Introduction to Scouting Guide

Introduction

This guide was created with Team 1678, Citrus Circuits in collaboration with *FIRST* HQ. Thank you to Team 1678 for helping us create this guide!

This guide is intended to be an introduction to scouting and cover scouting basics. Teams can also check out the [Intermediate Scouting Document](#) for more advanced ways to do scouting.

What is Scouting?

Just like in other sports, scouting is an important part of competitions. In *FIRST*® Robotics Competition, scouting is a process through which a team can collect important data on other teams' robots. This data can be used to formulate match strategies and determine the optimal alliance partners for teams that become alliance captains.

Before competitions, a team might try to get a head start by looking at past matches for other teams in the upcoming competition; this can also be used to help train scouts. Before matches begin, teams might ask other teams questions and inspect their robots to get an idea of how well they will perform. During matches, many teams have team members act as scouts. Teams generally have each scout watch and collect data on specific robots and might have a few scouts take notes on entire alliances. Much of the rest of this document focuses on the collection of empirical data from matches.

Why is Scouting Important?

The most fundamental reason for scouting to exist is to help form optimal ways of playing matches. When you shift from practicing at home by yourself, to playing a match with two partners and three opponents on the field with you, an element of strategy is introduced. With scouting, teams collect data on other robots such as: the number of game pieces they scored, where they collect game pieces from, if they played defense or not, and more. With this data, it is possible to form better strategies that are grounded in real evidence, rather than guesses. Scouting allows teams to always have a plan on the field that is derived from quantitative observations.

Scouting also helps teams make informed decisions during alliance selection. Relying on rankings or anecdotal observations to differentiate between other teams' abilities can often be misleading. However, with scouting data a team can pick their alliance partners based on the metrics they value. By interpreting the scouting data, an alliance captain can craft an alliance that performs well together, with each team's strengths complementing the others.

In the end, scouting is about offering teams a quantitative strategic advantage and a better insight into the performance of other teams. By relying on real data to make decisions, form strategies, and choose alliances, teams will give themselves a greater chance of success with a well-made scouting system.

What Information to Collect

Having a successful scouting system requires an abundance of information. However, the amount of information shouldn't be overwhelming and unnecessary. It is better to have accurate and important data, rather than cramming in insignificant data. One major reason to limit the amount of data collected is the more you ask a scout to watch and record, the harder it will be to do so accurately. In other words, less is more. The easiest information to collect is objective and quantitative, but subjective qualitative information also can be valuable. So what information is important?

The biggest question to ask as you go through each piece of data you might collect is "what will I use this data for"? Some teams know exactly how they will use information on what a robot weighs or how many batteries a team brought to the competition while other teams will find that information useless. Only collect data that you feel will be useful later.

At the start of every season, it is important to reassess what data is important to collect for that year's game. Here are some possible categories to get you started:

- Identifying information
    - o Recommended: Team Number
    - o Consider: Team Name, Robot Photo
- Physical Characteristics
    - o Consider: Robot size, height, weight, drivetrain style, wheel type
- Autonomous
    - o Recommended: Game tasks completed (scoring, crossing zones, etc.)
    - o Consider: Starting locations, pathing
- Teleoperated
    - o Recommended: Scoring actions
    - o Consider: Speed/agility, driving ability, defensive effectiveness, where they defended, fouls
- Endgame
    - o Recommended: Action attempted, action completed
- Other
    - o Consider: Reliability, Communication (feedback from Drive Team)

It's helpful to continuously update the data points you collect throughout the competition season. You might not know what exact data points will be important until you attend your first competition. Make sure to get feedback from strategists on what data points were the most helpful, what isn't being used, and what else they'd like to collect.

How Should Scouting Data be Used?

