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Several teams have attempted to get better at analyzing the game, so I'd thought I'd try and organize a rough progression of the tools available to you to try and arrive at a near optimal strategy for a given team. All of the below is predicated on an honest and truthful analysis of your skills as individuals. Things will go wrong even for the best prepared teams, and planning for that failure is essential to success on-carpet.

The Next Best 3ish Minutes in Robotics

The Game Animation

The most common and painful way to analyze the game is just to watch the game animation. While far from perfect, it does give you some idea of how the match will be played, shows off some archetypes of robots, and lists the obvious scoring differentials. That being said, it's far from complete, so we must soldier on.

Every Possible Point

Any and all analysis of the game worth it's salt involves listing every scoring and penalty method. After all, all strategies are derived from points, be it match points or rank points. Even strategies towards Championship advancement must use this method, as the ways in which teams advance to Championship are so diverse (District vs Regional vs District Team at a Regional, Pre-Bag, Post-Bag, etc.)

Play Of The Game

Though using game pieces in the context of the match is more robot strategy, the numbers, periods, and ranges of interaction with game pieces all need to be evaluated to inform your strategy. For example, if a given team is attempting to analyze the 2019 game, they hopefully would realize that they can't interfere with their opponents playing autonomous without incurring penalties. On the other hand, when they're in the end-game, attempting a climb on the Hab Platform, their opponents can't interfere without awarding their alliance some extra points.

Asking The Right Questions

Because my intent here isn't to be a totally exhaustive list, I'll defer to the Shaker Robotics Kickoff Analysis Worksheet made by Brian Maher to facilitate FRC2791's kickoff process of asking and answering the right questions.

Risk VS Reward

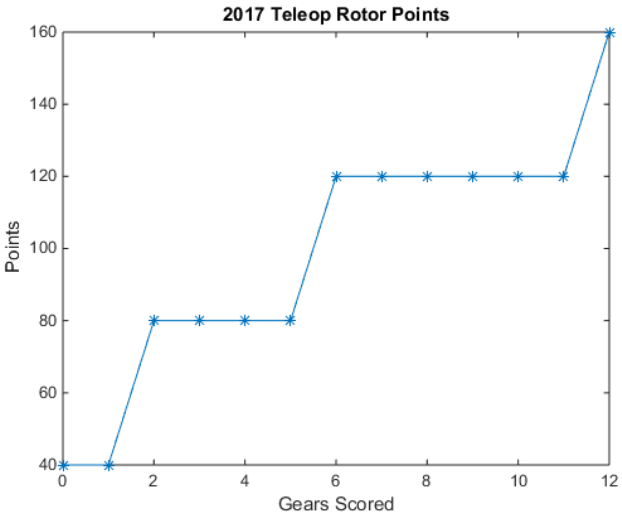
The next binning method teams might use is to compare the Risks and Rewards of a given task or strategy. Most teams using this method will either use a certain number on each axis, or a numerical scale. For example, in analyzing a given game I may have Low, Medium, and High risk tasks and Low, Medium, and High rewards. A more granular team may use the same scale, except mapped 1 to 5, such that they have granular intermediary steps, and in the event of the absurdly difficult task, they can also go *beyond* a given scale's units for a 6 or 7. Verbally you might say a task is "very hard" or something of the sort.

Tick Tock, We're On The Clock

When doing analysis of a given game, teams might run cycle time analysis, given the fastest a cycle could be if it went absolutely perfectly. This also might reveal an inherent cap on the game via the number of scoring locations, how game pieces are entered into the field, etc. For example, in the 2017 season, though we could theoretically cycle fuel (the 5" whiffle balls) infinitely, as they had the ability to be re-entered into the field. A more astute strategist would also realize the risk versus reward of fuel wasn't worth it compared to the enormous scoring potential of the gears.

Arrange The Waterfowl Colinearly

Unfortunately, not all scoring opportunities are linear. In certain games, one more task may mean an enormous points bonus in playoffs, but not in qualifications, or vice versa. This can often create at-odds incentives. For example, scoring four rotors in the 2017 playoff series would award your alliance 100 points as a bonus, a frankly, enormous bonus. This lead some high-fuel scoring robots to play a strategy of 3+D or 4+D, where they'd try to get as many points as possible and then deny their opponent the ability to do the same, making the difference too dramatic to earn otherwise.



Series of Time (not the Doctor Who episode)

When analyzing a game, it may be a useful task to understand how long things will take *at least*, as expected, and as worst. For example, getting off of the hab platform cannot take less time than a half second, getting to the scoring location roughly than 5 seconds (fairly uncontrolled or absolutely perfect cycle). You'd expect most teams to be able to achieve a 10-15 cycle, meaning a single game piece can be placed in autonomous / sandstorm, a few but competent teams to be able to score two, and the best

teams able to successfully score two game pieces and prep already for a third for when the teleoperated period begins. As with some other items described here, it's not easy to do without experience, but the information can be inferred for prior seasons since 2015 through use of The Blue Alliance Insights.

The natural extension of this type of analysis is "points per second". In other words, what tasks are worth in terms of the total available time during a given match. For example, a Hab Level 3 climb in the 2019 FRC season is worth 12 points, but if your team takes 30s to execute it, may only be worth .4pt/s, versus scoring three more cargo, which is worth .3pt/s. This math also extends to scoring deficits induced on your opponents, ie how low can you drop their scoring rate, and is that greater than your points gained for a given match? This simplification doesn't account for things like Ranking Points, but can still be useful to look at.

Strategic Design

Visiting The Library

The lovely thing about FIRST Robotics Competition is that almost no challenges are unique. They've all been solved long in advance, and bringing back a vintage task with a modern set of robot rules can be interesting and difficult all the same. For example, the 2018 game, moving power cubes (covered milk crates) bore much similarity to the 2015 game piece (totes), encouraging many teams to study how those successful robots in 2015 were built. All of that said, the 2018 game only allowed manipulation of a single game-piece at any point, meaning that not *all* approaches used in 2015 mapped 1 to 1.

The most dramatic example of prior games being easy to copy is the case of the 2011 and 2007 seasons. Both games had inflatable pool tubes as the game piece, and though they were different (all round versus different shapes), the intakes arrived at much of the same conclusions. FRC1678 (Citrus Circuits) openly states they copied FRC100's intake from 2007 for the 2011 season, leading them to their first ever regional victory.

KISS

Robot design is deceptively hard. Like, more difficult than most teams will accurately scope, and as such, we need to try and keep the robot simple. Not necessarily simple in terms of what it can accomplish, though that's a good goal, but simple in the method in which it does so. In 2019, for example, two game pieces made for difficult integration of mechanisms, so some teams just built two mechanisms regardless. More savvy teams took cues from FRC1684 and the like to build a two-in-one mechanism that enabled them to save not only space, but to simplify their elevator carriage to make it faster to score as well.

You Can't Do Everything

As a strategic and design rule, your robot cannot do every task presented in the game. This is accomplished by how many scoring locations there are, the periods of a single match, and just general design design. As such, you cannot rely on every task being accomplished by yourself, and relying on other teams is, unfortunately, not a consistent thing in qualifications. As a team you must strike the

balance between relying on other teams, and ensuring you *can* rely on them. This usually becomes part of your pre-match routine, but should be a significant part of your kickoff strategy to guide the discussion. Unfortunately this is mostly based on experiences, though you can glean some insight based on objectives by using The Blue Alliance Insights for a given season (after 2015)