

Joshua Guenther: Hello. For our Introductory Biology course with Dr. Sata, we chose to interview Markus Hogue. Markus works for Landscape Services within The University of Texas at Austin and has played an instrumental role in automating The University's irrigation system.

Krishna: Where did you go to school and what did you study?

Markus: I went to school at the University of Texas in Arlington. I started off as a CSE major and realized I did not want to program for the rest of my life, so I switched over to information systems.

Jay: What led to the job that you are working today?

Markus: So, I have a passion for water conservation, and back in 2011 UT switched their irrigation system over to a central irrigation system--a lot more management detailed. I was actually the contractor that installed it. Once they got done putting this new system in, they realized that they needed someone to manage it and asked me. I just wanted to be a part of the system and loved what was put in and the objectives for it. I was all on board and wanted to be a part of it.

Krishna: And when was that?

Markus: 2012 was when I first started.

Haana: Did you ever think that when you were a college student you would be in the job that you are right now?

Markus: Not at all. Actually, I thought I would be in the CIA, not working for a university. So it's a little off than what I was anticipating.

Markus: I loved programming I thought. It was great until I programmed 40 hours a week and realized that I didn't want to keep it up. I loved the way data is warped with different aspects and I wanted to get an aspect of that and be able to see what I can do with it, think outside the box, also getting a little bit with the drones, wanting to see the future capabilities of it. I was dealing with the drones before in college that were mainly used for warfare. How can we integrate that into civilian life? And now since I've been out of college it has been a huge move in that direction where we can start utilizing it, like I mentioned before, drones for building and envelope inspection, see where we have leaks and seals, roofs where we have leaks, integrate the military aspect into civilian and to improve on that aspect.

Krishna: What classes helped you the most in deciding what you wanted to do? And did you get involved in any research in a college campus?

Markus: No research in a college campus, but a lot of my programming classes actually connected here in some aerospace engineering classes. I looked at drones back when I had a customer that I was managing. They managed a company that did drones over in Iraq and

Afghanistan, so it got me interested in that, and some of the aerospace classes kinda connected the dots with it. So I saw a lot of possibilities back then in college with drones in future applications.

Jay: How long have you been working as the irrigation and water conservation coordinator here at UT?

Markus: So I had been here since 2012, so this is my seventh year.

Haana: What was it like when you first started, and how has the industry changed?

Markus: So when I first started, technology was not really used in irrigation a lot. And you bring it up, most of the people in the field don't even have iPhones back when we first started. Now we are integrating so much technology--utilizing live weather data, drones, and other aspects. Where I go to conferences now and people all have tablets, smartphones, technologies becoming more adverse in the irrigation industry.

Krishna: On that note, what do you see for any innovations in the future? Do you see any things that could benefit you even more?

Markus: I do. I see integration more with moisture sensors in drones. Drones give us a good image of how healthy a turf is to see if we need to make changes, or any diseases, or if anything else is going on. So I see a lot more integration in new technologies that are coming out. More communication between the systems in the field and people that are managing them.

Krishna: Since you first started working at UT, what have you improved on?

Markus: So, I have integrated more with the students. I have had several different groups of students come from different classes and professors that I share information with, integrating their work with what we are doing on the campus. I have a project going on with four students right now at LBJ utilizing drones in a concept that they are working. That they actually just started a business just on the outside with agriculture using what we are doing working together. So, I have improved a lot with working with students and trying to get what you are working on in the classroom with actually hands-on work in the field.

Jay: What advice do you have for students who are trying to conserve more on the campus and just be more green?

Markus: The biggest thing is just being self-conscious in what is going on and what you are doing. If you are in the shower and you are taking a long shower, realize that every drop of that water that is going down the drain is fresh drinking water. And in 2011 when we had the drought and everything was down, we were at 30% water--every drop counts. It's a big factor that we are going through. The bottle refillers used in those--different things that we are doing on campus to be more water conscious and sustainable--utilizing those. This is UT--we make a big difference in Austin and every drop matters. So much when you have over 50,000 students here--that's a lot of people, a lot of water, a lot of flushing toilets.

Haana: When Austin went through the water shortage last October, how were UT's landscapes affected by that?

Markus: What was lucky for us is that we were going into the off-season, so it wasn't as large an impact as it would have been during the summer time. What we did immediately is we shut down all outdoor watering. So anything out there, we contacted the city, let them know immediately that we are shutting everything off, shutting down all the fountains, that way we didn't impact the shortage of the water. We knew that they were limited on how much water they could filtrate and clean, and we did not want to be someone that was pulling off that gist water landscape that was going into dormancy.

