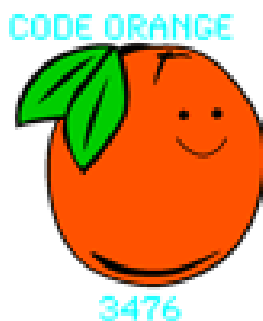# FRC #3476 Code Orange

Scouting 101

Introduction

This guide was written by the scouting sub-team of FRC team #3476, Code Orange. 2012 was our second year in the FIRST Robotics Competition and our first year of organized scouting. Because we are a small team, we were able to learn many aspects of the program first-hand. This guide is designed to be a short summary of scouting tactics and strategies that we applied to the 2012 FRC game, Rebound Rumble. However, it is designed so that the tactics covered within can be applied other FRC games. Please direct all comments, questions and suggestions to codeorangefrc@gmail.com.

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What is Scouting?

Scouting is an often-overlooked part of the FRC competition. Many teams abandon scouting with the supposition that they will never be placed in a position in which they will be picking during alliance selections. This supposition is immediately false, however, if your team is unexpectedly be thrown into the top 8. Furthermore, scouting data is extremely important if you are the first pick of an alliance, as the alliance captain might not have sufficient data to make a good second pick.

While scouting, strictly speaking, is the process of investigating and identifying how other teams' robots play the game, scouts often participate in the construction of match-by-match game strategy. You can have the best robot in the world, with the best drive team in the world, but your game will crumble without the proper strategy. To build this strategy, you identify the strengths and weaknesses of both your alliance partners and the opposition and design a tactic to capitalize on each. In addition, scouting is also a great way to meet other teams and make new friends, an asset that is much more valuable than any scouting data that you could obtain.

Say that your team has decided to scout at your next competition, whether it be district, regional, region championship, or world championship. First, you must decide how you want to go about scouting. Scouting is divided into several parts:
1. Pre-Scouting (Optional)
2. Pit Scouting
3. Match Scouting
4. Match Strategy (Optional)
5. Pick-List Formation

Let's start by talking about point 1, Pre-Scouting. This method is only really useful if some of the teams in your competition have attended another competition beforehand. In Pre-Scouting, you use the internet or other resources to gather information about other teams' robots. Oftentimes, searching for videos of past matches on YouTube or other video hosts can bring up some useful information. However, be wary of robot reveal videos - these tend to capitalize on the robot's best functions or attempts at scoring and edit out the worse ones.

Point 2 is Pit Scouting. Pit scouting can be as simple as walking from pit to pit with a notebook or as complex as using a custom mobile application to gather information about other teams' robots. Some people dislike Pit Scouting, as it allows other teams to exaggerate their robots' abilities and does not provide a good idea of how well other teams' robots can perform the functions. However, Pit Scouting can provide very good basic information about other robots. In addition, Pit Scouting allows you to make friends with other teams, which is always very valuable.

Point 3, Match Scouting, is likely the most important aspect of scouting. In Match Scouting, you watch matches and take notes on how well each robot can accomplish each aspect of the game. It is important to watch each robot compete in more than one match, because robots often get better as the competition goes on (or break down as the competition goes on!) Match Scouting allows you to collect statistical data on each robot in the competition, allowing you to determine their strengths and weaknesses. This information is the basis behind points 4 and 5.

Point 4 is not always considered a part of scouting, but it is a function in which scouting information can be very helpful. In Match Strategy, you use the information collected in points 2 and 3 to determine the strengths and weaknesses of your alliance partners and opponents for each match. You then share this information with the drive teams of your team and your alliance partners in order to make a working strategy for each match.

Point 5 is the basic function behind scouting - making the Pick List! In Pick List formation, you determine what other robots and strategies will compliment your robot and

strategy the best. To do this, you use information gathered from Pit Scouting and Match Scouting to construct a list of teams that you would like to pick during alliance selections.
So are you ready to start scouting?

Pre-Scouting

Point one is Pre-Scouting. Pre-Scouting is an optional part of the scouting process, and is often very time-consuming and tedious. If you are attending a Week 1 event, than Pre-Scouting is impossible and unnecessary! However, if you are attending the World Championship, in which all teams have competed beforehand, than Pre-Scouting information can prove itself very useful.

