Known Unknowns
Scouting to Win

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- Who is Oliver?
- Who is Shankar?

- Welcome!

- Housekeeping
  - Documents will be made available online at http://2056.ca/conference/
  - We will briefly touch on data analysis and pick lists, see our 2016 presentation materials for more on that
  - Question periods between sections

- Brief overview of the entire scouting process
- Last year's presentation is not meant to be a prerequisite, but we go into much more detail there (http://2056.ca/conference/)

- Right information ← right spreadsheet ← right scouting sheet
- "To find the answer, you must know the answer"
  - **Hypothesise** how the game plays out
  - What do you need to know to make the right pick
- Generally, the sheet governs the spreadsheet
- Sheet design → Spreadsheet design
- Good sheet → Good spreadsheet → Good decision → **Good results**

- Track every point-scoring action by every team
  - Measure a robot's actual ability to make point-scoring actions
    - Make **data-driven decisions** based on proven abilities

2056 Scouting Sheet 2017: FIRST Steamworks

Match: _____ Team: _____ Scout Initials: _____

Autonomous	**Tele-operated**	**Endgame**
Baseline Cross: 0 1		Climb: N/A 0 1
Gears: N/A 0 1 2	Gears: _____	Comments
Fuel High: _____	Fuel High: _____	
Fuel Low: _____	Fuel Low: _____	

- Establishes robot archetypes
- Individual scout tracking – accountability and commendation
- Qualitative comments

2056 Scouting Sheet 2017: FIRST Steamworks

Match: 56 Team: 1241 Scout Initials: SM

Autonomous

Baseline Cross: 0 (1)

Gears: N/A 0 (1) 2

Fuel High: 0

Fuel Low: 0

Tele-operated

Gears: 5

Fuel High: 0

Fuel Low: 0

Endgame

Climb: N/A 0 (1)

Comments

They hold the auto gear up high

What the spreadsheet tells us:

- Sort by all gears scored (weight auto and tele-op evenly)

	Auto cross points	Auto gears scored	Average climb points	Teleop gears scored	All gears scored	All points scored
Team	A-BC	A-GE	E-RPS	T-GE	C-GE	C-TPS
1241	1.0	0.8	50.0	4.5	5.3	128.3
494	0.9	0.3	40.0	4.8	5.1	119.7
2169	1.0	0.8	45.0	4.3	5.1	118.0
234	1.0	0.7	40.0	4.3	5.0	112.0
384	0.9	0.5	36.4	4.4	4.8	105.5
4039	0.9	0.5	45.0	4.3	4.8	114.9
4272	1.0	0.8	45.0	4.0	4.8	114.0
3929	0.8	0.4	40.0	4.3	4.7	106.7
230	0.9	1.0	45.0	3.7	4.7	116.2
4917	1.0	0.6	50.0	4.1	4.7	122.4
2609	1.0	0.5	45.0	4.0	4.5	110.1
3875	1.0	0.9	40.0	3.6	4.5	105.0

What the spreadsheet tells us:

- What about if we look at all points scored?

	Auto cross points	Auto gears scored	Average climb points	Teleop gears scored	All gears scored	All points scored
Team	A-BC	A-GE	E-RPS	T-GE	C-GE	C-TPS
2056	0.8	0.2	40.0	2.9	3.1	139.7
1241	1.0	0.8	50.0	4.5	5.3	128.3
2481	0.8	-	50.0	3.2	3.2	125.2
4917	1.0	0.6	50.0	4.1	4.7	122.4
494	0.9	0.3	40.0	4.8	5.1	119.7
2169	1.0	0.8	45.0	4.3	5.1	118.0
230	0.9	1.0	45.0	3.7	4.7	116.2
4039	0.9	0.5	45.0	4.3	4.8	114.9
71	1.0	0.6	50.0	3.7	4.3	114.3
4272	1.0	0.8	45.0	4.0	4.8	114.0
234	1.0	0.7	40.0	4.3	5.0	112.0

- Good sheet → good spreadsheet → good decision → **good results**

- What makes a good scouting sheet?
  - Capture every relevant difference between robots
  - Every piece of information needed to plan for and against robots
- Therefore ask: "**What will I want to know this year?**"
  - NOT "What can I scout this year?"
  - NOT "What can robots do this year?"

- As with robot design, **strategy must determine implementation** and not the other way around
- The scouting sheet is the foundation of good scouting

- What can I scout this year?

Year	Team	GP	GS	MPG	FG%	3P%	FT%	RPG	APG	SPG	BPG	PPG
2014–15	Minnesota	**82**	**82**	36.2	.437	.310	.760	**4.6**	2.1	**1.0**	**.6**	16.9
2015–16	Minnesota	81	81	35.1	**.459**	.300	**.761**	3.6	2.0	**1.0**	**.6**	20.7
2016–17	Minnesota	**82**	**82**	**37.2**	.452	**.356**	.760	4.0	**2.3**	**1.0**	.4	**23.6**
Career		245	245	36.2	.450	.329	.760	4.1	2.1	1.0	.5	20.4

- What will I want to know this year?

