Episode 3 – R+D

Narrator: Welcome to *Ground Breaking: Where Consulting Meets Innovation*.

Jad Sobh: Welcome back to *Ground Breaking: Where Consulting Meets Innovation*. My name is Jad (pronounced jahd) Sobh (pronounced SOO-b).

Peter Nabhan: And I'm Peter (pronounced PEE-ter) Nabhan (pronounced N-bon). Jad and I work for ECS Group of Companies, a nationwide engineering consulting firm.

Jad Sobh: Today, we have brought on two industry experts offering their insights on the world of research and development, also known as R+D.

I want to just give a quick introduction about our extraordinary thought leaders, Dr. Oliver-Denzel Taylor is a geotechnical principal engineer at ECS and adjunct Professor at Mississippi State University with a robust career in geotechnical research, military service and academic leadership. focused on advancing R+D in his field.

Dr. Beena Ajmera is an assistant Professor at Iowa State University, an award winning civil engineer with expertise in geotechnical engineering and a mentor and leader in the geotechnical R+D academic community.

Welcome. It's great to have you all on your, our show. Let's just take a quick second. Oliver, did, did we miss anything? Are we good?

Oliver Taylor: The only thing that I could say that you could add to that would be that I am actually the head of head of R+D here at ECS. So if you want to throw that in there, you can.

Jad Sobh: All right, head of R+D at ECS. Beena, what about you? Did we get everything?

Beena Ajmera: I think you're good. Yeah, you're making me sound better than I actually am. So I think we're good.

Peter Nabhan: Excellent. All right. So I want to say again, thank you both for being on the show today. And I want to get us going with the basics.

We're talking about R+D on this episode. So Beena, I want to ask you the first question. How do you define research and development or for short R+D and why is it so important for our industry?

Beena Ajmera: So R+D can take many shapes and forms. I think, It's from an academic perspective. We tend to view it at this very theoretical, very basic.

You're trying to develop and come up with something new, but that's not really the case. R+D spans the entire spectr. It's how do you do something better? it's being inquisitive, inquisitive about something. It's, just trying to innovate. Even everyday things to try to make them easier, more efficient, to doing something extremely new and novel that's developing a new medicine to a new engineering way of doing something.

So I think it spans the whole spectr for the engineering community. I think it's very important because that's how we continue to advance. That's how we continue to make the workplace safer, to make. Infrastructure that's more sustainable. That's more resilient. that's how we continue to be a better profession is through the R+D process.

Peter Nabhan: Absolutely. Yeah. That sounds like R+D is the essence of us moving the industry forward. And if I hear you correctly, you feel like that's, that's at the core of a lot of things that we do. And I want to take it back to something that's more tangible for folks like us in, in, in this space. how have you used R+D in, in the past to create reliable testing procedures?

for let's say CMT or material testing.

Beena Ajmera: So I'll give a couple examples. I'll give one that's a little bit neaR+Dear to my heart right now, which is a temperature controlled, direct shear device. And it's interesting because there's a lot of, focus on work these days. Under the spectr of climate change and trying to deal with climate change.

And that's particularly important for us as civil engineers to try to look at how does climate change impact everything we're building all the materials we're working with and soils as something that I work with. so the. Temperature control direct shear device lets us do, very cheap, very quick tests on something that's already available in most commercial geotechnical labs.

It's allowing us to, gain some properties and insights into information that we were estimating or trying to use our judgment on. And we now have tangible measurements, which makes our designs. Better and safer and more economical. And it's good for both the people that are using that infrastructure as well as the owners that are putting that infrastructure in place.

Peter Nabhan: Absolutely. So you're essentially trying to project what could happen in a future scenario with climate change. And so your testing is more significant from that standpoint, which I think is very cool, very fascinating.

Jad Sobh: Yeah and these projects sound super important to constantly improving, you know, our construction materials testing abilities.

we've often heard of the term valley of death. you know, it's used to describe a challenging phase where promising research kind of struggles to transition, you know,

from the lab to commercial applications. Oliver, would you elaborate on why this occurs in R+D?

Oliver Taylor: Sure. I mean, the Valley of Death is, is kind of a, a nice nomenclature, if you will, for how do you take something from theoretical to practice, right?

So, a lot of R+D, when we think R+D, right? We think we lp it together, research and development. It's actually two different things. There's research and there and a separate component is development. So if we think about the valley of death and what it really is, it's where the research doesn't transition to development, which then doesn't transition to practice.

