Algorithms & Power Systems Architecture:

Using Historical Analysis to Envision a Sustainable Future

Oral History Project

Interviewee:	Noel Schulz
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***Abstract*:**

Noel Schulz, Ph.D., discusses her educational, professional, and life experiences. She begins by detailing the academic institutions at which she has studied and worked. She explains that her work since graduate school has been application oriented. As an example, she describes early work on data analytics, what is now called artificial intelligence (AI), for Northern States Power in Minneapolis while completing her Ph.D. She discusses the role of Minneapolis as a center for development of simulation and modeling software for the power industry. She explains that while the power industry is a cutting-edge user of new computation technologies, some utilities are eager to experiment while others are more conservative. She credits Bruce Wollenberg for encouraging research projects that have real-world applications. She discusses developing new algorithms in parallel with industry adoption of smart

meters. She gives the example of predicting outages during heat storms and determining when to escalate up the system. She underscores the importance of building relationships between faculty and utilities; and the value of developing graduate student projects that will have value to industry. She describes changes over time in research programs at both the Electric Power Research Institute (EPRI) and within utilities. She projects that the addition of clean energy resources to the power grid will bring about focus on distribution management systems (DMS). She discusses the abundance of data now available for simulations of distribution networks. She describes her participation in the Institute for Electrical and Electronics Engineers (IEEE), its various societies and committees, and the leadership positions she has held. She discusses the Women in Power group within IEEE and underscores the value of female mentors and colleagues for women in power systems engineering. She discusses the IEEE Smart Village initiative and shares an anecdote about working with women in Kanpur, India, through the UI-ASSIST project. Dr. Schulz reflects on her experiences as a woman in a male-dominated field, how to juggle a two-career household and parenting demands, and the ways in which professors can support women and other minorities in their academic pursuits. She offers that discussing her work with a wide public entails giving concrete examples. She closes by explaining that to promote power engineering programs, it is necessary to cultivate advocates within industry and to advertise every accomplishment of the program, no matter how small.

Note regarding Transcript and Timestamps:

Timestamps appear in the transcript but may not align with the recording. Pauses and interruptions may have been removed, and the overall length of the recording may be reduced.

Transcript:

Julie Cohn (00:00:00):

This is Julie Cohn. I'm conducting an interview with Noel Schulz on July 22nd, 2024, at the Seattle Convention Center, Seattle, Washington. Sairaj Dhople will assist with the interview, and there are several others in the room who may ask questions as well. Dr. Schulz, during today's interview, we're especially interested in your work as an academic administrator, a leader of collaboration across multiple geographies, and your specific focus on islanded systems. But we'd also be interested in your reflections on the field as a woman in electrical engineering and in power systems, as that, for at least some length of time, has been a unique perspective. We'd like to begin with some introductory

questions and general background information about you. So, if you would, could you describe your educational background and your professional positions?

Noel Schulz (00:00:52):

Yeah. Great. So, I'm going to start with my parents because my dad was an electrical engineering professor, my mom was an elementary school teacher, so I come to engineering education from that angle. So, I got my bachelor's and master's at Virginia Tech in Blacksburg, Virginia. My dad was a professor there; he was in Computer Engineering, and I went the electrical engineering route. And then I taught there for a year and a half in Electrical Engineering and Engineering Fundamentals—freshman engineering class—before we moved. My husband was also a Virginia Tech grad, and after he finished his PhD, we moved to Grand Forks, North Dakota, where I taught for a year as an instructor in Electrical Engineering. And then went back to get my PhD at University of Minnesota. So, I got my PhD at University of Minnesota, Twin Cities, with Dr. Bruce Wollenberg.

(00:01:46):

And after I finished my PhD there, we got jobs at Michigan Tech University in Houghton, Michigan. And the Upper Peninsula of Michigan—two- to three- hundred inches of snow in winter, and we were there six years—there I was Assistant Professor and then gained tenure as an Associate Professor. And then, based on some opportunities for my husband in administration, went to Mississippi State, in Starkville, Mississippi. We were there for eight years. And there I got tenure again, because of some dynamics, and then Full Professor. I also had a chance to do some administrative—dabbled in administrative work there. And then, after we were there eight years, we moved to Kansas State University, where we were there seven years. And I was in the Electrical Engineering Department—also did some work as Associate Dean for Research in the College of Engineering there. And then in 2016, moved to Washington State University. For seven and a half years I was on the Pullman campus working in our power and energy. And then just moved in January to our Richland campus, one of our other campuses, which is about a half a mile from Pacific Northwest National Labs, PNNL. And doing some work on an institute looking at the overall picture of energy futures—kind of the systems approach to power, to energy—and looking at how do we look at all the different aspects.

Julie Cohn (00:03:14):

What drew your attention to power systems?

Noel Schulz (00:03:18):

So I was, as an undergraduate—I was very interested in power systems. And my junior year I had a professor at Virginia Tech, Jaime De La Ree, and he was very energetic about it—and so I got really interested in that my junior year. And then the next semester I took a microelectronics class. And so, I ended up doing my master's in microelectronics—it was kind of the latest, greatest area. And then when I went back to get my PhD, I kind of went back to some of my roots and got interested in power engineering, and something I was interested in. And I think I wanted to do something where I could see the impact of what the research does and work with industry. And so, the power engineering—and I was really fortunate to have a fellowship, Edison Electric Institute Fellowship in the power area, which helped fund my PhD.

Julie Cohn (00:04:13):

So, was your research work at that time, was it more application-oriented or was it theoretical in kind?

Noel Schulz (00:04:25):

My research was more application oriented. My advisor, Bruce Wollenberg had worked in industry and just recently moved into the academic environment, so he was very interested in the fact that things needed to be useful and applied in the research. And so, he had done a lot of work in AI at the time—way back in the earlier edition, I guess AI 1.0, or—and so we had looked a lot at—it really was data analytics, what we would call AI. And I was really interested in the computational interactions of power systems data. And so my first summer, my PhD, I actually worked for Northern States Power in Minneapolis—which is now part of Excel Energy—and did a project for them related to developing an expert system, or developing some code, so when they took different pieces of devices out on the transmission grid, they could make sure they were safely disconnected in the right order, in the right—so that it was safe for both keeping the grid going as well as for those working on it. So, I worked a summer for Northern States Power.

Julie Cohn (00:05:40):

Is that—do you know if that's still in use, the code that you wrote?

Noel Schulz (00:05:44):

I do not know if that's still in use, so probably not. So, it was pretty basic at that time. This would've been 1992. But it was really about—I mean, I would say it was an early expert system —where it was looking at developing: how do we automate some of that to help it be—making sure the lights stay on as well as making sure it's safely disconnected? And what are some of the other aspects that for both the human safety as well as the grid safety?

Julie Cohn (00:06:15):

Did that—did you continue conducting research along that line or did it veer off into other directions?

Noel Schulz (00:06:22):

No, it did. I actually, for my PhD, I actually developed the whole expert system. So that was—as a power engineer, I dabbled in Computer Science at that point and took an AI class without the prerequisites. It was a tad bit of a challenge, but it was a great experience—learned a lot. And so, I developed that expert system that would set up the different rules around the different devices—whether it was a transformer, transmission line, and all that—and set it up with different scenarios so that you could take it out of line and develop that, so—

Julie Cohn (00:06:59):

And that was research funded through the fellowship from Edison Electric Institute?

Noel Schulz (00:07:03):

Correct. Edison Electric Institute funded me for those three years.

Julie Cohn (00:07:09):

Oh, that's interesting. So, did—were there utilities that were paying close attention to what you were doing?

