I. Introduction

Logistics is the management of the flow of goods between the point of origin and the point of destination in order to meet the requirements of customers or corporations. This entire process is slowly becoming less human oriented and more robot-friendly. With the help of technology it may soon be possible to have an entire autonomous process to move shipping crates from one port location to another in a timely fashion.

II. Objective

The objective of this competition is to simulate the sorting of containers and packages at a port. To accomplish this, different colored and sized boxes will be picked up and sorted for shipping either by rail, sea or air.

III. Course Layout

The course for this competition will be placed on the ground, and will contain a ramp that extends to an upper playing field.

A. The main course is constructed out of a 4 foot x 8 foot sheet of MDF that has a boundary constructed of 1" x 4" wooden beams. The entire course will be painted black.
B. An unbounded ramp will extend from the main course to an upper platform. This will also be constructed of MDF and will be painted black. The ramp will be 24" wide at all points. It will start on the right hand side of the main course, 2 feet in and will have an angle of 11.25°. At the top of the first portion of the ramp, there will be a 2 foot x 2 foot level platform that creates a 90° turn. The ramp will then slope up at 11.25° to meet another 2 foot x 2 foot level platform.
C. A 12"x12" starting zone will be marked using white electrical tape.
D. On the playing field there are 14 marked areas that will contain the cargo to be loaded. The cargo will be cut into different lengths and will be painted different colors. These marked areas will have dimensions of 2-1/2" x 6". The different cargo blocks will be randomly placed in this area at the start of each round. The cargo area will be marked using white electrical tape.

E. On the playing field there will be 6 designated areas for loading cargo to be transported by **rail**.
    1. The blocks to be transported to the rail area will have dimensions of 1-1/2" x 1-1/2" x 4".
    2. Each block will be painted a different color.
    3. Each loading zone will have dimensions of 3" x 5".
    4. The loading zones will be removable, so that the colors can be randomized at the start of each round.
    5. The loading zone will be mounted flush with the track surface.
    6. Each block designated as a rail block will need to be placed on the loading zone that corresponds to the block color.

F. On the playing field there will be 6 designated areas for loading cargo to be transported by **sea**.
    1. The blocks to be transported to the sea area will have dimensions of 1-1/2" x 1-1/2" x 3".
    2. Each block will be painted a different color.
    3. Each loading zone will have dimensions of 3" x 4".
    4. The loading zones will be removable, so that the colors can be randomized at the start of each round.
    5. The loading zone will be mounted flush with the track surface.
    6. Each block designated as a sea block will need to be placed on the loading zone that corresponds to the block color.

G. On the upper playing field there will be 2 designated areas for loading cargo to be transported by **air**.
    1. The blocks to be transported to the rail area will have dimensions of 1-1/2" x 1-1/2" x 2".
    2. Each block will be painted a different color.
    3. Each loading zone will have dimensions of 3" x 3".
    4. The loading zones will be removable, so that the colors can be randomized at the start of each round.
    5. The loading zone will be mounted flush with the track surface.
    6. Each block designated as a air block will need to be placed on the loading zone that corresponds the block color.
    7. In order to place a block on the upper playing field, the robot **must** travel up the ramp (i.e. the robot cannot extend and place the block while located on the main lower platform)

H. On the main playing field, there will be two 1-1/2"x1-1/2"x6" obstacles. There will be a minimum of 20" of clearance around each obstacle.

IV. Course Tolerances

The main course and ramp will have tolerances of ±1". Tolerances on all other aspects (cargo blocks, loading zones and starting zone) will be ±0.25".

V. Course Material

All course materials are available from The Home Depot.

1. The main playing field will be a 4 foot x 8 foot ½" sheet of MDF (SKU 201-504).
2. The ramp will be constructed from the same MDF as the main playing field.
3. Electrical tape (SKU 715-642)
4. The course boundaries will be constructed from 1" x 4" lumber (SKU 687-642).
5. The main course, ramp and boundary will be painted flat black (SKU 923-365 – you will need to request black as the color).
6. The obstacles and cargo blocks will be constructed from 1-1/2" x 1-1/2" Trim Plank White Vinyl (SKU 227-557).
7. The cargo blocks and loading zones will be painted using Rustoleum Painters tough Ultra-Cover 2X Coverage Series, with the following colors:
    - Sun Yellow (SKU 619-323)
    - Real Orange (SKU 619-488)
    - Kona Brown (SKU 611-667)
    - Hunter Green (SKU 615-264)
    - Colonial Red (SKU 615-990)
    - Brilliant Blue (SKU 618-465)
    - Purple (SKU 619-521) – these are the obstacles

VI. Robot

At the start of each round, the robot must be able to fit within a 12" x 12" x 16" box. Once the round starts, the robot can extend to any dimension. A clearly indicated start button or switch must be present on the robot. Once the round begins, the robot **cannot** communicate with anything or anyone outside of the playing field.

