TASK:
A team of students will develop skills to operate a crane to move containers from a sea-going vessel (we will use a barge) to some form of land transport (train or truck). Additional members of the team will handle a presentation of work done by the team, skills learned and polished, and understanding of the concepts of intermodal transport and logistics. The team will maintain a notebook of process and progress to document the work.

Our crane:
**Organizational Options:**
Teams may be formed and develop their skills within a regular school course, but many teachers may find that some type of outside-of-class time is needed to allow sufficient opportunities to really prepare for competition. This would also allow for the team to consist of members across different courses and grade levels.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cranes (each rotates 90°)</td>
<td>1 crane (rotates 180°)</td>
</tr>
<tr>
<td>2 students per crane</td>
<td>2 students for crane operation</td>
</tr>
<tr>
<td>1 student to maneuver barge and land transport</td>
<td>1 student to maneuver barge and land transport</td>
</tr>
<tr>
<td>2 students for presentation</td>
<td>2 students for presentation</td>
</tr>
<tr>
<td>7 students per team (minimum)</td>
<td>5 students per team (minimum)</td>
</tr>
<tr>
<td><strong>Goal:</strong> to successfully move four containers through the terminal, from barge to land-transport in the shortest time</td>
<td><strong>Goal:</strong> to successfully move four containers through the terminal, from barge to land-transport and back again in the shortest time</td>
</tr>
</tbody>
</table>

A competition kit will be provided for each team. Depending on the level, appropriate crane parts will be provided in two containers. One container will act as the port and the other as the terminal during the competition. The team will provide the form of land-transport. HO train parts and Lego are easy options for that part of the terminal.

**Scoring** will be based on the:
1) time to complete the goal,
2) ability to control the container as it is moved from port to terminal,
3) presentation supporting the team’s work and understanding of the strengths and weaknesses of this robotics simulation
4) notebook that is kept to document the team’s progress and process

In addition, teams may choose to rearrange the order of the syringes on the base and/or change the ballast in the barge. Additional points will be awarded for successfully defending those choices in the presentation. Double-stacking containers earns extra points. Points will be deducted for dropping a container, especially if it is into the port.

Additional documentation is available in the student and teacher manuals that are available on the SMART Center website [http://www.maritime-technology.org](http://www.maritime-technology.org).
SMART Intermodal
Ports and Logistics
Robotics Competition

Instructor
Manual
Introduction:
The maritime industry is being labeled as the "invisible" industry as most people are completely
unaware of its daily impact. Maritime industries include shipbuilding and repair, ports and logistics,
recreational uses, and vessel operations. This competition will focus on ports and logistics as a hands-
on activity with an additional presentation component.

Task:
Your team has the challenge of unloading four 2-TEU containers from a barge onto a transport mode
of your choice (typically truck-trailer or train). The crane is designed to rotate 90° to allow it to pick
up a container and move it directly to the "terminal." A second crane is necessary to move from that
location onto terminal transport (typically train or truck). Scoring will be based on time, handling
skills, and correct use of terminology associated with occupation. Part of the team will make a
presentation of the work done by the team and defending the engineering notebook that was
maintained by the team during the preparation time.
The coach’s responsibilities include:

- Form at least one team
- Obtain school’s administration agreement to participate in the competition including making travel arrangements
- Create a meetings’ schedule for the team members
- Oversee that engineering notebooks are correctly maintained
- Checking with the competition organizers to determine what equipment and software will be available for the team’s presenters

The teams can be formed by:

- using a class, club, or collection of interested students
- helping interested students organize themselves to compete
- collaborating with a mentor, if needed

The competing team should include 4 to 8 total students, as follows:

- 1 to 2 students to control the each crane
- 1 to 2 students to control the barge and train (or truck)
- 2 additional students to make a presentation at the same time as the crane competition

The teams are provided with:

- One assembled crane
- Two large storage containers: one will be filled with water to act as the port and one will be the terminal, using a board on top of the container.
- One small container to act as the barge
- Four toothpaste containers (leave the toothpaste inside) to act as 2-TEU containers.
- One engineering notebook

The team will:

- Determine if the stationary syringes should be rearranged for better crane manipulation
- Design and procure a transport system for the terminal, e.g. train or truck. Toys, Lego, or HO train parts may be considered. The transport will need to have limited motion for the competition.
- Document all team activities in the engineering notebook on a daily basis. One notebook, maintained by the “secretary” of the team, will be provided for a summary of team activities, but each team member should procure and maintain a notebook. The format of that notebook is shown

Before the competition, the teams should:

- determine whether to change the position of the control syringes
- determine the roles of the team members
- maintain an engineering notebook
- document the experiences with pictures
- determine a branding for the team that might include a team name, logo, etc.
Teams will be scored based on:
- The time to unload four containers from the barge into your outgoing transport
- Skills in handling the containers such as:
  - Not losing a container into the water
  - Not letting a container slide or drop as it is moved
  - Not crushing the container
- The ability to explain and use the vocabulary of the job
- Correctly double-stacking the containers
- Presentation (explained below)

The presenting team members are responsible for:
- creating an oral presentation file, e.g. PowerPoint
- using the terminology and explain the operation of your terminal - including technology such as hydraulics, fulcrums, and gears
- explaining how a real intermodal terminal is different from your terminal
- referring to the engineering notebook to describe challenges and achievements during the practice sessions for the competition
- OPTION: calculating the tons/second your team can move in and out of your terminal based on an average weight of a 2-TEU container and how much time it typically takes your team to move the 4 containers

Engineering Notebook

It is usually a bound gridded (graphpaper) notebook. Each page is numbered and broken into the illustrated sections. The sections can be drawn in consistently or added based on the actual space needed for each set of comments/drawings. At the end of each day or session, any empty space should be marked by a single diagonal line so that additional comment can not be added later. The coach should sign each page on the day it is done. (larger view at end of this document)
Student Manual

Process:
Your team will be given:

- Two assembled cranes
- Two large storage containers: one to be filled with water to act as the port, and the other will be the terminal, using a board on top of the container.
- One small container to act as the barge.
- Four toothpaste containers (leave the toothpaste inside) to act as "2-TEU" containers.
- An engineering notebook to document daily progress on team's work
Your team should include a minimum of:

- 1 to 2 students to control each crane and move the containers.
- 1 to 2 students to control barge and terminal transport
- 1 to 2 additional students to interact with a judge during the competition by
  - Using the correct vocabulary to explain the operation of your terminal – including technology such as hydraulics, fulcrums, and gears.
  - Explaining how a real intermodal terminal is different your terminal.
  - Showing the average weight of a 2-TEU container to calculate the tons per second that your team was able to move in and out of your terminal. (Bonus)
  - Explaining why you chose your particular mooring design. (Bonus)

Your team's choice:

- Design your own transportation method to get the containers out of the terminal. This could be building trucks with Lego, using toy trucks that team members might have at home, use HO train parts, or other options that your team might consider
- Modify your crane to suit your needs – this usually means consider rearranging the order of the stationary syringes to allow your team to be more efficient while operating the cranes
- Create a Team Brand (terminal, intermodal transportation, and engineering notebook). Examples of branding may be any or all of the following: team name, school name, school colors, a motto or any other name or symbol you choose.

