Bioengineering Day Poster Addendum (with ABET questions)

**1. Desired Needs**

a. Develop ultrasound compatible vascular flow phantoms that mimic complex tumor vasculature and microvascular perfusion networks.
b. Validate advanced ultrasound imaging modalities such as ULM and CEUS imaging.
c. Improve visualization and tracking of single blood vessels and microbubble flow in tortuous vascular structures.
d. Develop a reproducible and cost-effective phantom workflow.

**2. Constraints**

a. Safety/Regulatory Affairs
    i. Safe handling of ultrasound systems, perfusion pumps, electrical/imaging equipment, and microbubble contrast agents.
    ii. Preventing phantom material degradation during experimentation
b. Risks
    i. Phantom ruptures/leaks, channel obstruction, and air bubble formation
    ii. Limited experience with ULM imaging and Verasonics reconstruction.
c. Global Impact
    i. Advanced ultrasound technology (e.g. Verasonics) is expensive
    ii. Differences in imaging infrastructure and technical expertise
d. Manufacturability
    i. Replicating tortuous microvasculature with narrow vessels is difficult.
    ii. Material selection required balancing acoustic realism, durability, manufacturability, and cost.
e. Quality Control/Marketability
    i. Repeatable channel geometry, stable perfusion, and consistent images

**3. Engineering Standards**

a. Tissue-mimicking materials were selected to approximate biological acoustic properties
b. Phantom geometries and perfusion systems were designed for high-frequency imaging
c. DICOM-compatible imaging and Verasonics supported data acquisition and analysis

**4. Ethical, Environmental, and Societal concerns**

a. Ethical: Reliable phantom validation reduces risk before clinical implementation
b. Environmental: Phantoms generates waste from hydrogels, tubing, and failed prototypes
c. Societal: Improved ultrasound imaging may support earlier tumor detection & diagnostics

**5. Active Teamwork** and **Leadership**

a. Collaboration and brainstorming was shared. Different opinions were welcomed and the combination of them ultimately led to the narrowing of our project scope
b. Subprojects were delegated. At times, lack of structure & communication hurt progress
c. Everyone contributed towards reaching our established goals and deadlines.
d. After constructive feedback, one would help where help was needed.

**6. Motivating Factors**

a. Acquire new knowledge: learning advanced ultrasound imaging, phantom fabrication, and image processing workflows.
b. Self-initiating: troubleshooting fabrication methods, imaging systems, and software.
c. Persist against challenges/setbacks: failures led to iterations, redesigning, and testing.

**7. Innovative and/or Entrepreneurial Ideas**

a. Standardize phantom workflows for ULM; develop customizable phantom platforms