Since Pre-Scouting can take so much time, especially if you are attending a large competition, it is often much easier if you have multiple people working on it at once. Google Docs (docs.google.com) is a very useful way to share documents, which are updated in real time and saved automatically. In 2012, Code Orange used a Google Docs Word Document and a uniform form for each robot, as shown below:

3476- Code Orange

Overall: *Awesome* robot. *Quick* intake. Quick lining up/shooting (from fender or top of key). Multiple autonomous modes. Bridge control takes no time at. Double balances quickly. Glides over barrier.

- OPR: 16.42; DPR: 5.47
- Win Record
  13-2-1
- How they Qualified
  San Diego Regional Winners
- Bridge
  Bridge control takes no time at all. Double balances quickly.
- Basket preference
  Top, no reason for it to shoot anywhere else.
- Where they can shoot
  Top middle of key (side during autonomous), fender middle.
- Barrier
  Glides over barrier.
- Autonomous
  Middle of top of key to top hoop (accurate), then backs up to lower bridge.
  Side of top of key to top hoop (not as accurate)

There is no one right way to do Pre-Scouting, except that you must gather information about other teams before your competition. There are several things you can do:

1. Pictures
   Pictures can be an excellent way to familiarize yourself with another team's robot. Some teams post pictures of their robot on their website, Facebook page or Twitter account. In addition, some teams post pictures of their robot in the Chief Delphi media repository: http://www.chiefdelphi.com/media/?. Pictures might also be posted on The Blue Alliance (http://www.thebluealliance.com/) or The FIRST Alliance (http://www.thefirstalliance.org/index.php). You may want to either print the pictures you find or upload them to a mobile device. As team numbers can easily get confusing, a glance at a picture can easily remind scouts what robot they are dealing with.

2. Match Videos
   This is the most obvious and perhaps the most valuable part of Pre-Scouting. A search on Google with the criteria set to "videos" (http://www.google.com/videohp?hl=en) can find individual match videos quickly. In addition, if the past competition had a webcast, sometimes the webcast is archived online. Finally, some match videos are archived on The Blue Alliance.

When you are watching match videos, you will often record the same information that you will when watching matches at the actual competition. However, also take the time to take note of the robot's weaknesses: Maybe it takes a lot of time to acquire game pieces, maybe it takes a lot of time to score then, maybe it is bad at the end-game. Teams often fix weak points on the robot between competitions. Never rule out a team if they did poorly in a match video.

Although it is nowhere near as important than the objective information you can gather from watching videos of past matches, there are several other statistics that can point to how competitive a robot is. This will help if you want to gather a general idea of how well robots fared in prior competitions.

1. Achievements

    Along with rankings, a robot's prior achievements can help show how competitive it is. A robot that has won a regional is likely to possess either a superior robot or a superior strategy, both of which can be desirable when choosing robots to pick. A robot that is an early pick is most likely one of the most competitive robots in the regional. Of course, these achievements can also compound. Robots that are consistently early picked or the regional winner across multiple regionals are probably some of the best robots in the game. Keep in mind that if competing along with other competitive robots, a good robot is less likely to be picked early or win the regional.

2. Rankings

    This record can also be found on the Blue Alliance. As with the Win-Loss record and the Match Scores record, a high ranking often indicates a competitive robot.

3. Win-Loss Record

    This record can be found on both the FIRST Alliance and the Blue Alliance. It is a
    good indicator of how consistently a robot wins matches. However, keep in mind that some regionals have each robot play more matches than other regionals. Also, a good robot that competes in a competitive regional is more likely to have a worse record than than if it had competed in a less competitive regional.

4. Match Scores

    This record can be easily be found on the Blue Alliance. A robot with a consistently high match score is very likely to be a very good robot. Again, be careful - a match score could be high or low depending on the robot's alliance members, opponents, strategies, and of course chance.

5. OPR and DPR

    The FIRST Alliance features the Offensive Power Rating and the Defensive Power Rating of each robot after it has attended a competition. Although OPR will not tell you anything about a robot's strategy or design, most of the time, a high OPR indicates a competitive robot.

