

SEI Podcasts

Conversations in Artificial Intelligence,
Cybersecurity, and Software Engineering

My Story in Computing with Sam Procter

featuring Sam Procter as Interviewed by Palma Buttles Valdez

Welcome to the SEI Podcast Series, a production of the Carnegie Mellon University Software Engineering Institute. The SEI is a federally funded research and development center sponsored by the U.S. Department of Defense. A transcript of today's podcast is posted on the SEI website at [SEI.cmu.edu/podcasts](https://sei.cmu.edu/podcasts).

Palma Buttles-Valdez: Welcome to the SEI's Podcast Series. My name is [Dr. Palma Buttles Valdez](#). I am the director of the SEI Office of Diversity, Equity, and Inclusion. Today, I am joined by [Dr. Sam Procter](#), a senior architecture researcher in the SEI Software Solutions Division. Dr. Procter has been a guest on our podcast series before, and we will provide links to his [previous episodes](#) in our transcript. Today, we are here to talk about his journey in computing, early forces and people who shaped his life, and the impact of diversity on his work today. Welcome, Dr. Procter.

Sam: Thanks. Please, just call me Sam.

Palma: I will. Let's get started by you telling our audience about yourself. What brought you to the SEI and the work that you are currently doing at the SEI?

Sam: Sure. I did my undergraduate degree at the University of Nebraska, Lincoln. I started out in computer science. But, I will be honest, I didn't love it.

I was actually thinking about switching majors until I took my first software engineering class and decided that that is really what I wanted to work with. I like the study of the way that people build software and ways to improve that. I went on to do graduate school at Kansas State University, which is in the town of Manhattan, Kansas. That is actually where I grew up, so that was sort of fun. I worked in the [SAnToS](#) laboratory. SAnToS is an acronym for the Specification, Analysis, and Transformation of Software. That is really what I worked with was the specification and analysis of in my case, the software that runs critical systems: so airplanes, medical devices, nuclear reactors, that sort of thing. I look at how they can be specified and then analyzed for safety. One of the main ways that is done is with a model-based, engineering language called [AADL or the Architecture, Analysis, and Design Language](#), and that language actually comes largely from the SEI. I came up here for a week or so when I was in grad school to work with everybody, and that went really well. After I graduated, I applied for a job here and got it. That work has largely continued. My work here at the SEI is twofold. I do research on software architecture for those critical systems, and then I lead the model-based engineering group, which continues to handle the development of AADL and the tools and research surrounding that.

Palma: Thank you. I know you and your team do very impactful work. Thank you. I would also like to look at your early years. For younger audience members, what were your early signs that you might be headed in a career in computer science? Were you taking apart a toaster, a lawn mower, or trying to build a computer when you were young?

Sam: Not so much the toaster. For a computer scientist, I am actually pretty bad at electronics or electrical devices. Rather, I came to computer science via rocketry and space exploration. When I was a little kid, I had a variety of science toys from my parents, one aunt, in particular by the name of Jan Butin, and my grandmother on my on my mom's side, a woman named Eva Lee Butin. They gave me, like I said, a range of toys, and one that really caught my eye were these model rockets from a company called [Estes](#), and they are really pretty great. As far as toys go, I think they are pretty close to the real thing, which is you buy solid rocket motors and put them in these cardboard and plastic models. Then you can set them off electronically, and they will fly and eject a parachute, and then sort of drift down. I got really into that. At one point in middle school, I tracked down a book that had simplified physics equations, so you could calculate things like, *Well, how fast is this rocket going at its maximum? What is the altitude?* That had me doing things like calculating the drag coefficient and stuff like that. About that same age, I attended a type of space camp—I don't think it is the official space

camp—where they told me that I was too tall to be an astronaut, because I am six foot six. They said they don't make space suits that big. But my eye was sort of caught by the computers behind all of this, doing all the map tracking the satellites. There are of course computers on the space shuttle. I got more and more into that. I have also been very fortunate to have a computer in the home basically for as long as I have been alive. My parents are also academics, and my father had a computer for writing that he got, because that same grandmother had a computer back in like the eighties when they were not nearly as common as they are now. My dad used it for word processing as he was writing and loved it so much that he bought his own. When he wasn't writing, I had this computer around, and I was allowed to play with it as long as I didn't break it more than I could than put it back together. I just grew up around computers as well.

