Powering Drifter Buoys with Wave Energy and Rotating Mass Technology

1. After Action Report

The topic area selected by the Drift-RMT team was student and local community engagement, specifically with K-12 student demographics. After completing the industry interviews, we noticed a lack of marine energy awareness in young learners and early curriculums. We believe that through hands-on engineering we can help maintain interest with rising generations in STEM fields. Our proposed solution hoped to incorporate our project design of ocean data acquisition utilizing marine energy to engage community members and students. We characterized our engineering journey into two basic concepts: ocean current lessons and renewable energy demonstrations. We felt that these two areas would spark a sense of inquiry in the early learners to facilitate the informational and rewarding experience of marine energy design to advance a sustainable society.

To address the challenge topic solution, Drift-RMT participated in five events, primarily targeting community and school members. These events were designed to excite the public about marine energy while providing beneficial experiences and knowledge to participants. The events targeting K-12 students thoughtfully consulted teachers, educational professionals, and Next Generation Science Standards (NGSS) to ensure the solution of promoting marine energy awareness with engaging materials was properly executed.

Logistics as far as transportation, safety, and appropriate material emerged as a challenge throughout the implementation. To navigate this, members of Drift-RMT repeatedly corresponded with education professionals, standards of practice, and maintained an open line of communication with the teachers.

1.1 Ocean Discovery Day, University of New Hampshire

Ocean Discovery Day is a two-day outreach event, targeting schools and the public hosted by the University of New Hampshire. The purpose of this event is to inform the public on marine science and ocean engineering. During this event, Drift-RMT members demonstrated two tidal turbines in the Jere A. Chase Ocean Engineering Laboratory.

Figure 1: UNH MECC Team at Ocean Discovery Day (10/20-21/2024).

Figure 1 shows an aerial view of community members at the event, as well as team members Will Moore, Matt Carlson, and Kara Wittmann educating the public on an axial flow tidal turbine.

1.2 Environmental Water Resiliency Institute Presentation, University of New Hampshire

Drift-RMT members attended a meeting for the Environmental Water Resiliency Institute (EWRI) at the University of New Hampshire. During this meeting, two team members presented a technical demonstration on the motivation of ocean data acquisition and the current Drift-RMT design (Figure 2).

Figure 2: UNH Team Members Presenting to the Environmental Water Resources Institute (2/19/2024).

1.3 Renewable Energy Day, Founder's Academy

Renewable Energy Day was planned and facilitated by Drift-RMT members and was hosted at the Founder's Academy in Manchester, NH with the 6th grade class. Team members facilitated three demonstrations on ocean currents, electrical energy generation, and renewable energy design. Activities were curated in collaboration with NOAA's educational program, Vernier, and KidWind. Close correspondence was held with the students' teachers through biweekly Zoom meetings to discuss content and to weave the material into current curriculum. After the event, Drift-RMT members reviewed the topics with the Founder's Academy science teacher who expressed interest in continuing partnership due to limited funding for science exploration. Subsequently, the Drift-RMT team donated a KidWind Advanced Turbine Kit to encourage continued renewable energy exploration at the school.

Figure 3: Composite of Founder's Academy MECC Outreach Day (3/29/2024).

Figure 3 shows team members helping students build turbine blades, showing students the Drift-RMT prototype, explaining ocean current maps, and all seven team members presenting marine energy.

1.4 Wave Tank Demonstration, University of New Hampshire

Drift-RMT hosted a demonstration of the design prototype in the Chase Laboratory wave tank for a Seacoast School of Technology class. The team provided a short lesson plan on circuitry and rotational energy generation followed by a question-and-answer session about the current design. Before the event, the team collaborated with pre-engineering teacher Scott Greenwood to incorporate a 2-week lesson plan on renewable energies to maximize the tour's effectiveness. Scott requested to remain involved in MECC and hopes to send students to UNH to continue development of the design.

Figure 4: Seacoast School of Technology visiting Chase Lab with Live Wave Tank Testing (4/19/2024).

Figure 4 shows the UNH Team at the Chase Lab with the Seacoast School high schoolers. Top: team members Will Weete and Kara Wittmann demonstrating the second prototype in the wave tank. Bottom: team members discussing device technical design and the first Drift-RMT prototype.