Qualification Matches

The first way to use your collected data is to plan strategy for qualification matches. While you could get information about your alliance partners by seeking them out in the pits and asking some quick questions, a quantitative measure of their abilities can offer additional insights in estimating performance. Even the best-intentioned teams will often overestimate their abilities. It's easy to get caught up thinking about what you designed your robot to do, what it did in practice back home, or how everything that slowed you down in a match could be done better next time and lose sight of the unbiased picture of what your robot is currently accomplishing. Make sure to capture data on your own team to avoid this pitfall!

Alliance Partners

Look at your alliance partners' past performances, including scoring positions, and intake locations.

- **Auto** - Compatibility can be gauged based on where teams previously scored in auto or other behavior. Start thinking about what some compatible plans for the alliance autonomous might look like.
- **Ranking Point (RP)** – Look at any bonus Ranking Point criteria and compare that to your alliances combined capabilities to help decide whether any are realistic objectives for the match. What about if 1 or even 2 robots play defense?
- **Teleop Paths** – Look at your partner's capabilities, your auto plans, and any data you may have on preferred intake or scoring locations. Start thinking about how your alliance can coordinate with each other to operate smoothly in teleop without stepping on each other's toes.
- **End game** – Look at your partner's capabilities and start thinking about what an end game plan might look like. How does what? Where do they do it (if applicable)? When do you need to start?
- **Score** – Estimate what your alliance might score if all three of your robots played offense. What about if 1, or even 2 robots play defense instead?

Opponents

- Look at where the opposing robots previously scored, how much they scored, and generally what they did during the match.
- **Score** – Estimate the opponents score undefended, what if 1 or even 2 robots defend them?
- **Defense** – How can you stop opposing robots from playing their preferred strategies? Important data to inform this includes how much a team scores and where they intake from and score. Standard deviation can also help spot inconsistent teams that may be easier to knock off their game than others.

Overall Plan

Now you can put all the pieces together by looking at the estimated scores and RP criteria progress. Matches often fall into one of 3 categories:

- **Favored to win** – Your alliance looks significantly stronger than the opposing alliance. Generally, this indicates you should stick to a safe strategy focusing on any RP bonuses.
- **Likely to lose** – Your alliance looks significantly outmatched by the opposing alliance. You will need to either come up with a unique strategy or make sure to focus on any RP bonuses and look out for significant events that might make the match up for grabs again (robots becoming disabled, dropping game pieces, etc.)
- **Toss-up** – The match looks like it will be fairly close. These matches often involve considering tradeoffs between playing defense and giving yourself the best chance at achieving RP bonuses. Consider figuring out "milestones" towards RP criteria to help you gauge whether you are on track at various points in the match (i.e. we should be 50% there halfway through the match and if not Team 123 will switch to defense).

Now that you have your thoughts about how to play the match optimally, you are ready to discuss with your alliance partners. Remember that your partners may have their own data and ideas about what to do in the match. They may even have different goals for the match than you do (i.e. try a new auto mode, show off a specific robot capability, etc.). Make sure to listen to everyone and try to come to a plan for the match that everyone is happy with.

Alliance Selection

In alliance selection, team captains can use their scouting data to find the teams that would best match their robot's strengths, weaknesses, and strategies. Especially for alliance captains of lower-ranked alliances, having data on every robot is imperative as careful selection of strategy and partners is the best chance to upset higher ranked alliances. Metrics that should be considered include defense played, positions scored in, ability to perform endgame actions, and autos.

How to collect scouting data

Scouting is an accessible resource for all teams. A team doesn't need electronic tablets, or an online scouting system to begin scouting and reap the benefits of having data on opposing teams. There are some simple ways to begin scouting; some of these include paper, Google Forms, and spreadsheet scouting.

Paper Match Scouting - Traditional

One of the most basic forms of scouting is paper scouting. Some teams do not have access to electronic devices with cell service during competitions (as Wi-Fi is not guaranteed in the venues), and paper scouting can be an easy, quickly accessible method to start. The method described works best if you have at least 7-8 scouts (mentors can scout too!), 6 to watch each robot during the match and 1-2 to help organize the paper and/or enter data.

