The Challenge
Your team has been contracted by a leading maritime logistics company to design and construct a support vessel that can maintain stability in open ocean conditions at a sea state of 3. The vessel must be capable of holding a specified weight of supplies, which may be at times unbalanced, while remaining stable at sea.

Real World Examples
Stability at sea is an everyday challenge for commercial and naval vessels. As wind travels uninterrupted across the open ocean, larger waves are generated. Additionally, the deeper water allows for larger waves. These conditions make working at sea extremely challenging. For example, consider the work being done right off the coast of Virginia Beach to install the foundations for wind turbines 27 miles out to sea. How do these ships remain stable as these large structures are installed and maintained? Or consider the recent events in the Middle East. To assist with the delivery of humanitarian aid to the people in Gaza, the US military constructed a floating pier that spans 3 miles off the coast into the Mediterranean Sea. How do vessels remain stable alongside this pier as their supplies are offloaded?

Things to Consider
Buoyancy and Stability: The ship must stay afloat and maintain stability while loading and unloading supplies at sea. Consider the ship's hull design, ballast systems, and stabilization mechanisms to ensure it remains afloat and minimizes rolling and pitching.

Unbalanced Load: Commonly ships will have an unbalanced load. This means that there is an unequal amount of weight to the right or left of the ship's centerline. How would you offset the unbalanced load to maintain stability if you are not allowed to touch the ship?

Stability in Saltwater: How does the salinity of water affect buoyancy and overall stability of ships? Pay attention to weight distribution across your ship to prevent capsizing and carefully design the shape of your hull for maximum performance. Conduct tests in saltwater environments of 32-25 parts per thousand to observe and adjust your design for optimal stability.

Inclining Test: The inclining test determines how much a ship tilts when weights are moved around on board. This helps calculate the ship's center of gravity and ensures it stays stable during operations. This is crucial for the ship's safety and stability at sea.

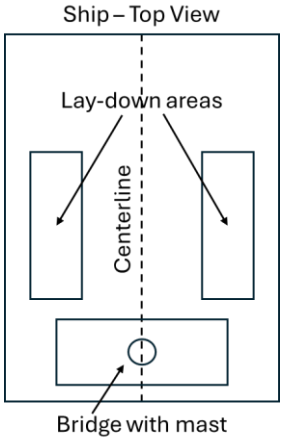
This challenge is not limited to existing ship designs. You are encouraged to think creatively and innovatively to design and develop a ship that excels in all aspects of the challenge. Exploring innovative ideas for the ship's construction materials is also highly encouraged.

The Digital Ship Challenge organizers would like to stress that the majority of work on all phases of the project is to be designed and constructed by the students.

Judging Criteria
The challenge involves six main components which will be judged: an engineering notebook, prototype iterations, oral report on the day of the competition (5-7 mins.), ship design and construction, the demonstrated ship performance, and the maritime maintenance mania challenge.

Constraints
Overall beam (width): 18" max.
Overall length: 18" max. (bow to stern)
Overall height: 18" max.

Ship must include the following spaces (all dimensions measured in L x W):
Lay down area port side (left of centerline): 2 ¼ "x 5 ¼ " – clearly mark the lay down area on your vessel.
Lay down area starboard side (right of centerline): 2 ¼ " x 5 ¼ " – clearly mark the lay down area on your vessel.
Both lay down areas must be 4" from the centerline.
*There is no restriction to the orientation of the lay down area for the containers.
Bridge with mast: At least 8" mast on top of the bridge, the bridge must be above main deck, aft of lay down areas, and allow for clear visibility above any supplies in the lay down areas. All teams must use the mast provided. The mast must be oriented with the flat side of the ruler parallel with the length of the ship.



*If the above constraints are not met, a penalty will be assessed. *

Supply containers will be provided at competition. The total maximum amount of weight is 5 lbs. The maximum height of supply containers will not exceed 2". Containers are required to be secured. Judges will have 10 seconds to secure the containers during the demonstrated performance.
Depth of water will be a maximum of 10".
Any Wire/Tubing used for ballasting must be between 3 and 5 ft. long and extend outside of the testing tank.

