The SEI Fellow Series: Nancy Mead

featuring Nancy Mead as Interviewed by Suzanne Miller

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

My name is Suzanne Miller. I am a principal researcher here at the SEI, and I am honored to introduce you to Nancy Mead, who is one of our SEI Fellows. This is the first in our podcast series featuring interviews with our fellows. We have seven of them, and Nancy is our first. Welcome Nancy, I am very, very pleased to have you here.

In these podcasts, we are going to be talking a little bit more about Nancy's professional career, her background, than we are about any particular research topic like we would in our other podcasts.

The SEI Fellows are people from whom the SEI leadership may expect valuable advice for continued success in the institute's mission, and they have been so named because of their contributions to the SEI. Nancy is one. You will learn some of her contributions to the SEI as we go on. She has been here for probably more years than she wants to tell us.

Nancy Mead: That is right.

Suzanne: But we will not go into that. You had a career before the SEI. Before the SEI she was at IBM for many years. She is also an adjunct professor at Carnegie Mellon University in the Software Engineering program. We share her with the university gladly so that she can continue in her mission as a teacher, which is one of the themes of your career that I have noticed and that we have taken quite advantage of at the SEI over time.

Suzanne: Why do not we start talking about your early days? You started at IBM, federal systems, and you were developing and managing large real-time systems in that arena. And this was in the early 60s, so this was not today where anybody comes into software engineering. There was no software engineering then.

Tell us a little bit about what that was like, and especially about some of the gender barriers that you encountered and had to deal with, when this was really about the math and not so much about the engineering, as we have today.

Nancy: Great. Well, Suzy, it is great to be here with you. I always enjoy the opportunity to talk to you, and this is certainly a great opportunity.

Let us go back. When I was in high school, I used to get a lot of telephone calls from my classmates asking for help, especially with math. My mother objected to this. She said, *you know, they are just calling to find out answers, and it is a one-way street*. What she did not realize was that by virtue of helping them, it helped me to learn and in fact was one of my earlier experiences that lead into my interest in education that has been a long time interest as, as we will see. The other thing about it, is it caused me to realize that I was really good at math. Hence, I decided that that would be my college major. I knew that when I was still in high school.

When I got to college at NYU [New York University], the campus that I attended was primarily an engineering and arts campus [University College of Arts and Science], a smaller one. The year that I started was the first year that they admitted girls. So, there were three women in my class who were math majors. There were about 100 girls out of maybe 3,000 students. We were a very tiny minority. There were three of us that were math majors. Very early on, we became used to the idea that we would be working in a field with men. That became comfortable for us.

When I finished and then went on for my master's degree, I started to look for a job because, by then, I was completely out of money and had to work. There was no thought of getting a Ph.D. at that, at that point in time.

The first month or so, I looked at the ads in the *New York Times*, which was the place to find a job in the New York area. The first month or so I wasted by looking in the *Help Wanted/Female* section because at that point in time it was split up into *Help Wanted/Male* and *Help Wanted/Female*. I quickly realized that there were no jobs for mathematicians in the *Help Wanted/Female* section.

Then, I switched and started looking in the *Help Wanted/Male* section. The jobs ranged from actuarial intro positions, statisticians, some in library science, and then programmer. Well, as a math major at that time, there was no exposure whatsoever to programming. So that was an unknown to me, but some of my classmates said, *It is a great field, you should get into it*. That

happened, and eventually I found my way to IBM, as you mentioned, where I enjoyed a long career.

In the beginning, most of the managers at IBM were promoted from marketing positions because marketing was the big thing. They were selling computers. Most of the marketeers were men. Virtually all of the management team was men. There were some women in the software development ranks, and that was kind of a mix of women and men.

Eventually, I was recommended for a management position. Interestingly, I did not find overt gender barriers, but I would get kind of side comments from people saying, *Well, you know, you only got that job because you were a woman*. There was that kind of atmosphere that was not very pleasant. It was as if you had to prove yourself, prove that you actually knew something, and you were not just a token.

Suzanne: For you, I do not expect that that was really very difficult.

Nancy: No, it was not because I have always been pretty forthright. Once I found myself in a leadership position, it was very natural for me. Years later, when I left management for a technical role, one of my friends said, *Well, she may not always be a manager, but she will always be a boss*.

Suzanne: Well, we all have our strengths.

Nancy: And our weaknesses. Maybe it was both.

