

Systems Engineering Research Center (SERC)

Capstone Marketplace Update

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What are Capstones?

Many types of Capstones are done at Universities today—

- “Capstones” are project-based learning events for senior undergraduate students. They can be found in engineering, scientific, management, business, other academic departments
- Professors generally select teams and assign project topics
- Two semester projects are common, some Capstones are one semester
- Some are studies and papers. Others are hardware or software prototypes
- Can include Industry sponsorship and participation

How are SERC's Capstones Different?

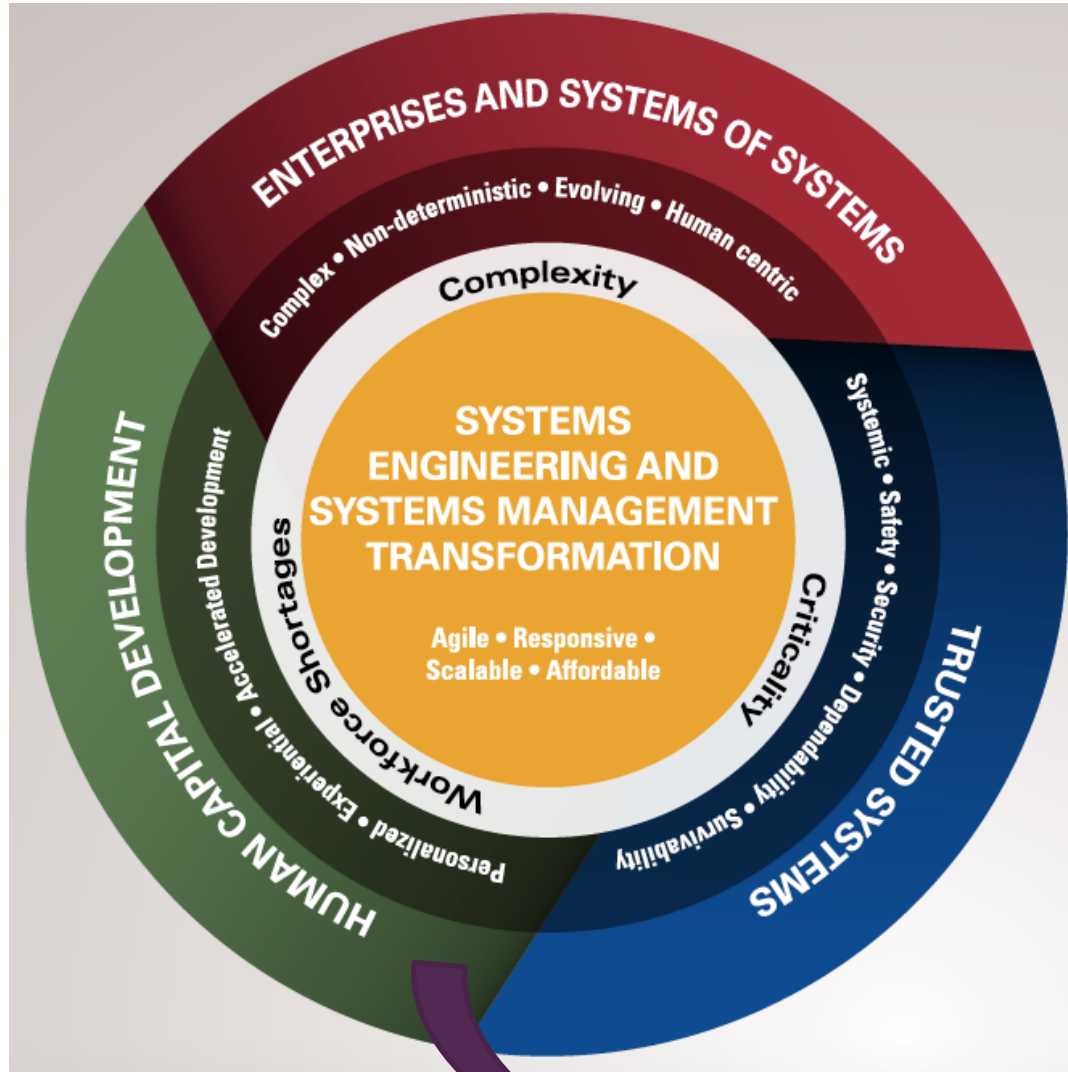
Typical University Capstones

- Professors organize teams and generate topics
- Two semester design projects
- Can include Industry sponsorship and participation
- Some Capstones are research only

SERC Capstones

- Students can select their Capstone topics—SERC connects students with military operators--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 are required— prototype software and/or hardware

Capstones Fit SERC's Research Thrusts



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*

SERC Capstones by the Numbers

8 Years SERC Capstones have been run

In 2020-2021:

- 27** Capstone project teams
- ~125** Student engineers involved
- 9** Universities
- 5** Non-SERC schools
- \$4000** Approximate dollar funding for each project

23 New project teams forming in Fall 2021

Self Intubating Airway Device—Multiyear Project

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.

