EPISODE 1187

[INTRODUCTION]

[00:00:00] JM: Agriculture infrastructure allows plants such as corn, soy and wheat to move from large scale farms to consumers around the world. The relevant players in the agriculture infrastructure includes growers, shippers and planners. These individuals need new technology to interact more efficiently. Growers need to be able to connect more smoothly with buyers. Farmers need better management of their carbon credits. Microbial technology can allow plants to be better shielded from tough conditions. Agricultural health, transport, commerce and logistics are all problems that Indigo Agriculture is focused on solving.

David Potere is a head of GeoInnovation at Indigo and he joins the show to talk about the problems that the company is solving and the engineering practices at indigo.

[INTERVIEW]

[00:00:54] JM: David, welcome to the show.

[00:00:55] DP: It's great to be here, Jeff.

[00:00:57] JM: We're talking today about Indigo Agriculture. Can you describe what Indigo AG does for people who are hearing about this for the first time?

[00:01:03] DP: For sure. Our mission at Indigo AG is to harness nature to sustainably feed the planet. And to break that down a little bit, we're helping farmers become carbon farmers, Jeff, and along the way we're helping them bring their grain to market in new ways.

[00:01:21] JM: And what does that have to do with software engineering?

[00:01:23] DP: Well, a whole lot, if we're doing it right. The challenge that we face in the team that I lead, GeoInnovation, is we're essentially trying to build Google Maps for agriculture. We're trying to build a living map of the food system and we're doing that because essentially the industry that we're trying to innovate in is the biggest, oldest factory in the world, and there isn't a particularly good map of all the different rooms in the factory. And so to kind of scale almost anything that we're up against at Indigo, we need to build digital systems for recording where farming happens and making it really efficient to sort of watch the harvest play out.

[00:02:04] JM: Can you tell me a little bit more about that supply chain that needs to be mapped?

[00:02:09] DP: For sure. I think, Jeff, the challenge starts with the production side of the chain. So if you start all the way back at where food comes from, those basics are not well constrained. So just to give you a sense of it, if you ask the question, “Where are all the farm fields in the world?” That's not an easily answered question. It turns out that we don't have a good digital up-to-date system of where all the field boundaries start and stop. And that's sort of the very beginning of the supply chain, is that fundamental activity around the farmer's natural experiment that happens every year of, “What will I plant? Where will I plant it and how will I cultivate it through to harvest?” Those decisions and the map that farmers use to make them is essentially uncharted at sort of a national scale. There're a lot of units of analysis, right? We're talking about you know essentially 1 billion farmers and 40% of the earth's land surface involved in this production activity. So that's kind of at the very beginning of the value chain.

[00:03:15] JM: And what are some of the opportunities for improving the efficiency of that e-value, of that supply chain?

[00:03:21] DP: Yeah. I mean, and I didn't really answer your first question, right? Which you were asking about the whole chain. I just got fired up about the first rung in the ladder, because we spend a lot of our energy there. But as a company, Indigo is worried about the whole chain. So just to give you – If you can give me one more minute on that, Jeff, I think from

the time that the farmer grows that grain and all the decisions they're making around how to cultivate the land wisely, then comes the harvest moment, right? And then the grain has to make it to market. So there's a whole complex network of transport decisions that get made to bring the food that we eat. Or what a lot of people forget, most of the calories that are made in the world are not for human consumption, right? The vast majority of it is going to animal feed or other uses like ethanol, changing the fuel that we put in our tanks.

Yeah. And so there's just a ton of that logistics decision making that has to happen. That's a really complex operations research problem. Then it arrives at aggregators and processors and eventually into the food manufacturers for direct consumption or some of those other end users. And a lot of times that involves international transport. We're talking about shipping flows between countries in large vessels. So it's a pretty complex chain. We just built an AG information supply chain at Indigo as part of a strategy project. It started as an idea in the engineering and technology group, and in the end, the final output, you have to print it out four-feet by six-feet, Jeff, and it's nine point – To sort of just follow the information flow that's underneath the physical supply chain for our food.

[00:05:01] JM: What kind of work is involved in creating this map of the supply chain?

[00:05:07] DP: Well, it does start with that simple first question. I think some of the coolest questions are the simplest to ask. That simple first question of where is food grown? So you need a reliable map of where food is grown. And the trick is – And I have experience before starting my company, Tellus Labs, and before we sold Tellus Labs to Indigo, I was doing a lot of retail work as a consultant, Jeff. And there the spatial problem was where are all the retail stores?

And that problem, for instance, mapping – What Google Maps does for us. Knowing all the places that we live and work and play, which we all take for granted, right, Jeff? I mean we expect to be able to use Uber to get from place, from point A to point B. That's all fairly recent. That's only about 15 years that that tech has happened. And that tech of knowing where all the places are for the consumer world, that hasn't been built yet for the farming world.

