Skunk Works Robotics
Systems Integration Notebook

Scouting Plan

Thinking Strategically

Raisbeck Aviation High School Team 1983

www.AHSrobotics.us

Created By: Systems Integration Team
Prepared By:
Grace Cieszkiewicz

Mentors:
Gary Miller
Steven Wright

Table of Contents

ABSTRACT

Scouting is the analysis of robot performance during gameplay. The process assists in the development of game strategies at competitions. Many team members take part in this process, and the quality of the results is dependent on their hard work and data organization. Scouting enables teams to understand the capabilities of competitors and select the optimal teams with which to form alliances. It also allows team members to familiarize themselves with all types of robots and approaches to the game.

1.0 Breaking down the Rules

To begin the scouting process, it is necessary to have a full understanding of the rules and how the game is played. This starts by having all members of the team read the game manual. All team members should take part in this process, as the game rules impact all of the sub-teams throughout the season. For students to have a full comprehensive understanding of how the game works, it is valuable to break the team up into several smaller groups covering specific sections of the manual. Through this method, each small group can share their part of the manual to the larger team so all students go away with a full understanding of the complete manual.

2.0 Full Team Match Simulation

Once students have a full understanding of match gameplay, they are ready to run through a full simulation of the game in real time. In a full simulation, six students act as robots, three per alliance, while the rest of the team watches as they run through a competition match. Running through a match helps students make the mental connection between the physical movements of the robots and the rules applied during gameplay. Also, many of the strategies that are not immediately apparent when analyzing the rules have a fair chance of being used once the game has been simulated.

3.0 Identifying Key Performance Parameters

The game simulation, tied with the understanding of the rules, builds a powerful basis for the team to begin identifying Key Performance Parameters (KPPs). KPPs define the most important actions that the robot performs during competition, and inform robot design, gameplay strategy, and alliance selections. Aside from robot strategy and performance, KPPs also define parts of the robot and the robot's design.

KPPs are identified in an all-team discussion where students and mentors contribute their ideas for how the robot needs to operate in order to win the game. Parameters such as driving and mobility may be high level KPPs while something like having a defensive mechanism may be lower priority. It is up to the team to determine what the high and low level KPPs should be.

3.1 *Robot Design*

While scouts continue working on understanding the rules of the game, the rest of the team works on building the team's robot for competition. It is essential to remain in contact with them so they are aware of the most important components of the robot that

are needed to optimize an alliance's overall score during competition. This can be handy for when the build team is running short on time to build the robot.

3.2 *Outline Strategy*

KPPs inform the strategies that are to be used in the competition. As a team, it is important to outline what potential strategies can be. This gives the students on the team an understanding of many different strategies that can be utilized during matches. The list of strategies that come from this team discussion later will be compared with the game plan strategy that the scouting team puts together.

4.0 Game Plan Strategy

The Game Plan Strategy essentially proves the strategic predictions of students and mentors on the team to either be effective or ineffective. This plan also informs the scouts of potential trade spaces, where strategies can be switched during a match, and ways of getting extra points against the opposing alliance when it counts most.

With a list of KPPs, a scouting team can put together a theoretical "ideal" robot, or an Einstein-performing robot, that can be used to simulate the "perfect" match competition. This robot serves as the baseline robot, and can be used to model several different strategies while performing by itself on the field. Once scouts reach an understanding of the different strategies that one robot can play on its own, with no defense involved, they can begin adding factors that may slow down point cycling (such as defense, robot performance, field transit barriers, etc.). This highlights all aspects of the single-robot performance and scoring potential. At this point, scouts can begin adding more robots into the simulation, where they can then analyze different two and three-robot strategies. Having different types of robots in one alliance then brings out what will be seen most commonly at competitions.

4.1 *Interaction with Coach*

After the Game Plan Strategy has been built to include a variety of robots and strategies, scouts can present it to the Coach of the drive team. This interaction is important to not only inform the Coach of strategies, but also in informing the Coach of key design components required for having optimal performance. Many of the strategies in the review with the Coach will be used to inform the design team of necessary components the robot should have, from most important to least important, in order to win the game.

5.0 Scouting Sheets

Following the Game Plan Strategy review with the Coach, the scouts will group together and begin highlighting key actions that show the quality of the robot. These actions will be used to create pit and match scouting sheets. Scouting sheets are used to collect data for each of the robots performing on the field at any given time, and are extremely valuable when it comes to the competition. A team that does not collect data about other robots during the competition is at risk of selecting a robot that may not complement their alliance. The data from the sheets serves to show the quality of competing robots; they can be graphed or modeled in a variety of ways for the Lead Scout to show the Coach

before the team competes. There are two types of scouting sheets that can be used to collect scouting data—pit scouting sheets, and match scouting sheets.
Pit scouting sheets are for collecting specific mechanical data on the robot that may not be visible on the field. The sheets can collect information about a robot's drive train, wheel type, weight, number of CIMs, or anything else the scouting team decides is worthy of collecting. The purpose of pit scouting is more than just collecting data about a robot; pit scouting enables one team to interact with another so they can form good team relations. These relations come in handy later during alliance selections.

