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Background and Goal

The goal of the Research Landscape Workshop Series is to engage with the marine energy research community (both research and industry) to create an initial UMEREC Research Landscape that conceptually represents research in the marine energy sector. This landscape will help avoid duplication, facilitate collaborations and create connections between people and research, as well as help identify areas of potential research, including needs and gaps.

Developing the Research Landscape contributes to UMEREC's three objectives by:

- Increasing awareness of research: creating the landscape will help us understand what research exists, how the researchers interact, and where the gaps exist
- Evaluate and recommend ways to enhance research: each individual will be able to identify their own needs for research (ground-up, not top-down)
- Improve coordination and collaboration: each cluster will include individuals with ties to university, lab, and industry

In order to accomplish these goals, we developed a series of three workshops:

1. Workshop #1 was held on Nov 10th, 2021. During the workshop the UMEREC team introduced UMEREC, the concept of a research landscape and communicated our goals and plans to the community. 58 people attended the two hour workshop. Presenters included:
 - Samantha Quinn - POET/UMERC - Samantha provided an overview of the UMEREC program and the goal of the workshop.
 - Shana Hirsch - University of Washington/UMERC - Shana gave an overview of human centered design and how we would be running the follow-up workshops.
 - Tim Ramsey - DOE - Tim provided an overview of why DOE wanted a program such as UMEREC created.
 - Henry Jeffrey - University of Edinburgh - provided details about similar programs that have been formed in the UK and Europe.

2. Workshop #2 consisted of three identical workshops to accommodate attendee availability and facilitate small group discussion. These workshops were entitled: *Collaborating to Create a Marine Energy Research Landscape* and the purpose was to engage the research community and elicit their expertise in refining a preliminary research landscape. Workshop #2 was attended by about 75 people between the three dates and times. These attendees were a mixture of industry, lab and university researchers, with the majority of attendees being from universities. The workshops were each roughly 1 hr 45 mins each in length and were held Nov 30, Dec 1, and Dec 2. These workshops are the topic of this report.
3. Workshop #3 is tentatively scheduled for February 23rd, 2022. At this workshop, we plan to present our refined, “Community-Driven Marine Energy Research Landscape.”

Methods

In order to solicit perspectives and knowledge of the research community, three workshops with identical programs were held. These workshops were styled as focus-group-type activities and relied on human-centered design methods. The workshops were virtual (through Zoom) and used two platforms for remote interaction: Menti and Miro. Menti is a presentation program through which the audience can interact through polls and answering questions live. Miro is a program that acts as a virtual whiteboard and allows all users to interact at the same time. This took the place of moving post-it, or sticky notes around on a whiteboard had we been able to meet in person.

In each workshop we:

1. Introduced our purpose and goals and aligned them with the participants using questions and comments through Menti. This allowed us to reach a common understanding around our purpose for the workshop.
2. We divided into two break-out rooms and worked collectively to refine a preliminary research landscape. The main reasons for beginning with a landscape were: to save time and to avoid replication of work due to the many roadmaps and landscapes that have been created for the sector over the past two decades. The preliminary landscape was derived from a combination of these previous conceptualizations, and the method for this is outlined elsewhere.

3. Each group spent ten minutes in each quadrant of the landscape with a facilitator (Sam or Shana). They were instructed in using the Menti platform and told to identify challenges, gaps, capabilities, connections, and general comments. They were encouraged to change the landscape in any way they wanted. As the groups rotated through the quadrants, they iterated on each other's work, generating layers of data and feedback.
4. The entire group then reconvened to discuss the changes that had been made, and were encouraged to continue commenting. They were also encouraged to locate themselves on the landscape. We concluded with another poll in Miro to solicit overall feedback and gauge overall perception of the success of the activity.

Results

The workshops resulted in two main sets of data: Miro and Menti. The data from each of these were collated in two spreadsheets, linked here: [Menti Data](#) and [Miro Data](#).

Overview of Menti Results:

- *Definition of community*: many participants agreed that sharing of goals, ideas, resources, vision, and collaboration were key to defining our community. Some other comments included: consistent interactions, relationships, care, and support network.
- *Defining a “representative” community*: inclusivity, diversity, and common goals were common themes. Other comments revolved around ensuring inclusion of a wide range of people across academia, industry, geographic, career, and age ranges.
- *Some ideas for making a research community useful*: facilitating connections to write funding proposals with new collaborators, connecting with new people working on similar problems, creating meaningful impact, learning about new technologies, a central repository of research projects, road-mapping, and development of objectives and questions that will help move technologies forward.
- When asked *whether they had used human-centered design before* most people said they had not, and two to five participants in each group had, or were unsure if they had.
- *Things that worked for people in these workshops included*: finding new people and connections or where they need to be made, understanding the vast breadth

of research in the field, creating momentum and excitement, potential for identifying places where there need to be more connections and networking, and the ability to compare this landscape with previous landscapes to see if progress has been made.