So try to search for winter wheat in Kansas in Google. You're not going to get very many results. Try to take a flight on Google Earth and look for the boundaries of fields and you can eyeball them with the imagery, but no one's ever translated those images into the kind of higher order modeled objects that are the boundaries of the fields. So essentially there is no Zillow for farmland. And that underlying layer, that first point of show me all the places where farming happens, has to get built for us to make any progress.

And the challenge, one of the reasons – It may be reasonable to ask why has that not been built? It sounds like the kind of problem that someone like Google would have gone against in the push around maps, which is arguably one of the coolest, biggest mapping projects ever undertaken. And the reason is that those boundaries change on a daily basis, right? Essentially, every season farmers are making different decisions.

[00:07:13] JM: So this logistics and mapping part of your business is just one facet of it. There's also this push to improve sustainability and microbial science work to improve yields. Can you tell me a little bit more about the other parts of your business?

[00:07:31] DP: For sure. You can tell I get most fired up around the mapping problem. We certainly need to solve that to make any progress. But if we step back a little bit on what Indigo's doing, you can think about the business in two clusters. And you mentioned the really important one, the one that we started with as a company, which is crop production. The second half of the business at Indigo is crop marketing. So essentially taking the crop to market, matching buyers and sellers and making the transport work.

So let's start, as you suggest, over on the production side of the house. Indigo is pushing hard on two sort of exponential technologies. One is the plant microbiome. And so that's how Indigo was founded. And the insight is that the same healthy microbes that we sometimes use as humans like healthy gut microbes that help our bodies and our human health and can have big impacts on human health, plants are no different. Plants have a really complex ecosystem of

microbes living inside the plant and next to the plant in the soil that really help make plants who they are and help make them successful. And it's essentially a very unexplored frontier.

So what Indigo does is we travel all over the world. And in any field that's undergoing a stress event, drought, or flood, there's always a survivor plant. There's always a small set of plants that do unreasonably well. And we harvest those plants and the soil around them and the plants nearby that didn't do so well and we essentially pull out all of the microbes that are in those ecosystems and identify these healthy microbes that are having beneficial effects on the plant. So they're helping the plant use water better. Uptake nutrients better and help them survive in stress conditions. We amplify those and we coat seeds with those or offer seed coating technologies so that farmers can put those healthy microbes in the ground in the places where the crops need them. So that's one part of crop production that's really important to Indigo.

And all those problems I talked about around understanding at scale, where farming is happening, monitoring that farming from space every day using satellite technology, is really important for Indigo to understand which microbes to promote and how to best pair microbes to the right soil conditions, the right farm at the right time. And half the trick is really selling in those microbes in the places where they have the most benefit, the most potential to do helpful things.

And then the second side of our business for crop production systems is this new one I talked about around helping farmers become carbon farmers. And what's remarkable, Jeff, is that whether farmers know it or not, they're all carbon farmers to some degree. So just doing the photosynthesis that you and i learned about in grade school, it's a pretty important force for helping farmers become part of the solution in climate change. And the idea is that plants, as part of the photosynthesis process, are converting carbon dioxide into soil organic carbon and there are practices, a bundle of practices, which are old practices that we're helping farmers to rediscover, are designed to boost the amount of soil carbon that is stored and retained in the soils. And what we discovered at Indigo is that if we can help a large movement of farmers migrate to these beneficial practices, then that is an enormous potential for sequestering

carbon dioxide in a long-term way into our soils. And there's all kinds of other benefits. So it helps those crops be more resilient to flooding and drought, which is something that everybody has to worry about because climate change is real. And it also has health benefits for us as consumers. So that bundle of practices we call it regenerative agriculture. And if we have time, Jeff, we can talk a little bit about what those big three are all about.

[00:11:27] JM: Yeah. I think all that would be interesting to dive into, although what I'm most interested in is the software side of things. So the improvements in carbon sustainability, for example, how do you use software to facilitate that?

[00:11:41] DP: I mean the first statement is you absolutely have to use software solutions for everything I've been talking about. So nowhere more so than in carbon. So the challenge for carbon to allow farmers to participate in a reliable way in carbon sequestration, you have to document the sequestration of the carbon. So it's essentially a data activity, Jeff. In the sense, it's different than cash crop production where at the end of the season you have grain and you can physically take it to market, weigh it at an elevator and know what came out of the ground.

For soil organic carbon, we have to model the presence of that carbon and test it at thousands of test locations all over the country. And so we build mobile apps to arm our field team to go out into the world and collect thousands and thousands of soil samples and the data around the location of those soil samples that helps us tie the soil sampling to the way that ground looks from overhead for training data. There's a whole mobile apps team around equipping human field tech resources with a flexible enough protocol that they can do their work well.