Team Registration

Team selection: Individual schools will determine how they will select their teams.
Maximum number of students per team is four.

Teams must officially register by September 27, 2024. Teachers will need to submit this information online at https://forms.gle/3UaDVJSJMgTUC9jH7

Project Completion Process

Teachers and Mentor(s) will create a schedule for the Mentor(s) to meet with the students several times to provide feedback. This can be done in person or virtually.
A mid-year workshop will be scheduled at OERI (formally VMASC). During this session, students will participate in a career panel, receive feedback on their progress, and have the chance to ask questions regarding the challenge. All teams and team members should plan to attend with documentation and prototype iterations.
(December 19, 2024: 9:00am – 1:00pm – lunch provided)

The Digital Ship Challenge will take place March 15, 2025, at OERI. Doors will open for registration at 8:00 am and the opening ceremony will begin at 8:45am. Teams should bring their completed ship to the competition ready to be tested and be prepared to present. Full details about the day of the event will be emailed to teachers after the registration deadline.

Project Submission: Competition will be held March 15, 2025, at OERI. Engineering Notebooks and Prototypes are due March 7, 2025, by 4pm. They are to be dropped off at OERI for judging prior to the challenge. Teachers, please make arrangements with Jennifer Renne for drop off of the notebooks. All other criteria will be judged at the event, which will culminate in ship performance testing.

Schedule of events

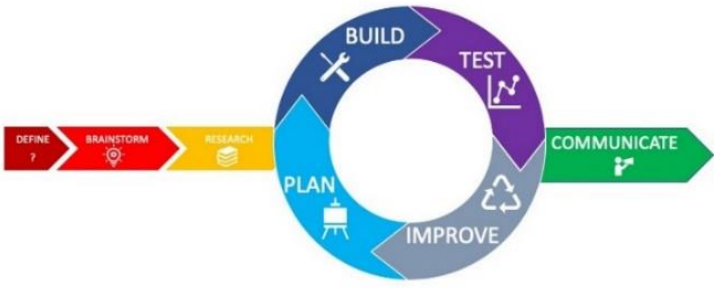
Team registration	September 27, 2024
Virtual Advisor Meeting	October 1, 2024
Mentor(s) feedback sessions	As scheduled.
Midyear review at OERI	December 19, 2024
Mentor(s) feedback sessions	As scheduled.
Engineering Notebook and Prototype Deadline (drop off)	March 7, 2025
Digital Ship Competition at OERI	March 15, 2025

If you have any questions, please contact Jennifer Renne at jrenne@odu.edu or 757-817-9975.

Criteria Information Sheet

The scoring for each section will vary. The information below gives an indication of what the judges will be looking for at the competition. For maximum points, all criteria for each section must be fulfilled.

Engineering Notebook: A binder that will formally document, in chronological order, all of the team's work that is associated with the planning, designing, production, and preparation for the challenge. Notebooks should contain EVERYTHING you do/think related to the challenge and should follow the VDOE Engineering Design Process:



This includes, but is not limited to, having brainstorming pages, sketches, technical drawings (CAD), research notes, calendar/schedule, roles of team members, calculations, daily log, safety procedures (if applicable). The technical drawings that the judges will be looking for are orthographic, isometric projections, and lines plan, all complete with appropriate annotations. The technical drawings should be printed on no larger than a B size template. Teams may include other plans if they feel it is necessary.

-Be clear
-Be detailed
-Be organized
-Include a title page, table of contents, and any references (citations in APA format)

Prototype Iterations: Designs from inception to final product should be brought including all models (can be cardboard or paper) and prototypes.

Oral Report: Team members will be dressed appropriately and be prepared to speak on any part of the challenge at their assigned time. The team will be given 5-7 minutes to make a presentation. Afterwards, time will be allotted to answer questions. The engineering notebook and prototype iterations should play a large part in the presentation. The Digital Ship Challenge organizers discourage the use of PowerPoint or Google Slides in this context.

Design and Construction, judges will be looking for the following:

-Achievement of design specifications and constraints.
-Creativity and innovation of design.
-Quality of construction.
-Finish and appearance.

