

TCEA Mindstorms Robotics Challenge 2018-2019

On the Factory Floor

Game Manual



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The TCEA Mindstorms Robotics Challenge is a middle and high school robotics competition based on the LEGO brand Mindstorms robotics platform. This competition is administered by TCEA whose mission is the improvement of teaching and learning through the use of computers and technology.

Each year, teams of students, sponsored by members of TCEA, receive a set of challenge rules and specifications designed around a theme that varies from year to year. Teams compete against one another in head-to-head competition at regional and state levels.

Section 1 Game Description

The 2018-2019 TCEA Mindstorms Robotics Challenge game is titled, On the Factory Floor and is designed around the theme of robotic process automation of the Fidget Company. Your robot will build product and clean the manufacturing floor after shift. This AGV (Automated Guided Vehicle) will sort out packaging (trash) from the parts of the product and will build the product and move it to the loading dock.

Your robot is building the next generation of toys. There are three pieces of the new toy to be assembled before being deposited on the loading dock. Before the next crew arrives, your robot must also take the trash to the trash compactor, recycle the container and move to the Robot Maintenance Station. Once in the maintenance station any part of your robot not in the maintenance station must come to a stop approximately 3 inches above the floor (competition mat) so that the cleaning crew can mop underneath it.

1.1 Field Layout Overview

The competition field for On the Factory Floor is composed of:

- a simple table frame (see Field Construction Manual)
- competition mats (one for each team)
- double sided Duck tape
- PVC couplers
- Electrical tape
- Dixie bathroom cup
- standard drinking straws
- glass craft stones
- checkers
- cotton balls (for advanced)
- standard Legos (for intermediate)

The competition mat that TCEA uses is SIMILAR to the “Race Against Time” mat PREVIOUSLY produced by LEGO Education – that mat has been discontinued, but TCEA was given the rights to reproduce the mat. Mats can be ordered online from the TCEA store.

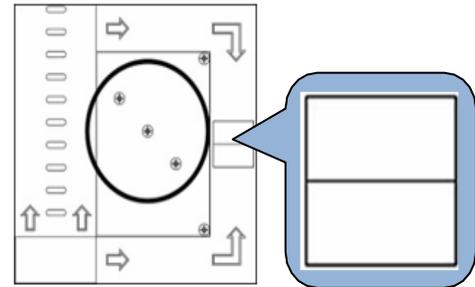
WARNING: Mats made after the 2014 competition season are made of a different mat material than those made by LEGO Education. The pattern printed on the mat is identical to previous years, and there are no distinguishing marks on the mat, so it may be difficult to distinguish a previous year’s mat from the current mat. It is recommended that teams mark the underside of their mat as “2014+” mats immediately upon receiving (taking caution not to mark in an area or in a way that shows through to the front of the mat).

The competition mat was chosen to provide a uniform field layout for the game so that teams and tournaments would be able to reproduce the same field environment for practice and competition.

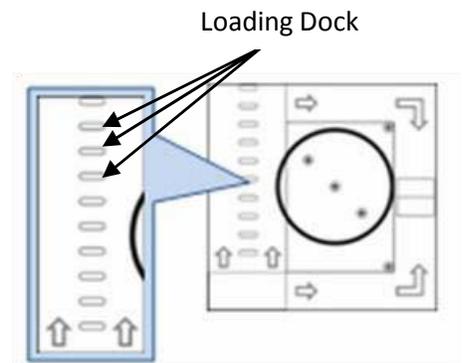
The mat has 5 primary areas that are of interest to On the Factory Floor :

- Robot Maintenance Station
- Loading Dock
- Manufacturing area
- Recycling area
- Trash Compactor

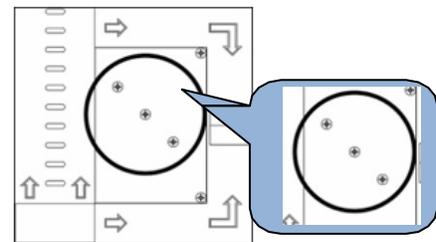
1.1.1 Robot Maintenance Station – The Robot Maintenance Station is where the robot needs to end the shift. If the robot does not end the shift in this location, it cannot be made ready for the next day’s work.



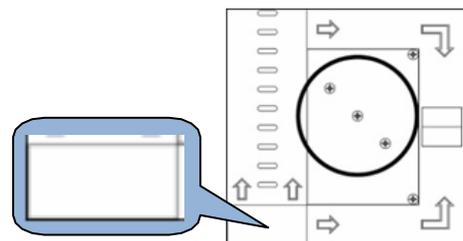
1.1.2 Loading Dock - The loading dock is where your robot will place the finished toys or parts of toys. Each completed toy, must be lined up on its own oval mark where partial toys may line up in any order on any oval.



