Panel 1B
Project Management

Description: Best practices for managing year-long capstone project (more than one semester or multiple quarters) engineering projects. Discuss different tools for project management, training for leaders, roles of faculty and client.

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Starting Questions:

1. *New instructors often are caught between choosing a project management technique to employ in their classroom. The common dilemma is the choice between agile and waterfall approach.*
    a. What are the pros and cons of each method? Which one do you (panelist) prefer and why?

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MC: Agile approach with rapid prototyping; try to get early feedback from sponsor; cons: too fast at some point–not enough time to absorb the information and apply it to the project.

HC: We have a studio in computer science and computer systems, engineer and informatics. And some students also related with industrial engineering, but a few of them. With the nature of these project we use an agile approach. combined with rapid prototype and of kind of going in both those 2 approaches. Quick and early feedback with our clients or sponsors, trying to learn as much as possible from them as quick as possible from them

EL (one-year program): When do they apply? Some clients are looking for waterfall, some for agile, some don't care. Project drives the approach. Cons: if you follow the right approach, there isn't much of a con.

EL: The most important thing between these methodologies is knowing when and how they apply to each project. Quick and early feedback with our clients or sponsors, trying to learn as much as possible from them as quick as possible from them. Others are more open, and others the other extreme. They want them to do agile they just want to see what the students are capable of doing. So obviously in agile there's more freedom that to kind of punt and make decisions along the way, because the students are having shorter goals and they want to develop things based building off every previous development. They get feedback from the faculty, from peers. If they go that we're even from users. If they go that way, and then they build off the next steps. Our teams have to meet every week with their sponsor liason and coach, maybe every other week. Based on feedback from this, sprints are about weekly depending on the results. This is fairly fast, so realistically there are some weeks without much to report.

How long for each sprint? 1 week is typical because of weekly contact with client

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CB: We work with capstone teams from all different disciplines, and not just necessarily in engineering either. Also communications, graphic design, the sciences. So in general I try to work with my teams, and whatever their faculty have set as the way that they would manage their project. But because of the scale of teams, I only meet with each team every 2 weeks, and the rest of the time we're communicating in slack. So, even if they're doing like a waterfall process, it becomes some ways a little bit hybrid, agile, because they're meeting with me every 2 weeks. So they're generally ready to ask me questions. They need real-time feedback on or show something that they've done. So it's a little bit of a mix. But we try to meet the teams, where their requirements are for their program. That being said for the teams that are doing scrum, for example, and agile process, it can be complicated for them, because if our meetings are off cycle with when they have their sprint summaries do for screens, for example, Helen and I encountered this a lot so lots of Cs teams from asu that takes a little bit of flexible thinking from the teams and thinking about having, in a sense multiple customers right? Because I'm the customer for the product. But their professor is the customer for their sprint summary for the for the gradable items. So I can see pros and cons about each one what I like about Agile, and I wasn't exposed to it till I was working with the Cs teams, computer science teams is that it doesn't allow the students to get bogged down in planning it does force them to make some decisions and see how those go with their client. So I think that's nice in the past. Before Asu implemented scrum with the Cs programs. Sometimes there'd be teams naturally really took their time and then they would come with this fully formed product, and it wouldn't meet. What our specifications were. And so I like that back and forth.

b. What are the best practices to implement an agile approach?

   EL: must train the students; teams must define their roles; the faculty coach has to be onboard with the approach; start with small tasks and get feedback; get more comfortable with the approach and tackle self-defined tasks

   Do you have a product owner? This is a role that doesn't really make sense in Agile - we have a project manager but not a product owner. EL: For us, the owner task is shared between the faculty and the liaison.

So it's important to train the team. They need to understand how this paradigm works. So in our case, for example, we, before they really dive into building we give them a workshop. On what a scrum! And then most of the software teams will attend that some others will turn it because they want to learn that. And we early on also expect them. to have roles in their teams defined, and with those roles they need to understand what they're bringing to the team in terms of the paradigm of Agile. And so we have the, you know, the people who are in charge of reporting people in charge of assigning people who have to do more of research. Once everyone is on board, then we focus first on small steps. So again at the beginning, we're doing a little bit more research and understanding of the project, and we give them these, you know, kind of prescribed tasks for them to do and see how they come out. And then they'll realize like, Oh, you know, this is quicker than I expected, or you know, some things weren't defined clearly, so I wasn't sure what I was supposed to do, and so we go through that for a couple of weeks. This is a one year program. Then by October we start a fall when they're more more developed, more.I'm sorry diving more into development. Then they'll feel more comfortable with it, and they can work on on defining their own task per week and being accountable for what the.

