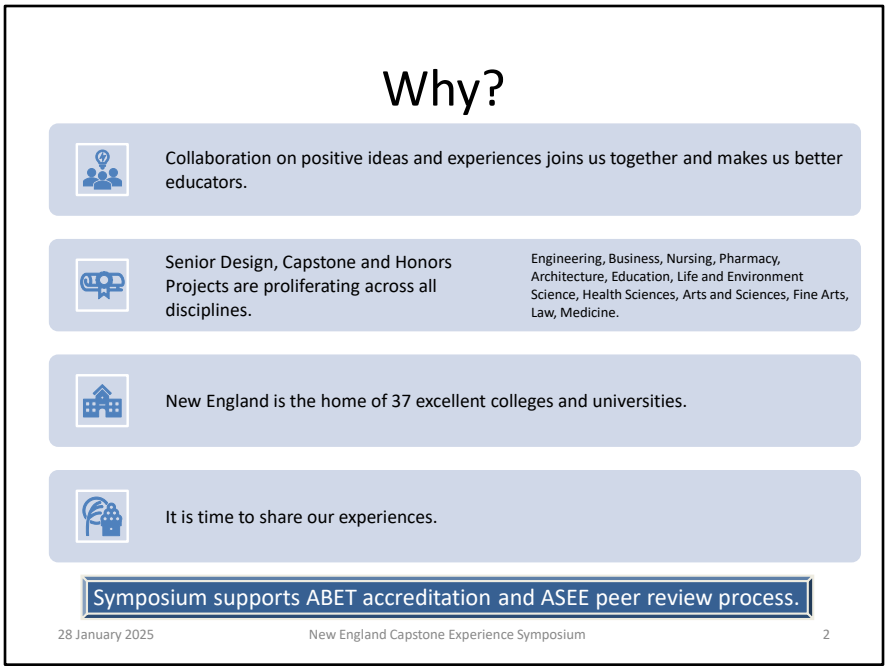
Most engineering schools in New England Universities have senior design or capstone programs. Each annual program involves hundreds of students and dozens of sponsors. Did you ever wonder what works and what doesn't in terms of organizing, incentivizing, promoting and measuring success of these projects? Would you like to find out over a 2-day weekend?

Since 2011, I've sponsored 14 senior design and engineering capstone projects at Roger Williams University, University of Connecticut, and University of Rhode Island. As a private sponsor, I've experienced many ways that staff and students design and build systems covering issues in environmental safety, homelessness, refugee shelter, human waste recycling, driving and police safety, physical therapy and injury prevention, healthcare, flood control, physical therapy, snow plowing, and rural road safety and accident prevention. That's quite a list of projects that involved mechanical, electrical, environmental, civil, biomedical, and electronic computing engineering.

This experience exposed me to the many ways engineering senior design projects are organized, funded, monitored, planned and executed. Some collaborate across engineering schools within the university. Projects are mostly sponsored by large corporations that contribute financial support but that was not always true. Students in some of my projects participated in weekly virtual or in-person meetings; others let sponsor meetings slide. Some teams submitted weekly reports; others maybe monthly if lucky. Some universities use formal processes to teach student teams like 'team building' using modules. This is popular at Uconn. Each university benefits when they exchange ideas and discuss different capabilities and limitations.



After sponsoring more than dozen projects over 10 years at public and private universities and reviewing university web sites information about their senior design projects, I realized that there are many excellent programs. However, each university approaches financial support, sponsorships, and procedures a little differently. A symposium on capstone programs can share these methods and ideas and explain what worked and what does not work. As a private sponsor, I always appreciated hearing from students about their progress or how well I did in coaching them. But that was rarely the case. Most do not provide sponsor's specific feedback. For instance, one university team presented me with an etched plaque congratulating me on sponsoring the team. Other times, I receive a nice email saying how much team members appreciated my sponsoring the project, how much they learned, and thanked me for supporting them with my private contribution. Most of the time, I hear nothing from the teams or schools. Nearly all projects end at senior graduation except for MIT. MIT does promote successful projects outside the academic sphere. One university only submits patents for qualified graduate projects, not undergraduate. Why? There are many ways to discuss how to thank sponsors, promote projects, and reward students.