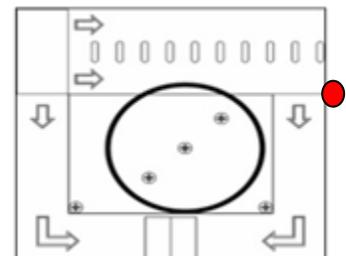
1.1.3 Manufacturing Work Area – The manufacturing work area is where the work is completed and the toys are built. There are three part bins located in this area.



1.1.4 Recycling Area - This is where the opposite team will place its recycling. It is also where you will place your recycling on your opponent’s game board.



1.1.5 Trash Compactor - This is where the robot must place the trash generated during the manufacturing shift. The trash compactor is shown as the red dot in the diagram to the right.



1.2 Game Pieces

In *On the Factory Floor*, the game field is the manufacturing floor where the next generation of toys are made.

It is recommended that kits are obtained from TCEA. This will assist with standardization and reduce the possibility of different equipment at competitions. Non-flexible straws are recommended.

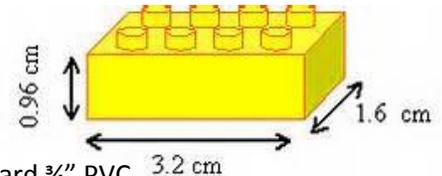
1.2.1 Duct Brand double sided tape

1.2.2 Red or black checkers – Five (5) interlocking black and red plastic checkers, about 1 ¼ inch diameter and ¼ inch thick. Color doesn't matter for this year's challenge.

1.2.3 Cotton ball (for advanced only) – One (1) standard fluffy cotton ball approximately 1 inch in diameter, not the compact wrapped cotton balls.

1.2.4 Dixie bathroom cup (3 ounce) Two (2) 3 ounce Dixie Bathroom cups.

1.2.5 2 x 4 stud LEGO brick (for intermediate only) – One (1) LEGO brick. There is NO specific color designation. The dimensions shown here are approximate.



1.2.6 Dura ¾" schedule-40 PVC pipe couplers – Two (2) standard ¾" PVC pipe couplers that can be found at home improvement stores for less than 50 cents per coupler. The Dura ¾" schedule-40 PVC pipe coupler is designed as a slip-slip coupler that joins two ¾" PVC pipes. A coupler is roughly 2.125" long (2 1/8" in height) and have a 1.3125" outer diameter (1 5/16"). The height can vary +/- ¼", and the outer diameter can vary no more than 1/16".



1.2.7 Electrical tape, Scotch Professional Grade Vinyl (Red and Blue are REQUIRED) - The two PVC couplers must have electrical tape on them.

- One (1) strip of blue electrical tape (approximately 110 mm long) to wrap center of PVC coupler with no more than ¼" overlap)
- One (1) strip of red electrical tape (approximately 110 mm long) to wrap center of PVC coupler with no more than ¼" overlap)

1.2.8 7 mm x 265 mm Drinking Straws – Ten(10) (7 mm x 265 mm) non-flexible drinking straws.

1.2.9 Glass Craft Stones – Five (5) glass craft stones, any color.



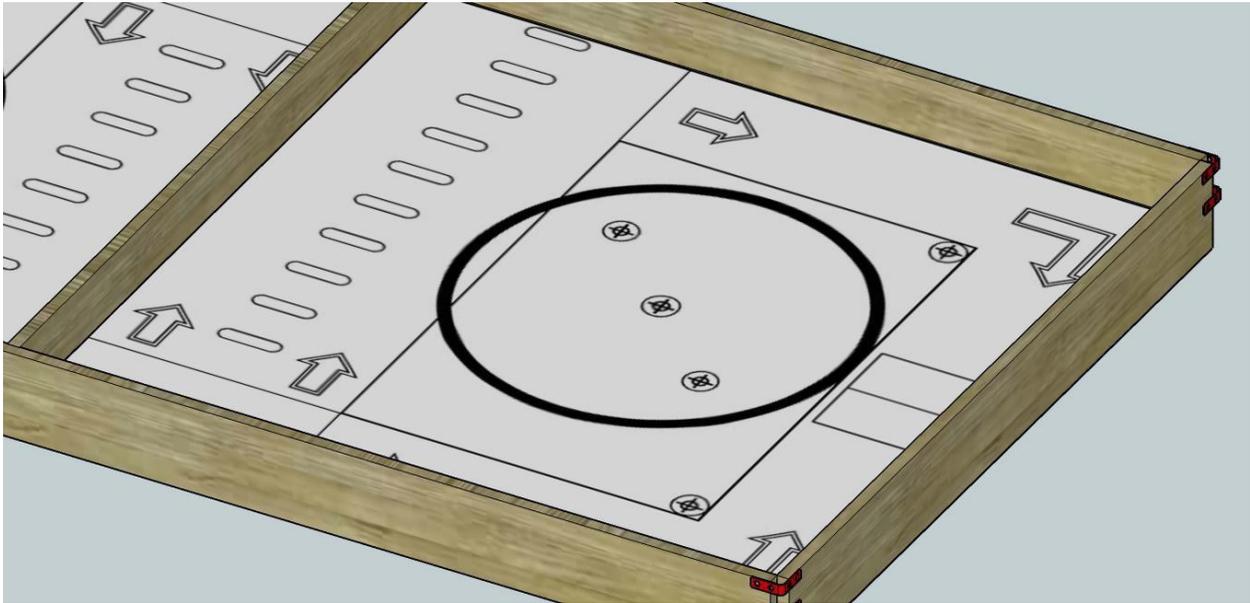
1.2.10 Team-provided game pieces – *On the Factory Floor* requires a "team-provided" game piece as a part of every toy created. These pieces are not optional.