The first thing to consider is whether the data will remain on paper, or whether you will enter the data into a computer for analysis. Leaving the data on paper suggests that all data should be organized by team number in order to analyze it in any meaningful way. If data on multiple matches is being collected on a single piece of paper, keep the partially completed pages organized by team number and pull them back out based on the teams playing in each match. If the data is being entered into a computer, this restriction is not necessary; instead, you can simply collect data on a single sheet until it is full, regardless of what teams are in the match, and then pass it off to the person doing data entry.

Review the "What Information to Collect" section to help determine what needs to be on your sheet. Consider the limitations of your data collection and analysis methods and how that might impact what you want to collect. For example, for the 2023 game Charged Up, the papers might have sections for the number of cubes scored, number of cones scored, and charge station level, as those are the main ways teams score.

Each paper should be assigned to one scout, who scouts one robot on the field. Generally, it's easiest to assign each scout to a specific player station (i.e. Red 1, Red 2, etc.) so they can look at the team signs to know what team to scout each match. Labeled clipboards can help make sure that all 6 stations are covered, and each scout knows which station they have. Throughout the match, have the scout keep track of the robot they are assigned to, noting down on the respective sections of the paper whenever the robot scores, and add up the numbers at the end of the match.

After a match (or every couple matches), collect all the paper and consolidate the data. There should be other members available on the team to analyze the data, while the scouts continue to scout as new matches start. This step of data aggregation and analysis is essential to extract meaningful insights from the data that is collected. Collected data can be input into a spreadsheet for easier data manipulation and display. Regardless of whether you are digitizing the data or not, file each paper in a folder in an organized way. This will be important in case you need to reference the raw data later to try to correct an error or see who scouted an individual match to ask a question.

Figure 1: Example Paper Scout Template for the 2023 Game

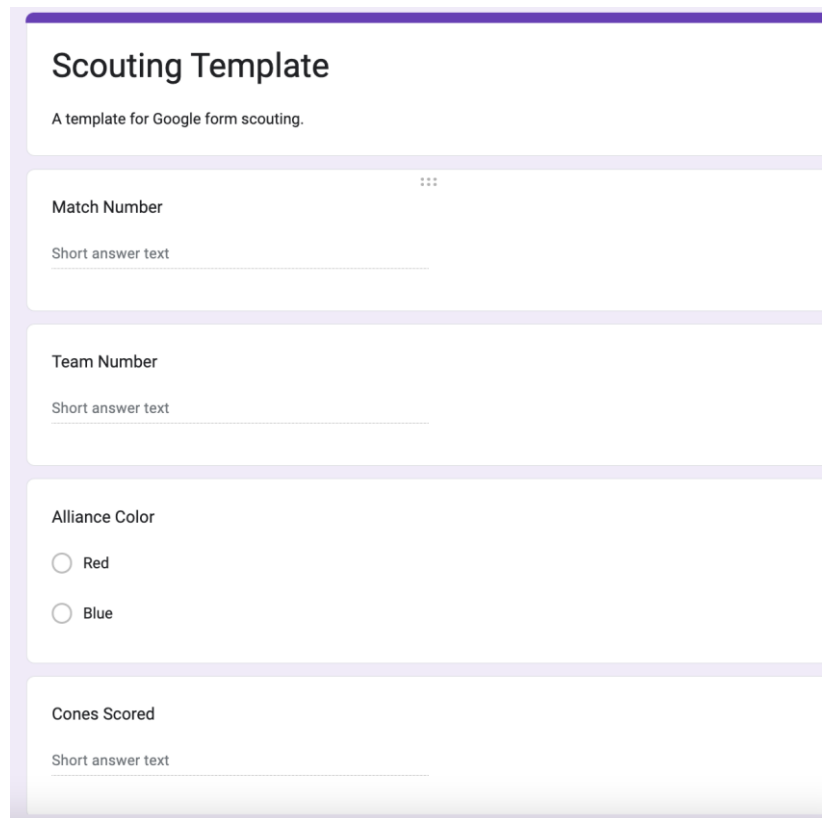| Name: _____		R/B	Auto		Teleop		P/D/E
Match #	Team #	Color	# Cones	# Cubes	# Cones	# Cubes	Charge Level
1	1234	R	1	0	1	3	P
2	2345	R	1	0	4	2	D
3	3456	R	1	0	6	1	D
4	5678	B	0	0	2	3	E
5	7302	B	2	0	4	1	E
6	6969	B	0	0	0	5	E