And then of course there's a farmer-facing software development effort around creating mobile and web apps that make it easy for farmers to help record the farm practice information around what they're planting, when they're planting it. Those practices I mentioned around cover cropping and tillage, they have to document those activities. And then we need software systems and tools to monitor, surveil from the outside those farmer claims as an auditing system. So a farmer says that I planted a cover crop, which is essentially, for instance, a grass crop that grows in the winter time to keep the ground from getting bare. We then use a satellite

from overhead and satellite software technology to process a view of that ground on orbit and translate that into an event that we detect from overhead that verifies or calls into question a farmer claim.

And that whole bundle of observation software systems, farmer-facing, data entry systems and the systems that face into the human field force and the machine field force, there's a whole IoT component to this, Jeff, around the tractors, combines, sprayers and planters that are creating machine data files on what they do on the ground. If we do it all well, it should feel a little bit like turbo tax. So it's that same experience of all the documentation and preparation work, semi-automating and automating as much of that as possible to take the pain out of complying with the protocol for the farmer to drive the costs down both physical costs and time costs to participate in a carbon program. And then to give the registries who essentially validate the value of these credits. Give them the confidence they need to stand behind the credits and allow governments and large corporates to buy into credits with confidence. So that's sort of the system of technologies that we're talking about to make this all happen.

And I should say, the last, most important software component I didn't mention is we actually have to model that soil organic carbon itself. So we have to simulate the soil properties with complex modeling software to allow us to infer what the carbon storage, what essentially the carbon budget looks like below the ground. And then we validate those models with physical samples. So it's a really complex system of software that's required to deliver these credits scalably.

[00:15:25] JM: To measure the carbon uptake of the soil, do you have to physically go on site to take a soil sample?

[00:15:35] DP: Well, you do if you want to have the most accurate read of soil possible. Of course, the challenge, Jeff, is if you did that on every farm field on the planet, the carbon footprint of driving out to all those fields and taking all that soil every year might exceed the amount of carbon sequestration you would do. So what you have to do is you have to have a tiered approach. You have to have sentinel fields scattered throughout the country where you

are doing intensive soil collection, sending that soil to a laboratory to identify the carbon with a very high accuracy.

And then you have a complementary technology, which is modeling technology, that uses satellite observations, weather data and other farm practice information from the farmer and essentially simulates the plant growth and the carbon sequestration. And that simulation technology is what allows you to take a small fraction of fields for physical sampling and make conclusions about millions and millions of acres. And that unlock the power of that technology is what's allowed – That modeling technology is what's allowing agricultural soil carbon sequestration to become a thing. Without that key step, it was just too burdensome to imagine a universal soil sampling program.

For instance, there are more than three million farm fields in the United States alone. So just the amount of soil and testing that it would be required to do that physically every year makes it not possible. You need this modeling software technology.

[00:17:11] JM: Tell me a little bit more about the company from a high level. Like how do you have your teams arranged? How many engineers do you have? Stuff like that?

[00:17:19] DP: So our overall technology group is order of 400 folks. And about half of those are software developers. And I mentioned that Indigo has two major business programs, one around crop production and one around crop marketing. And that's roughly reflected in the way we organize our software technology organization. So we have a team that's very focused around agronomic data and systems and supporting both the design and invention of the microbes that matter most, deploying those microbes well, and all of that carbon technology that I just talked about in a module around crop production.

And then right next to it, sitting right next to it is a team of engineers and modules, squads that are oriented around grain marketing. We haven't talked much about that. But the short story on grain marketing is that aspect of the business, the farmers activity around selling the grain that

they harvest to the best buyer is a very analog process today. Farmers largely call the elevator that's nearest them, have relationships with that elevator and make that match.

And essentially what we're doing is building a set of marketplace services to help actors in the market make a more efficient market. Helping those matches happen much further afield than they normally would before. Helping buyers of grain create marketplace experiences that give buyers a lot more context and information around their bids and allowing growers to shop just a much wider range of potential buyers.

And part of that innovation connects right into the heart of the crop production tech I just talked about, because one of the big unlocks in grain marketing is helping buyers and sellers match on data attributes other than just commodity. So not just yellow number two corn, Jeff, but, say, yellow number two corn grown with a high efficiency irrigation system by a female owned farmer in Wisconsin. Those extra attributes are of high interest to other actors in the food system so that you and I as consumers can start to buy food that's less commodity. Buy food that reflects more our preferences as consumers. And that data inflow between those two hubs, the crop production and the crop marketing hub, that system of connectivity is probably the third major element for us as an engineering group is an underlying infrastructure that allows efficient passing of field level attributes from these farms and aggregating that for buyers and sellers of grain. The technology that I'm responsible for is called Atlas, and it's essentially that connective tissue between those two halves of the business.

[00:20:12] JM: So that's a large engineering team. I'd love to know about some of the selection of technologies and infrastructure decisions.

