Dan Seed:

Hello and welcome to Big Ideas, a podcast from Texas State University in San Marcus, Texas. My name is Dan Seed and I'll be your host as we speak with some of the most interesting minds from our university. Today we're joined by Dr. Eddie Piner, a Professor of Physics here at Texas State University. Dr. Piner, thanks for being with us.

Dr. Piner:

Thank you.

Dan Seed:

So to start off, tell us a little bit about your background, your academic research, and what brought you to where we are today.

Dr. Piner:

Academically, I received my PhD in 1998, and immediately thereafter I went into industry for about 12 years. And toward the end of that timeframe, I decided it was time to make a switch. And what I really like doing is research with relevance, actually. And that's the tagline actually that caught my attention when I found Texas State. But anyway, back to the story. I decided to make the switch. And academia was an obvious choice. I really liked doing research. Even though I was with the industry for 12 years, during that whole time it was research and development with two different companies. And coming back to academia was a way in which I could continue to do that, as well as, obviously, start to be able to teach and to transfer that knowledge to the students at the university.

Dr. Piner:

Texas State caught my attention because of, at the time, the emerging materials science, engineering, and commercialization program that was being developed, specifically the requirement in the faculty profile of having commercial experience. When I was looking at that time, that was very unique, and that caught my attention. And then as I got to learn more about Texas State, it became more exciting, and so I decided to join and continue doing the research that I had been, in the same area I should say, not the same type of research. But having to do with sensor technology. That's one aspect of the bigger picture that we're discussing here today, which is materials with intelligence.

Dan Seed:

And so for the average person, when we say materials with intelligence, what is that? What does that mean?

Dr. Piner:

Okay, so materials with intelligence, as I have envisioned it, because it can certainly morph with time, and it may, comprises basically three components: big data, sensor technology, and then sensor networking. And so within those areas, big data, that's the term that most people I think are familiar with, we as a society, as a species, are literally drowning in data. Some of the numbers are staggering. Just in the fact that as of 2018, I'm interested to see what 2019 comes out to be, but every minute of every day in the United States we're using 3 million gigabytes of data. 3 million gigabytes.

Dan Seed:

That's mind blowing.

Dr. Piner:

That's mind blowing. And that's just one example of many of that I could give you where there's just so much data being generated. This data is coming from a variety of sources, let's just call it sensors, that's bringing to the next step.

Dr. Piner:

Sensors are becoming extremely inexpensive and therefore ubiquitous. Many sensors we're aware of. A smart home push that's being brought about by a number of different companies and entities, is one that's very clear to us. That in and of itself is generating new data. Then other sensors that most people take for granted. For example, what I work in, one area specifically, the amplifiers in your cell phone, basically allowing the cell phone to talk to the cell tower and then creating that wireless network that we all know and mostly love, I guess. But yeah, so that's the second component.

Dr. Piner:

Then the third component is the networking. So once you have these new sensors... And by the way, what I do is new sensor technology. So advancing the capability of the current generation sensors as well as generating new sensing capabilities.

Dr. Piner:

And then the third area again is once you have those two new sensors, more data being generated, how do you put those together? How do you pick those needles out of the haystack, out of that big data haystack, once you have those sensors? How do you put to use these new sensors? Where can you place them? What benefit do they bring society? That's the networking side of it.

Dr. Piner:

And it turns out here at Texas State, we have about a third of what I'm calling a research active faculty, meaning the faculty who are receiving currently external funding from one source or another, working in these three areas. That's a huge percentage of the faculty base here at Texas State University. We have the critical mass to engage this materials with intelligent thrust.

Dan Seed:

So when you talk about advancing the technology, where are we looking toward? I mean what we have now is, it's fascinating what we're able to do, where our homes know when we're home, and what the temperature needs to be, and... That's just one example I think of my Nest thermostat, right?

Dr. Piner:

Right.

Dan Seed:

Where do you envision or see this going down the road?

Dr. Piner:

There's a number of different ways it can go. One area of particular interest to me is instead of these networks, these mass of ubiquitous, I'll call them passive sensors, meaning it's something that's collecting some sort of data and then either dumping it into a bigger database or going to some other hub, let's call it, and then eventually going to some place where it's then extracted and utilized. Why not embed some intelligence at that point of connection, if you will? And so instead of, again, we're talking billions and billions of gigabytes every minute of every day, just in the United States alone. Add some intelligence to that.

Dr. Piner:

So instead of just creating more and more data that we then got to go into and try to extract exactly what we need, why not have the sensor itself with some intelligence? And only send the data that's of importance, and maybe keep the rest for future use. If someone wants it then they can ask for it. Otherwise, don't put it somewhere where it's just growing this snowball over time and just making our lives, meaning the technologists who are trying to get in and make use of this, making it more and more difficult with every passing day literally.

Dan Seed:

It's like putting boxes in the garage and eventually there's no room to go and you don't know where anything is. Is that kind of what we're looking at here?