Most capstone projects emphasize engineering, but the methods are applicable to all other disciplines like fine arts, law, and medicine. With so many excellent schools in

New England, most within a couple hours drive, it will be easy to plan and organize a New England area symposium. Such a symposium is right in line with the Accreditation Board for Engineering and Technology (ABET) and American Society of Engineering Education (ASEE).

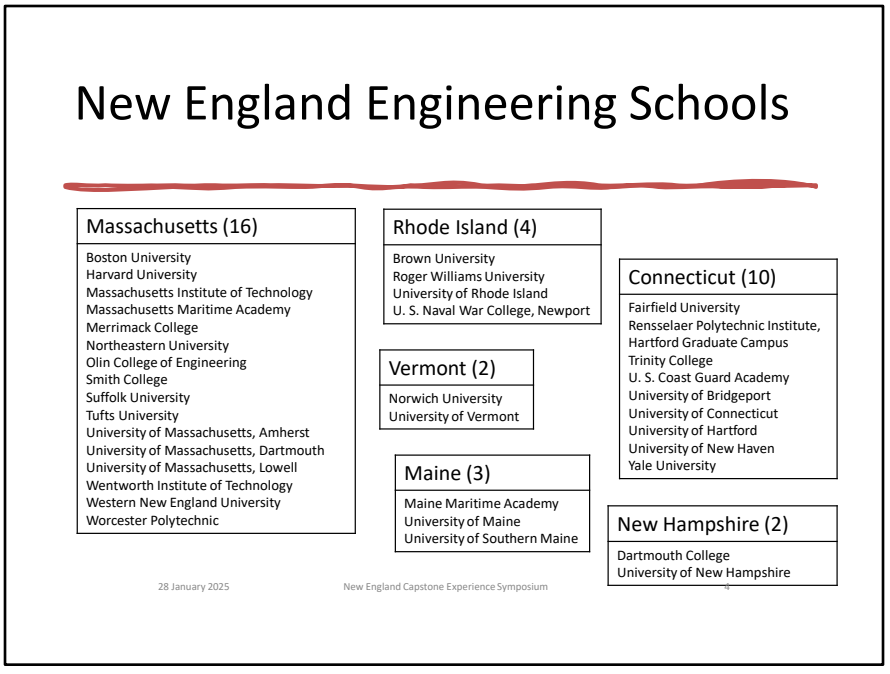
Here's the Idea

- Organize a weekend long symposium that focuses on the capstone experience of one college, e.g., **engineering**.
- Consider the first symposium as a pilot.
- Pilot symposium involves nearby RI, CT, and MA universities.
  - Within 2-hour drive; 25 - 50 participants.
- Symposium consists of panels and forums.
  - Panels consist of experts presenting specific topics with specific audience.
  - Panels organized by common degree programs, for example:
    - Biomedical, mechanical, electrical, computer, civil, chemical, ocean, and systems engineering.
  - Forums consist of broad discussion of topic with high audience participation.
  - Primary audience: deans and associates, department heads.

While most symposiums drag on for days, this symposium is a pilot project to see if there is enough interest and participation in sharing ideas about engineering capstone projects to most New England schools. This symposium might convene on a Friday and end on a Sunday. It might involve only half dozen New England schools depending upon URI's interest and commitment. An engineering multi-college symposium was selected since that's the field I am enjoy. However, this multi-school symposium applies to almost any common discipline in a university curriculum like business, health sciences, economics, arts and sciences.

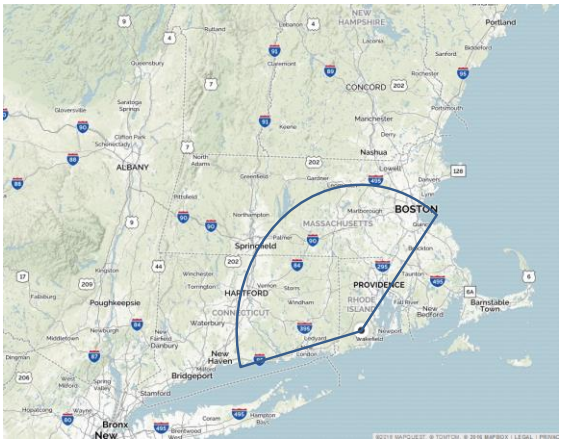
Limiting the symposium to schools within a 2-hour is based on convenience but it could stretch into a weekend event. URI is in South County (Washington County) in Rhode Island which has dozens of hotels and great restaurants within 20 miles of URI where attendees can lodge for an over night stay, if desired.