Noel Schulz (00:07:16):

I was very fortunate. Once I started my career as a faculty member, after my PhD, I did a lot of work with different utilities. And I worked with configured energy systems, which was doing some distribution system work, which is kind of how I got more into the distribution side. Also, Siemens in the Minneapolis area. I mean, if you really look at it, Minneapolis really was, was a core of a lot of different power, particularly simulation modeling type software applications in the power area. And a lot of them were ex-Siemens or ex-Empros or whatever the company was named at the time. Employees had spun off different aspects of that.

Sairaj Dhople (00:07:59):

So, you talked to Bruce about this offline. Why Minneapolis has been such a hotbed for power system computation. And that's the impression that we got. There was a lot of computing industry, and somehow that spawned into applications—and power was one of them. Am I getting that right?

Noel Schulz (00:08:19):

Yeah, I think that's true because when I reflect on my research, what I learned at Minnesota was really that connection between computer science and power systems. And that was still really—I mean, now it's just second nature to us and as we move into the AI and machine learning and power systems. But yes, there was a lot of expertise that understood computer tools, and now we were applying it to power systems. But if you really look at it, as Bruce said, "Electric utility were the biggest users of computers, mainframes, forever." And if you look at a lot of sparse matrix techniques, the math was done by power engineers. Because they didn't have enough computational power to run all those scenarios. So instead

of—you couldn't invert the matrix back then, so they would find ways that you would just change certain terms, so that you could still do calculations and some of that. So, I think there was a lot of—Minneapolis in general was kind of a tech hub and the power grid became part of that.

Julie Cohn (00:09:28):

Do you think that it's still the case that as an industry—I mean we have new industries now—but that the power industry is still a cutting-edge user of computing power, computing capability?

Noel Schulz (00:09:45):

I do—I think the power industry is a cutting-edge user, particularly in the research and development. But electric utilities do tend to be more conservative about making sure they have confidence in those tools before they go out. And I think that's part of the nature of the electric utility industry: is the risk behind the lights going out is making sure they have confidence in those technologies. But I think we've seen a lot of that. Bruce worked with the alarm processing, where all the alarms that are coming in from information, where something could sort through it, and be able to give you something; it was so much more effective. And I think once people saw it in use, it's like, “Yes, we should use this.” But I do see people want to be cautious, and not—someone once told me, "We want to be on the leading edge, not the bleeding edge of some of these technologies."

Julie Cohn (00:10:42):

Yeah, that makes sense. Do you think Bruce—I should say Dr. Wollenberg—was positioned in a unique place because he had worked on the utility side before his academic work took off?

Noel Schulz (00:11:01):

I do. I think, particularly in the power industry, there are probably some other industries that maybe didn't make as much difference. But I think Bruce could be a bridge between the academics, because he could probably, in addition to helping academics understand industry, I think he could help industry understand academics. And he could help translate at times. And he really told me one time, "We're not

doing research for research's sake; we're not publishing just to publish—I don't need to publish." I said, "I do need to publish. I'm a PhD student." And so, we published. But he really—one of the things in his classes is he always talked about all the different examples, and shared different—and that really brought it alive. And I think for me, it really made it about—as I tell my students, "You can work in power engineering anywhere. You can work in your backyard; you can work in a big city, or rural area."

(00:12:03):

My husband's a chemical engineer, and they tend to put chemical engineers all in one place because you don't have chemical engineers in every county and things like that. So, I think Bruce really brought that home. And I think he instilled in me the fact that: if I'm going to do research, it needs to be something that has use—not on a four-bus system that is just an experiment of thought. And so, I do think he really—and he was very involved in PES. He actually—when I think there was, I think it was a power systems committee divided into about eight different committees. Bruce was chair of that. And back then we had papers. So, I helped him sort the papers that were being reviewed into different piles—and some of that kind of stuff. So, I do think he provided a bridge and connection between industry and academics that was hard sometimes. Particularly if you look back then, it was kind of a them and us—and Bruce really helped do that.

Julie Cohn (00:13:03):

What, out of your initial research and through your early academic career, what did you consider the most difficult or interesting technical challenge that you tackled?

Noel Schulz (00:13:18):

Well, I was, as I was thinking a little bit about some of the questions you gave me, when I started in my work, particularly on my own, I'd worked with Bruce. And a lot of Bruce's work—Dr. Wollenberg's work—had been on the transmission side. And so, one of the things I got some advice to not do exactly what your advisor does. And so, I got really interested in the distribution side. And looking at, because it was a very—I would say—the Wild West back then. We didn't have much data; there wasn't a lot of modeling done on it. It was just kind of this area that was a wealth of opportunities to do research and to learn and work. And so, the biggest challenge with that was getting data sets.

Noel Schulz (00:14:08):

And we still have that problem today. Utilities, obviously the data is important, and we don't want to share something that we shouldn't, but as we work on these algorithms and do different things, having a data set that you can do “apples versus apples” instead of “apples versus oranges”—. And we had that with transmission because we had the IEEE test cases, and we were just starting to see the distribution test cases. But they were still fairly simplistic compared to what we have today, as we see more and more mature. So, I think the hardest part—and this was actually for my first National Science Foundation career proposal—one of the critiques was: "We don't think you can get the data to do what you say you want to do." And that was because what we were talking about doing was intelligent systems, or AI techniques, and distribution system analysis.

Julie Cohn (00:15:05):

And do you think that—or was it the case that the utilities were not collecting and preserving data? Or that they were reluctant to share it?

Noel Schulz (00:15:19):

I think a) there was the privacy issue and not having anything that could be put at risk. It was really important to make sure there wasn't any customer information that was out there. But we didn't have a lot of data on the distribution system at that time. And some of the work I did, we actually made, did pseudo measurements where we took some data we had, and we created estimations of that. Because we didn't have the data. And I also think there's also the challenge of making sure that the data available—I think that—because it took time and effort—we have historical tools now that you just run a script, and you get all sorts of data. It was very employee-intensive if you wanted to get a data set then, because we didn't have the tools we have today. So, I think it was the return on investment of giving me the data and then what I might be able to do with that. But I also think the data wasn't available.

Julie Cohn (00:16:27):

And did smart meters make a difference?

Noel Schulz (00:16:29):

Oh, smart meters made a big difference. And actually, Northern States Power started with some early smart meters, and that was a lot of the work that we—that I did—was looking at integrating those smart meters for outage management, storm management, before we had all the storms we have today. But looking at that and being able to help with crew scheduling, getting them to the right place, and understanding, and also being able to use the meters for restoration confirmation.

Julie Cohn (00:17:02):

So, did that require development of new algorithms for how to interpret information that was coming?

Noel Schulz (00:17:09):

Well, it did, because one of the things with the meters, the meters were going every five seconds; you were getting a signal. And then from there, and it had a signal that when it went out, as "I'm dying, I'm going out." And so, one of the important things was to try to look at how do you escalate that to where the problem is. And also challenges where some, if all of them come at the same time, do you lose some of the signals? So, you don't have all the data, and so how do you interpret that? One of the really interesting things we found, and did some work on, were what we called heat storms. And in Minnesota, in Minneapolis, people—the first day it was warm, they wouldn't turn on the air conditioning; the second, about a third; the third day—. And so, one of the challenges was that the transformers would overheat and there would be an outage, and there would be two outages. But the problem is that would escalate higher up because instead of two outages, a lot of the algorithms predicted one outage. And so, it would escalate up and not be identified. So, we did some work looking at how to how to identify multiple outages that might be on the same feeder that would create—that would escalate up to a different place than where the actual faults were.

Sairaj Dhople (00:18:32):

So, now I see your recurring theme here: you're looking at real problems. Was this an offshoot of your PhD experience, or was this even from earlier on—where you said, "I need to pay attention to what industry is doing?"

