# Smooth Sailing

How can CNC Machines be utilized to design digital and physical prototypes for the development of maritime products?

**Suggested Equipment Skill Level**

Advanced User

**Equipment Skills**

Gear Ratios
Tolerances

Marine Mechanical Engineer

**Career & Skillset Connections**

-Engineering Principles
-Analytical Skills
-Identify and resolve Complex Technical Issues

**Project Guiding Themes**

-Engineering design process
-Designing in 3D modeling software
-Designing a prototype that meets multiple constraints

**Suggested Software & Materials**

-3D Modeling Software
TinkerCAD, OnShape, Autodesk Fusion 360, Autodesk Inventor, Solidworks
-Carbide Create Software

**Aligned VDOE CTE Course(s) and Competencies**

**Industrial Robotics Technology**
36-Weeks

**Technology Assessment**
36-Weeks

**Engineering Explorations I**
36-Weeks

VMASC

# Smooth Sailing

CNC Advanced Skill Level

How can CNC Machines be utilized to design digital and physical prototypes for the development of maritime products?

## Project Problem & Career Prompt

You are part of a team of marine mechanical engineers and technicians tasked with designing and creating a state-of-the-art gearbox to power the engine of a fishing vessel. The captain and crew are looking for a gearbox that is lighter, stronger, and more efficient than any other on the market, and are expecting a functional prototype upon completion. Your team will need to consider the unique challenges of designing a gearbox for use on a fishing vessel at sea, such as corrosion, vibration, and the need for durability in harsh marine environments. You will need to come up with innovative solutions to these problems to ensure that the gearbox is reliable and performs well under these conditions. Upon successful completion of the project, your team will present the functional prototype to the captain and crew of the fishing vessel, demonstrating the benefits of the new design, such as improved performance, increased efficiency, and reduced maintenance requirements. The new gearbox will provide a significant upgrade to the vessel's propulsion system, ensuring that it remains competitive in the challenging and highly competitive fishing industry.

## Project Background & Resources

Types of gears and gear ratios

## Investigative Questions

What is the purpose of a gearbox on a vessel?

How does a gearbox work?

## Project Criteria

-Gearbox must be composed of both CNC machined and 3D printed parts

-Consider how the design would be improved for corrosion, vibration, and durability in various environments

-Prototype must be fully functional

-Final physical prototypes must be completed prior to project deadline

## Project Constraints

-All parts must be designed by your team in 3D modeling software (cannot use prefabricated parts)

-No constraints on overall prototype size

-Entire prototype must be constructed by either 3D printed and CNC machined parts

## Suggested Pacing

1-2 Days of research and sketching ideas

3-4 Days of design

3-4 Days of constructing and finishing prototypes

VMASC

# Smooth Sailing

## CNC Machine

## Career & Skill Set Connections

### Marine Mechanical Engineer

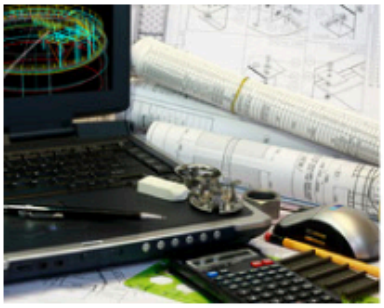
A marine mechanical engineer is responsible for designing, developing, and maintaining mechanical systems that are used in marine vessels.

### Essential Skills

*Analytical and Problem Solving
*IT Skills (CAD)
*Mechanical
*Project Management
*Understanding of marine equipment

### Academic Pathway

High School Diploma
and
Community College/Certification
or
Bachelor's Degree
or
Master's Degree



## Aligned VDOE CTE Course(s) and Competencies

Workplace Readiness Skills & Work-Based Learning Opportunities & Examine All Aspects of an Industry

### Industrial Robotics Technology

Understanding PLC/Industrial Controls

Describe the use of essential machine and basic measuring tools found in a machining lab

Produce a finished machined part

Produce a part using a three-dimensional (3D) printer

### Technology Assessment

Inventing a Technical Product or System

Assess a product or system currently in the market

Innovate a product or system to solve a problem or satisfy a need

Use 3D modeling and analysis

Producing a Technical Product or System as a Team

Produce a model or prototype that represents improvement in a product or system

Use tools, machine, and processes

Present the product or system as a team

### Engineering Explorations I

Practicing Engineering Fundamentals

Apply measuring skills using instrumentation

Apply the techniques and benefits of sketching

Examining the Engineering Design Process

All competencies that fall under this heading

# Project Management Plan

Team Member Roles

Team Goals & Timelines

Team Member Tasking

# Sketches & Design Planning