A combination of panels and forums might work to provide different venues for attendees. An engineering panel might have 5 deans or assistant deans discussing one topic like 'the future of capstone projects', 'compensation for sponsors', 'funding', 'collecting feedback from students, staff and sponsors', 'recruiting sponsors', etc.



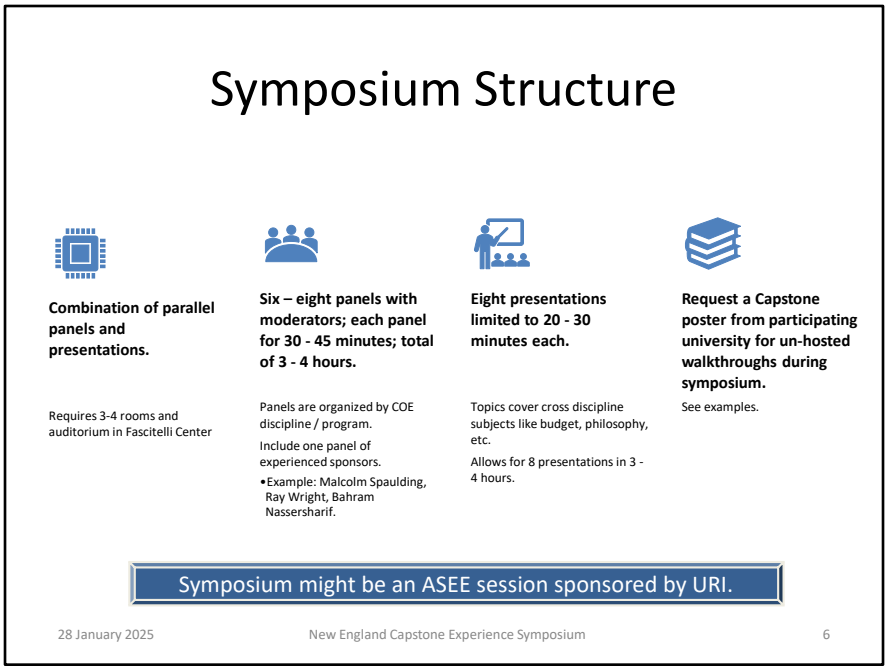
New England is home to over 30 excellent colleges and universities with many different schools in engineering, law, arts and sciences, economics, agriculture. Why not invite some of them to participate in a pilot project to share ideas, methods, and experiences about Capstone and Senior Design projects? Some are private while most are public.

