



Virtual 2021 Capstone Design Conference

June 9, 2021 - 1:00-5:30 PM Eastern

[Capstone 101](#)



Capstone Design Conference 2021

Wednesday, June 9, 2021
1:00-5:00 PM Eastern

Capstone 101: Discussion

Facilitator: Robert Hart (University of Texas Dallas)

Live Panelists:

1. Sindia Rivera-Jimenez (University of Florida)
2. Jenny Retherford (University of Tennessee Knoxville)
3. Mark Easley (Texas Instruments)
4. Cassie Bowman (Arizona State University)

Undercover Panelists:

1. Kris Jaeger-Helton (Northeastern University)
2. Jay Goldberg (Marquette University)
3. Shraddha Sangelkar (Rose Hulman Institute of Technology)

Discussion Notes:

Sindia Rivera-Jimenez (University of Florida)

- Chemical Engineering perspective; building a one-year course (2 semesters); not industry-sponsored--all projects come from the instructor; do a chemical engineering simulation Design 1 in fall and Design 2 in spring
- Build a community within your discipline; find mentors
- Ask your department to pay for very specific professional development
- LinkedIn Certifications that I use (still evolving as I receive feedback from the students). They complete one every two weeks divided into the two semesters. The grading is by completion showing the final certificate. I have received good feedback from the students. You can then ask things about how these presentations apply to their project. I use it a lot for Team-Building and Risk assessment.
 - Project Management Simplified
 - Learning Gantt Charts
 - Change Management for Projects
 - Project Management Foundations: Risk
 - Project Management Foundations: Teams
 - Leading Productive Meetings
 - Six Sigma Foundations
 - Project Management Foundations: Ethics
 - Teamwork Leading Projects
 - Managing Meetings
 - Managing a Diverse Team
 - Inclusive Leadership
- Also some links for setting up the assignment on you Learning management system:
 - Downloading the evidence:
<https://www.linkedin.com/help/learning/answer/82975/view-and-download-learning-certificates-of-completion?lang=en>
 - Adding certification to the LinkedIn profile:
<https://www.linkedin.com/help/linkedin/answer/44644/add-edit-or-remove-certifications-on-your-profile?lang=en>
 - I also tell them how to add it to their resume. The following is an example from one of my students:

Adding Certifications to Resume

Professional Development and Training

- American Institute of Chemical Engineering Membership
- National Society of Black Engineers Membership
- **Process Safety Certifications:** Facility Siting, Inherently Safer Design, The Role of Inert Gases in Process Safety, Risk Based Process Safety- Manage Risk: Operations, Chemical Reactivity Hazards, Process Safety Ethics- A Brief Introduction, Risk Review Using LOPA (Layer of Protection Analysis)
- ➔ **LinkedIn Certificate:** Six Sigma Foundations, Managing a Diverse Team, Process Improvement Foundations, Inclusive Leadership, Project Management Foundations: Ethics, Leading Projects, Managing Meetings
- Leadership Alliance Professional Development Certification
- **Ronald E. McNair Scholar Workshops:** How to Supercharge your Career with Grants & Fellowship, Composing A Competitive Personal Statement: A Step-by-Step Breakdown, Crafting Statements for Graduate Admissions or Summer Research, **Applying** for the NSF GRFP & Other Competitive Fellowships, Obtaining Strong Recommendations
- Leadership Alliance Professional Development Certification

- My teamwork strategies:
 - Video lecture on effective teamwork that will help them to create their team charter
 - Weekly addressing (~5 minutes) tasks, task, lead, and task status. They also add this to their report including a reflection of the good, the bad, and the ugly. I foster conflict resolution (not avoid it) by using clear documentation of team activities.
 - Team building and Peer evaluations (3 times in the semester to address issues early and see progress): Catme.org (not free but we share the license with other team base course in our departments)
 - Use only Microsoft Team for project related activities.
 - All of the above become data for ABET.