Pit Scouting

Point two is Pit Scouting. Pit Scouting is an optional exercise in which scouts go to the pits and ask other teams questions, most of which deal with their robot, but can also deal with their strategy as well. Scouts can also observe other robots and take notes. Some people do not like pit scouting as it provides no real information about what the robot actually can do on the field, but is left to the discretion of the scouts and the claims of the other teams. However, 3476 has found Pit Scouting to be quite beneficial - it allowed us to quickly eliminate robots from our picklist that were obviously did not work with our strategy.

There are many ways to do Pit Scouting. However, it is often the most effective if you consistently ask the same questions of each team. Because of this, a uniform Pit Scouting form for each team can be very useful. Here is an example of the form 3476 used at the 2012 World Championship:

Team Name:		Team Number:	
What have you changed since competition?			
Robot weight?:		Robot Orientation	
Question:		Yes	No
Autonomous			
Kinect (autonomous)			
Autonomous position?		1......2......3......4......5......6......NA	
Barrier			
Bridge Control			
Balance			
Game Play:		Offence	Defense
		Feeder	Other
Scoring	Top	Middle	Bottom
Notes (unique robot features)			

The first two spaces are for the team name and number. The third slot was a question that asked what they changed since their previous competitions, which allowed us to realize any fixes or improvements that were not visible in pre-scouting. The next two slots were robot weight and orientation ("long" or "wide") - two factors that were especially important in the 2012 game, as the end-game involved balancing robots on teeter-totters. The next three slots asked if the robot had an hybrid mode, had an hybrid mode that used the Kinect motion sensor, and

what the prefered starting position was. The following three slots asked if the robot could traverse the barrier in the center of the field, if the robot could push down a teeter-totter, and if the robot could balance on a teeter-totter. The next few slots were for the team's expected strategy and scoring location. The final section was for notes or unique robot features.

This simple sheet allowed us to tell a lot about a robot from only a few questions. We could immediately see if the team's hybrid mode would interfere with our hybrid mode, how well the robot could move across the field, and if its scoring would interfere with ours. However, the most important feature was the "notes" section, which allowed us to jot down or positive and negative thoughts on the robot.

Match Scouting

Point three is Match Scouting, which is the most important part of scouting. Simply put, scouts sit in the stands and watch other robots compete, taking down notes on how well the other robots compete tasks. However, it is very important that you collect data on as many robots competing in as many matches as possible. Neglecting to scout individual robots leaves "holes" in your data, and thus, your pick-list. Neglecting to scout the same robot in many matches does not tell you if they are consistent - a robot might perform poorly in the match that you watched them, but perform excellently for the rest of their matches.

What sort and how much data you record is up to your team. Keep in mind how many scouts can you devote, for how long, to Match Scouting. Some teams devote six students to every match, each student scouting one robot, and cycle students in and out to ensure that collect data for every robot for every match. If your team is too small to afford that luxury, you may have to consider less data to be recorded per match, so a single scout can handle multiple robots. Also, keep in mind that you only need to record data that will help you strategize.

That said, there are some guidelines for what sort of data to record. First of all, what does the robot do? Does it score or play defense, or play another role? If it scores, where does it score? If it plays defense, what part of the field does it defend? Secondly, how quickly or effectively does the robot perform these actions? How quickly can it acquire and score game pieces, or how many game pieces does it score per match? Does it play defense effectively? Thirdly, is there anything unique about the robot or its strategy? Does it score from an unusual location? Does it fall apart in the middle of the match? Does it have trouble moving? Does it score through defense? Does it really excel at the end-game?

Most teams that practice Match Scouting use sheets of paper to record data, and this is the method that 3476 used at the 2012 World Championship We dedicated one sheet of paper to each robot, on which there were six identical forms, each of which were for one match. This way, we could easily compare each robot's performance across several matches. Below is an example of a single match form for a single robot.