Team-provided game pieces are built or bought by teams and used to create the finished toy. Game pieces are brought with the team to the competition table when the team is scheduled to compete, used during the game, and are returned to the team after each competition match. The team-provided game pieces are built or bought using any allowed

materials, **MUST** be factored in the team's allowance, accounted for in the Bill of Materials (BOM), and fit within the robot start configuration.

1.3 Field Mat Setup

The Field Mat for *On the Factory Floor* will be oriented such that the Robot Maintenance Station is closest to the south wall. If the mat you're provided with is not exactly 4'x4', the mat should be centered on the field such that there is an equal amount of space between the wall and the mat on the 3 sides, except the south wall; in these cases, double-sided tape (such as double-sided Duct tape) is recommended to help keep the mat in place.

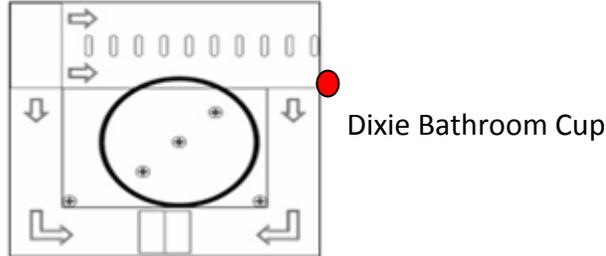


1.4 Game Piece Setup

Most game pieces are placed by the referee before each match. The only game pieces that aren't placed by the referee are the team provided game pieces.

- 1.4.1** Located on one of the bin marks in the manufacturing work area is the 5 checkers. All 5 are stacked together on any one of the three bin marks inside the manufacturing work area (section 1.1.3).
- 1.4.2** Located on one of the bin marks in the manufacturing work area is the 5 glass craft stones that are placed inside the blue bin (PVC coupler with the blue electrical tape). All 5 glass craft stones are stacked together (section 1.1.3).
- 1.4.3** The packaging materials are placed on the same bin (PVC coupler with blue electrical tape) as the glass craft stones. These are placed on top of the blue bin.
 - **For Intermediate** – the one standard sized Lego brick
 - **For Advanced** – the one cotton ball
- 1.4.4** Parts for a different toy are located on the third bin mark in the manufacturing work area (section 1.1.3). The straws are placed inside the red bin (PVC coupler with the red electrical tape) on any of the three smaller circles inside the manufacturing work area.
- 1.4.5** The Dixie bathroom cup is taped to the outside of the frame on the east wall directly in line with the line separating the loading dock from the rest of the manufacturing floor. The three-inch piece of double sided Duct tape is oriented vertically to the top of the wooden frame. The top of

the cup will be flush with the top of the wooden frame. This is the trash compactor described in section 1.1.5.



1.4.6 Team-Provided Pieces - The team must have a team-provided piece as part of each completed toy. These parts must be part of or contained within the robot PRIOR to being measured for compliance. These game pieces are considered part of the robot prior to competition start. The Team Captain must indicate to the referee what comprises the team-provided pieces prior to robot measurement and show the referee how this is represented on the Bill of Material (BOM).

Once the team-provided pieces are no longer in contact with the robot, these items are considered game pieces from that point on (and **NOT** as part of the robot). Game pieces are **NEVER** allowed to be touched during the match by team members once they are on the game field.

1.5 Game Tasks

In *On the Factory Floor*, a team's robot must perform specific tasks on the game field within the 2-minute time limit. There are six (6) possible tasks to perform in round 1 and seven (7) possible tasks to perform in rounds 2 and 3. All but the mystery task can be completed in any order. Each task completed by the robot accumulates points, though some of the tasks are not evaluated until the end of the match. If a task that is to be evaluated at the end of the match is completed and then undone before the end of the match, then the task is considered not completed.