Engineering Schools within 2-hour drive

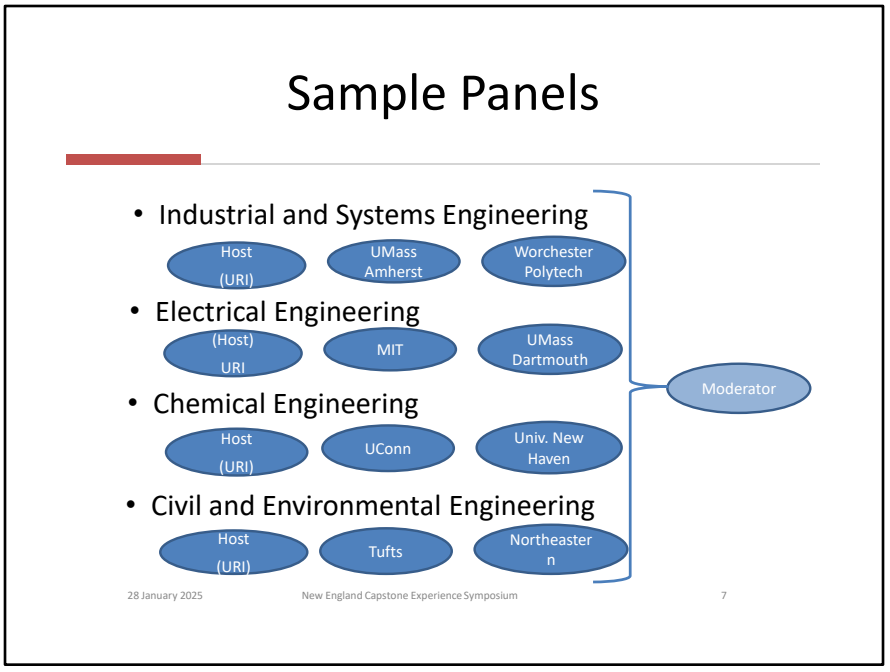


80% of NE engineering schools within a 2-hour drive.

Most of these schools are within a two-hour drive which makes it convenient for a one-day afternoon symposium or a weekend long symposium.



A combination of panels and presentations gives a good mix of opportunities for people. Each panel is less than an hour that gives time to mingle and mix. Refreshments are provided in the lobby as something Rhode Island, cheese, crackers, refreshing water, soda, tea. Let's mix it up for people from MA, NH, CT, VT, ME and show them a big Rhody welcome. Presentations might be half an hour long for university reps to give an overview of their capstone or senior design program. The entire symposium might be considered an American Society for Engineering Education (ASEE) session.

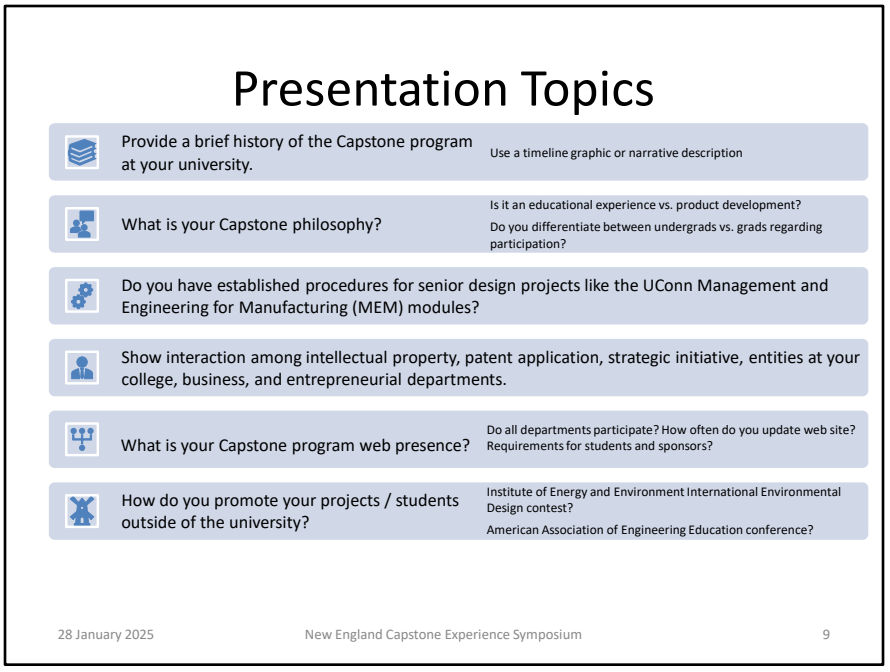


Here are examples of engineering panels hosted by URI. They would cover systems engineering, electrical engineering, chemical and civil engineering. The panels can be selected from examining the most popular and common engineering curricula across a sample of NE engineering colleges. Moderators and participants might be asked questions about how they approach assigning or volunteering students and staff, typical sponsor fees, financial support, typical problems or topics investigated, etc. Staff from participating schools might submit anonymous questions for panel members to answer and discuss.