So you get something that is too complex for people to understand. It does not translate into practice. Therefore, it goes away. That's one problem or one avenue into the valley of death in which good ideas literally go to die. And that's where they will stay. They never materialize. One of the problems in the R+D field is you get people that are so niche or specific to their, focus of research that they don't want to give it up or make it something new, right?

They want to keep doing the same thing for and studying this very small and that research then never gets used. It's just all the knowledge is contained. So if you can't disseminate the knowledge, then you, it doesn't matter how good your idea is. It doesn't matter how great your widget is. It doesn't work.

It's no good. And that's really what the valley of death is. And the thing that I must stress here is when we talk R+D, there's a timeline associated with if I have a brand new novel idea, it will take typically 15 years to go from a concept to a theory to a prototype to a, entity and then into practice.

Right? So there's a 15 year timeframe. So when we talk about R+D and we're going to solve the problem. The problems of the future, we're talking 15 years in the future. So these are, you know, long term predictions that have immediate impact. So if you can't cross that valley of death, if you don't have that partnership between, industry and the R+D community, then it doesn't matter how great your idea is or what you're doing. It will never come to fruition.

Jad Sobh: So you're dealing with pretty expansive timelines as well as just risk and reward of, you know, research, not necessarily going as planned or maybe better than planned, you know and that kind of leads me into the, this next question, Oliver, which is, you know, how has working in R+D kind of changed your perspective on failure

Oliver Taylor: So R+D is a special field, if you will. it is anybody that wants to be in the R. and D. world and in the R. and D. community has to understand what Failure. R+D by its very nature does not have an answer at the end of it. We don't, we don't know what it is. If you know what the answer is ahead of time, it's a homework problem, right?

So you might as well just take the class, you know, get a grade at the end and hope you pass and go on with your life. Well, that's not what R+D is. R+D is you have no idea what you're going to find. You have a theory, or a concept and you're going to develop that concept to something that is testable.

You're going to test it. That testing, if, if you do it and design it correctly, you don't know the outcome. It is going to inform you and change your decision. Now that can result in a failure, which is one of my favorite things. because you learn more about the thing that you were actually studying than if it succeeded.

Right? So if you always succeeded. you're probably not doing anything innovative. There's a disconnect there, right? And I like to use one of my most favorite, personal examples, of failure in the R+D community. when I started, I was about mid level at this point. I got my, my first, Theoretical R+D project.

and that was on the mechanics of near surface soils. And I was, I would say arrogant enough, which is a trait you must have an R+D, that I could solve this problem. And this problem is we in the profession, we've thrown away the upper five feet of soil. We don't count it for anything because it's a really tough problem.

And I was like, Oh, I can solve that. Give me three years and a few million dollars. And I got it. No problem. So. I got it. I got the project. They funded me for three years, several million dollars to do it. And at the end of three years, I had to stand up in front of the entire community and go, I failed.

Everything that I tried, failed but here's why it failed. And that's the, that's the nature behind R+D is you can fail, but you need to learn something. And what I learned along the way was, these were all the gaps that I had to fill in. in order to even be able to study this type of material. And that got more research, more funding and more years to study and tackle this problem.

But I ended up having to go back to square one. I had to reinvent the testing equipment to even be able to study this problem. and, but that all came from failure. You have to realize that. 98 percent of R+D is a failure. You might have one good success in your career, but that doesn't mean that it's wasted.

It doesn't mean that you haven't made advances elsewhere. It just means that that concept. Was a failure. if I take, well, I'm going to take an idea, another example here. I'm and I'm not going to name names, but there was a certain, executive we'll, we'll call it, that was like, we should drill on Mars.

And that is a great, phenomenal idea. We should do that. That's a, that's an idea, right? So if I think about that. idea or that concept in an R+D setting, what are all the things that I have to solve before I can even get there, right? So my 15 year plan is to get out onto Mars doing coring, right, drilling.

completely automated, obviously. and what do we have to solve along those way? I think about all those advances that then between now and 15 years, if we were doing that work would be put everything from automated drilling to, better sample protection and undisturbed, behavior, right? So all these things that we would have to consider out, these are all zones along the way to solve a bigger goal.

And that's what R+D really is about. It may just be at the end of the day at 15 years, you know, well, we can't actually draw on Mars that that's just not going to happen, you know, either. We fundamentally don't know some physics or we don't have the appropriate technology, whatever the case may be.