Each black line on the mat is considered a plane. When a task calls for something to be within an area on the mat shown by black lines, it must not "break the plane."

1.5.1 Take the trash to the trash compactor – The trash (cotton ball or LEGO) found on top of the blue bin containing part 2 of the toy (glass craft stones) must be taken to and placed within or on top of the trash compactor (Dixie cup).

1.5.2 Recycle the blue bin – The blue bin (PVC coupler with the blue electrical tape) that holds part 2 (glass craft stones) should be moved to the recycling area. The recycling area is on your opponent's game board. The blue bin must land completely within the recycling area. If it is outside the recycling area, it is immediately removed from play and no points awarded. Points are awarded if the blue bin remains in the recycle area for 3 seconds. It may then be removed from play.

1.5.3 Create toys – The toys that you are making consist of a part 1 (a standard checker), part 2 (a glass craft stone) and a part 3 (team-provided part). To be given credit for a completed toy, all three parts must be present in the same order and the team-provided part must be visible to the naked eye. Each toy **MUST** look the same.

The red bin contains material for another project (section 1.4.4). Don't move it or you will be penalized.

- 1.5.4 Move completed toys to the loading dock** – Those toys that have all three pieces are moved to the loading dock. They must touch their own oval mark and orientation does not matter, only that the three pieces are present and touch each other in the same order.
- 1.5.5 Move partial toys to the loading dock** – Any loading dock oval that does not have a completed toy on it may have a toy part(s) (any number of parts) for points.
- 1.5.6 Finish the shift in the Robot Maintenance Station (RMS)** – Your robot must finish in the robot maintenance station. Any portion of your robot that is not in the RMS must be approximately three inches off of the mat. A Dixie cup (section 1.2.4) will have to pass under the portion of your robot that is not in the Robot Maintenance Station easily (not touching the robot) at the end of the competition.
 - **For Intermediate Only** – Your robot can touch the wall of the playing field
 - **For Advanced Only** – Your robot may not touch any wall of the playing field
- 1.5.7 Mystery Task** - An unknown additional task will be given at the end of round 1 that must be accomplished at the beginning of rounds 2 and 3. This will be a simple programming task such as: have your robot perform a 360 degree turn before accomplishing any other task.

Section 2 General Game Rules

The “Robot” is defined by everything the team brings to the table for the game (including team-supplied game pieces). There is no weight limit on the robot. While the robot is active in play, there is no restriction on the size of the robot.

2.1 Robot Set Up

- 2.1.1 The team will set their robot up; touching the mat, touching the south wall, touching either the east or west wall without touching the Robot Maintenance Station (section 1.1.1).
- 2.1.2 Once the team is finished setting up their robot, the referee will measure to ensure that the robot fits within a 12” x 12” x 12” imaginary cube and within the game frame, no part of the robot may hang over the frame at the start of the competition.

Nothing on the robot may extend past the inner plane of the walls of the competition frame. The referee will measure twelve (12) inches from the corner of the wall along each wall. The robot shall not extend beyond these twelve (12) inches in either direction. The robot shall also not be taller than twelve (12) inches as measured from the surface of the mat. The robot must stand alone during referee measurement, no team member may touch the robot during or after measurement, except to start the robot.

- 2.1.3 Once the referee determines that the robot is compliant with the rules, the team may not touch the robot again until the match starts. Then only to initiate start.

2.2 Robot Recovery

During match play, team members are allowed to “recover” their robot from anywhere on the game field. If a team decides to recover their robot (by initiating touch contact with the robot):

- 2.2.1 Any game piece(s) touching the robot (except team-supplied game pieces not yet deployed from the robot) are left where they lie.
- 2.2.2 Any game piece(s) moved by the robot or team members during the recovery will be removed from play by the referee.
- 2.2.3 The robot is “disabled” and must immediately be prepared to be restarted according to manual

section 2.1.

- 2.2.4 The team will incur a touch penalty of 10 points every time the robot is touched during the match.
- 2.2.5 A team is allowed to “recover” their robot up to 10 times. Once a robot begins motion, the robot is considered “active” and if touched will incur this touch penalty.
- 2.2.6 While the robot is “disabled” and being prepared to restart, the team may change programs or repair/rebuild the robot. No new outside parts may be added to the robot, but parts may be removed. Once they are removed and the robot is restarted, they may not be re-added to the robot.
- 2.2.7 The robot must be approximately the same starting size. The robot cannot be larger than the starting size. The referee will estimate robot size, and if the referee determines the robot is likely still within size, the team may immediately restart the robot. If the referee feels the robot is not within size, the referee will quickly re-measure the robot.

