

# ONR Sea Air and Land Challenge Program Report

Period: July 1, 2018 – August 31, 2022

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ONR Grant N00014-18-1-2696

## 1. Program Overview

- Overall period of performance: 07/01/2018 – 08/31/2022
- Principal Investigators

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### Brief Description

The Sea, Air and Land (SeAL) Challenge is an Office of Naval Research (ONR) funded national Science, Technology, Engineering and Mathematics (STEM) educational program, which inspires and engages middle school through college-aged students in an engineering challenge. Using engineering processes, the students are tasked to develop a remotely operated unmanned vehicle with a custom payload for navigating a complex course. Students choose between designing an unmanned submersible vehicle for navigating in water, a quadcopter for flying an airborne course or a land rover to navigate a land-based course. Each course has elements that mimic those encountered by the Navy, Marines, national security agencies or first responders. This semester-long project culminates on Challenge Day when teams come together to compete and determine which engineering solution best meets the requirements of the Challenge. On Challenge Day, students also hear from and meet military personnel to learn about STEM careers in the U.S. Navy and Marines, and civilian STEM careers within the Department of Defense supporting the military.

### Primary Program Goals

**A. Maturing Regional SeAL Challenges:** The first goal was to mature the regional Challenges, which were planned for start-up or were already in place. These Challenges maintained the three objectives of the original program: 1. to provide students the opportunity to tackle a difficult engineering task while still in high school, 2. to provide insight into the tremendous technical careers in or supporting the Department of Defense and the armed forces, and 3. to help educators and administrators implement a successful STEM program into their schools given budget, time and resource constraints.

**B. Starting New Regions:** The second goal was to grow the SeAL Challenge program and obtain a critical mass of regions by fostering Regional Coordinators (RCs) and regional host venues in areas where there are no or relatively few STEM opportunities.

**C. Streamline and Transition Central Resource Role:** The third goal was to streamline the Challenge's Central Resource support role and transition it to business or non-profit based support so that it will be able to thrive on its own by the conclusion of the grant.



2022 Sea Air and Land Challenge Photos

## 2. Activities in 2Q/3Q 2022

These activities took place during the second and third quarters of 2022 (POP end date moved from 30 June 2022 to 31 August 2022).

- Provided support in hosting seven spring Challenges (April-May) in Southwestern PA (Harmony), South Central PA (Lancaster), Central PA (Altoona), Eastern PA (Berks) Northern PA (Bradford), Eastern OH (Rayland), Southeastern VA (Suffolk). Keynote speakers were from the Navy, DTRA, NASA and PSU ARL.
- Provided support to Michigan Technical University (MTU) faculty and staff in planning MTU summer camp for middle school students in Houghton, MI. This was held the week of June 19<sup>th</sup>.
- Presented the Sea Air and Land Challenge program to PSU ARL's Electro-Optics Center staff as an update over the past 10 years of EOC involvement.
- Presented the Sea Air and Land Challenge program to the Pittsburgh IEEE group July 19<sup>th</sup> via Zoom to promote awareness of the STEM initiative and seek potential involvement of mentors, judges and regional coordinators/hosts.
- Invited PSU Summer Bridge students to join the DTRA's Interaction of Ionizing Radiation with Matter-University Research Alliance (IIRM-URA) Technical Review attendees for the Student Challenge and Demonstration Event on July 12<sup>th</sup>. Students took part in the H3D sponsored event, flying drones and learning about radioactive materials and radiation sensing.

- Presented an overview of SeAL Challenge program and activities, which were supported via the association with IIRM-URA, at the IIRM-URA Technical Review at PSU (State College) on July 13<sup>th</sup>.
- Planned and supported Summer Bridge Challenge. Challenge Day was held at PSU on July 25<sup>th</sup> in the new Innovation Hub off campus in State College, PA.
- Attended and presented the SeAL Challenge program at the VTEEA (Virginia Technology and Engineering Education Association) summer conference in Winchester, VA (July 26<sup>th</sup>-28<sup>th</sup>) as we look to grow the Challenge in the Virginia area. This was a well-attended seminar.

### 3. Progress and Achievements Summary

Below is a description of the Sea Air and Land Challenge program’s progress against the program goals.

#### A. Maturing Regional SeAL Challenges –

In the spring 2018 seven regional Challenges were held. One year later, eight regional Challenges were held. For spring 2020, 12 Challenges were planned, though only one was held due to the pandemic. This one was reformatted as a completely virtual experience. With schools still working within the constraints caused by the pandemic, three formats were offered for the spring 2021; these are in-person, virtual and a hybrid of the two with a hands-on build and a virtual Challenge Day. In 2021, seven regions were planned, but three of these were canceled or combined virtually with other regions. The regions that were held during the spring/summer of 2021 included Southwestern PA (virtual format), Eastern Ohio (in-person format), Central PA (hybrid format) and Penn State’s Summer Bridge program (virtual format). A total of 75 students participated from PA, OH, WV and MN. For spring/summer of 2022, eleven Challenges were planned and 9 came to fruition in the in-person or hybrid formats with students from more than 9 states. Seven of the Challenges were held during the spring semester and two as summer programs. These Challenges were held in Pennsylvania, Ohio, Michigan and Virginia with 327 participating high school, middle school and rising college freshmen students from CA, CO, DE, MI, MN, NY, OH, PA, TX, VA, and WV.