Per Game

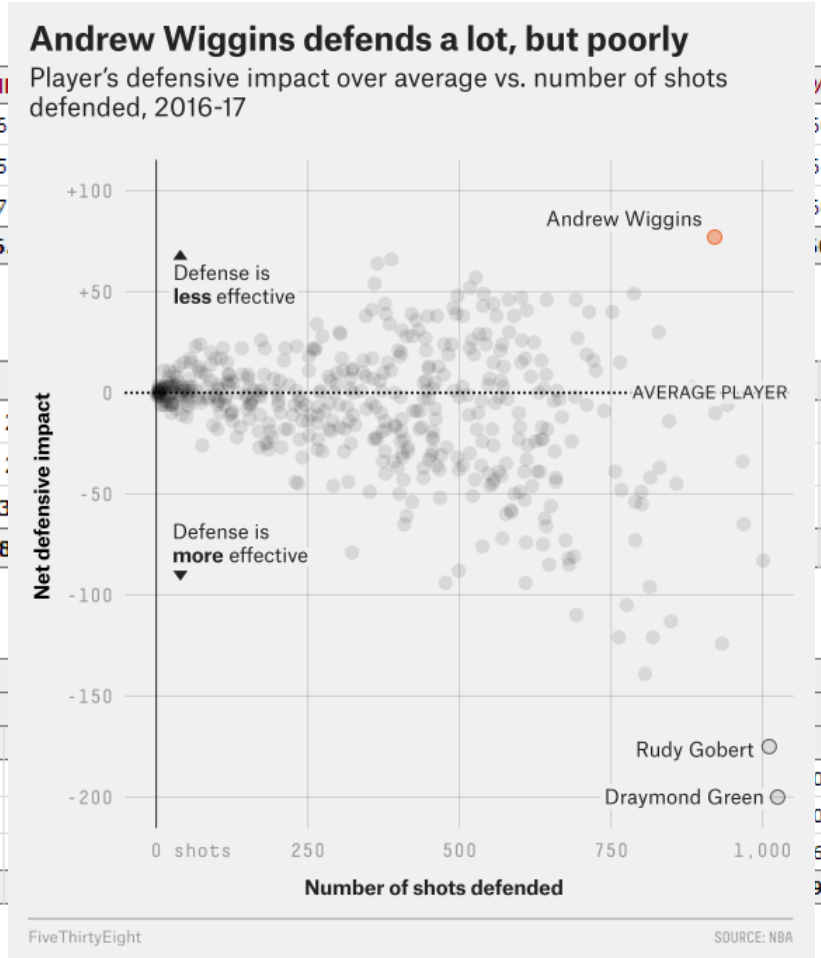
Season	Age	Tm	Lg	Pos	G	GS	MI	%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS
2014-15	19	MIN	NBA	SF	82	82	36	50	1.6	2.9	4.6	2.1	1.0	0.6	2.2	2.3	16.9
2015-16	20	MIN	NBA	SF	81	81	35	51	1.3	2.3	3.6	2.0	1.0	0.6	2.2	2.0	20.7
2016-17	21	MIN	NBA	SF	**82**	82	37	50	1.2	2.8	4.0	2.3	1.0	0.4	2.3	2.2	23.6
Career			**NBA**		**245**	**245**	**36**	**50**	**1.4**	**2.7**	**4.1**	**2.1**	**1.0**	**0.5**	**2.2**	**2.2**	**20.4**

Per 36 Minutes

Season	Age	Tm	Lg	Pos	G	GS		ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS
2014-15	19	MIN	NBA	SF	82	82		1.6	2.9	4.5	2.1	1.0	0.6	2.1	2.3	16.8
2015-16	20	MIN	NBA	SF	81	81		1.3	2.4	3.7	2.1	1.0	0.6	2.3	2.1	21.2
2016-17	21	MIN	NBA	SF	**82**	82	3	1.2	2.7	3.9	2.2	1.0	0.4	2.2	2.2	22.8
Career			**NBA**		**245**	**245**	**8**	**1.4**	**2.6**	**4.0**	**2.1**	**1.0**	**0.5**	**2.2**	**2.2**	**20.3**

Shooting

								2-Pt Field Goals			3-Pt Field Goals				
									Dunks			Corner		Heaves	
Season	Age	Tm	Lg	Pos	G	MP	FG%		%Ast'd	%FGA	Md.	%Ast'd	%3PA	3P%	Att.	Md.
2014-15	19	MIN	NBA	SF	82	2969	.437	0	.489	.077	79	.872	.246	.419	1	0
2015-16	20	MIN	NBA	SF	81	2845	.459	0	.510	.070	84	.825	.158	.400	1	0
2016-17	21	MIN	NBA	SF	**82**	**3048**	.452	6	.414	.052	77	.757	.104	.367	1	0
Career			**NBA**		**245**	**8862**	**.450**	**9**	**.468**	**.065**	**240**	**.799**	**.150**	**.396**	**3**	**0**



- Golden Principles of Scouting
  - Where did every point come from?
  - Where did every missed point go?

- Where did every point come from?
  - What actions were done to directly score points?
    - Score fuel
    - Cross a defence
    - Create a stack
    - Truss a ball
  - What did robots do that enabled points to be scored?
    - Gear/fuel/boulder/tote/ball acquisition
    - Ferrying boulders to your courtyard for alliance partners
    - Putting litter in recycling containers
    - Can burgling
    - Inbounding/assisting balls (2014)
  - **Where** did they come from?
    - Gear/fuel/boulder/tote/trackball acquisition location
    - Auto gear scoring location
    - Boulder scoring location in the courtyard
    - Burgling position

- Where did every missed point go?
  - Stopping your opponents from scoring points
    - Stealing dropped gears from opponents' retrieval zone
    - Dumping fuel from hoppers
    - Blocking boulder shots
    - Stealing boulders from opponents' secret passageway
    - Can burgling
    - Blocking balls in autonomous mode with a "goalie pole"

- Where did every missed point go?
  - Stopping <u>yourself</u> from scoring points
    - Dropping gears/boulders/totes/balls
    - Missing shots
    - Knocking over tote stacks
    - Missing truss shots

