Episode 3: R+D

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

Jad Sobh: Welcome back to *Ground Breaking: Where Consulting Meets Innovation*. We are happy to present part two of our conversation with Beena and Oliver on research and development. Let's jump right in.

Oliver Taylor: If I may, I want to add one thing and that is, what I would say.

Everybody thinks what an R+D person looks like and that's one of the biggest misconceptions that we need to get past is it's not some, old wizard or witch, or somebody hiding in an ivory tower with a tweed coat, that has never seen the sun for the last 30 years.

That misconception or misnomer needs to go away because it's what's going to inspire the next generation to join R+D. So, there is no right way to get into R+D. If you actually took my career and Beena's career, they are vastly different things. We ended up in the same spot, but there are vastly different ways to get there.

There's the more traditional academic route, Beena's route. Then there's my route, which was filled with life experiences. I had other careers before I ever got into R+D and I took all my life experiences and said, "You know what? I know these are wrong because I've had this happen to me."

And then I'm going to build R+D because I know these, these things occur, so it's not just necessarily, oh, well, you know, you're, you're 35 years old. You've, you've passed the option, right? Well, no, that's not true, That's about when I started R+D when I was 35. So it's not, you have to start when you're younger. You can start when you're, you're older.

Beena Ajmera: Sometimes you can go from that very traditional, you know, I'm going to go to school, get a job, go work and then suddenly discover the itch. And I think that when, when you discover that itch to do R+D, I think it's beneficial to everyone. if you actually explore it.

The other thing, one day, I would love to see is TV shows stop displaying the R+D person and that old white coat with the crazy glasses in a crazy laboratory trying to cook up evil schemes or whatever. I would love for that image to go away.

Jad Sobh: That's why things like this are so important so that we can kind of squash some of those, so to speak. So, we've talked about the expansive timelines and the world of possibilities that kind of already brings together. So, obviously, AI kind of plays into that world of possibilities, so Beena, how do you see advances in technology with AI and building information modeling being integrated into R+D?

Beena Ajmera: So, I think the key for any technology, whether that's AI, building information modeling or anything else that might be coming down the pipeline from 15 years ago, research that's going to show up on our door tomorrow. I think that the key here is the fact that none of that technology is going to replace human thought and going to replace the human ability to think outside.

Yes, it gives us tools that make our life easier, that advance the way we're doing things, but they can't be a replacement for the way humans think. And as long as we can, keep that in mind as long as we say, “Hey, yes, this new AI tool is great for writing lab reports.” But unless someone sits down and says, “Hey, that test doesn't look great, we should probably repeat it.” AI is never going to have that human judgment aspect that is going to make it a full proof method. It needs to have the human touch and the human-centric nature to it in order for it to keep advancing. As soon as that stops happening, which is very likely because we're all addicted to our cell phones and emails and all these cool tools, innovation stops.

I see that as the death of R+D coming. You know, people are like, “Oh, I can do that.” But no, AI needs someone to help it do those things.

Oliver Taylor: I'm going to go into my rant on AI,I do have a rant about this. I understand AI, all right. I dislike it immensely in that it takes away from innovation. It can be a tool to handle the big data problem that exists.

You're overwhelmed with information. A human gets overwhelmed very quickly. That is a tool. But it cannot and should not be used to replace the innovation because all AI at its very basis, is trained around a set of parameters. If those parameters for which it was trained are altered, changed or manipulated, then the AI system is no longer a reliable system.

So if I put all my faith into it, I'm going to pick up my phone and I'm going to go into my search bar and I'm going to type in; “I want the definition of the word widget.” It's going to spit out an answer. I have to have some confidence that that answer is actually correct. Well, if I changed the linguistics and I type in widget and it's like, oh yes, that's this, snow covered hill that you can ski down. Is that right? Well, I can change the parameters to get that. That's one of the cruxes of AI, reliance that gets to be.

So, we cannot be reliant on AI. We can we use it as a tool, yes, but we need to understand its limitations and the consequences of us using it.

Beena Ajmera: Adding to Oliver's rant here, AI kind of hit the academic institutions towards the beginning of last year, so like the fall 23 timeframe and the common conversations where “How do we prevent our students from using this?” “How do we know they're using it?” and so on and so forth, which I understand.

But I said, when Google came out, we were having these exact same conversations, that, “Oh, no, they have all this information at their fingertips, they're never going to learn anything.” I think the key for everyone, whether academia or industry or anybody else in between, is to realize that it's a tool just like Google is a tool. We need to learn how to use it properly with knowledge of its limitations, as Oliver said.