Noel Schulz (00:18:48):

Well, I think it was maybe in a way I wanted to make a difference. I wanted to, I wanted to have a feeling that I was making a difference in what I was doing—a concrete feeling. And I also really enjoyed working with industry. I think working with Professor Wollenberg, working with NSP, as an undergraduate, I'd done some internships at an electronics company, and I just felt I wanted to do research that was making a difference—that not only educating students to be masters- or PhD- prepared, but also was creating information that would be helpful to companies. And I think I just had a real interest in being involved with making that difference in something that I could see and not something at a level that I couldn't really see the impacts.

Sairaj Dhople (00:19:45):

Dan, did you have any questions at this point?

Daniel Molzahn (00:19:49):

Well, there was one point that I thought would be nice to follow up on. You said that there was this them-versus-us attitude about the academics versus industry, and I was just curious if you have any more you can say about that. Was it always that way or were there dynamics as to how this changed over time, or were they different in different places? I just thought that was an interesting way to frame it. And I'm curious if you can expand on it.

(00:20:20):

Yeah. Well, when I started in the '90s, a lot of utilities still had research departments, and they still put money into research. And so, it wasn't just the academics doing research; there was also people in the utilities that were doing research. Northern States Power had a big one using some of the intelligent switching, even in the 90s, and some of that. And I think at times they just felt we were doing a four-bus system—just an academic exercise, right? But one of the things I did find when I came into the community was the close knit—where people were working together on problems across different utilities, across different universities. There was never this competition that, "I can't tell you about this," it was just really a very welcoming group.

(00:21:22):

But I just think there was, when I first started, there was this feeling that, well, I don't know that you've really used the right assumptions. And, I think, for me it meant I had to go and work with those people more. I had to get my students in there for internships. And that's where I found, once I established that relationship, and they understood my background, and then I would listen to them, and what they asked, then I think that that went away. And I think that may have been partly from Professor Wollenberg's mentoring about the importance of making sure you're tackling the problems, making sure you're respecting the folks that are out in industry. And occasionally faculty can be a little arrogant in the way they approach things and telling people what they should be doing.

(00:22:15):

And I found that doesn't work very well with industry. That you need to say, "I'm here to help. How can I help you? What problems do you have that I can help you with my background?" Instead of, "I'm working on widgets, so you need to give me money to work on widgets," but saying, "What are the challenges you have? These are some of my talents and abilities. How can we find a project to work together that's a win-win situation?" And I even find that today, working—a colleague at Avista Utilities in Spokane, Washington, he really talks about how do we find projects that are a win-win. That the time I put in and my colleagues put in at the utility, I can justify that to my boss that we're benefiting from that—not just the benefit of helping academics and education, but we're helping our organization as well. And I think that's something that's really important in the relationship between faculty and industry and utilities: finding win-wins and finding ways that we can help both.

Daniel Molzahn (00:23:24):

That's really interesting and I appreciate the comments. Maybe one quick follow up on it is: you've been in a lot of different areas of the country, have you noticed any differences between attitudes, or in particular for this question, as you've moved around the country?

Noel Schulz (00:23:46):

Yeah, it's been interesting. So, I found Northern States Power, that I worked with, was very innovative at the time. And I found some of the utilities are more risk-averse than others. And some of them are more willing to look at these new technologies. Both Avista, that I mentioned in Spokane, and Northern States Power—now Xcel Energy—they were innovative. They wanted to try meters; they wanted to look at some of these algorithms we talked about. They were really interested in learning more, and they were okay that they knew some things might not work but just tried to minimize that impact. And so, I think I found there are some utilities that I've interacted with that are very innovative and have a kind of, Let's try this. There are others that I mentioned earlier that I ran into that said: "We didn't get automatic meters because we wanted to make sure it's a third or fourth generation, because our colleague utility got drive-by meters. And those aren't in use anymore and they spent all this money. So, we're waiting till the third or fourth generation to make sure we're getting the right technology." And so, there's some that were more conservative, and then, but there are some that are innovative and helping lead in those different activities.

Daniel Molzahn (00:25:15):

Got it. Very interesting. Thank you.

Sairaj Dhople (00:25:17):

Noel you spoke of a time when utilities had their own research divisions. Did that sort of evaporate gradually or was there a—?

Noel Schulz (00:25:25):

I think it—as we looked at deregulation and we look at—I mean, we all know research is one of the first things that gets cut in any organization when there are budget issues, as far as industry—. And so, it started, there was, also the EPRI model was changing. So, at one point everybody kind of paid into EPRI and they did the greater good. Well then things changed where you bought into different—you bought into nuclear, you bought into transmission, so it got piecemeal. And so EPRI didn't have as much money to help work with the utilities because a lot of times EPRI would partner with a utility on that work, just like we're doing with—it's not really any different than our DOE demonstrations that we're doing today. And so, some of those funds, some of EPRI's funds, went away, which meant those that supplemented the utility had X dollars and then they would have Y dollars because of EPRI. That money went away.

(00:26:26):

And so, we saw some of those labs go away. So, I think it was just a case of letting an external group do that. And I think we saw some growth in consulting companies around some of those same areas. But it was much more—those consulting companies would be much more in the development and implementation than kind of the research because there was some, "what-if" type stuff I saw in some of the utility research that really got lost because, it was always a very applied application that—applied work that was done after that.

Julie Cohn (00:27:05):

Were there other changes that you witnessed in the utilities with which you collaborated, that seemed to be related to deregulation or government roles that changed?

Noel Schulz (00:27:20):

Some of the different activities around when I was involved with NS—the Northern States Power—there were the—energy markets spun off. It was a non-regulated company that was related but different. And so, some of the expertise on the utility sides went off to some of those companies. So, I think a lot of the innovation that had been done in the utilities ended up spinning off into other areas, because it was a

greater risk, and they didn't feel they could have that risk within the utility budgets and within the utility activities there. So, I would say that would be one of the things.

Julie Cohn (00:28:03):

But if your focus was really at the distribution level that would've been somewhat less. There would've been somewhat less transformation, in terms of the elements that were taken care of by the utility versus computing company. Is that right?

Noel Schulz (00:28:18):

That's true, that's true. Yes. I would say—I mean obviously distribution. The whole distribution just blew up right in opportunities, because, as I said earlier, it was this wild west; we didn't know anything about it. We had one sensor here and one sensor there, and people would call in and say: “My lights are out.” And we worked on that. So, we really saw more emphasis on the distribution system over that time, which was good for me for research and all of those others in distribution. And so, I think distribution was kind of the stepchild, and generation and transmission had big impacts. So, they got a lot of the money and distribution was a lot of times bandaging things together to make sure things work. And people started to realize that—particularly as we started to see renewable energy down in the distribution system—that we have to model that so we can understand and keep the lights on and see how that impacts us.

(00:29:22):

And then the biggest issue was the fact that these were all one-way streets. The power was going one way, and now we're going to put something on it and have two-way, and we don't have any stop signs going the other way, or we don't have any protection going the other way. And so, there was kind of a realization that we needed to get more data and work on that. And I think one of the biggest challenges was the amount of data and the diversity. We didn't have, like when we talk about energy management systems, we had maybe four or five vendors that did all the energy management system. When we started to talk about distribution management systems, there were, maybe not a hundred, but there were literally tens of different groups doing outage management, doing GIS, doing automatic meters.

And so, one of the things we saw was such a diversity that, how do you do standards? How do you pull together that information to help make it manageable? And the sizes were also large, as we talked about, as we modeled more and more of the distributions.

