Cool Waters, Cool Tech

How can 3D printing technology be effectively utilized for on-the-spot repairs and maintenance in remote or challenging environments?

Suggested Equipment Skill Level

Intermediate User

Equipment Skills

Tolerances
3D Design

Machinist Mate

Career & Skillset Connections

-Adaptability
-Attention to detail
-Measurement

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

-PVC Pipe with connector

Aligned VDOE CTE Course(s) and Competencies

Engineering Drawing and Design
36-Weeks

Mechatronics I
36-Weeks

Advanced Drawing and Design
36-Weeks

VMASC

Cool Waters, Cool Tech

3D Printing-Intermediate Skill Level

How can 3D printing technology be effectively utilized for on-the-spot repairs and maintenance in remote or challenging environments?

Project Problem & Career Prompt

The USS New Hampshire (SSN 778), a nuclear powered submarine, left its homeport of Norfolk, Virginia over a month ago and is conducting operations in the Artic Ocean in support of Ice Exercise 2023 (ICEX 23). On a routine engineering walk-through, Machinist Mate First Class (MM1) Jimenez discovers a small leak on a chilled water pipe line. MM1 Jimenez acts quickly to isolate the leak b closing values , but a more permanent repair is needed. Luckily, the USS New Hampshire has a 3d printer onboard and all Machinist Mates received training before deploying for the exercise. MM1 Jimenez knows that a 3D printed pipe clamp will stop the leak until returning to Norfolk for maintenance.

Project Background & Resources

Understanding tolerancing
Using precise measuring tools

Investigative Questions

Does the temperature matter when implementing a 3D printed part?

Project Criteria

-Consider the type of connector currently connecting the pipes

-Physical prototype must fit around the pipes and be able to be sealed

-Final physical prototypes must be completed prior to project deadline

Project Constraints

-3D printer must be used for all parts

-3D printed part must be designed in CAD or other 3D modeling software (cannot use prefabricated 3D model as the part to be printed)

Prototype size will depend on pipe size

Suggested Pacing

1-2 Days of measurement and design (possibly research)	5-7 Days of sketching, 3D modeling, and 3D printing parts	1-2 Days of testing (more days can be added on for adjusting design and retesting)

VMASC

Cool Waters, Cool Tech

3D Printing

Career & Skill Set Connections

Machinist Mate

Machinist's Mate operate, maintain, and repair all equipment and systems on a submarine.

Essential Skills

*Math
*Detail oriented
*Aptitude for working with tools, equipment, and machines
*Problem Solving
*Oral and Written Communication Skills

Academic Pathway

High School Diploma
and
Basic Enlisted Submarine School

Aligned VDOE CTE Course(s) and Competencies

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

Engineering Drawing & Design

Exploring Engineering Design Foundations

Apply English and metric measuring devices and systems

Create objects using solid modeling

Producing Illustrations

Create parts of the assembly using a 3D printer

Create development drawings

Mechatronics I

Understanding Manufacturing Materials

Distinguish among a wide range of materials used in manufacturing

Understanding Tools used in Mechatronics

Demonstrate the use of precision measurement tools

Use U.S. Customary and Metric Units

Introducing Mechatronics Documentation

Define the differences in techniques among freehand sketching, manual drafting, and CAD

Interpret written specifications for manufacturing devices and systems

Adanced Drawing & Design

Focusing on Design

Use measuring skills

Create a 3D design model of an object

Construct physical models of designs

Focusing on Drawing

Create 3D model parts using CAD

Dimension drawings according to ANSI, ISO, MIL, DOD, and NCS

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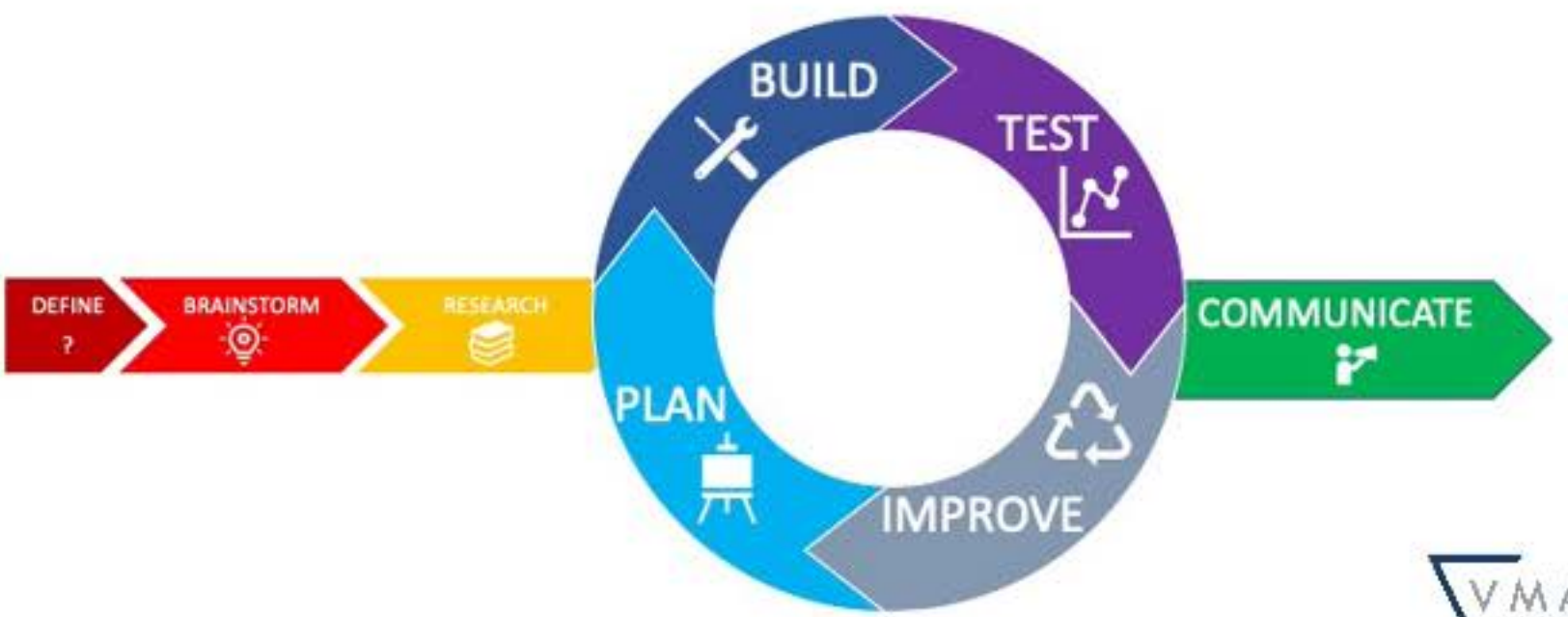
Project Management Plan

Team Member Roles

Team Goals & Timelines

Team Member Tasking

Sketches & Design Planning



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