Peter Nabhan: Right. It's a good point. Use AI to amplify what you can do or like a force multiplier, but don't rely too heavily on it where it essentially takes away all your human creativity.

And I hope we don't reach that inflection point Beena, where AI takes over and nobody's thinking of any innovation.

Beena Ajmera: Well, I'm hoping there will be a few people that continue to keep thinking about it, but I also think now is the time to remind the younger generations that are very in tune with all these technologies to be like, they're great, but how can you use them to, as you said, amplify what you already know and all the talents that you possess and your inquisitive nature and everything else?

Peter Nabhan: Exactly. I was also going back to your test that takes into consideration future climate changes. Actually, I was very happy to hear that. So I wanted to dive a little bit deeper on that topic. How do you feel like these global trends that we're seeing, like climate change or maybe more urbanization, do you feel like they're influencing any R+D, for construction materials, for example?

Beena Ajmera: Well, yes, is the short answer, I think everything we do has to be put into the light of what's happening on a global scale.

And I think overall, not to get into politics, but overall, we need to stop thinking of problems within our boundaries. A natural disaster hits. It doesn't affect just us. It affects all the people, right? It affects all of our friends and colleagues and other places around family around the world. But it also affects things in our world.

So as urbanization or as you know war or whatever else happens that is, but the point is that all of the climate change, urbanization, everything is impacting the way we are building communities and our infrastructure. It's impacting infrastructure that already exists and we have to find a way to make sure that it doesn't fail and and lead to some major consequences that we then have to deal with.

It's also impacting what we're planning to do. Some of the resources that we want to use. Some of the ways that we're looking at stuff is changing and so we have to start thinking about that in terms of not the 15-year time frame, but more closely like what's happening in the next two years.

What's happening in the next five years and also what's happening in the next 15, 20, 50 years.

Peter Nabhan: You make a very solid point on just making sure that we have that vision and not necessarily politicize any R+D mission because ultimately it's going to help enhance the lives of all of us and not one person versus the next one.

And I'm happy that both of you actually are very visionary. So I'm going to give you a little bit of space, Oliver, to share maybe on that same topic and then we can jump into a little bit more collaboration.

Oliver Taylor: Okay. So I actually have strong opinions here, I am a relatively strong opinionated person, but, one thing that we have to recognize and understand with changes in the climate, whether that's, an economic climate or a physical climate, especially in the world of natural disasters, what we have come to use currently, the here and now was developed in a different world, a different set of parameters than is existing now and will exist in the future.

So the theories, the concepts, the approximations that were developed in, say, the sixties and seventies, which guide our construction industry today, the bedrock guidance is not the same conditions as now. They're not going to be the same conditions as what's in the future. So, we don't really know if what we have come to rely on as a society, forget the engineering profession, but as a society, what we've come to rely on.

We don't know if that's really still applicable today or if that's going to be applicable in the future. If we add the human element into this, that's our man-made disasters, if you will, we're kind of amplifying this problem, right? We're accelerating it. We're amplifying it. We need to have the R+D to adjust or adapt and overcome a lot of these problems because as Beena was saying correctly, It's a global effect.

It's not just, "Well, that's happening half a world away. Why do I care? It's not in my backyard." Well, actually, it does affect your backyard. We're stuck on the same big blue ball floating in space. We don't have another option, we need to be able to understand what is happening now, but also if I go and take this to the AEC industry, right, I need to know whether or not my next super cool design, iis actually a net positive or a net negative.

There are plenty of instances and I point to them all around the world. I won't pick on anybody, where an amazing building or amazing architecture or renewable energy processes, have actually ended up being a net harm to the local community. So it's created problems that we didn't think about.

We never thought that could be a problem. Well, it's a problem now and it needs a solution. So, the R+D world cannot be politicized, It cannot be shrunk. You need to

invest, not divest from it in order to be able to predict what's, what you might see and the solution to that. You have to get there.

Peter Nabhan: That was actually part of my next question. We're on this podcast, Beena; you're from the academic world, Oliver; you've done a little bit of everything, but now you're working in the industry. How do both of you see the future of that collaborative space for the academic institution, industry partners, maybe government agencies in order to advance R+D for material testing, for example, in the next 10, 15, 20 years?

Beena Ajmera: I think that it has to be collaborative. If you're doing things in silos, if you're sitting in your academic figurative ivory towers and working on things without actually engaging with the people that are putting this in practice and using it or seeing how it is failing or seeing what shortcomings it has, (notice my focus on the things that don't work.), then, that's the only way you can continue to advance. So I'll use them since we were talking about the temperature control director, I'll use that as an example. Oliver and I've chatted about this quite a bit. It's very easy for me to sit there and say, this is my device and I'm going to guard it in this room and nobody but my grad students is ever going to use it and it's going to be my intellectual property.