Suzanne: Sometimes it is a little bit of both. Now, even today, the number of women working in high-tech software and hardware, it is still pretty low. Some recent studies indicate women only comprise 16 percent of the software workforce. I was really surprised at how low that number was, and 9 percent for hardware. What do we need to do to get more women involved as software engineers?

Nancy: I saw some interesting studies recently at the Conference on Software Engineering Education and Training [CSEE&T], which I have been involved in for quite a long time. One of the studies indicated that when people went into public schools—primary and high schools—to work with students, they would run software camps and software events. What they found was that girls that were in grammar school, maybe up until middle school, were very involved and very interested, and then it started to decline in terms of their involvement. So, that by the time they reached the junior and senior year in high school, the numbers were much lower.

Suzanne: Were there any indications of potential causes for that?

Nancy: Unfortunately, the people who reported this information were not collecting that kind of data, so I do not really know, but I think it is a pattern that needs to be reversed if we are to get

more women involved, because it has to start very early. You can't decide when you are a senior in high school that you want to study computer science in college if you have not had all the prep that comes before.

Suzanne: And there is much more today. I mean, you do calculus much earlier than you did in our day and you have got to have all the grades and everything. So, if you are not prepared all along the way, you are right. You are going to have a hard time getting into the best universities and being able to pursue that.

I like the idea of the software engineer, software camps and things like that. I wonder if we can-- we do some things with STEM here at the SEI—maybe that is something that we can do a little later.

Nancy: I am starting to get inquiries about that. I am working with some people at the community-college level, but I have not personally done any work at the high school level or below. It is definitely a different ball game because of the requirements that you have to meet in order to even step into the classroom.

Suzanne: I see. That is something we will have to figure out as we go along. Well, I know that if you start putting your mind to this problem, it will get solved like many of others that you've solved over the years.

We talked about your interest in being a teacher from a young age. This didn't stop. You were a teacher in your earliest days. I am sure you did some teaching as part of your management. What are some of the big things in the teaching field, in education field, that you have been involved with either before or since you came to the SEI?

Nancy: Well, I mentioned that I like to informally teach people. Even in high school my very first formal teaching job was tutoring one of my classmates who wanted to go to college but was struggling with the academic math requirements. That caused me to be interested in it. Then, at IBM, I was manager of an education team that taught software engineering and continued to teach at universities part-time, here and there, when the opportunity presented itself.

Suzanne: The federal systems, the kinds of courses that you developed at IBM, I know in that time frame, getting engineering education at a company, I got lots of engineering education at Lockheed. You were providing the same kind of thing. What was the reason that big companies were so interested in providing their own engineering education in that time frame?

Nancy: I think there were several reasons. One is that it was not being provided at universities. Two is that, as you know, employees were with a company for a long time. A company like IBM would have employees who were there for their entire career, so employee development was really important.

In the timeframe when I was doing it, one of the big initiatives had been started by Harlan Mills, who was one of the shining lights in software engineering. He convinced our division president [John Jackson] that every programmer in the division should have background, formal background, in software engineering education. And, that's how it started.

Later it transitioned to IBM corporate headquarters. In fact, some of the folks who had been here at the SEI were on that staff [Harvey Hallman and Maribeth Carpenter], and I knew them before I joined the SEI. When I joined the SEI, I was in the education program, which I later became director of and worked with campus on the Master of Software Engineering curriculum as it was instantiated here.

Suzanne: That was one of the first degree-granting software engineering curricula in the United States, if not the world, I'm not sure…

Nancy: It was not actually the first. Wang Institute I believe may have been the first.

Suzanne: But it was in the first three. It was very early.

Nancy: It was definitely very early and went on to inspire somewhere between 70 to 100 degree programs in just a few years. I do not have current statistics on where that went, but it was definitely a big impact.

Suzanne: That was partly because you not only developed the program, but you actually published the curriculum so that it would be available for other universities. This was actually a formal outreach to try and instigate these kinds of curricula in other universities. So, it wasn't just Carnegie Mellon trying to keep it to themselves. You were really trying to get this out there, and that was very successful.

Nancy: The curriculum was published, and also that was the time that the Conference on Software Engineering Education was started. Part of the purpose of that conference was to engage faculty to be able to teach software engineering.