- *Things that didn't work included:* some difficulty getting the hang of the tool, the need for more discussion during the break-out groups, lack of identification with the initial landscape, lack of focus on commercialization, need to focus on connections with other energy transitions, and concern that this was dominated by universities and lacked industry input.
- *At the end of the workshop,* there was a minority that felt confused or overwhelmed, but a poll showed that most people were left with a feeling of excitement and curiosity, along with some who felt inspired.

Overview of Miro Results:

The Miro Board exercises resulted in over 300 individual comments. What follows is a very brief overview of common and stand-out comments. Please refer to the spreadsheet for all results.

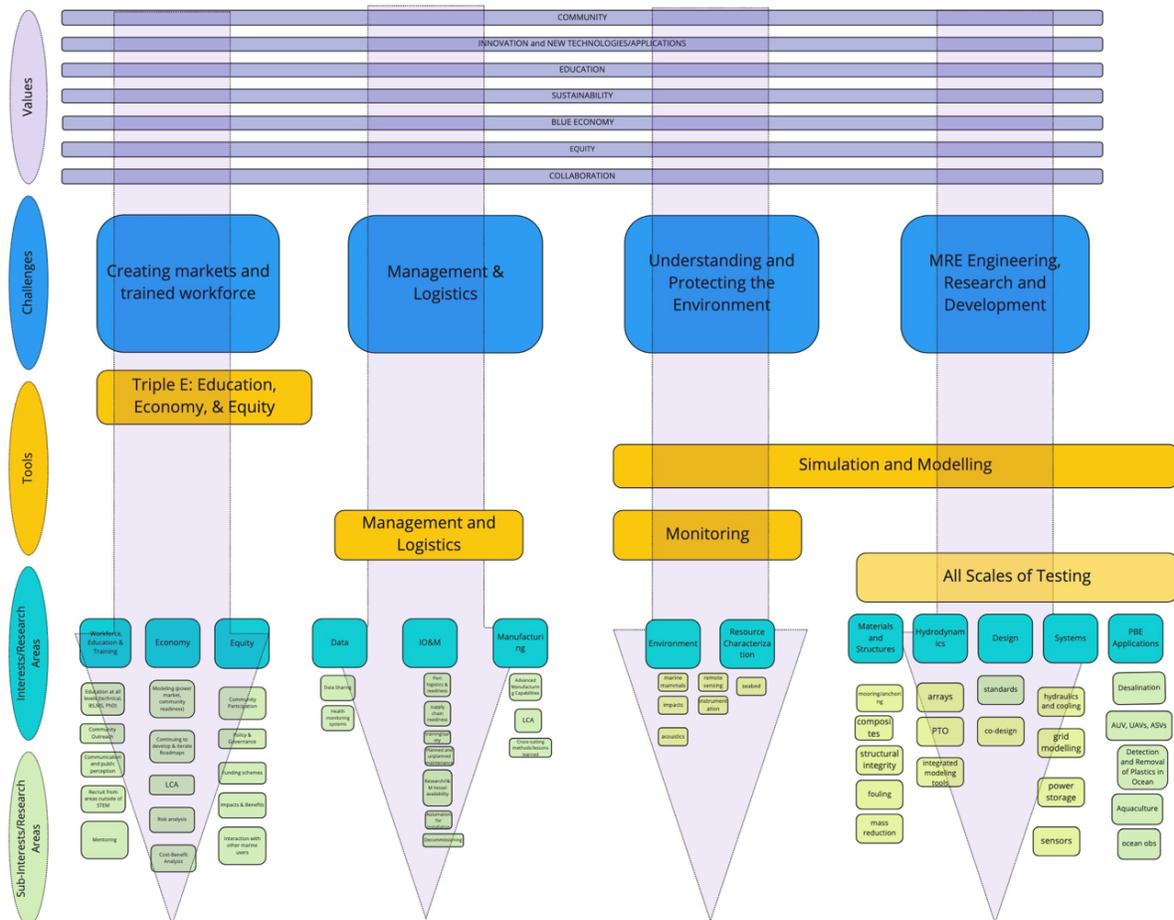
- **Challenges**
 - Spatial conflicts in the marine environment
 - Data sharing/collaboration/transformation into useful information (also funding needed for this)
 - Few deployments to look to to develop knowledge/best practices
 - Need to reach out to other sectors/fields with knowledge: for example groups with primary research on emerging technologies are not well integrated into the existing marine energy community
 - Generational knowledge gap
 - Need ways to measure and weigh, communicate and engage impacts/benefits to communities and environment
 - Salt water environment impacts on materials and electrical systems
 - DEI
 - Affordable vessels and understanding for O&M
- **Gaps**
 - Life-cycle assessment/sustainability
 - Funding, especially cross-disciplinary opportunities needed
 - Training across all education/career levels
 - Standard that fit all devices and deployment areas
 - Training needs for community participation

