



Women in Software and Cybersecurity

featuring Dr. Ipek Ozkaya Interviewed by Suzanne Miller

Suzanne Miller: Welcome to the SEI Podcast Series, a production of Carnegie Mellon University's Software Engineering Institute. The SEI is a federally funded research and development center sponsored by the U.S. Department of Defense. A copy of today's podcast will be available on the SEI website at sei.cmu.edu/podcasts.

My name [Suzanne Miller](#). I am a principal researcher here in the Software Solutions Division of the Carnegie Mellon University Software Engineering Institute. I am very pleased to introduce my friend [Dr. Ipek Ozkaya](#), who is one of our leading researchers in the area of software architecture, [technical debt](#), how it relates to cybersecurity...she has a lot of interests.

This is part of our Women in Technology series at the SEI. We want to highlight some of the interesting things some of our people are doing. We also have another series on our technical fellows. So we like to get the human side of these as well as the work. So to start this off, tell us how you got here. Because everybody wants to know, you're this well-renowned researcher. How did you get here? What led you to this? And what are some of the big milestones in your career that you go, *This is what helped me to end up here*.

Ipek Ozkaya: Oh, gosh, that's probably a long story. But before that, it's always a pleasure to talk to you, Suzy, my good friend and good colleague. What brought me here? So obviously I'm not originally from the United States. I am from Turkey.

Suzanne: I never would've noticed.

Ipek: You haven't noticed?

Suzanne: No.

Ipek: Well, I come from Turkey. When you grow up in Turkey, and you're an ambitious kid, one of the things that you really want to do is you want to get the best of the best. Probably a number of kids—and the world has changed between now and then—but you actually grow up with the ambition to learn more, to do more. Of course a lot of the U.S. academic system, the research system, is something that you look forward to.



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So I really wanted to come to the United States to do my graduate studies. But one of the things that was happening at the time then is these manual drafting techniques or anything that you do manually was being challenged by computers. But the tools weren't there yet. And I remember going to my professors and asking them, *I want to go to school, but I don't want to go to a traditional school. I don't want to go to a traditional design school. I want to do something with computers.* That was the question I asked. So that's what actually directed me to [Carnegie Mellon University](#).

Here I did my master's and Ph.D. in a field called computational design. That's where you really combine software engineering, developing software for design professionals, and designing software. That was really heaven for me because it really was where it all was happening. At the time, the joke at Carnegie Mellon was, *Oh, even English majors take programming.* It was really that pervasive; it still is. So that was the right place. My professors really directed me in the right direction. Then, as I was continuing my education, I was always after things that combined like bridging and...

Suzanne: You're an integrator.

Ipek: Yes. I was doing my work in the computational design area, but it involved a lot of software and software engineering. So I was spending most of my time in the [Master of Software Engineering Program](#).

Suzanne: In the studios.

Ipek: In the studio, helping the TAing [working as a teaching assistant] some of their courses. Through that I never thought I would end up at the SEI, but, opportunity showed itself and I joined the [software architecture](#) group right after I finished my Ph.D.

Suzanne: I remember when I first met you, and we're getting to know who the new people are, the whispers around the area was, *She's a real architect*, right? Because software architecture at the time, it was computer scientists applying architectural principles, right? But now, *We've got a live one. We've got a real architect in the group.*

Ipek: It's funny because a lot of the software architecture books—they don't anymore, but at the time—the preface, the introduction chapter, has a reference to architecture-pattern books like Alexander and all of that—which of course, I did learn about it, but in a completely different context. And to me it was also like, *I don't think these people...I mean, yes, they're using it correctly, but are they really?*

Suzanne: Exactly what they think it means, yes.



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Ipek: That was also a big surprise for me as well. It made it easier for me to communicate obviously initially. And it also made it easier for me to contribute because I could see it from different perspectives. But I do recall those days as well. Like a blueprint, I'm like, *No, I don't think it really works here, but let's go with it.*

Suzanne: You have done a lot of different things at the SEI. They have all been anchored in software architecture, but tell us a little bit about the variety of work that you've been able to do in your role as a researcher at the SEI.