Match #.			Alliance score		
Baskets Scored:	3		2		1
Robot type:	Offence		Defence		
	Feeder		Other		
Scores from:	*Top of key*		*Fender*		
Category	**Yes**		**No**		
Autonomous					
Kinect (hybrid)					
Barrier					
Bridge control					
Balance (1,2,3)					
	Total	Tech	Red	Yellow	
Fouls					
Defense	3	2	1		
Comments:					

As you can see, the data is somewhat similar to the Pit Scouting data - but this time, we check to see if the robot can actually perform the functions that the team claims they can. Also notice that there are spaces for in which goal the robot would score - we would place a tally mark for each goal the robot scored. Again, notice the "comments" section.

Match Strategy

Point Four is Match Strategy, an optional exercise. Most drive teams, when queing for a match, talk strategy with their alliance partners in the que. However, it can be beneficial if the drive team knows beforehand the strenghts and weaknesses of both their alliance partners and their opponents. Scouting data can be perfect for this.

There are several steps to Match Strategy. First, you must collect your data (Pre-Scouting, Pit Scouting and Match Scouting) for both your alliance partners and your opponents for the upcoming match. Secondly, you must relay this information to your drive team and the drive teams of your alliance partners. Oftentimes, the best way to do this is in person. You may be able to meet with both your drive team and the drive teams of your alliance partners at the same time, allowing you to share your information easily or even combine scouting information from the other teams. If meeting in person does not prove feasible, communicate with your drive team another way, such as a phone call or text message. At the World Championship, Code Orange wrote a data summary and proposed strategy for each of the other teams on a piece of paper and sent it to the drive team.

There are several things that you will want to consider when developing a match strategy. First of all, focus on the capabilities of you and your alliance partners. If one alliance partner can score much more effectively than the others, develop a strategy to capitalize on that. It may be feeding game pieces to them or ensuring that opposing robots do not interfere. If it is decided that more than one alliance partner should score, develop a strategy to ensure that multiple teams will not go for the same pieces or the same scoring location at the same time. Secondly, realize the weaknesses of you and your alliance partners. If your scouting data tells you that an alliance partner is an ineffective scorer, suggest that they play another role. If you realize that you do not perform well on an an aspect of the game, ask your alliance partners to do it instead.

Thirdly, make sure you know the strengths of your opponents. If they are very effective scorers, it may be worth devoting an alliance member to defense. If they play very good defense, factor that into your strategy. If they have a special function or feature that may inhibit you or benefit them greatly, make sure to strategize around that. Fourthly, capitalize on your opponent's weaknesses. If they can only score from one location, see if it is possible to cover that area with defense. If only only one or two members can perform a vital task, see if you can inhibit those robots from doing so and thus cripple the alliance.

Pick-List Formation

The final point is point five, Pick-List Formation. This is the process in which you gather all of your team's Pre-Scouting and Match Scouting information and combine it with personal observations and experiences to make a list of teams that you would want to pick during alliance selections, in descending order of preference. This process generally occurs the night before the final day of the Competition. At its very most basic, it includes the scouts, but often also includes the drivers and possibly the rest of the team.

When forming your Pick-List, be sure to include at least 23 teams. This is because there will be 24 total teams playing in the elimination rounds: eight alliances of three teams each. However, it is always a good idea to include more that 23.

The key point of Pick-List Formation is to come up with a list of robots that would complement your robot. Do not give special preference to a robot that appears to be dominant just because it appears to be dominant. Consider whether or not this dominant robot would work well with your robot. Also, do not disregard apparently weaker robots because they might complement your strategy perfectly.

In this mindset, consider what type of robots you are looking for. Obviously, the point of eliminations matches is to outscore the opposing alliance. What other robots would most help your robot outscore other alliances? Say your robot scores points in a certain fashion. What other robots would help your robot score the most points, without interfering with your scoring to the point that the advantage is negated? Say you expect to play against other high-scoring alliances. What other robots would best help you interfere with their scoring?

With that said, build your pick-list strategically. If you want to pick an offensive robot and a defensive robot, you may want to consider building multiple pick-lists for the different categories. If you want to pick only offensive or only defensive robots, there is no reason to list the other category on your list.