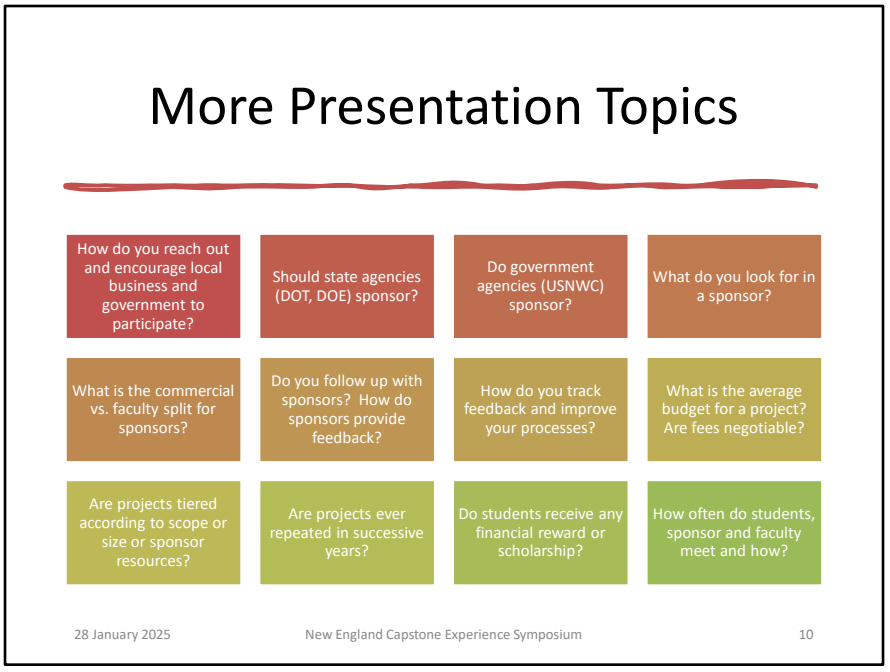
Panel Topics

How do you select capstone projects and sponsors?	**How do you communicate your Capstone results to academic and outside parties, e.g., government?**	**How would cooperation with other NE COEs improve your program / discipline?**	**Do you measure success? What works?**	**Do you collect objective and subjective feedback?**	**How would you improve your Capstone program?**	**What is your annual average budget?**
Faculty vs. commercial vs. private sponsors?						How much do sponsors provide?

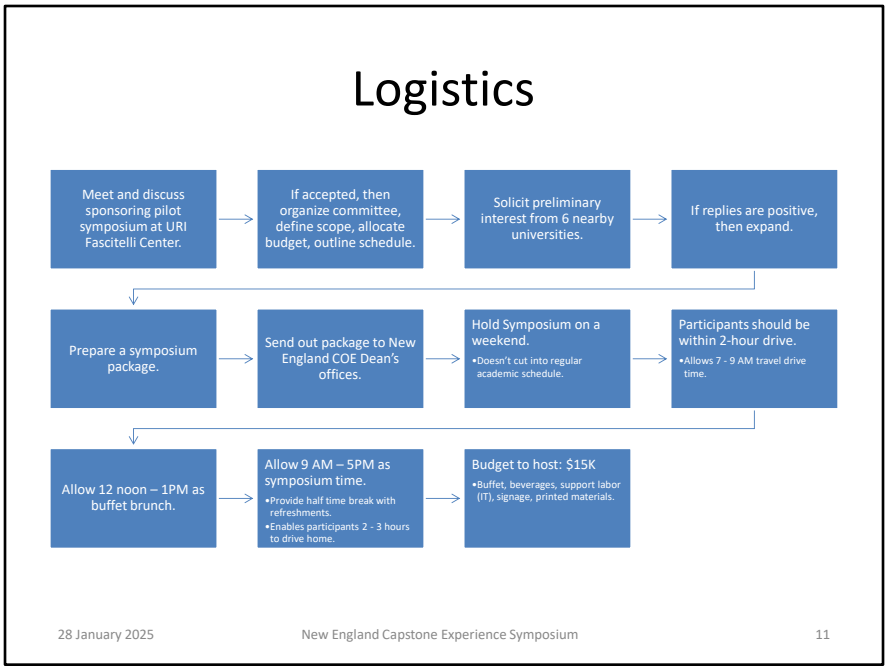
Here is a selection of questions for panel members to answer. Questions cover solicitation, measuring success, collaboration with other schools, structured vs. anecdotal feedback from students and sponsors, rewarding sponsors, budget. Etc.



Here is a selection of presentation topics. Presentations would include some visual display like a PowerPoint presentation, a video, or a testimonial from a student or sponsor.