Yes, that's one way to go about approaching this, but it's not the way that benefits society. It's not the way that benefits the, the AEC industry. The way to do that is to say, “Hey, Oliver, I have this tool, you're doing projects related to this, how can I make it better?”

To be able to, hear from him that, “Hey, this is horrible and here's how you should fix it,” or “This is cool, but I wish it could do X, Y, Z,” that's the only way that we can continue to advance, is if we listen to each other's ideas and we don't take offense when somebody says something isn't good.

Peter Nabhan: The thick-skinned concept, Oliver, right?

Oliver Taylor: Yes, the very thick-skinned concept. To add to what Beena was saying, You have to understand that R+D, the problems that are in R+D now and in the future, are much bigger than you. I can be as arrogant as I want and say “I've got a massive brain, I know, I know, I know,” there are plenty of people out there. I can point to them again that are exactly like that, right? Like “I know because I am, Insert name,” or “I have been doing this for 50 years,” or whatever the case may be, but the problems that exist today are so much more complex that one person can't know the entirety of the solution.

It requires a collaboration with a vast different amount of people. I'm going to use a great project that I was involved with, one that I'm very proud of, when I was back with the government, we had a bunch of scientists together, right? And we were going to try and do something very simple.

And Simplistic thing was we're going to create a literal zone, which is nothing more like think about a beach, right? An intersection of land, water and air. We're going to set off some charges, so we can create some, disturbance or waves, all right, acoustical or physical waves. Then we're going to measure how that energy transforms as it goes, crossing between the water media to the sand media and the sand media to the air media or the water, whatever the direction of propagation is.

Not that none of that is really important. It was a really cool project. Awesome, I'm super excited that I was part of it, but the, what we learned from the very onset was that the acousticians could not talk to the geotechnical engineers, the hydrologists, or the geophysicists, all because our understanding of the linguistics, the terminology, was incorrect.

So we actually had to hire and bring in a linguist into a technical field just so the ivory tower specialists could sit and discuss and talk about the same thing. If you don't collaborate, that will never happen. So, it requires humility, to understand that you can't do it on your own. You need a partner. And the stronger the partnerships are, the better off everything will be.

So yes, the things of the future are going to require somebody from industry. They're going to require somebody from academia. They're going to require somebody from the federal system as well, which has an entirely different need, in order to come up with a collaborative solution that is actually worth something that's going to pass that valley of death. The other thing that you have to realize is when you set up these teams, you have to throw your ego out the window. I mean, it requires a certain degree of arrogance to do the work, to begin with, but you have to have enough to not have a bunch of what I would call “yes men.”

So if I have only underneath me, people that go, “Man, you are the smartest person, yes, yes, yes, yes, yes.” Eventually you're going to buy into that, is the only mantra you hear, That is the only mantra, you know. That becomes “I am always right,” and that's the end of innovation more so than AI, right?

AI is just that. AI can become the yes man to you. So, for a collaboration to happen, you have to have a multidisciplinary one, you have to have an across all spectrums of thought, people that are willing to say, “No, I think this,” but in a respectful way, you can't be, “No, it is this and only I know that it's this.” But be able to stand up for what you know, but also be open-minded to accept other people's knowledge and experience to come up with this other idea. So, you know, Beena has absolutely zero problems, in our collaborations of telling me that I am not only wrong, but I need to sit down and pay attention and maybe think about fuzzy bunnies in a corner. But it only works because of that.

If I only ever got from Beena, “Oh man, that's a great idea,” we would never have the strength of collaborations that we have, nor would we have the ability to tackle a lot of these complex ideas.

Beena Ajmera: And that's part of what's the fun in this, is again, part of being successful in R+D is being able to fail.

And so that means that someone has to at some point come to you and be able to say that's a stupid idea or you're crazy, we should try this. Being able to do that is and being able to accept that is what's going to allow R+D to progress in the future. Whether that's In how we use AI or what I think we really need.

I'm sure Oliver will agree with me, is a revisit of all of our basics, going back and looking at how do we define strength and reexamining that and being able to, as a profession, not be hurt when someone questions what we have “accepted” as a truth in the field.

And as was said earlier, what we know, the parameters that we're dealing with today are not what we had in the 1960s or even in, 2020 or in the early 2000s, that, hey, that's not the situation we're dealing with. The world in front of us is unprecedented. Experiencing changes we've never seen before.