Recently, Grace Lewis has an initiative to bring in software engineering faculty for a few days in the summer for a workshop, which is very interesting. That will be this year [2016] in August, I believe. The Conference on Software Engineering Education and Training, of course, is still going on and there are…

Suzanne: 20 plus years.

Nancy: I think the next one is the 30th in 2017.

Suzanne: I knew it was more than 20 years, but I didn't know it had gone back that far.

Nancy: We skipped one year because we were re-factoring the conference, if you will, and it came back with quite a good success. Lately, it's kind of been like many conferences, it just continues.

Suzanne: The attendance goes up and down, but the themes retain their importance, because we have more need for software engineers than we ever have before. This is getting engineers that are trained for the engineering, not just for the programming. I think one of the differentiators of that conference is understanding that programming alone is not sufficient to be a member of a professional team in building safety-critical, human-critical kinds of systems that many of the software engineers are asked to do.

Nancy: One of the changes that we have seen recently is the introduction of the software assurance curriculum. That was an activity that I led. We tried to transition that via the CSEE&T [Conference on Software Engineering Education and Training] and also some other educational conferences that are related to cybersecurity.

Suzanne: Yes, and that theme is one that is not going to go away anytime soon--not in our lifetimes, that is for sure. Let us shift gears a little bit and talk a little bit about what you get to do when you are an SEI Fellow.

One of the advantages of the SEI Fellows, you are given a grant. Unlike some of our other processes where you have to sort of compete for funds to get to do the research that you want to do, you get to pick whatever you want to do. Tell us a little bit about what you have done with your grant and sort of what kinds of things have excited you enough to put some of your effort into.

Nancy: Sure. I should point out that the grant is a recent innovation. Some of the Fellows that you will talk to who became fellows earlier did not get the grant, and they are a little bit jealous of that.

Suzanne: Well, we will get to that when we get to them, but you got one.

Nancy: Yes, I did get a grant. It was for two years. It was for about a third of my work, and it allowed me to work on several things. The first was transition of the software assurance curriculum, which is continuing. We have had incorporation of the materials into curriculum at the Air Force Academy as well as five or six other universities, including Carnegie Mellon.

And we have had incorporation of the material at the community college level, and there is a pretty successful effort involving Illinois Central College, which is now offering a two-year program in software security programming. In fact, they advertised the program and immediately got 20 students to sign up without doing any extra work. It is pretty exciting and it is a model

that we may be able to implement nationwide, remains to be seen. That is one piece of work was transitioning the curriculum.

Another piece—and we're close to finishing—I am writing a book with Carol Woody as co-author. It is called Cybersecurity Engineering in the Addison-Wesley SEI series. Right now, it is in edit with the publisher, but it is already announced on Amazon. If you go to Amazon and do a search on my name, the new book will pop up.

Suzanne: I have written a book myself. I know how much work it is. You have written other books as well, so this is significant work.

Nancy: Yes. People thought I was crazy to do it again.

Suzanne: One of the editors at Addison-Wesley said to me one time, he said *Some people only have one book in them, and then they are done. Other peoples have lots of books that they need to get out of their system*. I think you are probably more one of the latter.

Nancy: I enjoy talking about it but actually doing the writing is very painful.

Suzanne: Carol has got a very good partner though. Like you, I had a partner when I wrote my book. Rich Turner was my co-author. I could not have done it without the coauthor. Sometimes we have to find ways to get those things through.

Nancy: With Carol it was…You are right, it was very easy to work with her, going through the edit review process and all the permissions and hoops we have to jump through.

Suzanne: Yes, there is some pain there.

Nancy: …makes it a little more time-consuming.

Suzanne: OK. You said there was a third thing.

Nancy: Yes. I have a research project on how malware analysis can be used to help identify overlooked security requirements. We did not talk yet about my work in security requirements. Back in 2005, I was a PI [principal investigator] on a research project and developed a security requirements method called SQUARE that's available on our website. There is a lot of documentation, many reports, and a tool that can be downloaded and used.

The new work was really novel, in my view, because typically people who do research and malware analysis are trying to identify patches to basically fix vulnerabilities in software. But that work does not necessarily get fed back into the development process. Somebody developing a new system might sit and brainstorm about what security requirements they need, but they do not necessarily know what successful attacks have already taken place.

Suzanne: In a system that is similar.