- Where did every missed point go?
  - What actions **could have** scored points (but score no points through no fault of your own)?
    - Crossing weakened defences, stacks other robots knocked over, assists without scoring
    - Actions that might not show up on the scoreboard
    - Also includes point-scoring potential that was not shown because strategic choices were made
      - Accounts for variance, NOT simply untapped potential
      - BIG in 2017
    - With an organized alliance, these potential points can be converted to actual points

Case Study: FIRST Steamworks

- Where did every point come from?
  - What actions were done to directly score points?
    - Mobility
    - Placing gears
    - Scoring fuel
    - Climbing
  - What did robots do that enabled them to score points?
    - Gear intake
    - Fuel intake
    - Could have had ferrying gears for partners (this was very rare)
  - **Where** did they come from?
    - Auto gear location
      - Not every robot could score on every peg in auto; most robots could score on every peg in tele-op
    - Gear/fuel intake and scoring location
      - Relevant but would have added excessive complexity

- Where did every missed point go?
  - Stopping your opponents from scoring points
    - “Defence“
    - Causing opponents to drop gears/miss shots
  - Stopping yourself from scoring points
    - Dropping gears
    - Missing climbs
    - Scoring fuel when other tasks could have been done
    - Preparing to climb very early
  - Actions that **could have** scored points (but score no points through no fault of your own)
    - Stopping gear cycling after 3 or 4 rotors
    - This requires imagining how qualification **and** elimination matches will be played

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
4. Gear acquisition count
5. Mobility
6. Fuel scoring
7. “Defence”
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
4. Gear acquisition count
5. Mobility

Very easy!

6. Fuel scoring
7. “Defence”
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
4. Gear acquisition count
5. Mobility
6. Fuel scoring } **Quite easy!**
7. "Defence"
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

Make a priority list!

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9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

Very difficult!

Brainstorm solutions with your team. Be creative! This is FIRST!

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
4. Gear acquisition count
5. Mobility
6. Fuel scoring
7. "Defence"
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

Omitted because it would have added too much complexity to the system we chose

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
4. Gear acquisition count
5. Mobility
6. Fuel scoring
7. "Defence"
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location } **Easy!**
13. Fuel intake location
14. Fuel acquisition count

Make a priority list!

1. Placing gears
2. Climbing and missing climbs
3. Dropping gears
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6. Fuel scoring
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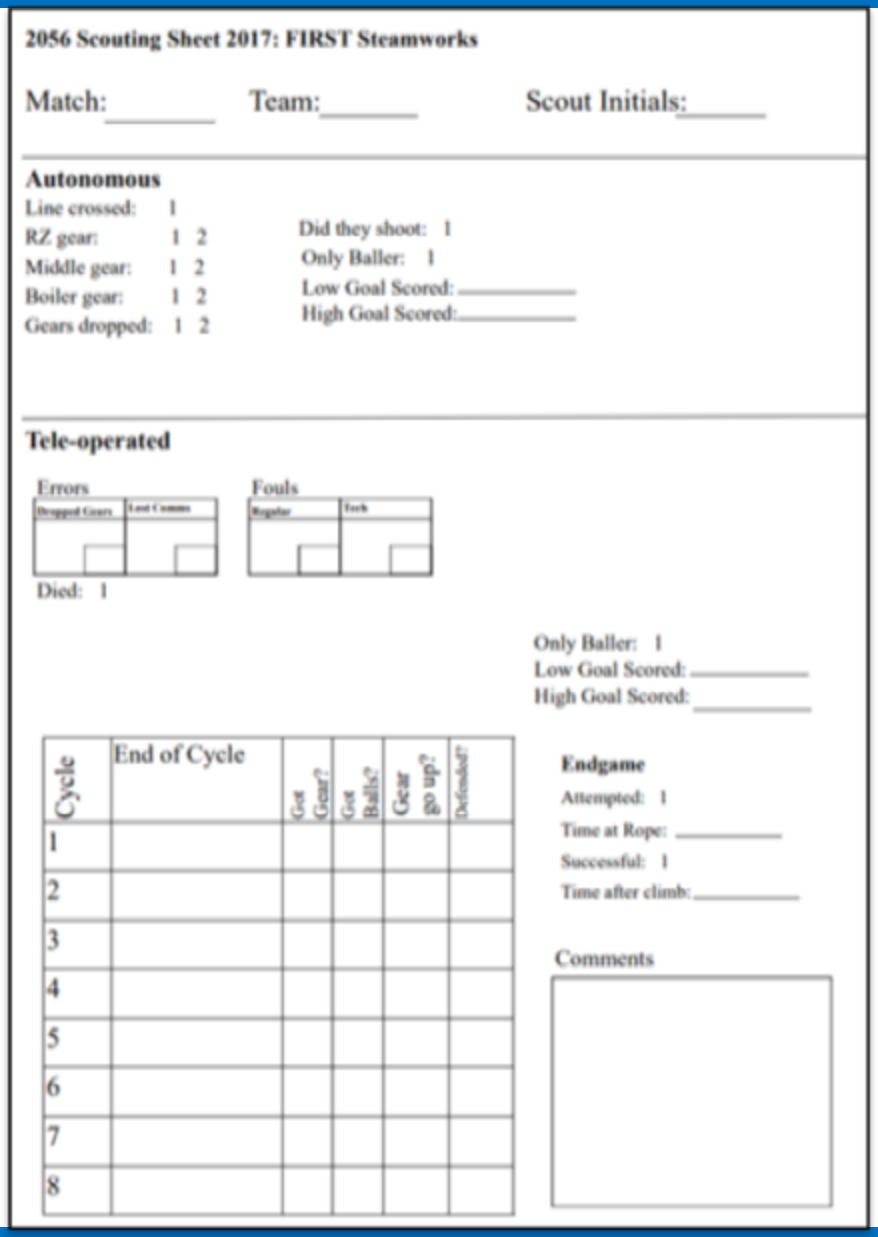
8. Scoring gears/fuel when other tasks could have been done
9. Stopping gear cycling after 3 or 4 rotors
10. Preparing to climb very early
11. Gear intake/scoring location
12. Auto gear location
13. Fuel intake location
14. Fuel acquisition count