Ipek: I think one of the most fulfilling aspects of working at the Software Engineering Institute and in the software architecture group was that you get to be able to work both in the research aspect but see it applied in practice as well. Some of the earlier work that I've done with my colleagues, such as [Rod Nord](#) and [Felix Bachmann](#), [James Ivers](#), and others, has been investigating Agile software development and software architecture and how they actually gel into each other.

Along with that process, we also looked into architecture evolution. How do you actually teach software architecture practices to organizations that need it but they may not have those roles? And then through that work, we stumbled upon the technical debt work, which actually explains these tradeoffs between short-term versus long-term architectural decisions most of the time. And then how do you actually go about monitoring those decisions, when do you actually change the system to be able to fit what you need in the moment?

So systems evolve, that's one of the exciting and challenging things of our profession. Software changes very quickly, systems evolve. But they're out there for decades, so you need to be able to continuously monitor them, continuously maintain them to be able to have them fit their purpose.

Suzanne: And we need ways of reasoning about that so that we don't end up making too many short-term decisions, or, conversely, making decisions that only serve the long term, and then end up not serving us in the near term. So it's a dance.

Ipek: Exactly. I've been fortunate enough; a lot of my work has always been in that bridge and integration. I think the technical debt work is in that space as well. It integrates and bridges the technical stakeholders of the software development with the non-technical stakeholders and also between different domains. You need to be able to actually communicate these aspects, both very quantitatively and in detail as well as being able to abstract them to the level of different...

Suzanne: Right. And talk to the business.



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Ipek: Talk to the business. Talk to decision making from a financial perspective, as well as, *When do I upgrade to a particular technology?* That is not an easy question always. Sometimes it is OK to keep the old version of the software framework that you're working on. *But when do we make that choice?* And that requires a lot of bridging between different disciplines as well as different camps, both financial and technical as well as managerial.

Suzanne: I hope people are seeing just from this discussion that you enjoy talking about this stuff, not just about doing this stuff. To me that is one of the differentiators between somebody who is a software engineering practitioner and somebody who is a researcher. If you are a researcher, you need to be willing and hopefully find it to be fun to talk to other people about the different ways that people do things. What are some of the exciting things you have gotten to do that relate to communicating about the technical aspects of your work?

Ipek: I think you can be both in both camps. You can be a very outgoing person and be a practitioner, a software engineering practitioner. As well as you can be an introvert who does not necessarily want to communicate it and be in the research camp. So I think there are opportunities in all different walks of life.

More often than not, I would like to be able to communicate. And I also like having people who would like to contribute, have opportunities. I've been fortunate from that perspective being involved in both conferences, writing conferences, as well as being in communities such as the [IEEE Software community](#) or the [workshops of technical debt](#). So we run those but also have opportunities for ourselves and other people who would like to connect with others and talk about those aspects.

Suzanne: So tell us a little bit about your role...so *IEEE Software* is a magazine that is for the IEEE Computer Society. Tell us a little bit about your current role with the [IEEE Software magazine](#).

Ipek: That goes back to your original question in terms of you like communicating. I got involved with *IEEE Software* way back when, at this stage maybe a decade, 10 years ago, when I went to one of their conferences which was called at the time Software Expert Summit. So they put on these events to connect different people who are working in a similar area. There I communicated with some of the, at the time, the leaders of the magazine, and they invited me to their board. So I've been volunteering with the magazine in different roles.

When you get involved with that, what is exciting about these kinds of organizations is that you immerse yourself with different individuals from all walks of life that are going after that same mission. And here the mission is to be able to transfer research to practice and practice to research. It's really again another bridging activity. And I've been volunteering with them for a



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number of years. And starting in 2019, from 2019 to 2021, I'm going to be their editor-in-chief. So that's a very exciting opportunity as well as a challenge for me.

