TRANSCRIPT

Deok Young (Dean) Seo (ECSA Student Ambassador) interview with **Dominik Zupan** (TUGraz);

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Dean Seo: What initially drew you into the semiconductor field and ultimately made you decide to pursue it as a career?

Dominik Zupan:

- My first touchpoint with the semiconductor field was back in school when I was about 14 years old. My biology teacher asked me if I wanted to participate in an initiative called "SEMI High Tech U," a project like the ECSA. We visited a company located in Villach in southern Austria, the headquarters of Infineon Technologies Austria. During the couple of days I spent there, I was introduced to microelectronics. I remember we played games with digital logic boards (which was really fun) and visited the semiconductor production site.
- Moving forward, when it was time to decide what I wanted to study for my bachelor's, I looked through the university study programs and was drawn into Information and Computing Engineering which was a mix of information technology and electrical engineering. I liked the idea of being able to study how both hardware and software works. If I had to summarize this bachelor's degree, with this study program, you could understand how computers work: from the moment the computer is plugged in, to the software program running on the computer and everything in between.
- Along with my bachelor's degree setting my path towards microelectronics, whilst studying for my bachelor's, I was also given the opportunity to work at Infineon at a test lab, writing test programs and designing test PCBs.
- What finally drew me into microelectronics was my master's. My bachelor's was quite strict without many opportunities to dive into specific topics; however, during my master's, I was presented with eight catalogs I could select. One of these catalogs happened to be "Microelectronics and IC design", and I chose this to study as I already had experience in this area with my internship at Infineon and wanted to deepen my knowledge. In addition to this, Infineon offered to support with my master's thesis.
- From Infineon being located just around the corner of my school to my internship experience working at the same company, everything seemed to point me towards microelectronics.

As a PhD candidate, you are heavily involved in research. If possible, could you give a breakdown of a day in your life as a PhD candidate?

- It depends which phase of your PhD you are in. The beginning of a PhD sees a lot of literature research (books, scientific papers, etc.) to understand the basics of the topic you want to dive deeper into. The next phase would then be to ask yourself, "Is there anything I can improve upon this topic? Are there any gaps in knowledge that have not been researched well?" Based on these questions, you would attempt to work to improve current research with new

methodologies. This might involve proving or disproving research statements you set prior to the research.
- In my case, in the beginning, I developed a framework then I moved onto designing circuits where a lot of analysis was involved through various testing and simulations. I started researching through simulations and now continue to test my manufactured test chip in a lab.

Do you have a favorite/memorable moment of your PhD career thus far?

- I think the most memorable moment would be presenting my first paper. When I wrote my first paper, my supervisor encouraged me to join a competition with my paper. Entering this competition, I was greeted with a room full of people, more than I'm used to, which made me extremely nervous. Although I didn't end up winning the competition, standing in front of everyone and presenting my first paper made this a moment to remember.

I understand your research is currently focused on analog digital design and electronic digital automation. If possible, could you explain what these two entail, and what you hope to achieve with your research?

- My main research topic is making analog integrated-circuits more robust against EMI (electromagnetic interference). Generally, the area of EMC (electromagnetic compatibility) revolves around two principles: a circuit should not present high electromagnetic emissions that could disturb other devices, and a circuit should be immune to external disturbances. My research focuses on the latter principle. I'm especially focused on making operational amplifiers more robust against EMI. I started off my research by estimating how my circuit would respond to these disturbances using two methods: a mathematical/analytical approach, and a machine learning approach. Based on these results, I then thought about how I could simplify the design of robust circuits. I developed a framework to support designers by highlighting possible areas of a circuit where there could be a problem with robustness, later using the same framework to design a more robust operational amplifier myself.

How does one become a PhD candidate in the semiconductor field? Should students have taken a specific degree or course (Electrical Engineering, Material Science, Computer Science, etc.)? Are there certain skills you would recommend students develop before pursuing a PhD (research skills, communication skills, time-management, etc.)? What are some of the topics I could be researching?

- To answer the first question on becoming a PhD candidate, in my case, it was quite simple. My university had job offerings for university assistant positions and after applying for the position, I was given the choice to pursue a PhD.
- Regarding the specific degree or course, a formal requirement in order to become a PhD candidate is to have a master's degree. In my case, I had a master's degree in Information and Computer Engineering and because this degree involved a mixture of information technology and electrical engineering, I was able to transfer my skills from my master's to my

PhD in electrical engineering. There may be additional requirements for those who have obtained a master's degree from a field unrelated to electrical engineering.

