

PUTTING IT ALL TOGETHER (FINAL PREPARATIONS BEFORE TOURNAMENT)



OVERVIEW

- It is a week before the regional tournament. Your team has a solidly built robot with a number of well-designed attachments. The mission programs run fast and reliably.
- So are you truly close to being ready – close to being fully prepared in getting the maximum table score that your robot is capable of attaining in its current state?
- Hardly! You left out the human part! And all really good engineering incorporates the human part.
- The challenge is that your team must be programmed like your robot. At the table the handling of the robot, attachments and mission objects must be done fast and reliably. You have just three attempts and 150 seconds for each attempt.

OVERVIEW (continued)

- Most teams miss this essential point and come away from the regional tournament with their top score far below what they know they should have gotten.
- **KEY POINT:** Achieving the maximum score means drilling your team to perfection, turning your team into a lean, mean, focused machine.
- From six winning seasons, the Sea Monsters learned that this will take the better part of the last two practices where our practices ran three hours each. The time also includes some research presentation and robot design dry runs.

BASIC SCHEDULE

- Practice #1
 - Determine mission sequence
 - Create master program
 - Work out team member assignments
 - Slow dry runs to work out individual steps for handling robot
 - Correct robot as needed
- In between practice #1 and #2
 - If you found a significant problem that needs to be fixed, have focused session with a few team members to correct problem.
- Practice #2
 - Dry run team repeatedly as if they were at tournament
 - Deliberately insert errors

STEP 1: DETERMINE MISSION SEQUENCE

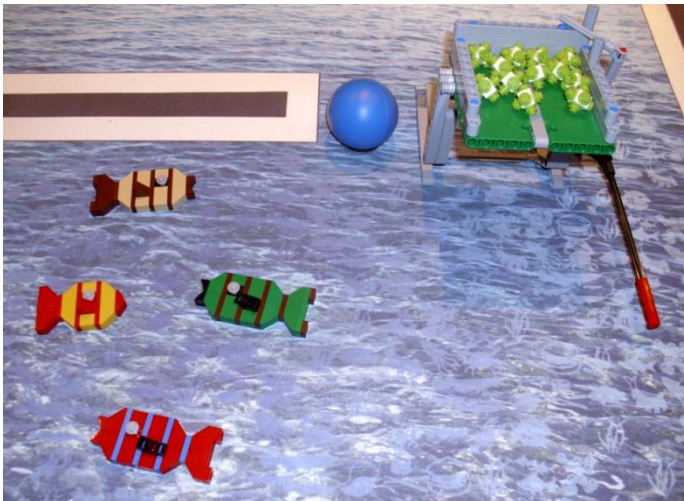
- KEY POINT: Optimize the mission sequence to get the maximum score within 150 seconds.
- Although this step can be done with paper and pencil, you'll eventually want to put this in a spreadsheet so that you can include it in your robot design documentation.
- Collect the following information:
 - Which mission must be done first?
 - Which missions must precede other missions?
 - Which missions need to be run together?
 - Which mission must be done last?
 - How long does each mission take to run?
 - How long does it take to set up each mission?
 - What is the probability that each mission will work?
 - If the mission failed, will it be catastrophic for other missions?
 - How many points is that mission worth?

WHICH MISSION MUST BE DONE FIRST?

- Most years there will be a mission that is a race against another team.
- For 2011 Food Factor, there were two rats that were worth 15 points each when collected.
- Collecting the nearer rat was doable if this were the first program, but the second rat would likely be gotten by the other team first.
- So if you're not confident to win race, it is probably worth skipping this part of the mission.
- Also, consider the interaction of mission model with your robot if the other team is manipulating it at the same time. Will it disrupt your robot?

WHICH MISSIONS MUST PRECEDE OTHER MISSIONS?

- Often times a mission object must be picked up in one place and delivered elsewhere. Or an object must be collected to clear the path for another mission.
- For 2011 Food Factor, the fish must be collected to clear the path to the dispenser of the green bacteria. Next, the green bacteria must be collected before the groceries can be delivered to the table. Finally, the small fish must be returned to collect the fish points. In addition, the truck must be collected to get more groceries, and the viruses must be collected with the bacteria before being delivered to the sink.



