Capstone Design CONFERENCE 2022
JUNE 6–8, 2022 ▸ DALLAS, TEXAS

Panel 2B
101 Ways to Structure a Capstone Course

Facilitator: Bahram Nassersharif – University of Rhode Island

Panelists:
1. Robert Hart – University of Texas at Dallas
2. Abdelrahman Suaib – Arizona State University
3. Katherine Breeden – Harvey Mudd College
4. Samuel Malachowsky – Rochester Institute of Technology

Description: Speak to 10 different capstone instructors and you will probably find 10 different ways to administer, organize, and assess a capstone design course. Attendees will learn about a variety of course structures and their pros and cons.

Notes:
The room is super cozy
+1

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KB
- Computer science
- ~50 projects across engineering (?)
- Most sponsors there mainly for recruiting; creates unique atmosphere. When recruiting projects, pitch as
    - ~1 FTE
    - A good project fit is the ‘unerased whiteboard problem’ that has been sitting there for a while w/o being solved; not critical path enough to make it to the front burner
- All faculty mentor teams and it counts as part of teaching load; and recruit more adjuncts to mentor
- A few hours/week in class

AS
- ME and manufacturing

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- ASU (Saudi Arabia)
- Co-author recent book
- 6 member teams, find a need, solve it
- Only instructor, 5 teams of 6, $600/team
- Check lists and design process and development they all work through
    - Need assessment, requirements development, functional decomposition, component selection/design, design for x/drivers/optimization, CAD, design for safety/reliability/etc, DFMA, Cost, drawings, materials
    - For prototyping, they pick a subset of requirements/functions that can't be validated w/ analysis, then design the prototype
    - Build book: where they ordered all the parts, quality acceptance, etc
- ABET outcomes
- Assessment fair - students present to committees from industry, using rubrics
    - committees are assessing the program, not the students.
- 50% for teamwork, 30% for contribution (?), 20% for 'assignment' (prep for team meetings)
- See poster for more

RH

- ME, UTD
- Each dept has one lead for capstones, and an office at the dean level that provides resources to all.
    - Enables a lot of informal cross-collaboration
- ME + BioE capstone courses had a lot of natural overlap, so now fully combined.
    - Flipped class format, videos they watch beforehand, do group activity/discussion
    - Cover range, from codes and standards to writing a business-like email
- Almost all industry; what are projects that are 5 years down the road
- ~ 50 teams/year
- 6 on team; ~70% with external industry mentor (retired, alums, etc) that get paid $1500 stipend per semester
- Do a training for clients, and a training for team mentors
    - Want to try and implement a team mentor 'apprenticeship'
- For assigning teams, run a multi-part bid project, where students also write up a bit about why they are interested in it
- Don't rely on capstone solely for many parts of ABET (?)

SM

- RIT, software engineering

Commented [1]: are these from the client or a different company? any concerns w/ NDAs?

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- Don't charge for projects, and within a different college from other engineering programs; makes for difficult multi-disciplinary collaboration
- Have open sourced their own capstone project management software; similar to edusourced(?)
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Notes: These questions are suggestions that can be modified, reduced or deleted

Leading questions:

1. Many schools are reducing the required credit hours for graduation, this results in students lacking, or deficient in, knowledge in core courses needed for capstone design. What are some capstone course strategies for addressing this issue?
2. Engineering programs strive to ensure their graduates meet the desired ABET learning outcomes. Recently, the Entrepreneurial Mindset is increasingly becoming a desirable skill in engineering graduates, by hiring industries. How can the Entrepreneurial Mindset be incorporated into the capstone design course?
3. Some capstone projects have business potential. How can these projects keep going once the course finishes?
4. Sometimes,large student enrollments in capstone courses, in some engineering programs, lead to insufficient or lack of resources to support manufacturing and testing prototypes. A solution, these programs may consider, is dropping prototyping and testing as a capstone course outcome. The reason they give is that ABET does not specifically require prototyping. Should designing, testing, and validating a prototype be an ABET requirement?
5. What are the challenges and ways of overcoming them in conducting multidisciplinary capstone courses, as preparation for entering the professional life? Is developing a generic capstone structure possible and acceptable by the involved programs?
6. What role should Capstone courses serve in shaping professional habits and etiquette? To what extent can these be taught in the classroom (vs on the job?)
7. What factors should be considered when matching students with projects?
8. Many Capstone projects involve working with for-profit organizations. What are the pros and cons of designing courses that include projects from non-profits, community groups, start-ups, scientific research, …
9. For AS: do all the teams go through a rigid structure schedule?
    a. Generally, yes, key is giving them rapid feedback so they can act to it