2.3 Other

- 2.3.1 Robots must be able to handle some field variances, such as tolerances in board length/width/height and slight waviness in the field mat. Teams should not rely on specific field attributes that can vary with tolerances (such as the amount of spacing under the north wall, the vertical angle of the field walls, etc.) when designing their robots. Teams and/or sponsors are not permitted to touch or inspect boards prior to competition.
- 2.3.2 Teams may request that any element that is not a part of their robot or was not presented by the team at the start of the match be immediately and permanently removed from the field of play at any time during a match if that element resides on their half of the playing field. Such elements would be considered “debris” and could be (but are not limited to) stray parts from the opposing team’s robot and/or game pieces from the opposing side of the playing field. These elements are to be held by the referee until the end of the match.

This rule does not apply to the other team’s recycled bin as long as it resides completely within the recycling area. If the opponent’s recycling bin lands in the recycling area it must remain there for 3 seconds and then may be removed by the referee.

- 2.3.3 Teams must have a properly formatted and correct Bill of Material (BOM) to be allowed to score any points as noted on the score sheet.
- 2.3.4 Team-supplied game pieces are considered part of the robot until they are removed/dropped/detached from the robot. Once a team-supplied game piece has been removed/dropped/detached, the game piece can no longer be touched/recovered by team members and may no longer be considered part of the robot for the remainder of the match. If a team member does touch a game supplied piece(s) that has been removed/dropped/detached, the referee will remove it from play.

Section 3 General Competition Rules

3.1 Team Requirements

For safety reasons, the number of people allowed in various locations during the contests (such as the pits) is controlled. Additionally, for fairness during the contests, communications and the amount of assistance sponsors can provide in setup/teardown is limited. Please carefully read through the rules below:

- 3.1.1 Teams are led by at least one team sponsor and are composed of at most four students.
- 3.1.2 Students are not allowed to participate on more than one team.
- 3.1.3 Teams may only compete in one division (Advanced Arena, Intermediate Arena, Advanced Inventions, or Intermediate Inventions).

- 3.1.4 The team sponsor must have an active TCEA membership for the duration of your contest season. www.tcea.org/membership
- 3.1.5 All teams are required to have a team name that meets common school standards.
- 3.1.6 Only registered students are allowed to touch the robot and the computer used to program it. The only exception is when technical problems with the computer occur. Live student problem solving is part of the spirit of this competition.
- 3.1.7 Only registered students will be allowed in the team's work /competition area.
- 3.1.8 Only the robot and team provided game pieces will be allowed in the competition area. No additional parts and definitely no computers or cell phones.
- 3.1.9 Teams must designate one student member to be the Team Captain. The Team Captain is the only person from a team who can review and/or initial score sheets or dispute field setup with the referees.
- 3.1.10 Each team must have its own robot.
- 3.1.11 Each robot, for both Arena and Inventions, should be a unique design for each team.
- 3.1.12 Students in third grade and below cannot compete in TCEA contests.
- 3.1.13 Students in grades 4-5 may ONLY compete in the intermediate division.
- 3.1.14 Students in grades 6-8 may compete in either Intermediate or Advanced divisions.
- 3.1.15 Students in grades 9-12 may ONLY compete in the Advanced division.
- 3.1.16 Teams must compete in their designated Area unless there are not enough teams in that Area to hold a contest. Contact your Area Director with questions.
- 3.1.17 For the Area contests, each school may enter no more than three (3) teams per division without special permission from the Area Director. If space allows, the Area Director may allow schools to register more than three (3) teams.
- 3.1.18 A maximum of two (2) Arena and/or Inventions teams from each school per division may advance to the State Competition.
- 3.1.19 No more than three (3) wildcard teams per division from each Area can advance to the State Competition.
- 3.1.20 Wildcard teams will be selected for remaining spaces at the State Competition. Wildcard teams are selected by comparing all Area results. The top scorers who did not place first or second at the Area contests may receive invitations (depending on the number of spaces available).
- 3.1.21 If changes to the advancing team makeup need to be made due to conflicts with schedules or grades, the decision to fill the spot is up to the team sponsor and the school's principal.
- 3.1.22 NO registrations will be allowed past the deadline at the Area or State Contests.
- 3.1.23 Every effort to provide wireless Internet access will be made, but it cannot be guaranteed; please plan accordingly.
- 3.1.24 Laser pointers are NOT allowed at contests.
- 3.1.25 Sponsors/parents may help transport heavy equipment before and after each contest, but they must immediately leave the pit or contest area after delivering the items. No lingering or further assistance from the sponsors/parents will be allowed. If further help is necessary, please communicate your needs to contest personnel.
- 3.1.26 Parents, sponsors, and spectators may not be on the Arena competition floor, the pit, or the Inventions Contest location during the competition. These areas will be clearly defined at the competition.
- 3.1.27 During the competition, students may not communicate with anyone except other registered students and competition staff; all forms of communication are prohibited, including, but not limited, live and electronic communication (talking, texting, videos, etc.). Students should request assistance from competition staff if any communication with parents or sponsors is necessary.
- 3.1.28 Any filming of the competition must be done from the designated spectator area (Arena) or by a team member who is in the competition area (Arena/Inventions). Students are allowed to

videotape with a video camera but not with an Internet or Bluetooth accessible device. (i.e. cell phone, tablet)

3.1.29 Violations of these rules may result in the team's disqualification and ejection from the competition. A point deduction may be taken in circumstances where the team is not eliminated for the violation.

