Taking Strategy To The Next Level

Presented by Team 303 – Bridgewater Raritan High School

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Taking Strategy To The Next Level

The Strategy function in any FIRST team is a very critical part of the teams' success. Most teams spend a lot of time and effort to collect and interpret data about the performance of various robots to make alliance selection both more effective and simpler.

Why Does Strategy Matter

"Why does strategy matter when there are official rankings posted of every team during the qualification rounds?" Indeed, it seems obvious that the rankings posted by FIRST during each event could be used. It is very simple to choose the highest ranked team that is available, and it seems intuitive that the highest ranked teams would be the best. However, this may not always be true. During the qualification rounds of any FIRST game, random alliances are created, and three robots are given the same score in a given match. This can lead to robots being placed higher or lower in the official rankings due to chance, which in turn leads to imperfect alliances being formed. In addition, each robot has a specific role, which must be brought into consideration when forming an alliance. To attempt to minimize these possibilities for error, the strategy team collects data on each individual robot's performance during its matches.

Strategy Process in The Past

For the past 3 years, in Team 303, we had 6 scouts in the stands collecting data at all times, covering all robots in order to gain the most comprehensive knowledge possible. In 2013, we used a formula based system on Microsoft Excel combined with paper "strategy cards" which contain quantitative data in order to collect usable data. This system worked, but it had many short-comings. With more than 50 matches in an event, we used over 300 pieces of paper each day! And looking for pencils was always a challenge. This system also required that a seventh

person enter in information to the Excel database constantly, as there were simply too many pieces of data to put them all in at the end of the day. In 2014, we evolved to using laminated strategy cards and dry erase markers. This eliminated the problem of paper, but augmented the pressure on the seventh person, as he or she had to put in data in the two minutes between matches to give the cards back to their scouters.

In the 2013 and 2014 seasons, Team 303 relied on an Excel sheet to collect and organize data. By using separate sheets to review overall rankings based on previously decided on criteria, we were able to choose the best teams at any given task. For example, in the game Aerial Assist, we were able to quickly determine the team that had the robot that could climb, shoot, or perform in autonomous the best. However, our data was missing crucial information about the robot's role in a given team. For example, robots which could shoot from the human player stations were indistinguishable from robots that drove back and forth to shoot.

Strategy in the 2015 season

This season, Team 303 has completely revolutionized the process by using a cell phone app that we have made available from the Android App Store. The App contains a template that scouts fill data into. Once submitted, the App sends the data via a text message to a server owned by IFTTT, a third party app that is free to download. Once IFTTT receives the data, it places the text into a Google Sheet, which can be imported to an Excel Sheet and formatted at will (this process was developed and shared with us by FRC team 1986, Team Titanium). This eliminates all need for extra resources, and allows for live updating of data with only six people. We also have more flexibility with the contents of the application; we have updated the app several times in order to account for parameters which we realized would be important to scout

between events. These updates are usually very difficult to do with physical materials, as all previous materials would be rendered obsolete. The cell phones used for scouting are owned by the team members and can use a robot battery to stay charged.

For data interpretation we used a new Data Visualization tool called Tableau which has gained huge success in the industry (The student version of the software is available at no charge through FIRST's partnership with Tableau). Tableau can connect to data sources such as Microsoft Access, Microsoft Excel and Oracle to create visualizations and graphs which allow for quick and effective expression of data. The primary graph used this season to measure effectiveness of teams is shown in Figure 1 below. The X Axis provides the average height of a stack of totes and the Y axis provides the number of stacks. The size of the bubble representing a team dictates the average score contributed by one individual robot to the total score.