} **Omitted because very difficult and very low importance**

Final Scouting Sheet

- Every piece of information needed to understand a robot
- All the information you need to make an **informed prediction** of what a team can do **for** or **against** you
- Answers infrequent but important questions
- Captures performance across different strategies
  - Allows for prediction of performance in the strategy you need



2056 Scouting Sheet 2017: FIRST Steamworks

Match:_____ Team:_____ Scout Initials:_____

Autonomous

Line crossed: 1
RZ gear: 1 2
Middle gear: 1 2
Boiler gear: 1 2
Gears dropped: 1 2

Did they shoot: 1
Only Baller: 1
Low Goal Scored: _____
High Goal Scored: _____

Tele-operated

Errors | Fouls

Died: 1

Only Baller: 1
Low Goal Scored: _____
High Goal Scored: _____

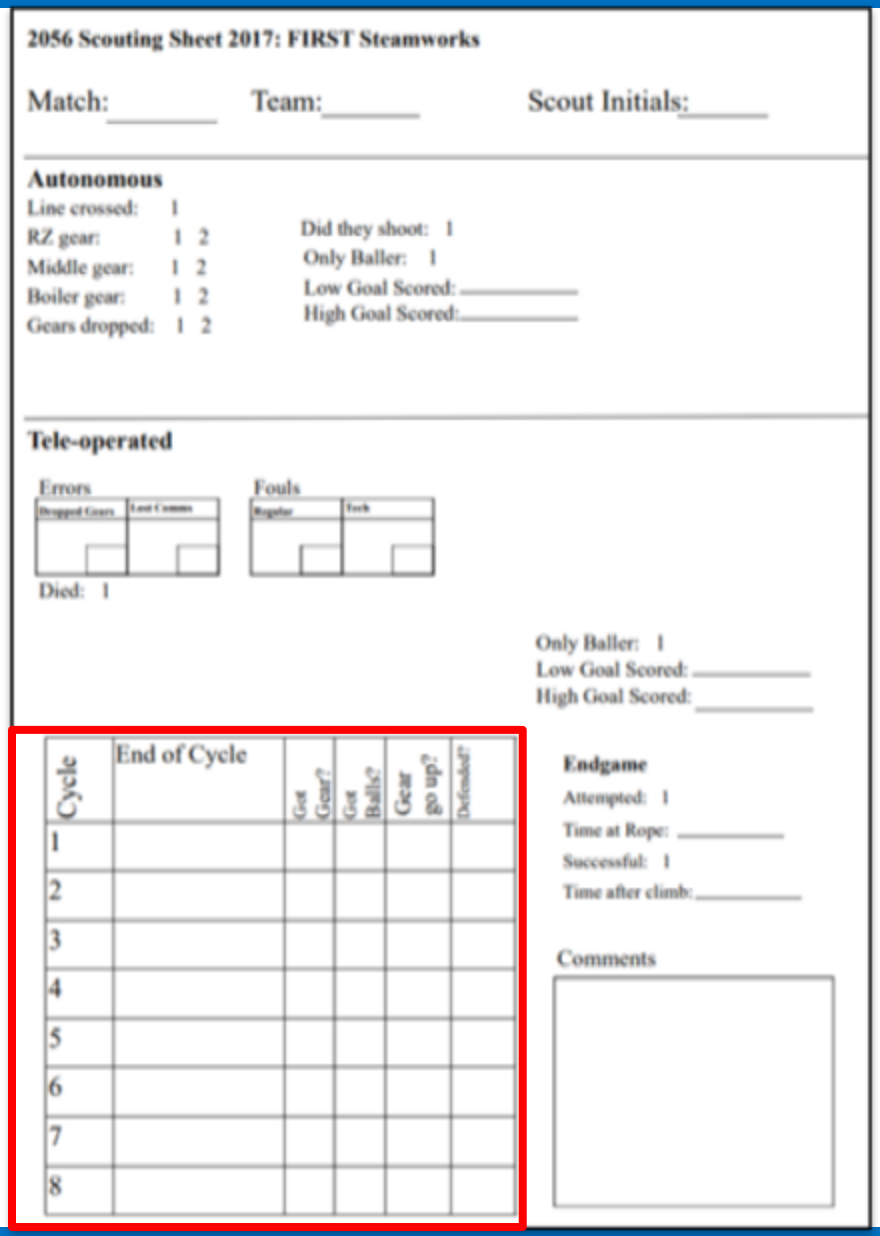
Cycle	End of Cycle	Got Gear?	Got Balls?	Gear go up?	Defended?
1					
2					
3					
4					
5					
6					
7					
8					

Endgame

Attempted: 1
Time at Rope: _____
Successful: 1
Time after climb: _____

Comments

- **Cycle Times!**
- Predicts gear scoring ability even when robots stop cycling early, or do more than cycle gears in a match
- Captures variance across cycles
  - If X scores 4 gears in 80s and gets no more gears, they potentially could have scored 6 gears
  - If Y scores 2 gears in 30s, then scores 1 gear in 70s, then scores 1 gear in 10s, Y could be a team with high upside
- Effect of defence on cycle time