Julie Cohn (00:30:32):

It's interesting because you went from a dearth of data to an overabundance.

Noel Schulz (00:30:36):

Yes. And really that's where the AI and machine learning—I mean, the AI of that time—that's evolved into machine learning, data analytics of today is, at first, we didn't have any data. Then we got a little bit that helped us, and then we got more than we knew what to do with. And I mean, I've had several utilities tell me I have way more data and I don't know, it just goes into a PI Warehouse, and I don't worry about it. And I'm like, "Give me the data; let us find trends for you." And it's a great student project and stuff like that. But a lot of times the data originally on the meters—about probably 20%—was really used, and the other was collected, but not always used. And there's been different research done to try to find reliabilities, outage management, even tree management that, okay, we've had a lot of strikes in this area, so we need to cut every year versus every other year. So, people have gone back and used that data. And, I would also say there's an evolution from planning for the data to the operations side, where we're actually operating a distribution system with that data, and have a confidence. At first it was planning, and it was, outage management would be, it was estimating where something was, but then we would confirm it. Now we've seen that evolve into a closed loop where it's actually the operation side.

Julie Cohn (00:31:55):

So, looking ahead, do you think the kinds of tools that you use to analyze data will be adequate? Do you need to ask your students to think outside the box and consider new ways to tackle these vast quantities of data? Any, any projections about that?

Noel Schulz (00:32:17):

Well, as I think of AI—when I was a PhD student and AI now—the tools have gotten better, the computers have gotten faster. So, they can do more what-ifs, which then gives you more confidence in the final result. And so, I think—my dad was, I mentioned, an electrical engineer, he used a slide rule. I used a calculator and then a computer. And now we're talking about AI tools. And it enables you, right now, I think the challenge is how do you separate the noise from the important data, and how do you get it in a timely way that it can be useful, particularly in an operation setting. And so, I think it's an evolution of tools, that we see, with just improvements in technology—I mean, improvements in sensing, right? We have more data, even phasor measurement units.

Julie Cohn (00:33:19):

I was going to shift directions, but I want to make sure if there are any other questions related to what we talked about so far? It's the time to ask you.

Ali Mehrizi-Sani (00:33:29):

There was a question Dan asked about: do you see a difference in the utilities and how the priorities were across the country? So, I wanted to follow up on that question. As you grew in your position and became more senior, did you see also an impact of, maybe, utilities trusting you more, or your time, or listening to you in kind of a different way? So, Dan asked about the kind—the geographic; I'm asking about the time difference.

Noel Schulz (00:34:06):

No, I would definitely say, having—because I did move around, because of my family situation, I did see that, if I would walk into my next utility, and say, "I worked with so-and-so, and so-and-so, and did this and did that," and I'd share about what I did with them. And they'd be like: “Oh, well, she does know what she's talking about.” And sometimes they would actually call the utility person and find out. And so, it did enable me to—since I wasn't always working—because utilities tend to work with regional universities. Of course there's some they do, but a lot of times—. And so, I think that credibility of having people I talked to, work I'd done, projects—and a lot of times actually my students were then

there, particularly my master's-prepared, occasionally PhD, were there, working there. So not only did they have the work we did, but they had the students there that—as that. But yes, it did. As you go through your career, you have that credibility within the industry that really helps. And sometimes I would talk to utility A and say, "Hey, I'm moving to this place," And they said: “Oh, you need to talk to Susan Smith and Tom Jones when you get there—they're doing similar work in the area.”

Jess Slater (00:35:29):

You know that your mentor Bruce said it was not publishing just to publish. What advice do you give to your students to make their work more applicable into the real world?

Noel Schulz (00:35:42):

Yeah, so I think it's important. I want our research activities to be something that is, it's not necessarily going to be implemented in the field, but it's going towards that direction. And so, I think it's important, because you have real data sets and really, probably for them, it's going to be better for their long-term career. If they're doing something that's totally—and I'm in power engineering; I'm not in pure math—so I can do that. But I think it's important the publishing is a tool for them to get experience in pulling together information, presenting information, as well as disseminating the information. So, I see publishing and presenting as kind of just like a class, where it's a way to help them mature and be able to talk technically around there. So, I'd like to have applied activities and what I tell them, particularly if we have a research project that we're working with a utility, I say, “The great thing about your thesis, or PhD, is we can say ‘what if?’" And they say, “Well, we don't have that data.” I say, "Well, that's what we can do. I mean, for this report for the utility, we can't make up data, but for your master's thesis, we can say, ‘What if we had automating meters? What if we had distribution PMUs, what if we had—?’” But we're still based on the foundation of what is industry-based and reality-based and not something that we're just making up for that site.

Jess Slater (00:37:13):

Oh, thank you.

Julie Cohn (00:37:15):

Dan, anything else at this point?

Daniel Molzahn (00:37:18):

I think this has been really interesting. I don't have any other questions immediately.

Julie Cohn (00:37:23):

Okay. I wanted to talk a little bit about your role in the IEEE and why that has been of value to you and why you think it's a value to others. You've held more than one position. Would you like to describe that and then just reflect on that a little bit?

Noel Schulz (00:37:43):

Sure. My different positions?

Julie Cohn (00:37:44):

Your positions and then your reflection on why that was important to make part of your career.

Noel Schulz (00:37:49):

So, I was really fortunate. Some of my—the faculty I'd met in Virginia Tech, as well as Dr. Wollenberg, made sure and introduced me to folks. And so, I got involved really early in a committee and then ended up being the chair of the committee.

Sairaj Dhople (00:38:05):

Which one was that one?

Noel Schulz (00:38:07):

My first committee was Career Promotion, Power and Energy—Power Engineering Society at the time—Power Engineering Education Committee, Career Promotion. And we actually created a couple videos to try to, in the late '90s, to try to promote power engineering careers. And so, then I was asked to do awards. And so, I spent some time doing awards. And that was really interesting; I got to learn more about the IEEE as well as the Power and Energy Society. I got to present at the banquets and meet all the people on the governing board.

(00:38:44):

And that was just a really great opportunity. And I got to meet all these famous people that I knew their names, and they were just real people, just like me. And they were all very kind and, talking about — what are *you* doing? And, I think that's probably one of the things I found with IEEE: as an early career—which I don't feel I am anymore—as an early career, that people around were willing to listen, talk, or provide advice to me, to help think of: "Oh no, you should think about this or not that," or "Hey, this is a really good committee for you to be on," or "You should go this direction or that direction." So, after doing the awards committee, I was asked to run for secretary and won that election—two years.

(00:39:33):

And then I was asked to run for treasurer, did that for two years, and then asked to run for president. And I was president, so I was on the governing board for 12 years. And as I mentioned to others—in fact, I was talking to a grad student today at lunch, a former grad student—he said, "Well, what's really in it for you as a PES volunteer? All this time and effort that you're putting in?" Because I'm running for another office now. And I said, "a) One of the things is I want to be able to give back. There are people that helped me along the way, and I want to help give back to that." But I can say that every position I have had an opportunity to be part of, I've gotten way more out of it than the time and effort I put into it, whether the people I met or a researcher I met that we didn't do a process.

(00:40:27):

I've done some work with the Women in Power, and we started a group, Women in Power Faculty back in like 1995, with four or five of us, which is now, there's probably over 30 or 40 we invite to that every year. But that group I did to just meet other women power faculty. Well then, we ended up writing a proposal together, writing a paper together. Recently a group of us wrote a book, edited a book and wrote a book. And so it wasn't that I went in there that: "I am going to do this, so I get this," but that was an unintended consequence and opportunity I got. And so those were—and the relationships I met. That people that I could just call or email and say, "Hey, I have this question about this," or "my student's really interested in going into this type of work, and I know you've done that. Can you share what this, this, and this?" And so, the networking and opportunities and really to meet the pillars of the organization and the pillars of our field and just see they are real people, and to sit down and talk to them. Those are just priceless experiences I had as a PES and IEEE leader.