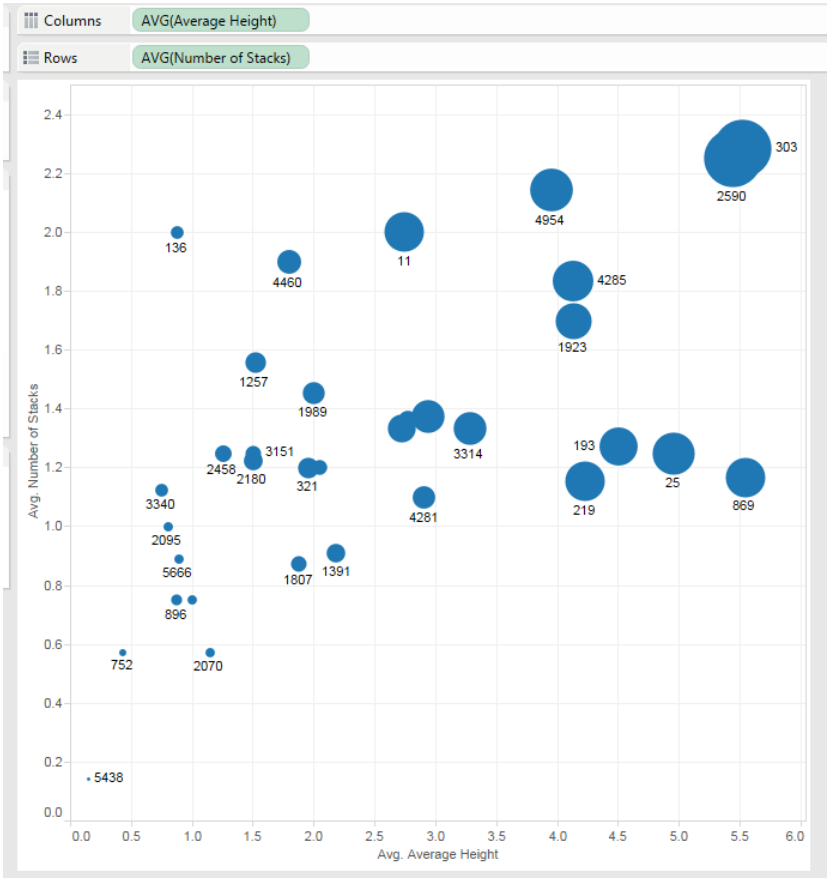

Figure 1: Overall teleop graph, created in the North Brunswick MAR District event.

However, only looking at this graph leads to a one dimensional view of the robots, leading to the same pitfalls that we had in previous years. To improve upon that, we have created 17 other graphs to measure other parameters including reliability, autonomous scores, and ability to take bins from the step, leading to a comprehensive view of each robot's abilities. We can also create filters that omit robots that do not collect totes from the landfill or the human player stations. By using these graphs together, we can quickly choose the robots that best complement our robot in any event.

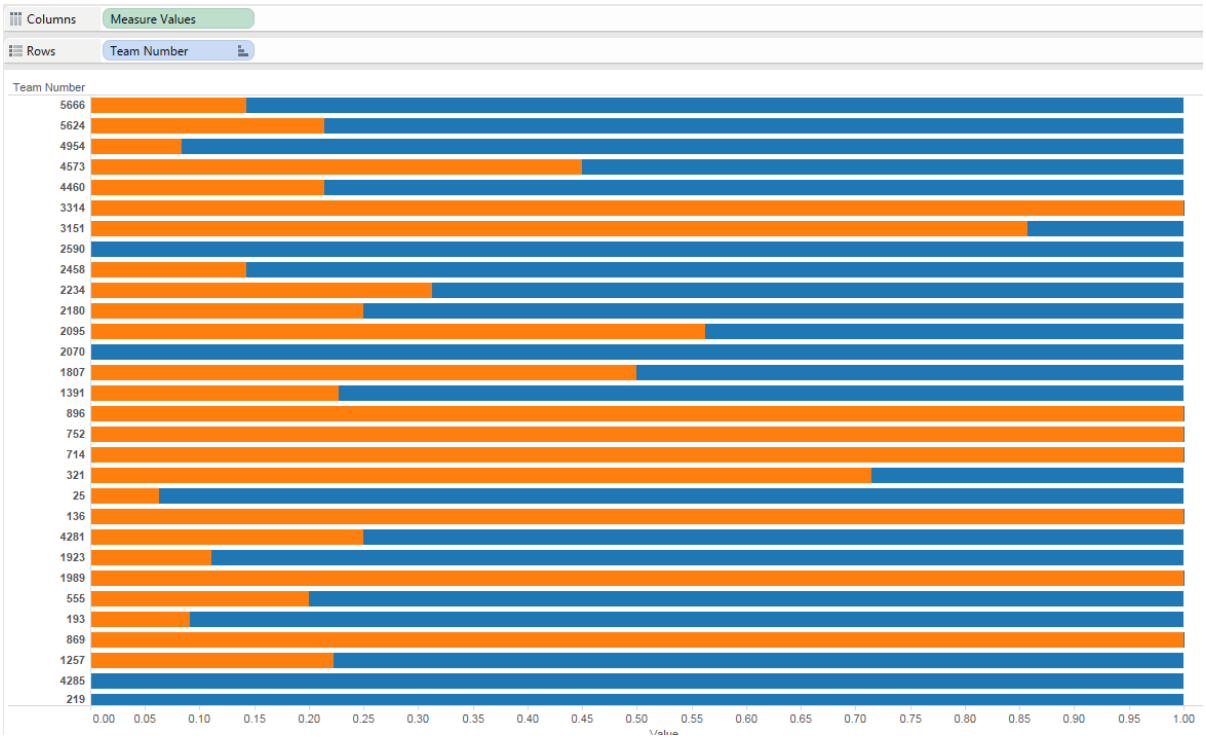

Figure 2: This graph has each team as a row, and shows the fraction of the matches that they collected totes from the Human Player Stations or the Landfill Zone. This enables us to easily pick out robots that are primarily landfill in order to avoid conflict for the Human Player