Presentation topics can cover government sponsorship, commercial support from businesses, statistics on budgets for projects, who provides the majority of support, etc. Are there any requirements for sponsor and students to meet? How often? How do you track meeting minutes? Is there a standardized form for 'action items'?



Here is a description of logistical considerations starting with soliciting and discussing the pilot symposium with invited faculty. If URI faculty agrees on supporting the project and allocates budget, then you could compile a list of potential attendees to 'test the water'. You might start with 6 or 12 nearby universities to meet via Zoom to discuss the project. Maybe instead of inviting all 30 New England schools, you decide on just 10 - 15 schools. If each school sent 5 faculty, then total attendance might be 75 people.

Besides academic participation, perhaps other Rhode Island agencies and businesses might be interested in attending. Certainly, a local newspaper or TV station might be interested as well as state senator (State Senator Susan Sosnowski, District 37).

Timeline

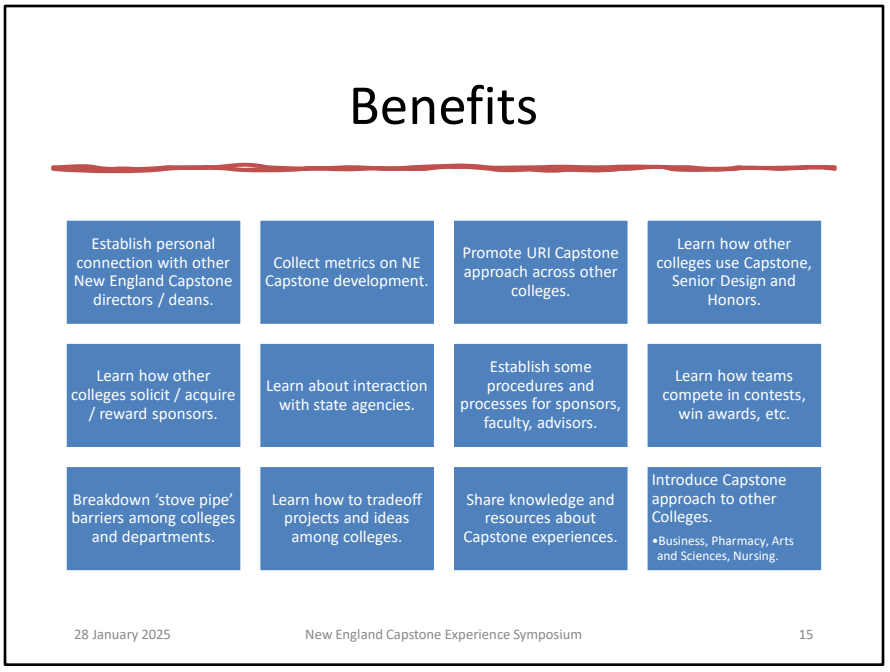
1st month	2nd month	3rd month	4th month	5th month	6th month
Define Scope Get URI Consensus and funding	Develop Symposium Package; Solicit selected interest	Proof and Distribute Symposium Package	Participants Return Package	Review Inputs; Down Select	Solicit Additional Support

7th month	8th month	9th month	10th month		
Down Select	Notify Participants	Finalize Logistics	Convene Symposium		

Here is a notional timeline. It might take about 8 months to plan, organize, supervise this symposium.

Lobby Posters for Interacting

To promote conversations in a lobby at the Fascitelli Center, perhaps participants will put together one or more posters for people to read about their capstone programs. Perhaps schools might bring promotional materials like flyers and business cards to promote follow-up engagements.



Getting people together in a great location to discuss common interests and how to improve their own processes benefits everyone. Besides involving like minded academic collogues, a capstone symposium can bring outside leaders from business, industry, government, banking together in one place.

I sponsor Capstone Projects at URI, RWU, and UConn. Since 2011, I've sponsored 15 College of Engineering Capstone, Honors, and Senior Design projects; the projects are a mix of mechanical and electrical engineering and computer science. Some have won awards at the international level; but all were successful in motivating students to achieve objectives and work in teams. My role is to support the students in systems engineering and problem-solving techniques based on my 34 years of aerospace experience and training.