Your team score will be based on:

- The time it takes your team to move four "2-TEU" containers from the barge onto your terminal transport.
- Skills in handling the containers such as:
  - Not losing a container in the water
  - Not letting a container slide or drop as it is moved
  - Not crushing the containers
  - (Bonus Points) Double-stacking the outgoing containers
- Your team's ability to explain your project
  - Regarding branding: team name, logo, and other identifications
  - Using appropriate vocabulary related to the operation of your terminal. This explanation should include the process of moving the containers, and various occupations of individuals involved in a real terminal (see the terms in Appendix A) during your presentation.
  - As your team developed skills and made changes to the setup, especially explaining syringe location changes
- Maintain an engineering notebook that documents the team work. You will find details for maintaining your notebook and an example in Appendix B.
Judges' Rubric

There should be one judge for each team competing with their port/terminal event and one judge evaluating the team's engineering notebook and presentation.

For the port/terminal event:

- A stopwatch will be used to determine the time it takes the team to complete the event. To determine timing points, the numerator of the equation will determined by taking the team with the best time for the whole competition and multiplying that time by 10. That means that the best team will get 10 points for that category. Therefore a team that takes twice as long as the best team will get 5 points and so forth. Rules for rounding are explained in the first section of the rubric table.
- Containers should be inspected before and after the event to determine damage done by during the event. This will affect the Handling Skills points.
- Alignment, relative to the transports and to each other, of containers is significant. A judge should clearly communicate what tolerance s/he will allow and still give full points for that portion of Double-Stacking points. You may want to clearly mark the areas on the barge that are expected to be used when the containers are returned to it.

For the presentation event:

- The presenters should be dressed "professionally", meaning clean clothes. For boys, a collared shirt and dress pants (coat and tie optional) and for girls, similar attire (pants are acceptable)
- Each member of the presentation team is expected to participate equally.
- The team should be prepared to answer questions from the judge, especially if the presentation does not adequately cover the process that the whole team would have had to perform.

Evaluation:

<table>
<thead>
<tr>
<th>Parameters for Scoring</th>
<th>Points earned (integer) = (best value**)/(time in sec)</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>The time (seconds) it takes the team to move all four containers from the barge to the transport</td>
<td>Points earned (integer) = (best value**)/(time in sec)</td>
<td>Points earned</td>
</tr>
<tr>
<td></td>
<td>(.5 or above rounds up to next integer otherwise truncate e.g. 7.4 = 7 but 7.5 = 8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1 points for any container dropped into the water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>**best value is determined by multiplying the best team's time by 10 10 points max</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 point for successfully moving each container to the terminal transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any container that is dropped cannot be moved again (except to remove it from the competition)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 points max</td>
<td></td>
</tr>
<tr>
<td>Handling Skills of Crane and Containers</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Containers were stacked correctly on the transport without being dropped in the water, crushed, dropped or slid while being moved.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Containers were stacked correctly on the transport without being dropped in the water and one of the following occurred: dropped or slide while being moved or crushed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containers were stacked correctly on the transport without being dropped in the water and two of the following occurred: dropped or slide while being moved or crushed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Double Stacking Containers (Bonus Points)</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both containers are on top of the containers below them, within a defined amount</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Both containers are on top of the containers below them, but poor alignment of either container</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL (17 points max)

### Team's Presentation

<table>
<thead>
<tr>
<th>Engineering Notebook</th>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains all page documentation and team members present details of decisions made in design of three of the following items: terminal, barge, crane, and mooring lines.</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Contains all page documentation and team members present details of decisions made in design of two of the following items: terminal, barge, crane, and mooring lines.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contains all page documentation and team members present details of decisions made in design of at least one of the following: terminal, barge, crane, and mooring lines.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall presentation</th>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students knew what the team had done to prepare for the competition and presented all of the required elements well. The presentation flowed easily between points of interest and included: pictures illustrating the development of the intermodal port and an excellent understanding of terminology.</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Students had a general idea of what the team had done to prepare for the competition and presented most of the required elements well. The presentation flowed between points of interest and included: pictures illustrating the development of the intermodal port and a good understanding of terminology.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students had an idea of what the team had done to prepare for the competition and presented a few of the required elements well. The presentation flowed between points of interest and included: a picture illustrating the development of the intermodal port and a good understanding of terminology.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intermodal SeaPort and Logistics Competition: Level I Student Manual

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Team branding</th>
<th>Creative choices made and effectively used on port/terminal equipment and in presentation</th>
<th>Some branding created and used</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Bonus) Tons per Second Calculation</td>
<td>Team used correct formula and performed correct arithmetic</td>
<td>Minor errors in formula and/or arithmetic</td>
</tr>
</tbody>
</table>

**TOTAL (14 points max)**

**Conclusion:**
For a port to work efficiently, its many component parts must work together correctly. Communication between the manufacturer and the purchaser must also include the Port Authority so that materials can reach their destinations quickly. The Port Authority acts like air traffic control for ocean and river going ships, barges, and recreational boats. One of the products shipbuilders build is ships that transport products, and ship repair facilities keeps those ships in working order. These industries are located in ports where products are off-loaded. Ports need ground transportation such as trucks and trains to move products inland where ships and barges cannot go. Unless you live on a river, bay or ocean, you may never notice ships and barges travelling on the “liquid highway”. Because more people live inland, they only notice the trucks and trains and not the ships and barges that deliver goods to the trucks and trains.