But that doesn't, that means that that part was a failure. We didn't get there. But. All the things that we learned along the way, we're not. And that's what failure in R+D is really about. It's about pushing the boundaries. And if you're not failing, you're not pushing a boundary.

Jad Sobh: Gotcha. So you kind of talked about that, that personality trait, you know, character trait of arrogance, but what about using, you know, Maybe your creative or curious side to kind of, come up in R+D and use those as well.

Oliver Taylor: So in order to excel in R+D it takes a kind of a certain personality to trait Okay. The, you must have one, a thick skin and a willingness to fail. You will be told no more times in R+D than you could ever possibly think of. Right. I have told no to my kids when they were toddlers less times than I have been told no in the R+D world.

Right. So just keep that in mind. You must have a thick skin, but you also must be inquisitive Right. You have to have an innate desire to question everything that is being done. Right. You can't go into R+D with a mindset that these are solved anything. Right. So you have to have an inquisitive mind. You have to have an open mind.

You cannot go into R+D and say, all right, I am going to, Change this thing and it's going to work. And it all will be well, like I'm going to create the greatest widget ever. And that's not how R+D works. You can set out as a goal to do something, but you have to follow the scientific method, which is the really a third trait that you need to have is the willingness to, have enough self control to adhere to the scientific method, because that is the only thing that you actually have in R+D.

That is concrete. That that becomes your truth. If your scientific method falters in any way, you don't have a R+D. You've skewed or biased your results. So the person that can excel in R+D is one with a thick skin, one that is inquisitive in nature and one that is willing to adhere strictly to the scientific method.

Now, what I didn't mention, is anything about a degree or anything about an intelligence level or anything like that. R+D can come from anybody. And this is, you know, one of

the biggest misnomers out there, but R+D blanketly can come from anybody. One of the best researchers I've ever come across in my entire life.

Again, I'm not going to name names, but he is a, does not have a degree. at all, zero. Yet he intuitively, could understand complex physical processes that people with PhDs barely could keep up with. And it took me, when I was back in my old job, it took me three years of working with this individual to finally understand what he was describing to me and the physics behind it.

And it was incredibly complicated, incredibly complex. A lot of it, I didn't understand until I had to go and learn the material. But, you know, if you looked at him on paper, he would never be allowed near, you know, a chalkboard, but he's one of the most brilliant minds that I've come across. So one of the key things is, That's not a requirement for R+D.

Like the, the papers on the wall, the diplomas, that's not a requirement. Does it get you in the door? Yes. But is it a requirement? No. It's your innate characteristics.

Beena Ajmera: I also don't think that it's gonna, the diplomas on the wall, the and I think that, you know, what looks on paper to be a quote unquote good R+D person isn't necessarily what's going to make you successful, right?

It's not what's going to lead you to a breakthrough in the area or to advance the area in any way. I think it's that ability to say, okay, you said no to this. Let's try this. Or this didn't work out. Let's try this. Or, Hey, I got this really cool idea from the way an artist was doing something. Maybe it'll work in this engineering sense.

It's that ability to explore and connect different areas from whatever walks of life you're coming from That makes you I think a successful person in the R+D world.

Oliver Taylor: And one other thing One other thing I would like to stress here is that people who are innately driven into the field of R+D, cannot shut their brains off, right?

There's no off switch in your brain. and that's one of the, the key precursors, if you will, to knowing, am I, Going to be an R+D or would I be okay in this field or what? Right. So your brain never switches off. I can't tell you how many family vacations I've been at or kids sporting events or recitals, a whole nine yards where I'm like, Oh, wait a second.

This is phenomenal. I've had a mathematical breakthrough and everybody around me is like, really? You realize it's like two o'clock on a Sunday.

Peter Nabhan: It's not the time. It's not the time.

Oliver Taylor: Exactly. Now is not the time, right? You wake up in the middle of the night going Oh my goodness, I've just now solved this thing that's been bothering me for two months, right?

And and you have to go do it, right? It's, it's a compulsion, if you will. It's, it's a, a, not a nine to five job. And if you're okay with that, then that's the right field for you. but it is, it is very much a. You cannot shut this off because it is innate to you.

Peter Nabhan: That's true. And I think what both of you are describing sounds a lot like entrepreneurship, but in the scientific term, is that right?