Jenny Retherford (University of Tennessee Knoxville)

- Teaching-focused faculty @ UT ~10 years
- Capstone has transitioned from floating to anchor course
- Sole faculty, up to 15 projects/semester + external mentor or faculty
- Lesson: Important to know the teaching value you bring to Capstone
 - Articulate your role to students
 - Communicate what you are providing
- Lesson: Accept that you will be continually evolving
 - Creating new content
 - Crafting new assessment methods

Mark Easley (Texas Instruments)

- Part of the TI University Program; sponsor and mentor perspectives
- Embedded systems background
- Networking is crucial:
 - internal network of faculty and staff
 - industry network
 - career center

- Learn how to delegate the tasks--right people internally--colleagues, lab managers, staff
- The Industrial Advisory Board is a good place to recruit mentors and sponsors!
- Look at UTD list related to intellectual property

Cassie Bowman (Arizona State University)

- Associate Research Professor - Capstone Role sponsor/mentor of 50-60 teams from ~10 universities
- Lesson: Things will not always go as planned; reach out to your colleagues either at your university or from within the CDC community beyond. People are very open about what has worked or where they have had problems.
- Engage your sponsors in understanding your course's learning goals and objectives; let them know what you are trying to accomplish with your course so they can help reinforce.
- Take advantage of all the Capstone research literature and resources out there (can also help you make the case to your department stakeholders for things you want to implement)
- We have an IP agreement for all students, but not an NDA. The IP agreement outlines the rights of the student as well as the project sponsor.

Kris Jaeger-Helton (Northeastern University)

- Full Teaching Professor at Northeastern University in Dept of Mechanical & Industrial Engineering
- 12 years in Capstone, 7 years as Industrial Capstone Lead, 5 years solo and 2 years with a Co-Coordinating partner as the program has grown
- 2-semester sequence, full academic year
- We have initiated a commitment letter for any external sponsor, typically used for student-developed projects with outside sponsors
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Jay Goldberg (Marquette University)

- 20 years experience with Capstone Design at Marquette University; 14 years medical device industry experience in new product development
- Design faculty would benefit from industry experience through sabbatical or other experiences.
- 12 years There is no one way to teach capstone design. There are many ways to do this effectively. Each way has its pros and cons - it depends on what you want to accomplish, your available resources, and what your priorities are.
- What is your priority - delivering a working prototype to your industry sponsor, or ensuring that your students learn about design? Remember that students learn a lot through failure.

- +1 (Cassie Bowman, ASU)
- I suggest that capstone courses focus on preparing students for their careers.
 - +1 (Cassie Bowman, ASU)

Shraddha Sangelkar (Rose Hulman Institute of Technology)

- 9+ years experience. 3 years at small private school, 6 years at large state schools (PennState Erie and Texas A&M).
- ME capstone traditional design projects.
- One advice: Feel free to experiment around, it takes a while to all click together.

Ethics embedded in Capstone:

- JR: Not always explicitly included, but Capstone is used as an example set for ethics in other courses
- SRJ: Embedded in many aspects of course
- KJH: Infused in parts of the course as well as covered in IRB (Human Subjects protection) also we asked students to outline the societal, global, and inclusive impact and considerations for their projects.
- CB: address issues specific to projects, get put in front of any breaches

Questions

- [Jeff Wood, Stanford MechE] I wanted to pose a question to the members of the conference – **is anyone incorporating the topic of ethics into their capstone course teaching, and if so how, what's worked well, and what would you recommend changing?** We've been doing it for a few years now and it's been valuable to the students; and I'm curious as to how others may be doing it as well.
 - We are still working on ethics - although we do discuss them in the context of research (citing your sources) and in terms of IP (don't steal others' IP). One thing we did bring in that is related to ethics is Diversity, Equity, and Inclusion in Design. We talk about examples such as sensors that only work for light skinned people, anthropomorphic data that does not take into account plus sized people, or gender recognition software that can be problematic for transgender folks. We just started doing this the past spring, and it was well received, but we're still gathering data...
 - [Jay Goldberg, Marquette University] We have an ethical compliance officer from a medical device company talk to our students about what to do if they witness unethical behavior in the workplace. Many of our students receive training in the Responsible Conduct of Research where they learn to identify unethical behavior.

