# **Panel 1B:** Managing Large Capstone Classes

**Facilitator:** Steve Zahos (UIUC)

**Panelists:** Todd Polk (UT Dallas), Rachana Gupta (NC State), Sarah Oman (Oregon State)

**Description:** Do you feel like you're herding cats? If your program is growing, or you're new to a program at a large school, come here for suggestions to manage the crowd.

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Introductions:

- Steve: University of Illinois, Coordinator of project procurement, typically 200-300 students graduating each year
- Rachana: Co-Director of ECE Capstone, NC State, used to be 120-130 students, now 240-250 students in capstone in one large class, external folks help with reviews otherwise it's just her and one other instructor managing the course
- Todd: UT Dallas, Biomedical and Mechanical; started with 40 students, now it's up to 200-250 with two instructors
- Sarah: Oregon State University, Director of MIME capstone, graduating 200-250 per year, have some MIME students go to the multidisciplinary capstone program as a coping strategy

Steve: Potential Challenges to consider: harvesting a large number of required projects, funding to keep the program running, grading, etc.

Tom at Vanderbilt audience: about 100 in ME, the challenge is resources without external funding, all funded with internal mechanisms but it's never enough, also run the Expo yourself, a large disparity between the haves and have-nots in terms of project success being showcased at Expo.

Steve: Too many cats to herd, each program uses its own herding mechanism. The University of Illinois is siloed, some charge for projects some don't, some projects from faculty by grants, and some community projects.

Rachana: Most projects are funded by industry and external organizations (non-profit, individual, start-up, corporation), looking more for good projects first and then funding next. Work closely with the university, advertising the program to non-engineering departments to plug for connections between departments in-house AND connections to other universities through departmental connections (research units at other universities). Talk with the department and understand where the funding comes from to determine if there is a buffer for other things. Go to sponsorship meetings at the college and university level with a one-slide pitch - sponsors love to find other ways to connect to the students like capstone.

Todd: all projects are “sponsored” by external clients or other departments on campus, such as ER docs at the hospital. Bring in enough money from external sponsors to fund the others. Corporations pay more, non-profits not as much, etc. so there is a sliding fee schedule of sorts. You need to walk in on day one with enough projects.

Sarah: has a 12-month contract so she can source projects during the summer. Ask for donations for the projects with a sliding scale. Typically ask for $5000 but sometimes it is $2000 or an IOU. Covers resources to cover other things such as community projects or nonprofit projects. These projects can also cover the unexpected late add situation.

Steve: Sponsorship agreement that has the option to customize per company based on what works best for them and the program (like amount of money etc.), includes NDAs and IP assignments. Sponsors can request IP is signed over to them ahead of time.

Jenn UMichigan: question on the IP agreement, who provides the IP sign-off, sponsor or university, is there room to negotiate?

Steve: the University of Illinois approved a document with some flexibility

Question: what’s the issue with requiring a fee rather than a donation? Fee in support of education does work for them, similarly with NDA and IP, they too have an agreement with that. Always have more projects than students intentionally. Industry showcase so the industry presents their needs to the students and includes info on NDAs and IPs then so students can choose what type of project they want before signing up for a project.

Todd: base NDA and IP agreement they give to the sponsor or company and students can do one themselves without UTD stepping in (it’s up to the students to determine if they want to sign it).

Kurt: U Central Florida, is about to step into an interdisciplinary role, graduating about 2,000 seniors across the departments, now the discussion is talking about resources and then sponsorship, so it's interesting that we need to talk about resources and that universities need to provide the resources necessary to support. In aerospace, he can’t get sponsored projects - Lockheed Martin can’t get their students to design missiles for example. The university requires lab fees for students to take courses; which helps accumulate funds and components. They make an effort to reclaim durable goods from year to year so that new teams can use these materials to help offset costs/budgets to reduce the amount of funds needed to find each year. Can fund multiple teams on the same project.

Jason: UC Irvine, standalone alone program, very large. [missed information]. Every time he gets in front of a company, that takes time. Students don’t understand the experience of the large class size themselves - and don’t understand how important the course is as well. Visible awareness of students, but external awareness of the sponsors - there is a disconnect that causes issues with growth and scaling. There are also 10 faculty teaching together so there is a lot of disconnect between them all. Have a centralized person to coordinate.