Oliver Taylor: I think to a degree, yes. but the, the researchers out there, are very from entrepreneurship. in one key element. You're not driven by dollars and cents. You're not driven by an economic anything. The curiosity cannot be motivated by anything other than the sheer scientific, unknown, if you will, right?

the, the joy that you get is a, here is a, like, for example, a mathematical equation, right? How many people wake up in the morning and go, Math was awesome last night. I am like the super happiest person in the world. I don't care about this rollercoaster and theme park idea that you want to go to. I want to sit down and doodle out differential equations.

Beena Ajmera: I mean, I, I go to theme parks that I have, you know, Literature with me in my purse so that I could actually read it because the roller coaster might be a little too boring, right? It's just sitting there and it's like this is more exciting than the roller coaster is And I have people that can back me up that I actually do have literature with me when I go to a theme park.

Peter Nabhan: That makes honestly that makes me really happy that you both really enjoy what you do and it doesn't matter where you are You're you're always seeing the world in mathematical equations.

Beena Ajmera: Well, it's not just math, but it's seeing the world from that curiosity perspective. Oh, we know what's going on. I, my brother and I went to the beach not too long ago and I was sitting there looking at the, the anchoring that was done along some of the rock faces instead of paying attention to this supposedly calm beach.

And he's like, you're looking the wrong direction. The view is out that way. And so I think that's part of, you know, being an R+D is. your brain is never turned off.

Peter Nabhan: It feels like you always want to solve problems.

Oliver Taylor: Well, I, I, so I think it's, it's more not necessarily I want to solve a problem. I think the, it's a compulsion to solve a problem.

It's, it's not. It's not a one implies that this is something that I could turn off. It's not, it's a compulsion to solve it. And one of the, the greatest things about thinking or seeing the world in this way is and I tell my students in classes all the time, the answer is always found in nature, it's out there.

The answer is written in what's, what you can see, poke, prod, in, in observe, right? That's why there's a scientific method. The answer is there. It's how in tune are you to opening your eyes to see the answer for what it is and then being able to recreate that on a at will basis. And that's really, you know, when you talk about who is, who is a person for R+D, that's the person.

Peter Nabhan: So understanding that you're trying to understand nature around you. And at the same time, you're learning from nature on how to implement that same process to potentially solve other problems.

Oliver Taylor: Correct. And remember those problems are 15 years in the future. So you have to be something of a witch, right?

You're prophesizing the future. That's why, if I look at, The discipline of physics. I like using physics as a discipline for this exact reason. They bifurcated that discipline many, many, many, many years ago, well over 100 years ago, into you have theoretical physicists and then you have experimental physicists, your theoretical physicists.

You know, they're wandering around the woods coming up with like new dimensions. and [00:23:00] then your experimentalists are there to prove or disprove these different theories such that you can arrive at a, you know, more uniform, fundamental law or understanding.

Peter Nabhan: That makes a lot of sense. So now I want to open up to the both of you.

If you have any advice Let's say we have people at ECS or other listeners that want to get involved and engaged with R+D. What kind of advice are you able to provide to them?

Well, I'm going to say that I don't think, except for a natural curiosity, I don't think there's anything you need as a prerequisite to get engaged in R+D.

some of the best researchers in my group have been You know, high school and incoming freshmen that have no engineering training. They're just curious. They want to know how something works. They want to play with that. they want to, you know, poke and prod at something and [00:24:00] explore what it does. And I think, That makes them very excited.

I think part of the playing with it is kind of knowing where you want to go with that. And for that, I think you need a mentor, someone who's going to tell you, Hey, it's okay to

fail, but at the same time, help you explore some avenues, help you build that ability to continue to see the creativity and to see the innovation and what you're doing.

Peter Nabhan: So it's a combination. It sounds like it's a combination of. Mentorship and an ability to be curious, having people that will mentor you through the process and maybe seeking out those mentors. And how, how would you say you can find those mentors? Beena let's say someone, I mean, at the ECS, we have an R+D lead Oliver, but how would you be able to find them if you're just entering the industry?

Beena Ajmera: So I think there's a, there's a A little bit of you need to know what you want, right? You, there's no one who can sit there and mentor you [00:25:00] into the R+D world, right? You, that's not something that can be trained. It's something that you, it, like Oliver has already alluded to and I know I'm stealing his thunder, is that it's, it's a, It's a compulsion.

It's something you're very excited to do. And yes, there will be mentors that recognize that you have that desire and that curiosity and that willingness to keep pursuing something despite failing. And, you know, I'm lucky enough to be in the field because someone saw that in me and it would have taken me years before I realized this is where I was supposed to be.