Note that the two canceling regions were again due to pandemic-related issues. The stoppages due to the pandemic did result in a loss of forward momentum for growing the Challenge program. Though comments from regional hosts in 2022, were filled with enthusiasm and ideas for growth and regaining the size and reach of the Challenge prior to the pandemic

From a post-Challenge survey of this year’s participants, 100% of the teachers said they would want to participate in the Challenge again next year. Ninety-six percent of the students said the program improved their understanding of engineering and 86% said that they are more aware of career opportunities with the Department of Defense. Additionally, students stated that they learned about themselves, technical skills and soft skills over the course of the program. Student comments included, “The competition was very fun! Would come back again!”, “This was a really amazing experience glad I got a chance to participate!”, “Judges and volunteers were REALLY nice. Was cool talking to them between matches and answering questions.” and “This was awesome :) I really had fun and although I won't be coming back as a student, I'd be happy to help as a volunteer.”

Overall, the program was on the right track until the pandemic struck, closing schools. Though a switch was made to the virtual format, much continuity was lost in the subsequent two years. Rebounding, there was much excitement, planning and ideas for forthcoming years from regional coordinators, educators and students who took part in this spring's events.

#### **B. Starting New Regions –**

At the beginning of this grant, there were seven regional events. This included:

Southwestern Pennsylvania at Freeport HS

Northern Pennsylvania at Bradford HS

Central Pennsylvania at Bald Eagle HS

South Central PA at IU13 in Lancaster, Pennsylvania

Central Indiana hosted by the Naval Surface Weapons Center (NSWC)

And two first year Challenges,

Suffolk Virginia at Kings Fork HS

Eastern, Ohio at Buckeye Local HS

One region (NSWC) no longer hosts the Challenge. All other Challenges, except for Ohio, have changed regional coordinators or Challenge Day locations or both, but still continue to offer this worthwhile and fun program for students from surrounding schools. Since the start of the program, a traditional spring semester program has been added in Berks Co. Pennsylvania as well as two summer programs at Penn State University and Michigan Technological University.

The SeAL Challenge has been added to the PSU College of Engineering Summer Bridge Program in the all-virtual format (during the pandemic) or as a hands-on program. For the summer of 2022, a new region was hosted at the Michigan Tech University in Houghton, MI. This was a one week summer camp that they choose to host for middle school students from all over the state of Michigan.

With the return to schools and hands-on programming, there are three new regions that have already expressed interest in hosting for the 2022-2023 school year. A region in the Bronx (New York) was established at the Bronx Community College. This program did not conclude with a Challenge Day due to student attendance, and therefore completion issues, related to the pandemic. Bronx Community College is planning to host again in the coming school year. A region in Sarasota, FL had been established by an educator at a Sarasota Public High School. Though this did not come to fruition due to another pandemic-related issue, Sarasota Public Schools is excited to host the program for the coming school year. Additionally, personnel from Schuylkill Intermediate Unit 29 located in eastern Pennsylvania, spent time learning about the Challenge from IU14 (Berks, PA). They plan on hosting a region for the 2022-2023 school year. There is discussion with other areas, too, at this time.

Overall, the program did not grow as planned during the PoP. Those who took part were very excited about the program, and there is interest from various regions including school boards, regional coordinators, educators, engineering societies and supporters. A rebuild is currently underway.

### C. Streamline and Transition Central Resource Role –

In order to assist regional coordinators in presenting the Challenge to schools in their region and helping them get started, several tasks were completed. These include an updated website, videos, and a curriculum.

With the assistance of Penn State’s Learning Factory, which matches senior Capstone project teams with businesses, the Sea Air and Land Challenge website (<https://seaairland.psu.edu/>) was updated and made more user-friendly. This included a modernization of the website style, improved navigation and added features.