2056 Scouting Sheet 2017: FIRST Steamworks

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Autonomous

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Only Baller: 1
Low Goal Scored:_____
High Goal Scored:_____

Tele-operated

Errors | Fouls

Died: 1

Only Baller: 1
Low Goal Scored:_____
High Goal Scored:_____

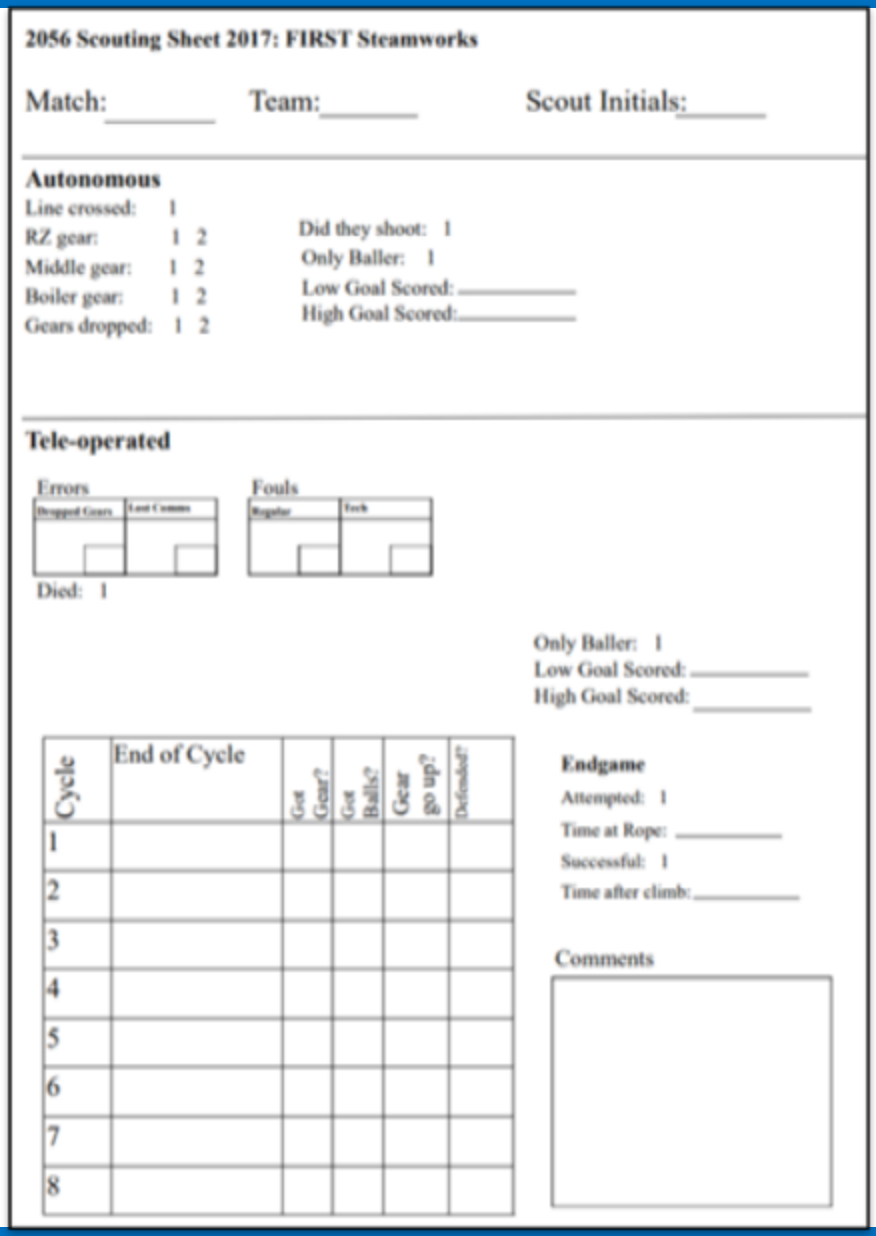
Cycle	End of Cycle	Got Gear?	Got Balls?	Gear go up?	Defended?
1					
2					
3					
4					
5					
6					
7					
8					

Endgame

Attempted: 1
Time at Rope:_____
Successful: 1
Time after climb:_____

Comments

- Cycle times
- Set-up for autonomous mode
  - Plan for 3 gears
- Errors; dropped gears
  - Point of comparison between similar robots
- Climb times
  - Fast climbs → More time to cycle/shoot/defend



2056 Scouting Sheet 2017: FIRST Steamworks

Match:_____ Team:_____ Scout Initials:_____

Autonomous

Line crossed: 1
RZ gear: 1 2
Middle gear: 1 2
Boiler gear: 1 2
Gears dropped: 1 2

Did they shoot: 1
Only Baller: 1
Low Goal Scored: _____
High Goal Scored: _____

Tele-operated

Errors | Fouls

Died: 1

Only Baller: 1
Low Goal Scored: _____
High Goal Scored: _____

Cycle	End of Cycle	Got Gear?	Got Balls?	Gear go up?	Defended?
1					
2					
3					
4					
5					
6					
7					
8					

Endgame

Attempted: 1
Time at Rope: _____
Successful: 1
Time after climb: _____

Comments

A new spreadsheet – is the perspective on gear capability any different?