WHICH MISSIONS NEED TO BE RUN TOGETHER?

- Where an attachment is used by multiple missions, these missions need to run sequentially to minimize transition times.
- For 2011 Food Factor, Sea Monsters built an attachment for collecting the bacteria. This same attachment was used to move the yellow pollution ball and to push the harvester to release the corn.



WHICH MISSION MUST BE DONE LAST?

- Often the challenge will award points for the robot to be parked at a location at the end of the round.
- For 2011 Food Factor, touching the east wall was worth 9 points.



MISSION RUN AND SETUP TIMING

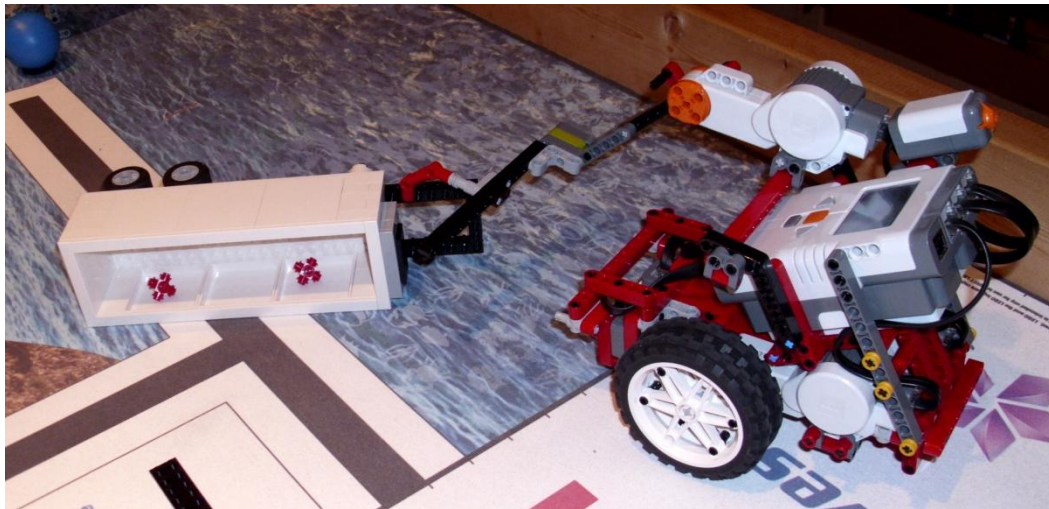
- Measure precisely how long it takes to set up the mission. This includes switching out attachments and loading mission objects to be delivered.
- Measure precisely how long it takes to run the mission.

PROBABILITY THAT MISSION WILL WORK

- Do 10 or more runs and determine what percentage of the time will the mission complete successfully.
- Second, where there are multiple scoring events, adjust also for partial completions.
- For 2011 Food Factor, groceries delivered to a table were worth 2 points each for a maximum of 24 points. Since it is easy for some to fall off, it is important to measure the average number that will score.
- Another consideration is what it will mean to the team if the mission fails. In the stress of a round, an early failure can cause the team to lose concentration and make mistakes in handling the robot. So you should avoid having an unreliable mission early in the mission sequence if you can help it.

CATASTROPHIC MISSION FAILURE

- Are there any missions where if it would fail, it would prevent another mission from succeeding?
- For example in the 2011 Food Factor, the Sea Monsters found that the refrigerated trailer could fail to get to base in earlier versions of the mission. The rules say that in such a case, the trailer must be left where the robot is rescued. This could be at the center of the table where it would interfere with some high scoring missions.



MISSION SEQUENCE CONSOLIDATED ANSWERS

- *2011 Food Factor Scoring & Timing.xlsx* includes the following summary:

Block	Objects	Score	Prob. of Success	Prob. of Rescue	Run Time (secs)	Trans. Time (secs)	Total Time (secs)	Weighted Score	Weighted Score / Total Time	Sequence
Queso	Blue rat	15	80%	10%	11.8	0.0	11.8	11.4	1.0	First
Pizza Man	Pizza	7	90%	10%	22.2	2.0	24.2	11.3	0.5	Any
	Ice cream	7	80%							
Pizza Man 2	Red rat	15	80%	20%	27.2	2.0	29.2	22.7	0.8	Second
	Pizza	7	90%							
	Ice cream	7	80%							
Go Fish Go	Fish	0	100%	0%	5.3	6.0	11.3	3.6	0.3	A
	Blue ball	4	90%							
Bacbucket	Green bacteria	12	100%	0%	5.4	6.0	11.4	12.0	1.1	B
Bacbucket #2	Pink bacteria	12	100%	0%	7.3	2.0	9.3	12.0	1.3	B
Bacbucket #3	Purple bacteria	12	10%	80%	11.2	2.0	13.2	-3.6	-0.3	B
Sweet Corn	Corn	9	80%	0%	4.2	2.0	6.2	10.4	1.7	B
	Yellow ball	4	80%							
Truck	Truck	9	90%	0%	7.4	5.0	12.4	8.1	0.7	Before C
	Truck food	0	90%							
Happy Meal	Groceries	20	80%	0%	9.2	5.0	14.2	16.0	1.1	C
	Truck food	4	0%							
Fish Go Home	Fish	9	90%	0%	2.9	3.0	5.9	8.1	1.4	D
Trailer	Trailer in base	12	90%	0%	18.5	2.0	20.5	10.8	0.5	Any
Sink	9+ viruses	13	60%	0%	8.1	6.0	14.1	10.2	1.3	After B
	1 virus	6	40%							
No Time	Thermometer	20	100%	0%	25.9	3.0	28.9	41.6	1.4	Last
	Timer	14	90%							
	Touch wall	9	100%							

CALCULATE POINTS PER SECOND (SECOND RAT)

- Below assumes that the second rat is available (run Pizza Man 2).

Block	Total Time (secs)	Max Score	Weighted Score	Weighted Score / Total Time	Sequence	Running Total Time (secs)	Running Likely Score + Bonus	Running Max Score + Bonus
Go Fish Go	11.3	4	3.6	0.3	A	11.3	75.6	76
Sweet Corn	6.2	13	10.4	1.7	B	17.5	86.0	89
Fish Go Home	5.9	9	8.1	1.4	D	23.4	94.1	98
No Time	28.9	43	41.6	1.4	Last	52.3	135.7	141
Bacbucket #2	9.3	12	12.0	1.3	B	61.6	147.7	153
Sink	14.1	13	10.2	1.3	After B	75.7	157.9	166
Queso	11.8	15	11.4	1.0	First	87.5	169.3	181
Happy Meal	14.2	24	16.0	1.1	C	101.7	185.3	205
Bacbucket	11.4	12	12.0	1.1	B	113.1	197.3	217
Pizza Man 2	29.2	29	22.7	0.8	Second	142.3	220.0	246
Truck	12.4	9	8.1	0.7	Before C	154.7	228.1	255
Trailer	20.5	12	10.8	0.5	Any	175.2	238.9	267
Bacbucket #3	13.2	12	-3.6	-0.3	B	188.4	235.3	279

PICKING SECOND RAT MISSIONS

- **KEY POINT:** Pick the missions that maximize the score per second of robot execution plus handling time.
- Looking at the previous page, running Pizza Man 2 and above would yield a likely round score of 220 and a maximum possible score of 246 points. Both would be monster scores and should be winning scores.
- Notice that running all of these missions would take 142 seconds, giving 8 seconds to spare. The total time assumes almost perfect transitions. So during the dry runs, a reality check is needed on whether this is too tight. If it is, substitute Trailer to gain an extra 9 seconds in exchange for a 17-point lower score.
- **KEY POINT:** Be prepared to modify the mission selections based on actual dry run timing results.

OPTIMIZED SECOND RAT MISSION SEQUENCE

- Putting together the sequence is easy. Grab the nearest rat, followed by the second rat. Follow A – D sequence. Then do Sink and finish with No Time.