- Besides the formal requirements, there are also informal requirements to pursuing a PhD. One, which I believe is highly important, is possessing a curious mindset on how things could be improved. "How could I improve this? Is there anything I could change to make something more convenient?" These are important questions to consider. Another attribute that is important for pursuing a PhD is being skilled in scientific writing. One mistake I made when writing my first paper was complicating my paper with advanced terms and overabundant details. I realized later that it was more effective to use simpler language to allow readers to easily follow my research, drastically improving my paper. Now, I'm much more focused on using simpler terms.
- In addition to scientific writing, I also want to highlight the importance of project management. This is essential when organizing your PhD projects so I would highly recommend participating in activities which help to improve your project management skills.
- To respond to the last question about what topics you could be researching as a PhD candidate in the semiconductor field, there are a lot of topics. Example topics include: making a circuit more power efficient, and the increasingly popular subject of designing microelectronics with artificial intelligence, just to name a few.

A lot of students may be interested in pursuing a PhD but are too daunted by the idea. Were you also daunted by the idea, and if so, how or what made you overcome it?

- I have to admit, I wasn't daunted because I already knew I wanted to help and improve current research by introducing new ideas. However, I did encounter a barrier when pursuing microelectronics research. Unlike software engineering, where learning/researching is highly accessible and often only requires a notebook to write/run codes, electronic engineering involves various tools which sometimes require signing NDAs and agreeing not to publish your findings. I find this to be a hindrance to microelectronics development whereas in software engineering, people can often share and download codes to foster collaboration.
- There are some initiatives that aim to create open-source tools for microelectronics design; however, they are still in their early stages. For those interested, I would recommend the IIC-OSIC-TOOLS developed by the Johannes Keppler University in Linz.

What's next for you after you have completed your PhD? (If you have given some thought about this)

- In the short term, I will continue my research with the test chips that my team and I have created as there are still a lot of measurements and analysis that can be done even after my PhD. Another thing I would like to focus on after my PhD is the teaching I'm currently doing. I would like to swap to open-source tools and implement new challenges for my students. During my bachelor's, we had a lecture on operating systems where, in groups of 4, students were challenged to improve a simple operating system. These improvements were then tested with a program which outputted a score depending on how many test cases our

system passed. This competitive approach to problem-solving encouraged students to think critically whilst having fun and I would like to implement the same approach for one of my own lectures. An example would be challenging students to create an operational amplifier with a set of specifications. Higher scores would be given to students who were able to meet more specifications.

- In the long term, given the opportunity, I would love to continue to work in academia. However, I am also open to working with the many semiconductor companies in the surrounding area of Graz.

The world has recently seen so much interest and investment in semiconductor technology and research. Why do you think this is? What makes semiconductor technology so crucial to the functioning of modern society?

- This interest and investment in semiconductor technology have been around since the last twenty years or more. If you think about the improvements that have been made in technology, most of them are based on semiconductors. Think of cars, phones, televisions, medical appliances and so on. All these devices have microelectronic components inside and without investment in this technology, devices like smartphones never would've been introduced.
- Further illustrating the high investment in semiconductor technology is the rise of NVIDIA. In the past 2-3 years, NVIDIA has grown a lot through the increasing interest in artificial intelligence technologies which require semiconductors to perform the required calculations.
- Everything we have right now is based on semiconductor technologies and although many individuals may only recognize companies like NVIDIA or Intel, they play only one part in the whole semiconductor industrial landscape. It relies on other companies like TSMC to manufacture the semiconductor chips, ASML to produce the equipment used to manufacture the chips, Cadence to design the chips, amongst many other examples.

Despite the increasing reliance on semiconductor technology, there are concerns about not having enough skilled workers to meet the demand. How do we attract and encourage young people to pursue a career in this industry?

- This is where the ECSA (European Chip Skills Academy) comes in where we try to foster interest in the semiconductor industry from young students to students pursuing their master's. It's not easy to accomplish this as we face competition from other industries who are also attempting to garner interests from students in their own respective fields due to the talent gaps that are also plaguing them. What the ECSA project tries to do is to provide activities, such as online courses and summer schools, to generate more interest in the semiconductor industry.
- There's also another project called GreenChips-EDU. As the name suggests, the focus of this project is on sustainability in microelectronics. Although the microelectronics industry has seen improvements in sustainability throughout the years, there are still many additional

measures that can be taken. Think about the many consumer devices that get thrown away after half a year, the power consumption of these power-hungry devices, and the overall manufacturing process of electronics. All these could be improved to promote sustainability.

For the final question, what advice would you give to young people interested in this sector?

- Stay curious! Have the drive to want to know the inner workings of electronics. As a starting point, if you're still in school, I would recommend first getting to know the basics of electronics through hands-on projects like soldering a simple board. Then, I would encourage you to reflect on your projects. "Why are the LEDs blinking? What's happening behind the scenes of my circuit board?"
- Another important advice I would give is to try to build your own team and expand your network. Doing so makes it way easier to succeed not only in your university lectures but also in your workplace. Having colleagues to ask questions and converse with is truly valuable, and it is always better to have multiple opinions.