But I also think it's a little bit of, if you have that, if you're self aware of that, Then you need to go and find people that are equally curious that are challenging Ideas that are doing things that interest you as well so you can work together collaborate And engage and you have to be willing to put in the effort To be mentored and find someone who's going to put in the effort to mentor you as [00:26:00] well, like someone who's willing to spend the time to guide you and to, to be your support system, to listen to you at, you know, 2 a m. when you come up with a crazy idea and say, I want to do this, but also at 2 a. m. when you just got your pteenth rejection on a paper and say, it's okay, you could, you can bounce back and try a different way.

Oliver Taylor: And I need to add to that, or else my compulsion is going to take over and it's going to be very bad for everybody.

the, the idea of a mentor is, is absolutely crucial. It is the gateway. Right? But as as a mentor and I would say anybody at ECS that wants to get into R+D can do that. They can contact me. open door policy for it. But, a mentor is not going to seek you out. I cannot go out and seek that R+D, the next generation of R+D, or the next individual.

That that just cannot happen because of the innate [00:27:00] characteristics that are required to thrive. So you have to take the initiative and most of R+D is you taking initiative on your own, but you have to take the initiative to find that mentor. But You have to come prepared. you cannot just come empty handed and be, I want to be an R+D.

So I like to put it in terms of, you have a 30 second elevator pitch. Imagine me trapped with you in an elevator going up to the 10th floor. This is how long you have to convince me that I need to listen to you.

And, you know, when I first started, I had the exact same thing I had, you know, literally on a clock on a timer, we had 30 minutes or 30 seconds to pitch an idea, right? Which you think about trying to pitch a complex problem in 30 seconds is a very, very daunting task. But if you can boil down your idea to 30 seconds, you have an idea.[00:28:00]

You've thought about this. You are somebody that I'm going to wake up to and go, hang on, wait a second. You've put a lot of effort into this. I want to hear your story. And that's how it starts, is you have to, somebody has to want to hear your story. and If you can get that part of your salesmanship down, you will find a mentor.

People will take notice. And you have to realize though, that you may come up and say, I got this great 32nd idea. Boom. Here it is. It's well polished. I, I nailed this one out of the park. And your mentor, may go, That is about the dbest thing I've ever heard, but I like you and you might go in a completely different direction.

so when I first started, I wrote 12 different proposals. And I handed them off to the person that was my mentor and they looked at them and in front of me [00:29:00] put all 12 of them in the trash can. To this day, they're, they're still in a trash somewhere. They're probably in a landfill, but you know, all my ideas at that time went straight to the trash and I was heartbroken.

I was like devastated. I was like, I have just, you know, I'm now out of a job. This is terrible. But that individual saw the potential in me and then was able to mentor me into this is how you refine those ideas. This is how you attack that research project. problem on a scale to get the funding necessary to do everything. So that person really did me a huge favor.

Beena Ajmera: One of the, one of the questions I asked prospective graduate students is, you know, what do they see themselves doing?

What projects interest them? And it's mostly for that elevator pitch. It's to see, do you have something you're passionate about? Do you have something that you've invested time [00:30:00] and effort into exploring to figure out what, Okay. Frontier needs to be pushed and it, it doesn't have to be, I don't have to think it's a good idea, but are you passionate enough about it for, for that to be there?

And I, that one question is enough for me to determine whether or not I want to take on that graduate student, because there are some graduate students that will come in and say, Oh, I can do anything and everything under the moon and put me on any project and I, I and I want to work on it. And, That's great.

Yes, you want to work on all these projects, but you don't have an actual desire to do anything. You, you're doing this because I'm telling you to do it, not because you want to do it. It, it goes back to that compulsion. And when a student comes to me and says, Hey, I did this, I failed at it, or I did this and I was successful at it.

It, it, it and I really want to expand it to do XYZ, it tells me that they're driven, that they have something that they're excited about, something that keeps them [00:31:00] awake at night or wakes them up in the middle of the night to write down a mathematical equation or anything else along those lines. And so those students are the ones where I'm like, I want you to be here.

I don't care what the grades are. I don't care what institution you're from. I don't care how famous or unfamous your advisor was or it's, do you have that innate desire to want to do that?

Peter Nabhan: And I think what you've just given us, Beena and Oliver, is a very good recipe for anyone looking to get into R+D, in my opinion, at least.

Jad Sobh: Thanks for listening to part one of our conversation with Beena and Oliver on research and development.

Be sure to listen to part two of this conversation coming next Wednesday.

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