

GENERAL DYNAMICS
Electric Boat

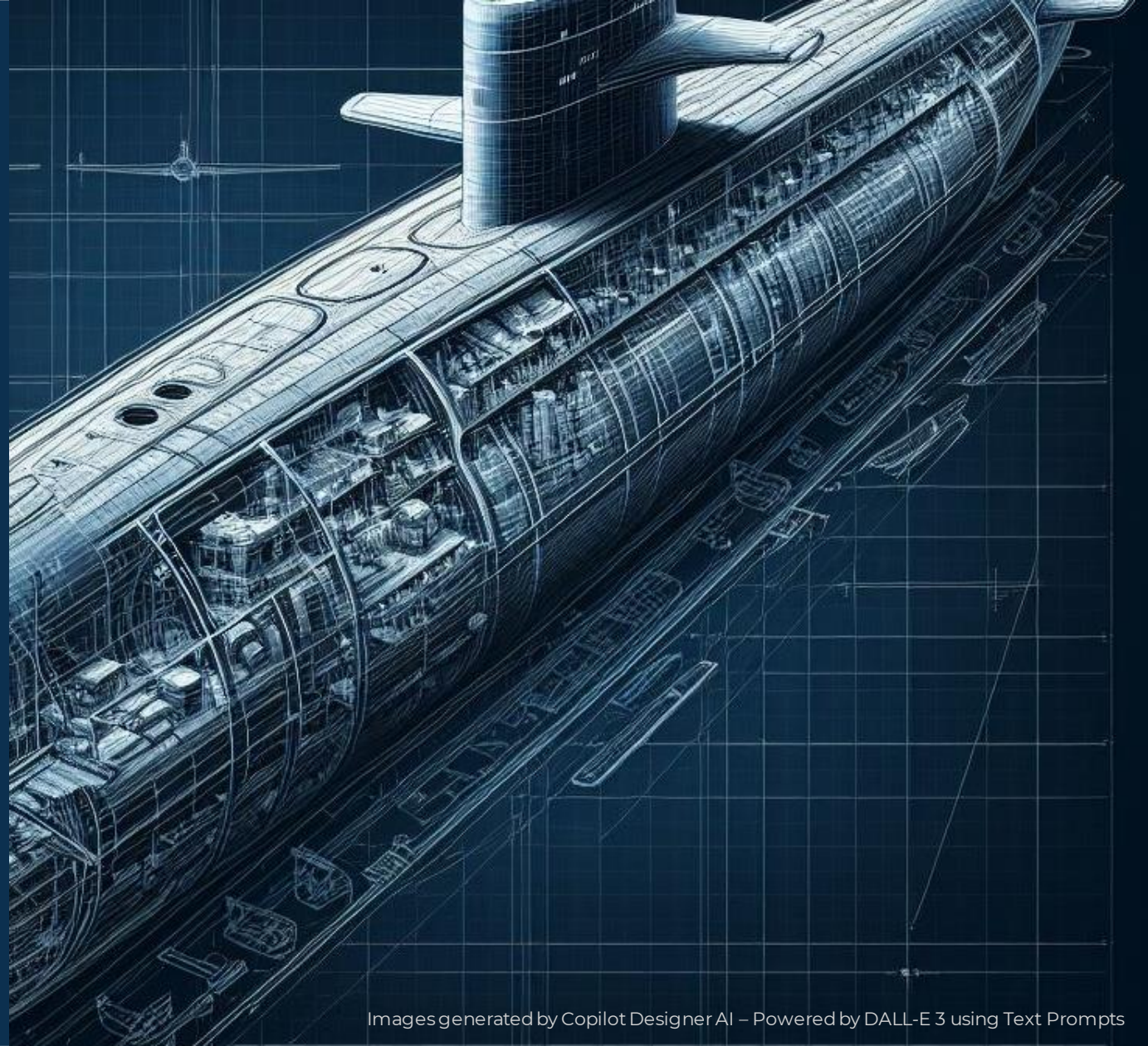


VR Simulations: Lines of a Ship

Proposal for EB Training Programs

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Scope of Lines of the Ship

- The Lines of the Ship simulation will provide a virtual environment where learners can navigate the complex interior of a submarine.
- This realistic setting allows novices to understand spatial layouts and compartmentalization within a submarine, crucial for situational awareness.
- Safety training will be integrated into this simulation by including in situ hazards, allowing trainees to practice and respond in real-time without the risks associated with physical training.
- This method prepares them for scenarios in which understanding the environment and quick, safe responses are critical.



Domain agnostic

- The Lines of the Ship immersive VR simulation is a primer to navigational training and safety awareness for all trades
- The environment is an unclassified version of a submarine with a pedagogical agent.
- This realistic setting allows novices to understand spatial layouts and compartmentalization within a submarine, crucial for situational awareness.
- Safety training will be integrated into this simulation by including in situ hazards, allowing trainees to practice and respond in real-time without the risks associated with physical training.