**Resources:**
Southeastern Maritime Center  
http://www.maritime-technology.org/  
Port of Virginia  
http://www.portofvirginia.com/  
Maryland Department of Transportation: Port of Baltimore  
http://www.mpa.maryland.gov/  
United States Maritime Administration  
http://www.marad.dot.gov/

**Tags:** Port, Crane, Barge, Container, Double Stacking, Engineering, Force, Fluid, Hydraulics, Simple Machines, Transportation, Lever, Longshoremen, Mooring, Robots, Robotics, Ships, Shipping, STEM, STEAM, Train, Truck, Work
**APPENDIX A:**

Your team should know and understand this vocabulary and use them during your presentation and in your engineering notebook:

<table>
<thead>
<tr>
<th>Term</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballast</td>
<td>Lever</td>
</tr>
<tr>
<td>Barge</td>
<td>Logistics</td>
</tr>
<tr>
<td>Conex container</td>
<td>Maritime</td>
</tr>
<tr>
<td>Crane Operator</td>
<td>Mooring/Mooring Line</td>
</tr>
<tr>
<td>Counter Balance</td>
<td>Pulley</td>
</tr>
<tr>
<td>Distance</td>
<td>Recreation</td>
</tr>
<tr>
<td>Double Stacking</td>
<td>Robotics</td>
</tr>
<tr>
<td>Engineering</td>
<td>Ship</td>
</tr>
<tr>
<td>Fluid</td>
<td>Terminal/Port</td>
</tr>
<tr>
<td>Force</td>
<td>&quot;TEU&quot;</td>
</tr>
<tr>
<td>Freight</td>
<td>&quot;2-TEU&quot;</td>
</tr>
<tr>
<td>Fulcrum</td>
<td>Terminal Transport Options</td>
</tr>
<tr>
<td>Gear</td>
<td>Time</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>Velocity</td>
</tr>
<tr>
<td>Intermodal Transportation</td>
<td>Weight</td>
</tr>
<tr>
<td>Load and Unload in this context</td>
<td>Work</td>
</tr>
</tbody>
</table>
APPENDIX B:
Engineering Notebook Guidelines:

- Record your work neatly in pen every day your team meets for this competition.
- Include a Table of Contents in the front of the notebook (update this every day too).
- Include a page after the table of contents with full contact information for your coach, team members, and any expert mentors.
- Include details as they happen (sometimes when you wait until later in the meeting, you forget something important).
- Include sketches / drawings with labels and details.
- Tape any loose pages related to the project to include, pictures, receipts, technical data or design work.
- At least one team member and your coach must sign each page when the team finishes the meeting; design work taped in the book should be signed by a witness (another team member) on that page.
- Draw a diagonal line across parts of a page that you do not use that day.
- Include a resources section in the back of the notebook of sources listing sources of information and businesses or other groups or individuals that are not on your team that helped your team with this competition.

<table>
<thead>
<tr>
<th>Page #</th>
<th>Engineering Notebook</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Drawings: |                       |       |

| Notes: |                       |       |

Student Signature: Date: / /
Coach Signature: Date: / /
We decided to use our school colors for branding our terminal. Annie and Jamal said they would paint. Tom and Keshia said 6 mooring lines would work best but Jasmin, Connor, and I think 4 lines are better out of crane. We will try both kinds and decide.

John T.

Mrs. O’Connor said she will buy the paints for us and we can use Mr. Smith’s brushes as long as we clean them up after.

John T.

Date: March 27, 2014
Introduction:
The maritime industry is being labeled as the "invisible" industry as most people are completely unaware of its daily impact. Maritime industries include shipbuilding and repair, ports and logistics, recreational uses, and vessel operations. This competition will focus on ports and logistics as a hands-on activity with an additional presentation component.

Scenario:
Your team has the challenge of unloading four 2-TEU containers from a barge onto a transport mode of your choice (typically truck-trailer or train) and back again. The crane is designed to rotate 180° to allow it to pick up a container and move it directly to the opposite side of the "terminal." Scoring will be based on time, handling skills, and correct use of terminology associated with occupation. Part of the team will make a presentation of the work done by the team and defend the engineering notebook that was maintained by the team during the preparation time.
The coach's responsibilities include:

- Form at least one team
- Obtain school's administration agreement to participate in the competition including making travel arrangements
- Create a meeting schedule for the team members
- Oversee that engineering notebooks are correctly maintained
- Checking with the competition organizers to determine what equipment and software will be available for the team's presenters
- Checking that any repairs of the equipment are done correctly and completely.

The teams can be formed by:

- using a class, club, or collection of interested students
- helping interested students organize themselves to compete
- collaborating with a mentor, if needed

The competing team should include 4 to 6 total students, as follows:

- 1 to 2 students to control the crane
- 1 to 2 students to control the barge and train (or truck)
- 2 additional students to make a presentation at the same time as the crane competition

The teams are provided with:

- One assembled crane
- Two large storage containers: one will be filled with water to act as the port and one will be the terminal, using a board on top of the container.
- One small container to act as the barge
- Four toothpaste containers (leave the toothpaste inside) to act as 2-TEU containers.
- One engineering notebook

The team will:

- Design a mooring system for the barge so that the barge can be secured and then moved for the crane to unload the four double-stacked containers.
- Determine ballast for the barge.
- Determine if the stationary syringes should be rearranged for better crane manipulation
- Design and procure a transport system for the terminal, e.g. train or truck. Toys, Lego, or HO train parts may be considered. The transport will need to have limited motion for the competition.
- Document all team activities in the engineering notebook on a daily basis. One notebook, maintained by the "secretary" of the team, will be provided for a summary of team activities, but each team member should procure and maintain a notebook. The format of that notebook is shown
Before the competition, the teams should:

- determine whether to change the position of the control syringes
- determine the location and amount of ballast for the barge
- determine the roles of the team members
- determine location of mooring posts
- maintain an engineering notebook
- document the experiences with pictures
- determine a branding for the team that might include a team name, logo, etc.