EL: Teams are typically 5-6 students in size.

HC: Teams are normally 4-6 students We start early training on the process, assigning tasks, how to use the results to plan the next sprint; rotate the scrum master role; work with an instructors to define tasks and spread the work evenly; 2-week sprint; instructors meet 2-3 times per semester with each team; 1-year projects; try to detect early problems within the team or with the sponsor–if problems, then call all-hands meeting; typically meet with sponsors biweekly. We part of the implementation is for us to detect early problems with the teams So we this one on one interviews or one-on-one meetings. What we're looking for is to detect if any team is struggling with anything, either with within the team or with the sponsors, and that we, if that is a risk, the situation we call a or hands meeting when we depending on the situation, we invite the sponsors, we were with the team to figure what's going on and help them to move forward with the project. We asked the students to meet as a team weekly. They have to do that, and they have to meet with the sponsors every other week. This is how we implement the agile approach.

c. What are the best practices to implement a waterfall approach?

CB: what's been interesting for me to see is in the groups I worked with that used that approach. There's been a lot of hands on interaction from a coach like Edward was talking about, or faculty member that has a lot of interaction with that student or with that team. So, you know, in general they report to me how they're doing, but it's that faculty member, or that coach or that guy that is making sure they're making progress in that way. I think, in general, I have a little bit more input as a client into the schedules and the progress of teams that are using an agile methodology, because every 2 weeks they're coming to me with a product update or things like that. So, you know, like Edward was saying, both of them have their place. I think that teams trying to implement the waterfall approach without a lot of hands on faculty guidance. Would maybe struggle a little bit more to keep the project on track, to keep the project to a manageable size for capstone.

EL: So I agree with what you said. Right? If I didn't have that structure of the faculty coaches, it would be a lot tougher to manage that, having all these approaches at the same time. In one course, one thing we do with waterfall is, we do expect them to early on understand what are the expectations of the project once they're done as a one year project, so we want them to have clear expectations of what they're supposed to have by the end of the year. But we I don't really emphasize planning the year. Early on. So we do kind of a break it into 2 and and the first semester. The expectations is that they have their waterfall plan for the first semester, and then when we're finishing the first semester based on this feedback and what they've been able to do, then we'll tackle the second semester and we'll see how the how the goals have shifted, based on what they've done.

HC: We don’t have too many teams working with our instructors on the waterfall approach. What’s most important is that our instructors help teams define the design phase. They help teams move forward, avoid what causes them to get stuck in the process, and what the end product should be. We need to work with them a lot in helping them to acquire or understand all the requirements very, very clearly.

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d. How is agile practiced? What do the basics look like? Versus what does above and beyond look like? (Resources available to share with teams)

   HC: Trello, Notion, Atlassian, Jira, gethub, discord, slack, Teams, Zoom, Hangouts, use surveys for peer reviews

   EL: SW students love to try whatever SW tool is trendy. Waterfall teams usually stick to Gantt charts.

e. Any advice for someone who is transitioning from waterfall to agile?

   HC: Moving from waterfall to agile, one of the things that's important to understand is that it's a shorter and faster process. quick processes for Agile requires a shift in mindset–can be overwhelming; gain early feedback from stakeholders; communication with client is improved–need to better understand their needs; clients will suggest technologies they are interested in and want the team to try out; Use tools like Slack (set up by instructors); need code repositories with who is contributing and who is not (used for grading purposes); reinforce why it is important