Suzanne: And all of us at the SEI are very proud to have an SEI person as the *IEEE Software* editor.

Ipek: I'm not the first one. Forrest Shull, who is our colleague, was one of the previous editors. So this is a community. And I think it also speaks to our job at the SEI, being involved in the community and contributing back to the community as well as bringing back that knowledge.

Suzanne: If I am parent of child, middle-school child, we hear a lot about STEM and a lot of those kinds of things. What is it that you think is important to communicate to those children about opportunities in the technical fields, what they need to do to get ready for that? What were the important things in your childhood that you think prepared you for being in these kinds of technical roles?

Ipek: I was reflecting back, kind of thinking about it as I got a little bit into the mindset of this podcast, and I don't think I ever thought I couldn't do something. I don't know what it was in the environment.

Suzanne: That's a mindset then?

Ipek: I never questioned it. It wasn't necessarily me being extraordinary. But, OK, like we could do it. Fortunately I think maybe it's because we have technology making things so much easier. Like the environment has changed a little bit. If you can't do something very quickly, we give up. Our kids I think give up too quickly. Part of it, learning takes time. Learning is a process.

Suzanne: Yes. 10,000 hours to master something.

Ipek: Sometimes kids are not educated in the right way in the first time, and that might discourage them from being engaged with that topic. To the parents, my biggest advice would be, you know your kids better than anybody else. If you think there's something there, don't allow them to give up. That doesn't mean pressure them, but introduce the subject to them in different ways. I think that's one of the mistakes we make as parents, as adults, as well as the community; we think it's just easy. We expect it to be easy, and if they don't get it as quickly, they say, okay, I'm not good at it. Which is I think a big, big, big disappointment.

Suzanne: I was kind of the opposite. I was always encouraged to try everything, do everything, but I was not as good at math, for example, as, you know, I didn't get straight A's in math early on. But, as you said, my parents were very patient with me in looking at what are the different ways that I can approach this math problem. I mean, learning to crochet, my father taught my grandmother how to make that a math problem. Don't ask me to go down that path. But they



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found different ways, as you said, to reinforce. And I think that's a really important message is that, even if you don't start out really good at something, you can still get adequate enough at it to be able to meet whatever your goals are.

Ipek: And I think part of it is also...that's another...and it's somewhat difficult for me to observe this. I have two kids and they're going through the education system, which is quite different in a different country. Getting all A's, for example, I did not graduate any of my years with all A's. I mean, it was a different system. It's like that's a bizarre expectation. And I wasn't bad, but a B was a perfectly fine grade, and I worked hard for a B. Nobody thought I was bad at it because I got a B. So I think that's a very, very bizarre expectation that we put to the system today. Why do we all need to get all A's? It's like it's really wrong. And I think that gives the wrong message. Unfortunately, we start attacking these kids too late. This starts when they're three, four. We expect them to read and write when they're three. No, they need to be kids when they are three. I think there's a little bit of a mismatched expectation somewhere that's happening that discourages kids without we even recognizing them. That's my observation. Of course, this is like my ad-hoc observation...

Suzanne: Of course, we all have the different types of experiences. So going a little farther, you're advising somebody graduating from secondary school from high school and that's thinking about these kinds of different fields. What would you tell them in terms of how should you approach getting into technical fields? What are the things that are important in becoming a software engineer or becoming maybe a researcher in software engineering eventually?

Ipek: I experienced this from my firsthand experience as well raising kids, and it's unfortunate that it's impossible to separate them sometimes. Unfortunately sometimes what happens is, when you're at that age, you think what you're going to study at school determines what you're going to do in life. And I give myself as an example. I'm a perfect example where life might take you to paths that you never anticipated and they might turn out better.