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The Development Cycle

Lines of the Ship VR Training



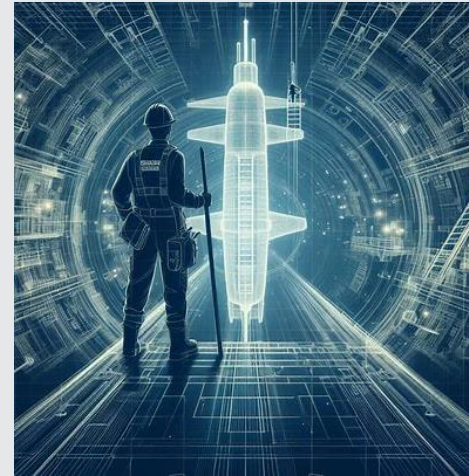
Phase 1

Submarine Model &
Navigation Orientation



Phase 2

Tasks and Procedures
Micro Learning



Phase 3

Assessment/Mission

Module 1: Pedagogical agent pointing out locations and safety hazards.

Module 2: Less scaffolded navigational tasks, identifying the relationship between blueprints and locations.

Module 3: Assessment mission module that would have trainees engage in a series of tasks without assistance from the pedagogical agent.



P1: Submarine Model

3D Model & Navigation Orientation

New trade employees may be ready to learn their trade, but they also need context for the work they will be completing.

Phase 1 of the *Lines of a Ship* VR program will comprise of the development of a virtual ship environment. This environment will become the basis for additional phases and can continue to be utilized in future VR and 3D efforts. It will provide the virtual training ground for new trades workers as well as a safe environment for experienced resources to practice or be assessed.

In addition to a simplified core 3D model, interactive areas and visual layers will be identified for phases 2, 3, and 4 so the model can support immediate and phased learning objectives. These layers and interactions will also help convey the relationship between 2D drawings and their 3D counterparts.

