Scouting For The Win

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Agenda

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- What Is Scouting in FRC?
- Why Do Scouting?
- Good and Bad Scouting Practices
- Phases of Scouting at FRC Events
- Demo: Team 254's Scouting System
- Q&A

About Me

- 2001-2006: Team 296
  - Montreal, Quebec, Canada
  - 2006 Championship Winner
- 2007-2011: Teams 1503 and 1114
  - Niagara Falls, Ontario, Canada
  - Multiple regional wins and Einstein appearances
- 2012-present: Team 254
  - Role: Scouting, manufacturing, software, admin

What Is Scouting?

- Gathering information about robots and teams at an FRC event
- Using that information to make strategic decisions at both the match and tournament levels

Why Do Scouting?

1. Know the capabilities of your partners and opponents and plan match strategy accordingly

2. Take the upper hand in match strategy discussions

3. Form the best possible eliminations alliance

Why Do Scouting?

What if you don't do scouting?

- You might get lucky and still do well
  – E.g. 296 at the 2006 Championship
- You'll probably just lose to teams who did scout properly, though
  – E.g. 296 at the 2006 Granite State Regional

Bad Reasons

- Because you have a bunch of people with nothing else to do
- Because other teams do it
- Because you think scouting will magically make your team more successful

These lead to what I like to call…

Cargo Cult Scouting

"An attempt to recreate successful outcomes by replicating circumstances associated with those outcomes."

Cargo Cult Scouting

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- A misunderstanding of cause and effect
- Practiced by many teams
- Teams do pit and match scouting, but don't benefit from it
  - Data is bad quality
  - Teams don't know how to use it

Cargo Cult Scouting

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How to spot it:

- Fancy iPad or Android apps ("86% fast")
- Freshmen or other inexperienced people doing pit scouting
- Long lists of pit scouting questions
- Students running the scouting team are not respected or are doing so in isolation of the "important" parts of the team

How To Scout

Decide what outcome you want, determine what data metrics you need, and figure out how to collect them.

Good data metrics:

- Are objective

- Are easy to determine

- Correlate well with robot success

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How To Scout

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What data does Team 254 need?

- Relative ranking of robots, divided by function

- Reliability of a given team

- Team idiosyncrasies
  - E.g. Starting positions, autonomous modes, scoring positions
  - Knowledge that will allow us to work together better as partners, or defeat them as opponents

Phases of Scouting

- Pre-event scouting
- Pit scouting
- Qualification match scouting
- Picklist meeting
- Pre-alliance-selection strategy
- Alliance selection
- Elimination match scouting

Pre-Event Scouting

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Should you scout *before* getting to your event?

Yes, if:

- There is current season data available about the teams

- There are too many teams to learn about in just two days

- You need to test out your scouting system

Pre-Event Scouting

- Don't worry too much about performance
  - It often doesn't carry over
- Focus on familiarizing yourself with the teams, their names, where they're from, what their robots look like
  - A lot of good strategy comes down to memory and judgment calls
- Note rookies and teams from abroad

Pit Scouting

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Visit each and every team's pit on practice day

Good:

- Familiarizing yourself with the robots
- Noting drivetrain characteristics
- Assessing overall reliability and quality

Bad:

- Asking about features or effectiveness
- Anything you can learn by watching a match

Pit Scouting

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Take a photo of the robot as a memory aid for later

- Clear, without people
- With the team number in the frame
- As close to final/field configuration as possible
- Consistent orientation (portrait/landscape)

Pit Scouting

Take note only of what you can't tell by watching them in a match

- Don't ask about speed, scoring capability, or autonomous modes

- Drivetrain type
  - Wheel type and quantity
  - Number of motors

- Overall robustness and quality of construction
  - Quantify if possible

Team	P?	DT	W/L	Wheels	Motors	Notes
27						
51						
58						
78						
85						
116						
120						
178						
192						
207						
233						
244						
254						
279						
288						
293						
341						
415						
433						
461						
503						
525						
537						

Pit Scouting

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Qualitative stuff:

- Check that they know what they're doing
  - Pit organization, batteries
- Make sure that you can communicate
  - E.g. San Diego 2011

Feel free to chat, but take everything they say with a grain of salt.