I am not practicing what I studied to practice. I am not designing buildings. I'm still in the design field and I'm enjoying it, and I think there's a lot of learning that comes to it. So what you study does not necessarily define what you end up doing as a profession. It prepares you. I think they should pick the study areas to areas that are close enough that they would actually be able to build on top of. But it doesn't mean that's the end all. So that's one advice that I would very strongly encourage.

I think we put unnecessary stress on our kids, on the youth, saying, OK, you need to know what you need to know. No, it takes time. But that's one. And give yourself an opportunity.



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Don't get discouraged too quickly. If that's something you want to explore, go ahead and explore. So I think that's also something that we discourage. We label people.

Suzanne: I had an adviser when I was early in college who said that, *The focus of your time as an undergraduate is really about learning to learn. You need to find the things that make you willing to really do the work of learning. Graduate school is really often where you choose sort of what do I want to learn about.* That freed me to take some courses in things that I never would've even thought about if I hadn't had that kind of encouragement. So I definitely resonate, with that. I don't design buildings either. I ended up in a different place.

Ipek: That is one aspect. The other aspect is, I think I try to, when things get challenging, I try to remind myself, if someone else has done it, there is no reason why you cannot do it. On the other hand, if you can do it, there is no reason why someone else cannot do it. It keeps you humble as well as ambitious. It goes both ways. I think we discourage ourselves unnecessarily in some of these aspects.

Suzanne: Yes, I hear that. I have sometimes hesitated to be the first one to do something, because you get all that attention. That if all you really want to do is do it, you don't really want all the attention for being the first one to do it. But sometimes we have to take that leap too, depends on what the context is. What do you think is the most important thing that you have done at the SEI to contribute to the software engineering community?

Ipek: I think in that regard, it is really on the eye of the beholder. The community is the judge of that. But I could answer that question from the perspective of what I'm most proud of. There are quite a number of ones that I'm very, very proud of. One of the earlier ones was actually being involved in the [SEI Architecture Technology User Network \(SATURN\)](#), the conference series, that is today the practitioner conference. I was very fortunate to be given the opportunity to be involved in its organization. It was a huge learning opportunity, a very humbling learning opportunity because you realize how so many experienced people are there and how much you can learn from it. Thinking about what can we contribute to that community really changes the way you approach your work and how you actually go about your work.

So that's one of the earlier experiences I had. And the conference is still going on today, which also makes us very proud. The other piece of work is the technical debt work. That was actually where we are very fortunate because the environment that I'm in allowed me to work with the best of the best. I'm very proud of the team we worked with. I learned a lot from them. Both my colleagues Robert Nord and Phillippe Kruchten and all the others that I wouldn't probably be able to remember all the names and do justice. We really worked in a collaborative manner. I think as a community, we actually are not giving up on it because we see that there is an opportunity for the software engineering community to step back and embrace the software



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systems as long-lived systems that age, that need to be managed like the debt metaphor with the technical debt. It's like you create value when you have financial debt. You borrow money to buy a house, to buy a car. You are creating value, but then you manage it. It's similar, when you create a software system, it has a long life, and you have to manage that through that life.

Suzanne: There was [a recent Defense Science Board report](#). One of the things they said is, *software is immortal*. I know everybody's quoting that everywhere, because it gives that perspective that, I mean, yes, we can get rid of software if we decide we need to. The initial development of these large systems is a very small part of the long term of their life. Once we've made that investment, we don't want to give it up, so we evolve it. If you don't make evolvable systems—it comes back to architecture, it comes back to understanding technical debt—then you are not going to have a system that anybody wants to use.

Ipek: Exactly. Actually we have developed a number of principles and one of the principles we have related to technical debt is every system has technical debt. So it's similar to every system has requirements, architecture, or whatnot.

Suzanne: Every homeowner has mortgage debt.