Figure 1. Overview of Proposed Solution

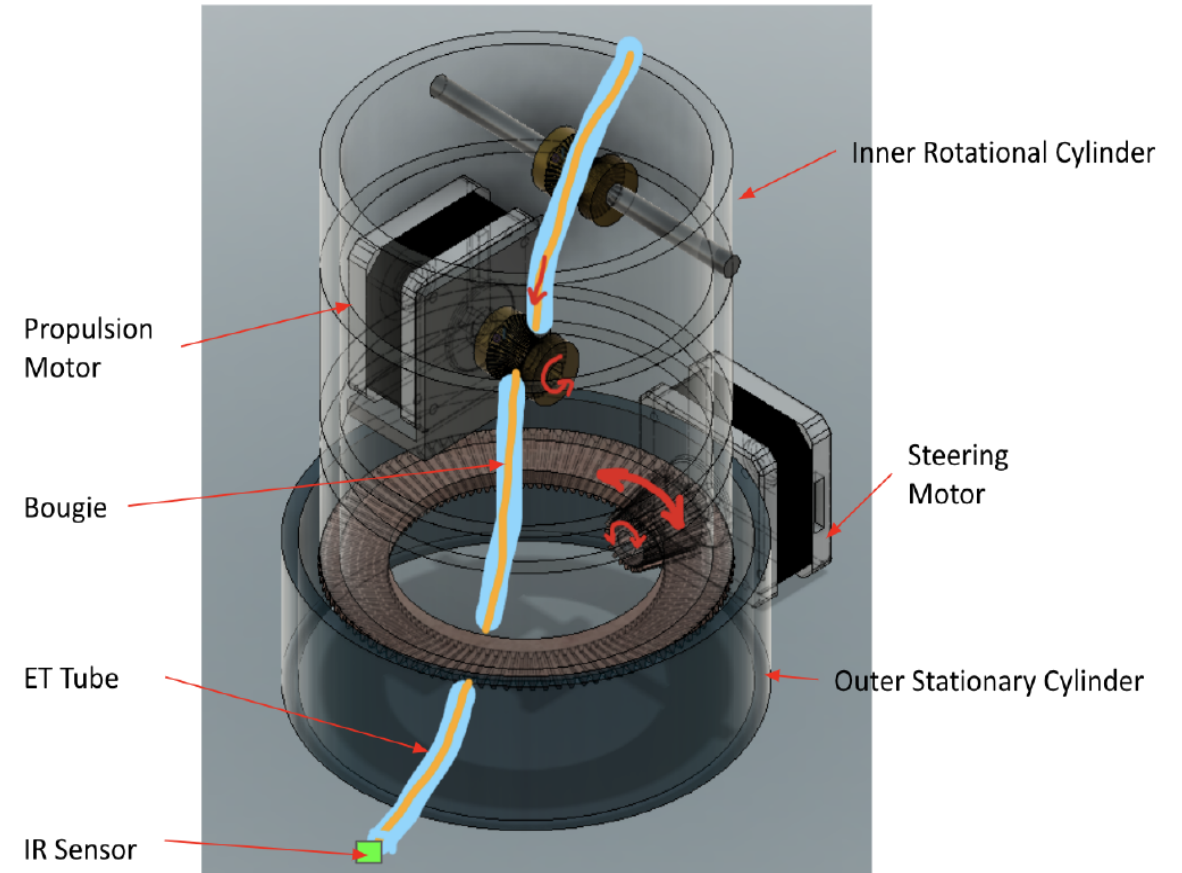


Figure 1. This figure demonstrates how the subsystems will work together. Note the inner and outer cylinders. The outer cylinder will be stationary and will hold the motor that controls steering. The inner cylinder will rotate as a unit, including the propulsion motor, the roller, and the ET tube and bougie.

Interior Storage for a Submersible

Objective: Design and build a prototype of an internal storage system to accommodate necessary items within a submersible vehicle.