Match Scouting

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Watch all qualification matches and collect data on each team

- Quantitative data
  - Objective statistics (like in sports)
- Qualitative data
  - Observations about characteristics or behavior

The goal is to both become familiar with the teams and to generate metrics to rank them

Match Scouting

Quantitative

- One person watches each robot and records what it does during the match
- Example – 2014 metrics:
  - Starting position (left/middle/right)
  - Autonomous (score/miss, high/low, hot/cold)
  - How the robot participated in each cycle
  - Fouls, breakdowns

Match Scouting

Qualitative

- Take notes on:
  - How skilled the driver is
  - 2014: inbounder potential
  - Good/Mediocre/Bad is good enough
- Note any idiosyncrasies
  - E.g. Team 3683 has to lower an appendage before they can shoot
- Note abnormal occurrences

Data Analysis

- Defining all those metrics and taking those observations is a great start, but now what?
- You now have a few sheets of scouting data and hundreds of sheets of match data
- By itself, the data is almost useless – hard to get the big picture of how teams compare
- Need to collect, aggregate and present the data in a way that leads to sorting teams

Data Collection

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Four requirements for scouting data collection:

1. Must not rely on an internet connection
2. Data collection uptime must be 100%
   Corollary: Can't depend on powered devices
   Corollary: Data collection needs to be easy

Data Collection

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Four requirements for data collection:

3. Data entry can lag collection, but statistics should be available throughout the day
4. Data entry needs to be 100% accurate

Data Collection

Example data collection mechanisms:
- 842's Wiimote-based system
- 987's Google Docs-based system
- 1503's computer keyboard-based system
- 1114's paper-based system
- Audience: any other examples?
- 254's paper/scanner hybrid system

254's System

- Paper-based: one sheet per robot per match
- Binder for sheets for each position ("Red 1")
- Metrics are tallied then bubbled in
- Sheets are scanned in batches after matches
- Web app aggregates and displays statistics
- Meets the four requirements
- Robust to unforeseen issues
  - E.g. 2013 Championship

254 — 2014 Scouting Sheet

Match: 58   Position: Blue 2

Team: 254

[0]	1	2	3	4	5	6	7	8	9	x1000 +
0	1	[2]	3	4	5	6	7	8	9	x100 +
0	1	2	3	4	[5]	6	7	8	9	x10 +
0	1	2	3	[4]	5	6	7	8	9	x1

Scout: Matt

Starting position or no-show: L   [C]   R   GZ   NS

Auto moving bonus: [Y]   Auto blocked shots as goalie: Y

Auto high scored hot: [1] 2 3   Auto low scored hot: 1 2 3

Auto high scored cold: 1 2 3   Auto low scored cold: 1 2 3

Auto missed: [1] 2 3

IH: Inbounded from human, P: Picked up from floor or robot, TH: Truss shot to human, T: Truss shot
C: Caught over truss, M: Missed shot, M2: Missed 2 or more, SH: Scored high, SL: Scored low

Ball 1 actions: IH   [P]   TH   T   C   M   M2   [SH]   SL

Ball 2 actions: IH   [P]   TH   T   C   M   M2   [SH]   SL

Ball 3 actions: IH   [P]   TH   T   C   M   M2   [SH]   SL

Ball 4 actions: IH   [P]   TH   T   C   M   M2   [SH]   SL

Ball 5 actions: IH   [P]   TH   T   C   M   M2   [SH]   SL

Ball 6 actions: IH   P   TH   [T]   C   M   M2   SH   SL

Ball 7 actions: IH   P   TH   T   C   M   M2   SH   SL

Fouls: 1   2   3   4   5   6   7   8   9

Broke Down: Y   Fell Over: Y

Picklist Meeting

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- Every team should do this, no matter where they are currently ranked
- Friday night after dinner
- Should take 2-3 hours if done right
- Discuss
  - Desired partners for alliance selection
  - Strategy for making elimination rounds
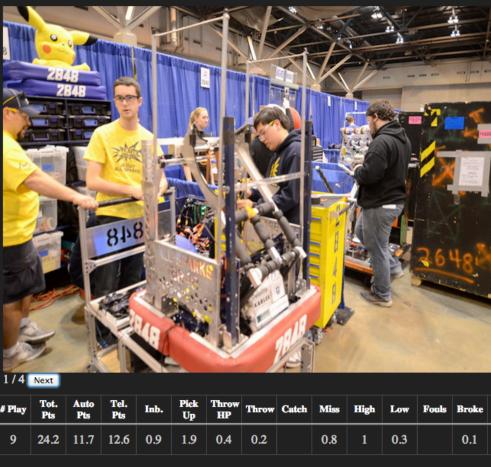 - Strategy for remaining qualification matches

Picklist Meeting

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Who should attend?