[00:20:20] DP: Yeah. I mean it's a large group. And Indigo is not a new company either. We've been at it for about five years now, Jeff. I can speak most to the part of the technology stack that I worry about most, the geospatial technology stack. And there, in the Atlas program, it is primarily a Python shop. And we work really hard in the GeoInnovation team to bring forward engineers and data scientists that sort of operate across that barrier between data science and engineering. So bringing forward engineers who are excited and ready to meet data scientists

kind of more than halfway around taking code off the lab bench, and then vice versa, hiring data scientists that are really comfortable coding and with some of the scalable technologies that are required to handle that just terabytes and terabytes of high velocity satellite data that we have to process every day.

[00:21:20] JM: What's your choice of cloud provider?

[00:21:23] DP: So we're a multi-cloud shop, but we do a lot of our work in AWS.

[00:21:29] JM: So let's take a top-down approach. If I'm a farmer, how am I using Indigo?

[00:21:34] DP: Sure. So if you're a farmer and you're interested in unlocking the potential of your land to store carbon and you'd like to be paid for carbon credits, then you're working with carbons with Indigo's carbon business. And the way that works is we have a web app where you would register your farm, the places that you farm down to the field level, and check to see whether the activities you're doing or some of the activities you could do could make you eligible for a carbon credit. And then you participate with us throughout the growing season, sharing some of the practice decisions you're making like when you planted corn, when you harvested corn, the kind of cover crop that you planted in between seasons. And that information is collected by our team. And based on that information and those modeling systems that I talked about, we assess how much soil organic carbon you've stored and then you're paid for a carbon credit, and Indigo's on either sides of that deal. So we're working with large corporates to facilitate their purchase of credits and then we're paying farmers who are part of that campaign, that season. So we're in the middle right now of our 2020 carbon season.

So that's one way as a farmer you would work with Indigo and the software you would be experiencing directly, that UI experience you'd have would be the carbon web app. You can also buy microbiologicals from us. You could buy those biological products, the coated seeds that I talked about. And there you would have experiences around the physical purchase of that hardware and the placement support on that hardware. And then when it comes time to

marketing your grain, to finding a buyer for your grain, you would work with Indigo Marketplace. A mobile and web app that helps you to identify buyers of grain near you. Think kind of like a kayak experience to identify some of the best deals in time and place near you. So we're checking through billions of potential combinations of over-road routings to get the grain from your farm to a delivery point and the daily changing price being offered by the many, many buyers in the system and kind of optimizing all of that to show you on a daily basis where some of the best deals are. And you can use that technology after registering your business all the way through to doing a transaction, to agreeing to sell that grain, to pricing that grain, to take some of the risk out of that transaction. Some of the risk that comes from fluctuations in the futures market.

On the other side of the deal, if you're a major buyer of grain, you can work with that same marketplace technology to help make your buying operation show up in the way that makes sense and advertise those bids in the right way to the farmers near you. Make good, smart decisions around the way that you buy grain. And I should say I've left out Indigo Transport, which is a really important adjacent business to the marketplace to the crop marketing side of the house, which is an operation that helps carriers and shippers efficiently identify loads to move grain to market.

And that's really important, Jeff, because a lot of the value in really unlocking the efficiency of the grain marketing system is better matching the carrier, the movement of grain. And what's really important there for a lot of farmers is in some cases delivering grain further than they've ever thought about delivering it. And so we realized early on that some kind of a transport solution, essentially like an Uber for grain freight moving, was going to be really important to really unlock the full potential in the network.

[00:25:20] JM: So the idea of an Uber for grain freight shipment is definitely really appealing. But to me it seems like a lot of the constituency who would be a player in this market, like the grain silo operators, or the farmers, they're not as technologically sophisticated necessarily. I could be totally wrong about that. Forgive me if I'm like a Silicon Valley person making

sweeping generalizations. But can you onboard those people into your marketplace effectively?

[00:25:57] DP: Well, I will say I understand where that comes from, Jeff. And I have been surprised. So I've been at it for about five seasons. I'm not a farmer by background. And I've been in the AG tech space now for about five seasons. It's pretty remarkable how much advanced technology has been deployed around grain production. So there's decades of investment around tractor technology and planter technology, and of course like just the technology that it takes to advance seeds. So there's a lot of tech savviness and tech on the crop production side of the house.

I would say when it comes to grain marketing, and that includes transport, to your question, Jeff. It still feels pretty early days. And there's a lot of analog activity there. So you're probably right in some sense on that estimate of things. And a lot of that has to do with the scale of the operation. There's a very specific kind of truck that we're talking about. It's called a hopper truck. You've seen them before. They have that kind of funnel arrangement that allows grain to be poured in from the top and then it comes out through a couple of funnels at the bottom. Those are specialized rigs. And the fleets tend to be fairly small. And so there just hasn't been an amazing business case up until now to kind of digitize a lot of those operations. And a lot of the consumers of that kind of transport include things like gravel and fertilizer and those kinds of operations are not as digitized as well on the demand side.