Paper Scout - Alternative

An alternative method can also be implemented. Instead of collecting precise data, scouts can simply take notes on their teams instead. These notes can include observations on the team's scoring, estimations rather than exact numbers, robot qualities, defensive ability if applicable, or any other things that contain strategic importance. Each scout's notes on a team should also be sorted and consolidated. Data collected in this fashion can be analyzed and referenced during alliance selection, or when creating match strategy, offering benefits just as valuable as objective data.

This method can be scaled down more easily, with one person covering 2 or even 3 robots, though the quality of data will certainly decrease.

Google Forms Scouting

If you prefer to try to save some paper and avoid having 1-2 people dedicated to data entry, Google Forms can be used for reusable data input forms. If a team's scouts have access to cell service in the competition venue, this method can be easily implemented. The Google Form should contain the same prompts as those mentioned in the paper scouting section and contain inputs for the same essential metrics the scouts keep track of. Google Forms can send the information directly into Google Sheets where data analysis can be carried out.

Figure 2: Template Google Form for 2023 Game

Some tips when considering this type of scouting:

- Your [local Program Delivery Partner, Senior Mentor](#), or even other teams, may be able to tell you whether cell service at a given venue is generally reliable.
- Make sure to have some USB power banks charged and on hand for recharging devices, having the screen on all day scouting matches can really drain the battery!

Aggregating Data in Google Sheets

After scouting data is collected on a few matches, it's time to organize and aggregate the data into a viewable, calculation-friendly format. To analyze scouting data in Google Sheets, it's important to first put the scouting data in a format that can be fed into Google Sheets:

- If you are paper scouting, you'll need to enter this data into a spreadsheet.
- If your scouting data is already in another digital format such as CSV, you can import it into Google Sheets. To import a file into Google Sheets, select **File > Import**, navigate to the Upload tab, and choose the file from your computer.
- If you are using Google Forms to collect data, go to your form, click **Responses**, and click **Link to Sheets** to get the responses placed into a spreadsheet.

Once your data has been imported, you may have a spreadsheet that looks like this:

Table 1: Example Google Sheets Data Table

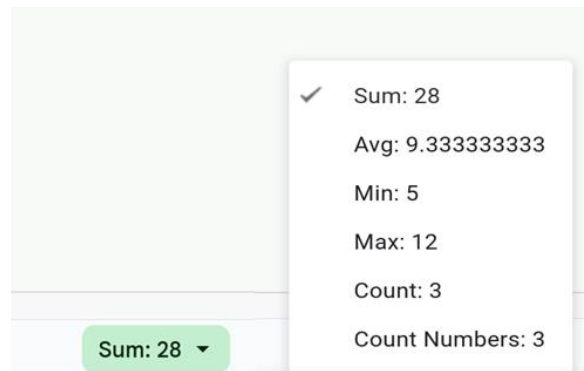| Match	Team	Balls scored	Blocks scored	Climbed
1	123456	12	0	TRUE
1	234567	5	4	FALSE
2	123456	11	2	FALSE
…	…	…	…	…