Julie Cohn (00:41:40):

Would you say that there's a formal interaction that happens in an organization like this, where you prepare a paper, you receive feedback before you present it, you present it, there's feedback, then publish—there's feedback then. And then there's the informal kind of confirmation and critique of your work that can happen. Did you experience both through your participation in IEEE?

Noel Schulz (00:42:08):

Yeah, obviously the formal part we all participate in. I think the informal part is through some of those—whether it's a working group or task force, whether you go to lunch or you go have coffee here, and you talk about an idea and you throw a couple different things at the person and they say, "Well, this is probably more relevant," "That's more relevant," or, "Have you talked to Anamika Dubey? She's doing some cool work in this particular area," or whatever. Those kind of things. And those informal interactions, particularly when you're in a leadership position or a volunteer, you get those, you get the work you have to do for PES, but there's also those times that you network and have a chance to talk through things and can bounce ideas off of somebody. Because sometimes at your organization where you are, you don't have someone in your exact area, so you want to bounce them off of somebody else.

Julie Cohn (00:43:02):

Is there an anecdote you could share about, like a problem you were puzzling over for your research that was resolved by talking to people through this organization? If not, that's okay.

Noel Schulz (00:43:16):

I probably can't come up with that off the top of my head.

Julie Cohn (00:43:21):

There's probably too many to share.

Noel Schulz (00:43:22):

Too many to share. No—I had—I'll use an example: I had colleagues that had gotten a National Science Foundation career proposal, that I've met through PES, and I reached out to them and said, "Can I see your proposal so I can just see how you did it?" I'm in a different area, and they would send it to me. And I do the same, I did the same thing for my proposals to others that asked. So, while that's probably not an exact anecdote, that relationship through PES gave me the relationship that those people trusted me enough to share that with me to help me in my career. So, and that was very helpful along the way to see examples of successful proposals, and some of that kind of thing.

Julie Cohn (00:44:09):

I'm personally interested in the Women in Power organization—your role in that group. I'm fascinated that you started a Women in Power faculty group with four or five people—and now you've got what, did you say 40-something along those lines? Can you talk a little bit about being a woman in this power industry, and any of the challenges or opportunities that really stick out in your mind as you reflect on your profession?

Noel Schulz (00:44:41):

Yeah. Well, I'm going to have to go back to a Bruce Wollenberg story. So, I was in my second year in my PhD, and he called me into his office, said, "Noel, I need to talk to you." And I was really nervous. And he goes, he said, "Well, there's one area I just can't mentor you in—it's being a woman in power. So, I would like to introduce you to Mariesa Crow, who's at Missouri Rolla." And she's also—her husband was also a faculty member, similar to my situation. And I think he said, "She's closer to your age as well." And so, he got us two connected. And when he did that, it was great, because it was someone I could talk to about having children—I'd had one son, I would have my second son the last year of my PhD—about being on the tenure track.

(00:45:30):

She was a couple years ahead, and so that was an enormous help to me. When I started my faculty position—and I was very fortunate—my very first tenure track position—Martha Sloan, the first woman president of IEEE, was in my department. She was a great resource for IEEE, but she was in a very different life stage than I was. She was very senior, she had lost her husband, she was empty nest; I had a one and five-year-old and—you know—just starting my career. And so, I started a network there at the university where we just got together for lunch with all the women in engineering. And it was selfish at first because I just wanted to hear from other people, but I just found a lot of momentum from that.

(00:46:20):

And it filled my heart and gave me a chance to—so I did that throughout my career at different universities. I did that with Mariesa Crow when I first started here at PES, we started having lunch. There were four or five of us. And sometimes we had children with us along the way. And then it just started to grow. We got to a point that we were too big to go to dinner. We had to have a banquet. And so, we just have an evening event where people come together and I think we usually, in those sessions, we just talk about best practices, people share about their research. They may bring up a challenge and how people dealt with it, advice about tenure promotion, all those kind of things.

(00:47:08):

So, it's a bit informal. But then I think, those interactions happen today, but then there are things that happen throughout the year because of those meet and greets that we have, and those kind of things. Also, in 1997 the IEEE Women in Engineering Committee had started, and I can't remember what year they started, but they started giving grants for you to have a reception for women in engineering at a conference. And so, I applied for a grant in 1997 in Tampa. We had a Women in Engineering Reception. I was very active doing that throughout PES over time under the Women in Engineering umbrella. And then PES also picked it up and helped support those as well, because the grants went away. But as we evolved in that, and as we started to look at the evolution, and particularly with Wanda Reder being the first woman president of PES, and then me following too, after that, we started to have more women on the governing board, and we began an effort to—

(00:48:21):

And Shay, who's current PES president, really was interested in a Women in Power, to really specifically do it at PES. And so that really started, and that was broader, not just women faculty, but—and continues. We have the reception on Wednesday night, Women in Power has different events, and things like that.

Julie Cohn (00:48:41):

Were there more women pursuing academic professions in electrical engineering and power when you were finishing your PhD? Or were there more in industry, do you think?

Noel Schulz (00:48:54):

Well, there weren't many women any, overall. So that was part of the challenge. And as an undergrad, we only had, we had less than 10% women. So, by the time you got to the PhD—I think most of the women that I knew were in academics, but I think that was because of the circles I worked, I was in. There were a few women in industry, Virginia Sulzberger and others that come to mind that I met, and I met through the governing board and some of that. But most of the women, it was interesting, a lot of the women that I met were in the power—when you talk about Power and Energy Society, you talk about energy conversion, power systems, power delivery. A lot were in the power systems modeling,

computer modeling, like I was. So, it was just really interesting to see that evolution and less in some of the other areas. But I think it was an up-and-coming area, and it was new. There weren't a lot of people in it, so it was, maybe felt more open than other areas.

Julie Cohn (00:50:00):

Interesting. Other questions related to these topics? IEEE—

Sairaj Dhople (00:50:07):

Well, maybe not directly, but knowing you've worked a lot across the world, I've seen you collaborate very aggressively in India and Africa. Like what's driving some of those collaborations and those engagements?

Noel Schulz (00:50:21):

I think it—so, early in my—let me back up. This is a little bit of personal information, but my husband and I met on what's called an alternative spring break. And we were going to—we worked in Kentucky on low-income housing. We were both college students and as we talked about—we wanted to give back. We wanted in our career to go to Africa for a year and give back and do some of those kind of things. And my husband went into university administration, so he was worthless. And he—we couldn't do that. But I just was really passionate about being able to give back in the grid. And I would probably say—also, I had a chance to work, I was involved in some of the very early discussions with Robin Podmore on the IEEE Smart Village.

(00:51:19):

And it just really resonated with me about the Smart Village and rural electrification and making a difference. I had a chance to—because of some activities at Kansas State—to go to Ethiopia and do some work there and talk about power and talk about smart grid or micro grids and some of those kind of things. And then I had a chance, working with Anurag Srivastava, who was at Washington State University at the time. We had this large India project, this $30 million project. And I was just moving to

Mississippi State, but—I mean to Washington State—but I'd worked with Anurag at Mississippi State. So, we had a connection. And I had met lots of, through my PES experiences as, on the 12 years, I had been to India multiple times, met lots of folks there in the PES and IEEE.