- Sort by all gears scored (weight auto and tele-op evenly)

	All Auto Gears	Average climb points	Teleop gears scored	All Gears	Teleop number of potential cycles	All gears + potential cycles	Teleop max gears	Teleop all cycle time	Teleop gear only cycle time	All points scored
Team	A-AAG	E-RPS	T-TGS	C-AGS	T-NPC	C-APG	T-MG	T-TAC	T-GOT	C-TPS
1241	0.80	50.00	4.50	5.30	0.30	5.60	7.00	22.35	22.57	138.07
2169	0.80	45.00	4.30	5.10	0.40	5.50	7.00	22.30	22.30	124.67
494	0.30	40.00	4.80	5.10	-	5.10	7.00	24.08	22.54	121.17
234	0.70	40.00	4.30	5.00	0.40	5.40	7.00	21.30	20.41	123.63
384	0.45	36.36	4.36	4.82	0.18	5.00	8.00	22.47	22.62	107.03
4039	0.50	45.00	4.30	4.80	0.60	5.40	6.00	22.65	22.65	119.90
4272	0.80	45.00	4.00	4.80	0.40	5.20	6.00	24.07	24.07	127.33
230	1.00	45.00	3.70	4.70	0.30	5.00	7.00	26.68	26.68	127.73
3929	0.40	40.00	4.30	4.70	0.30	5.00	7.00	23.96	24.07	108.33
4917	0.60	50.00	4.10	4.70	0.30	5.00	6.00	22.73	21.80	125.60
2609	0.50	45.00	4.00	4.50	0.80	5.30	7.00	22.95	24.11	114.27
3875	0.90	40.00	3.60	4.50	0.10	4.60	5.00	28.41	28.41	106.67

Maybe we want to plan autonomous gears for a chance for a 2-rotor auto

- Sort by auto retrieval gears scored

	Auto boundary crosses	Auto boiler gears	Auto middle gears	Auto retrieval gears	Auto gear points	Auto gears dropped	All Auto Gears	Auto ball points	Auto total points	Average climb points	All points scored
Team	A-BC	A-BG	A-MG	A-RG	A-GPS	A-DG	A-AAG	A-BPS	A-TPS	E-RPS	C-TPS
4272	1.00	-	-	0.80	24.00	0.10	0.80	-	29.00	45.00	127.33
1511	0.90	0.10	0.10	0.60	22.33	-	0.80	-	26.83	45.00	101.17
234	1.00	0.10	-	0.60	21.00	-	0.70	-	26.00	40.00	123.63
2252	0.91	0.18	-	0.55	21.82	0.18	0.73	1.55	27.91	45.45	107.36
5801	0.90	0.10	0.10	0.40	16.33	0.10	0.60	-	20.83	45.00	105.83
2609	1.00	-	0.10	0.40	13.33	0.30	0.50	-	18.33	45.00	114.27
2410	0.90	0.10	-	0.40	15.00	-	0.50	-	19.50	40.00	99.50
2077	0.90	-	0.10	0.40	13.33	-	0.50	-	17.83	50.00	101.17
1675	0.90	-	-	0.40	12.00	0.30	0.40	0.20	16.70	35.00	102.37
203	1.00	0.18	0.18	0.36	18.79	-	0.73	0.55	24.33	45.45	114.64
470	0.90	0.10	0.20	0.30	14.67	0.10	0.60	0.50	19.67	50.00	116.83
4039	0.90	-	0.20	0.30	11.67	0.20	0.50	0.90	17.07	45.00	119.90
1241	1.00	0.60	0.20	-	20.67	-	0.80	2.10	27.77	50.00	138.07
2169	1.00	0.20	0.40	0.20	17.33	-	0.80	-	22.33	45.00	124.67

And the corresponding summary?

- For 4272, 1511, and 234

Autonomous					
Cross?	Retrival Zone Gears Placed	Middle Gears Placed	Boiler Gears Placed	Geards Dropped	Balls Points Scored
A-BC	A-RG	A-MG	A-BG	A-DG	A-BPS
1	*1*	*50*	*31*	*13*	*31*
1.0	**0.8**	**-**	**-**	**0.1**	**-**
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	-	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	-	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-

Autonomous					
Cross?	Retrival Zone Gears Placed	Middle Gears Placed	Boiler Gears Placed	Geards Dropped	Balls Points Scored
A-BC	A-RG	A-MG	A-BG	A-DG	A-BPS
23	*2*	*39*	*18*	*35*	*31*
0.9	**0.6**	**0.1**	**0.1**	**-**	**-**
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	-	-	1.0		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
-	-	-	-		-
1.0	-	-	-		-
1.0	-	1.0	-		-

Autonomous					
Cross?	Retrival Zone Gears Placed	Middle Gears Placed	Boiler Gears Placed	Geards Dropped	Balls Points Scored
A-BC	A-RG	A-MG	A-BG	A-DG	A-BPS
1	*2*	*50*	*18*	*35*	*31*
1.0	**0.6**	**-**	**0.1**	**-**	**-**
1.0	-	-	-		-
1.0	1.0	-	-		-
1.0	-	-	1.0		-
1.0	-	-	-		-
1.0	-	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-
1.0	1.0	-	-		-

Do errors affect anything?

- Sort by all points scored

	Auto gears dropped	Auto total points	Average climb points	All Gears	Mistake - teleop dropped gears	Mistake - foul points scored	Mistake - stuck gear	Teleop points scored	All points scored
Team	A-DG	A-TPS	E-RPS	C-AGS	M-DG	T-FPS	M-SG	T-TPS	C-TPS
2056	-	36.60	40.00	3.10	0.40	-	-	106.27	142.87
1241	-	27.77	50.00	5.30	0.60	-	-	110.30	138.07
230	-	32.90	45.00	4.70	0.10	-	-	94.83	127.73
4272	0.10	29.00	45.00	4.80	0.30	-	-	98.33	127.33
4917	0.10	17.23	50.00	4.70	0.40	-	-	108.37	125.60
2481	-	22.40	50.00	3.20	-	-	-	102.47	124.87
2169	-	22.33	45.00	5.10	0.50	-	-	102.33	124.67
71	0.10	24.00	50.00	4.30	-	-	-	100.13	124.13
234	-	26.00	40.00	5.00	0.50	-	-	97.63	123.63
449	0.27	27.18	45.45	4.45	0.55	(0.45)	-	94.79	121.97
494	-	13.27	40.00	5.10	0.10	-	-	107.90	121.17
4039	0.20	17.07	45.00	4.80	0.30	-	-	102.83	119.90

How's everyone climbing?