Markus: So what was nice was that we were in the off-season by that time. It was almost November--everything was to the stage where it doesn't need water for over the winter time, so we just left everything off. It actually helped UT save a lot of money.

Krishna: How has technology transform your career? It is a big part of what you do.

Markus: It has transformed it quite a bit. Instead of being in the field digging ditches and digging holes, fixing things and trying to troubleshoot; now we are getting alerts on our telephone letting us know when a break happens and where to locate it. We now have iPads where we can have plans of the irrigation system; so we can get an alert if there is an issue and we have a plan of where exactly to go and then we can use our iPhone or iPad to turn on that zone and look at what is happening. A huge difference from what we used to do before. Sending two guys out into the field, one to run the controller and one to try to find out where that call was coming from--very inefficient.

Haana: So I have a quick question. I know you said that you did some programming classes in college and then you switched to information studies, but have your programming classes come in handy in your job?

Markus: They have. I took C++ as my major programming language that I had. I now use a program called Tableau, and some of the stuff in programming behind the scenes--I guess maybe my calculus helped me a lot more with the formulas that I am having to use within the program--trying to visualize some of the data sets and also integrating different programs to communicate. I pull data out of one database and put it into the program myself. I didn't ask the vendor to do it; I figured out how to do it by thinking outside the box and saying, "I learned this in school, I can create this program to get this to work for me."

Haana: So like a pipeline plan?

Markus: Exactly.

Haana: Okay. Because I am interested in CS, so it is interesting to hear that.

Markus: So a lot of technologies that we have out there can be modified, or combining different data sets to be able to pull that information out of. And a lot of people don't see that as a whole. They see irrigation or building water usage. Well those are data sets that are ones and zeros. We can bring those together and create visualizations, and see where we need to cut back water or we are using too much water using that information.

Jay: Can you talk specifically about how you used drones in your everyday life?

Markus: Sure. So we are utilizing them with special cameras--NDVI and NDRE--which looks at the plant chlorophyll that is being released and how green it is. So we will fly it over a landscape and see if a turf is stressed or not. If it is not stressed enough, I will cut back water. I want it stressed because if it is stressed, a lot of the times it's going to grow its roots deeper looking for more water. If it is too healthy, it's going to have a shallow root system. So I want it stressed to a level. But then we also look at the trees. There is a lot of construction on campus, and our trees are a very valuable resource for us. We will fly them before a project and throughout the project to see if any of the activities going on is stressing those trees out. But we are also looking at roofs to see if we leaks in roofs, 3D modeling of buildings, progress shots of buildings going in, and we are about to start a new process of superimposing the drone image in an AutoCAD file and making sure the measurements are lining up precisely with that building as it is being constructed.

Josh: How does the sensor work with the chlorophyll?

Markus: So it looks at the light reflected. Everything has a wavelength. If you are looking at a color, it has got a wavelength coming back off it depending on the type of material it is. So it takes the information in and calculates it. It first started with hyperspectral cameras that looked at every wavelength, and they shortened that down to certain indexes that show plant health and what level they are and that is what created the NDVI--Normal Differential Vegetative Index is what it is called. And that is what let us know the health of it. But other cameras that are coming up, we are looking at thermal, we are looking at basically larger sized drones that can hold more payloads than just NDVI normal camera. Thermal. Looking at the thermal image that way we can see where we have a leak underground that we never knew existed. So we have large pipes that are underneath UT that are sixteen to thirty-two inches in size and bigger, and if they are having a leak that is 15 feet down, how do you know? It's so much water. But my goal is to use the infrared/thermal imaging. As the water percolates up, it is going to cool off the soil around it that way I can take a look as we fly it over and say that, "ok we have a cool area in the soil over here, and your leak is in this area. Go digging for it." So trying to use that. But we are also working with students in this concept. We have an aerospace engineering department here. We have people that are flying drones that are about to be moved into the old gym. We want to integrate what we are working on with what they are doing so we can learn from what they are utilizing.

Markus: It has taken me over four and a half years to get UT approval to fly drones on the campus and it has been a struggle to get through and pushing, showing the usefulness of it. I've

been able to present in front of the senior vice president and showcasing the usefulness of it, but it's more showing the cost savings of it. I found out you can show someone great pictures but if there's not a cost savings associated with it, they don't care. With a roof, if we have a leak in a roof and they decide to replace a whole roof, that's about 1.5 to 1.8 million dollars to replace the roof of your own campus. People don't understand that. But if I fly with my drone and find out that it may not need to be replaced or if there's a few issues that we can repair that's around forty thousand dollars. So you go from 40,000 to around 1.8 million at the max. The drones have improved quite a bit of information there. But, we're trying to find out different departments that can utilize this. We are talking to school of architecture. How can they use it to do renderings of buildings. We work with different companies out there when they are planning a project. We'll fly an area and overlay images on top of it with what they want to have as the final image. So we try in different ways of integrating more and more of the drones into what they're doing.