Palma: That is fascinating. You talked a little bit about your aunt and some influences we are going to talk about right now in in your life and in your career. You might expand on your aunt yourself. But who are those early influencers that you had, and what specific actions did they take that had the biggest impact on you?

Sam: Yes, that is a good question. I think it is mostly members of my family. Like I mentioned my father had this computer. There was also one in his office that I played on when he was in meetings, and I was hanging out on campus. My parents had a no video game console rule, so no Nintendo, PlayStation, or anything like that, but not a no PC game rule. Anybody who played video games on computers in the early 90s can tell you that it wasn't very easy. I spent a lot of time learning about computers, just trying to get these games to run. Similarly, my brother, who is older, would play video games, and I would watch him and try and figure out the games that he was playing. But yes, maybe the biggest influence was this grandmother. She is from a small town called Halstead, Kansas, which is near, at least on the Pittsburgh scale, a small town much bigger than Halsted, a town called Hutchison, Kansas. In Hutchison they have the [Cosmosphere](#), which is one of the It is a museum, and it has one of the best collections of space equipment outside of the Smithsonian. They have pieces of some of the Apollo rockets. They have V-1 and a V-2 from Nazi Germany. They have a mock-up of the Goddard rocket and really sort of tell the whole story of the space program. There is stuff in there on like the Berlin Wall. It really told this very cohesive, fascinating story of the space development, and we went there when I was a kid all the time it was my favorite place. My grandmother took me and my brother, who, I think, was less interested. Yes, my grandmother was really fundamental to this early love of space exploration. Then I mentioned, I

think, my Aunt Jan. She is from Lawrence, Kansas. They had—I don't even know if it still exists—a science store in Lawrence, on Massachusetts Avenue, and she would get the coolest sort of science toys from there. Natural science like gems and minerals, and more sort of physical sciences like airplanes, things like that. I also have to credit my mother, who was always very encouraging, as I was learning, particularly in math and science. She is far more technical than my brother, who is not great at math, or my dad, who is also not great at math. I don't think they would disagree with that. She went back to school first when I was maybe about kindergarten age to get her masters, and then actually got a doctorate later on. I think I was in college by that point. But all through was in dietetics and food science, which is a surprisingly hard science. It is chemistry under the hood. There is a lot of math in that. There is a lot of stats for a public health angle, and so she was always the one that was helping me with the math or science.

Palma: You had some phenomenal role models that were women.

Sam: Absolutely.

Palma: Can you touch a little bit about what was so fascinating about rockets and space? It seems like these are very mission-critical focuses that you had, and your career now is also very mission-critical or critical systems. Is that something that you started as a young child with going to see these different museums and the rockets. Can you elaborate a little bit on that?

Sam: Yes. Well, I mean, I think like a lot of people I am just really fascinated by space. It is effectively boundless. The universe is so much larger than we are ever going to be able to explore, at least in my lifetime, and that is just fascinating to me. I think computers are similar in some ways. I heard a description from someone I think that said that really building software is like building with Legos or something, but you never run out of pieces, and so software is also sort of limitless. There is that neat parallel. But to answer your question about the critical aspect of all of this—whether it is safety critical or time critical or that sort of thing—I have always been very interested in things that happen extremely quickly but still sort of safely. You have rockets, like the Apollo rockets, or whatever that are going to space, and they are doing a ton of math very, very quickly. It is very important that they get it right. There is that scene in Apollo 13 where they talk about the re-entry is the width of a sheet of paper if the earth is a basketball. You have to get this math absolutely correct, and you have to get it correct at the right time. I have always just been very fascinated by the ability to calculate things very quickly to predict where very quickly moving things are going: airplanes,

rockets, that sort of stuff. And computers are the tool to do that. That I think is where a lot of that interest comes from.