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EL: You know, if a project is not really meant for it doesn't call for it I wouldn't transition I allow, the class to go with whatever's best for them, and I have to be ready to guide them in what ever it is that they're doing again. I come with it with some experience in and software development. I did that for a few years, and I was trained as an electrical engineer and learned more of the project management from industrial engineering. So I did have some of that background for both. But the important thing is the again that it's what the project calls for. You can really expect a team that has, you know, very straightforward goals, you know. We want you to build this. And that's it. Here are the guidelines, and you go ahead and build it. And at the end of the year we want that being built, you know you you can break it down into having, you know, kind of a sprint approach into you know how we're going to develop this thing. But if it in a multi disciplinary setting, we're kind of each like. First, we have a project, and there's like one electrical engineering student, one mechanical engineering student and so forth. First, we have a project, and there's like one electrical engineering student, one mechanical engineering student and so forth. And they're gonna have to develop, and there will be stages where one will depend on the other. But it's more of a waterfall, anyway, because, as each one develops their own parts, then they can start integrating and but not any sooner than that. So I've I like to let the projects kind of dictate what is, how, how the approach has to be, instead of, you know, trying to force it.

Q: Are any of you using Agile for Hardware development? It is overall difficult to go through design, build, test in a two week span. Also are you holding the students accountable (grading) their sprints based on the deliverable that they said they would have?

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HC: We have some teams that are hardware based projects and sometimes the two week sprint is short for the design, build, test phase. These sprints do offer the ability to measure your effort better and help students plan better on how long it will take them do complete certain things. Certain projects, software or hardware, learn from the two week sprints and if that's working or not working and why. What are the things that delayed this particular accomplishment or task? It might be that we didn't get the pieces when we needed. in terms of holding the students accountable. We review their task list, and efforts every sprint – so we are reviewing the workload between students at each interval to hold them accountable and each of them are contributing equally. We also ask them about four times a year to do a peer review between team members. We also ask the sponsors the same – to do a review of the team four times a year. to provide us feedback, and to evaluate our students, and this is considerable percentage of the final grade.

HC: students need to learn how long it takes to complete a task or type of task– reflection required for what prevented them from getting the planned work done in the timeframe; review velocity and task work for every single sprint; need to insure tasks are balanced–either the task is not well defined, the effort is not there–want each software engineer is have similar workload/coding responsibilities; students peer assess 4 times–these count toward the final grades; ask sponsor for feedback on technical and professional skills–high percentage of final grades

Q: What tools/software do you use for each method?

SS: MS project, Monday (students hated it), Excel spreadsheet or GoogleSheet for Gantt

EL: SW students love to try whatever SW tool is trendy. Waterfall teams usually stick to Gantt charts.

HC: Agile: taiga.io, some sponsors provided tools. Github. Use Discord for communications, or use Slack or Teams. Peer review: surveys with likert scales/rubric.

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CB: Well for us, as the customer of the client, because we have so many teams, we've kind of created our own system that lets us add students from outside of Asu put students into their teams and also into larger teams based on their institutions slicing and Dicing folks in different ways. So we use heavily used slack, and I let the students know that's the preferred means of getting in touch with me. 'm always seeing slack notifications, whereas my email inbox, it's completely filled up and probably a lot of your other customers and clients are like that as well. We use Google drive They're welcome to still use the one from their school. But we asked for final deliverables, things that we need to review, to be put into that Google folder or if we put it to slack with us, we use zoom unless we're bringing in someone from a NASA center or something that needs to use webinars or teams we have all of those. So I think students tend to be very comfortable with Zoom. But we have these other things available, and then, you know, the students use what the students use discord. The university really doesn't want us to be using discord with students. We have our, own surveys that students can opt into with an informed consent, and we use survey monkey for those. So yeah, it's it's a hodgepodge of things that just happen to be what we have access to through enterprise accounts.

Q: Do you use a specific tool for peer evaluation feedback?

CATME, homegrown surveys,

Q: Do any of you require project management performance metrics, such as Earned Value, Cost Performance Index (CPI), Forecasted Cost at Completion (FCAC), To Complete Performance Index (TCPI)? I don't know the analogous Agile performance metrics

EL: I don’t. That would require teaching these to students and sponsors have described they’d rather spend more time developing. On teams with industrial and system eng students, they know some of these and will do post-analysis to support their effort.