- [Shraddha @Rose-Hulman] we ask students to document their decisions (ethics checklist) at the end of each quarter's report. That helps them document and receive feedback. Our Advisory board highly recommended "FMEA (failure modes and effect analysis)" as being extremely important.
- [Beth @ RIT] we worked with a professional ethicist from our philosophy department on this. He helped us build a discussion about harms into our risk management process. It works OK but you have to be really explicit with the students about it because most really just focus on project risks, not harms that their decisions might cause.
- [Jenny Retherford] separate professional development course uses past capstone projects as ethics examples, helps students to assess without being in the weeds of the project
- [Susannah Howe, Smith] This year, I sent an email to our alum mailing list and asked if any alums had experienced ethical situations in their workplace that they'd be willing to share. I then followed up with 8 of them, did short interviews to learn about their experiences, and then wrote a short ethics case for each one. I had the students discuss the case studies in class (knowing they were actual cases) in two stages - the first stage, each small group read one case and developed 3-5 possible actions/recommendations. The second stage: each small group read a different case and selected the action/recommendation they thought was best - or wrote a new action. Then we had a full class discussion about all the cases. For HW, students had to write their own hypothetical case based on their own capstone project, or do a full analysis of one of the alum cases from class.
- [Sindia Riveria-Jimenez] embedded in site selection for project, project management, risk assessment, team work, environmental risk assessment,
- [Alex Bailey] In my experience (admittedly non-technical), students appreciated being asked to think through ethical questions associated with their project. Students in Nuclear Engineering and BioEngineering have much coursework requirements along these lines. Students in ME, CS, Industrial Engineering aren't as up to date.
- **What do you teach in capstone?**
 - [Doug Willard] **What portion of the course is related to System Engineering, opposed to project management, and in particular the subject of requirements. Also would this come early in the course (my assumption)?**
 - [Shraddha @ Rose-Hulman] entire design process, project management, teaming, Failure modes and Effects analysis, etc and lot of self selected workshops (such as arduino, PCB, Flexible machine elements, etc)
 - [Jenny Retherford] separate professional development course uses past capstone projects as ethics examples, helps students to assess without being in the weeds of the project
 - [Steve Byerlein, U Idaho] Good point. Capstone design doesn't have to be the dumping ground for addressing whatever uncovered instruction/assessment holes might exist within an engineering program.

Capstone instruction/assessment should be purposeful within the framework of well-conceived learning outcomes. Way to stick to your guns.

- [Jenny] Thanks, Steven! Agreed! There's a need to define and then protect the learning objectives for this course!
- [Sindia Riveria-Jimenez] project management and conceptualizing the project, software to combine theory and practice, econ - all content framed around meeting deliverables. Separate process safety course; include optimization
- [Cassie Bowman] As a project sponsor/mentor, we don't expect the students to already know or be "taught" everything they need to do their project - students are expected to do research into/learn what they need in order to accomplish their project.
- [Mark Easley] PM, discipline specific professional skills Students seem to have some experience with general team work in their other engineering courses, but in capstone it is developing a plan for division of labor and assigning work to be efficient with the time constraints is what is new to them.
- [Bridget Smyser] High quality research, PM, brainstorming and project scoping, materials selection, design for sustainability and design for manufacturing, DEI in Design, Presentation and teamwork skills, IP. Those are the big ones.
- [Jay Goldberg, Marquette University] We cover topics that are either needed for them to complete their projects or to prepare them for their careers. If a topic does not support either of these, it is not included in the course. Be careful not to let ABET make you feel that you need to add topics that do not meet these criteria.
 - Amen, Jay.
- **Anyone wants to chime in on Final Reports ?** I think a lot of effort does not get noticed
 - [Shraddha @Rose-Hulman] Can you clarify your question? Our reports are evolving incrementally as they progress on their projects. The reports are reviewed periodically and students edit based on the feedback received. So it is not seen as a waste of effort. [@ Penn State Erie] they only required a final presentation, but did not require a final report.
 - [Jay Goldberg, Marquette University] Our students' final reports are a repository of their entire two semester projects. They provide value to industry and other sponsors.
 - +1 (Cassie Bowman, ASU)
 - [Jenny Retherford] intermediate deliverables, conversations with students and mentors about content improvements. Learn language for client reports like showcase (ex. Introduction paragraph)
 - [Sindia Riveria-Jimenez] 50% project grade and 50% other assignments. Weekly deliverables with feedback given. iteration .
 - [Mark Easley] long reports are a difficult task for busy engineers, oral reports have much higher impact, but students still need to learn to create written reports.

