FINAL REPORT

The Ship as A City
Webb Institute
Award #: 70NANB21H174
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Program Goals and Importance

This program aimed to create educational materials to strengthen the resources available for promoting the understanding of documentary standards, standards development, and standardization among personnel entering and currently working in the U.S. maritime industry.

The materials developed in this project are valuable as nearly every decision made in marine vehicle design, construction, and operations must include consideration of existing standards and requirements. Students enter the maritime industry with limited knowledge of the significant impact of established standards, rules, and regulations on marine vehicle design, construction, and operation. The materials were developed to reinforce that mindset early in students' professional careers. The materials are intended to serve the short-term goal of providing guidance and references for student capstone projects (senior year projects) and as valuable reference sources throughout their college-level education. After graduation, these materials will provide the long-term benefit of building foundational knowledge of this aspect of the industry, which will serve the graduates whether they become marine vehicle operators, designers, port engineers, shipyard managers, or regulators.

The materials produced are intended to serve:

1. Graduate and Undergraduate-level maritime technical programs (both marine engineering and naval architecture) and capstone projects
2. Undergraduate-level maritime license programs (both Deck and Engine Licenses)
3. Non-degree technical programs for both licensed and unlicensed mariners

The materials produced focus on the following subject areas:

1. **Standards and the Maritime Industry:** What standards are used in marine vehicle design, construction, and operations, and why and how are standards developed in the maritime industry?
2. **The U.S. Commercial Maritime Industry:** Commercial marine vehicle specifications, national and international maritime regulations, and the classification and compliance verification process.
3. **The U.S. Government Shipbuilding Industry:** Government combatant and non-combatant ship and small craft specifications and standards, national and international requirements, and classification variations for Government assets.
4. **Applying a Standardization Process to Innovation:** Applying standards to innovation and new technology.

All materials produced in this project are available to the public free of charge via a webpage accessible from Webb Institute's webpage - https://www.webb.edu/ship-as-a-city-standards-in-the-maritime-industry/.

Key Participants

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Program Outcomes

The project produced a collection of educational materials that can be used in several ways. The presentations can be used together to deliver a multi-hour short course that explores standards in the maritime industry in depth. Alternatively, individual program modules can be used à la carte, allowing instructors or students to select the components that best fit their educational objectives. Finally, the presentation materials are available upon request in an editable format, allowing educators to extract specific slides, graphics, and text for use within their course materials.

At the time of this report, ten modules were produced and posted to the program's webpage.

The program modules are assigned to five categories.

1. **Ship as a City Introduction**
    a. Ship as a City Introduction Video
    b. Program Introduction (18 Slides)
    c. Standards, Codes, Specifications, and Regulations (20 Slides)
2. **Standards and the Maritime Industry**
    a. Standards in the Maritime Industry (42 Slides)
    b. Introduction to the Maritime Regulations (47 slides)
    c. Sources of Standards and Regulations in the Maritime Industry (51 Slides)
3. **The U.S. Commercial Maritime Industry**
    a. The U.S. Commercial Maritime Industry (54 Slides)
    b. Commercial Ship Lifecycle and Standards (19 Slides)
4. **The U.S. Government Shipbuilding Industry**
    a. The U.S. Government Shipbuilding Industry (69 Slides)
5. **Applying a Standardization Process to Innovation**
    a. Applying a Standardization Process to Innovation (36 Slides)
    b. The Future of the Maritime Industry & Decarbonization (80 Slides)

The titles and descriptions of the modules produced under this award are listed in Appendix A of this report.

The individual modules include relevant references and links to additional information and resources. A question bank has been developed for educators and is available on the program's website. This question bank supports the development of assessment tools.

Matthew Werner of Webb Institute will continue to add materials to the webpage, including new presentations, educational videos, references, links, and relevant industry news. The web page invites industry and academic partners to request additional content and contribute materials for public distribution through the program.