3.2 Competition Format

The *On the Factory Floor* game is a head-to-head challenge where two teams are separately competing on identical physically adjacent competition areas. Teams work to complete their tasks as efficiently and effectively as possible.

3.3 Tournament Scheduling and Scoring

Each tournament will attempt to keep to the same scheduling for consistency between tournaments. Depending upon the number of teams, the time allotted for the tournament, and/or the number of playing fields available, the actual tournament schedule may vary from tournament to tournament.

A typical tournament is scheduled in rounds; in the first round, all teams play one match versus another randomly selected team. Once all teams have played at least one match, the round is over and the tournament typically takes a short break. In the second round, all teams play another match against different teams, until all teams have played at least twice. The same goes for the third round, where all teams play against a different opponent than previously played, until all teams have played at least three times. The tournament should attempt to maintain a minimum amount of time between matches for each team to allow teams time to tweak their robots and programs between rounds.

3.3.1 Teams have 3 attempts, or *rounds*, in which to play and earn points.

3.3.2 Each match can last up to 2 minutes (120 seconds) in duration.

3.3.3 Rounds never occur in immediate succession for any team.

3.3.4 When practical, no two teams play across from each other twice. Surrogate teams may be used to fill holes in the schedule.

3.3.5 If any teams play more than three rounds, as in the case of surrogates, only the team's first match in each round is for points.

3.4 Match Procedures

3.4.1 Prior to each match, the referees or table-reset crew will place game pieces on the field according to the rules.

3.4.2 Teams must inspect the field and ensure that all game pieces are correctly placed.

3.4.3 Team members ARE NOT allowed to move game pieces themselves; if the team wishes to contest the placement of game pieces prior to the end of their setup time, the team must request the referee to correct the placement.

3.4.4 Teams may begin to set up their robots on the table when instructed by the referees.

3.4.5 Teams have a minimum of one minute to set up their robots prior to the start of the match.

3.4.6 After one minute of setup time has elapsed, if referees have determined that both robots are legal and meet all robot requirements, referees may start the match whether the teams are ready or not. **Teams MUST be able to set their robots up quickly.**

3.4.7 If a referee determines that a robot is not legal, the team must bring the robot into compliance before starting; if a team cannot bring their robot into compliance with all robot rules, the team may be disqualified.

3.4.8 Each match begins when indicated by the tournament host, head referee, or individual field referee; this may be done with any means indicated to teams prior to the beginning of the

tournament.

- 3.4.9 Once the match begins, teams are allowed to initiate action to start their robots (starting their programs, pressing a touch sensor, waving hands across an ultrasonic sensor, etc...).
- 3.4.10 Robots must begin the match in accordance to all rules, including but not limited to robot size, robot location, and any other rules defined. Once the match starts, robots may exceed any robot size limitation for the duration of any fully-autonomous play.
- 3.4.11 While the match is in play, robots are fully autonomous unless specified by the specific game rules. Robots may not be controlled or influenced by outside interaction.
- 3.4.12 The match continues until the match timer expires or the referee (or other designated official) calls the end to the match.
- 3.4.13 The match timer NEVER pauses.
- 3.4.14 Once the match ends, teams must turn off their robots. Teams MAY NOT remove their robot from the field of play, nor move their robot from its final condition, until instructed or allowed by the referee.
- 3.4.15 The referee will complete a score sheet indicating the condition of the field (and the robot) at the moment the game ended.
- 3.4.16 Any action taken by the robot after time expires is not valid, and any such action will be reversed by the referee to restore the field state to the condition present at the end of the match.
- 3.4.17 The score sheet indicates the number of points a team has accumulated during a match and may not be calculated for teams before leaving the playing field. The completed score sheet must be initialed by the referees AND the team captain prior to leaving the field. The score sheet is then the ONLY and FINAL indicator of the results of the match and CAN NOT be contested EXCEPT when the score sheet itself is in clear violation of the game rules (i.e. the score sheet indicates a score that is impossible). In NO SITUATION will external review be admitted or allowed, especially video replay.

3.5 Team Ranking

Teams are ranked based on their performance in the game. Eligibility for awards and advancement is based on a team's *ranking score* and any tie breakers (if necessary).