Palma: Fantastic. Now we are going to switch gears a little bit and talk about the importance of diversity in software engineering. The things that you are talking about are innovation. We all know that diversity helps to spark innovation. I know that you personally have been an advocate of diversity in your own work and in the teams you have managed at the SEI. Yet still software engineering is a very male-dominated culture. It has been estimated that the percentage of women software engineers is [at 27.5 percent](#). In your experience what is the impact of gender-diverse teams on software engineering? How can that make a difference?

Sam: That is a good question. I think that 27.5 percent number is really striking. I would love to see that number come up. I think hiring is a big part of that. I have heard that jobs like those at the SEI in STEM they sit at the long end of a leaky pipe, which is to say that members of minoritized population, including women, face barriers not just at the hiring point, but throughout pre-kindergarten primary secondary education into college and postgraduate. There is [a really good talk on this, at least it covers the college and graduate barriers, by a professor by the name of Nancy Leveson](#), who is really a pioneer in system safety, which is the field that I work in.

With that caveat or discussion out of the way to answer your question about the impact of diversity, I don't think it is controversial to say that certainly, diversity of thought on teams is a good thing particularly in the types of areas that we work in, which are very poorly defined problems. The solution space is not well-defined. It requires a lot of creativity and out-of-the-box thought. Anything that you can do to reduce groupthink, to come up with a wide range of strategies for various problems, is really good. I think increasing diversity goes at that problem directly. I see this on some of the teams that I have managed with new hires, particularly those who may come from a traditional computer science background, but not necessarily a critical systems and computer science background. We will get these questions from them that really come from out of left field. But then, the more we think about that we iterate on it, the insights in those questions, and in those out-of-the-box viewpoints can prove very valuable, and not something that we're likely to come up with if we stick with the sort of people who have been doing these jobs for 30 years, who are, of course, also very valuable, but it is just it is harder to break out of the box when you have been doing the same thing with the same people for a very long time.

Palma: Sam to build a little on what you have just said, the same research

when viewed through the lens of ethnicity or racial identity, showed that more than half of the software engineers in the United States identify as Caucasian, followed by 33 percent Asian, 6.9 percent Latino or Latina, and only 4.9 percent being African American or Black. I think this expands upon what you were just saying, but I didn't know if you wanted to comment a little bit about that data.

Sam: Yes. I think I would go back to that previous answer that the diversity of thought is really vital for the sorts of domains that are just poorly defined. They require a lot of creativity. There are a number of different aspects. We have talked about gender. We have talked about race. I think that this problem is so challenging, but also a really important one to look at, this problem of diversity in STEM and across government jobs more generally, across a range of different aspects of sort of personal identity. One that hits very close to my heart is diversity and gender expression and sexual orientation. If you will permit me a brief digression, there was an article in the Atlantic recently by a guy named Jonathan Rauch. The piece is titled [The U.S. Should Apologize to Gay People](#). In it, he describes how—and this is a quote— *Beginning in the 1940s, and continuing for more than six decades, the United States waged a campaign of legal, social, and psychological obliteration against its homosexual population.* He goes on to clarify that this isn't necessarily just homosexuals, but it is LGBTQ and gender nonconforming individuals as well. What is powerful about the article is that it makes the case that beyond obvious issues of justice and equity, that the persecution that the government pursued—he uses examples from the foreign service—ran people out of their jobs and out of government who fully believed in the ideals that America represents. They worked tirelessly towards that. By running them out of work, we, as a nation, lost access to their ideas. It reduced diversity of thought, but we also lost their labor and their passion for the sort of things that the United States at its best stands for. We lost all these contributions. I think that, like I said, in addition to that sort of justice and equity line of thinking, there is also a dollars and cents line of thinking. Any STEM field, certainly software engineering, if people don't feel welcome then they are not going to participate. They are not going to be part of that. We are narrowing the hiring pool for what are often very specialized, hard-to-fill roles. I think that people who have put together teams in software engineering or other STEM fields know that it is very hard to hire for some of these roles. The idea that we have fewer candidates than we otherwise would because of various sort of reasons that diversity is lower than it might be, can sympathize that this is really something that you should work to remedy.

