Sara Hendren:

Welcome to episode three of Sketch Model, an audio series about the engineering classroom and how the humanistic disciplines of the arts, the humanities, the social sciences, shape the why and should questions about the technologies we build. In episode two, we spoke with Matthew Wisniewski and James Malazita about the larger history of engineering education in the United States. And we thought it would make sense to tell a little bit about the origins of our own institution as it met up with that history.

Olin was started a little over 20 years ago to reinvent engineering education for the 21st century. And it was pretty carte blanche in those days. What would engineers need to know and experience? And then what kinds of curricular structures might bring those ideas to life? There was a partner year before the college even opened its doors, where students came to a not yet finished campus and thought it through, experimentally and collegially alongside faculty with a wide latitude and a lot of imagination, laying some of the building blocks that still shape our campus today. But I wanted to hear about what that felt like in the 1990s and from one of our founding faculty members. So I talked with Dr. Lynn Andrea Stein.

Lynn Andrea Stein:

Olin set out to educate students who could think about their technical knowledge in ways that related it to the societies whose problems they were trying to solve. And as a result, the students weren't asking whether they could design the thing right, they were asking whether the thing they were being asked to design was the right thing.

Sara Hendren:

Dr. Lynn Andrea Stein is professor of computer and cognitive science at Olin College. Prior to coming to Olin, she was a professor at MIT in computing and worked at the AI laboratory and laboratory for computer science there. Her research spans the fields of artificial intelligence, programming languages and engineering and computer science education. She's one of those broad and expansive thinkers who's been deep in the heart of technology education for decades. Welcome Lynn Andrea Stein to the Sketch Model podcast. Can you tell a little bit of the story of how you got to Olin in the early days? What was the first email or phone call that came to you that was like, "Here's this new idea." What invitation came and what was appealing about it?

Lynn Andrea Stein:

So I'd been a professor in computer science at MIT for the better part of 10 years, probably first heard about Olin, more like six or seven years into my time at MIT when there was some publicity about some foundation creating a college in the Boston area. But maybe a couple of years after that, after I'd forgotten about it, my department head had a friend coming to spend some time at MIT because she was part of this thing that turned out to be Olin and they weren't ready for people on that campus yet. So she and her husband were spending some time in the area before they became part of Olin.

And I had multiple conversations with her, was invited to come visit Olin. When they were looking for people to come join the faculty, I applied and in thinking about what it would mean, my department head very wisely said to me, when I said, "I think it's a once in a lifetime opportunity." "No Lynn opportunities like that don't come along that often, even as often as once in a lifetime." And I think, I felt like if I had not taken the opportunity to be a part of this, figuring out what it means to create a

college and why, I would've spent the rest of my life wondering. This was so open-ended and unpredictable and ambitious and really just an interesting adventure.

Sara Hendren:

Yeah. And when you say open ended and unpredictable and ambitious, I mean, some people would think, "Wow, this is completely uncharted territory so lots could go wrong." And I guess I wonder, I mean, at that time, what was your attraction to that ambition? What was either happening for you and your research or your observation of engineering or with students that made you think, "Yes, this new venture." I mean, what was appealing at that moment?

Lynn Andrea Stein:

Remember that it was the late 1990s and it was the height of the dot-com boom. And many of my colleagues were starting companies and heading off on their own adventures. And I never really had an interest in starting a company, but this was something I cared about. This was about educating young people, the thing that I thought was core to a lot of what I was doing. And yet it was about doing something in a new way. It was about addressing a need out there. So it was as exciting as the startups that my colleagues were starting up, but it was in an area I really cared about.

And one of the first things we had to do, one of the things that I knew, even from my early conversations, that the folks behind Olin were doing, was articulating why it made sense to create a new school. What it was that existing engineering schools were too entrenched to be able to do, even though many of them believed in the same things and aspired to the same things. It wasn't clear that anyone really knew how to do this in an existing school. While MIT was at least in the 1990s, focused on educating students to have great expertise, possibly in a narrow area, but enormous proficiency, Olin set out to educate students who could communicate, who could think across disciplinary boundaries, who could work in teams, who understood project management, who could think about their technical knowledge in ways that related it to the societies, whose problems they were trying to solve, which meant understanding people and their problems and opportunities and challenges.