Teams will be scored based on:

- The time to unload four containers from the barge into your outgoing transport and then putting them back onto the barge
- Skills in handling the containers such as:
  - Not losing a container into the water
  - Not letting a container slide or drop as it is moved
  - Not crushing the container
- The ability to explain and use the vocabulary of the job
- Correctly double-stacking the containers
- Presentation (explained below)

The presenting team members are responsible for:

- creating an oral presentation file, e.g. PowerPoint
- using the terminology and explain the operation of your terminal – including technology such as hydraulics, fulcrums, and gears
- explaining how a real intermodal terminal is different from your terminal
- defending the amount and location of any ballast for the barge and mooring points
- calculating the tons/second your team can move in and out of your terminal based on an average weight of a 2-TEU container and how much time it typically takes your team to move the 4 containers
- referring to the engineering notebook to describe challenges and achievements during the practice sessions for the competition
Engineering Notebook

It is usually a bound gridded (graphpaper) notebook. Each page is numbered and broken into the illustrated sections. The sections can be drawn in consistently or added based on the actual space needed for each set of comments/drawings. At the end of each day or session, any empty space should be marked by a single diagonal line so that additional comment can not be added later. The coach should sign each page on the day it is done.

<table>
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<tr>
<th>Page #</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Content:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Drawings: |

| Notes: |

| Student Signature: Date: / / | Coach Signature: Date: / / |
Starting point:
Your team will be given:
- An assembled crane
- Two large storage containers: one will be filled with water to act as the port and one topped by a board to act as the terminal
- One small container to act as the barge
- Four toothpaste containers (leave the toothpaste inside) to act as 2-TEU containers.
- An engineering notebook to record daily process and progress
Your team should include
- 1 to 2 students to control the crane
- 1 to 2 additional students to move the barge and terminal transport while interacting with a judge by
  - using the terminology and explain the operation of your terminal - including technology such as hydraulics, fulcrums, and gears
  - explain how a real intermodal terminal is different your terminal
- 1 to 2 additional students to make a presentation to a judge during the competition by
  - defending the team's engineering notebook
  - describing the processes that the team tried and finally used to prepare for the competition
  - Using the correct vocabulary to explain the operation of your terminal - including technology such as hydraulics, fulcrums, and gears.
  - Explaining how a real intermodal terminal is different your terminal.
  - Showing the average weight of a 2-TEU container to calculate the tons per second that your team was able to move in and out of your terminal.
  - Explaining why you chose your particular mooring design.
  - Explaining why you chose the ballast used.

- One team member should be responsible for maintaining the team's engineering notebook but each team member should maintain an individual notebook. The Coach's manual has a more detailed description of what needs to be in an engineering notebook.
- Other students can be involved with the team development process throughout the preparation time.

Your team's choice:
- Design and assemble the land transport to get the containers out of the terminal (even though they don't leave)
  - Your team may have access to Lego, toy trucks, HO train parts; any of which could be used to create the outgoing terminal transport
  - Whatever the team choice, the mode must be able to accommodate the container's size and be able to move enough to get all four containers onto it.
- Design a mooring system for the barge so that the barge can be secured and then moved for the crane to unload the four double-stacked containers.
  - The barge must be moored while a container is being unloaded or loaded and will need to be moved to allow the crane to be able to be perpendicular to the starting and ending positions of the container being moved.
  - The containers will be double-stacked on the barge, need to be double-stacked on the terminal transport, and then double-stacked when placed back on the barge.
- Determine the best ballast to use with the barge
- The specific arrangement of the stationary syringes to allow more efficient crane control by the student operators
- Team branding: can include team name, logo, color theme, and other components
Your team score is based on:

- The time it takes your team to move four containers from the barge to your outgoing terminal transport and then moving them back
- Skills in handling the containers, for example
  - Not losing a container in the water
  - Not letting a container slide or drop as it is moved
  - Not crushing a container
  - Double-stacking the containers, with good alignment with the transport and relative to each other
- The ability to explain the process and use the appropriate vocabulary of the job
- The engineering notebook completeness
- The presentation that describes what the team did and learned

Vocabulary:
Your team should know and understand these terms and use them during your presentation and in your engineering notebook. You are not required to use every term in your notebook, but you will be expected to use many of the terms in your preparation and presentation. Judges may ask you to explain some terms to demonstrate solid preparation for the competition.

Alignment
Ballast
Barge
Blue water vessel
Brown water vessel
Collision
Crane Operator
Conex container
Construction
Container
Counter Balance
Distance
Double Stacking
Efficiency
Engineering
Fluid
Force
Freight
Fulcrum
Gear
Hydraulics
Intermodal Transportation
Load and Unload in this context
Lever
Logistics
Longshoreman
Maritime
Materials Handling Worker
Mooring/Mooring Line
Power
Pulley
Recreation
Robotics
Ship
Ship Building
Ship Repair
Terminal/Port
"TEU"
"2-TEU"
Terminal Transport Options (truck/train)
Time
Various Ship to Shore Cranes/Gantry Cranes
Velocity
Warehouse Worker
Weight
Work
Judges' Rubric

There should be one judge for each team competing with their port/terminal event and one judge evaluating the team's engineering notebook and presentation.

For the port/terminal event:

- A stopwatch will be used to determine the time it takes the team to complete the event.
  - To determine timing points, the numerator of the equation will determined by taking the team with the best time for the whole competition and multiplying that time by 10. That means that the best team will get 10 points for that category. Therefore a team that takes twice as long as the best team will get 5 points and so forth. Rules for rounding are explained in the first section of the rubric table.
- Containers should be inspected before and after the event to determine damage done during the event. This will affect the Handling Skills points.
- Alignment, relative to the transports and to each other, of containers is significant. A judge should clearly communicate what tolerance s/he will allow and still give full points for that portion of Double-Stacking points. You may want to clearly mark the areas on the barge that are expected to be used when the containers are returned to it.

For the presentation event:

- The presenters should be dressed "professionally", meaning clean clothes. For boys, a collared shirt and dress pants (coat and tie optional) and for girls, similar attire (pants are acceptable)
- Each member of the presentation team is expected to participate equally.
- The team should be prepared to answer questions from the judge, especially if the presentation does not adequately cover the process that the whole team would have had to perform.

Up to 2 bonus points may be awarded in either category for creativity/exceptional job, the maximum points are 25 for port event and 24 points for presentation

Evaluation:

<table>
<thead>
<tr>
<th>Parameters for Scoring</th>
<th>Points earned (integer) = (best value**)/(time in sec)</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>The time (seconds) it takes the team to move all four containers from the barge to the transport</td>
<td>-1 points for any container dropped into the water</td>
<td></td>
</tr>
<tr>
<td><strong>best value is determined by multiplying the best team’s time by 10 10 points max</strong></td>
<td>0.5 points for successfully moving each container to the terminal 0.5 points for successfully moving each container back to the barge</td>
<td></td>
</tr>
<tr>
<td>Any container that is dropped cannot be moved again (except to remove it from the competition) - so a dropped container as it is moved to the terminal would not be available to be moved back to the barge. Rounding rules from previous section still apply. 4 points max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**Handling Skills of Crane and Containers**

- **Points 6**
  - Containers were stacked correctly on the transport without being dropped in the water, crushed, dropped or slid while being moved.