And so both supply, the people that can move with these hopper trucks and the demand tends to be fairly analog. So there's a ton of opportunity right now to kind of unlock loads that people have never imagined before. You're right. There's a challenge around digitization. But I think that's where smartphones come in, right? And so just the prevalence of smartphone means that by deploying the right android and iOS apps, all the drivers of these vehicles are using those apps. And so there's a nice ability via a mobile app bring through a lot of the position information that you need to start to digitize the fleet.

And the same thing goes with the web app technologies that are used at the larger centers of demand and supply. And there there are digital workflows in place there. So that's a less dry area when it comes to sort of tech readiness.

[00:28:20] JM: So as you said, you have a marketplace for buying and selling grain. Now, there have been marketplaces for grain buying and selling for a long time. I mean the whole futures market, derivatives market relies on this. What's new about the marketplace that you've built?

[00:28:39] DP: Yeah. It's been an adventure for a lot of us in the technology team. So I mentioned there's about 400 people all together, if you think about data scientists, product folks, software developers at Indigo work in this problem. And a lot of us are a few seasons in, right? So in a relative sense, fairly new to this space.

I think one of the eye openers for me as I started to learn about this sector is that the futures market that you're referring to, that is very old. I mean it probably goes back in a way 20,000 years, right? As long as we've been doing agriculture, we've had a way to try to take risk out. And the reason is that every season is a random number generator in terms of weather. So there's a tremendous amount of volatility in agricultural commodities. It's one of the most volatile asset classes in the world. It's obviously one of the biggest ones, right? We all eat.

And so we've found ways, market mechanisms, like the ones you mentioned, the futures market, to help manage risk at the system level. And so things like the Chicago Mercantile Exchange, one of the oldest, most important futures markets in the world, that system helps mitigate risk around country level crop failures and surprises and it allows people to offload risk by trading in futures.

What is new and coming, and this is sort of inevitable. Indigo's going to be a part of this transformation. Is what's called cash grain marketplaces. And that's the marketplaces where physical the producers of grain. The farmers are physically agreeing on contracts to move their grain to a buyer facility at a certain date with a certain quality specification. Those

marketplaces to match the physical cash buyers of grain are quite analog processes, very primitive with a lot of the inefficiencies that come with primitive analog processes.

These matches are happening across millions of farmers and tens of thousands of buy facilities. And you'd be pretty surprised how dated some of the technology is that makes those transactions happen. So that's the system that's new on the scene. And it's that system that's really important if we want to de-commoditize agriculture. Nobody wants to eat commodity food. And the way you get specialty characteristics into our food is you have to capture at the moment the food is being created, and that's for food and fiber, the cotton that we wear as well. You have to capture a bundle of attributes about the choices the farmer is making and the environment that the food is being grown in. And you have to capture the identity of that all the way through the food value chain, all the way through to the box of cereal, the tank of ethanol or the North Face jacket. And that acid trace all the way back to the production moment. That's the unlock, and no one has ever built systems that do that reliably in at scale. And I was surprised when I heard that. I mean it seems strange to be in 2020 and not have software systems and tools for creating that kind of traceback.

[00:31:38] JM: Do you have a sense of why that technology doesn't exist yet?

[00:31:42] DP: There are barriers, yeah. I mean I'd say, one, let's start at the beginning of the value chain around the farm field. So we're standing on a farm field together, you and I. Recording, each season that farmer is making 60 important decisions at least to grow that crop. These are really entrepreneurs, Jeff, these farmers, right? They have to be mechanics. They have to know a lot about biology. They have to understand meteorology and agronomy, and then they have to understand futures markets and trading to trade that grain well. So they're solving a really complex problem every season. They're making many, many decisions, 60 to 100, and they're making those decisions for each field. Many of these operators are farming on dozens to hundreds of fields. And then even within fields they're making different choices with management zones.

So there are tens of thousands of decisions in the farmer decision space each season. And those are the things that I'm talking about that need to be captured efficiently, summarized and reduced and then kind of attached to the physical grain. So that's hard. That data capture is a hard problem. It's all happening out in the real world with low rural bandwidth, right? Not the same connectivity that you and I are used to in big cities. And it's all happening out in tough harsh weather environments that are not friendly to tech in general. And those decisions are changing based on a constantly changing set of environmental conditions the farmer is reacting to, the physical environment, to the weather. So that's hard, that capture moment.

And then I'd say that the second biggest obstacle that has held us back up until now is essentially the sausage maker that is required to take that grain all the way through the food production system. So how do you maintain trace on that one truck, that one hopper truck full of yellow number two corn all the way through the production system? So it's getting mixed at maybe an aggregator elevator. Those big, tall towers that grain is stored in. It might get remixed a second time and then loaded onto a ship and say it's shipped to China. So that whole flow all the way through to, say, a pork product that on the other end of things represents the final product of that farmer's operation in Iowa, that's a pretty daunting challenge to keep those metadata tags associated correctly and instrument the food system well enough.