The materials developed in this project are being incorporated into the following courses in Webb Institute's undergraduate naval architecture and marine engineering program:

Course Name	Description	Academic Level	Module(s) Used
Introduction to Naval Architecture	Introductory course introducing students to topics in naval architecture	First Year	1. Introduction to the Maritime Industry 2. The U.S. Commercial Maritime Industry 3. The U.S. Government Shipbuilding Industry
Marine Engineering Auxiliary Systems and Components	Course presents the fundamentals of system components and auxiliary shipboard systems	Second Year	1. Applying a Standardization Process to Innovation
Ship Structures	Engineering course focused on modern ship structural analysis and design techniques	Third Year	1. Standards, Codes, Specifications, and Regulations 2.
Ship Design 1	Introduction to ship design culminating in a concept ship design	Third Year	1. Standards in the Maritime Industry 2. Sources of Standards and Regulations in the Maritime
Marine Transportation		Fourth Year	1. Commercial Ship Lifecycle and Standards 2. The Future of the Maritime Industry & Decarbonization

The use of these materials in Webb Institute's academic program will serve approximately 100 undergraduate students each year.

The project materials were provided in an editable format to the following parties:

- Dr. Thomas McKenney, Associate Professor of Engineering Practice in the Naval Architecture and Marine Engineering Department of the University of Michigan, for incorporation into the department's undergraduate and graduate courses. The University of Michigan's naval architecture programs serve approximately 150 undergraduate and graduate students annually.

- Mr. Jeffrey J. Hough, Highly Qualified Expert and Special Advisor for Ship Design, Office of ASN (RD&A), U.S. Navy. Mr. Hough plans to use the materials for the education and training of engineers working in the US Navy's ship design and acquisition workforce, which employs thousands of engineers.

The project materials have also been shared with the faculty advisors of the 41 student sections of the Society of Naval Architects and Marine Engineers. There are approximately 1200 student members of SNAME located in 41 countries.

Evaluations of Work

The materials for these presentations were delivered to a varied audience, including undergraduate students, college faculty, and industry professionals. The presenters received positive feedback on the presentation and materials from audience members. Academic reviewers deemed the material suitable for students in terms of scope and depth. Furthermore, the availability of the source material was appreciated as it allows for the flexible incorporation of materials into existing academic courses.

Findings and Lessons Learned

A centralized resource addressing the use of standards in the maritime industry did not previously exist. The completion of this project has created such a centralized resource. A web-based hosting platform makes the materials accessible to students, educators, and industry professionals. Additionally, the web-based platform facilitates easy augmentation and updating of project materials. Collaborators are invited to submit content to add to the project library and to request additional content and topical focuses.

The academic audience preferred in-person presentations over recorded lectures. Faculty members welcomed the ability to have access to the presentation material in a format that allows them to incorporate select material into their course lectures. For this reason, editable PowerPoint files will be made available to educators on request.

Many standards organizations have outreach efforts to share the importance of standards and explain how their organizations develop and maintain them. The project materials incorporate references to these resources rather than recreating what is already available in the public domain.

The leading US professional society dedicated to the fields of ship design, naval architecture, and marine engineering, SNAME, does not currently produce a comprehensive compendium to marine industry standards and guidance documents. There is an opportunity to utilize the results of this project as a starting point for developing a compilation on behalf of the SNAME organization.

The international and US regulations applicable to ship design and operation are well-documented and easily accessible to students and practicing professionals. Similarly, classification society rules are made available for free on the internet by most classification societies.

Outreach Activities

Outreach for the project took several forms. First, presentations using materials developed for the

project were delivered primarily to undergraduate students. Engineering students from at least four different naval architecture, marine engineering, and ocean engineering programs attended these presentations. (NYS Maritime College, Stevens Institute of Technology, United States Merchant Marine Academy (USMMA), and Webb Institute)

Table 1 lists the presentations made by project participants using the products developed in this project.