- [Todd Polk] Our Final report goes to the Client so it is closely reviewed by the mentor and the instructors. It is set up to build on previous written deliverables they have submitted throughout the project, so a lot of it is already created and only needs to be updated for any changes that occurred throughout the project.
- [David Schmidt UMN] **I am having a problem convincing faculty in the department that Capstone is more than a final engineering exam (all about the engineering analysis). It is a one semester course from scoping to final design report (no building). But I have to cover ethics (ABET) scoping, design process, project management, writing, etc. Anyone else have this problem. How do I judge the weighting of all these different demands?.**
 - [Sindia] some linkedin learning certifications for professional skills. Choose content based on your style and personality. Curate content from experts instead of creating it yourself
 - [Shraddha @Rose-Hulman], Agreed, it really depends on the department's perspective. Look at it as a gradual process change. Try strategies such as change along with the department to get their buy in. Make your priority list and focus on max 3 changes at a time. Unfortunately, all schools collect a lot of ABET data from the capstone class, maybe you can use that as the leverage to bring the department on board.
 - [Alex Szatmary] Ask your industrial advisory board to say what's important.
 - +1 Mark Easley
 - [Nathan Kathir] One way is to connect the course learning outcomes of capstone courses to ABET student outcomes. Assessment of the attainment of most of (not all) seven outcomes are appropriate in the capstone, and thus the significance of capstone can be highlighted to the leadership.
 - [Jay Goldberg, Marquette University] Capstone design is about design - the focus should be on the project. Final exams might not be appropriate - final reports and presentations may be more appropriate.
- [David Schmidt UMN] **I also am now getting worried about NDA. Our final presentations are all public, is this a problem?**
 - [Shraddha @Rose-Hulman] we require our students to get approvals on their posters/presentations from the clients if they have signed the NDA. The client needs to approve the content to avoid any conflict.
 - [Beth DeBartolo @RIT] If you have an NDA in place, there are probably terms included. That can be your guide. The ones I've seen require students to give their client a chance to review material before public review. That said, our projects were totally public for many years before we clamped down on this, and there was no formal agreement w/clients, and we only had one incident with an inadvertent disclosure. But it's definitely something to avoid. If you want to talk more, I'm happy to walk through our processes with you.
 - [Jenn Carlson] At the University of Michigan, students own IP when they are earning credit. Our students largely sign IP and NDA agreements with the sponsors, and the contract the University signs with the sponsors covers NDA for

faculty and staff. Final presentations are done privately to faculty and sponsors only. (similar to what Robert is saying happens at UT Dallas right now). Caveat - we aren't exactly a capstone class. Multidisciplinary Design Program runs like a capstone, but is elective. Also we have a standard "reasonable" NDA form we encourage the sponsors use with the students. Most agree, and if they don't, we use our legal team to negotiate something that is still reasonable from a student course perspective.