Ipek: Exactly. I think that and whether that contributes to the community. I think we have made contributions, but it makes me proud because, first of all, the experience of doing that work was very fulfilling. I think that is when you are proud. Also when you see your work being picked up by others, that is very fulfilling as well. When you have a conversation with a software engineer, software architect in the trenches, who resonates and who says, *OK, can I get some advice?* That is very fulfilling. So that's, I think, what I could reflect on going back.

Suzanne: I have taken a couple of things out of this conversation that I would say are elements of advice to people that are getting into this. One is, don't be afraid to volunteer. Find the passion, the area that you have a passion for and get involved with the people as much as you can. Even if you are not the world-renowned researcher, get involved. Do the work with them. Learn about that community. I would assert that that early work in organizing these conference workshops introduced you to people that became colleagues, right?

Ipek: Exactly. They became colleagues, and actually, you hear their challenges. And that's a whole different perspective than you reading about it, so you see those challenges. Right, you need to be involved in this. Earlier you asked about what are the career path if you want to communicate versus you don't want to communicate. I actually see it as a spectrum. There are so many different ways of communicating. You do not necessarily have to be the bubbly outgoing person to succeed versus you do not have to be the person who likes just sitting in front of the



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computer. I think there is an aspect of both, and there are opportunities for, I think, all different kinds of personalities to blossom in different career paths.

Suzanne: I think that there is another piece of advice there that is, *don't be afraid to communicate about your work*. Because even if you end up...and we've all been there, right? We have got a great idea, and we go and we put a paper out on it or a workshop, paper or something, and it gets shot down. But that's learning too, right? That is the failure that leads us to different insights. If you are afraid to communicate, if you are afraid of that failure, then you are not going to get anything accomplished. You are not going to have the opportunity to learn.

Ipek: I think there we all have probably a role to play. I was extremely fortunate. One of the things that I really, really did not like doing earlier on, and to this day sometimes, I don't like doing is presentations. And we do a bunch of them at the Software Engineering Institute. I remember very early on when I was just maybe in my first or second year, [Linda Northrop](#) actually would make me present. I am pretty sure they were the worst presentations ever. But you know what? Practice and practice and practice. I think being in that environment where there are individuals who are...at the moment you get nervous and you say, *Oh, my God, why are they making me do this?* But it's for your own good. I think we try to avoid painful experiences, but they are actually the ones that pay off the most.

Suzanne: Well, and that kind of goes back to, don't always expect to get an A.

Ipek: Correct, exactly.

Suzanne: When you get out into the workforce, you can't always expect to get an A either, but you have got to keep going. I think any of us that are successful in the tech field all share that experience is you have to keep going.

Ipek: I don't think it's just the tech field, Suzy, I think it's all fields. I think it's just somehow we have made the tech field, put it on a pedestal. I don't think it is any different in any of the other fields. I kind of have that perspective because I was in a field, which has technology aspect, but it also has more of the artistic aspects. It is no different. A lot of the artists fail so many different times and so many number of times until they make it.

A lot of writers, they have so many stories. I think we put the tech field on the pedestal in a very, very wrong way. I don't know why that is the case. It is no different than any of the things. If anybody is interested in any profession, that is the path they are going to take.

Suzanne: I think there is some mystery. If this is not the field you work in, there is a little bit of mysteriousness to it. I think both you and I agree that it is not that mysterious.



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Ipek: It's not that mysterious. I'm hoping with the increasing of some of the availability of the tools, also they're entering to the schools earlier on, that mystery will be uncovered. That is what my hope is, but it's no different. And I...

Suzanne: There is a difference today from when you and I were coming up, and that is the availability of information out on the internet. Have you heard of the [Khan Academy](#)?

Ipek: Yes.