The HOME Shelter – At RWU in the 2012 ASEE Northeast Division Conference, the Senior Design Team won 1st place in the poster section and 3rd place overall in the undergraduate division against Yale, Olin and others. Plus, 1st place in RWU Academic Showcase. At URI in 2013, a team of 16 Honors Class university students in HPR "Designing Sustainable Solutions for Developing Communities' chose the HOME Shelter as their class project. They chose to research and build prototypes of selected subsystems to test compliance to requirements. In 2015-2016, I sponsored two Capstone projects: "Hack That Flood" and "Highway Safety; Flashing Lights". Hack That Flood developed a smartphone app that tracked local historical flooding, NOAA weather projection, and flood data (water depth, acceleration or wave intensity, and GPS) from a sensor buoy that the team built. Flashing Lights investigated the phenomenon of phototaxis or 'moth to the flame', whereby drivers are attracted to the

confusing configuration of red / white / and blue flashing lights on police patrol cars at night. Drivers rear-end stopped highway patrol cars stopped on the side of the road late at night. This Capstone project identified the optimal configuration of low-intensity, blue flashing lights that attracts your attention but does not distract you from the road. CircuiTree – In 2014, the RWU CircuiTree Decay Detector won 2nd place in the Open Category at the NMSU WERC Institute for Energy, and the Environment and 1st place in the Peer Award category.

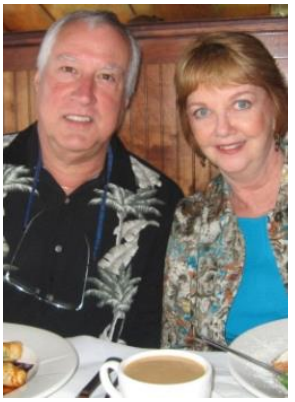
Comparison of My Projects Analyses, Products and Outcomes

PROJECT TITLE TOOLS AND METHODS	HOME	HOME	HOME Honors	CircuTree	InstaPlow	Flashing Lights	Hack That Flood	Thera Walk	LooLoo	Home Body	Making Rural Roads Safer
School	URI	RWU	URI	RWU	RWU	URI	URI	UConn	UConn	UConn	UConn
Year	2011 2012	2011 2012	2013 2014	2013 2014	2014 2015	2015 2016	2015 2016	2018 2019	2020 2021	2021 2022	2022 2023
Sponsor Proposal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Students	4	5	15	4	5	2	4	4	12	5	4
Problem Statement	No	No	No	Yes	No	No	No	No	No	No	No
Charter	No	No	No	No	No	No	No	No	Yes	Yes	No
Mentor Plan	No	No	Yes	No	No	No	No	No	No	No	No
Logo	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Job Ticket	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
$ Provided by	Unk	RWU	URI	RWU	RWU	URI	URI	Sponsor	Sponsor	Sponsor	UConn
Budget	Unk	$1K	Unk	Unk	Unk	Unk	Unk	$500	$2K	$200	$1K
Final Report	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Final Presentation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unk	Yes
Video	No	No	No	No	Yes	Yes	No	No	Yes	No	Yes
Team Photo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
System Specification	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Design Reviews	Yes	Yes	No	No	Yes	No	No	No	Yes	No	No
CONOPS	Yes	Yes	No	Yes	Yes	No	No	No	Yes	No	No
FMECA	No	No	No	No	Yes	No	No	No	No	No	No
Student / Project Evals by Sponsor	No	No	No	No	No	Yes	Yes	No	Yes	No	No
Student Resumes	No	No	No	No	No	Yes	No	No	No	No	No
Post Project Publication	No	Yes	Yes	Yes	Yes Patent Ap	No	No	Yes	No	No	No
Progress Reports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Meetings and Minutes	Yes Weekly	Yes Weekly	Yes	Yes	Yes Weekly	Yes Weekly	Yes Weekly	Yes	Yes Weekly	Yes Monthly	Yes Monthly