VII. Competition Rules

1. A single team member must place the robot inside the starting area. No portion of the robot may extend past the bounds of the starting area before the time starts.
2. When indicated by the judges, one individual from the team will activate the robot by pushing the start button or switch. Once the switch has been pushed, there can be no interaction between the robot and any human or machine external to the course until the challenge has been terminated.
3. Each challenge run will last for 5 minutes.
4. The robot can perform the tasks in any order.
5. The robot can transport a maximum of 2 cargo blocks at a time.
6. The robot cannot place blocks on the upper platform without traveling up the ramp.
7. The robot is not required to finish in any particular location.
8. For a task to be considered complete, the robot must complete all required aspects of the task.
9. The robot cannot drive over or move obstacles on the course.

10. If a team member calls time, their run is terminated and no additional points will be granted. At this time they may remove their robot from the course. A retrial is not permitted.
11. The judges reserve the rights to revise the competition rules between rounds if necessary.
12. The judges reserve the right to disqualify any team for un-sportsman like or unethical behavior.
13. The judges' decision is final.

VIII. Scoring

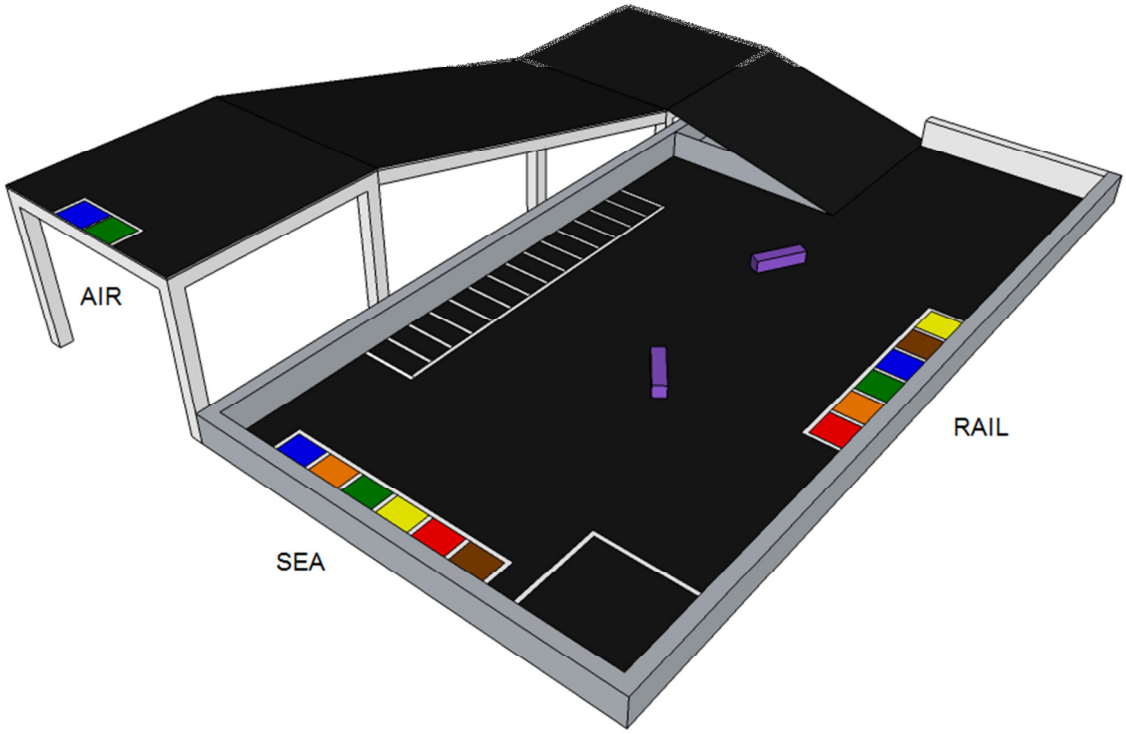
Points will be awarded for performing certain tasks during the competition. Deductions will be awarded if certain tasks are incorrectly performed.

1. **Rail Cargo**
    - 50 Points for transporting the correctly sized box to the rail loading zone
    - 100 Points for correctly locating the box by color
    - Points are only awarded once for each box
2. **Sea Cargo**
    - 50 Points for transporting the correctly sized box to the rail loading zone
    - 100 Points for correctly locating the box by color
    - Points are only awarded once for each box
3. **Air Cargo**
    - 350 Points for transporting the correctly sized box to the air loading zone
    - 100 Points for correctly locating the box by color
    - Points are only awarded once for each box
4. **Deductions**
    - -20 Points for placing a box in the wrong location (i.e. a rail box in the sea loading zone)
    - -20 Points for placing a box on the wrong color loading zone
    - -40 Points for driving over an obstacle
    - -20 Points for hitting an obstacle (an obstacle has been hit if it moves)

IX. Competition Format

1. Each team will have **three** 5 minute runs in the preliminary rounds.
2. Each team's score will be the **total** of their 3 runs.
3. In the event of a tie, the team with the lowest total time will advance.
4. If time cannot be used as a tie-breaker, the team with the fewest total number of deductions will advance.
5. After the preliminary rounds, the **top 8** teams will advance to a single elimination bracket. The teams will be seeded based on their placing in the preliminary rounds.

X. Course Layout


AIR
RAIL
SEA