Lack of a specific organization system makes access to essential equipment cumbersome and space is not maximized

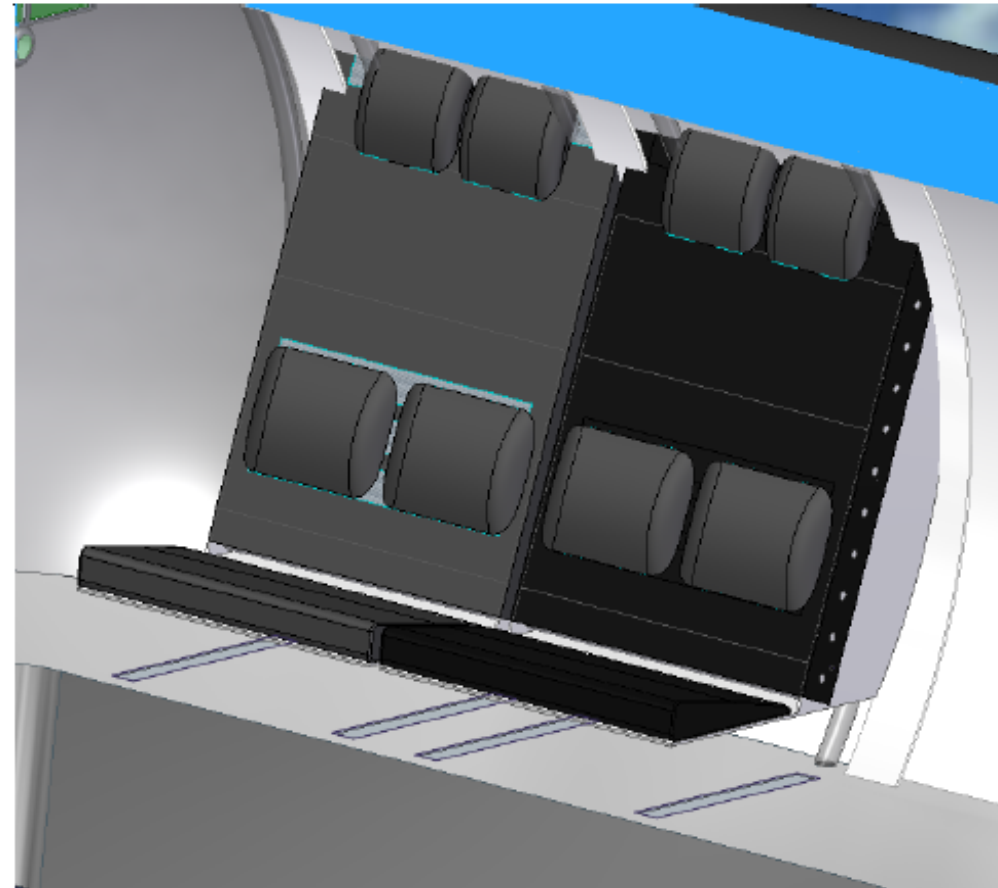


Figure 7.1.2.5: Curvature Storage in Operational Environment. The gray slits are velcro strips attached to the ballast tank (Credit: T. Ruffalo)