And also what it would mean to make a real solution that was adaptable and adoptable and sustainable. And that was baked into what Olin was attempting to do and quite different from what, at least 1990s MIT was focused on. In the year 2000, which is when I joined Olin, we were aware that the problems we were likely to face as a world were not going to come demarcated with disciplinary boundaries. The technical challenges were also human challenges. The need was very clearly for people who could work together and work across disciplines and interdisciplinary was a big word. And they were inventing words like transdisciplinary. The question of what kinds of knowledge, skills and attitudes would be important in the new millennium, we knew it would be different from what had been before. And I don't know whether we understood the depths of that, but it was clear that the separation of the technical and the technological as disconnected from the human, was causing more problems than it was solving.

Sara Hendren:

Like Matthew Wisniewski and James Malazita in our last episode, Lynn told me a similar sweep of history in the 20th century that included a post world war II investment in the sciences.

Lynn Andrea Stein:

In the academy engineering was applied mathematics and applied science and some hands on work, but mostly it was like experimental physics that way, it wasn't deeply connected to society. And when the

National Academy of Engineering made its list of the most important achievements of the 20th century, they were largely things that engineers had done, I don't want to say in isolation, but more isolated. And when the national academy of engineering talked about what the grand challenges of the 21st century would be, they were all hugely interdisciplinary topics. They were things that could never be done by engineers alone, but required social scientists, required science required in some cases, humanists, required collaboration, political will and yes, some technology. But we went from a world in which technology was seen as the answer or at least the core of the answer, to a world in which technology could only be the answer if it was really integrated with a whole host of other things that had more to do with people.

So in computer science, there's an interesting story that comes out of the war as well. There were really two kinds of precursors of computer science that were important in the war. One was a combination of the calculations that enabled missile trajectories, for example and the decryption that we all know about from the Alan Turing in the movie Enigma, that was very much that sequencing steps to produce an answer. And I should tell you the word computer actually meant a person, usually a woman, sitting at a calculating machine doing this calculations, computing and only leader was adapted to refer to the mechanical computers, the kind that Alan Turing built in Enigma and that we subsequently now think of as computers. There was a second thread of computationally related work in the same era, and it was called cybernetics.

And cybernetics was all about the ways in which the organism or the engineered artifact interacted with its environment. It was continually interacting. And it was understanding the relationship between the agent and the environment on a continuing basis that was fundamental to cybernetics. It turned out that the computers, the mechanical computers that we built in the mid-century and just beyond couldn't really keep up with the complexity of cybernetics. And so cyber dynamics went by the wayside and instead the Von Neumann architecture, the Turing machine, these are the theoretical precursors of what we now call computers, won the day. And so in the seventies and the eighties, this idea of a single thread of control and you control it, and what is the computer going to do next? What is the problem you're solving? That was built on one of the two possible threads coming out of the war era. And the cybernetic thread, the thread that was about interaction, that mostly got lost and found a little bit of a resurgence in the 1980s.

And it was actually some of that work that led me to do the work that I was doing in the 1990s about conceptualizing computing, this thing that had come out of the other thread, but conceptualizing it as building communities of interacting entities and the idea that a computer could be an agent, that it could be a more like a person, think about how we interact with and through our phones now. Cybernetics understood the importance of the thing and the environment and the interaction between the two of them. And that got a little lost because of the success of computers in the late 20th century. And it's come way back and is so much more accurate in some ways, a description of the kinds of worlds we're building now and cybernetics would've had room for human beings and the computer science of the late 20th century didn't really know what to make of humans.

Sara Hendren:

So how do you address what to make of humans? How do you do that in the classroom? Olin tried to tackle that head on.

