WRT-1017: Capstone Marketplace
2019-2020

Sponsor: OUSD(R&E) | SOCOM

CAPT Bill Shepherd
Michael DeLorme

12th Annual SERC Sponsor Research Review
HOSTED VIRTUALLY ON: November 18, 2020
www.sercuarc.org
How are SERC’s Capstones Different?

Typical University Capstones

- Professors organize teams and generate topics
- Two semester design projects

- Can include Industry sponsorship and participation
- Some Capstones are papers—market studies and analytics

SERC Capstones

- Students can choose Capstone topics--Real Customers with Real Problems
- Two semester projects are preferred
- Introduction to common business tools and practices— Reviews include Cost, Schedule, Deliverables, Technical Performance
- Industry participation is encouraged but up to universities to coordinate
- Tangible deliverables required—prototype software and/or hardware
SERC Capstones by the Numbers

7 Years SERC Capstones have been run

In 2019-2020:

24 Capstone projects worked
~125 Student engineers on design teams
11 Universities participated
5 Non-SERC schools
4000 Approximate dollar funding for each project

27 New projects started Fall 2020—more new project starts coming in Jan 2021
Capstones are Part of SERC’s Research

Enterprises and System of Systems (SoS)
- Enterprise Analysis
- System of Systems Modeling and Analysis

Trusted Systems
- Systemic Security
- Systemic Assurance

SE & Systems Management Transformation
- Affordability and Value in Systems
- Quantitative Risk
- Interactive Model-Centric Systems Engineering
- Agile Systems Engineering

Human Capital Development
- Evolving Body of Knowledge
- Experience Acceleration
- System Engineering (SE) and Technical Leadership Education
Capstones Extend SERC’s Network

“Outside” Capstone Universities:
- San Jose State University
- Oklahoma State University
- US Naval Academy
- University of South Alabama
- University of Texas-Austin
- Connecticut College
- University of Rhode Island
- University of Hawaii at Manoa
- Tuskegee Institute
- Sweet Briar College
- Coast Guard Academy
- United States Military Academy
- Smith College
- Johns Hopkins
- Michigan Technical University
Thrust of the SERC Capstone Experience

• Harvests good ideas which are “below the radar” of formal R&D programs
• Stimulates innovation in govt organizations--especially in the most junior people
• Provides students and schools “real” problems owned by “real people”
• Introduces a thin layer of “system engineering” thinking to students’ problem solutions—without the bulk of SE process “overhead”
• Creates model business environments; student teams develop solutions and track technical performance, schedule, costs in design reviews with their gov’t customers
2019 Scan Eagle UAS Deice System Test at OSU
2018-2020 Capstone at UT Austin
Self Intubating Airway Device

Develop a Self-intubating snake, a multidirectional device that can be loaded with an endo-tracheal (ET) tube and advanced into the mouth of a warrior in need of an airway. This device reduces the exposure of an operator to hostile fire.
CO2 Tracking Models

Initial Component Assembly:

2,500 Particle Coordinates

II
I
III
IV

O-Tube
I-Motor
N-Tube
O-Motor
I-Tube
Capstones transitioned to Programs

Problem—

Configure a Water Activated Personal Flotation Device that won’t inflate in heavy spray on small boat operations, but will protect an unconscious or injured user who may fall into the water inadvertently.
Vessel Disablement

Stopping non-compliant vessels under sail or with highly robust, protected propulsion systems

Prototype Developed by Academic Team Proved 100% Effective in 5 of 5 Underway Tests duplicating Operational Scenarios
<table>
<thead>
<tr>
<th>Research Topic</th>
<th>Number of Universities</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aural Signal Analytics</td>
<td>1</td>
<td>NSW</td>
</tr>
<tr>
<td>AR VR MR for Training and Operations</td>
<td>1</td>
<td>DOD/DIA</td>
</tr>
<tr>
<td>Dry Combat Submersible (DCS):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCS Atmospheric Monitoring</td>
<td>2</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS External Life Support</td>
<td>1</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS Fatigue/Stress Management</td>
<td>2</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS External Storage</td>
<td>1</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS Internal Storage</td>
<td>2</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS Regenerative Charging</td>
<td>1</td>
<td>NSW</td>
</tr>
<tr>
<td>DCS Salinity Specific Configurations</td>
<td>1</td>
<td>NSW</td>
</tr>
<tr>
<td>Emojis In Context</td>
<td>1</td>
<td>USASOC</td>
</tr>
<tr>
<td>Expedient Underground Sensing</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Hegemony Online</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
</tbody>
</table>
### 2020-2021 Capstones cont’d

<table>
<thead>
<tr>
<th>Research Topic</th>
<th>Number of Universities</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Military Freefall Flight Data Recorder</td>
<td>2</td>
<td>USASOC</td>
</tr>
<tr>
<td>Object Obscuration</td>
<td>1</td>
<td>USASOC</td>
</tr>
<tr>
<td>Passive Patient ID</td>
<td>2</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Pressure Measurements of Blank Ammunition</td>
<td>1</td>
<td>USASOC</td>
</tr>
<tr>
<td>Self Intubating Airway Device</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Terrain Positioning System – Ground</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Terrain Positioning System – Ground</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Terrain Positioning System – Sky</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Traumatic Brain Injury Self Assessment</td>
<td>1</td>
<td>USD (R&amp;E)</td>
</tr>
<tr>
<td>Wearable Technologies</td>
<td>1</td>
<td>USASOC</td>
</tr>
<tr>
<td><strong>Total Student Teams</strong></td>
<td><strong>27</strong></td>
<td></td>
</tr>
</tbody>
</table>
Capstone Timelines

Government Fiscal Year

Fall Semester
- Capstone Milestones With Deliverables
- Subcontracts Let
- SERC Sponsor Research Review (SSRR)
- Capstone Summit

Spring Semester
- New Govt Funding Identified
- First Topics Posted
- New Research topics collected
- Expressions Of Interest & RFPs

Fall Semester
- Funding allocations
- Research Topics Assigned to Student teams
- Letters of Intent

New Academic Year
Capstone Marketplace Benefits for USG

- Energizes “innovation” in government organizations
  - Ideas and solutions often unconventional and “Out of the Box”

- Value added—Capstones are moderate investments in comparison to resources needed for industry or govt studies. Average project ceiling is $5K for 2 Semesters’ work

- Provides customers technical background for subsequent R&D and acquisition actions

- Creates interest in advanced technical education for both students and customer personnel

- Generates student interest in USG for future employment
DOD Customer Quotes:

"Employment of a student team ensures that the results of the project reflect views unfettered by organizational prejudices and preconceptions...a perfect ‘tabula rasa’.”

"In one project related to maritime issues, a student team outperformed a warfare laboratory that had been involved in the same project for over ten years."
How to Learn More

• Capstone Marketplace website:
  www.capstonemarketplace.org

• Email us:
  capstonemarketplace@stevens.edu
  wshephe1@stevens.edu
  mdelorme@stevens.edu
Questions?