(00:52:12):

And so, we created this proposal that was awarded. I ended up being the US lead for the Project UI ASSIST, which had 16 US partners and 15 India partners. A few of these gray hairs are from that project. But that was an amazing opportunity to—for me personally, but also for our students to see the differences and the similarities between the power grid in the two countries, and the ways of thinking and doing that. And so, I think it goes back to: I'm an educator at heart, and these are all tools to help the students gain an even better perspective on what they're doing. And the other thing that was interesting with UI ASSIST is, it was, it was the whole distribution system. We weren't just looking at one different aspect.

(00:53:05):

So, the students were getting a broader perspective there. But I would say the coolest, probably in the top three of my personal, my professional experiences, was last September when I went to a village near Kanpur that we had electrified. And I went in 2019, and I didn't realize it when we got there. I was the only woman on the team. All my colleagues from India were men. So, when we got to the village we talked to the men, which would be traditional, and then they said, then they shooed all the men away, and all the women and girls came. And then I talked to them through a translator, and I asked them what were they excited about with the idea of getting electricity? And they talked about their children learning and new opportunities. And so, I did that in 2019, and of course, Covid happened, so I didn't get back again till September 2023.

(00:54:02):

And when I got there, the same women, they—as part of the project with the solar, biomass, and batteries, we also did an Ag processing center. I met these women, and they talked about how this electricity had transformed their life, of course, through a translator, but their smiles and their energy

and their—it just was so impactful for me on—what are—what we do with electricity? We take it for granted, like we talked about this morning, we all expect the lights to come on, but just to see these women. And one of the women talked about that now people want to marry our children because of where—and everyone knows where this village is now because it has electricity. And that just really was an amazing experience for me to see that.

(00:55:00):

And I think sometimes we get, I don't want to say jaded, but in the US we just—we just say the voltage is a little bit better this way or are we—the restoration time is five minutes instead of 10 minutes. And so, we can get lost in the impact of the grid and appreciation for it. I always get more out of these opportunities and really feel that I have a lot of friends now, as well as colleagues, in India through, through six years of working together on this project. But again, it's an opportunity for the students as well as others to understand. And that was another good example. We had national labs, we had universities, we had industry, we had organizations—NWPPA, Northwest Public Power. So, we had a lot of different entities in that. Which gave headaches, but it also helped us do the whole ecosystem, and working together. So, sorry, long answer to that.

Sairaj Dhople (00:56:05):

But that was an incredible story.

Julie Cohn (00:56:05):

I think we're all moved.

Noel Schulz (00:56:12):

Anamika has a question.

Julie Cohn (00:56:13):

Okay.

Anamika Dubey (00:56:15):

So, listening to your story, and of course we had many interactions before as well, seems like. Not seems like, you had an incredibly impactful and satisfying career to yourself, right? So, it seems like that at every stage, wherever you were in career, you were at the right place, at the right time, right? I'm sure that doesn't happen. It happens in hindsight. Probably not when you look forward. What suggestion will you have for someone who is charting a career forward to ensure that, or at least have a sufficiently good probability of achieving that?

Noel Schulz (00:56:48):

Well, a couple things. I'll say to that I'm sharing all the positives. I could go back and share, and something I talk about when I talk about leadership is, I say, "When a door closes, a window opens." And as I reflect back, there were opportunities I didn't get, and I was crushed at the time. But then a new opportunity came up that I wouldn't have had if I'd had that other opportunity. That ended up being an amazing experience for me. And so, I think one of the big things is, and I also like to use, from the book "Lean In." Cheryl Sandberg talks about a jungle gym instead of a ladder for careers. And the thing with a ladder is you go up, you go down, you fall off, right? If we talk about a career ladder. But with a jungle gym, if you think about a jungle gym, sometimes you go up to go down, and there are multiple ways to get from one point to the other point.

(00:57:43):

And I think today, particularly as we do careers and as we work to balance professional and personal activities, there's not a singular path on how to do this. And so being flexible and looking at different opportunities, I think making the most of what you can in your current situation to show people that you're ready for the next thing. And the other thing is, I think particularly in my case, in the dual career where—and I did—we did not want to live apart with our children and stuff, is making the most of what you're doing then, and figure out what new skills you can get in that, that are going to help you at a later

time and working on that. But I would say the other thing that's important is to have someone that you can cry with and have someone you can celebrate with.

(00:58:39):

Because when that door shuts, it's tough. It's tough. I mean, when I got my reviews back from proposals, I would read them. And fortunately, my husband was a couple years ahead of me, he said, "Put them in a drawer and come back and see them in a week." I was like, "No, I've got to work on it," I said. And so, I did that, and then I was much more focused on, "Okay, how do I prove things?" rather than rejection. And so, when that door closes, you need someone that can support you, whether it's a family member or partner or colleague to get you through that, because there are new, other opportunities along the way. And there's not one path, there's not one, one path for any of us. And mine's been partially because of being a dual career. I've been, my path's been a little different, in moving in different places.

(00:59:27):

But one of the things we have worked on is, there's always been a good power program where we moved, because that was my passion. And in this case, I'd worked with Schweitzer Engineering Labs. So, we got not only a good power program, but SEL was located in Pullman, so it was beneficial in that way. And the other thing I think is really important is to communicate with your partner, if you're in a situation, on what are the things you need and for your career and activities, and make sure they're dreaming with you.

Ali Mehrizi-Sani (01:00:02):

So, you mentioned dual careers, and so both you and your husband had very demanding careers, right? Both in academia and in administration. And both of you have done administration. At the same time, you had kids, and you traveled quite a bit. So how did you balance this with all the responsibilities you had and then your role as a mom and your role as a wife and being part of the family? I mean, I can't imagine because each of these alone are going to be a full-time job. But you, you manage very well. Actually, this was a question, and part of this was a question that very first time that I talked to you at

Washington State, I ask you this, you are not the faculty there, but I think you were coming to visit. But a lot of things that—you keep going strong. So how do you, how do you manage?

Noel Schulz (01:00:58):

I would—I start out—first I tell people—I said, "The most important professional decision I made was my partner because he supports my goals and at times pushes me." So, when they asked me to run for PES president, I said, "Oh, I'm not ready yet." And Kirk's like, "You're going to do it"—my husband. And so, I did it. And there have been other times where I said, "Well, I'm not sure I can do this." And he's like, "let's go for it," and if it doesn't get it—and I got it. And so, he has been supportive of me, and he has been my number one cheerleader all the time. I think first of all is find a partner that, like I said earlier, dreams with you and that you can dream together. The second thing is we had our first son in—we had both our kids in graduate school.

(01:01:48):

One was during my husband's PhD; one was during mine. We probably we did that partially—both of our parents, both of our dads were professors, and we were really worried about me starting an engineering career and having to take time off right away for—so we had kids in grad school, which—pros and cons related to that. We didn't have any money yet, so we didn't know how we did that. And we really created support structures. We moved away. We were with my parents for the first couple years. We moved away. So, we had to create support structures around us in those places we were, so we typically had baby good babysitters. We paid well, so the babysitters were available when we needed them. We typically had—the great thing about being around a college campus, is you can find college students that are interested in being helpful.

(01:02:47):

When we moved to Mississippi, we actually had a nanny that was with the boys from like three, three to six every night. And that person became a big sister. So, there's—early in my career, I went to an American Society for Engineering Education conference. And there was a dual career talk. And one of the speakers said, she said, "If you're dual career, and let's say one of you, let's say you're both making a

hundred thousand dollars, just for an easy number. You can spend $99,999 on services, and you're still ahead if you enjoy what you do in your career." And so, the big thing is time versus money. I don't like to cook. Kirk likes to cook, but it's normally like weekends and holidays, so we ate out a lot.