Palma: I agree, Sam. As you know, I go to a number of conferences for the

SEI. I tend to have students because most of our college students are just graduated. They identify across the board with different genders, gender expressions, ethnicities. But one of the things that I see most frequently is the students who say, *I went to community college. I don't have...* A lot of the impostor syndrome or feeling not as worthy of coming to work for an organization like the SEI. Part of what I do is spend my time helping them to change that narrative. Since we have this opportunity, I was thinking maybe you could give some advice to someone who comes maybe from a socioeconomically disadvantaged background, who really wants to come and work in this field but doesn't feel confident enough or somebody who from the LGBTQ community, who doesn't feel confident enough, or anybody that has those issues. Is there any advice that you could give to someone who wants to come and work with us or wants to pursue this career that would help lift them up a little bit?

Sam: I think that if you are interested in this stuff that that you should, would, I would like to tell you—and I know that it is hard to just sort of hear this—but I would tell you that that is enough; that the interest is what sort of motivates basically everybody. If you are interested in science, technology, math, engineering that is enough. I think that the concept of imposter syndrome is really interesting. In fact I am glad you brought it up, because I think...[Alicia Liu, to my knowledge is the person who came up with that concept, and she wrote about it in, I think, 2013](#). The way she described it was that she felt like she got into university due to affirmative action. She had a good GPA [grade point average] because her university didn't have weeder classes, and she didn't really take the hardcore classes. She only got her job because her interview only covered things that she knew. She only got good performance evaluations because she was given manageable assignments. The takeaway there is that she has this objective feedback that what she is doing is great, right? She is getting good grades. She is in a good college program. She has got a good internship, but she doesn't feel like it counts. I think that is one really important part of having the confidence is to try and as objectively as possible look at the feedback that you are getting. Are you getting feedback from people who are qualified to give it to you? Because if there are people that are sort of not qualified telling you that you shouldn't be there, you should feel comfortable disregarding that. But if you are getting good feedback from your teachers, if you are getting good feedback at your job, trust that these people are empowered to make the decisions that they are making. You should have confidence in that, and I guess that is maybe the first thing that I would say, the place I would start. I imagine my younger self hearing some of that, and it is like I don't know how far I can take that. But yes, I guess that is where I would start.

Palma: Well, Sam, I would say that just having people meet you and know that you value that diversity on your team, and you are a leader now, and you will be a leader for many years to come. There are people like you that that folks can come in and work for. I think that is inspiring in and of itself.

Sam: Absolutely, and please know that yes, if you are interested in this stuff, I am excited to talk to you. I am excited to work with people who are interested in this stuff.

Palma: Let's talk a little bit kind of a segue into your management style and what actions you have taken to ensure equity on software engineering teams that you work with, or that you manage.

Sam: It is a good question. It is sort of a tricky one, and it can get a little bit into the subtleties of equity versus equality versus other measures of fairness. I think there are some easy things like trying, or rather not trying, to lowball salaries since I don't think that minoritized populations generally negotiate at the same rate or with the same aggressiveness as people who may come from the majority and be more confident in the sort of high-pressure salary negotiation things. I think pay transparency in general is something that I have heard organizations engage in and do really exciting stuff with. It is a lot easier to have gender or racial pay equity when that stuff is public. So you can say, *Given your title, here is the salary.*

I think there are other things which I believe you all in the DE&I [diversity, equity, and inclusion] office are doing: recruiting at outside venues, intentionally seeking out ways to broaden the field of candidates encouraged to apply to the SEI. I think those sorts of things are very exciting as well, just to get the SEI name out there and have conversations with people who otherwise may not feel like they are a good fit here.

Palma: We are talking a little bit about hiring, so I am going to talk about sometimes managers who are looking to hire people on their teams don't want to take a risk in hiring somebody that comes from a conference that may not be part of the mainstream conference circle. Any advice on maybe thinking outside of the box or investing in hiring people from conferences, such as [oSTEM \[Out in Science, Technology, Engineering, and Mathematics\]](#)? [NSBE](#) is a very large one, the National Society of Black Engineers, phenomenal candidates. But sometimes, how do you get managers? Any advice to a manager who could potentially hire somebody from one of these smaller events or smaller venues?