2. How do you train a project leader? Do we enforce rotating roles or how do you encourage the rotations of team roles?

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CB: If there's one student who's the designated client contact, then that's the student I get to know really well. So my preference, if it doesn't upset the apple cart with that program is to have students take turns and speak up, and you know, to take leadership at different points, so that I get to know them better than if they come back to me and they want a letter of recommendation or something I actually know them, and how they've contributed. But I definitely understand that programs have regulations/accreditation, so I usually am flexible to that, and I can understand for other clients where they would only want to have to communicate and look out for emails from a single student. But for me I prefer it when I can get to know each one of them individually.

EL: don't train students to be leaders–faculty coaches responsible to make sure students are accountable; encourage them to rotate roles twice per semester; purpose: it is an educational experience–sometimes have to tradeoff between sponsor deliverable with the learning experience

HC: typically have an IE or Eng Mgt student on the team to be PM for project; have other students rotate within the technical roles–2xs each semester; want instructors and your client to notice you–important for your portfolio

3. How do we guide the students to practice their own project management?
4. How do you help students to define project management within a one-year project?
    a. How do you train them to define tasks (appropriate level) and expected time to complete? Continued check from faculty side Project management on the backend (instructor-side)

HC: It happens during the reflection at every sprint, having instructors help them define tasks within each sprint. The first few months all teams struggle because they don't know how to estimate time for research, implementation etc. Reflections help them redefine estimations. More than training or lectures, the practice of doing the work helps them define these. We tell students forget about the year-long goal, think about the next two weeks first. Sometimes we will sacrifice the scope of the project if the sprints are met, as long as the teams are meeting sprint goals.

EL: when we start the year, we do give them team based roles and a handbook. Handout that defines what each role does and what their expectations are. That includes a leader and includes someone to plan the agendas and a scribe. All these things happen on a weekly basis. And then later on they will define more project development roles based on the framework that they want to follow. So whether they're doing agile or waterfall, they do have to plan, long term or short term, something. Those plans are discussed in class or discussed with the liaison. The liaison is really, defacto owner, as I was mentioning earlier. Sometimes liaisons, you know, a little bit more hands off, especially if they've been assigned by someone in the company instead of being volunteered. they will get feedback on in terms of you, know, that's not a realistic timeline or that's too aggressive, or that's too passive. And we'll help them build off. And and again, usually by admit of the first semester they've caught on to what the expectations are, and they'll they'll do pretty good other than you know Students who don't pull their weight.

CB: I would say. What I witness is for some teams, because, especially our projects, are often exploration. Engineering, more open-ended, more student driven for we know we have an end goal and we want them to determine how to get there. Sometimes they have plans that are just too big, they, and they're adding that they wanna do these really exciting and very feature rich projects. And that is a hard one. Sometimes it's really hard to get teams off of that. But II think I've learned through working with so many great capstone faculty. You know, we really encourage them, on my side to think about what's your core. Deliverable. And what are these nice to have? That if you have to, by the end of the school year you can cut away, and you still have your core project. And so that has been a way that for the bigger picture that I've tried to help students make sure they're going to get to the end of the year with something they feel good about. Right cause. It's not just what they're turning into me, but something like you were saying at work that they can have on their resume. I think, Helen was saying, that you can really speak to an interviews and be excited about, and there have been a few teams that have just been unwilling to move from this huge vision and they haven't made it to the end. And so, if you have all these extras that actually are integral to your project, and you don't complete them, then you don't have to be. You feel good about, and I think none of us want students to be in that situation. So that is a that's a challenging one.

SS: SMART goals–have the students use this approach

Capstone Design Conference 2023

Wednesday, June 14, 2023
1:00-5:30pm EDT

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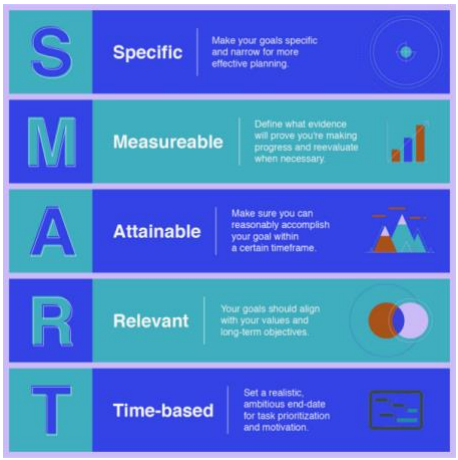

https://project-management.com/smart-goals/

b. Tools that instructors use to keep projects organized
c. Any differences due to size of programs - 700 students per semester versus 50 students
d. Scaffolding versus hand holding