- Scouts

- Drive team

- Strategy team

- Anyone who has watched a lot of matches and has an opinion

- New members

Picklist Meeting

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- Set ground rules, get silliness out of the way
- Examine all teams, individually and ranked by aggregate metrics
  - Average points per match is usually good, correlates with OPR but is more accurate
  - Look at top/bottom in each relevant category
    - E.g. accuracy, autonomous, fouls, "end game"

1 / 4 [Next]

Drivetrain rating (0-10): 8
Drivetrain description:
6 Kit; 6 CIMs
Driver rating: ○ Bad ○ Mediocre ● Good
Inbound capability: ○ None ○ Bad ○ Mediocre ● Good
[Save]

[Add comment]

# Play	Tot. Pts	Auto Pts	Tel. Pts	Inb.	Pick Up	Throw HP	Throw	Catch	Miss	High	Low	Fouls	Broke	No Show	Num Cyc.	Tot. OPR	Auto OPR	Tel. OPR	Foul OPR	Ass. Pt.
9	24.2	11.7	12.6	0.9	1.9	0.4	0.2		0.8	1	0.3		0.1		2.8	49.3	12.1	37.2	0.8	38

Match id	Position	Start position	Fouls	Broke	Fell over	No show	Auto moved	Auto blocked	Auto low hot	Auto low cold	Auto high hot	Auto high cold	Auto missed	Num cycles	Inbounded	Picked up	Threw human	Threw	Caught	Missed	Scored high	Scored low	Exclude
1	2	R					1						1	3		3		2					☐
25	5	L					1						1	3	1	2	1				1		☐
40	6	L					1						1	4		4				2	1	1	☐
52	4	L					1					1	1	1		1				2	1		☐
75	3	R					1				1			3	1	2					3		☐
84	2	R					1					1		4	2	2				1	3		☐
105	5	C					1					1	1	3		3				2		2	☐
126	2	L		1			1							1	1								☐
147	6	C					1						1	3	3		3						☐

Rank	Team	# Play	Tot. Pts	Auto Pts	Tel. Pts	Inb.	Pick Up	Throw HP	Throw	Catch	Miss	High	Low	Fouls	Broke	No Show	Num Cyc.	DT	Dr.	Inb.	Tot. OPR	Auto OPR	Tel. OPR	Foul OPR	Ass. Pt.
1	254	9	86.8	42.2	44.6	0.2	4.2		0.7		0.2	3.8	0.1				4.6	11	G	G	125.9	21.7	104.2	13.6	106
2	2451	9	60.8	27.2	33.6	1.2	2.3	0.2	0.4		0.4	2.9	0.2				3.9	9	G		86.0	24.7	61.2	17.5	52
3	624	9	60.2	38.9	21.3	1.7	1.7				0.2	2.1	0.2				3.4	10	G	G	163.0	39	124.0	-7.8	108
4	180	9	58.6	25	33.6	1	3				1	3.3	0.2				3.9	9	G	G	57.6	21.7	36.0	-4.5	54
5	359	9	52.9	23.9	29	1	1.9		0.6		0.1	2.3	0.1				3	9	G		57.0	20.3	36.7	-14.2	38
6	3476	9	50.1	22.2	27.9	1.2	1.8				0.8	2.8	0.1				3.4	9	M	G	83.7	10.5	73.1	-10.1	80
7	118	9	49.2	31.1	18.1	0.7	2.2	0.2	0.2		0.3	1.6	0.3		0.1		2.9	10	G	G	62.3	29.4	32.9	-7.2	52
8	2468	9	47.4	21.7	25.8	1.1	2.3	0.3	0.6		0.6	2	0.2	0.1			3.6	9	G		77.7	21.2	56.5	8.3	47
9	1718	9	46.6	25	21.6	0.8	3.1	0.6			1	2.1	0.4				3.9	9	G		74.7	12.7	62.0	-15.2	77
10	125	9	46.3	26.1	20.2	0.7	2.1		0.3		0.8	1.7	0.2		0.1		2.8	9	G	G	41.1	24.5	16.6	-7.9	50
11	177	9	44	23.4	20.6	1.2	1.8	0.1		0.1	0.3	1.9	0.6		0.1		3.2	6	G		35.9	13.4	22.5	1.2	26
12	135	9	43.3	17.8	25.6	2	1.4	0.2	1.6			1					3.6	8	G	G	63.9	17.2	46.7	-13.4	52
13	469	9	42.9	20.6	22.3	0.9	2.2	0.3	0.6		0.6	1.7	0.1				3.1	10	G	G	72.7	20.1	52.5	15.9	50
14	1311	9	42.9	25.6	17.3	0.8	2.1		0.2		0.7	1.4	0.7				2.9	5	M		50.4	20.2	30.2	0.1	26
15	1629	9	41.6	24.4	17.1	0.8	1.9	0.3	0.9		0.4	0.8	0.4				2.8	5	M	G	70.2	31.2	39.0	-16.1	62
16	230	9	40.1	21.7	18.4	1.1	1.4		0.9		0.7	0.9	0.7	0.1			2.6	7	M		69.5	24.2	45.3	1.8	38
17	4522	9	39	24.4	14.6	1	1.8	0.8	0.8		0.3	0.7	0.1				2.9	5	M		30.9	10.7	20.1	-4.2	54
18	842	9	37.8	20	17.8	0.9	2.1	1.4	0.2		0.8	1.6					3.1	8	M	M	40.6	16.4	24.2	-0.6	52
19	294	9	37.2	24.4	12.8	1	2.4	0.7	0.3		0.3	0.9	0.6				3.3	9	G	G	32.5	20.2	12.3	13.4	58
20	987	9	37	24.4	12.6	0.6	2.8	1.1	0.3		0.9	0.9	0.3				3.1	10	G	G	73.2	28.7	44.5	19.4	62
21	2478	9	36.9	18.3	18.6	1.8	1.6	0.7	1.2		0.7	0.6	0.8				3.3	9	B	G	56.2	12.9	43.3	-5.3	25
22	1323	9	36.6	22.2	14.3	0.4	2.7	0.7	0.8		0.2	0.6	1				3	10	G		49.5	20.3	29.2	-5.5	42
23	236	9	35.9	18.9	17	0.7	2.1		0.3		0.3	1.3	0.3		0.2		2.7	8	G		75.2	13.1	62.1	8.8	44
24	4334	9	35.8	22.2	13.6	0.7	1.7		0.1		0.7	1.2	0.2		0.2		2.7	8	G		53.1	18.2	35.0	-18.7	46