The match scouting sheets are for collecting the number and description of actions that a robot does. On the scouting sheet, scouts can collect a number of things—from positioning on the field to points scored or missed. The data collected can be used to organize and determine quality alliance partners before alliance selections. This data can be modeled to create graphs and charts that are used as a visual representation of each teams' progress.

Pit scouting and match scouting does not have to be organized on paper sheets—they can be done through a scouting application as well, which quickens the scouting process. This removes data entry and in turn makes the scouting process faster and simpler.

5.1 *Proof of Concept Testing*

Once scouting sheets have been created for data collection, the Scouting Team can then begin testing them in a real competition scenario. This can be done by testing the scouting sheets and scouting system at an early event or by having students act as robots on a field. This will ensure that the sheets are collecting the data necessary for alliance selections and it will open up areas where there may be error (either from the scout or from the Quality Assurance team error checking the incoming data).

The proof of concept testing with the scouting sheets also serves the purpose of training scouts. New scouts should have a fair understanding of how to collect data, and of what values are acceptable for data input. As errors come up, they are noted by the scouting team and changes are made to assure the quality of the data coming in. This process continues until scouts are satisfied with their data.

6.0 Competition Scouting

Forming bonds with other teams is a very valuable component to the scouting process, and it will be a huge advantage later on when alliance selections come. Scouts can connect with other teams while doing pit scouting or while wandering around during the competition. This puts the scouting team in a significant advantage by the time alliance selections come around. Teams will remember conversations they have with other teams, and those connections will be valuable in the lobbying process before alliance selections.

6.1 *Match Scouting*

There are several key factors that distinguish scouting practice from scouting at the actual competition. Team members must be trained and prepared to communicate with one-another while scouting; this ensures that scouts do not accidentally scout the same robot,

or put down false information. The training process happens before competition, so scouts know how to collect quality data. Communicating with scouts from other teams throughout the competition is equally important. During the match scouting process, it is the responsibility of each scout to fill out the match scouting form, as seen in Appendix A. This form covers the actions taken by the robot and the positions where some actions are taken. After a scout completely fills out their form, the Quality Assurance (QA) team is responsible for reviewing the data then clarifying and removing bugs or conflicting information. This data is then sent to the Data Team, who enters the data from the scouting sheets and uses the data to generate charts.

In a digital scouting system, the QA team has the same responsibilities, but having a Data Team to enter data is no longer needed. The data team's only responsibilities at this point is to create charts and graphs to model data that is given to the Drive Team and Lead Scout for review.

6.2 *Data Processing and Analysis*

Once data has been collected and stored on a database where it can be easily viewed and edited, it is then graphed in a variety of ways to relate the qualities of each robot. This helps to distinguish between high and low scoring robots. Data can be modeled to show each robot's specific autonomous scores, tele-op scores, assist points and anything else of significance in the competition. Defense is often noted by the scouts in their comments or by the Lead Scout when they analyze individual robot strategy on the field. This analysis is key to informing the Drive Team and Lead Scout of each robot's individual capabilities.

6.3 *Robot & Match Assessment*

Before each match that the team's robot is performing on the field, the Lead Scout and Data Team are responsible for creating informative charts that describe the alliance partners and opponents of those matches. T5 he Lead Scout At this point the Lead Scout and Data Lead analyze the charts and describe them to the Drive Team so they can gather important information about the robots on the field.

At the end of the first day of competition, the Lead Scout is responsible for having a short analysis on each robot at the competition. This information is then shared with the team during a team review, and this discussion helps the Lead Scout organize a pick list.

6.4 *Team Review*

End of the day Friday the team comes together to discuss who the top robot picks should be, and who potential second picks are. This discussion is key to getting the input of other students, but most importantly the input of the team as a whole. In the review, the team debates over who the top robot picks are, we group up and talk as a team. End of the day Friday the team decides who the top picks are.

6.5 *Lobbying*

There comes a point in the competition when the Lead Scout has made an informed pick list, and is prepared to share the information they gathered with the Drive Team and

Coach. Before this happens, it is important that the Lead Scout talks to their top alliance picks to confirm that those teams are interested in forming a partnership. The discussion the Lead Scout has with these other teams is known as lobbying.

Lobbying helps the Lead Scout to come to an agreement regarding alliances in eliminations with other teams. Before talking to those teams, the Lead Scout should be aware of what robot characteristics their top picks have, and what those robots need to win. By having a presence at the competition and selling what it is that other teams need in order to win, a team will have a fair chance of being detected by another team. To become noticed at the competition, it is important to highlight a list of features that will appeal to other teams, and be able to demonstrate quality robot performance in one aspect of the competition. This reliability in one or more performance aspects on the field is the kind of thing other Lead Scouts are looking for when determining their pick lists. Each team will come up with a list of highlights to promote their team. They will also search for a list of features that they need in order to win. Having the ability to sell this point is very advantageous, and it helps teams persuade one another to form alliances.