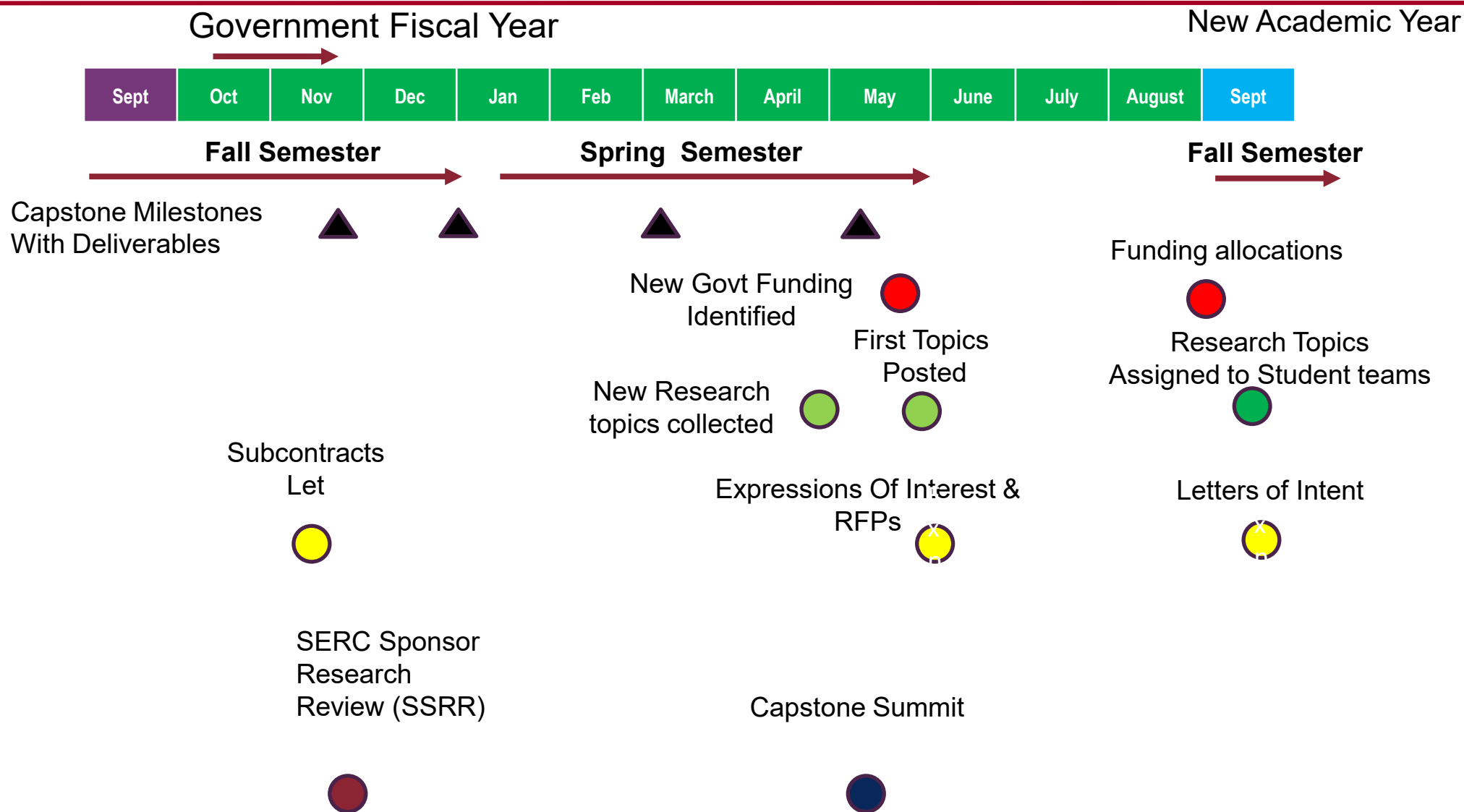
Planned 2021-2022 Capstones

Research Topic	Number of University Teams	Customer
Dry Combat Submersible (DCS):		
DCS Atmospheric Monitoring	2	NSW
DCS External Life Support	1	NSW
DCS Fatigue/Stress Management	2	NSW
DCS External Stowage Pods	1	NSW
DCS Salinity Specific Configurations	1	NSW
DCS Smart Tow Cable	1	NSW
DCS Dive Computer	1	NSW
DCS Data Logger	1	NSW

Planned 2021-2022 Capstones cont'd

Research Topic	Number of University Teams	Customer
Electric Service Monitor	1	USASOC
Working Dog Analyzer	1	USASOC
Remote Drone Recharging	2	USASOC
Self Learning Sensor Network	2	USASOC
Quiet Drone	3	USASOC
Augmented Reality	1	MARSOC
Virtual Reality	1	MARSOC
Traumatic Brain Injury Self Assessment	1	USD (R&E)
Self Intubating Airway Device	1	USD (R&E)
Total Student Teams	23	

Capstone Timelines



Capstone Marketplace--

- Provides students and schools with “real” problems connected to “real people”
- Introduces students to “system engineering” thinking
- Creates model business environments—Students track Cost, Schedule, Technical Performance
- Focuses on working Prototypes—
Students have to “Build Something”

Capstone Marketplace

Benefits for DOD and other US Govt

- Energizes “innovation” in government organizations
- Harvests “intellectual capital”, often from low level personnel
 - Ideas and solutions can be unconventional and “Out of the Box”
- Increases “bandwidth” of traditional govt R&D efforts
- Low cost. Average project ceiling is \$5K for 2 Semesters’ work
- Builds technical data on key subjects
- Can augment other funded development efforts
- Cultivates unit “MacGyvers” who understand innovation, and who want to work on important projects
- Generates student interest in USG for future employment

Capstones Extend SERC's Network



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.**"

"This has probably saved us a million dollars" (Navy Commanding Officer)

How to Learn More

- Capstone Marketplace website:

www.capstonemarketplace.org

- Email us:

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Questions?