(01:03:43):

And the good thing about eating out a lot is you don't have to cook, and you don't have to do dishes. We spent that time playing games with the boys while we're waiting for restaurants, and things like that. We also took our sons on different activities and Tim, our younger son, went to a lot of AIChE meetings and IEEE meetings, student meetings, and everyone loves a baby. So, he passes, he gets passed around and stuff like that. I think there's time versus money and you have to work on those kind of things. We made sure I gave a seminar one time at Kansas State University to a family development group. And the first question was: “do you think your kids got the shaft because you value your career more than them?”

(01:04:32):

Which was a little bit, okay, it was a little abrupt, but, and I said, "You're asking the wrong person. You need to ask my kids that, when they grow up.” The challenge is I would like any person to be able to either stay at home or work. But I don't want someone to feel they want to stay at home, and they have to work, or not someone to have to stay, feel they have to stay at home and work. It's all different personalities and it's all what you do with that time. My kids have traveled internationally because we have the means to do that. My kids have traveled around the country, and so we've taken—. I may not be there with them every, all day, but there are other opportunities that they have had, that we wouldn't have had if I were not working.

(01:05:21):

That's a very personal decision and every couple has to make that decision. But I really think time versus money has been a really important thing for me along the way, and not being perfect. I used to joke, I would always bring Kentucky Fried Chicken to the potlucks because I didn't have time to cook, but it was always gone quick because everybody liked it. You have to find those balancing—the balancing act. And then the last thing I'll say—and sorry, I've gotten on my soapbox here—is you have to communicate, you

have to really have an open communications plan. So, when I ran for president of PES, we knew, for two years when I was president, I was going to travel. I did 240,000 air miles over those two years on six continents.

(01:06:13):

I had an international trip at least every other month, sometimes every six weeks. It was a wonderful experience, but I was gone. And we, I had one son in high school. So, the deal with him was he got to go on one international trip with me a year. Because he wasn't going to see mom. That was the exchange. And Kirk had to pick up the slack, and he's always been that way. I don't think I mentioned, but when I went back to get my PhD at Minnesota, my husband was working in Grand Forks, North Dakota as a professor at University of North Dakota, so we lived 325 miles apart. He had a 2-year-old, because I was focusing on my degree. So, he was a single dad for two years, so I could get my PhD. Not all partners would do that for people. Kirk has picked up the slack when I needed it. Hopefully he would say I picked the slack up when he needed it. But Andrew, our son, got to go to South Africa for a week, New Zealand for 10 days, France, I mean, he goes to, he still occasionally comes to some of these IEEE-PES meetings from people he met at different events. So, I don't know that I've answered your questions, but there's just a lot of different aspects.

Julie Cohn (01:07:36):

We've taken up a good bit of your time.

Noel Schulz (01:07:40):

Yeah, I'm sorry. I feel like I've got really long answers too.

Julie Cohn (01:07:43):

I'm checking with Dan since he's not in the room to wave hands at us to see if you have any other questions you wanted to ask before we wrap up.

Daniel Molzahn (01:07:51):

Well maybe this is kind of building off the discussion we're just having, and I suspect you may have partially answered this at least, but I'm wondering if you can reflect a little bit more. So, for those of us, especially male professors, wanting to support our female colleagues, female professors and female students, do you have any specific advice on how we can best do that?

Noel Schulz (01:08:15):

Yeah, so a couple things come to mind. And there's a lot of research that talks about imposter syndrome. And particularly in minorities and, or, in activities. So, I would say women and underrepresented minorities in engineering—if you don't see people like yourself, or you see not many people like yourself, there can be this insecurity. One of the important things, I think, is to realize that there may be a different way that your female students approach some things. Research has shown that if you have a male and female take the class and they both, one gets a 70, they both get a 70, that the woman will internalize and say, "I'm not good enough," and maybe transfer out of engineering. And the guy will say, "Well, the professor's a jerk.

(01:09:08):

This was a stupid test. So, I—it wasn't my fault. It's the professor's fault." So, realizing that they may internalize, and this can be for students of color as well, they may internalize. So that would be one thing, is just to be aware of that, that you may need to support in a little different way, because they're internalizing it. Versus saying, "You can do this type of thing." The second thing is role models. And Bruce Wollenberg does something for me by saying: "I can't be a woman in engineering for you as an advisor, but I'm going to introduce you to somebody who can do that." And so maybe someone—and maybe you set up a meeting with one of the, let's say a woman alumna comes to campus and does a seminar.

(01:09:58):

Maybe you help set up a time for the women students to meet with her and share her experiences. So, it's a role model, they see that. I think that's something, and I would say the other really important thing is to be an advocate for the women in situations where they maybe can't be. So particularly when I was an untenured faculty member, right? I didn't want to speak up, and I didn't want to be “that” woman faculty member. And a couple times I was actually, you may have heard, they talk about women being invisible, that a woman says something, and nobody says anything, and then a guy says the exact same thing, "Oh, that is a great idea, Ollie. I wish I had thought about that." And you're like, I just said that. I had a situation where, in a meeting when I was at Michigan Tech, where I said something—early career faculty member—and then five minutes later, one of the guys said something. And then they're all slapping his back saying: “What a great idea.”

(01:11:07):

And one of my colleagues said, "Well, Noel said that 10 minutes ago." And by doing that, he—it wasn't me saying it, and so he defended me in a way. And it wasn't that I asked him to say that. He saw that I was being dismissed in my contributions and stepped up with that. And particularly if you're a tenured faculty member, a senior faculty member, and as a junior faculty member, that's really important. The other thing to be aware of is that University of Wisconsin Madison did some research on implicit bias. And one of the things they found: women that promote themselves, it's considered negative. But women who promote other women, it's considered positive. And so, one of the things I encourage, so an example would be, let's say your junior colleague finds out she gets an NSF career award. Well, she doesn't want to send that out, but you can send a note to your department head or your colleagues and say, "Noel got her career award and congratulations to her." Because if she sends it, that is perceived as not good; that she's being too braggart in some of that kind of stuff.

(01:12:21):

So, I think helping promote the accomplishments, and I'm not saying doing any differently than a male, but not all women will be, on average, will be as outgoing and sharing some of those kind of things. So those are a couple things that come to mind.

Julie Cohn (01:12:40):

I'd like it. No, appreciate it. I'd like to bring that back around to sort of where we started in the conversation to ask about your contributions in research and did you have to fight harder to bring attention to an algorithm that you developed that was going to solve a problem, when others were doing parallel work out in the world? Or were you able to, did you feel that intellectually your work was received as if it was gender neutral or region neutral?

Noel Schulz (01:13:22):

I think I would say with people that I interacted with regularly, no. Because I had a relationship.

Julie Cohn (01:13:31):

Yeah.

Noel Schulz (01:13:32):

But if it was someone new, that I didn't have a relationship with, I, and whether it's my perception or reality, I would feel that I had to justify myself, or justify my work, probably differently. But if I went and worked with a utility, a group of utility folks, and I just went there and interacted with them, I gave a seminar. I had students, we had this relationship, then I felt it didn't matter. It was genderless. But there's always—in my career, there were times that you could see people look at you and think, well, is she only in this position because she's a female or does she really know her electrical engineering? And there have been times I've had that.

(01:14:17):

And so, I've had to approach it by demonstrating that. So, I went to a visit a company in Kansas City one day with a colleague, and we started talking. And one, there was two men, and one of them leaned over to my colleague and told her, wow, she really does know what she's talking about. And it's just like, well, why would we set up this meeting if I didn't know what I was going to talk about? But that's just an

example of—and I would say that, and back to Ali's point—as you go through your career, that's less of an issue. Because you have. But in your early career, you—I do feel at times I felt I had to prove myself. And that may have been an internal perception. That's true as an undergraduate student, you felt that you had to. And even when I was a freshman, my advisor, Virginia Tech, you don't pick a major.

