Panel 3B
Industry-Informed Capstone: Preparation for Professional Practice

Facilitator: Keith Stanfill– University of Tennessee, Knoxville

Panelists:
1. Jay Goldberg – Marquette University
2. Scott Shaffar – San Diego State University
3. Robin Ott – Virginia Tech
4. Steve Zahos

Description: Capstone instructors have to carefully balance and sometimes modify how current industrial practices are implemented in their courses. This panel will share ideas on introducing/adapting industrial practices such as ISO standards, stage-gate development processes, and professional skills for capstone design to better prepare students to work collaboratively in their future careers.

Notes:

Introductions: Name the Gaps You've Identified

J. Goldberg: Project Management, Design Controls (Standards), Design for Manufacturability, and Business Basics.

S. Zahos: Establish a baseline skillset that is modern. Asking what industry sees as gaps, Communication skills (presentation written, spoken, quality over quantity), well matched to the discipline, Manage sponsor expectations

Tom Barber: Company expectation of linear burn rate (vs. student "exponential" ramp up), Students treat $ expenditures as their own, lack software accommodation between university and industry organizations, understanding that failure of an idea is not failure (=knowledge)

S. Shaffar: System engineering, Challenge = Learning activities, student transition from student to industry professional (ex. communication), having an ethical standard (737 max, reviewing good and bad behavior),

T. Barber: They do anonymous quizzes on ethics. Suggested that based off of results there is a challenge with ethics. There are ten traits that define an engineer. Personal ethics are not great these days.

Keith: How many of you are using [NAE Case studies](#).

Audience: We have a fundamental breakdown in society from an ethics standpoint. Ethics is not viewed as an absolute. It's difficult to introduce the code of ethics if everything is considered relevant.

S. Shaffer There are two sides to ethics, personal and professional;

Keith: In your respective course have you spent time on ethics?

J. Goldberg As a part of NSF program required take a responsible research course.

→ Its one thing to help students identify unethical behavior

→ Another thing to give them tools to deal with such things.

S. Shaffar:

Audience: Students are not empowered to make changes when corporate culture sets the boundaries and the tone for ethical behaviors.

T. Barber: As a 22 year old coming out of college you have very little to risk.

S. Shaffar: Mented need to have examples/case studies illustrate challenges.

Audience: Issue with ethics around pacing. Students might not spend time on tasking to take time to engage.

T. Barber: Should we have a general course that supplements what we're doing in engineering. Brought in PEs to encourage taking the exam. Case - boss wants the PE to dump batteries. Boss took care of it and dumped batteries in the river. He didn't report it as there weren't many downstream.

Audience: Issues in the workplace arise slowly like a frog boiling in water. Things go slowly and students need to be aware that this might be happening. There is group think in many of these situations.

T. Barber: Challenger issue. Whistleblower was inundated with hate from peers and colleagues. You want to develop ethical behavior but at what cost.

Audience: Most people will do the right thing to a point. How do we change company culture to promote more ethical behavior?

S. Zahos: We bring companies in to talk to students. Students are more likely to listen to external/guest voices than the teacher. Example - company sent a senior over to talk to class - would you like to be called at 75 years old to be brought in to talk to a court re: a design problem in the past. Intro to considering to be careful with emails (Easy Money Awaiting Interested Lawyers), etc.

T. Barber: Dr. base principle is to do no harm. In the case of a particular pacemaker there was an engineering challenge that caused about 2% of the units to fail. When do you inform or remove the pacemaker?

S. Shaffar: Even in a capstone project students can encounter ethics concerns. Added an ABET question to look at students' experience on projects. Had some interesting responses. Puts a hard line on consumer safety.

A teachable moment might be when students do not share adverse information with you as an instructor. Encourage students to enact ethical behavior throughout the course/project and reinforce what are ethical behaviors within the group.

Keith: Often students will miss deadlines. Students ask for extension at the deadline; not the right thing to do professionally.

T. Barber: When getting direction from your leadership you want to respond. Asking for a need by date. Connects to Keith's question.

T. Barber: Why do companies do capstone projects? Various reasons. Big companies use internships and sponsored projects to get access to students.

S Zahos: Some companies also want to clear projects off of an engineer's desk. To clear out a backlog.

S. Shafer: Successful projects bring companies back to do more realistic projects.

J. Goldberg: Some companies also want to have a hand in what academia teaches students.

Audience: How can you quantitatively evaluate quality of projects? (shelf this discussion)

Audience: Would there be value in exploring an advisory board for capstone? Some are exploring, some have not.   Could bring in programmatic lens to the relationship between academia and industry. Keep donors off the advisory board, as this is a conflict of interest and changes the dialog.

Keith: An industrial advisory board would be another thing to manage. Balancing the frequency.