- **Points 4**
  - Containers were stacked correctly on the transport without being dropped in the water and one of the following occurred: dropped or slide while being moved or crushed.

- **Points 2**
  - Containers were stacked correctly on the transport without being dropped in the water and two of the following occurred: dropped or slide while being moved or crushed.

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Double Stacking Containers**

- **Points 3**
  - Both containers were placed on top of the transport-containers and correctly aligned with the containers below them.

- **Points 2**
  - Both containers are on top of the containers below them, but one container is not correctly aligned with the container below it.

- **Points 1**
  - Both containers are on top of the containers below them, but neither container is correctly aligned with the transport below it.

<table>
<thead>
<tr>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

**Mooring design**

- The mooring design helped the team accomplish the task and the team could explain reasoning.

**Ballast choice**

- The ballast choice helped accomplish the task and the team could explain reasoning.

**Bonus (if awarded)**

**TOTAL (25 max)**
## Team's Presentation

<table>
<thead>
<tr>
<th>Points 10</th>
<th>Points 6</th>
<th>Points 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall presentation</strong></td>
<td>Students knew what the team had done to prepare for the competition and presented all of the required elements well. The presentation flowed easily between points of interest and included: pictures illustrating the development of the intermodal port and an excellent understanding of terminology.</td>
<td>Students had a general idea of what the team had done to prepare for the competition and presented most of the required elements well. The presentation flowed between points of interest and included: pictures illustrating the development of the intermodal port and a good understanding of terminology.</td>
</tr>
<tr>
<td><strong>Points 6</strong></td>
<td><strong>Points 4</strong></td>
<td><strong>Points 2</strong></td>
</tr>
<tr>
<td><strong>Engineering Notebook</strong></td>
<td>Contains all page documentation and team members present details of decisions made in design of three of the following items: terminal, barge and ballast, crane, and mooring lines.</td>
<td>Contains all page documentation and team members present details of decisions made in design of two of the following items: terminal, barge and blast, crane, and mooring lines.</td>
</tr>
<tr>
<td><strong>Points 2</strong></td>
<td><strong>Points 1</strong></td>
<td><strong>Bonus (if awarded)</strong></td>
</tr>
<tr>
<td><strong>Tons per Second Calculation</strong></td>
<td>Team used correct formula and performed correct arithmetic</td>
<td>Minor errors in formula and/or arithmetic</td>
</tr>
<tr>
<td><strong>Mooring Design explained</strong></td>
<td>A design that is based on solid reasoning</td>
<td>A design based on some understanding of the issues moving the barge</td>
</tr>
<tr>
<td><strong>Choice of ballast</strong></td>
<td>Choice well defended</td>
<td>Choice based on trial and error with no understanding of concepts involved</td>
</tr>
<tr>
<td><strong>Team branding</strong></td>
<td>Creative choices made and effectively used on port/terminal equipment and in presentation</td>
<td>Some branding created and used</td>
</tr>
</tbody>
</table>

**TOTAL (24 max)**
Conclusion:
For a port to work efficiently, its many component parts must work together correctly. Communication between the manufacturer and the purchaser must also include the Port Authority so that materials can reach their destinations quickly. The Port Authority acts like air traffic control for ocean and river going ships, barges, and recreational boats. One of the products shipbuilders build is ships that transport products, and ship repair facilities keeps those ships in working order. These industries are located in ports where products are off-loaded. Ports need ground transportation such as trucks and trains to move products inland where ships and barges cannot go. Unless you live on a river, bay or ocean, you may never notice ships and barges travelling on the “liquid highway”. Because more people live inland, they only notice the trucks and trains and not the ships and barges that deliver goods to the trucks and trains.

Resources:
Southeastern Maritime Center
http://www.maritime-technology.org/
Port of Virginia
http://www.portofvirginia.com/
Maryland Department of Transportation: Port of Baltimore
http://www.mpa.maryland.gov/
United States Maritime Administration
http://www.marad.dot.gov/

Tags: Port, Crane, Barge, Container, Double-Stacking, Engineering, Force, Fluid, Hydraulics, Simple Machines, Transportation, Lever, Longshoremen, Mooring, Robots, Robotics, Ships, Shipping, STEM, STEAM, Train, Truck, Work
SMART Intermodal
Ports and Logistics
Robotics Competition

Student Manual
Introduction:
The maritime industry is being labeled as the “invisible” industry as most people are completely unaware of its daily impact. Maritime industries include shipbuilding and repair, ports and logistics, recreational uses, and vessel operations. This competition will focus on ports and logistics as a hands-on activity with an additional presentation component.

Task:
Your team has the challenge of unloading four 2-TEU containers from a barge onto a transport mode of your choice (typically truck-trailer or train). The crane is designed to rotate 90° to allow it to pick up a container and move it directly to the “terminal.” A second crane is necessary to move from that location onto terminal transport (typically train or truck). Scoring will be based on time, handling skills, and correct use of terminology associated with occupation. Part of the team will make a presentation of the work done by the team and defending the engineering notebook that was maintained by the team during the preparation time.
**Process:**

Your team will be given:

- Two assembled cranes
- Two large storage containers: one to be filled with water to act as the port, and the other will be the terminal, using a board on top of the container.
- One small container to act as the barge.
- Four toothpaste containers (leave the toothpaste inside) to act as “2-TEU” containers.
- An engineering notebook to document daily progress on team’s work
Your team should include a minimum of:

- 1 to 2 students to control each crane and move the containers.
- 1 to 2 students to control barge and terminal transport
- 1 to 2 additional students to interact with a judge during the competition by
  - Using the correct vocabulary to explain the operation of your terminal – including technology such as hydraulics, fulcrums, and gears.
  - Explaining how a real intermodal terminal is different your terminal.
  - Showing the average weight of a 2-TEU container to calculate the tons per second that your team was able to move in and out of your terminal. (Bonus)
  - Explaining why you chose your particular mooring design. (Bonus)

Your team's choice:

- Design your own transportation method to get the containers out of the terminal. This could be building trucks with Lego, using toy trucks that team members might have at home, use HO train parts, or other options that your team might consider
- Modify your crane to suit your needs – this usually means consider rearranging the order of the stationary syringes to allow your team to be more efficient while operating the cranes
- Create a Team Brand (terminal, intermodal transportation, and engineering notebook). Examples of branding may be any or all of the following: team name, school name, school colors, a motto or any other name or symbol you choose.