One of the places we work a lot at Indigo is cotton, and that's particularly challenging. The cotton gin is integrating cotton from many different fields to create that bale of cotton that eventually becomes our pullover. And there are technologies coming to bear kind of just now. I'd say last five years or so, the right industrial and IoT systems are in place finally to allow that tracing. But you can imagine the software integration challenges to connect the APIs and feeds that are coming from all those different systems to create one dossier of the journey of a bushel of corn through the whole system. I'd say those are the two biggest challenges; the original moment of capture and then the trace through the value chain.

[00:34:57] JM: Have you managed a company this big before? Was your previous company this big?

[00:35:01] DP: So my story, as a technologist, the team I'm managing right now is the largest team I've ever been a part of. So there's about 75% of us that care most about GeoInnovation at Indigo. I cut my teeth on technology builds at Boston Consulting Group in the data science team in the earliest days. So we got started right as data science was starting to become a thing around 2010. Hanging up a shingle inside that consultancy around solving problems with data. We were one of the first teams at BCG to use AWS and start doing compute off of kind of beefy laptops and starting to work in a cloud environment. And at that time I grew that group out to about 40 folks, the North America team for data science at BCG. And that became a practice which is called BCG Gamma today. So that was probably up until now one of the largest teams I worked with. And I left BCG to start my own company, Tellus Labs. And as I sold Tellus Labs to Indigo, we had about 15 folks on board half of whom were engineers.

[00:36:08] JM: Gotcha. Well, what have you learned about management as you've shifted into, I guess, management at a larger independent startup?

[00:36:17] DP: Yeah. I mean it's a pretty wild ride, Jeff, to go from a team of 15 and a seed stage startup like Tellus Labs to becoming part of a company the scale of Indigo. So Indigo has raised a billion dollars. There're 1200 employees. It's the largest AG tech startup in the world by many multiples. So it's a big place. And I think I benefit from some of the excitement and bruises I had at Boston Consulting Group, which itself was five, six thousand folks even when I was there. It's much bigger now. And some of the lessons I've learned, one of the most important things you can do as a department head is advocating for your division and making sure your division has a strong fit with where the company is going.

And so working really hard to develop kind of some of the same customer empathy you have to develop as an entrepreneur, as a seed stage startup CEO with your colleagues in the enterprise. Really understanding what's the problem that we're working. And I find that half the time making sure we've asked the right question and that we're trying to solve for the right problem is the unlock, right? More so than you know how sophisticated and carefully we're thinking about the solution itself. That first step of, “Hey, wait. Are we solving the right problem

here?" That's oftentimes the difference between keeping the team really effective and being stuck.

I'd say the other thing from a leadership perspective is I'm a big believer in building real, authentic relationships with the people who work closest with me. And know I a trust-based leadership style. So I try not to be afraid of delegating. I have a really strong sense, Jeff, of what feels right. So I've got all the all the normal micro manager tendencies. But I find that what's really important is, in that delegation moment, really trusting the folks you work with to work the problem. And I'm proud to have been working with people across multiple hops. So people, some of whom have been with me all the way back to the mid-2000s with BCG. So those kind of relationships I think matter a lot to be an effective leader.

[00:38:32] JM: Give me a little bit of your perspective on the future of agriculture and how companies like Indigo can change the flow of goods.

[00:38:42] DP: Yeah. I'm thinking about a few forces that are really shaping the future from where I'm sitting. One is not unique to agriculture, Jeff. We're entering a new kind of golden age when it comes to watching the planet from on orbit with aircraft, with drones on the ground with IoT. So we're just in the middle of an explosion of instrumenting rural areas where most of the food is grown at the same level of velocity, recency, specificity that you and I expect from the consumer and the urban world.

And so that onslaught is real and it's going to totally change the envelope of what's possible in food production, fiber production, because we're simply going to be aware of what's happening all the way from farmer management decisions, all the way through to the end of the supply chain in ways we never were before because the data is there for the very first time. And that's recent.

We've only been really intensely watching the earth I'd say for the last 20 years in terms of daily revisit satellite observation, and it's just exploding. Commercial space is doing some of that, but the government space programs at ESA and NASA are just remarkable public goods that

are all license free for commercial use and their satellites are starting to see the ground with radar imagery that is cloud ground penetrating, hyperspectral cameras that have hundreds of colors that they're responsive to, not just red, greens and blues. And all that data is landing in platforms and systems like cogs and stacks. These formats that are starting to make them much more accessible to non-engineer experts, non-geoengineer experts for application development. So I'd say first and foremost, we're looking a whole lot more often and with much better eyeballs than ever before. And that's going to allow us to manage that system much differently.

Probably the other thing that's coming from you asked, “What's going to change agriculture?” Climate change, Jeff. So we're going to have to start – Like this technology of being able to watch much more intensely and build a digital representation of food is coming just in time, because we're about ready to see the impacts of climate change. We're already seeing them around crop suitability, floods, droughts, extreme events. We're going to start growing crops in places that we've never grown them before and stop growing crops in places that we've always grown them in recent history.

