

Returning KIT students discuss research, experience and offer advice

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Four students ventured to Germany for an eight week (May 18--July 13) summer research exchange program hosted at the [Karlsruhe Institute of Technology \(KIT\)](#). Kristen Venditti, Samuel Ludwig, Kaitlyn Chapman and Mahfuz Ali Shuvraz were chosen to participate in various research projects at the university's west and south campuses. Each selected student received a \$3,500 travel award and after successful completion of the program, up to 6 credit hours.

"I participated in a research project that contributed to improving the efficiency of the vapor-compression refrigeration system. The majority of the time, I worked on this project in German," Venditti said. She is currently a junior working towards her second degree in Mechanical Engineering with a concentration in Energy. Her research project on "Improving the Heat Transfer Coefficient during Flow Boiling" involved successful programming, in LabVIEW, to measure the compressor tube's temperatures using six thermocouples and four RTD's (analog input) to then calculate and convert to analog output in amps. This complex structure then measured the performance of the metal foam tubes of the compressor.

Although the program does not require students to speak German, the KIT group advises students to have a basic knowledge of the language since the whole program is in German. The school also wanted us to take German. So, we had to place into a German level course and they sent us to another school that does all of the languages," Venditti said. Mentors, supervisors speak primarily German and the level of language proficiency varies by program. "You really have to be familiar with some of the German language. All of their software and signposts (at KIT) were in German, so knowing a bit of German will help you a lot," Shuvraz said.

Shuvraz is a second year, international, graduate student pursuing a PhD in electrical engineering with a concentration in power and energy systems. His research on the "Harmonic Compensation of HVDC (High Voltage) Network" worked to create a more universal HVDC network to filter out harmonics in order to maintain reasonable power quality. For example, [U.S.] power systems operate on 60 Hz, Germany has a different frequency system. The difference in frequency creates loss, overheating, voltage sag, and numerous other quality power problems. "I worked on the power electronics converter side. My job was to design a control system using MCCF (Multiple Complex Coefficient Filters) structure to eliminate 5th, 7th, 11th, and 13th harmonics in order to create a more universal HVDC network," Shuvraz said.

He also mentions research at KIT differs greatly than research at UNC Charlotte in that KIT provides a more advanced level that is very autonomous: "You have to work on your own, double up your own system, come up with your own ideas." Shuvraz also cautions the importance of maintaining your deadline and being prepared for peer reviews.

KIT is similar to UNC Charlotte in terms of EPIC's labs, but much more extensive. The biggest difference in KIT's work setting is that everything is computerized. "They have more than one (campus) and all of it is dedicated to engineering, economics, anything related to energy," Ludwig said.

A junior majoring in Mechanical Engineering with a concentration in Energy, Shuvraz's research project focused on the thermal behavior of Lithium Ion batteries, specifically, how they react to heat. "The overall goal of my project was to come up with a better computer model to simulate how lithium ion batteries heat up during operation. Heat is a battery's worst enemy, and hopefully with the improved model manufacturers can design better batteries right from the beginning. In a battery cell there is something called an anode, which is where electrons are "stored" until the battery is used to power a device. The anode is made of graphite, and my small piece of this project was to create different 3D shapes to represent single graphite particles. Then I used software to simulate heat flow, electric charge transfer and ion diffusion for each shape and compared the results to real-life battery behavior," Ludwig said.

He enjoyed the opportunity to work with different people (both international and German students) on various parts of the research project and believes establishing an international community is key in the development and transference of ideas. "Engineers can take what they know and bring it to other parts of the world that aren't as developed as we are [in the U.S.]. You can always donate money and things but I think that if you actually go there and bring knowledge and skills, experiences to a place that doesn't have it, you can make a bigger difference that way. [Those ideas] can build, snowball," Ludwig said.

The research you choose will include numerous people simultaneously working on different parts of the project. For example, Chapman, a senior Civil Engineer major, worked alongside economists for her research on electrochemical battery storage. "I was working more so with economists than engineering students. I was separated from the rest of the students who went with us because I was on Campus West, which is more economics-focused, rather than Campus South," Chapman said. (KIT is divided into four campuses, spread throughout the city of Karlsruhe, which is about 300 years old. The university was established in the 1800's so it has a more historical setting.)

"My group was more economics-focused, even though they had an engineering background. They were more concerned with the life-cycle of energy and the life cycle of the batteries we observed in terms of their cost benefit," Chapman said. She accepted her research assignment unaware that it was on electrochemical battery storage. "When I applied, my interest essay was about smart homes, the idea of green infrastructures and the ability to look at energy efficiency. In terms of what I plan to do after I graduate, I'm interested in regional planning and also the green building aspect of it," Chapman said. Although her research was not directly related to her research interests, Chapman now understands why they saw the need to partner her with the topic. "It is kind of related; the idea of having battery storage in a green infrastructure definitely helps because being able

to use batteries to store energy when you don't need it comes in handy when you're dealing with renewable energy," Chapman said.

She advises students: Don't be afraid. The KIT exchange program was her first time studying abroad and she admits she does not know German. "I think that the immersion experience was, by far, better than any class I would've taken," Chapman said. She encourages students to take the initiative to get out and explore. "Take advantage of everything, so if there's a trip, go. If there's an event on campus, go." Chapman explored many places on her own.

The program provided a train pass, in which the students could go up to 2 hours away. Samuel Ludwig embarked on the opportunity to visit Strasbourg, France. "It's always good to push yourself or to move yourself out of your comfort zone...and to go abroad, that is a great way to get out of this comfort zone. It's a great way to experience other cultures, other people, how they live. Even if it's another first world country, like Germany, it's still very different from here," Venditti said. Before journeying abroad, the group says to expect the unexpected by being able to handle the little things. "You have to be able to go with the flow and figure things out for yourself," Chapman said.

Interested in studying abroad? Here are some things to consider:

- Research the culture: Germany closes everything on holidays.
- Learn the layout of the school's campus and city before you go.
- Bicycles are important for getting around.
- Prepare for the weather: Germany had an unexpected heatwave.
- Purchase an international cell phone plan *before* you go abroad.

As for career planning, a study abroad experience trumps all. Study abroad opportunities are the first thing recruiters notice on your resume. "Recruitment and finding a career after having an international experience is so much easier," Chapman said. "I can tell you that is the first thing I get questions about when I hand a recruiter my resume: 'You were in Germany this summer, tell us how that was?' Being able to say I went abroad and did research at a world-renown university definitely has its benefits, Chapman said.

The students expressed that they greatly appreciate the opportunity given to them to study abroad. Those involved in the exchange process did an excellent job at transitioning us to Germany, Venditti said. She and Ludwig gave special mentions to Dr. Kai Rebenburg (international coordinator), Dr. Julia Johnsen (program director) and Lena Birkhäuser (sponsor/translator). Mahfuz also gave special mention to his supervisor Simon Wenig: He pushed me a lot but he helped me learn a lot, Mahfuz said. He also thanks Dr. Badrul Chowdruy, David Causey, Joye Palmer and Julia Johnsen.

Students who are interested in applying for the 2016 summer opportunity to study abroad in Germany can contact Robin Moose (robin.moose@uncc.edu) for more information.