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10. Do you enforce contact hours w/ the students? (meeting in person w/ the students)
    a. Yes; make it clear it's expected
    b. Track through individual weekly progress reports; and team meetings
11. What do you charge and what does that go toward?
    a. UTD: $15000 for 2 semester; $3k(?) for supplies, some goes toward faculty, rest for facilities
    b. RIT: $0; some students already push back that they are paying tuition to 'work for the company'
    c. UC irvine: ask for monetary gift, and then allow them to get resumes, recruiting, etc
    d. Don't pitch it as 'paying for a project', but 'paying for talent'
    e. Poll of the room: seems like over half charge
    f. KB: more important than the amount of the fee is that it represents skin in the game
    g. See more details in big survey that Susannah Howe et al release every 10 years, eg: https://peer.asee.org/the-2015-capstone-design-survey-observations-from-the-front-lines
12. How is IP handled?
    a. SM: offer 3 and only 3 forms for sponsor to pick - open source, students own but they get license, etc
    b. KB: sponsors own everything
    c. AS: students own everything (?)
    d. RH: students own IP, but most sponsored projects required an NDA/IP form so if students have concern they don't get those projects
13. How to handle public disclosure?
    a. SM: students have to put together a 2 sentence description and 2 videos (1 minute on why the project is important), that are intentionally supposed to be publicly disclosed
    b. RH: keeps it quite private - get it in written from the sponsor w/ a checklist of exactly all the parts that they are ok with, otherwise don't disclose anything
14. How to teach IP?
    a. KB: yes, in first week, cover IP, NDA, etc
    b. AS: also teach IP. let each sponsor know that the design reviews are disclosed to the committee. Have had to redact some final reports.
    c. SM: don't have any instructure from the podium

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   d. U of Wash: several of our programs have a lawyer from our universities technology transfer office come and give a guest lecture about IP
15. Cornerstone-to-capstone integration? Getting more experience early?
   a. AS: yes(?), some
   b. AS: MIT(?) has a sophomore intro to engineering course that involves some design projects
   c. KB: Harvey Mudd starting an impact course, where students propose a project at the end of the course; then while they are juniors, the department tries to take some of the better ones to shop it around externally and build support/funding, then offer it during their senior year to some of those students
   d. UTD: has an EPIC (?) program for first/second year students for non profits that are funded through another mechanisms
16. Funding opportunities through NSF for capstone projects
   a. Dear Colleague Letter: Supplemental Funding Opportunity to Support Student Design Projects Directly Related to NSF Research (nsf19078)
17. Offering entrepreneurship projects? Eg, student-proposed
   a. Yes, a few places seem to offer a few each year…
   b. Usually have them participated in the various pitch competitions
18. How do you structure the 'lecture' vs the project - parallel vs in sequence:
   a. AS: in parallel - teach house of quality, etc, and then students directly apply to their capstone project
   b. SM: none - expect all their students to have it earlier (teamwork, etc)
   c. RH: partner with business school to teach teamwork and other things;
19. What do you like about how you grade?
   a. AS: reports are graded by him; minutes are also graded based on a rubric, but graders
   b. SM: tells them about ABET and bases it on that
   c. RH: 4 levels - exceeds (A), meets (B), below, far below expectations
      i. To meet, you need these 4 things; to exceed, you need these additional
   d. Specification Grading, book by Linda Nilson
      i. https://www.google.com/books/edition/_/hRbqnwEACAAJ?hl=en
   e. KB: don't do much individual grading, mainly group grading
20. Peer reviews?
   a. KB: use round robin feedback; some private to instructors, some to each other
      i. Have dropped the public portion of it during pandemic
   b. AS: uses CATME

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c. RH: uses CATME, if below 0.8, students need to speed w/ faculty
d. SM: use the same peer eval template throughout their program. Would never see a 1 out of 5 though…

21. What about non-design capstones? (process and continuous improvement)
    a. SM: design, process, teamwork, and …
    b. AS: also include documentation
    c.