And so that change that's coming to the way the food system gets managed, because of the stress event of climate change, is probably the biggest force that's coming. And I'm hopeful that the third major factor is that essentially we're going to harness that farming system as part of the solution around climate change. So we're going to turn farming from one of the largest emitters of climate gases to one of the most important reservoirs for atmospheric carbon. And I think that that means that farmers all over the world, the billion farmers, are going to radically change the way they farm both to be more ready for some of the harmful effects of climate change and to help their farms become part of our storage solution for climate. We're going to have to find ways to pay them for that because farmers are business people. And so we'll need systems like the ones that we're starting to build now to reward them and help them understand how to do these carbon farming practices well.

[00:42:26] JM: Tell me a little bit about the future of Indigo AG itself.

[00:42:32] DP: Sure. As a company, Indigo, had its roots in plant microbiome in helping farmers learn how to help plants be all they can be with the microbes that occur naturally around them. As I look forward to where Indigo is going, it's really those two clusters that I talked about, Jeff, and it's about bringing those two clusters together. So as a company, really becoming a part of the movement towards agricultural carbon. And Indigo certainly won't be the only player in this space, but as a company, we're going to be proud to be one of the leaders in helping farmers learn how to become carbon farmers and be rewarded fairly for that carbon farming. So that's a big part of the future of the company. That's a global problem. We're getting started in the United States right now. But stay tuned. It's an opportunity for you know all the major grain producing regions in the country or in the world.

And then the second part is really creating that infrastructure for grain marketing and transport of grain. So building that underlying technology that lets farmers find really competitive offers for their grain. Oftentimes the grain marketing decisions they make, Jeff, are more important to the bottom line of the farm than the crop production side of the house. And every farmer is naturally really good at maximizing crop production, maximizing yield. It’s just built into the DNA of every farmer.

That grain marketing decision is not always something that comes naturally. And so the future of Indigo is in helping farmers make that part of the crop production story something that's easier and something that can be actually an advantage to them in the profitability of the farm. And then the same thing from the buyer side, buyers, and you and I as consumers, we struggle because there isn't a technology to bring our preferences all the way through the food system. So as a consumer, I might want to buy a low water t-shirt, a t-shirt that doesn't stress and drain aquifers. But I don't know how to do that, and the t-shirt company doesn't know how to send that signal through the supply chain to incent farmers to grow that way. And the future of Indigo is building that connective tissue. So helping to connect buyers and sellers more efficiently. Helping them build their own technology systems to make that a more efficient marketplace. And the same thing for those that move food and fiber with trucking and transport. So that's kind of where it's headed. It's a pretty exciting story to get to be a part of. It's exciting to be part of sort of turning farmers into the heroes when it comes to climate

change and it's been really rewarding to see the software technology get the uptake that it has had with our growers and customers.

[00:45:24] JM: Yeah. I really see a lot of parallels between what you're doing. And there's another company we interviewed recently called Pachama. Have you heard of that company?

[00:45:31] DP: I've not.

[00:45:32] JM: Yeah. They do informatics about carbon capture similarly to help companies make good decisions about how to allocate their carbon credits, which – I don't know. It's just interesting to see platforms that are creating financial incentives for making better sustainability decisions.

[00:45:54] DP: Yeah. I think there's a challenge right now which is that we're largely living in a supply-constrained environment when it comes to carbon credits, right? There's just a huge appetite that's just getting fired up around demand for credits, for offsets, for lots of reasons, right? And hopefully some government mandates on carbon. Fingers crossed, right? And then if you look at the supply side, there's a quick catch up moment happening right now to kind of help carbon sequestration systems hit the kind of standards they need to hit to be regulated and to be part of the solution. So there's a bunch of catch-up happening right now in carbon tech in general, I think.

Jeff, I recognized, we didn't get to talk as much about software technology. There's a bunch of stuff that I'm passionate about around geospatial tech, satellites. And I thought it would be more fun for us to stay more focused on agriculture and the sector that I'm in.

[00:46:51] JM: Well, if you've got a little time. Do you have a little time? We can dive into that stuff.

[00:46:54] DP: I definitely do. I don't know if you're curious to do that or not though, Jeff.

[00:46:58] JM: Of course. Of course.

[00:46:59] DP: There's a cool dimension to what we're working on, because we started Tellus Labs as a satellite imagery analytics company. And we did a demonstration around forecasting grain yield to sort of demonstrate why satellites matter. Pick a really big financial event that matters a lot. The uncertainty around the US harvest, and it plays out over a really big area, the whole US corn belt. Let's demo our tech. So that was really – It was like an MVP effort. And then it turned out that was the thing. Like that was probably the highest order thing to be working on. But the domain that we care a lot about, a lot of us in the crew, is satellite imagery and analysis. And we're kind of in a funny place right now where like the actual – And this is the engineering challenge that I thought your listeners might be interested in, that if I had to break it down for you, the challenges we face right now in geospatial tech – First of all, it's a pretty rarefied space, right? Like engineers who can work effectively on pixels and rasters and vector work, GIS work, and do that efficiently at scale. It's a pretty rare community. And I think that's going to change because the applicability of the tech is just kind of exploding and the amount of data that's out there is exploding.