Yes, this is quite an ‘eyechart’. It compares the capstone, senior design and honors projects I’ve sponsored at RWU, URI and UConn from 2011 through 2023. The purpose is to compare different analyses, deliverables, processes, and methods that I strongly suggest, and schools require from sponsors and student teams. For instance, at Lockheed Martin we require FMECAs, CONOPs, and a list of system and detail requirements as a starting point for programs. Attempting to initiate students into the real world of business and industry, I provided examples of these types of analyses and encouraged students to implement these analyses in their senior designs. Some teams provided these analyses but seldom validated or verified in the design. The most common product was a final report, a final presentation, team photo, and senior day poster. Each department within a school appeared to have different levels of guidance for students. For instance, URI ELECOMP has very detailed guidance for capstone projects, but it is not apparent in other departments. UConn MEM provides detailed modules for their student teams and maintains an UpToDate website on all their past and current senior design projects. UConn enabled online web site for sponsor that was updated monthly by students. Each school maintains different standards for their projects. It is time to find out what works and how to make things better for students, staff and sponsors.

My Background

- BA (Psychology, Biology), URI, 1971.
- MA (Engineering Psychology), NMSU, 1974.
- Senior Staff Human Factors and Systems Engineer, Lockheed Martin, Sunnyvale, CA, 1974-2007.
- Applied human factors engineering principles and design standards to mobile shelters, large facilities, missiles, ships, planes, spacecraft, command centers, equipment racks and consoles, transportation systems, handling fixtures, railcars, support equipment, and computer human interfaces.
- Worked with mechanical and electrical engineering, systems engineering, manufacturing, training, logistics, parts, materials and processes, facility and field engineering, DOD and special customers.
- Taught Specialty Engineering, CONOPS, Human Factors Engineering classes.
- Certified Human Factors Engineer #529.
- Retired 2007 after 33 years in aerospace industry.
- Married Julie Yingling (URI 1970) September 2008.
- Moved to West Kingston, November 2008.



Rick and Julie at Turtle Soup.

I started out in the URI College of Engineering but couldn't quite understand all those forces and vectors in statics and dynamics. I passed slide rule and math, but I flunked statics and decided engineering wasn't my calling. I was graduated in 1971 with majors in psychology and biology, and minors in statistics and speech and hearing. Al Lott recommended I get a graduate degree at NMSU because it was far away from home, had a low student/faculty ratio, and the profs were from great universities. So, I tried 'engineering psychology' which focuses on understanding the capabilities and limitations of humans and applying that knowledge to the design of equipment, user interfaces, and facilities so they are easy to use. In 1974, I got a job at Lockheed in Sunnyvale, CA and stayed there until 2007. I worked on ships, planes, communication centers, missiles, spacecraft, submarines, health care delivery systems and other things that 'go bump in the night'. Never a dull moment except between jobs when you're looking for new work which was often…. I retired in 2007, got married in 2008, and looked for a place to retire. Which turned out to be Rhode Island which is amazing because most people leave RI and don't retire here. But it's worked out very well.

References

- https://www.rwu.edu/undergraduate/academics/honors-program/academic-standards-requirements/your-senior-capstone-experience
- https://www.alcorn.edu/uploaded/files/oaa/schools/grad/ASU_Capstone_Project_Manual.pdf
- https://libguides.webster.edu/capstone
- https://www.jefferson.edu/content/dam/academic/population-health/student-resources/forms-and-handbooks/22-23-Capstone-Guidelines-6-10-22-FINAL.pdf
- https://citetotal.com/writing-guides/how-to-write-a-capstone-project/
- https://ibe.lehigh.edu/current-students/senior-project-course
- https://extension.harvard.edu/registration-admissions/for-students/degree-candidate-academic-opportunities/capstone-projects/
- https://undergrad-inside.wharton.upenn.edu/senior-capstone/
- https://universitycollege.asu.edu/thrive/senior-capstones
- https://college.brown.edu/sites/default/files/2020-12/Capstone%20Report_Revised%20with%20Ex%20Sum.pdf
- https://engineering.uga.edu/capstone/student-info
- https://www.engineering.uga.edu/uploads/resources/Capstone_Design_Sponsor_Guide_2021-2022.pdf
- https://www.ada.edu.az/frq-content/SPIA/Capstone_Project_Guidelines_for_Undergraduate_Level_Jan_2021.pdf
- https://vpuefacstaff.stanford.edu/grants-and-resources/designing-capstones