- [Bridget Smyser] We finally got to the point that we won't work with sponsors that require NDA's, because it is such a hassle.
 - [Mark Easley] Very wise Bridget! It is worth asking the sponsor at the very beginning if the sponsor has a project that does not require an NDA. You may still go forward with it, but at least you gave them an option to reshape the project proposal to be easier to work on.
- [Mark, TI] try to structure projects such that there are no IP issues, avoid NDA
- [Robert Hart @UTD] students own the IP for student work; industry ask to have students sign off on IP transfer; Have students treat each project as confidential.
- [John Estell @ ONU] We require an external presentation, but allow students to count presenting to their industry client as that presentation (otherwise they present at ASEE Section Conference or similar). They also have to present to the faculty and their peers as well, so they work with their client to vet what can and cannot be presented in that venue.
- [Neal Skinner] We have had to cancel at least one project after it started because the university's lawyers and the sponsor's lawyers could not agree on an NDA.
- [David Schmidt UMN] One last issue . . . **I would love to see how the quality of our capstone projects compares with others. I have no idea how well our student's project stack up against others.**
 - [Susannah Howe, Smith] If your projects are partnerships with PEs ever, the NCEES Competition ([NCEES Engineering Education Award](#)) is a good one, and has great prize money!
 - [Jay Goldberg, Marquette University] Encourage your students to enter a design competition to see how their project compares to those from other schools.
 - ^^This is also a great way to find projects if you're new and haven't yet developed your network of industry clients!
- [Jodi Bolognese, Northeastern] **What kinds of background research do you expect from your students for their capstone projects? Are there any research or information literacy-related skills that you see your students struggle with?**
 - [Shraddha @Rose-Hulman] students are usually good about finding benchmarks in general on the internet. We do not require any specific research regarding research papers but they are expected to know it from their technical communication classes.
- [Eli Patten, UW] There seems to be a spectrum for capstone programs from a structure course w/ class time, smaller dedicated instructional team, and graded intermediate deliverables on one side, and more independent projects where faculty advising is dispersed (each team has their own faculty mentor) and shared w/ industry/external

client/advisors, and no uniform structure across the projects. There's also the spectrum of how the design theory is taught and integrated: either as part of its own structured course that happens right before the capstone itself, or side-by-side the capstone. **Any sense of which is more common or works better? Best practices for how to capture the benefits of each?** Specifically interested in how this scales for large programs (100-200 undergrads per year in department)

- [Shraddha @Rose-Hulman] Look at Susanah Howe's prior papers on [capstone survey](#). Lots of useful information there. My recommendation is to use the original structure as is. And gradually change a few things at a time and observe for yourself what works the best. Unfortunately, what works best for me at a small private school may not work for you.
 - Yes, I've looked at those - need to revisit them, so much good stuff! Good advice about only gradually changing - that's what we're leaning towards.
 - I am sure you will find a good spot for yourself.
- [Bonnie Roberts, CSU] **Do you specifically explain/discuss expectations/responsibilities of project advisors/mentors when asking a potential advisor/mentor to participate? In other words, do you have a clear outline of how advisors/mentors should participate?**
 - [Jenny Retherford] hotwash with sponsor/clients at end of semester; sponsors network and learn from each other and implement in next cycle. Asked to create a playbook document--living GoogleDoc
 - [Keith: I have a liaison engineer guide that may have some useful tips]
 - [Cassie Bowman, ASU] Make sure your sponsor/mentor/advisor knows to check with you if they have questions about things students have told them - follow up on disconnects in communication--lots of "telephone" happens where what you tell students can get interpreted and communicated differently by the time they pass it along to the project sponsor/mentor/advisor.
 - [Bridget Smyser] All our advisors are faculty, although there are some projects that are sort of co-advised by sponsors. We do explicitly discuss what they are required to do, as it is part of their teaching load, but we don't over script their interactions. One thing we have found is that there were a few advisors who were either constantly hamstringing their teams by putting unnecessary constraints on the projects or were ghosting their teams, or were pushing their own ideas on the students. We (the coordinators) will coach these folks as much as possible. But we have had some faculty who are not invited to be advisors anymore. That sometimes is tricky, but we have had department head support on this.
 - [John Estell, ONU] Rogue advisors adding and/or changing specs has been an issue for us as well, but we're sufficiently decentralized for how capstone is operated that the onus is on the client to catch (and fix) such changes, which unfortunately usually doesn't happen.
 - [Bridget Smyser] How frustrating! In some cases the client = the advisor, so that can be good or bad depending on how overbearing the professor is. We have a lot fewer outside projects (probably would be nice to have some more) so the coordinators