Block	Run Time (secs)	Setup Time (secs)	Total Time (secs)	Max Score	Weighted Score	Weighted Score / Total Time	Sequence	Running Total Time (secs)	Running Likely Score + Bonus	Running Max Score + Bonus
Queso	11.8	0.0	11.8	15	11.4	1.0	First	11.8	83.4	87
Pizza Man 2	27.2	2.0	29.2	29	22.7	0.8	Second	41.0	106.1	116
Go Fish Go	5.3	6.0	11.3	4	3.6	0.3	A	52.3	109.7	120
Bacbucket	5.4	6.0	11.4	12	12.0	1.1	B	63.7	121.7	132
Bacbucket #2	7.3	2.0	9.3	12	12.0	1.3	B	73.0	133.7	144
Sweet Corn	4.2	2.0	6.2	13	10.4	1.7	B	79.2	144.1	157
Happy Meal	9.2	5.0	14.2	24	16.0	1.1	C	93.4	160.1	181
Fish Go Home	2.9	3.0	5.9	9	8.1	1.4	D	99.3	168.2	190
Sink	8.1	6.0	14.1	13	10.2	1.3	After B	113.4	178.4	203
No Time	25.9	3.0	28.9	43	41.6	1.4	Last	142.3	220.0	246

CALCULATE POINTS PER SECOND (ONE RAT)

- Below assumes that the second rat is not available (run Pizza Man).

Block	Total Time (secs)	Max Score	Weighted Score	Weighted Score / Total Time	Sequence	Running Total Time (secs)	Running Likely Score + Bonus	Running Max Score + Bonus
Go Fish Go	11.3	4	3.6	0.3	A	11.3	75.6	76
Sweet Corn	6.2	13	10.4	1.7	B	17.5	86.0	89
Fish Go Home	5.9	9	8.1	1.4	D	23.4	94.1	98
No Time	28.9	43	41.6	1.4	Last	52.3	135.7	141
Bacbucket #2	9.3	12	12.0	1.3	B	61.6	147.7	153
Sink	14.1	19	10.2	1.3	After B	75.7	157.9	172
Queso	11.8	15	11.4	1.0	First	87.5	169.3	187
Happy Meal	14.2	24	16.0	1.1	C	101.7	185.3	211
Bacbucket	11.4	12	12.0	1.1	B	113.1	197.3	223
Truck	12.4	9	8.1	0.7	Before C	125.5	205.4	232
Trailer	20.5	12	10.8	0.5	Any	146.0	216.2	244
Pizza Man	24.2	14	22.7	11.3	Any	170.2	238.9	258
Bacbucket #3	13.2	12	-3.6	-0.3	B	183.4	235.3	270

PICKING ONE RAT MISSIONS

- Notice that without the second rat, the Pizza Man mission points drop significantly and the mission isn't worth doing. Unfortunately, this was missed by the Sea Monsters who still included it in their mission sequence.
- Since most teams will go for the first rat, particularly at the championship tournament, the team should practice this sequence either exclusively or significantly more than the two rat sequence.
- **KEY POINT:** If there is a choice of two mission sequences based on what the other team will do, find out before the round what the other team will do and load the appropriate sequence.

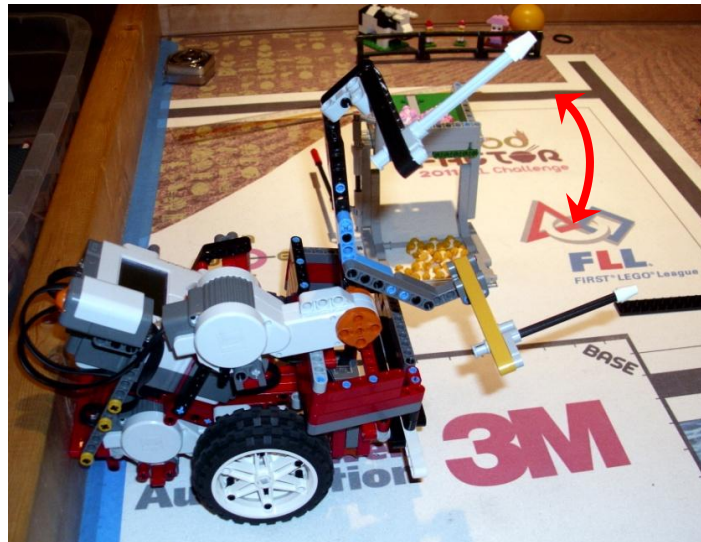
OPTIMIZED ONE RAT MISSION SEQUENCE

- This time, there are more options. Truck must be done before Happy Meal. Trailer and Sink must both be done before No Time. However, Happy Meal requires transferring groceries from the truck, and Sink requires grabbing viruses out of the bacteria collector. Both of these will consume time. Best to do the first just after Queso so the Truck attachment is already on and the second while the robot is out of base for 18 seconds collecting the trailer.
- KEY POINT: If a mission requires setup time with gathered mission objects, do the setup while the robot is out of base on another mission.