Your team score will be based on:

- The time it takes your team to move four “2-TEU” containers from the barge onto your terminal transport.
- Skills in handling the containers such as:
  - Not losing a container in the water
  - Not letting a container slide or drop as it is moved
  - Not crushing the containers
  - (Bonus Points) Double-stacking the outgoing containers
- Your team's ability to explain your project
  - Regarding branding: team name, logo, and other identifications
  - Using appropriate vocabulary related to the operation of your terminal. This explanation should include the process of moving the containers, and various occupations of individuals involved in a real terminal (see the terms in Appendix A) during your presentation.
  - As your team developed skills and made changes to the setup, especially explaining syringe location changes
- Maintain an engineering notebook that documents the team work. You will find details for maintaining your notebook and an example in Appendix B.
Judges’ Rubric
There should be one judge for each team competing with their port/terminal event and one judge evaluating the team’s engineering notebook and presentation.

For the port/terminal event:
- A stopwatch will be used to determine the time it takes the team to complete the event. To determine timing points, the numerator of the equation will determined by taking the team with the best time for the whole competition and multiplying that time by 10. That means that the best team will get 10 points for that category. Therefore a team that takes twice as long as the best team will get 5 points and so forth. Rules for rounding are explained in the first section of the rubric table.
- Containers should be inspected before and after the event to determine damage done by during the event. This will affect the Handling Skills points.
- Alignment, relative to the transports and to each other, of containers is significant. A judge should clearly communicate what tolerance s/he will allow and still give full points for that portion of Double-Stacking points. You may want to clearly mark the areas on the barge that are expected to be used when the containers are returned to it.

For the presentation event:
- The presenters should be dressed “professionally”, meaning clean clothes. For boys, a collared shirt and dress pants (coat and tie optional) and for girls, similar attire (pants are acceptable)
- Each member of the presentation team is expected to participate equally.
- The team should be prepared to answer questions from the judge, especially if the presentation does not adequately cover the process that the whole team would have had to perform.

Evaluation:

<table>
<thead>
<tr>
<th>Parameters for Scoring</th>
<th>Points earned (integer) = (best value**)/(time in sec) (.5 or above rounds up to next integer otherwise truncate e.g. 7.4 = 7 but 7.5 = 8)</th>
<th>1 point for successfully moving each container to the terminal transport</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>The time (seconds) it takes the team to move all four containers from the barge to the transport</td>
<td>-1 points for any container dropped into the water</td>
<td>Any container that is dropped cannot be moved again (except to remove it from the competition)</td>
<td>4 points max</td>
</tr>
<tr>
<td>**best value is determined by multiplying the best team's time by 10 10 points max</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points</td>
<td>Points</td>
<td>Points</td>
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<td></td>
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<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Handling Skills of Crane and Containers**

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Containers were stacked correctly on the transport without being dropped in the water, crushed, dropped or slid while being moved.

Containers were stacked correctly on the transport without being dropped in the water and one of the following occurred: dropped or slide while being moved or crushed.

Containers were stacked correctly on the transport without being dropped in the water and two of the following occurred: dropped or slide while being moved or crushed.

---

**Double Stacking Containers (Bonus Points)**

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Both containers are on top of the containers below them, within a defined amount.

Both containers are on top of the containers below them, but poor alignment of either container.

**TOTAL (17 points max)**

---

**Team's Presentation**

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**Engineering Notebook**

Contains all page documentation and team members present details of decisions made in design of three of the following items: terminal, barge, crane, and mooring lines.

Contains all page documentation and team members present details of decisions made in design of two of the following items: terminal, barge, crane, and mooring lines.

Contains all page documentation and team members present details of decisions made in design of at least one of the following: terminal, barge, crane, and mooring lines.

---

**Overall presentation**

Students knew what the team had done to prepare for the competition and presented all of the required elements well. The presentation flowed easily between points of interest and included: pictures illustrating the development of the intermodal port and an excellent understanding of terminology.

Students had a general idea of what the team had done to prepare for the competition and presented most of the required elements well. The presentation flowed between points of interest and included: pictures illustrating the development of the intermodal port and a good understanding of terminology.

Students had an idea of what the team had done to prepare for the competition and presented a few of the required elements well. The presentation flowed between points of interest and included: a picture illustrating the development of the intermodal port and a good understanding of terminology.
<table>
<thead>
<tr>
<th></th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Team branding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Bonus) Tons per Second Calculation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion:**

For a port to work efficiently, its many component parts must work together correctly. Communication between the manufacturer and the purchaser must also include the Port Authority so that materials can reach their destinations quickly. The Port Authority acts like air traffic control for ocean and river going ships, barges, and recreational boats. One of the products shipbuilders build is ships that transport products, and ship repair facilities keeps those ships in working order. These industries are located in ports where products are off-loaded. Ports need ground transportation such as trucks and trains to move products inland where ships and barges cannot go. Unless you live on a river, bay or ocean, you may never notice ships and barges travelling on the “liquid highway”. Because more people live inland, they only notice the trucks and trains and not the ships and barges that deliver goods to the trucks and trains.