Dr. Piner:

Well, I guess a better version would be, it's not that there's not more room to grow, it's just that the room to grow is taking up more and more space and energy. Just as an example, some of these data centers that we're talking about, decisions like how much the electricity costs. And one story I've heard over in East Asia, it's not because they want to locate there because of cost of labor, it's because the electricity's cheap. And they've got access to relatively cold water. So it's easier to keep these sensors cool and the electricity doesn't cost a lot. So they just got this, banks of data, electronics racks, just collecting all this information.

Dr. Piner:

And so decisions like that are becoming important. But the reason they're becoming important, again, is because of this massive, this flood of data that's being generated by all of us. I mean, we're all contributing to it in some way or another.

Dan Seed:

And as you mentioned, it's a topic that the general public, or that people are aware of, this idea of big data and data out there. But when you talk about extracting data, what is it that we're looking for? I think that that's something that people may not be totally on board with understanding, right? When we hear this idea of extracting data, what are we pulling? What are we looking for?

Dr. Piner:

Well, first of all, I'll mention, so we have, again, a third of our faculty working in different areas. Specifically within the area that you're asking, this data extraction, we have a number of faculty specifically in the math department, as well as computer science who, their passion, their research, is in exactly that problem that you're asking about. Specifically how you do that, well, I'm not the expert there. But essentially at the highest level, the way to think about it is it's like any other computer science problem. You've got to write an algorithm. And so writing the most efficient algorithm, the right algorithm that's going to go in and find what you need, and only what you need, and give you good data. Any algorithm will give you something. Is it really good data that it's giving you?

Dr. Piner:

But to give you a specific example, so the GIS, the geospatial information system that folks in our geography department use routinely, NASA, for example, is collecting millions of gigabytes again. In fact, I think it's on the order of petabytes of data every year going into their database, that then assessable by researchers around the country and world. And so they're collecting all this data from satellites, from aerial, from airplanes, from drones, of the geography, geographical information.

Dan Seed:

Right.

Dr. Piner:

And then, so it's just being dumped again into NASA's database. How do you go in, if you're interested, for example, in land utilization around Houston after hurricane Harvey, how do you get at that? So you've got to write an algorithm to figure out some way through a mathematical approach of computer code to go in and get only what you need, exclude the rest, and then ensure that the data you're getting are good, not just any data.

Dan Seed:

It's mind blowing to think that there's just so much out there. You know, again, we realize that it's there, but it's one of those... Just to think of all the stuff that is being collected, and that is out there, and what's accessible and not, is really fascinating. And I think that that segues naturally into what your big idea proposal is.

Dr. Piner:

Correct. Yeah. So the big idea proposal that I have specifically is to effectively leverage this huge, I call it critical mass, of talent within the faculty pool here at Texas State. Again, when I say a third just to give you specific numbers, we're talking over 70 faculty and counting, growing. I mean that's a lot of the recent new faculty coming in and a variety of colleges are contributing to this area. Tapping into that resource, that critical mass resource, and getting those folks, helping them, facilitating their collaborations. I did a survey a couple of years back now under a special assignment through the president, to basically assess the research capabilities at Texas State University. And that's where I first discovered, if you will, all these faculty members working in this area.

Dr. Piner:

And the key is by and large, 95 plus percent of these faculty are working independently. We have our independent projects, we pursue our independent funding. I'm included in that group. And yet we're working in this same area. We were only peripherally aware of other folks working in this area. And so, one of the keys is to bring those folks together through what I see as a materials with intelligence research center, maybe even a research institute, institute meaning multiple centers falling under it, to help the collaboration, to help the dissemination of the knowledge being gained, and to help the interaction with the students. Again, at the end of the day-

Dan Seed:

Sure.

Dr. Piner:

We are an educational entity. And so helping facilitate that and doing even more with that critical mass resource that we have than we're currently being able to do.

Dan Seed:

So how would the center... You mentioned all the faculty that worked independently and they're now coming together. But how would the center put Texas State at the forefront of this research and this operation across the country and the world?

Dr. Piner:

Clearly, as we discussed previously, big data, home networking, those things are becoming, either they're either known or they're becoming more ubiquitous in society. So what I see Texas State's area of critical importance in this theme would be very much along the lines of applied research, and the application of what we're developing here within this materials with intelligence, or advanced sensor technology maybe. That's another term that we've, that has been used across campus for this endeavor. Addressing the problems that are near-term issues for society, and getting those innovations, getting that research conceived, completed, the innovation transferred within a relatively short period of time.

Dr. Piner:

Again, and not to belabor the point, but with 70 plus faculty, we have the resources that we need. And that also makes us unique, I believe, of a number of universities across the country who are either probably at this point just considering this as an opportunity. And those 70 are, again, working in that applied research area.

Dr. Piner:

So near-term problems that we can solve, get into the innovation areas, companies, startups, whatever that may be to help, again, benefit society. And so looking forward, again, if we can get these collaborations developed and do more with what we have, and then maybe even be strategic in terms of where we're going, which is what I like about the big ideas that's happening, or that just happened this past semester. And materials will intelligence was fortunate to be one of the ones selected for now assistance with university advancement. I see this growing and taking on a life of its own. And once that happens then it's like anything else. Once you get momentum behind it-

Dan Seed:

Right.