Block	Run Time (secs)	Setup Time (secs)	Total Time (secs)	Max Score	Weighted Score	Weighted Score / Total Time	Sequence	Running Total Time (secs)	Running Likely Score + Bonus	Running Max Score + Bonus
Queso	11.8	0.0	11.8	15	11.4	1.0	First	11.8	83.4	87
Truck	7.4	2.0	9.4	9	8.1	0.9	Before C	21.2	91.5	96
Go Fish Go	5.3	6.0	11.3	4	3.6	0.3	A	32.5	95.1	100
Bacbucket	5.4	6.0	11.4	12	12.0	1.1	B	43.9	107.1	112
Bacbucket #2	7.3	2.0	9.3	12	12.0	1.3	B	53.2	119.1	124
Sweet Corn	4.2	2.0	6.2	13	10.4	1.7	B	59.4	129.5	137
Happy Meal	9.2	5.0	14.2	24	16.0	1.1	C	73.6	145.5	161
Fish Go Home	2.9	3.0	5.9	9	8.1	1.4	D	79.5	153.6	170
Trailer	18.5	2.0	20.5	12	10.8	0.5	Any	100.0	164.4	182
Sink	8.1	6.0	14.1	19	10.2	1.3	After B	114.1	174.6	201
No Time	25.9	3.0	28.9	43	41.6	1.4	Last	143.0	216.2	244

ADDING WAGGLE TO MASTER PROGRAM

- KEY POINT: When creating the master program, add a “waggle” block to the beginning.
- Waggle moves the arm attachment up and down two times before going to the first block. Train your team to look for the waggle whenever they start the master program.
- Why waggle? With multiple programs on the robot, it is easy to pick the wrong program. Team won't know that they picked the wrong program until the robot is launched out of base.



TEAM ASSIGNMENTS

- FLL allows only two team members at a time at the table.
- Now that the sequence of missions has been set, who should be working at the table and should be standing by watching?
- Obvious answer: every team member should spend at least some time on the table. Why?
 - FLL's first core value is "We are a team." Deliberately excluding team members from the fun and excitement of being on table directly counters this core value.
 - It is easier for individual team members to focus on just a few missions than having two team members maintain focus continuously for two and a half minutes.
 - In six seasons, the Sea Monsters have placed first or second in robot performance five times at the VA/DC FLL Championship, which is the largest region in the U.S. Some 30 kids have all had time at the table. Our history shows that this philosophy can work.

ON MY SOAPBOX: TEAMWORK AND TABLE

- For the reasons given in the last slide, I strongly believe that fairness to the FLL spirit demands that every team member should be on the table.
- I'll go further: I strongly advocate to FLL that teams who do not put all team members at the table should
 1. Be disqualified from a teamwork award
 2. Be penalized in their teamwork score
- Sorry, but how can a team be rewarded for teamwork when they manifestly don't show it where it is most visible: at the table?

TEAM ASSIGNMENTS (continued)

- So how should you assign team members to different missions? A few guidelines:
 - Start by allowing those who worked specific missions to run their missions when possible.
 - Look at pairs who work well together.
 - For really tricky missions, decide who keep the coolest heads.
 - Try to give everyone a similar amount of table time.
 - Lastly, take into account anyone who has mobility issues. On our 2011 Food Factor team, we had one team member who had disabilities with his legs and focus. We assigned him to prep the robot at the table prior to the round start.

PREPPING FOR DRY RUNS

- Arrange the table as it would be at the beginning of the round. Mission objects in base or elsewhere per the challenge setup rules.
- Assuming base is at the southwest corner of the mat, put a chair next to the table along west wall away from base.
- Place the attachment storage bin on top of chair. Place the storage bin top away from the table.
- Make an initial decision on which attachments stay in the storage bin and which will be held by team members to be taken to the table.
- Put starting pair at the table and line up remaining team members along the south wall about four feet from the table.