Especially if you are attending a large competition, the amount of information you have might seem overwhelming. One of the easiest ways to "cut it down" is to form a "Do Not Pick" list. On this list, gather robots that you have decided that you do not want to work with. First, eliminate robots that consistently do not move or do not show up to their matches. Then, eliminate robots that lack any functions that would benefit your strategy (For example, if you want to pick two offensive robots, eliminate any robots that do not have a scoring mechanism).

Next, start listing robots that you would like to pick in order of preference. Whenever you add a robot, ensure that you ask all present for input. Oftentimes, scouts or drivers will have personal experiences or observations about other robots that can help in ranking other robots. Most of the time, the first few robots will come rather easily. Following robots will take more thought. Of course, factor in common sense - the best robots will be taken early on in selections, so make sure you list these robots first. Robots that are less likely to be picked early should be listed down lower (for example, a dominant scoring robot will normally be picked earlier than a robot that will play defense).

Also consider what other alliance captains might do. If you suspect that a captain will pick a team and employ a strong strategy with them, it might be in your interest to "break up" that alliance if possible by picking one of those teams first. Remember, if a team declines a request, they cannot accept any other requests. If you suspect or know that a higher-ranked team will pick you, be absolutely sure not to decline the request unless you are in the top eight or suspect that one or more of the other alliance captains will pick each other, allowing you to move into the top eight. If you are in such a position, be sure to discuss which requests you would accept and which you would decline.

During the final day of competition, you may want to modify your pick-list depending on how well robots are performing, or if you find a robot on your list has broken down. However, be sure to have your pick-list finalized well before the end of Qualification matches - at that

point, only modify it if a robot on your pick-list is obviously broken or another robot suddenly starts to perform amazingly well.

During alliance selections, your team representative (which should be your head scout) should cross off teams on the Pick-List as they are chosen. If you are picked by another team, the representative should share their scouting information with the other alliance captain and make suggestions as to their second pick. This is one of the reasons why scouting information is so vital to have for all teams, as demonstrated in the following anecdote.

So, does it work?

At the beginning of our first and only competition in 2012, we entered the area eager to show off our new robot. We were also eager to employ our scouting strategy for the first time. As the competition progressed, our robot performed admirably, and it was realized by the end of the second day that we were among the best at the competition at a specific portion of the game.

That night, we had our scouting meeting. We quickly eliminated teams that had no advantageous mechanisms or those that did not show up to matches, and with some difficulty, managed to assemble our pick-list.

The third day began and it immediately became obvious that several high-ranked teams wanted to pick us. Our scouting team was approached by two teams in the stands and similar requests occurred in the pits. By the time qualification matches were drawing to a close, we were ranked just below the top 8.

The top few teams all shared a few common characteristics: They all had good records and were good at the end-game. However, none of the top three excelled at the same portion of the game that our robot did. We realized that we could not decline an offer from any of these teams, as we would very likely not move into a picking position.

Before alliance selections, we were frantically looking for teams that would complement ours: Teams that could score with a different goal than us and then do the end game. Right before alliance selections, we rearranged our picks, giving higher priority to these teams. We were still arranging our picks as they were assembling alliance captains on the field. Our representative rushed down with seconds to spare.

We were the first pick of the entire draft, by team #4161, a rookie team. As selections wore on, both representatives soon agreed that team #3255 would be the perfect match for our alliance - if they lasted to be the last pick of the draft. They did, and our alliance was rounded out by the third-year team. And thus was built the "1-2-3" alliance with a total of only 6 years of experience.

Our strategy and amazing steal of 3255 proved to be the perfect match in the eliminations. At the start of the match, 3255 would score and then go participate in the end game with 4161, leaving the field open for us to score all match long. We proved to be extremely consistent throughout the eliminations, attaining the same score in both finals matches. We won the regional.

So what does this story go on to prove? It shows that just because you might be a rookie team, you may suddenly be thrown into a picking position, or even the #1 seed. So scouting is necessary! It shows that even if you are a second year team, you might just be the first pick of an alliance captain who needs your data. So scouting is required! It shows that if you strategize properly, you can pick up a perfect complement for you alliance. So what are you waiting for? If your team doesn't have a scouting team in operation, start one. It might just be the best decision you'll ever make in FRC.