Two videos were created to assist regional coordinators, new educators and student teams. The first is a two minute introduction to the Challenge promotional video about the SeAL Challenge ([https://www.youtube.com/watch?v=S3P5hYPbP\\_8&t=12s](https://www.youtube.com/watch?v=S3P5hYPbP_8&t=12s)). The second is a detailed fifteen-minute “How-To” video for new educators and student teams to help them understand the SeAL Challenge program and how to get started (<https://www.youtube.com/watch?v=mBXjXS0MHIE>). These were completed and shared with regional coordinators and educators and are available on the SeAL Challenge website

Per educators’ requests, a one semester length curriculum was written with the assistance of the International Technology and Engineering Educators Association (ITEEA). The curriculum is for 7<sup>th</sup>-12<sup>th</sup> graders and can be used with the SeAL Challenge or as a stand-alone Introduction to Engineering curriculum. Either the Challenge or the curriculum may be confidently presented to students by educators and advisors who do not possess an engineering background.

For the Central Resource (PSU ARL), the program is mostly contained within the website, including the description of the program, photos, school and student registration, student guidelines (mission updated every two years), information on written team reports called PDRs or preliminary design reviews, guidelines and timelines for Regional Coordinators (RCs), guidelines for educators, mentors and judges, participation (permission) forms, pre- and post-Challenge surveys, etc. Links to other programs, such as Qualtrics for surveys, were removed and replaced with website (WordPress) functionality.

In terms of streamlining and improving the process of delivering the SeAL Challenge to RCs, the online Survival Guide for Regional Coordinators continues to be updated given feedback or requests of current RCs. Members from the IIRM-URA have helped to update the Air Challenge mission for teams; this includes an explanation of radiation and simulations of sensor reading. The Sea Challenge and Land Challenge missions will be updated summer of 2023. Additionally, the Central Resource methods have been streamlined in terms of communication with RCs (timing, formatted letters) as well as planning information and checklists.

As the third program goal also included a transition to business or non-profit based support, plans are being made within ARL to accept such support as well as co-operative efforts continue with ARL personnel working under a DTRA IIRM-URA cooperative agreement (HDTRA1-20-2-0002) which includes workforce development and outreach.

Overall, the streamlining of the Sea Air and Land Challenge, itself, was accomplished and will be continually updated as needed. The efforts under this third goal for transitioning to support other than this grant, are not complete and will need continual work moving forward.

#### 4. Participation Summary

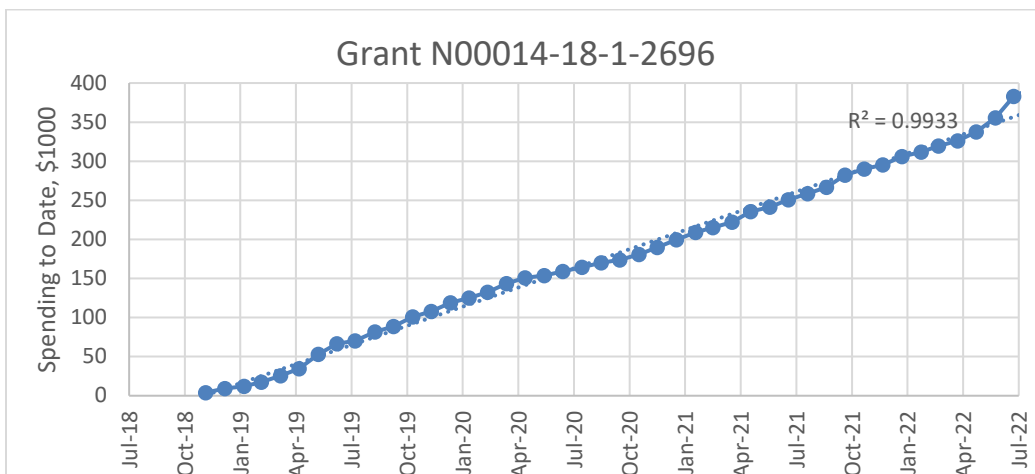
The PoP covered four spring/summer Challenge seasons. The table below shows the participation of schools and students in the culminating Challenge Days including the effects of the coronavirus pandemic on the program. Note that 518 students had registered by March of 2020 prior to school closures. One hundred six teams had submitted their Preliminary Design Review reports earlier in the semester and received their resulting scores. Many teams had gone on to complete their robotic system builds. Spring/summer 2020 had been on course to have much growth over the previous year. The following years have been rebuilding regions and are on target to exceed 2019 in the coming school year.

Spring/Summer	Format(s)	# Schools	#Students	#Teams
2019	In-person	48	553	108
2020	Virtual	1	31	6
2021	Virtual, Hybrid, In-person	11	122	25
2022	Hybrid, In-person	37	327	81

In addition to student participation, there were 22 active and retired Navy and other government agency Challenge Day keynote speakers, who talked with students about STEM-based career options. They also presented the need and various opportunities for engineers and technologically trained people in the Department of Defense as either a civilian or in the military. Several from Navy NTAG also joined in on Challenge Day and interacted with the students.

#### 5. Budget Summary

This PoP ends on August 31, 2022, and the budget is (projected to be) exhausted. The program expenditures over time through July 2022 are shown below.



## REPORT DOCUMENTATION PAGE

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