- Sort by average climb points (only 9 teams climbed every time)

	Auto total points	Average climb time	Average time at rope	Average climb points	All points scored
Team	A-TPS	E-RCT	E-RT	E-RPS	C-TPS
2077	17.83	6.80	18.90	50.00	101.17
470	19.67	4.80	13.90	50.00	116.83
71	24.00	9.90	17.80	50.00	124.13
1807	11.83	7.10	17.90	50.00	112.50
1241	27.77	4.90	15.20	50.00	138.07
226	14.73	8.40	16.60	50.00	110.07
4917	17.23	7.30	16.00	50.00	125.60
6753	9.00	5.40	16.60	50.00	108.33
2481	22.40	5.60	13.50	50.00	124.87

And the corresponding summary?

- For 470, 1241, 6753

Endgame				
Climb Success?	Arrival Time	Finish Time	Climb Time	Last Cycle End Time
E-RS	E-RT	E-RF	E-RCT	T-LCT
1	*18*	*40*	*3*	*-1*
1.0	**13.9**	**9.1**	**4.8**	
~~1.0~~	~~2:00~~	~~2:04~~	~~4.0~~	~~1:41~~
1.0	2:09	2:14	5.0	2:08
~~1.0~~	~~2:02~~	~~2:10~~	~~8.0~~	~~1:53~~
1.0	1:55	1:59	4.0	1:52
1.0	2:01	2:08	7.0	1:56
1.0	2:06	2:09	3.0	2:01
1.0	2:07	2:11	4.0	1:25
1.0	1:55	2:01	6.0	1:44
1.0	1:59	2:03	4.0	1:50
1.0	1:57	2:00	3.0	1:40

Endgame				
Climb Success?	Arrival Time	Finish Time	Climb Time	Last Cycle End Time
E-RS	E-RT	E-RF	E-RCT	T-LCT
1	*30*	*50*	*5*	*-1*
1.0	**15.2**	**10.3**	**4.9**	
1.0	1:54	1:57	3.0	1:18
1.0	1:59	2:02	3.0	1:26
1.0	1:59	2:04	5.0	1:55
1.0	2:11	2:15	4.0	1:56
~~1.0~~	~~1:55~~	~~2:00~~	~~5.0~~	~~1:38~~
1.0	2:05	2:11	6.0	1:59
~~1.0~~	~~1:58~~	~~2:02~~	~~4.0~~	~~1:51~~
1.0	1:59	2:02	3.0	1:54
1.0	2:04	2:12	8.0	1:34
1.0	1:54	2:02	8.0	1:42

Endgame				
Climb Success?	Arrival Time	Finish Time	Climb Time	Last Cycle End Time
E-RS	E-RT	E-RF	E-RCT	T-LCT
1	*44*	*62*	*8*	*-1*
1.0	**16.6**	**11.2**	**5.4**	
1.0	1:55	2:05	10.0	1:30
1.0	2:02	2:07	5.0	1:47
~~1.0~~	~~1:57~~	~~2:02~~	~~5.0~~	~~1:30~~
1.0	1:55	1:58	3.0	1:42
~~1.0~~	~~2:00~~	~~2:08~~	~~8.0~~	~~1:34~~
1.0	2:00	2:04	4.0	1:57
1.0	1:58	2:01	3.0	1:47
1.0	1:59	2:03	4.0	1:53
1.0	1:56	2:01	5.0	1:51
1.0	2:02	2:09	7.0	1:49

All together now:

Team #	Teleop gears scored	All Gears	All gears + potential cycles	Teleop all cycle time	Auto retrieval gears
1241	4.5	5.3	5.6	22.3	-
234	4.3	5.0	5.4	21.3	0.60
2169	4.3	5.1	5.5	22.3	0.20
230	3.7	4.7	5.0	26.7	0.10
4272	4.0	4.8	5.2	24.1	0.80
4039	4.3	4.8	5.4	22.7	0.30
384	4.4	4.8	5.0	22.5	0.09

Team #	Average climb points	Average climb time
1241	50.0	4.9
234	40.0	8.1
2169	45.0	6.4
230	45.0	9.6
4272	45.0	5.4
4039	45.0	6.8
384	36.4	7.3

Team #	Auto retrieval gears	Auto gears dropped	All Auto Gears	Auto boundary crosses
1241	-	-	0.8	1.0
234	0.60	-	0.7	1.0
2169	0.20	-	0.8	1.0
230	0.10	-	1.0	0.9
4272	0.80	0.1	0.8	1.0
4039	0.30	0.2	0.5	0.9
384	0.09	0.1	0.5	0.9

Team #	Mistake - teleop dropped gears	Mistake - foul points scored	All points scored
1241	0.6	-	138.1
234	0.5	-	123.6
2169	0.5	-	124.7
230	0.1	-	127.7
4272	0.3	-	127.3
4039	0.3	-	119.9
384	0.5	-	107.0

Case Study: : Lunacy

How it works:

The Game

- each team has a "trailer" hitched to them for the whole match
- opponent robots and HPs score balls in the trailers