But some of the fundamental challenges, they sound really easy, but they're super hard. One is place management systems. So if you don't have a digital representation of all the places that you care about, it's really hard to do anything meaningfully about modeling or monitoring them. And it's amazing how primitive we are right now on having accurate place management for the earth. There's been a lot of headway in the last decade or so, but there're big swaths of what's going on the surface of the earth that are not reliably mapped on a regular basis. And that's going to change particularly deep learning technologies combined with high resolution satellite is allowing us to describe features.

We work with a startup in Canada that helps us map every single grain bin in the United States. Those are the circles. And it's a deep learning algorithm to recognize circular objects. When we first ran it, you identify a bunch of septic tanks and swimming pools as well as the grain bins, right? But you build the kind of logic you need to build to weed those out and you end up with a map of the 300,000 center pivots, those big circles that you see when you're flying over the

middle part of the country and the bins themselves, those big towers. Those are not on anyone's map.

Like up until we did that, no amount of money would allow you to buy a map of where the US harvest went. And that's just kind of surprising, Jeff. So I think that's the first layer of the problem in terms of satellite imagery. And the potential is that the prevalence of the imagery is exploding and the kind of data systems we need to store it, process it, make it what we call analytics-ready. There's a whole term in remote sensing called ARD, Analytics Ready Data. It's just a fancy way of saying like something beyond the raw pixel that's coming off the CCD camera in orbit that allows you to solve a problem. And the prevalence of that ARD data is getting a lot better. And then the deep learning algorithms plus the prevalence of these very high resolution, high spatial resolution satellites, is exploding. And that combination means we're just mapping a lot more reliably.

It sounds boring, building a map of all the center pivots. But if you think about that as sort of evidence of what's happening more broadly, we're going to find ourselves able to just activate on a whole bunch of problem areas that have never really been accessible because they were living in an analog world, where like really only a human analyst could go in by hand and mark these features.

So, Jeff, once you have that base map, you've got a living map of where food is grown or where forests are or where water stands. Then you can put into play this second component of satellite remote sensing that's really exploding right now, which is pervasive monitoring. So once I know that I'm looking at a farm field I care about or a forest stand or a lake, I can then bring through every observation from every satellite or aircraft that ever overflies that site. And we're starting to see more integrated platform technologies that let you bring through eyes from lots and lots of different platforms. And, again, that sounds really obvious, but you can imagine the compute and the storage challenge of processing petabytes and petabytes of these pixels coming from individual platforms each of which has its own quark and turning that into a same united observation, apples to apples observation of that site many times a day

going back 20 years in the past. Making that all accessible so I can watch what's happening on the ground.

And then there's one more step, which is what everyone really wants in the end, which is the insight, right? It's not enough. Like if I talk to a developer community and say, “Good news. I have a new image service which allows you to do reliable summary of arbitrary.” Say, millions of spatial units. Watching them for their color change in time. There aren't that many developers out there who are delighted about that, right? What they really want to know is how many new housing starts were there in Chicago and when did they start and where are they? Because I'm Zillow, and I need to update my imagery.

And so those solutions all the way through to the problem, that's the last stage, and that's getting a lot faster and better. Because once you have reliable places, where the thing is happening, once you can watch it overhead pervasively and not care about all of the overhead costs required and integrating to 10 or 20 different satellites, if that work is done for you, then there's the modeling work of translating that time and space signal into an indicator that you care about. At Indigo, it's things like what crop was planted? When was it planted? When was it harvested? Was there a cover crop? Did they till? Those simple event detection problems get a lot easier when you take out all those overhead costs.

And what I think is starting to happen in this sector for geo is a lot of the plumbing and tools in those first two stages in the problem of did I watch it and can I make basic sense of it to make it sort of analytics ready? Those are starting to get solved scalably with uniform standards. So that now all of a sudden that whole community that was spending a whole lot of time doing data munging is starting to be able to shift its attention to creating higher order symbolic models and really starting to solve problems directly that matter to you and me.

[00:53:47] JM: Well, that's a lot about software. Is there anything else you wanted to add?

[00:53:51] DP: No. I don't. I don't think so, Jeff. Did you have any more questions for me? Anything I can do to help make this punchier?

[00:53:57] JM: No. No. I think this was a great show. Thanks for coming on and giving a lot of information about the future of agriculture.

[00:54:02] DP: Jeff, I had a lot of fun. Thanks for being a great host.

[END]