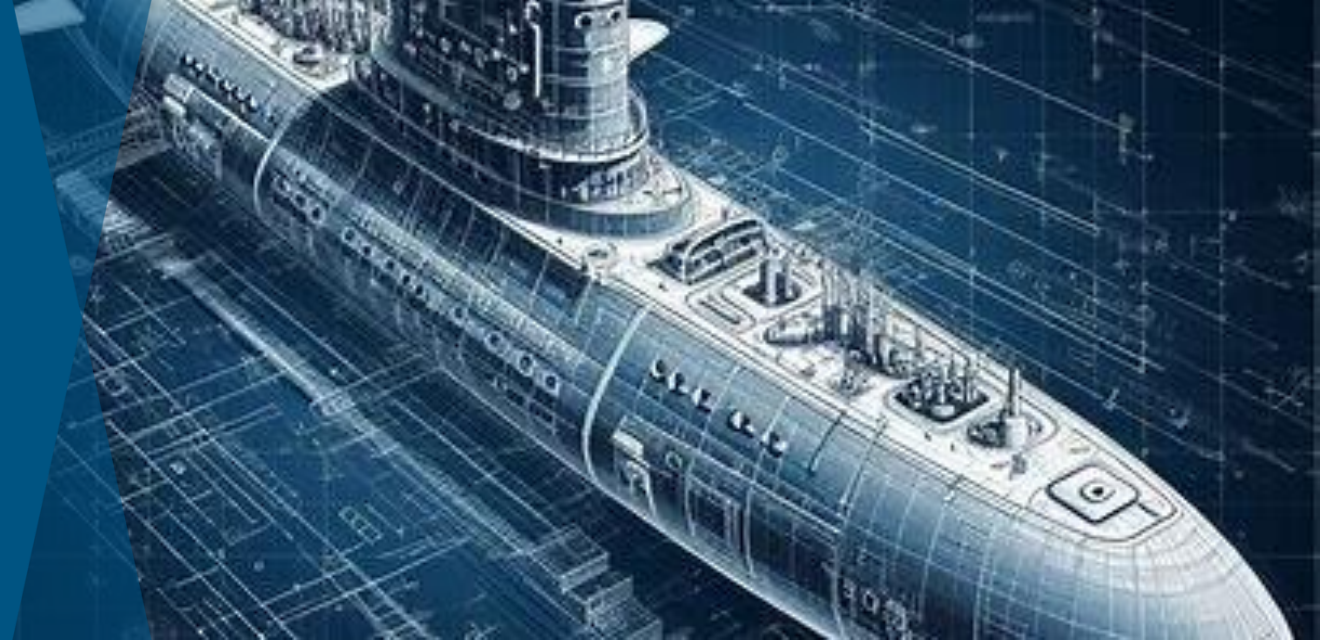
The learner will be able to navigate and explore the virtual vessel and learn terminology, orientation, and familiarize themselves with their work environment and important mission of Electric Boat.

SKILLS/LEARNING OBJECTIVES

- Become familiar with the layout of a submarine, identify areas of a submarine, and navigate within a submarine

Submarine Model

Experience a real ship, virtually.



3D Model

- A simplified, non-classified 3D submarine will be designed and developed
- Learners will be able to navigate around and within the ship
- The model will accommodate visual *layers* to be turned on and off in *specified* areas within the VR experience (labels, drawing lines, measurements, systems, etc. TBD)
- The model can be reused and modified for other XR projects

Navigation & Locomotion

- The first-person VR experience view will allow the learner to move within and around the ship using physical movement, teleportation via VR hand controls, and visual map selections designed within the experience
- Labels and markers will help orient, teach, and instruct the learner on how to navigate a real workspace and submarine
- Hazards and impediments will also be included

Interactions

- The learner will be accompanied by a virtual assistant (person/tablet) who will guide and instruct along the way, pointing out dangers, safety considerations, and information
- The learner will have a map to help navigate to specified positions, earning bonuses for finding points of interest, and will get used to VR sensory elements and controls while becoming familiar with the ship
- Learners will have simple tasks to complete to demonstrate mastery, such as identifying workspace elements (nautical orientation, navigation, lines, boundaries, markers, tags, hazards)



P2: Tasks and Procedures

Micro learning to teach work tasks and safety.

Following the tutorial style module of the P1 Submarine Model experience, learners will be ready to tackle Tasks and Procedures. Critical real-world tasks will be designed to be completed within the virtual environment.

The set of activities may be categorized and be presented to the learner through a menu system to allow learners to “learn and practice” when time is limited; some procedures may require prerequisite mastery to select (i.e., gated). New tasks and procedures may be developed over time. Each specified task, procedure, or awareness event (i.e., safety) will be defined, designed, and developed to be within the shared ship environment – Learners will move about the 3D environment to complete activities.

After the learners experience P2, their knowledge will lend itself to P3, where instruction is reduced and necessity to apply multiple areas of knowledge are essential for success and safety.