**Resources:**

- **Southeastern Maritime Center**
  http://www.maritime-technology.org/
- **Port of Virginia**
  http://www.portofvirginia.com/
- **Maryland Department of Transportation: Port of Baltimore**
  http://www.mpa.maryland.gov/
- **United States Maritime Administration**
  http://www.marad.dot.gov/
**APPENDIX A:**

Your team should know and understand this vocabulary and use them during your presentation and in your engineering notebook:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballast</td>
<td>Lever</td>
</tr>
<tr>
<td>Barge</td>
<td>Logistics</td>
</tr>
<tr>
<td>Conex container</td>
<td>Maritime</td>
</tr>
<tr>
<td>Crane Operator</td>
<td>Mooring/Mooring Line</td>
</tr>
<tr>
<td>Counter Balance</td>
<td>Pulley</td>
</tr>
<tr>
<td>Distance</td>
<td>Recreation</td>
</tr>
<tr>
<td>Double Stacking</td>
<td>Robotics</td>
</tr>
<tr>
<td>Engineering</td>
<td>Ship</td>
</tr>
<tr>
<td>Fluid</td>
<td>Terminal/Port</td>
</tr>
<tr>
<td>Force</td>
<td>&quot;TEU&quot;</td>
</tr>
<tr>
<td>Freight</td>
<td>&quot;2-TEU&quot;</td>
</tr>
<tr>
<td>Fulcrum</td>
<td>Terminal Transport Options</td>
</tr>
<tr>
<td>Gear</td>
<td>Time</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>Velocity</td>
</tr>
<tr>
<td>Intermodal Transportation</td>
<td>Weight</td>
</tr>
<tr>
<td>Load and Unload in this context</td>
<td>Work</td>
</tr>
</tbody>
</table>
APPENDIX B: Engineering Notebook Guidelines:

- Record your work neatly in pen every day your team meets for this competition.
- Include a Table of Contents in the front of the notebook (update this every day too).
- Include a page after the table of contents with full contact information for your coach, team members, and any expert mentors.
- Include details as they happen (sometimes when you wait until later in the meeting, you forget something important).
- Include sketches / drawings with labels and details.
- Tape any loose pages related to the project to include, pictures, receipts, technical data or design work.
- At least one team member and your coach must sign each page when the team finishes the meeting; design work taped in the book should be signed by a witness (another team member) on that page.
- Draw a diagonal line across parts of a page that you do not use that day.
- Include a resources section in the back of the notebook of sources listing sources of information and businesses or other groups or individuals that are not on your team that helped your team with this competition.

<table>
<thead>
<tr>
<th>Page #</th>
<th>Engineering Notebook</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawings:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Student Signature: [Date: ]
Coach Signature: [Date: ]
<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>We decided to use our school colors for branding our terminal. Annie and Jamal said they would paint. Tom and Keshia said 6 mooring lines would work best but Jasmin Connor and I think 4 lines are better out of crane. We will try both kinds and decide.</td>
</tr>
</tbody>
</table>
Introduction:
The maritime industry is being labeled as the "invisible" industry as most people are completely unaware of its daily impact. Maritime industries include shipbuilding and repair, ports and logistics, recreational uses, and vessel operations. This competition will focus on ports and logistics as a hands-on activity with an additional presentation component.

Scenario:
Your team has the challenge of unloading four 2-TEU containers from a barge onto a transport mode of your choice (typically truck-trailer or train) and back again. The crane is designed to rotate 180° to allow it to pick up a container and move it directly to the opposite side of the "terminal." Scoring will be based on time, handling skills, and correct use of terminology associated with occupation. Part of the team will make a presentation of the work done by the team and defend the engineering notebook that was maintained by the team during the preparation time.
### Starting point:

Your team will be given:

- An assembled crane
- Two large storage containers: one will be filled with water to act as the port and one topped by a board to act as the terminal
- One small container to act as the barge
- Four toothpaste containers (leave the toothpaste inside) to act as 2-TEU containers.
- An engineering notebook to record daily process and progress
Your team should include

- 1 to 2 students to control the crane
- 1 to 2 additional students to move the barge and terminal transport while interacting with a judge by
  - using the terminology and explain the operation of your terminal - including technology such as hydraulics, fulcrums, and gears
  - explain how a real intermodal terminal is different your terminal
- 1 to 2 additional students to make a presentation to a judge during the competition by
  - defending the team’s engineering notebook
  - describing the processes that the team tried and finally used to prepare for the competition
  - Using the correct vocabulary to explain the operation of your terminal - including technology such as hydraulics, fulcrums, and gears
  - Explaining how a real intermodal terminal is different your terminal
  - Showing the average weight of a 2-TEU container to calculate the tons per second that your team was able to move in and out of your terminal.
  - Explaining why you chose your particular mooring design.
  - Explaining why you chose the ballast used.
- One team member should be responsible for maintaining the team’s engineering notebook but each team member should maintain an individual notebook. The Coach’s manual has a more detailed description of what needs to be in an engineering notebook.
- Other students can be involved with the team development process throughout the preparation time.

Your team’s choice:

- Design and assemble the land transport to get the containers out of the terminal (even though they don’t leave)
  - Your team may have access to Lego, toy trucks, HO train parts; any of which could be used to create the outgoing terminal transport
  - Whatever the team choice, the mode must be able to accommodate the container’ size and be able to move enough to get all four containers onto it.
- Design a mooring system for the barge so that the barge can be secured and then moved for the crane to unload the four double-stacked containers.
  - The barge must be moored while a container is being unloaded or loaded and will need to be moved to allow the crane to be able to be perpendicular to the starting and ending positions of the container being moved.
  - The containers will be double-stacked on the barge, need to be double-stacked on the terminal transport, and then double-stacked when placed back on the barge.
- Determine the best ballast to use with the barge
- The specific arrangement of the stationary syringes to allow more efficient crane control by the student operators
- Team branding: can include team name, logo, color theme, and other components
Your team score is based on:

- The time it takes your team to move four containers from the barge to your outgoing terminal transport and then moving them back
- Skills in handling the containers, for example
  - Not losing a container in the water
  - Not letting a container slide or drop as it is moved
  - Not crushing a container
  - Double-stacking the containers, with good alignment with the transport and relative to each other
- The ability to explain the process and use the appropriate vocabulary of the job
- The engineering notebook completeness
- The presentation that describes what the team did and learned

Vocabulary:

Your team should know and understand these terms and use them during your presentation and in your engineering notebook. You are not required to use every term in your notebook, but you will be expected to use many of the terms in your preparation and presentation. Judges may ask you to explain some terms to demonstrate solid preparation for the competition.