Lynn Andrea Stein:

Olin came out of a really pragmatic place. There were a number of reports that talked about how engineers were technically proficient but weren't necessarily skilled communicators, skilled

collaborators, skilled leaders, the idea that the quintessential MIT graduate and I don't mean to pick on MIT, I think any engineering school would do here, would potentially become the chief technology officer but would never become the CEO. And MIT, I know has done a lot to try to change that about the way it educates its own students since that time. But this idea that engineers were quite capable technically and not necessarily good partners, good leaders or aware of the world around them, that was a key motivation for Olin.

Sara Hendren:

Just to be clear listeners and underline what Lynn's saying here. It's not as if Olin was the only institution struggling with these ideas. Lynn told me that at MIT and presumably many other institutions, there was also some real restlessness about this very thing at the turn of the 21st century. How did technically minded people learn to deal with human complexity? It's quite messy, not just how questions of the tools. Lynn then reminded me about one of the great champions of creative and robust engineering education, Woodie Flowers.

Lynn Andrea Stein:

Woodie Flowers who was an advisor to Olin as we were getting started and an amazing mechanical engineer who truly believed in hands on education and helped us to envision a lot of wonderful things at Olin, used to tell a story about a course he co-taught with Bill Mitchell, who later went on to become Dean of the School of Architecture, in which both mechanical engineering and architecture students were enrolled. And the story goes that they gave an assignment for students to design something. I think it might have been a chair. They gave an incomplete specification of what they wanted. So the engineering students came back and said, "Professors, we don't understand what you're asking for here. What should this number be? And how big should this piece be? And what stress or strain does it need to be able to take? So give us a better, more complete set of specifications because we know how to design a thing that meets criteria. You have to help us understand what criteria we're supposed to be meaning."

And the architecture students came back and said, "Professors, we've been studying this thing that you gave us. And we think this is not actually what you want. We think you want something different. This is what we think you might want." So they were not asking about whether they could make sense of the technical specification, but they were asking, why is this thing specified this way? What is the purpose? What is the bigger problem here that we're trying to solve? And as a result, the architecture students weren't asking whether they could design the thing right, they were asking whether the thing they were being asked to design was the right thing.

Sara Hendren:

This really is the heart of the matter. Isn't it, with ethics and tech? We talk about this all the time now at Olin, the technical questions matter, as in what's the right way to build this thing, once we know how it has to perform? How fast? How high? How strong? But there's a different set of considerations when you're asking the questions before that moment of specification, what's the right thing to build in the first place? What are all the possible ways to address this conundrum with or without technology? Whose lives are affected by this thing? And how would we know?

Lynn Andrea Stein:

At Olin we told that story and we were very clear to ourselves that we were hoping to educate engineering students who would ask the architecture question, who would look at the specifics and yes,

perhaps understand where there was ambiguity or where the specification didn't make sense, but who would not just get stuck in the technical details, but who would also step back and say, "Why are we doing this? What is the purpose? Are there other ways to meet the purpose? If we do what we've been asked to do, will we be accomplishing the need that this thing is intended to address?"

So one of the things that's important in the Olin education is that from day one, I might even argue prior to day one, students are practicing being engineers. They're doing things, they're exploring, they're experimenting, they're trying, they're building, they're asking engineering questions and they're asking broad questions about what they're doing. We make a real effort to have many of the students' experiences involve a client, ideally an external client, somebody who is not themselves, not like themselves, so that they can't simply say, "Well, what would I want in this case?" So that they're impelled to ask, "What is really needed here?" And then to learn the tools, the skills of inquiry, of co-design, of empathy that allow them to understand what it would mean to satisfy a need.

Sara Hendren:

Yeah. This reminds me of one of the great humanist refrains that passed down through the centuries, it's Terrence's dictum. He says that nothing human is alien to me, meaning if I can see other people, even people precisely unlike myself, I don't have to think of them as relatable as we say now, to think of them nonetheless, as recognizable, as human. So not alien and therefore conjoined with me in some fundamental way in this thing called life. And it sounds like that's what the encounter between students and older adults is composed of in what you're describing.