Picklist Meeting

- 2014 was a difficult year for objective scouting
  - Same robots would do different things in different matches, or that didn't earn points
    - E.g. 1678 at the Championship
  - Focus on the kind of robot that complements your team well, and shut out the rest
    - Scoring vs. inbounding

Picklist Meeting

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How to make a picklist:

- Start with the best teams at the event
- Take 2-5 who belong in the same tier
- Discuss them, rank them relative to each other, add them to the end of the picklist
- If you really have to, watch match video
- Repeat until you have 23 teams (31 at CMP)

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Match Video

Good or bad idea?

- Bad to watch too much of it – kills time like nothing else
- Good if you really need to see a robot or two, but only useful if
  - All matches are captured
  - Video is trimmed to matches
  - Easy to tell what match it is

Picklist Meeting

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Should you have a "blacklist"?

I say yes:

- Teams with whom you can't communicate
- Teams who don't have their act together
- Teams that you had difficulty working with in qualifications
- If you're not the captain, you want to have an actual list to advise them against picking

Alliance Selection

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As the last round of qual matches winds up:

- Watch the rankings carefully
- Try to predict the top seeds and picks
- If you are #1 seed or the likely first pick, you have a significant time advantage – use it!
  - Compare and merge picklists and blacklists with your prospective partner
- Collect more data (e.g. CMP 2014 auditions)

Alliance Selection

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Aside on Team 254 alliance selection philosophy:

- Team representative has a tough job
  - Decide who to pick off a list
  - Decide whether to accept or decline
  - Keep track of teams already selected
  - Merge picklists with allied teams
  - Remember what they're supposed to say
  - Pronounce team number and name correctly
  - All under the scrutiny of thousands of people

Alliance Selection

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- The success of the team at the tournament comes down to this moment and how well a student holds up to pressure (e.g. FLR 2009)
- Either find a student equal to that task, or
- Offload the decision-making/tracking to an off-field team
- Use a whiteboard to communicate decisions
- It's not necessarily a student vs. mentor thing

Eliminations

- Understand how the bracket plays out and scout one series ahead
- Look for your opponents' strategies and idiosyncrasies
- Watch your own alliance for inefficiencies
- E.g. 2014
  - Time cycles and list what happened in each one

Takeaways

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- Scouting is important and wins tournaments
- Scouting should be an integral part of the team and have broad participation
  - Have a passionate/influential student or mentor lead
- Don't engage in "cargo cult scouting"
  - Don't blindly copy someone else's scouting system, thinking it will work perfectly for your team
  - Figure out what data you want, how you would use it, and work backwards from there
- Iterate from year to year