Krishna: How many drones do you have?

Markus: So far I have two, technically I have three, I brought my own. So, UT is still looking at funding the different stuff. Office of sustainability funded one drone with a special camera due to the student group wanting to test out some stuff. So we have that one. And I brought my personal one with me as well. So trying showcase the usefulness of them and try to get UT to purchase them. We're in the process right now of looking at a higher level drone to utilize more on campus. I actually have two meetings this week to discuss that. We want to get 30 zoom camera. So we can fly away from the power plant and take images of the buildings and stuff around it. They don't like me flying around the power plant with the drone. They're too concerned about it falling and crashing. The drone is about this big. I think if it hits anything it's going to break the drone and not. But they're overly cautious. We are trying to get more higher level equipment. There's a professor here on campus who's doing a project for the Department of Energy, looking at switchgrass. He's flying a large size drone with a hyperspectral camera. That's a \$75,000 set up. So, trying to get him to let me use that drone for a little bit for some mapping, seeing maybe some possible issues with the streets. If we have an area where there's a different reflective, that could be a weak area in the street and we can repair before it becomes a pothole and someone on a scooter or bicycle doesn't fall into it. So trying to be more proactive as we move forward.

Krishna: So, how much have you invested into the company?

Markus: So, so far, UT on drones has invested about \$8,000. The central irrigation system to save water is 2.1 million. So, it sounds like a lot but we have a cost avoidance now of over a million dollars a year. We're saving around 125 millions gallons of freshwater a year that we used to put out that we no longer. A reduction of 75% of our original water use and we also put this out on the dashboard where people can go without a password and see exactly what we're doing. So, that way complete transparency. First ones in the world to do that and that's why we won an award in 2017 from the TCEQ for Texas Environmental Excellence Award. Where I actually got to go with President Fennes to the capital and meet the Governor and receive the award for the efforts.

Krishna: So now that we have a broad understanding of what you do right now, we are wondering what is next?

Markus: So I am always looking at different things to come in. Drones are one thing, but I am looking for automizing and automative mowers. So basically, I want a mower on our satellite locations, to go out and mow on its own, and be able to see it with my drone if I need to to be able to keep an eye on it. That way we don't have the same personnel out there, waste time and money and gas. That the mower will do its job. I am also looking to integrate smaller sized drones on each irrigation controller, so if there is a high flow break, the drone will go up, take pictures of that zone while it is running, so it can see what the issue is before I even send a guy out to the field. So trying to think to the next level, we are still probably five to ten years off on that. We have to get the FAA approval that Amazon and everybody are working on, but once that gets cleared off, it opens up the world of opportunities. Save a lot of time, effort, and water out there.

Josh: Throughout all of this, what has been your favorite part?

Markus: I really like working with students. Y'all think of things outside the box and I am like "how did you get that idea?" But I like working and having that different aspect. Seeing your new minds as you're going through stuff that I wasn't going through in college and bring that to the forefront and say "try this." I like that aspect. I like that freshness that's constantly coming through with each year with new students, new ideas and then allowed to actually integrate those ideas with what we're actually doing.

Jay: What advice would you give college students today in picking a career? Are there any questions you went through that you've answered?

Markus: Find something you have a passion for. Find something that you really want to be apart of and go for it and look outside the box with what your thinking. If you are in a certain school or department, most people don't look at the college you're at has so many opportunities when you graduate to come back and work for. We have a legal department here. We have a project management, construction, facilities management. We have so many opportunities here that you could come work right now with before you go out into the real world to see if you really want to do that career path. I think that a lot of students don't utilize that enough. Where if you want to come sit with a project manager for a week and see how he works on it. We have that available right now. We have a power plant here that's one of the most efficient in the world. Come utilize the resources here and help guide you in the right direction.

Sarah: Working on this project, I've been able to learn about Markus and his work here at UT, and it has helped me gain a better understanding of how technology is being integrated into new fields and about just how important water conservation is. As the program coordinator for irrigation and water conservation, Markus has helped transform UT's irrigation system to be more efficient and sustainable. Listening to Markus talk about sustainability and what we as individuals can do to better conserve water, made me reflect on my own habits and how I can

change those for the better. As a student who is still trying to figure out what career I would like to have, it was helpful to hear about Markus' path to finding a career where he is able to both do something that he is passionate about and make a difference. Learning about how Markus was able to use his computer science background in his work with irrigation showed that all learning is productive, and even if you don't end up having a career in a subject area that you've taken classes for, that knowledge can still be put to use.