And that also means we have to rethink the way we've done everything. And so going back, if you get a paper that you're reviewing that says, hey, your approach to this was great six years ago, but it doesn't work now, shouldn't be offensive to you that, Hey, it served the community well for six years, but it's time to re-envision it. I think that's how we're going to be successful.

Jad Sobh: I tell you what, with everything that we've kind of been over today, I feel like maybe doing just one podcast episode might not have been enough. I feel like we should have done a two, three or maybe 4-part series because I feel like we just kind of scratched the surface with a lot of this stuff.

But before we wrap up, once again, thank you to both of you for being here today. We, might need to revisit some of these for sure, but we kind of like to end our podcast with one question. It's going to go to both of you and to preface it; it can be from either your professional or your personal life.

But can you tell us something in your life that has been groundbreaking? Oliver? Let's have you kick it off.

Oliver Taylor: That's been groundbreaking? Wow, so there's a lot to point at here. I have been very fortunate in my life. I have stumbled on through a lot of things, I know Beena will, agree to some of these that have been uniquely groundbreaking, that are just mind-blowing, but I would say, the one thing, if you're going to nail me down, what do I think the coolest thing that I've ever done, the most unique and groundbreaking, was, I broke the physics behind sand.

The physics behind sand is that, a dry sand cannot stand by itself, unsupported, hold weight and have no deformation. It is a bedrock principle of the definition of what sand

is. It is a granular material, but one of the things that I was able to do was not only, show that you could have a column of sand that has no cementation, no water, nothing, just sand particles, natural material that can stand on its own and hold weight. When I say hold weight, I was able to get one set, to, I've never actually been able to load it to breaking, I've even put humans on top of it. And these aren't like, you know, large giant blocks. These are two-and-a-half-inch diameter standard specimens.

Being able to then pick that specimen up, which you're not supposed to be able to do, invert it, put it back down on the table, load it back up again and have the same things happen, that was probably if I had to say what it was, my most groundbreaking thing that I'm proud of.

It's not the equipment that I patented. It's not, you know, other things that I have done. It's really this because it was a fundamental breaking of everything that we held true. And It's repeatable. It can be done with any of the granular materials out there. It does not require all the things that from my discipline, I was told from all the years I've been in school are required, so it changes fundamentally how we have to look at these systems and these materials. So, for me, I'm going to pick, but that's the one I would say is the most unique and the most groundbreaking, in that it should never have been.

Peter Nabhan: I think, Oliver; thank you for sharing that. I think we can call it “sand breaking” now instead of Ground Breaking. Beena, I'd love to hear yours, please.

Beena Ajmera: So I think I agree with Oliver that there's a lot of things that come to mind when it comes to groundbreaking and considering this. My arrogance is that I think all the research I do is amazing, but that's a different story because there are a bunch of failures along the way that helped me get to that point.

I couldn't pick one in two different worlds between personal and professional, so I'm going to give you an example of both of them because I think they're equally important, if that's okay.

I think I'll start with the the professional one a little bit more, following Oliver here. But I think for me it was just changing the way we think about, strength in clay. What I mean by that is that you know, sands will liquefy. They will completely lose their strength. You know, we see these pictures of the cars, you know, sinking into the sand, the buildings, you know, into the sand and you see, it's very well accepted that sands can completely lose their strength.

“If sands can lose their strength, why can't clays?” Clays are a different type of material and everyone seems to have, or seem to have this preconceived notion that clays will not lose strength. They will remain stable in an earthquake condition. Proving that wrong, was, I think, one of my bigger achievements so far. Yes, clays do lose strength to some degree, maybe not completely lose strength, but those impacts can be substantial and to run the experiments to show that and to demonstrate that led to a lot of different cool things. I'm very excited to be able to be part of that.

But as I was thinking back about being able to get into the R+D world and what it means to be in R+D and mentors over the podcast, I would say that none of that would have been possible without having a mentor that changed the way I thought.

So I think the groundbreaking part on the personal side is having a mentor find me, because I don't think I would have thought about R+D until much later in my career when I was bored at an office desk in the industry. To me that would have been a boring job. I don't think I would have realized I liked or enjoyed R+D as much as I did or had as much fun in my career so far had it not been for someone coming to me and saying, “I think you should do research” and to give me that opportunity and to recognize that in me beforehand. And it doesn't always happen. I think that was very groundbreaking for me personally.

Jad Sobh: That's good stuff. You know, like we like to say, that's definitely “Ground Breaking” or, as Oliver and Peter have now coined, “sand breaking,” so once again, just thank you so, so much to both of you. You know, it was a delight having both of you on the podcast today.

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