(01:15:21):

And I was going between industrial engineering and electrical engineering, and my advisor said, "Well, I tell all my girls to go into industrial engineering, it's people engineering." And I said, "Well, which degree has the least women engineers?" And he goes, "Oh, electrical engineering." I said, "Why don't you sign me up for that one?" And so, for me it was a challenge sometime to be able to show someone they didn't know what they were talking about, but you had to do it in a way that was professional and not necessarily what's raging inside on what you really want to say versus what you end up doing. And some of those—But no, I do think earlier in your career for people that don't know you, and they just think that, that you're there because of your gender, but typically I was able to change those people to see that I did know what I was talking about.

Julie Cohn (01:16:12):

As I mentioned a moment ago, we have taken up a good bit of your afternoon.

Noel Schulz (01:16:15):

No, I've enjoyed this. I've enjoyed this.

Julie Cohn (01:16:17):

We've enjoyed it very much. And I'm going to see if anybody has a final question.

Jess Slater (01:16:23):

You mentioned something about how people, or in general, people will take for granted the impact of electrification or just keeping the lights on. How do you engage in conversations with people to mention: “Hey, you might be taking this for granted.” Especially from women engineers or from students. How would, how would you recommend they engage in that?

Noel Schulz (01:16:47):

Yeah, so, I think today's—we have a great opportunity today in the environment, as we talk about clean energy. I mean, I do this all the time right now, where people are like, well, we know where—can't we just have more wind and solar and take care of all this? Or why can't we just plug in all the EVs today? And so, I will talk to them about some of the—in a way, like we talked about earlier today, in communicating to the non-technical public. Well, these are, these are what you have to understand and go through that. So, I think you have to have thought through some of these kind of things. So, you can talk about it in a way, at universities, we teach people to talk to other university people or other PhDs. We don't always get them to talk to non-technical people.

(01:17:32):

So, I think one of the things is to use some concrete examples, specifically, that people can think of. And with women in engineering, people taking things for granted, and understanding, I think it's important to just share some of the numbers that are out there. And some of these challenges, like I talked about imposter syndrome, and I know just with some of my colleagues and even my husband, one of the other things that happens in academics is women in engineering tend to get more service, and they get asked to do these service roles and men don't. And so, I talk about that to department heads. I talk about that to leaders, senior leaders, and say, "Realize this person's on three committees and this other colleague same time is on one committee."

(01:18:24):

So, I think it's really important you have concrete examples, and you don't talk in generalities. Because numbers, particularly when you're talking about engineers, numbers, numbers will matter. And if you give concrete data, and for people in general, and I've had this conversation with a non-technical person

about—she said, "Well, electric vehicles, the utilities are just against electric vehicles." And I said, "No, the utilities aren't against electric vehicles. The utilities want to keep the lights on." And what you—they're trying to balance all this, and you've got to realize that you're plugging in, and you want it to be a green electron. Well, utilities have got to find those green electrons to get it to there, and we're not at that point right now that we can guarantee we're going to have green electrons for you. And they don't want the lights to go out because you're plugged your car in.

(01:19:17):

And so, we need to work together, and this is something that came up this morning, too many times policies are made without technical folks there to—not say we can't do it—but to say: "The timeline you're giving us to do it is probably not reasonable." Technology has not caught up with us. And a lot of the clean energy goals, they're great goals to have, but the technology is not there yet. And unfortunately, the public now thinks we're going to be carbon-free by 2030, and the chances of that are not very high, because the technology hasn't caught up. And how do we balance having the engineers and the utility and others there to say: "These are some of the constraints we have, these are the pros, these are the cons." Instead of just jumping to the solution. So, I'm not sure I answered your question.

Jess Slater (01:20:05):

Oh, thank you. Thank you, yes.

Julie Cohn (01:20:06):

This has been a wonderful conversation.

Noel Schulz (01:20:11):

Oh, I really enjoyed this.

Julie Cohn (01:20:11):

Thank you so much for participating. I think we all appreciated your time.

Daniel Molzahn (01:20:15):

Julie, can I, can I ask one more question?

Julie Cohn (01:20:17):

Yes.

Daniel Molzahn (01:20:17):

If we have another five minutes, maybe

Julie Cohn (01:20:19):

We have four minutes left, so one last question is fine.

Daniel Molzahn (01:20:22):

Okay. So, I'll, so one piece that I was hoping to ask you about, Noel is your time as an administrator and—you're at these, as you were saying, at institutions that have traditionally had strong power programs, and that was very intentional from what you described. How, and in your role as, as sort of IEEE-PES president, how did you try to frame the importance of power engineering as a discipline and get people to understand why this is relevant to their lives, and to make sure it's continued to be an important part of university curricula. And you advocated for the field as a whole—can you reflect on that a little bit?

Noel Schulz (01:21:09):

Yeah, so I think one of the important things is to have advocates that can do that for you. As you work with your industry, as you work with your local utilities, as you work with your consulting companies, if they tell the dean or the department head: “this is important,” he or she are going to listen to that way more than if I tell them that. So, it's important to have those relationships and when those people come visit you on campus, make sure they're visiting with other administrators and talking about how great your program is: “And we're hiring this many of their—and we really could use five more. And your work is going—this work is really amazing. It's going to change the way we're doing this. And we really appreciate the workforce you're doing, the research you're doing.”

(01:21:56):

So, find ways to do that. The other thing I think is important is, you're going to have to make sure and toot your own horn as a group, maybe more than you might want to at times. And might think “if they build it, they will come.” But that's not true. If you look in academics, the loudest mouth gets fed. And so, you need to make sure that, when there's a success, that you are writing an article about that. And maybe your people say: “Well, we don't—we're not going to do it on that.” Write a blog post, put it out there on social media, get it out there. And so, I think it's important being an IEEE-PES president that—and I was—this student that asked me earlier today, why do you do this?

(01:22:46):

I said, "For university's recognition, some of these IEEE positions, that's recognition. Every time I go up there, it says Washington State University. And so that—and actually being involved in high positions in IEEE, also is on the radar of a lot of electrical engineering professors and faculty. So, I would say first is to find advocates who are not you that can talk about the people that you're providing research and workforce for, that they should be talking to the department head, the dean, the president. And particularly if you have donors that are in the power area, make sure they're talking about how important the program is. Because those are the right people, the industry people. Some of those people, I think, are the most important people that you can have them talk to, and to your own horn.

(01:23:39):

You may have to toot each other's horns, because you don't want to look like you're being arrogant, but you can, I think sharing those stories and making sure those get out there is really important. And they may say: “Oh, this is just a small thing.” But the more it's on people's radar: “Oh, the power group did that, oh, the power group did that, oh the power—." Then, all of a sudden, the power group's doing great things. And you've just got to make sure it takes some extra work. But I think that work will pay off in the end.

Daniel Molzahn (01:24:07):

Great. No, thank you. Very, very insightful.

Noel Schulz (01:24:10):

All right.

Julie Cohn (01:24:10):

Okay.

Noel Schulz (01:24:11):

The real end of it, right?

Julie Cohn (01:24:12):

This is the real end.

Noel Schulz (01:24:12):

Well, thank you. This has been so energetic, energized me today.

Julie Cohn (01:24:18):

Oh, good.

Noel Schulz (01:24:18):

I appreciate the opportunity to be selected, and to be here and talk to you.

Julie Cohn (01:24:22):

Well, thank you very much. We had a great time.

Noel Schulz (01:24:24):

Thank you.

[End of interview]