INITIAL DRY RUNS

- **KEY POINT:** The primary goal for the initial dry runs is to work out the details for all of the transitions:
 - Work out each and every step in handling robot, mission objects and attachments.
 - Work out exactly where to line up the robot for each mission.
 - Work out where each team member stands next to the table. Assuming base is at southwest corner of the mat, one team member will be west of base and the other will be south of base.
 - Work out which team member does each step.
 - Work out how team members avoid each other.
 - Work out when team members leave table and teammates come to table.

INITIAL DRY RUNS (continued)

- KEY POINT: For initial dry runs, have the team do transitions slowly. This includes picking up the robot, turning it around, switching attachments and pushing the touch sensor to launch next mission.
- When details are worked out, allow them to speed up. Whenever a problem comes up, pause the execution, analyze, and either continue with the rest of the run or restart.
- Remind team members that they should not do each other's tasks. Otherwise, they will be fighting over the robot.
- KEY POINT: Don't time the initial dry runs!
 - Team will beg to know if the time is below 150 seconds. Just don't time. Team will not yet be fully in their groove, so they may well be taking 20 seconds too long. Knowing this will unnecessarily discourage them.

RECHARGE BATTERY

- KEY POINT: Charge battery at every opportunity during the first and second day dry runs.
- At each day's dry run the robot will be used almost continuously, so the battery can easily get drained. This can cause erratic behavior, so monitor that voltage stays near 8.4 V.

BETWEEN TWO PRACTICES

- If you found a significant problem that needs to be tuned, have a focused session with a couple team members to correct problem.
- This can be finding a way to take a few seconds out of execution to ensure staying under 150 seconds.
- It can also be reordering master program or tuning a mission that is not as reliable as it should be.

FINAL PRACTICE: DOING IT LIKE THE COMPETITION

- KEY POINT: The final practice needs to duplicate the tournament conditions as much as possible.
- Set up table as it would be at the tournament, with a chair at side.
- Have team come up to the table as they would in tournament, carrying the robot and attachments in the two storage bins. Robot should have starting attachments. Team should be lined up with selected attachments in hand.
- Only two team members can be at the table a time doing the preparation. Preparation needs to happen in under 1 minute, including light sensor calibration.
- Run the practice round like a real round.
- Say "is team X ready?" and then count down "three, two, one, Lego".
- Time the round, though don't stop at 2:30.
- Tally round with official score sheet.

DRILL TO PERFECTION

- Repeat, repeat, repeat. Do quick debrief or stop in middle of the round to deal with problems.
- To speed things up, skip light sensor calibration at the beginning and formal scoring at the end for some of the rounds.
- Consider playing upbeat music somewhat loudly, which happens at the VA/DC FLL Championship. Regional tournaments can also be loud even if music is not played, so adding noise during some practice rounds makes sense.

TRIP UP YOUR TEAM

- When the team lines up to approach the table, have them stand far enough away so that they don't see how you are setting up the table.
- KEY POINT: Deliberately place one or more mission objects in the wrong place or starting configuration, but not in an obvious way. Hopefully, the team will miss it and the robot will misbehave.
- This will emphasize the lesson that the team is responsible for seeing that the table is set up perfectly.
- Make it a game for them to spot every subtle error in placement. Have them create a checklist of what to look for.
- Important: They cannot move the mission objects. Instead, they must point out issues to the table ref (you) to correct. Sometimes, you'll have to say no, that small imprecisions are acceptable.
- However, one time make an obvious, egregious error, but refuse to change. When they want to argue, ask if that is the gracious professional way to resolve this conflict. Instead, train them to appeal to the head ref.

ARE YOU READY?

- KEY POINT: When you ask “are you ready?”, make sure that the team member who launches the robot is the only one who answers. Try to trip up the others to say “yes”.
- It is imperative that the decision to launch is solely the robot launcher’s. It would be a disaster if the round starts and the robot isn’t ready.
- Next, train the robot launcher to hold down the touch sensor when you say “three” in the countdown.
- When you say the “L” in Lego, have the robot launcher release the touch sensor.