Table1. Project Presentations

Title of Presentation	Name of Presenter	Date of Presentation	Presentation Venue	Audience of Presentation	Description of Presentation
Introduction to Classification Societies	Richard Delpizzo	3/21/2022	Webb Institute In Person – approx.100 students, 8 faculty	Undergraduate Naval Architecture And Marine Engineering Students	Explored the role of Classification Societies and how they support technology development in the marine industry.
Introduction to Standards for Hybrid Power and Alternative Fuels	Richard Delpizzo	3/22/2022	SNAME NY Met Section Meeting In Person - approx. 40 participants (additional online)	Professionals and college students from Webb Institute, USMMA, NYS Maritime College, Stevens Institute	Explored the role of Classification Societies and how they support the evolution of technology, with a focus on alternative fuels and hybrid power.
Introduction to Classification Societies, Regulations, and Evolving Technology	Richard Delpizzo	4/17/2024	United States Merchant Marine Academy In Person – approx. 50 students	Undergraduate Students	Explored the role of Classification Societies, US regulations, and evolving technology.
Introduction to Classification Societies - Regulations and Evolving Technology	Richard Delpizzo	4/18/2024	MIT In Person – approx. 30 students	Graduate Students – US Navy 2N Program	Explored the role of Classification Societies, US regulations, and evolving technology.
The U.S. Government Shipbuilding Industry	Richard Delpizzo	5/14/24	United States Merchant Marine Academy In Person – approx. 50 students and Faculty	Undergraduate Students in Ship Management Class	Explored the US Government's ship acquisition process, including the use of Mil-Specs and Mil-Standards

The Ship as a City: The Use of Standards to Design, Build, and Operate Marine Vehicles	Richard Delpizzo and Jorge Segovia	9/16/2024	ANSE Fleet Maintenance and Modernization Symposium In Person – Approx. 50	Professionals seeking continuing education	Overview of the project and the discussion of the role of standards with a focus on government ships.
US Government's Ship Acquisition Process	Richard Delpizzo	Fall 2024	United States Merchant Marine Academy In Person – Approx. 50	Undergraduate students in Ship Management Class	Explored the US government's ship acquisition process, including the use of Mil-Specs and Mil Standards
Introduction to the Maritime Regulations	Matthew Werner	11/7/2024	Webb Institute – NA1 Class In Person – Approx. 30	Introduction to Naval Architecture Course	Introduced the regulatory structure of the international maritime industry and the role of classification societies.
Introduction to Classification Societies - Regulations and Evolving Technology	Richard Delpizzo	12/4/24	George Mason University – Engineering and Society Course In Person – Approx. 35	Undergraduate Students	Explored the role of Classification Societies and how they support the development of evolving technology in the marine industry.

Approximately 390 students and 50 professional engineers have been educated through the in-person presentations using the materials developed during this project. Additional live presentations are scheduled for spring 2025 at Webb Institute and MIT. One or more of these presentations will be recorded, and the recording will be made available on the project's webpage.

The second approach discussed the project, its goals, and its products with colleagues teaching naval architecture, marine engineering, and ocean engineering programs in US higher education institutions. These conversations and meetings were facilitated through participation in the annual meetings of the Society of Naval Architects and Marine Engineers (SNAME) and the American Society of Naval Engineers (ASNE).

The third approach announced the availability of the finalized project deliverables on a publicly accessible website. Upon request, the materials can be provided in an editable format to facilitate future updates and collaboration, allowing users to utilize specific content for educational purposes. Table 2 lists the methods used to announce the availability of the program's materials.

Table 2: Project Announcements

Announcement Source	Communication Channel	Target Audience
Webb Institute	Email	SNAME's Faculty Advisor Committee
Webb Institute	Email	SNAME's Education Committee
Webb Institute	Email	Institute of Marine Engineering, Science & Technology email distribution list
Webb Institute	Social media channels[1]	Students, Parents, Alumni[2], Industry Supporters.
Webb Institute	Social media channels	Tagging SNAME, ASNE, IMarEST, RINA, ABS, and other industry organizations.
Webb Institute	Posting on website	Visitors to Webb Institute's website, including prospective students and individuals interested in naval architecture and marine engineering

1 – Social media channels include Facebook, Instagram, Twitter, and LinkedIn.
2 - A large proportion of Webb Institute alums work in the maritime industry.