S. Shafer: Presents to advisory boards

J. Goldberg: also present how instruction/curriculum/pedagogy works. This provides a backstop to what we're teaching, and brings in a check on the materials being covered. Are these things still current?

→ Using industrial advisory board to validate what is being taught and suggest new content

→ Inviting industry to the classroom can help both the students and industry professionals

T. Barber: Use end of year showcase to get feedback from the industry sponsors. Survey after the symposium/expo/poster session. Bringing in industry judges who are not also current sponsors.

S. Shaffar: In industry as you get evaluated performance wise and the engagement with capstone can support their performance; plus they enjoy capstone.

Keith: Now a days you can have a feedback session with sponsors. Crowdsourcing feedback.

Goldberg: Students need to know how to explain technical issues to non=-technical people. Watch the use of acronyms.

Keith: Do people train students on elevator pitches. A good way to provide some training for students on translating engineering jargon to english

Audience: Do people train in customer discovery? Looking at customer real requirements.

Goldberg: Students have customer requirements and specs. Ask students also to interface with users and customers

Shaffer/Keith: Using storyboarding to help engage with customers needs

Audience: Need to have some ideas on company support. Some companies use entry level mentors as a test for early career engineers. Cheap way for companies to test out their own engineers.

Keith: some sponsors want reports from students re: how did mentors serve their team.

Audience: need to protect the students. Some are timid and in a position of reduced power and so might not want to disclose poor situations.

Audience: often ask for a standby mentor or a pair of mentors. Some send middle-level and junior engineer. Then middle-level stepped away and junior took over. Provides a training path for mentorship within the company. Often junior engineer might be an alum of the institution.

T. Barber: Means of communication of student teams with sponsor evaluation. Student being emails with "hey" similar to texting. Students have to be taught to interact with their sponsors.

Audience: Students are not used to telephone/direct talking with students.

Shaffar: Students need to follow professional meeting protocols - agenda, followup, content ahead of time. General communication skills are necessary. Also have weekly status reports. Section that shows what every student has done over the past week. Often generalized, but working to get more detail. Status reports with help needed section keeps the sponsors up to date on the progress, and provides a venue for discussion of problems.

Barber: pay attention to academic breaks that cut off the contact with the sponsors.

Shaffar: encourage students to work over break.. Get parts ordered before winter breaks to avoid delays.

Goldberg: All projects have failures/setbacks. Project manager should try to maintain the project integrity - minimized downtimes, etc. Assume failure on projects and put in downtime on a project to accommodate delays arising from unforeseen risks. This is rewarded in industry settings.

Shaffar: remind sponsors that we are on a different timeline. We are done in may and need to pay attention to academic timelines.

Keith: Team peer assessments a few times/semester. Nothing actionable comes from these when people are poorly performing. Now, after the 2nd team evaluation. Students had to schedule 20 min 1-on-1 with an advisor to review peer evals. Students need to develop a plan of action to correct shortcomings on peer evals/teamwork.

Barber: Faculty define a team that best applied fundamentals to achieve a goal, in addition to awards for best competition.

Shaffar: If performance matches specifications, you pass the course. In industry grade is at the end of the project.

Goldberg: in industry we are based on results. Academia is the last chance for a more protected active learning environment. If we don't meet specs, can students identify their shortcomings and have demonstrated learning in the course.

Barber: we've made a commitment to a company to do a job. If we didn't achieve the goal, students need to continue on with the project. If this is from a lack of student performance, then they do not pass. A students don't get As in senior design.

Goldberg: Susannah Howe does a survey. In 2015 - what do you focus on in the course - process or product? 50/50 split on the evaluation.

Keith: Students often haven't seen systems engineering. First semester can be a brain cramp.

Goldberg: Students need to understand that if they make a mistake it might affect their grade. If they do this on the job, it could kill someone. Giving examples of medical device recalls - sometimes negligence causes problems. Your work as an engineer really means something.

Audience: How to measure quality of projects

Barber: Difficult as projects are different, scopes are different. Comes down to experience in the fields.

Shaffar: The last slide of every lecture is quality is personal. Your reputation is built on what you do 0 every email, every meeting, every document, etc. Everything has to have that quality element in it. Drive for student ownership of projects.

Barber: These are 22 year old+. In two months they'll be working at a company. They need to be treated as adults. They come back later to agree.

Shaffar: set the bar high and they will rise to it.

Zahos: Projects are open-ended. This is new to them. Industry is more willing to accept process of going form a concept to a solution that has not been pre-determined by the company. This should be a focus early in the course, or early in the curriculum. Another hard ot accept concept is that everyone wants each student to be successful. People are willing to accept some failure. If everyone gets an A, everyone is happy.

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T. Barber: Sponsors in some cases are 2 hrs away.