1.5 Manchester Hillside School Visit

UNH hosted a campus visit for seventh-grade students from Manchester Hillside School. The visit included structural engineering activities, experiencing wind energy in the UNH Flow Physics Facility, and learning about wave and tidal energy in Chase Ocean Engineering Laboratory. The goal of the campus visit was to expose students to possible STEM career paths. A team member from Drift-RMT demonstrated our technology during the visit.

Figure 5: Manchester Hillside School Students

Figure 5. shows MECC team member, Will Weete, explaining the Drift-RMT technical design with the Manchester seventh graders.

While completing the Community Connections Challenge, Drift-RMT members gained valuable experience with engagement strategies and communication. Many connections were formed with industry partners that guided professional development for team members and promoted greater interest and diversity in the marine energy community. Team members also found this portion of the MECC to be fulfilling and demonstrated the importance of sharing their passion for marine renewable energy with others. We hope to serve as a steppingstone and look at the horizon of sustainable development of our planet through the next generation of engineers.

2. Metrics Report

Following the requirement for industry interviews for the Community Connections Challenge, the team leveraged connections previously established by industry partners within the University of New Hampshire oceanographic and oil spill response research communities. Five interviews were conducted with professionals to identify areas of improvement within current ocean observation practices, methods for designing and testing marine energy technologies, and future needs from surface buoy information.

Four of the interviews were conducted virtually due to location restrictions using the Zoom platform. One interview was conducted in person by four Drift-RMT members. Prior to all interviews, correspondence occurred via email for communicating meeting logistics.

Two of the virtual interviews were conducted by one Drift-RMT member. During these interviews, the members struggled to record information while staying engaged with the participants. As a result, the remaining three interviews were attended by three or more team members. This enhanced the discussion between participants and improved the information retained from the interview.

2.1 Global Drifter Program, NOAA

Name/Email: Dr. Shaun Dolk, Shaun.Dolk@noaa.gov
Company/Affiliation: Manager of Drifter Operations Center, NOAA Physical Oceanography Division
Origin of Relationship: Professional
Marine Energy Sector: This interview served as high level research and development for integrating small-scale marine energy for maintaining surface drifter power demands. Best practices for community outreach were also discussed in relation to NOAA's "Adopt a Drifter" program with K-12 schools.
Continued Participation: Dr. Dolk expressed interest in the continuation of Drift-RMT's design and further coordination with the Global Drifter Program is expected for future validation of the rotating mass technology against currently utilized technologies.

2.2 Northeastern Regional Association of Coastal Ocean Observing Systems

Name/Email: Dr. Jake Kritzer, jake@neracoos.org
Company/Affiliation: Executive Director, Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)
Origin of Relationship: Professional
Marine Energy Sector: NERACOOS utilizes commercial data observation and marine energy technologies for high performance data management.
Continued Participation: Dr. Kritzer is interested in further correspondence with research and development projects including MECC.

2.3 Ohmsett Oil Spill Response Research and Renewable Energy Testing Facility

Name/Email: Dr. Tom Coolbaugh, tcoolbaugh@ohmsett.com
Company/Affiliation: Program Coordinator, Ohmsett Oil Spill Response Research and Renewable Energy Testing Facility
Origin of Relationship: Professional
Marine Energy Sector: This facility guides commercial or developing full-scale marine energy equipment testing in a ten-million-gallon seawater tank using real-time weather and biofouling impacts to simulate near-real ocean conditions.
Continued Participation: Future participation in MECC events is not expected.

2.4 CalWave

Name/Email: Marcus Lehmann, marcus@calwave.energy
Company/Affiliation: Co-Founder and CEO, Calwave
Origin of Relationship: Professional
Marine Energy Sector: CalWave develops and manufactures commercial long-term wave energy converters.
Continued Participation: Future participation in MECC events is not expected.

2.5 Portsmouth, New Hampshire, City Planners

Name/Email: Peter Britz, plbritz@cityofportsmouth.com
Company/Affiliation: Director of Planning and Sustainability, City of Portsmouth, New Hampshire
Origin of Relationship: Professional
Marine Energy Sector: Coastal communities like Portsmouth would benefit from more accurate storm forecasts enabled by more reliable, longer-lived ocean data buoys and a denser buoy network.
Continued Participation: Future participation in MECC events is not expected.