Nancy: In a system that is similar. That was the problem we have been tackling. We have taken that to a point where, once again, we have done some research. We have a tool. There is a lot more that needs to be done. We are having conversations with potential sponsors about how we might continue the work because, quite frankly, the fellow grant is almost finished and so…

Suzanne: It does not last forever.

Nancy: We need to find a new funding source. That is right.

Suzanne: But it gave you enough to do a proof of concept that this idea actually had some merit, so you actually have a better chance at competing for funds than you would have if you had just started from scratch. The grant has been useful in that sense.

Nancy: Absolutely. For sure. We have also found some outside collaborators that we may be working with to try to secure those funds.

Suzanne: Collaboration is good, and it gives you different perspectives on things, so that is all goodness. Let us fast forward five years. Cybersecurity still going to be an issue. Lots of other things are going to be issues in software, what are the big issues besides cybersecurity that you see in the software arena, and what should the SEI be doing about those?

Nancy: Besides cybersecurity, well, one of the big issues—although cybersecurity comes into play, a lot of other things do as well—is what we call the Internet of Things. The idea of wearable computers, wearable software, what if you have a fit band that captures information and transmits it? I do not have one.

A lot, a lot of people say *Oh, this is great. It is all being stored for me in the cloud somewhere.* Well, they do not usually say "in the cloud," but that is where it is. But, they have not really thought about the consequences of that.

If you look at the recent self-driving car accidents that have taken place, people say *Oh, it is great, the car drives itself.* Well, not quite.

Suzanne: I heard someone say that *If all the cars were self-driving, we would actually have less risk than having a mix of self-driving and cars with humans, because the algorithms…Humans are completely unpredictable in terms of how they will react to different things, and the software has actually some greater level of predictability.*

I am not sure that we would still be safe, per se. I just think about people in my life that I know that would never give up their control of the car to a computer. So, we are going to be in that situation of autonomous and non-autonomous vehicles for quite a while I think.

Nancy: I don't know if we'll see it in my lifetime. Personally, I would welcome a self-driving car if the bugs get worked out. If you have to sit there and, in effect, watch it all the time as if you were still driving, you are not...

Suzanne: You are not reducing your stress. So, Internet of Things. I think all of us agree is a big one and that sort of, we went into autonomy as one of the other areas that affects both Internet of Things and has its own set of issues. What kinds of things do you think the SEI brings to the table to help address some of those issues?

Nancy: I think that a lot of our research projects are aimed at a number of areas that could be beneficial. Probably not all of them will pan out, but…

Suzanne: That is the nature of research.

Nancy: If there are a few big winners, then I think we are definitely ahead of the game. I hear people talking about scenarios about robots and drones and I say to myself, *Those ideas are really sophisticated and interesting, but there are much more fundamental things that could also be addressed with information that we have on hand right now. If we would just get it into the field and get it implemented across the board, we would be so much better off.*

Suzanne: So, getting transition of basic kinds of ideas is just as important as getting the more sophisticated ideas. That is part of our mission, as well, is not just to do the research but to figure out how to transition it into the world that it is relevant to. Yes, we have challenges there.

Nancy: I think the SEI is really in a good position and a unique one. We have really benefitted from that. I have certainly enjoyed all of the work that I have done here, from education to technology to seeing a published book, even if I may not enjoy all the writing quite so much. It's been a lot of fun and continues to be.

Suzanne: You have been one of the people I have always enjoyed anytime I got a chance to work with you even in a small way. It's always been, been not just fun but enlightening. You think beyond the obvious, I think, is the way I would put it. That is very useful, because we can always get caught up in the obvious and not see some of the subtler paths. I really applaud you for continuing to think about that.

You have touched so many things. You have a lot of experience to bring. We are honored to have you as an SEI Fellow. I think I can speak for everyone at the SEI when I say that.

I am really glad that you took the time to talk to us today and give people some background that they probably did not know. I certainly did not know, sort of, where you started your teaching passion and, and some of those other things. So, thank you very much for having this conversation with us.

Nancy: It is a pleasure and it is always a pleasure to talk to you, in particular, Suzy.

Suzanne: Well, thank you.

Suzanne: I am really glad that I got to do this one. All right, this podcast is available, as I said earlier, at sei.cmu.edu/podcasts. It is also available on the Carnegie Mellon University's iTunes U site. As always, thank you for joining us. If you have any questions, please drop us an email at info@sei.cmu.edu. Thank you so much for viewing.