Scoring

- Moon Rocks are 2 points (120 total, 60 to each alliance to start)
- Empty Cells are 2 points (8 total, 4 to each alliance to start)
- Super Cells are 15 points (8 total, 4 to each alliance to start)
    - these can only be entered in the last 20 seconds
- penalties (10 points) are *deducted* from your *own* score

LUNACY™

How it works:

Rules Overview

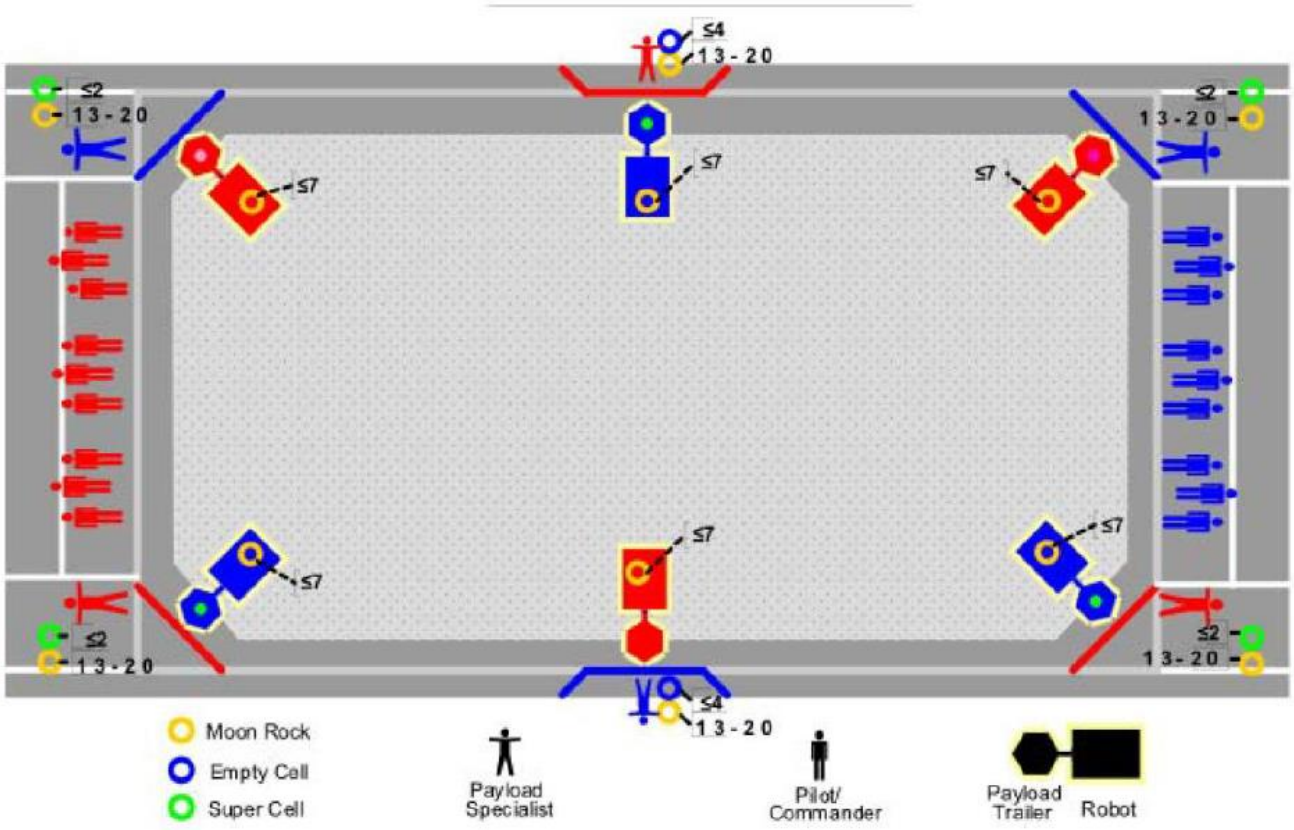
- each team gets 20 Moon Rocks to start, up to 7 go in the robot, the rest go to the team's HP
- any game objects may be scored by both alliances
- Empty Cells delivered from the centre HP to the corner HPs unlock Super Cells
- robots may not possess more than one Empty Cell – there are no limits on Super Cells

Important Considerations

- there is no autonomous bonus
- no ball recycling
- descoring is not allowed
- if you double your opponent's score you only get 3 Super Cells in your next match; if you triple your opponent's score you only get 2 Super Cells in your next match
- the field is a slick plastic surface; as are the wheels that teams have to use

How it works:

The Field



- Where did every point come from?
  - What actions were done to directly score points?
  - What did robots do that enabled them to score points?
- Where did every missed point go?
  - Stopping your opponents from scoring points
  - Stopping yourself from scoring points
  - Actions that **could have** scored points (but score no points through no fault of your own)

Notes about culture

1. Work within your team's capabilities
   - Number of scouts and mentors
   - Data analysis skill sets → need to have data you can trust, no matter how comprehensive your sheet or spreadsheet may be
2. Buy-in from the top
   - Respect begets respect
   - Show off results delivered (and the impact the scouts had)
3. Scouting can be as critical and practically applicable as engineering, programming, business planning, etc.
   - Big data analytics is a $200B industry; scouting develops key skills
   - Good scouting requires year-round dedication
   - Develop scouting systems or data analysis skills in the off-season
4. Trust your data
   - Ensure there is room for "unpopular" ideas and decisions

- "To find the answer, you must know the answer"
- Good sheet → good spreadsheet → good decision → **good results**

- What will I want to know this year?
- Think about how the game will be played and what information will help you play the game better

- FIRST is a microcosm of life; scouting is a microcosm of data analytics and decision-making
- Have good data; your alliance partners will thank you

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Questions?

Thank You!