RESCUING THE ROBOT

- KEY POINT: Chances are that the robot will need to be rescued at least once during the tournament. In all likelihood, this will happen a few times during the dry runs.
- How to rescue:
 - Don't panic. Train team to pick up the robot as soon as they realize that it will not recover on its own.
 - If the robot will collide with something that costs points, train team to intercept before it does. Have a team member hover near the robot to intercept in places where robot is likely to fail.
 - Don't touch the program. Let the program run through to the next mission.
 - If the mission uses light sensors to find black line, have black Lego piece nearby to place in base. Wave light sensors over black piece and white base area to advance through the mission.



RESCUING THE ROBOT (continued)

- If a pair on the table doesn't experience a rescue during the dry runs, force a rescue so that every pair knows what to do.
- If there is a particularly high scoring mission that must succeed and there is time to rerun, consider having that mission also loaded on the robot to run at the end or put a second mission block at the end of the main program.

PLAN B

- Timing in completing all of the missions can be very tight. If the last missions are particularly high scoring, failing to do them can be fatal for achieving a high score.
- Plan for failure. For instance for 2011 Food Factor, the final mission No Time counted for 25% of the total earned points (excluding no touch bonus). Since it takes 29 seconds to set up and run, the robot must be back in base by 2:01. Consider a threshold time that if crossed a couple of missions earlier, train the team to abort the main program and run either No Time or No Time plus another mission combined into a second mission.
- **KEY POINT:** Have a Plan B to ensure that the “must do” missions are accomplished. Train your team for this contingency.

SCORING THE ROUND

- KEY POINT: Pick the team representative who best understands the challenge, can stand his or her ground, and can observe most of the round.
- At the dry runs, score the rounds with the official score sheet. This will give the team representative experience with the score sheet.
- Some of the time, deliberately say one thing but score differently. This happens in the round, so it is imperative that the team representative catches the mistake. Otherwise, once the team representative has signed the score sheet, it cannot be appealed!
- Train team representative that if the referee misinterprets the challenge, refuse to sign but instead appeal to head referee.
- Train team representative that if a mission is border-line completed, ask for benefit of doubt. Nothing to lose and again be willing to appeal to head referee.

FINAL DRY RUNS

- It was a Sea Monster tradition to have family members come for the last 60 minutes of the final practice runs.
- This will triple the number of people near the table, helping to recreate the crowd that will be at the tournament.
- Showing off to their families builds the team's confidence.
- It has an additional advantage of educating the parents what to look for at the tournament, making them even better fans.

KEY POINT SUMMARY

- Achieving the maximum score means drilling your team to perfection, turning your team into a lean, mean, focused machine (page 3).
- Optimize the mission sequence to get the maximum score within 150 seconds (page 5).
- Pick the missions that maximize the score per second of robot execution plus handling time (page 15).
- Be prepared to modify the mission selections based on actual dry run timing results (page 15).
- If there is a choice of two mission sequences based on what the other team will do, find out before the round what the other team will do and load the appropriate sequence (page 18).

KEY POINT SUMMARY (continued)

- If a mission requires setup time with gathered mission objects, do the setup while the robot is out of base on another mission (page 19).
- When creating the master program, add a “waggle” block to the beginning (page 20).
- The primary goal for the initial dry runs is to work out the details for all of the transitions (page 25).
- For initial dry runs, have the team do transitions slowly (page 26).
- Don’t time the initial dry runs (page 28).
- Charge battery at every opportunity during the first and second day dry runs (page 29).

KEY POINT SUMMARY (continued)

- The final practice needs to duplicate the tournament conditions as much as possible (page 29).
- Deliberately place one or more mission objects in the wrong place, but not in an obvious way (page 31).
- When you ask “are you ready?”, make sure that the team member who launches the robot is the only one who answers. Try to trip up the others to say “yes”. (Page 32)
- Chances are that the robot will need to be rescued at least once during the tournament (page 33).
- Have a Plan B to ensure that the “must do” missions are accomplished. Train your team for this contingency. (Page 35)
- Pick the team representative who best understands the challenge, can stand his or her ground, and can observe most of the round (page 36).