Stations. The blue represents the times that the team went to the human player stations, while the orange represents the times the team went to the landfill

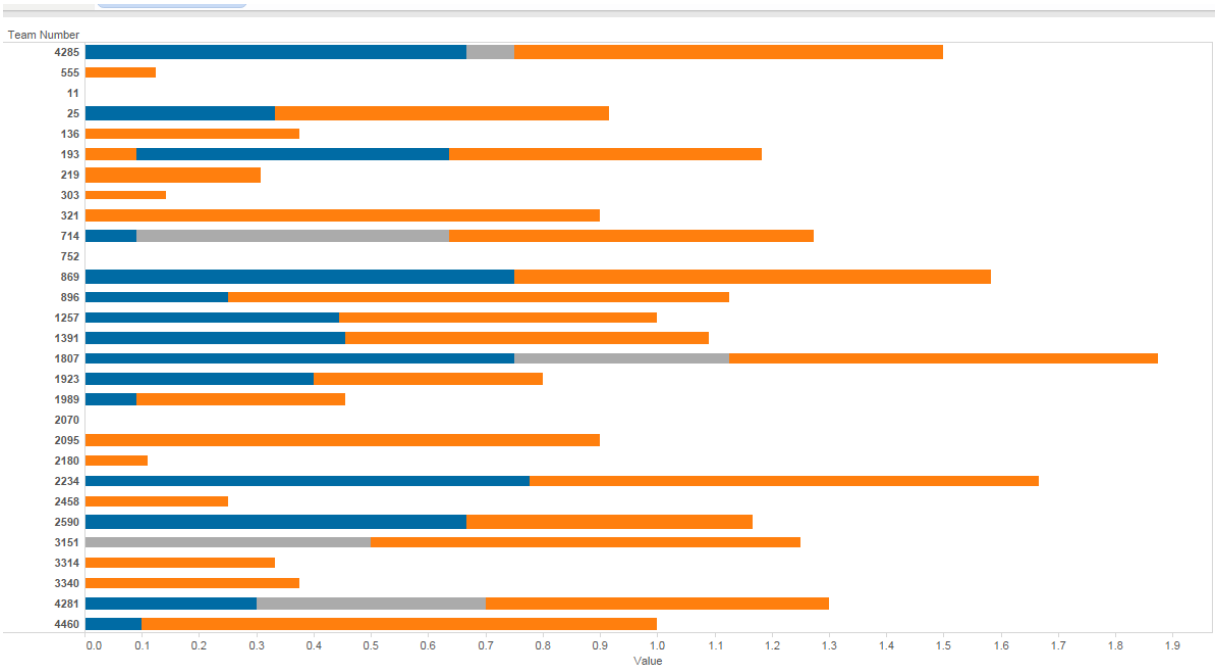

Figure 3: This is a graph of a teams' autonomous actions, weighted according to the number of points each action would be worth with the alliance's cooperation. This clearly demonstrates how often each team can create their share of a given set, and could potentially help us build an alliance which can score in the autonomous period.

How did we use the visuals?

In the 2015 season, we built a robot that specialized in Human Intake but cannot gather bins from the step. Our broad strategy is to build an alliance with the following, in order of priority:

- A robot that can take bins from the step for capping stacks of totes

- Two robots(including our own) with the ability to intake totes from the Player Stations and one with the ability to take totes from the landfill
- A robot that can complete an autonomous set independently

Our pick lists are created to fulfill these goals while maximizing the teleop score per robot. Our primary tool to accomplish this is the graph shown in Figure One, which is used to create a list of the highest scoring teams. After that, we filter the teams based on whether they use Human Intake or the landfill to get totes. Teams which are able to put up more stacks from the landfill are given preference over teams that are able to put up the same number of stacks from the Human Intake. If any teams are able to complete an autonomous set, they are moved higher on our rankings as well.

In order to resolve ties, we analyze teams' improvement over matches and their general consistency. If two teams have similar designs and output, we look at graphs of their Standard Deviation and their individual match points in order to see which team has a more consistent performance. In addition, if a team's point output decreases significantly over the day, we would decrease their standing on our pick lists.

This process helps us narrow down the list of picks very rapidly. Once we have a shortlist, we focus on the qualitative aspects and finalize the decision.

We will be very happy to assist other FIRST teams to implement a similar process. Please reach out to captain@team303.com.

Our app can be found at:
https://play.google.com/store/apps/details?id=scoutingapp.testteam3032015.true2015frcscout
(requires setup, talk to team 303 for more information)

A free trial of Tableau can be downloaded from:

http://www.tableausoftware.com/products/desktop/download-academic?os=ios

(an activation key provided by FIRST is required to unlock)