Rough Seas – The Marine Technology Field in STEM Education & the Government

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Engineers technologically enable the discovery of the unknown. While the quest to explore the cosmos has made giant leaps, the expansion of knowledge of our own planet has only taken small steps. 71% of the Earth's surface is covered by water, yet less than 5% of it has been explored.[1] To begin to understand the remaining two–thirds of the planet, breakthrough technologies must be invented. The oceans contain potential discoveries with world changing implications in climate science, energy, never before seen lifeforms, and more. Marine technology encompasses the development and use of technologies for surface and underwater navigation, transportation, exploration, scientific observation, environmental conservation, naval defense, and natural resource exploitation. One would expect an opportunity of this magnitude to lure curiosity driven engineers in droves. However, outside of the few schools with oceanographic engineering programs, the marine technology field has lacked institutional exposure in STEM (science, technology, engineering, and math) education, while also suffering from minimal governmental support.

One of the alluring aspects of an engineering degree is that it can be used in almost any field. The classroom is a platform for disseminating knowledge to not only build a foundation in a field, but also find inspiration. So why limit the potential of students to conventional routes in the applications for subjects taught in the classroom? Incorporating specialized examples in lessons can introduce students to niches that were previously unknown to them and lead to more driven students finding a passion for a field. With my interest in marine technology, I had looked forward to taking fluid mechanics, the most relevant class to the field in my mechanical engineering education. However, the examples and applications provided in class were very general and unrelated to any of my interests. It seems silly to think that being a little more creative with in-class examples could be that impactful, but the potential to expose students to a field they have never known about is a golden opportunity for educators to influence students' directions in life.

Fortunately, STEM education is evolving. Schools are recognizing the need to teach students methods of innovation and to anticipate problems the new generation of engineers must address. These are summarized by the National Academy of Engineering's Fourteen Grand Challenges for Engineering.[2] Of these fourteen, four have direct applications to the oceans, including developing carbon sequestration methods (ocean sequestration), providing access to clean water (through desalinization), engineering better medicines (from marine organisms with chemical compounds unknown on land),[3] and engineering the tools of scientific discovery.[4] In addition to the Grand Challenges, the final recommendations of the Interagency Ocean Policy Task Force established by President Obama in 2009 outline the role marine technology plays in national environmental priorities. One high ranking priority in the memorandum is listed as "Ocean, Coastal, and Great Lakes Observations, Mapping, and Infrastructure: Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts."[5] To address these and other Grand Challenges as well as national priorities, we must empower students with the knowledge and opportunities to help them find their own niches like marine technology.

The government has also contributed to the plight of the marine technology field, with legislatures continuing to cut funding for science and technology. This past May, the house passed the America COMPETES Reauthorization Act (H.R. 1806), which according to a statement from the White House Office of Management and Budget "undermines key investments in science, technology, and innovation and imposes unnecessary and damaging requirements on Federal support of research."[6] Most notably, this bill includes funding cuts for geosciences and implements a stricter grant review process for the National Science Foundation (NSF).[7] Meanwhile, the Woods Hole Oceanographic Institution (WHOI), one of the leading research institutions in ocean exploration and marine technology, indicated in its most recent annual report (2013) that "the federal funding environment continues to provide a challenge. WHOI is looking to expand its sources of revenue by leveraging its industry recognized core skills in both the federal and industry marketplaces. We have begun an Institution-wide initiative to examine WHOI's blueprint for success in future years."[8] The serious repercussions of government funding cuts and regulation on the marine research field could not be more evident than from this 85-year-old institution having to seek new avenues for revenue.

With all of these obstacles, how can marine technology and ocean exploration gain recognition as a frontier rivaling space exploration? Author John Steinbeck answered this question 49 years ago in an open letter to the magazine Popular Science: "What the exploration of the wet world lacks, and must have to proceed, is organization. Undersea study is split up into a thousand unrelated groups, subjects, plans, duplications, having neither direction nor directors. There is no one to establish the path to be followed and see that it is taken. Our space probes could not have gotten off the ground without NASA, a management for analysis, planning, engineering, and coordinating, having the power to give orders and the money to carry them out. The movement to possess the sea must be given the strength and structure to move."[9] In 2012, James Cameron completed the "Deepsea Challenge," a single manned mission to the bottom of the Marianas Trench. Prior to this, the only manned mission to the deepest part of the world was in 1960 in the Bathyscaphe Trieste. Without any existing government administration to assist and the current resource-challenged climate for marine exploration, a mission with the magnitude of the Deepsea Challenge was only possible through the funding, organization, and research and development of a major private benefactor.

With overfishing wiping out aquatic life faster than we can discover it, climate change continuing to intensify, and the demand for natural resources outpacing the supply, the need to explore and understand our oceans has never been more crucial.[10] The great ocean explorer Jacques Cousteau once said, "The sea, the great unifier, is man's only hope. Now, as never before, the old phrase has a literal meaning: we are all in the same boat."[11] If mankind is to keep its boat afloat on this ocean planet, a unified effort must be made between governments, schools, and all institutions of marine technology to regard the marine technology field as a critical frontier, and move forward accordingly.

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