6.6 *Coach's Meeting*

During the competition, the Lead Scout is responsible for communicating strategies and competition data Drive Coach and Drive Team before each qualification match. This meeting is directly after qualifications matches have ended, and it informs the Drive Team of the opposing alliance's qualities along with the team's alliance and their qualities. It is essential to communicate the quality and detail of each robot's performance so the Drive Team can formulate strategies with their alliance partners to win each match.

If the robot performs strongly and is in the top eight, then it is important to have a detailed list of potential first and second alliance picks. Even if a team does not seed in the top eight, it is in their interest to have a prepared pick list just in case they are selected and need to discuss a third pick with their alliance partner. On the day of alliance selections, the Lead Scout and drive team have a group discussion going over potential alliance partners to choose from. It is the Lead Scout's responsibility to have made a pick list to show them during the discussion. The purpose of the Coach's meeting is to verify the teams on the pick list and reach a unanimous decision on the pick list order.

6.7 *Alliance Selections*

Once the Coach's Meeting has ended, the Lead Scout will need to quickly make their way onto the field with their prepared list of robots to pick from. At the point the Lead Scout will have finished organizing teams on the pick list to fit a variety of situations. The robots will be organized by their qualities—from shuttle bot or defensive bot to great autonomous and great tele-operated scoring. The Lead Scout will strategically match up robots that complement each other in the alliance.

After the Lead Scout has made the first pick, or was a first pick by another team, they will talk with their alliance partner and quickly come to a decision on who the third team should be. Having strong data and different lists for first and second robot picks is extremely helpful in making an educated decision.

6.7.1 District Level

At the District level, there are fewer teams to choose from. The pick list will end up including every robot at the competition, because the number of robots at the competition is anywhere between 20 and 40. This means that having quality data is absolutely imperative, as any team is at risk of being chosen.

6.7.2 District Championship Level

The District Championship level is very similar to the regional level; there are three to four times as many teams that are seen at Districts. This means the pick list must be even tighter than at Districts, and still manage to be the same length. The team discussion we be even more complex, going over more teams, and the Lead Scout's job becomes more difficult in determining alliance partners.

6.7.3 World Championship Level

The Championship level is even more complex than Districts, Regionals, and District Championships. In a competition where there were around fifty to sixty teams, there are now around one hundred, and they are mostly high quality teams. A few teams from each of the four fields at Nationals will make their way to Einstein, so winning one of the four mini-regionals at the National Championship is only the first part to winning the entire competition. This means that scouts must be thinking in the mindset of winning their field before thinking about winning Einstein. This pick list is even harder than the last few, and keeping track of all one hundred teams is key to selecting a powerful alliance.

6.8 *Alliance Assessment*

Following the alliance selection, the Lead Scout will put together a Coach's binder for the Drive Team that has data on each of the 24 robots competing in eliminations. The description and assessment of each robot on the opposing alliances is essential to working around them and understanding how they think and perform. This informs the Coach of how the Drive Team can work with their alliance partners, what teams should be focused on most for defensive strategy, and how to work around the opposing alliance’s strategies to win the game.

7.0 Appendix

2014 Aerial Assist:

Match Scouting Skunk Works 1983

Team #:_____ Scout Name: _____ Match #:_____
[Blue] [Red] Partners: #1:_____ #2:_____
Opposing Alliances: #1:_____ #2:_____ #3:_____
QA:_____

Dead Bot ☐
No Show ☐
Fatal Jam ☐

Hybrid / Auto

Start/End Location

1	4
2	
3	

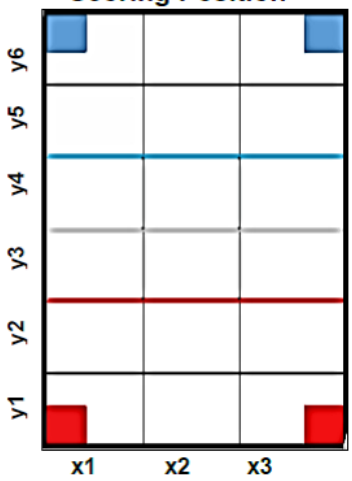
Ball Control
High:_____
Low:_____
Hot:_____
Start Position:_____
End Position:_____
Zone Move: ☐

Comments

Auto Score
High:_____
Low:_____
Hot:_____
Start Pos:_____
End Pos:_____
Zone Move: ☐

Tele-Op

Scoring Position



Ball Control
Collect:_____
Pass:_____
Truss:_____
Missed:_____
Dropped:_____
Low Goal:_____
High Goal:_____

Scoring Position
x-coord:_____
y-coord:_____

Tele-Op Score
Collected:_____
Passed:_____
Truss:_____
Missed:_____
Dropped:_____
Low:_____
High:_____
x-coord:_____
y-coord:_____

Fouls/Sketchy Business

Fouls
Technical:_____
Red:_____

Win ☐
Lose ☐
Draw ☐
Fouls ☐

<Pit Scouting Sheet>