3. Action Outcomes

3.1 Activities and Events

To address the challenge topic solution Drift-RMT engaged in five events, primarily targeting community and academic members. These events were designed to fulfill the goals of Drift-RMT while providing experiential learning opportunities for all participants.

Table 1: Overview of Community Outreach Metrics

Date	Community Outreach	Participants	Activities	Team Attendees	Organized By
20 & 21 Oct 2023	Ocean Discovery Day	Friday: NH schools 7th-12th grades, 1,500 students; Saturday: Open House, 800 participants of all ages.	Showcased marine turbine test beds.	4 team members	UNH SMSOE
19 Feb 2024	EWRI Club Presentation	23 environmental engineering club members and 2 water resource professionals.	Presented on MECC, marine energy development, and Drift-RMT.	2 team members	MECC Team
29 March 2024	Founders Academy Marine Energy Demo	Founders Academy, 6th grade, 74 students (3 groups of 23-27 students).	Facilitated activities showcasing ocean currents, electricity generation, and wind turbines for a 1-hour session.	7 team members	MECC Team
16 April 2024	School tour of Chase OE Lab	Manchester Hillside Middle School, 7th grade, 80 students (4 groups of 20).	Showcased rotating mass wave energy converters.	1 team member	UNH CEPS
19 April 2024	Seacoast School of Technology Tour	Seacoast School of Technology, High school, 21 students.	Provided a tour of the Chase Laboratory along with a demonstration of the rotating mass wave energy converter.	6 team members	MECC Team

3.2 Communication Materials

Curriculum materials utilized in action outcomes were tailored from established educational programs including NOAA's Adopt a Drifter Program, Genecon supply packages, and KidWind educational

programs. Adjustments were made based on the knowledge level of participants, feedback from educators, and input from curriculum program designers. All curriculums were evaluated against the NGSS, specifically MS-ETS1 Engineering Design. Materials included posters illustrating data outputs, design drawings, and generalized information.

4. Outreach Strategy Outcomes

To fulfill the team's solution, outreach was directed across a diverse range of demographics with the intent to gather information, educate, and expand the marine energy community.

4.1 Outreach Methods and Demographics

The strategy for outreach utilized established educational platforms including KidWind and the Global Drifter Program. These were adapted to reflect Drift-RMT's goals and MECC guidelines. Methods for outreach included leveraging existing relationships with industry professionals, continuing the University of New Hampshire MECC Instagram account, and attending events to promote Drift-RMT team goals. An estimate of 200 community members, 15 industry professionals, and 100 students were engaged through these methods.

4.2 Outreach Strategy Reflection

Through performing our outreach strategy and methods, Drift-RMT members learned to appreciate other perspectives and understandings of the impacts of ocean observations and marine energy on society. The experience helped to guide the other aspects of the MECC deliverables including Drift-RMT target end-users, financial partners, and key stakeholders. Beyond the scope of MECC 2024, the outreach strategy gave Drift-RMT the tools to modify design development and community engagement strategies to provide sustainable societal benefit. This fulfills the goals set forth by Drift-RMT at the beginning of the competition.

5. Social Media Strategy Outcomes

Social media was utilized as part of the outreach strategy as a platform for promoting awareness of Drift-RMT and team goals. The primary platform utilized was Instagram, with the main account dedicated to providing design updates, community outreach outcomes, and Drift-RMT team diversity. Additional appearances of Drift-RMT were made on Instagram accounts owned by the University of New Hampshire marketing department, UNHToday news outlet, and the LinkedIn account owned by UNH Peter T. Paul College of Business and Economics.

5.1 Metrics on Social Media Growth

Instagram Account Name: unhmecc
Followers: 110
Drift-RMT Posts: 10

LinkedIn Account Name: UNH Peter T. Paul College of Business and Economics
Followers: 19,000
Drift-RMT Posts: 5

Website Name: UNH Today
Drift-RMT Posts: 2
Article 1 and Article 2

5.2 Social Media Strategy Reflection

The Drift-RMT team's social media strategy was to provide professional and frequent updates via posts on the main account. Best practices included expanding the social media strategy to accounts with more

traction like the UNH Business College and UNH Today. Partnering with these larger organizations allowed us to reach more viewers in the short time, where it would have been difficult to grow our own platform. Additional posting and engagement from the account would have likely reflected an increase in metrics throughout the duration of the competition.