Lynn Andrea Stein:

One of the things that we did in the early days of Olin is that we knew we had eight semesters and that was an absolute dictum we were given. And it was such a gift because we could not do everything that every other engineering program did. And so we started to ask the question, what are the things that if we don't do that will be problematic? What can we possibly let assume that people will learn later? What can we possibly equip people to go out and continue learning after they leave Olin and not worry about giving them before they walk out the door? Because we only have a four year bag and we can not stuff five or seven or eight years worth of material into it, it will break. So we stopped trying to put everything into the curriculum. We started to ask the question, "What do people know in order to be able to learn the rest?"

And absolutely there are some basics that folks need to walk out understanding. And among those basics are not just the traditional pieces of math or physics or software. They're also how to talk to other people, how to listen to other people, how to work together, how to scope a project, how to ask for help, how to reflect on what I'm doing and understand where there are opportunities for improvement. So how to think about my own thinking and learning, how to go out and learn something I don't know when there isn't a professor in the room to teach me.

Sara Hendren:

How to learn something. When there isn't a professor in the room, maybe if you're like me, someone trained in the arts and humanities, you're thinking, "Well, right of course, we call this the liberal arts, learning how to learn, how to think instead of what to think, the conceptual tools that will outlast any short term skills." It's an old idea and an old argument, but what does this look like in an engineering school? That is, I have to say really exciting. An engineering school is a giant workshop for prototyping those ways to think, at its best it is those things.

I have to say that the distinction of the engineer really can be missing in a liberal arts environment. And that's the agency of the builder, the person equipped with enough bravery to try a new thing, to quite literally build it, to tear it apart again, to tinker and test, to be unafraid to act in the face of challenges, doing it in the workshop, the laboratory and ideally, in a life. A liberal arts education, even with its beautiful and deep commitment to creative analysis and expression, especially in texts, it can miss something really magical that's happening in engineering. If you've seen it in action, then you know. Young people at work with the literal building blocks of everyday materials, with the provisional confidence and excitement about what might be, what if, what else might be possible?

And maybe this is where you're thinking STEAM, S-T-E-A-M with the arts in there for good measure. Or maybe like us at Sketch Model, you're thinking, "Yes, well STEAM." But what does that actually look like if in the mix of those disciplines, we're trying to help students actually think through the human and technological complexities of the world. You can't just add things in and hope for the best. To explore what it really looks like. We'll talk next to artist and creative technologist, Mimi Onuoha, who uses her training in anthropology and in engineering to build her way through socio technical questions.

Mimi Onuoha:

The truth is making anything is so, so hard and so endlessly worthwhile, you have to, you have to do it. This is something I've also encountered I think with students in the liberal arts, who are like, "I would prefer to not make it." And then you give them a taste of it and they're like, "Oh, okay. I see now."

Sara Hendren:

Yeah, it's magical. That's an episode four next and I hope you'll join us. Sketch Model is a production of Olin College of Engineering. A four year undergraduate engineering college outside Boston, Massachusetts. Sketch Model is an ongoing investigation into the substantive engagement between the arts and humanistic disciplines in engineering education. And it's been supported by the Mellon Foundation. We spent the last four years running programs at our institution, bringing more robust arts and humanities to our campus in the form of residencies, some are fellowships for students and collaborations for faculty and staff. You can read all about these programs and ideas on our website, olin.edu/sketchmoel, that's O-L-I-N.E-D-U/sketchmodel. Sketch Model team members are Sharon Breitbart, Kristin Casasanto, Jonathan Adler, Deb Chachra and Benjamin Linder I'm Sara Hendren. This episode is dedicated to the late Woodie Flowers, a much loved and visionary thinker about the very best that engineers can do. He was a mentor and friend to our team and to Olin College.