Demonstrated Performance: This is the most exciting part of the Digital Ship Challenge! Each team will have the opportunity to demonstrate that their hard work has resulted in a ship design that can successfully meet the challenge.

Maritime Maintenance Mania: This day-of-event challenge will require students to work together in their teams and race against the clock to complete a ship repair challenge that demonstrates their problem-solving skills. This year's challenge will require the use of Sphero Programming, through either the use of a Sphero Bolt or Sphero RVR. Teams will be provided all materials and the Sphero at the event.

Scoring

Engineering Notebook

Max. Points	Criteria
5	Title Page: Clearly states the name of the challenge, team name, team member names, name of school.
5	Table of Contents.
10	Chronological documentation: Provides record of all team activities related to planning, designing, production, and preparation for the challenge. It should clearly demonstrate the progression of work over time.
50	Content: Should include (but not limited to) brainstorming pages, sketches, technical drawings (CAD – including orthographic, isometric, and lines plan), calendar/schedule, roles, calculations, daily log, safety procedures (if applicable). It should cover all aspects of the engineering design process. Drawings should reflect that the design of the ship meets the criteria provided.
20	Clarity: All components of notebook should be clear and understandable. Pictures, diagrams, charts, etc. should be labeled and explained effectively.
15	Detail and organization: The notebook should be well-organized and exhibit a high level of detail. It should provide insights into the thought processes and decisions of the team while following the flow of the engineering design process.
5	References: If external sources are used, they should be appropriately cited in APA format.

Prototypes

Max. Points	Criteria
20	Designs from inception to final product are displayed (this includes all models or prototypes).

Oral Report

Max. Points	Criteria
10	Appropriate attire: All team members should be dressed professionally and on time.
15	Knowledge and preparedness: All team members should demonstrate a comprehensive understanding of all aspects of the challenge. They are well-prepared to speak on any part of the challenge.
10	Presentation duration: Team presents in the 5–7-minute time frame.
15	Content: The presentation features content from the engineering notebook, prototype iterations, and engineering design process.
10	Engagement and confidence: All team members should display confidence and be engaged while presenting. This includes maintaining eye contact, using a clear and audible voice, and conveying enthusiasm.
10	Question and answer session: The team should be prepared to answer questions from the judges after their presentation. Responses should be knowledgeable and reflect a deep understanding of the project.

Design

Max. Points	Criteria
40*	Overall beam (width): 18" max.
	Overall length: 18" max. (bow to stern)
	Overall height: 18" max.
	Bridge: must be above main deck, aft of laydown areas, and allow for clear visibility above supplies in laydown area
	Laydown areas (port and starboard): 2 ¼ " x 5 ¼ " (clearly marked) and 4" from centerline
	Mast: 8" located on top of bridge
	Ship includes a functional mechanism to securely hold containers
20	Creativity and innovation: Ship design exhibits creative and innovation solution and demonstrates a unique and thoughtful approach to solving the challenge.
20	Quality of construction: High quality construction with attention to detail and precision, it is durable and reliable.
20	Finish and appearance: The finished ship has an aesthetically pleasing appearance and the overall finish and surface quality meets or exceeds expectations.

*If any of the above criteria are not met, all points (40) will be deducted. *

Demonstrated Performance

Max. Points	Criteria
60	Ship floating, stable (mast at 90 degrees), for 30 seconds
60	Loaded Out: Port side, floating with containers secured, stable (Mast at 90 degrees) for 30 seconds
60	Loaded Out: Starboard side, floating with containers secured, stable (Mast at 90 degrees) for 30 seconds
20	Waves: floating with containers secured, effectively drains any water taken on

*For every degree to the left or right of 90 degrees, 2 points will be deducted during the loaded-out portion of the demonstrated performance. If the mast is between two numbers, we will round up or down depending on if it is to the left or right of 90 degrees. (Example: if the mast is between 85 and 86, we will round to 85; if the mast is between 98 and 99, we will round to 99.)

All hands on deck – let's build a sea-worthy stable support vessel!