rely on students complaining about the advisor in a lot of cases. Student proposed projects tend to have a lot fewer of these problems.

- [Todd Polk UTD] - we do a training session (one hour) to go over the role and responsibilities for our project mentors early in the project cycle. We have several areas we cover and then open it up to our “veterans” that have done it a few times to relate their experiences.
- [Doug Willard] **Would it be good practice/idea to attend the initial meeting with sponsor to make sure expectations, agreements, etc up front?**
 - [Mark Easley] A meeting can be good to have with a sponsor if you have concerns about deliverables. It is probably good if you ask the sponsor to submit a project proposal first so you have some expectations before the meeting.
- [Jenny Retherford] our faculty are not formally assigned to advise the students; we have 'official' mentors from our external network
- [Joe Klaesner] We identify the company or faculty person with a project as a client...
- [Jay Goldberg, Marquette University] Capstone design is about student design - faculty advisors/mentors should not be designing with the student team and contributing to IP. In my opinion, a nonpatentable design that is 100% created by the students is more important than a patentable design that was partly invented by a faculty advisor.
 - [Todd Polk] Jay I agree. With us having IP turned over to the client, the mentor (usually faculty) cannot contribute as they cannot assign their IP rights to the client like the students can. In other words, all of our projects are 100% student designed.
- **How long is your class? How many credits? How many semesters?**
 - [Susannah Howe, Smith] The 2015 Capstone Design Survey results (which include responses from ~500 programs across the U.S. on various capstone logistics and teaching methods) are in IJEE (International Journal of Engineering Education Vol. 33, No. 5, pp. 1393–1421, 2017; see [download on Smith ScholarWorks](#)) Next survey will be in 2025.
- [Peter Schuster] **Can you clarify the terminology: What is a "Mentor"? We have Sponsors (industry, non-profits, clubs, etc) and Advisors (faculty). I presume a client is the same as a sponsor.**
 - [Jenny Retherford] for me, "mentor" is our technical advisor - the person they go to and ask questions about the engineering analysis and design work required to perform their work. Client (for me) would be the same as sponsor (ours do not pay, so we don't quite take on that title)
 - [Shraddha @Rose-Hulman] Client = sponsor = drives or sets expectations, Mentor = project advisor (maybe a faculty advisor who provides support and guidance).
 - [Cassie Bowman, ASU] Many of the programs at ASU have the professor and the sponsor, but no other advisor mentor. The sponsor is the mentor/advisor and

brings in other technical folks as appropriate to advise the team. There are many different models depending on how the specific course is structured and funded.