Nathan at George Mason: How many students per project team are assigned? Most effective way to give students a good experience. Tried 4-6 per team, seems 4 is the best.

Arizona State: Optimum number: 3.5. 140 students, looking for 45 sponsors to pitch in Industry Day. Students who have any personal struggles shouldn't be on a larger team.

Nathan: 100% projects sponsored by partners, so that's my summer

Marie: Virginia Tech, has some interdisciplinary, larger teams but the project scope is always slightly bigger than the number of students on the team. If the scope is big enough, it's going to take all 6 or 8 persons. Then determine how to manage the team. The scope of the project determines the size of the team. Sometimes projects are too small for even 4 students and they then struggle to find something to do for it later in the semester. IP is usually signed away to sponsor. Careful of NDA - cannot prohibit students from talking about it during job interviews, etc. Two-semester program. ME program is 400-450 students alone. She wants to grow interdisciplinary to 200, how do we grow that?

Nathan: Every faculty member in the department must be a technical mentor.

Marie: That's hard for interdisciplinary.

Nathan: Managing takes time, tenured faculty don't want to mentor the projects

Rachana: Important point: we've talked about sponsorship and such, but another important point is quality. Getting mentors' buy-in is important for this. When the numbers grow, we don't have enough time to mentor the teams and students. Yes, multiple sections are one way, but what other ways can we get quality mentorship and project scope once projects start?

Every non-large capstone class has the potential to grow. Just hit 402 in one class. Acknowledge we need help when it gets that big. Research foundation funds so it's an unrestricted grant to use as needed - hire adjunct faculty for project management and technical advisors (industry experience!) to pay them with soft money. How many of us are having healthy involved conversations with leadership (dept. head/chair, dean, etc.) about growth resources? Need to advocate that for leadership.

Todd: Hire them as contractors instead of adjunct faculty. Got feedback from students to evaluate mentors as well as mentors evaluating students - the paper this year will present this.

Tenured are great technical researchers but not great mentors.

Rachana: presented during faculty meeting [missed information]. To help with tenured, created tiered mentorship: [tier 1] technical mentorship on average 1 hour per team by graduate students, second tier is professor advising their graduates who are technical mentors, third tier puts professor office hours listed and classes they teach or knowledge expert so students can see this information and go to their office hours. Advisors need to get credit for

their mentorship - we talked to leadership about adding a category in the annual review process to increase awareness of mentorship.

Emily: ME at WSU, we have 150 ME grads each year, and it's growing (at 30 projects). Rely on industry sponsors to keep quality up - be demanding customers. Provide students with resources like office hours and such, but ultimately the customer is the one pushing to find technical mentorship. Professors are not great with mentorship - they microfocus on one specific problem on the project, and they don't take a step back to look at the bigger picture of the project.

Bill, Director of the capstone program in ME at MichTech, talking about quality and scale. Consistently delivering to spec is quality. This means we need processes and tools - it can't be a free-for-all. Need templates, grading forms/rubrics. The key is the advising team. Every faculty member should not advise as some faculty are not good at it. Some people will never be on the advising team. Some faculty members have no practical experience or don't want to get into the weeds. People with industry experience are good mentors as part of the advising team. Each person in the team has a topical hat for any team but is also assigned to some specific teams. Four projects per person per year is one course equivalent. That's the level of effort of advising they have. Directorship is equal to four course equivalents.

[missing intro] - looking for 50 projects for fall. Two-semester program. Studios meet 4 hours per week with 4 teams per studio. Sponsors are required to provide technical mentors. Scope project ahead of time for the size of the team.

For quality questions, we are aware we are preparing students for industry. Get students to trust me enough to be honest about weekly progress. Students understand that the faculty wants them to succeed. More trust = students who are more likely to say "We're screwed" "We're missing a deadline" etc. so they don't lie. In industry, you can't lie to the manager about progress, so don't do that in capstone. How do we get students to not look at us like just another teacher? They need to learn to come forward early and say they're behind or they don't understand or don't know what to do.

How do they not see you as a grader too?