Sam: I think that every manager or anybody putting together a team is going to be looking for the best candidate. I am not trying to dissuade anybody from that. I think that it is a narrow view of what makes a candidate the best. That is what is really detrimental. I would say that you really need to look at all of the things that somebody is going to do in the job, into the role that you are hiring them into, and really look hard at all of those tasks. Let's say that we are putting together a team, and we need a programmer. Of course you have to have some amount of programming knowledge, but the range of qualified candidates might be pretty big. Maybe some people are better at a particular programming language or have a longer history in it. Whereas another one might be better on the theoretical side of things. A third one, a better communicator. A fourth one, someone that you can hand this sort of vague, poorly defined problem to, and the other three would need more management support. Which one of those candidates is the best? I think it really depends on the specific task that your team is going after, the strengths and weaknesses of the rest of the team, but it is not necessarily the person who has been coding since middle school or knows the C++ standard backwards and forwards. I think this came up recently. We were talking to somebody who is not at the SEI, but just sort of exploring a role here. They mentioned that they were really excited by problems, and they viewed model-based engineering in my case as a way to go after those problems. I was really encouraged to hear that answer as opposed to somebody who is just sort of, *I know this particular tech stack. I apply this tech stack to problems.* It is so much more exciting to me to hear, *I am a problems-first kind of person, and the tools that I have used historically have been these, but really, what I'm trying to do is solve problems.* That is the sort of mindset that I am looking for, and I think that in that broader app, that broader search, if you listen to what people are saying, and you look at the strengths they have that that can really come through.

Palma: Great advice. One aspect of the work we have here that we like to highlight in our podcasts is transition. What resources are available to those who work in software engineering who are seeking to make more of an impact on diversity in the field of software engineering?

Sam: I think the first place that I would recommend a lot of people start, is if they have any sort of internal resources within their current workplace. If they have a DEI office at their workplace. I know that you all here put out everything from guidance on running better Zoom meetings that can be more inclusive to putting out information on upcoming community events for things like Black History Month or PRIDE. In terms of specific resources. I

would also mention that work of Alicia Liu on impostor syndrome. We have talked about her original post, which went into what is imposter syndrome and how to recognize it in yourself. She wrote some [follow-on posts](#) that are less popular, but I wish more people knew about, because those are aimed at management a little bit. Also, they explain that...Imposter system is sometimes treated as just a lack of confidence, but it is not really that, right? I don't have imposter syndrome if I say, *I can't do open heart surgery*. That is an accurate assessment of my abilities, and I am right to not have confidence in it. You really need to look at objective, ideally external measures of your competency, and then give those credence.

Then another post that she had—I think this one was [the third of the series](#)—was that you want to be careful to create an environment that doesn't build imposter syndrome in other people. She mentions that you can really exacerbate the effect of making people feel like imposters by being like—and this is her word—a blowhard. She says these people litter the industry. They want to appear smarter than other people. They are about putting others down for not knowing this or that as if they were born knowing how to program.

I think that being able to recognize that behavior either in yourself or in the team that you have, and being really careful about that, is important. I would point to that resource as well: Alicia Lu or other writings, deep, thoughtful writings on imposter syndrome and how to how to either catch that in yourself or build a team where that is not going to be as big of a problem as it might otherwise be.

Palma: What I hear you saying is that the culture of the team of the group is really important. So, managers need to be very cognizant of what they are rewarding and what they are valuing. That is interesting. Thank you very much.

One thing that has always impressed me about the research and groups we work with here at the SEI is that they all have these incredibly diverse pursuits outside of the workplace. How can having a hobby help someone who works in STEM field?