Suzanne: The first time I saw the Khan Academy, which is a guy who talks about math in different ways, I thought to myself, *Man, I could've so much used this in fifth grade. Where was this in fifth grade?* I want to say, don't forget you've got this advantage, this resource that we didn't have. I could've read 1000 books, not that I would've in fifth grade, but I could never have gotten the same level of understanding of some of these topics that some of these venues provide. And just the variety of people—the [TED talks](#)—the variety of people that I never would've met if... I haven't met them, but I mean, I feel like I've met them by watching their TED talks. Those kinds of resources are one of the things that I think children and young adults today have an advantage over us that grew up in that time. Because even today, I don't think to go there first.

Ipek: That's not our mindset.

Suzanne: We're in a different mindset. So take advantage of your resources that are all around you that we may not even think as parents to suggest to you, but they're there. You are the ones that already know that they're there.

Ipek: I think there's also one other aspect that we don't do as well in helping young professionals, which is we expect them to take the initiative. I think it is on us to take the initiative. It's on us to make sure that those resources are easy to access. It's on us to make it easy to ask questions. It's on us who feel competent in these fields to be able to...because it's intimidating. I mean, we've been there. We've been intimidated in situations, let's admit it, in one way or another. Maybe not you, but maybe...It's on...I think everybody needs to take...

Suzanne: And I think both of us have had the experience of having mentors who did say, *OK push. Go out there. Don't wait. Don't wait 'til it's perfect.*

Ipek: Mentors and, I will say, team members. The teams, our colleagues, have actually been extremely influential in my life. I've been very fortunate from that perspective. Of course, were there not bad experiences? Of course there were bad experiences, but that's normal, right, you want the bad experiences.



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Suzanne: There was one thing in graduate school that I took away. I had this [organizational] behavior class, and this is back in the '80s. And, research that said that, *The most important factor in your job satisfaction is how you get along with your boss*. And you know what? I can say for my career that has held. When I have had a good relationship with my boss, I've progressed, and I've learned. And when I haven't, it's been much harder. So that's my piece of advice, is choose your boss.

Ipek: But also it's like, do it. And I remember this. Gosh, it's like, I don't how it came to mind. But very early when I started programming, we were working on this system, it was a research project to be delivered to the Army Corps of Engineers. I did not want to touch that software, because I'm like, *Whoa, what if I break that?* That was like so scary to me. I did not want to have anything to do with it. I was doing my little thing at the side but was not integrating my piece of code. I had to come in during a weekend. The professor in charge left me, literally almost locked me in the room. He was like, *I want that code integrated by the time I come back*. I'm like, *No, I'm not doing it*. And he's like, *No, you're going to do it*. So of course he knew better that there's no way I could break it the way I thought I could.

That experience was like, *Yes, it took me maybe longer than I thought it would be*. Seeing that I was able to do it, really broke the ice for me, so I think you really need to get your hands wet. Unfortunately, we keep emphasizing social aspects, but technical excellence comes with it. That happens by doing it. It's not just by finding the mentors, the teams, or the environment and whatnot, but...

Suzanne: You have to do the work.

Ipek: You have to do the work, and that also brings confidence. As you build the confidence, some of these other intimidating aspects become less intimidating.

Suzanne: I agree with that. Ipek, thank you so much. This had been a wonderful conversation. We knew we had things in common, but this is always fun. I want to invite our listeners...are you available for people that have questions?

Ipek: Of course, yes.

Suzanne: We have our info@sei.cmu.edu. They can use that to send questions. I am excited as always to have you working with us, and I am glad to continue to find things that challenge you here.

Ipek: It's always a pleasure.

Suzanne: I'm very pleased about that.



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This particular series is focused on helping people to understand what is exciting about technology and working in technology. So I hope that they've gotten that out of it. It's available on the SEI website at sei.cmu.edu/podcasts. Other places that you can also find this are on [Apple Podcasts](#) and the [SEI's YouTube channel](#). Yes, we have one, and something called [SoundCloud](#), which I actually haven't used yet. So I'm the laggard on that one. So as always, viewers, don't hesitate to email us with any questions at info@sei.cmu.edu. Thanks for viewing.