- 3.5.1 At area competition the team's average of 3 scores becomes their *ranking score*.
- 3.5.2 In the event that two or more teams have the same ranking score at the end of the tournament, the team's last score will be used as an initial tie breaker; the highest score in the third round wins.
- 3.5.3 In the event that two or more teams are still tied in ranking score after an initial tiebreaker, the lowest score of an individual round for each team will be used as a secondary tiebreaker; the team with the highest of the tied teams lowest scores wins.
- 3.5.4 After both tie breakers have been evaluated, for teams still tied for first, second, third, fourth or fifth places ONLY, the team who scored the highest score first wins. This is determined by the round where the highest score was earned; a team scoring their highest score in the first round of play beats a team who scored their highest score in the second round, and soon.
- 3.5.5 If any teams in first, second, third, fourth or fifth places ONLY are still tied, tournament directors will determine how to break ties. This may involve, but is not limited to, limited time playoff matches (an additional round that ends after 45 seconds on the clock have elapsed), first-to-score match (an additional round that when one team scores the match is over and the scoring team wins), or a smallest-robot-volume-wins determination.

Section 4 General Robot Rules

The robot is the cornerstone of the competition. Teams are given the game rules in advance of the tournament then design, prototype, build, program, and test their robots prior to arriving for the tournament. These rules provide the general framework for standardizing robots and keeping the game fair.

4.1 Robot Composition

4.1.1 This competition is a LEGO Mindstorms competition, so all robots must use the LEGO Mindstorms product to build and execute their robot design.

4.1.2 Teams are allowed to use exactly one LEGO Mindstorms programmable processing unit; this could be an EV3, NXT, or RCX controller. “Slave” devices are not allowed. Teams that elect to use a LEGO Mindstorms EV3 programmable processing unit MAY NOT have anything plugged into the USB Host port on their EV3 at any time.

4.1.3 Teams are allowed to use any number of LEGO-branded sensors (regardless of the actual vendor of the sensor) on their robots, as long as they DO NOT belong to one of these standard class

- Sound Sensor
- Infrared Sensor
- Magnetic / Compass Sensor

Teams are NOT allowed to use sensor multiplexing devices. Teams may use as many unmodified LEGO wires and/or converter cables as necessary for their sensors.

4.1.4 Teams are allowed to use any number of LEGO-branded motors on their robots. Motor signals and power MUST originate from motor ports on the programmable processing unit; robots with motors using sensor ports will not be allowed to compete. Teams are NOT allowed to use motor multiplexing devices. Teams may use as many unmodified LEGO wires and/or converter cables as necessary for their motors.

These electrical part limitations of LEGO-branded devices are important – ONLY LEGO-branded devices outside the disallowed classes are allowed to be used.

4.1.5 There are no restrictions on the quantities or sources of non-electric LEGO elements, except that factory-made wind-up/pull-back “motors” are not allowed. Pneumatics ARE allowed.

4.1.6 Teams are not allowed to melt, deform, cut, bend, glue, solder, or otherwise alter LEGO elements (plastic and electrical) for use in their robots – the only exceptions are that LEGO tubing or LEGO string may be bent and/or cut to length.

4.1.7 Teams are allowed to incorporate non-electrical, non-LEGO parts on their robots to enhance functionality or as decorations, but there is no requirement to do so; **ALL TEAMS** are **REQUIRED** to have a Bill Of Materials (BOM), whether or not they are using non-LEGO parts on their robots. The total retail value of all non-LEGO parts may not exceed \$5, and all teams that incorporate non-LEGO parts must specify the quantity and cost of each of the items in use – scrap or surplus items with less than one cent per square foot retail value may be specified as having zero cost. The BOM must be in the following format:

Description	Cost	Quantity	Total
LEGO Plastic & Electronic Parts	--	Unlimited	--
Popsicle sticks	\$2.50	10	\$2.50
Bubble Gum	\$1.00	1	\$1.00
Plutonium Rods	\$0.25	2	\$0.50
Stopwatch	\$0.25	2	\$0.50
Cardboard, Scrap	\$0.00	Unlimited	\$0.00
String	\$0.00	Unlimited	\$0.00
TOTAL			\$4.75

- 4.1.8 Extra items may not be used to enhance the structural stability of your robot, only the functionality or aesthetics. Extra items (such as string, etc.) cannot be used to reinforce the LEGO structure — they may ONLY be used to attach other objects; glue or any permanent (or chemically altering) adhesive is NEVER allowed to be used on LEGO parts for any reason. Tape is also not allowed for any reason.

4.2 Robot Etiquette

At the competition, there are a number of things that teams should not do with their robots.