Now, let's say you want to view all the data about a given team. To filter by a certain column, for example the team number, right-click the column header and click **Create a filter**. Then, click the filter icon to show sorting and filtering options:
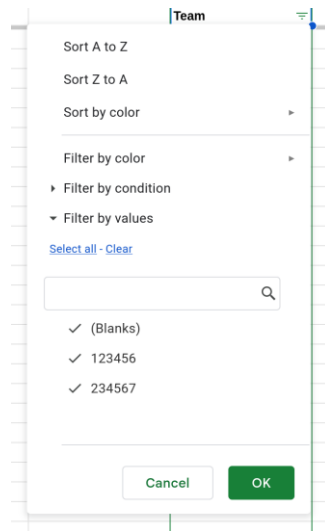
If you select a range by clicking and dragging, the sum of the values in the range will show up in the bottom right, and you can click on the button to view other values such as the average:

Figure 4: Sum and Statistics Menu

Creating an Averages Sheet

You can also create a summary sheet with averages for each team for each data point

For example, let's say your raw data is in this format:

Table 2: Example Data Table

Team	Match	Balls scored	Blocks scored	Performance Rating
123456	1	12	0	4.0

234567	1	5	4	5.0
123456	2	11	2	3.5
…	…	…	…	…

Sheet1

A way to aggregate this data is to use the **AVERAGEIF** formula to take averages. Create a new sheet using the '**+**' button at the lower left of the screen, and enter the list of teams into the first column:

Table 3: Summary Sheet Creation

Team				
123456				
234567				
345678				
…				

Sheet1   **Sheet2**

In the cell to the right of the first team number, enter this formula:

=AVERAGEIF(Sheet1!$A$2:$A$999, $A2, Sheet1!B$2:B$999)

This formula looks at the values in the same column of the first sheet, and takes the average of the values that match the team number.

Then, if you select this cell and drag the circle at the bottom right of the cell to copy the cell down and across, the spreadsheet will show you the average values for each data point for each team, in the order they were in your raw data (the first sheet). If you copy the first row from the raw data and put it in the first row of the new sheet, you can see the data point names. Your sheet should look something like this:

Table 4: Summary Data Sheet

Team	Match	Balls scored	Blocks scored	Performance Rating
123456	3	13	3	4.0
234567	4	8	2	4.5
345678	3	5	10	3.0
…	…	…	…	…

Sheet1   **Sheet2**

You can ignore the **Match** column, since the average of the match numbers isn't meaningful. However, the other data can be used to give insight into what the strengths and weaknesses of teams are.

You could also choose to add additional calculated columns (i.e. Gamepieces = Balls + Blocks) to help further summarize the data.

Creating a "Picklist"

A "picklist" is the term often used to describe an ordered list of teams you would like to pick to play with in the Playoffs. Often this is a single list with at least 24 teams (8 alliances * 3 teams each at a typical non-Championship event). Sometimes it can be broken down into multiple lists such as having one "overall" list to use for a first selection, but then separate lists for different skills that are used depending on the first selection. It's helpful to always be prepared with a picklist. Even if you're not an alliance captain, if you're chosen as a first pick, you can help your captain select a second pick.

If you are using a Google Sheet and have created an Averages Sheet as described above, it can also work as a picklist. You can click on rows and drag them to rearrange teams. Share this spreadsheet with your teammates to work on the picklist together at a meeting.

One good way to go through the picklist creation process is to start by discussing what you want out of an alliance partner. Take your most important category and sort your sheet in descending order by that category, this is a rough start to your list. Then start from the top of the team list and for each team, compare them to teams higher in the list one at a time and either move the team up or keep it in its place; this process is also known as a pairwise comparison. This process can help you get through the picklist process systematically and efficiently. Remember

to also use any subjective data you have collected or observations you have made about each team to inform your decisions because the raw numbers might not tell the whole story.

Having your picklist creation meeting the night before the alliance selection process will allow you more time for discussion. Then, you can adjust your picklist further leading up to the selection process. Manage your time wisely, since picklist meetings can take a lot of time. Make sure you get a good night's sleep after your meeting and have fun at the rest of the competition!