<table>
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<th>Alignment</th>
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<tbody>
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</tr>
<tr>
<td>Counter Balance</td>
<td>Ship</td>
</tr>
<tr>
<td>Distance</td>
<td>Ship Building</td>
</tr>
<tr>
<td>Double Stacking</td>
<td>Ship Repair</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Terminal/Port</td>
</tr>
<tr>
<td>Engineering</td>
<td>&quot;TEU&quot;</td>
</tr>
<tr>
<td>Fluid</td>
<td>&quot;2-TEU&quot;</td>
</tr>
<tr>
<td>Force</td>
<td>Terminal Transport Options (truck/train)</td>
</tr>
<tr>
<td>Freight</td>
<td>Time</td>
</tr>
<tr>
<td>Fulcrum</td>
<td>Various Ship to Shore Cranes/Gantry Cranes</td>
</tr>
<tr>
<td>Gear</td>
<td>Velocity</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>Warehouse Worker</td>
</tr>
<tr>
<td>Intermodal Transportation</td>
<td>Weight</td>
</tr>
<tr>
<td>Load and Unload in this context</td>
<td>Work</td>
</tr>
</tbody>
</table>
Judges’ Rubric
There should be one judge for each team competing with their port/terminal event and one judge evaluating the team’s engineering notebook and presentation.

For the port/terminal event:
- A stopwatch will be used to determine the time it takes the team to complete the event. To determine timing points, the numerator of the equation will determined by taking the team with the best time for the whole competition and multiplying that time by 10. That means that the best team will get 10 points for that category. Therefore a team that takes twice as long as the best team will get 5 points and so forth. Rules for rounding are explained in the first section of the rubric table.
- Containers should be inspected before and after the event to determine damage done during the event. This will affect the Handling Skills points.
- Alignment, relative to the transports and to each other, of containers is significant. A judge should clearly communicate what tolerance s/he will allow and still give full points for that portion of Double-Stacking points. You may want to clearly mark the areas on the barge that are expected to be used when the containers are returned to it.

For the presentation event:
- The presenters should be dressed “professionally”, meaning clean clothes. For boys, a collared shirt and dress pants (coat and tie optional) and for girls, similar attire (pants are acceptable)
- Each member of the presentation team is expected to participate equally.
- The team should be prepared to answer questions from the judge, especially if the presentation does not adequately cover the process that the whole team would have had to perform.

Up to 2 bonus points may be awarded in either category for creativity/exceptional job, the maximum points are 25 for port event and 24 points for presentation.

<table>
<thead>
<tr>
<th>Parameters for Scoring</th>
<th>Points earned (integer) = (best value)**/(time in sec)</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>The time (seconds) it takes the team to move all four containers from the barge to the transport</td>
<td>0.5 points for successfully moving each container to the terminal 0.5 points for successfully moving each container back to the barge</td>
<td></td>
</tr>
<tr>
<td>**best value is determined by multiplying the best team’s time by 10 10 points max</td>
<td>Any container that is dropped cannot be moved again (except to remove it from the competition) - so a dropped container as it is moved to the terminal would not be available to be moved back to the barge. Rounding rules from previous section still apply</td>
<td></td>
</tr>
<tr>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**Handling Skills of Crane and Containers**

- **Containers were stacked correctly on the transport without being dropped in the water, crushed, dropped or slid while being moved.**
- **Containers were stacked correctly on the transport without being dropped in the water and one of the following occurred: dropped or slide while being moved or crushed.**
- **Containers were stacked correctly on the transport without being dropped in the water and two of the following occurred: dropped or slide while being moved or crushed.**

<table>
<thead>
<tr>
<th>Points</th>
<th>Points</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Double Stacking Containers**

- **Both containers were placed on top of the transport-containers and correctly aligned with the containers below them.**
- **Both containers are on top of the containers below them, but one container is not correctly aligned with the container below it.**
- **Both containers are on top of the containers below them, but neither container is correctly aligned with the transport below it.**

**Mooring design**

- **The mooring design helped the team accomplish the task and team could explain reasoning.**

**Ballast choice**

- **The ballast choice helped accomplish the task and team could explain reasoning.**

| Bonus (if awarded) | TOTAL (25 max) |
## Team's Presentation

<table>
<thead>
<tr>
<th>Points 10</th>
<th>Points 6</th>
<th>Points 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall presentation</strong></td>
<td>Students knew what the team had done to prepare for the competition and presented all of the required elements well. The presentation flowed easily between points of interest and included: pictures illustrating the development of the intermodal port and an excellent understanding of terminology.</td>
<td>Students had a general idea of what the team had done to prepare for the competition and presented most of the required elements well. The presentation flowed between points of interest and included: pictures illustrating the development of the intermodal port and a good understanding of terminology.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Points 6</th>
<th>Points 4</th>
<th>Points 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering Notebook</strong></td>
<td>Contains all page documentation and team members present details of decisions made in design of three of the following items: terminal, barge and ballast, crane, and mooring lines.</td>
<td>Contains all page documentation and team members present details of decisions made in design of two of the following items: terminal, barge and blast, crane, and mooring lines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Points 2</th>
<th>Points 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tons per Second Calculation</strong></td>
<td>Team used correct formula and performed correct arithmetic</td>
</tr>
<tr>
<td><strong>Mooring Design explained</strong></td>
<td>A design that is based on solid reasoning</td>
</tr>
<tr>
<td><strong>Choice of ballast</strong></td>
<td>Choice well defended</td>
</tr>
<tr>
<td><strong>Team branding</strong></td>
<td>Creative choices made and effectively used on port/terminal equipment and in presentation</td>
</tr>
</tbody>
</table>

| Bonus (if awarded) | TOTAL (24 max) |
Conclusion:
For a port to work efficiently, its many component parts must work together correctly. Communication between the manufacturer and the purchaser must also include the Port Authority so that materials can reach their destinations quickly. The Port Authority acts like air traffic control for ocean and river going ships, barges, and recreational boats. One of the products shipbuilders build is ships that transport products, and ship repair facilities keeps those ships in working order. These industries are located in ports where products are off-loaded. Ports need ground transportation such as trucks and trains to move products inland where ships and barges cannot go. Unless you live on a river, bay or ocean, you may never notice ships and barges travelling on the “liquid highway”. Because more people live inland, they only notice the trucks and trains and not the ships and barges that deliver goods to the trucks and trains.

Resources:
Southeastern Maritime Center
http://www.maritime-technology.org/
Port of Virginia
http://www.portofvirginia.com/
Maryland Department of Transportation: Port of Baltimore
http://www.mpa.maryland.gov/
United States Maritime Administration
http://www.marad.dot.gov/

Tags: Port, Crane, Barge, Container, Double-Stacking, Engineering, Force, Fluid, Hydraulics, Simple Machines, Transportation, Lever, Longshoremen, Mooring, Robots, Robotics, Ships, Shipping, STEM, STEAM, Train, Truck, Work