- **Would it be good practice/idea to attend the initial meeting with sponsor to make sure expectations, agreements, etc up front?**
 - [Shraddha @Rose-Hulman] I always do and make sure that we are on the same page. I attended the first few meetings and they gradually let go and let them drive it. I attended the last meeting to gather feedback on the completion.
- **How do you handle issues with teams? Workload, disruption, etc.**
 - [Sindia] train them on teamwork; first 2 weeks is all about teamwork; item in the agenda for the meeting with faculty lead; teach them how to do minutes, action items; teach students how to handle conflicts
 - [Jenny Retherford] informal; create a Gantt chart where students define their responsibilities across the project; the team hosts team briefings (4) spread out across the term. Report on individual tasks completed and next tasks--some peer pressure to motivate completion; 30 minute sessions; teams asked to use the process internally for their meetings--use the tool; professional skill to transfer out to their career
 - [Cassie B] Something we'll keep from COVID - we asked at the end of each meeting, "how are you as a human?", which helped gauge how individuals and teams were doing, ferret out some personal and team issues, and create some empathy within the team; we offered 1 v 1 sessions at the beginning of the year to understand individual backgrounds and potential issues better (early in the project)
- [Pradeep George] **How is capstone workload calculated for faculty? Is it calculated differently based on the number of projects? any thoughts on the workload is highly appreciated?**
 - [John Estell] At ONU each faculty member in the college is expected to advise one capstone project. That specification gets around trying to set a numeric value...
 - [Shraddha @Rose-Hulman] Since rose-human is very much focused on individual attention and support. It is 20-24 students (5-6 teams) per section of capstone and the instructor does it all for the entire 30 weeks (3 quarters, so 3 courses out of total 9). One instructor may have upto 2 sections or capstone. At PennState Erie, one instructor for 8 teams (1 course release for all lectures and content) but each faculty in the department had to advise teams (1/3 course load for whole year advising). Second semester was just 1/2 course load for the entire cohort's coordination - no lectures nor course evals.
 - [Jenny Retherford] preach it, Pradeep! We have spoken about changing workload calculations to 'contact hours' rather than 'credit hours', but it's not widely accepted at our institute...it's the department head's call for us
 - [Peter Schuster] We teach capstone as a lab course, so faculty get 'teaching units' for leading a lab section. One section has 6 projects and gives 4 teaching units per quarter (12/year), making up 1/3 of our teaching load. We used to do it ad-hoc and it was very unbalanced.

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- [Peter Schuster] **What type of project management tools do you use in your course(s)?**
 - [Peter] We have students create/maintain a Gantt chart (TeamGantt) and then use an internally developed Weekly Status Review sheet prepared for each weekly meeting. I would love to have a tool that combines both of these! TeamGantt is a nice platform and is free for education.
 - +1 Jeffery Yiin
 - [Eli Patten] re gantt charts, I find ms project and other 'professional' project management programs are a bit complicated for a shorter project and students can get too distracted by details and not as accessible (\$); but excel/sheets are harder to keep updated or modify. Is there a platform/tool that people find strikes a good balance?
 - [Sylvia RJ] Trello is simple and can be integrated in Microsoft Teams
 - [Mark Anderson] Our course collaboration tool is Redmine. Open source, includes Gantt charts, discussion forums, a wiki and integrates with git or Subversion for change management.
 - [Jay Goldberg, Marquette University] We use Work Breakdown Structures, Gantt charts, and risk assessment tools to manage threats to their project schedules.
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- **Faculty onboarding/expectations outlined formally?**
 - [Robert Hart]: “Training” Session for Capstone faculty, now doing online
 - [Kris Jaeger-Helton] : Been mentoring new faculty for each first-time Advisor
 - [Jay Goldberg, Marquette University] I use a Faculty Advisor Handbook for our faculty project advisors that defines their roles, course deliverables, and how to handle team issues. I am willing to share this document.
- **Handling Issues with Team members?**
 - SRJ: Specific module on Teamwork - always talk about teamwork, even on the agenda
 - Teach them how to take minutes and generate action items, done early on, raise the issue of dealing with conflict
 - JR: More informal - Create a Gantt Chart to outline responsibilities and timing. One tool: host team briefings, up to 4 briefings with Coordinator
 - CB: Ask: “How are you as a human?” Optional 1-1 with students, helps gauge where they are Encourage students to speak up
- **Peer Evaluation Tools**
 - SRJ - CATME
 - [David Schmit] I did a course review that is not graded. They evaluate how their team is functioning as well as their mentors, advisors and instructors and general course.
 - [Alex Beliaev] For peer-reviews, I ask students to provide rankings.
 - [Jenny Retherford]R Peer Reviews, but they have drawbacks, GoogleDoc