- 4.2.1 All teams using NXT and EV3 systems must disable Bluetooth on the device in the arena. Bluetooth may be used to program in the pit only.
- 4.2.2 All teams using RCX systems must be mindful of other RCX robots when downloading programs. Use only the lowest power setting, and please shield your robot/tower when downloading programs.
- 4.2.3 No computers are allowed in the competition area within 10 feet of any robot or programmable controller. Teams are strictly forbidden from bringing any computers into the competition area at all – with the only exception of security reasons, and in those situations the computer must be OFF at all times when in the competition area.
- 4.2.4 Light detecting, color detecting, and Ultrasonic sensors are allowed but realize that no consideration will be made for ANY interference to them.

Ultrasonic interference at the competition must be expected. Please consider carefully your choice to use an ultrasonic sensor, as your opponent's ultrasonic sensor will most likely cause your ultrasonic sensor to incorrectly function (and vice versa). However, please observe professionalism in this matter; if it is determined by any referees or competition staff that your robot is using an ultrasonic sensor in a way specifically designed to subvert the use of an ultrasonic sensor by your opponent, the competition staff may ask that you remove the sensor from your robot.

- 4.2.5 Teams should make every effort to minimize the likelihood and impact of physically contacting or interfering with an opposing team's robot, and will not be deemed "interference." However, if a robot's actions or design are deemed deliberately malicious to the opposing team (either intentionally by design or by lack of prevention), that robot may be disqualified for the round at the discretion of the Head Referee.
- 4.2.6 At the conclusion of each match, teams should inspect their robot and ensure that all pieces are accounted for. Robot parts left at the table are not guaranteed to be returned, even though all reasonable efforts will be made to do so.

Section 5 State Championship Variations

It has become tradition to have a variant or two to the rules for the State Championship. This gives teams an extra "something" to strive for, and if known in advance teams can design for it in the beginning.

5.1 State Championship - Intermediate competition

- There will be two LEGOs as packing materials (see section 1.4.3).
- Additional points will be awarded to teams that do not recover their robots during competition play (use no touch penalties).

5.2 State Championship - Advanced competition

- There will be two cotton balls as packing materials (see section 1.4.3).
- Additional points will be awarded to teams that do not recover their robots during competition play (use no touch penalties).

Section 6 Game Intent FAQ

In this section, the game designer answers some of the most frequently asked questions about the *On the Factory Floor* competition. This is designed to help teams and referees understand the task rules, scoring methods, and anything else related to the game and its mechanics.

6.1 Can we use tape if it is nonstructural?

No. One of the changes to this year's competition is that absolutely no tape can be used during competition. Except for the electrical tape on the PVC couplers.

6.2 What is a Bill of Materials and why do you require it?

TCEA allows you to add non-LEGO items, but you have a spending limit in order to keep things fair, and a requirement to track this. Even if you do not use non-LEGO items, the Bill of Materials (BOM) is required. Please review section 4.1.7 to see the correct format for a BOM. The BOM also needs to have materials specifically called out for the team supplied game pieces so the referee is absolutely clear about what the team supplied game pieces are made of.

Another great reason to require a BOM is that engineers create/use them for their designs and projects all the time; it is a concise way of communicating your design intent.

6.3 Is there a place where I can ask questions if this FAQ isn't enough?

Every sponsor must join the Robotics Contest Group in the TCEA Community.

6.4 Is there any expectation that the fields will be level?

No, there is no expectation that the fields will be level. The expectation is that your robot will be able to handle variations in the field.

6.5 I understand that the rules start off as DRAFT and can be changed until they are finalized. When will the rules be finalized?

The rules are generally finalized towards the middle of October. If you find rules that don't make sense after that point, the rules will be followed to the letter of the rule as written. So it's in everyone's best interest to make sure the rules are bullet-proof by then. Please help us vet the rules and make suggestions/corrections/questions in the robotics contest community. The final rules will be marked as such on the title page, and have a history which includes the final rules changes. The FINAL rules are the only ones that will be accepted/referenced at competition. BE SURE to bring a copy of the final rules to the competition with you.

6.6 If the robot comes back to the Robot Start Zone on its own, can I grab the robot and reset it without penalty?

The robot start zone doesn't exist once the robot starts moving. There's no such thing as touching the robot without a penalty once the robot starts moving in the match.

Revision History

- 5/29/2018 (Draft Version 1)
1. Original release of Game Manual
- 8/7/2018 (Version 2)
1. Changes made per board suggestion
- 9/3/2018 (Version 3)
1. Added graphic to front page
 2. Corrected spelling errors
 3. Rewrote the task in section 1.5.5 to have the portion of the robot outside of the RMS be 3 inches off of the mat
 4. Added a state competition variation in section 5 to incentivize teams to not use touch penalties and removed the variation concerning completion height off of mat (both advanced and intermediate)
- 11/15/2018 (Version 4)
1. Various typo corrections and clarifications
 2. Addition of new task 1.5.5
 3. Removal of duplicate rule (3.1.21)