SKILLS/ LEARNING OBJECTIVES

- Navigation (navigating, locating, marking, measuring, lines, etc.)
- Safety (ladder, tripping, confined spaces, etc.)
- Intro to Drawings (views of a drawing, work location, completing simple work per drawings).

Tasks and Procedures

Complete work tasks, follow procedures, be safe.



Navigation

- This activity will teach and allow the learner to practice elements of navigation
- The activity will be designed to incorporate the ship line concepts that are necessary for accurately identifying work locations
- Virtual resources or tools may be incorporated
- The learner will move about the ship to complete several tasks
- Visual progress markers and success indicators will help guide the learner – along with the virtual assistant providing instruction and support

Safety

- This activity will teach and allow the learner to practice proper work safety and to identify and avoid typical workplace hazards
- For initial launch, three safety areas will provide instruction and practice for ladder safety, tripping hazards, and working in confined spaces
- Essential aspects of each will be included, however some steps of safety procedures may be “completed for the learner” (ex. proper ventilation already in place for confined spaces, LOTO in place for electrical, etc.)

Intro to Drawings

- This activity will teach and allow the learner to practice the concepts of drawings (“blueprints”) including how to conceptualize 2D to 3D
- Using various drawing views (plan, elevation, section) on their virtual assistant tablet, learners will navigate to the identified work location
- Using the details of the work order, learners will complete simple tasks with virtual tools
- Precise aspects of tasks may be implied (ex. putting two pipes together may join them, touching a wrench to a joint may tighten)



P3: Assessments/Mission Game

Do it right before you do it for real.

After the learner has the opportunity learn and practice, they will be assessed on their mastery of skills covered in the Lines of a Ship VR experience.

Assessments will take a similar form as the micro learning activities from Tasks and Procedures, but without any guidance and support from virtual avatars, 3D labels, lines, or hints.

Learners will be given a score and shown steps they got correct and incorrect.

SKILLS/LEARNING OBJECTIVES

- Show mastery of measurement, safety, drawings topics as covered by the Lines of a Ship VR *program*
- Experience real-world pace and urgency
- Apply knowledge to problem solve and plan
- Apply skills learned in Lines of a Ship VR program
 - Ship orientation
 - Measurement
 - Safety
 - Drawings

Assessment/Missions Game

Learning. Gamified.



3D Model

- This activity will utilize the 3D submarine model and interaction mechanics designed in earlier phases to provide the game environment
- Additional points of interaction will be identified (not just a repeat of the same tasks) that expand knowledge and practice
- For interactions not taught in previous phases, quick tutorial info panels can guide the learner

Missions

- This activity will arm the player with a daily mission “work package” that lists out the shift’s tasks
- The player will need to navigate the ship, identify, avoid, or remove hazards, and complete work using information in their digital work package

Gamified

- This activity will be gamified, from the visual aspects, to interactions, to monitoring time and points, tools and even post-work inspections
- Navigate around non-player characters (NPCs)
- Find your foreman for help
- Avoid hazards (welder in action), identify hazards (broken ladder rung), and fix hazards that could hurt others (pick up dropped tool)
- Too many mistakes will end the game
- Win by completing the day’s mission items before time runs out



Investing in Future Readiness

- Incorporating immersive simulations into submarine trade training accelerates the pathway from novice to journeyman by providing a platform where skills can be practiced intensively and iteratively.
- An instructor can incorporate the sim into their lesson plan at any point in their curriculum: first day of school, midway through, or as an activity that would support content learned over the entirety of the course.
- The use of immersive simulations in submarine vocational training offers substantial benefits across various dimensions of learning and operational readiness.
- By creating a safe, realistic, and engaging learning environment, these simulations are pivotal in preparing a skilled workforce capable of meeting the demands and challenges of submarine operations.
- The integration of such technology in vocational training is an investment in future readiness, ensuring that all tradespersons not only understand the specifics of their job but also the broader operational context of submarine safety and functionality.

Silent strength