Dr. Piner:

Then it can really take off.

Dan Seed:

So I want to get into the future of this, and where we are now, and where we're going in terms of the project itself. But I do want to address, what are some of the near-term societal issues I think is how you termed it, with data that you're currently looking at and exploring?

Dr. Piner:

Well, one clear example that has transpired in the timeframe that I was working with the president to now, Texas State's new civil engineering program, which is literally, was birthed this semester. Our first cohort of undergraduates is on campus this semester. That whole program, that whole department now was conceived around the idea of technology enhanced infrastructure. That's a term that basically... Well one aspect of that term is embedded sensors within what is a field that's been around for more than a century, which is civil engineering.

Dan Seed:

Mm-hmm (affirmative).

Dr. Piner:

Civil engineering, I mean most people are familiar with that. It's basically how do we design and build roads, bridges, housing, apartments, buildings. It's again, an old engineering program, one of the early ones. But to distinguish from all of those other engineering programs around the state and nation, Texas State's program is being intentional about teaching our students the concept of embedded sensing.

Dr. Piner:

And so how does that benefit us, to your question? Well, instead of building a, let's call it a dumb road or a dumb bridge, why not imbed sensors in that road or that bridge that tell us things about traffic patterns while it's happening in real time? Or in the case of a bridge, give information about its structural integrity. Instead of having an inspector go out every five years, at best probably, to do a visual inspection and then look for the cracks that are forming, why not have the bridge tell you in advance, "Hey, I'm," either, "I'm doing okay. Hey, everything's good, no problems." Or, "Something just happened. I'm getting more stressed than I am designed to." And then send someone out to investigate what's the assignable cause.

Dr. Piner:

Same thing for the roads. Instead of waiting to fix the problems, be proactive about it. And so that's one area. And that... So our civil engineering program is designed, the curriculum is actually designed around embedding sensors. That's one area.

Dr. Piner:

And then there's a number of others that actually got kickstarted last semester, spring of 2019, under the umbrella of materials with intelligence that we could discuss if we have time.

Dan Seed:

Sure. Yeah, it's incredibly fascinating. And especially here in central Texas with all of the infrastructure road issues that we have, to be able to know traffic patterns and better assess roads and construction would be I think beneficial to all of us, especially those who commute up and down I35 everyday, like myself.

Dan Seed:

Getting back to the institute. So you mentioned that these 70 faculty members, you're collaborating more. Where are we with the creation of this and what's the end point I suppose? When do you want this thing launched and off the ground?

Dr. Piner:

So currently we have really been focusing on bringing the folks together, bringing those faculty together, and making them aware of each other's research. Specifically, we had a CoSearch event, I think back in March timeframe. And of those, at the time it was 66 now we're up to 70, over half of those faculty showed up on a Saturday at Star Park and gave their whole Saturday to this brainstorming, data gathering, get to know each other session.

Dr. Piner:

And out of that five teams were formed. And those five teams were tasked and are pursuing now the proposal, if you will, that then potentially could be funded, to be submitted to funding agencies, whether that's federal, state or local. And so, again, the key there was to get these faculty members who are mostly working independently aware of each other. And so from that the goal is in the near term, over the next few years, to get research funding up into the low millions, let's call it, in dollar range, primarily through these proposals that are being funded by external funding agencies.

Dr. Piner:

And then at the same time also being proactive at making people aware of this big initiative, this new initiative that we have at Texas State to generate additional funding. Whether that's philanthropic, federal, state, local, could be corporations.

Dan Seed:

Mm-hmm (affirmative).

Dr. Piner:

That's a big resource that we're looking to tap into and are currently pursuing. But anyway, get some funding coming in. And specifically, what do we need the funding for? Obviously to do the research. That's the easy one. But the key to, in my mind, the vision, the key to the center of the materials with intelligence center or institute, depending on how it finally ends up functioning, is to snowball those research funds. Meaning to exponentially grow them.

Dr. Piner:

So bring in the funding separate and distinct from the grants, let's call them, the funded support for specific research projects, to a general pool. And then allocate that to specific projects to faculty and supporting students, graduates and undergraduates alike, to continue to grow this. And so, keep the administrative costs as low as we can, but provide the infrastructural support to the faculty, whether it's grant specialists, admin to do, handle the paperwork things for them. Even interfacing, interacting with the funding agencies. Basically to make their lives easier so that they can focus on their passion again, which is the research that they want to do. That will then grow into a bigger research project-

Dan Seed:

Sure.

Dr. Piner:

Which will then, it self-perpetuates at some point.

Dan Seed:

Well, Dr. Eddie Piner, best of luck with advancing the ball forward, that snowball effect, in making this happen. And thank you for joining us today.

Dr. Piner:

Thank you.

Dan Seed:

All right. That was this latest episode of the Big Ideas podcast. I'm Dan Seed. Thanks for joining us, and we look forward to you joining us next time on our podcast. Thank you.

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