Jenn UMichigan MDP: How we try to get around that - oversee the recruitment of projects and have industry experience, so we try to tell them. We grade on a unique scale - everything is somewhat binary - options are 100, 90, 80, 70, or 0 for grades. Nothing in between. Nothing is perfect. It's a two-semester program, but most of the grade is on the last day of class. The faculty advisor gives an individual grade and a team grade.

Stanford: We have 70 which I thought was big for ME, and rely on course assistants (CA). Like a TA but don't grade. We're on quarters. Each team has an industry coach - retired industry people. Each team gets an industry coach and a CA. The CA is the sounding board for the students.

CinniState - talking about how finding out a project is circling the drain late. What tools can we implement to ensure sponsors are on task and teams are doing well early on?

Rachana: have a structure in class - templates and rubrics. Team Charter that everyone has access to and has progress updates in the template - living document. Explain issues, achievements, risks, etc. documented every week. Teams meet with her biweekly then. Provide a Help Me section - technical help, management help, sponsor help, etc. for categories of help. At the start, teams think it's busy work. But if the instructors and mentors are commenting on these documents live, weekly, then the students realize this is a good tool. Also create a requirements document in any method they choose (list, Gantt chart, etc.) provided it has dates, etc. for them to track.

Todd: we require clients to meet with teams each week. Teams come to us early if the client starts ghosting the team. After peer evaluations, if needed they have one-on-one meetings with those that peer reviewed low.

Steve: touched on it a bit, but how do manage grading

Todd: we have TAs that grade weekly stuff. Large stuff the two instructors split up and grade half each. Meets, Exceeds, Below Expectations. The rubric says if you are doing just enough that is a B, if they want to go above and beyond, that is how to get the A work.

Rachana: Comprehensive rubrics, added a grade for health and quality of project - overall team grade that allows subjective grading between different teams. Typically students want exact feedback on why they lost points. The Health and Quality provides a rubric of what is good, better, and best. But you don't need to give an explanation of tiny points missed

Vanderbilt: External panels from industry that do not have their own projects that term. Done before the expo so earlier in the semester. Students learn to present. Non-biased panel if you have about 5 panelists.

Steve: Students need to understand we are not the enemy, we want you to succeed

Vito, UConn: Mech and Aero; Coming from industry experience myself, students need to understand results and perception. Results are how you approach a problem. When did you recognize you had a problem, and how did you communicate the problem? So what if you are smart, you need to learn to make mistakes and own up to them. Show initiative. Get away from the grading thing. Build perception. Sponsors grade them but look at differentials between students. Twice a semester they do oral and poster presentations and spot struggling teams then. Fall has benchmarks of Halloween, Thanksgiving, and Christmas to state where each team should be at each mark. We hire external support as well. Results = Perception.

Matt, UCF, and CompSci; have the opposite issue. Grading is very VERY final weighted. The strength of it is that students know that what they get graded on is the results. So if they are in trouble, they are more willing to say they are having a problem. Right now we are considering how we inject more summative assessment in the middle without losing that strength.

Many of our technical students are more of a lawyer than an engineer. So in the spirit of 'results matter', so at the start of the semester, tell them they have zero points. Now you have to earn your points. Convince me to give you

points to increase your grade. Now you have a partnership with the students - prove to me that you've done things to earn points. We also have rubrics that are publicly presented.

Sarah: Show some slides on the first day of who you are so they see you as a person, not just an instructor

Interdisciplinary: we have intensive rubrics, but students don't seem to refer to them. We want to use it as a tool for students to learn, so looking for suggestions on how to implement it better. How do we match the experience of student knowledge/expertise to project requirements?

Todd: For interdisciplinary, sometimes we go steal some ECE folks and put them into the class for a specific project.

Tie it into Lifelong learning: you aren't going to always know everything and that's okay.
Todd: Go learn it

Sarah: Self-learning assignment in the second term that forces students into that lifelong learning part

Rachana: For the rubric,we like starting at zero so you are the points giver, not the one taking points away. Keep consistent grading. We do a grade on teamwork and professionalism where they assess themselves and their peers. We take input from the teams every two weeks and do a sponsor assessment every month. Students need to know what their peers think of their work early so they know to correct their work. Avoids the "I didn't know that's how they felt about me or my work".