5. Project management on the backend (instructor-side)

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EL: So after the pandemic, when we had to start using teams, I fell in love with it. And we've kept using it. Each team has a private channel. I have access to everything. So I see the conversations that are ongoing. We have canvas as our learning management system, for that's where the submit for grading purposes and to give them materials.They have their own repository in teams for all their documents. They also have a notebook automatically assigned. And so they have team notebooks, and they have individual notebooks, and they have to do a weekly reflection as individuals of what they do. And I have a course assistant that will help me every week with reading those, and I have some clear instructions on what should be there. The assistant will let me know which are the list of students who you should keep an eye on, and I'll go and spend time on those, and then the rest are doing well. I get to spend my time on those that's been that need the most help. The teams also have weekly memos, so that also kind of summarizes what they do. They send that to liaison like I keep an eye out on those those right to my email automatically. We do peer reviews, coach reviews, program reviews.We do those twice a semester, and that also helps me out.

HC: On the backend, we split up by discipline who is going to review which students. Main/first point of contact faculty reviews all of those deliverables to review each team. Coordinators are there to help instructors with teams that are struggling. HC has about 160 teams every semester, so she can meet with those who need the help and meet with sponsor of those teams to coordinate efforts. We use Canvas as well for deliverables and grading. We don't have a specific channel for each team so we let them use whatever they want (slack, discord, etc.)

CB: Well, I think I address the things that we do is, you know, I have a number of student workers who help there in the slack channels with the students, so that students post in their slack channel. I like them, too. Someone is always seeing their messenger. We try to get back to them as quickly as we can. So that think that's the key for us. Because with so many teams I can't meet with them every single week, I can't meet with them for an hour, you know. We only have 30 min, so we really heavily rely on the messaging.

6. How do you help students/teams with client communication (also within the team)? *(Specific focus on project management)*

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Notes: *Please continue typing below*

How do you keep track of all the project teams?

EL: teams repository for each team; team notebooks, individual reflections due weekly; course assistant helps flag individual reflections that indicate students are struggling–EL with follow up directly with the struggling students; weekly progress memos; Canvas for grading only

HC: divide up the projects among instructor by project discipline focus; typical instructor will have 15-20 teams; instructors track the sprints; HC has 130-160 teams each semester; will meet with teams and sponsors that bubble up through the instructors; use Canvas for deliverables; each team has their on process–most teams want to use Discord–ASU discourages this, but some sponsors use this

CB: heavily rely on Slack

Zoom Chat Discussion

Q: So Edward, might a team use Waterfall in the first semester and shift to Agile in the second?

EL: Yes it has happened

Q: What tools are they using for each method?

EL: SW students love to try whatever SW tool is trendy. Waterfall teams usually stick to Gantt charts.

Q: So to clarify Ed, you have some teams using Agile and some using Waterfall at the same time?

EL: Mantra is: To each their own

Q: Do you use a specific tool for the Peer Review Feedback?

EL: We use homemade MS forms. We have a script to send the results to coaches.

Jenn Carlson: We use CATME for peer feedback.

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Steve Larimore: Do you like CATME? We are considering adopting this tool

Jenn Carlson: It can be a bit fussy but it does a nice job. We have 2 semester projects and we use it once per semester.

Q: Do any of you require project management performance metrics, such as Earned Value, Cost Performance Index (CPI), Forecasted Cost at Completion (FCAC), To Complete Performance Index (TCPI)? I don't know the analogous Agile performance metrics.

EL: I don’t. That would require teaching these to students and sponsors have described they’d rather spend more time developing. On teams with industrial and system eng students, they know some of these and will do post-analysis to support their effort.

Gary Bradley: Ok thanks. Its actually part of the curriculum in our program.