- Limited areas to test/study impacts and operations
 - Supply chain readiness and port logistics
 - Research and learnings from other policies/regulations in other clean energy sectors
 - Simulation and modeling tools and training for structural and load analysis
 - Need for power to collect big-data in the ocean–marine energy may fill this
 - Regional and national roadmaps
 - Economic modeling
 - Workforce development
 - Focus on environmental justice and equity
 - Anchoring and environmental impacts
 - Blue economy scale design tools
 - System optimization tools
 - There is overarching need to coordinate all aspects with international community learnings and standards
 - Need to capture how existing commercial of the shelf technology holds up in marine environment
- **Comments**
 - Equity should be integrated into all categories
 - Confusion about sustainability category including resource monitoring and characterization
 - Can rare earth elements category co-exist with sustainability?
 - Confusion about what Blue-sky meant
 - Powering communities: to call this equity, ensure that those powered communities have a voice.
 - Include technology diversification in emerging technologies
 - Cross-sector essential for emerging tech
 - Nanotechnology: it will be very interesting to see how this can be used since its application in other fields is very useful
 - Automation and autonomous inspection can be connected to UAV/UUV development
 - Need to understand markets in rural electrification and water production
 - Need cost estimation tools beyond LCOE
 - What energy justice issues can ME uniquely address?
 - Advanced manufacturing and 3D printing is good for prototyping, but how can we make it withstand ocean environment, but good way to reduce cost
 - Life-cycle assessment must be a top priority as ocean is end point for billions of tons of waste
 - Workforce must be capable and have tools for maintenance
 - Coordinate research/deployment ships with offshore oil and gas
 - We have more fouling on instruments than turbine itself
 - Hybrid systems could have good potential and especially for storage

- Are we exploring development trajectories well enough?
 - Sometimes we are not on the same page about the goals of innovation
 - Co-design in engineering and for communities is very different
 - Develop or leverage blue economy clusters
 - Remote sensing supports marine energy and requires marine energy as well
 - Maintenance and operations: there is much to learn from offshore wind
 - Sub-systems: what about full systems? Should there be a category for different WECs, TECs, OTEC, etc.?
- **Capabilities**
 - Many names, centers, research groups and affiliations were listed, so not replicated here (see spreadsheet)
 - Some other comments included:
 - Many engineering programs prepare students for the field
 - Seek out sources from social media groups—examples given
 - Use citizen science
 - Engage entrepreneurship programs

Development of the Final Workshop

The final step in the development of UMEREC's research landscape was the integration of the data from Workshop(s) #2 into a presentable and useable research landscape. This was done through iterations between a core working group (Sam, Shana, and Aaron). Most of the feedback, changes, and suggestions outlined above were integrated into the landscape. Where there were conflicting opinions, expert judgement was used to enable the creation of a useful tool. It is important to note that this "final" research landscape is not really final. It will be adapted continuously as UMEREC evolves, collects data through surveys, and develop working groups. A preliminary image of the research landscape is below - this image will then be turned into an interactive illustration with additional information and links to the member portal.



Next Steps

Workshop #3 - Presenting our Community-Driven Marine Energy Research Landscape will take place in late February 2022. During this workshop, the UMERC team will present the finalized roadmap to attendees. The roadmap will also be viewable on the UMERC website. This workshop will be shorter in duration and will mainly focus on highlighting the key findings, sharing with attendees how to officially become a UMERC ‘member’ and introducing the new portal. The main goals of this workshop are outlined below.

3rd Workshop Goal: Full buy-in and ready for next steps

- Present findings and re-organization from Workshop 2.
- Introduce next steps

- the areas/themes will drive future UMERC activities
- will work with these categories to help understand the “cutting edge” of research in that area, begin to identify research gaps and needs, and facilitate collaboration.
- Generate ideas for next steps which will include workshops to:
 1. Identify people working on themes
 2. Introduce them to each other
 3. Create a platform that will facilitate collaboration

Outcome: Developing the Portal

Using the information gathered during the workshops, the UMERC team is developing an interactive member portal. The team has tested several online portal platforms and will move forward with HiveBrite. With the portal, members will be able to create a user profile, direct message, create message boards and share papers and other research documents in a secure network. The aim of this portal is to help people connect with one another, increasing knowledge sharing and collaboration amongst university researchers as well as university researchers and industry.

HiveBrite will allow the UMERC team to identify required fields for each member to fill out, which will be searchable within the portal. Members will be able to keyword search based on the different categories a person has identified for themselves.

More information on the details of the platform are forthcoming.