- [Jenny Retherford] SOW is always a draft. Don't know if student expertise will line up with project requirements. Work through matching with students, clients and mentors
- [Keith UTK] 2-semester project with 6 students/team = 600 hour project scope
- [Jay Goldberg, Marquette University] Projects should provide value to a customer, client, or sponsor. This is really what engineering design is about. They should include a final deliverable that can be completed in the time available. Projects that are academic exercises only should be avoided. Research projects are not design projects.
- [Kris Jaeger-Helton] Be certain that you have outlined a problem to be solved, not merely a thing to be build or done, even if it is implicit. It may evolve, but they can make milestones for how to scope the work.
- [Kyle Cowdrick @ Georgia Tech BME]: Many of our design programs have so many student teams in each cohort, keeping up the "flow of projects" we can provide to our students can be a challenge. **What are some "best practices" your programs have adopted over the years to source real-life design projects for your students?** Here I am particularly emphasizing external sponsors (clinical, industry, government, etc.) but am also open to hearing about internal (within your University) projects.
 - [Shraddha @Rose-Hulman] Focus on building relations with the industry around you. Establish your network, I use my design expo as advertisements to recruit next year's projects. Also, usually my clients are repeat customers because they are happy customers who got some value at the end. Also, source a few from local non-profit organizations.
 - [Jay Goldberg, Marquette University] I solicit project ideas/problems from medical device companies, physical therapists (assistive technology projects for people with disabilities), and faculty (not research projects).
- [Bridget Smyser] I don't know if other programs have this issue, but we're a MechE program and we get EVERYTHING. We get Baja cars, liquid rocket engines, consumer products, research apparatus, drones, affordances for the disabled, etc, etc, etc, How do other people juggle such broad topics, or do you purposefully limit things?
 - ^^This is what keeps it interesting! But it also means we need to set appropriate expectations with clients - if a project is way out there and new for us, we tell them they're not likely to get a fully functional prototype at the end.
 - [Peter Schuster] @Bridget - same for us. It's what makes it "interesting" to teach senior design! We have several different sections/advisors, so we tend to cluster projects with the person who has most experience in that area. We also encourage students to get technical support from other faculty, and focus on PM in the course.
 - [Jenny Retherford] Yep! ...also...I don't worry about the variety of project types. I create a fairly universal rubric for assessment which allows me to grade regardless of project. I have conversations with students - I remind them that professionally they will work on different projects - the projects we have are not

perfectly similar - and I just communicate this as something they can expect in the future

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- How do you evaluate your Teams?
 - Jenny Retherford] - Milestones and deliverables on percentage basis
 - Final report is key, given the content reflects the process
 - Use Final report as a reflection tool
 - [Sindia Rivera Jimenez] - Project grade is 50% will also include individual aspects,
 - Deliverables every week which will contribute to the final written product
 - Grade can be adjusted in terms of contribution
 - [Mark Easley] Require the writing, but not necessarily the most impactful element

Post Session 3:

Design Reviews - Birds of a Feather Conversation

- Advice for Design Reviews (5 words or fewer)
 - Focus on process
 - Emphasize pros and cons
 - Where are we and why?
 - Be vigilant against scope creep
 - Use less scary assignment names
 - Seek meaningful feedback
 - Feedback is a gift
 - Start design reviews early
 - Emphasize the life value

A guide for design reviews was published by Denny Davis a few years ago: ***Project Design Reviews: A Mentor for Successful Design Reviews, 2nd Edition***. It identifies timing, process, and participants for successful design reviews. It is available through Amazon: <https://www.amazon.com/dp/1983488968> or for additional information see: <http://veritydesignlearning.com>.