Sam: Yes. I agree. I mean one of the things that I really like about the SEI is that it is a place where a lot of people are able to build careers. I knew that it was a place that I wanted to apply to when I started talking to some people who had been here for a very long time and had these long illustrious research careers at one place as opposed to something shorter term that

can end in burnout. One of the things that the institute does really well is to support this work-life balance that lets people have a life outside of work. Hearing about those hobbies and the way that people spend time outside of work has been very eye opening. I have friends here that have run marathons. They have cooked wild and fabulous meals. They climb rocks, play day-long space-opera-themed board games, travel all over the world, all sorts of wonderful things. I think they bring that back with them. To answer your question, I think that the creativity built into a lot of these pursuits, the changes and perspectives that you get when you switch from something like coding to then reading a novel or going for a hike, can really help with the creativity required to tackle these sorts of challenging, poorly defined problems that that we deal with. JFK had [a great quote](#) that was specific to exercise, but I think it applies pretty broadly, which is that physical fitness is not only one of the most important keys to a healthy body, but it is the basis of a dynamic and creative intellectual activity. This idea that there is more to being good at work than just doing the work over and over is really important. I think as a little bit of a digression, I would also push back just a little bit on a mindset that I sometimes see that is almost like an extreme view of that question, which is this idea that your whole life should be oriented towards professional success. I have seen people who try to optimize their life including their free time for some sort of extrinsic purpose. I think that the pursuit of joy, whether that is great expression or appreciating art in any of the various forms, or even just spending quality time in nature with your loved ones, it doesn't need any justification. For me, at least, it is the justification for all the other things. To speak to one of my hobbies, which is this reading there's this real interesting book that just came out, I think, last September by an author named C. Pam Zhang called [The Land of Milk and Honey](#), and it explores this idea of can we use pleasure as a motivator, not necessarily towards hedonism, but towards an enjoyable life that is also good for the world, good for everybody else. I love the work that I do here at the SEI. I think that some of that joy is immanent in the work itself. It is also what it enables though in terms of setting up a work-life balance where I can read these interesting books, listen to music that I love. In a sense, it is almost the reverse of the question that having a job in STEM can really support some great fulfilling hobbies and lead to a well-rounded life.

Palma: Sam, I would also like to ask about working at an FFRDC. This is a career option a lot of people don't realize. A federally funded research and development center like the SEI is a great place to have a career. What attracted you to an FFRDC, and what do you think that that can benefit someone who is now looking to pursue a career.

Sam: It is a really good question because I like this topic a lot. When I was graduating with my Ph.D., when I was finishing grad school, I knew that I wanted to do research. There is this whole spectrum of research jobs out there. You can go into a tenure track [R1](#) if you are fortunate enough even to get an interview for a few tenure track jobs, where you have nearly complete freedom, anything that you get funding for within the scope of your department you can go after. On the other end, there is corporate research where you are told what to do for a particular product, and you do that research. You don't have the publish or perish aspect of the tenure track. You don't have any teaching responsibilities, but you don't have much freedom. To me the FFRDC model, and the SEI in particular, really struck a great balance between that. I like interacting with students, but I don't know that I want to teach full-time. The lack of a teaching load at the SEI was a big plus. I get to be hands-on in my research. I am not running a lab and spending the majority of my time applying for grants. Even though I am a manager, most of my time is spent on actual research. Not that I am always doing cool stuff on a chalkboard, but it is a lot of research. It is a lot of reading. It is a lot of writing. The things that make grad school fun are the things that I get to do here. There is some freedom. It may not be the full amount of freedom that you would have as a professor somewhere. But I think the freedom that you do have and the ability to work on important problems, is to me the best of both worlds. Where it is not corporate research. It is not university research, but it is really in the middle, and it is a sweet spot. Yes, I agree. Not many people know about FFRDCs, and I think, had I known about it, I would have been excited about this sort of job even earlier. I lucked into it because the SEI came out with AADL, and that is what I used my research. But I agree it is a really great model.

Palma: A great answer. Thank you, Sam. Sam, thanks again for sharing your story with us today. We will include links in the transcript to resources mentioned during this podcast, and finally, a reminder to our audience that our podcasts are available on [Soundcloud](#), [Apple Podcasts](#), and the [SEI's YouTube Channel](#), if you like what you see in here today, please give us a thumbs up. Thanks again for joining us, Sam.

Sam: Thank you.

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