Sustainment Plan

Matthew Werner and Webb Institute will maintain the program's web page and content library. This maintenance will include:

1. Posting updated versions of the program materials as they become available.
2. Posting videos of record lectures on standards in the maritime industry.
3. Posting updated links and references to relevant information sources related to maritime industry standards.
4. Posting materials and courses produced by contributors
5. Posting and sharing invitations to collaborate in developing valuable standards-related education content.
6. Posting and sharing information about conferences, meetings, and lectures related to topics addressed in this project.

The goal is to collect content from stakeholders from academia and industry to serve the needs of students and industry stakeholders.

Conclusion

The project has successfully produced educational materials that address the role of standards in the maritime industry. The modules provide students with the opportunity to learn about

- The role of standards, classification, and regulations in the maritime industry.
- The relationship between standards, codes, classification, and regulations.
- The importance and approach to conformity assessment
- The organizations that produce and utilize standards in the maritime industry.
- The processes used to develop standards.
- The role of standards in the commercial maritime industry.
- The roles standards play in the lifecycle of a commercial vessel.

- The role of standards in the government shipbuilding industry.
- The approach to working with standardization when developing new technologies and products.

The presentations using the project materials have been well received by students and professionals. Feedback from academic partners suggests the material will be valuable for student learning and career preparation.

The ongoing maintenance and updating of the program's web page content will enable the program's objective to be sustained over time with relevant information. Students exposed to the content will recognize the program's web page as a source of valuable information as they enter their professional careers.

Questions on this project and the final report should be directed to:

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Appendix A: Module Descriptions

1. Ship as a City Introduction Video

   A video introduction of the Ship as a City project and the content covered in the course modules.

2. Program Introduction (18 Slides)

   This presentation provides an overview of the content covered in the educational materials. Discusses the concept of the ship design triangle, including specification, classification, and regulation.

3. Standards, Codes, Specifications, and Regulations (20 Slides)

   This presentation explores the differences and relationships between standards, codes, specifications, and regulations.

4. Standards in the Maritime Industry (42 Slides)

   This presentation provides an in-depth discussion of standards' role in the maritime industry. Explores how standards are formed, used, and enforced.

5. Introduction to the Maritime Regulations (47 slides)

   This presentation outlines the international regulatory framework for ship trading, including the roles of the IMO, Flag States, Port States, and Classification Societies.

6. Sources of Standards and Regulations in the Maritime Industry (51 Slides)

   This presentation examines the development and maintenance of maritime industry standards and regulations. It discusses the processes the IMO, flag states, port states, classification societies, and industry players use to create, promulgate, and enforce regulations and standards.

7. The U.S. Commercial Maritime Industry (54 Slides)

   This presentation describes the US commercial maritime industry and its primary industry segments. It then explores the regulations and standards applicable to US flag ships and offshore infrastructure.

8. Commercial Ship Lifecycle and Standards (19 Slides)

   This presentation begins with the concept design phase of a ship and progresses through construction, operation, and recycling, highlighting the role of standards in each stage of its life.

9. The U.S. Government Shipbuilding Industry (69 Slides)

This presentation explores the US government's acquisition process and the role that standards play. It addresses the concepts of Mil-Spec and Mil-Standard, as well as the role that classification societies can play in the government's acquisition process.

10. Applying a Standardization Process to Innovation (36 Slides)

    This presentation describes the processes that classification societies use to apply standards to innovations in design and equipment.

11. The Future of the Maritime Industry & Decarbonization (80 Slides)

    The presentation discusses approaches to decarbonizing maritime transportation, including new standards and regulations being developed to address the challenges of incorporating new technologies.

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