

Paul Thies: With the incredible ramp-up in the importance of digital capabilities in the face of the pandemic challenges, coupled with daily advances in technology, we are generating a huge amount of data across the board. According to database company Statista, there will be 74 zettabytes of data created [00:00:30] in 2021. To give you some sense of the scope, a zettabyte is a number with 21 zeroes behind it.

But all that data is not simply bits inside computers and phones. It's words and pictures, memories and voices, where untold stories can be gleaned and decisions can be informed. And giving voice to the data to tell those stories is the special purview and art of the data scientist.

Hello, I'm your host, Paul Thies, and on this episode of If/When, we discuss data [00:01:00] analytics and data science with Dr. Kirk Borne, chief science officer at DataPrime, and Michael Brown, global technology lead for predictive analytics at Jacobs. Well, Kirk and Michael, thank you both so much for joining me today and joining this discussion about data analytics and data science. There's a lot of fascinating things and developments going on, and obviously with the advent of the pandemic, it seems like our digital lives have accelerated exponentially, with all the [00:01:30] proliferation of virtual meetings and things like that. We're going to talk about data analytics and data in the context, particularly in large organizations.

Just to start us off, Kirk, I'd like to direct my first question to you. How do you see the role of the data scientist evolving these days, especially as I was saying in the light of the pandemic and the resulting digital acceleration in business and in our lives?

Kirk Borne: Well, for one thing, I think the [00:02:00] pandemic accelerated already a trend that was happening, which was in the very fast evolution that's been the data science profession in the last 10 years or so. The early days was a lot of working in the sandbox, so to speak. People were just hired, go look at our data and see what you can find in the data. Find patterns, find insights, find things we can monetize or improve decisions from.

It had to get out of that sandbox [00:02:30] phase to more of an enterprise-level operational phase, with more structure and governance around it. I think with the pandemic, that sort of forced our hand, that we had to do that. For one thing, people talk a lot in the last year about what they call concept drift, that is, that previous models of consumer behaviors, for example, were just obviously completely wrong, because what we were buying and when we were buying and how much we were buying, it all completely changed. So concept drift, and the different types of data that were being collected, it was obviously [00:03:00] very difficult.

Just for example, if you were shopping online and it was during normal business hours, you could probably safely assume, not always, but most of the time

assume, it was a business-related purchase. Those were the kinds of that an eCommerce store [inaudible 00:03:15] might be related that way. I'm not saying that's a strict rule, but I'm just saying it was probably more likely. Whereas now, if you're working from home, it's like all bets are off. One hour of the day is work, one hour of the day is play.

So [00:03:30] concept drift became a very important feature of the data scientist's life. That is, how could you track whether your model is still working, is still right? That is, the data hasn't changed or the thing you're predicting hasn't changed.

I always say that concept drift and data drift are just two endpoints one one general concept, which is called model drift. A model is just basically an output given an input of data, right?  $Y = F(X)$  or something like that. Okay, so  $X$  is the [00:04:00] input,  $Y$  is the output, and the  $F$  is the function, is the model that converts data to insights or to value. So model drift is that changing process, where either the data, the  $X$ , or the thing you're predicting, the  $Y$ , is changing.

So there's a lot more attention paid now to model ops and ML ops as functions of the data sciences. That puts it square into the realm of the enterprise function that it is, that there needs to be that governance over [00:04:30] the work that's being done. It's not just we're having fun with finding patterns and data.

Paul Thies: But I can only imagine that our basic assumptions that we have on behavior patterns have been upended, like you're intimating. So the poring through the data ... I mean, I assume, and I'm not a data scientist, but you'd have to get really granular and try to parse out what kinds of behavior fall into what kind of models, because it's no longer this [00:05:00] clearcut, these types of behaviors tend to proliferate during this hour of the day versus that hour of the day. Now you're having to look for other indicators to really be able to judge and pull the intelligence out of the data.

From an enterprise standpoint, they're investing resources in it, and of course the digital model of how business is transacted these days is changed. What do [00:05:30] you see are the keys to expanding data intelligence and fluency within an enterprise to match this new world?

Kirk Borne: Well, I think for me I like the philosophy that I heard one company's CEO said once, in that he basically introduced this culture of data democratization. But the way he said it was what really struck me. He said, "In my company, we no longer have a front office or back office." All right? So the way I interpreted that was, [00:06:00] the front office is the customer-facing thing and the back office is the infrastructure team, right? So the idea is that if anybody sees interesting insight or pattern or something in the data they have, they should say something. So that's how I like to say it. If you see something, say something, right?

So don't pass it off saying ... Like, you see some interesting thing that someone posted about your company online on your social network site. Okay, so you're on Facebook and someone says something about your company or your product. [00:06:30] That's not my job. That's the marketing people's job, or something like that. No, no. He said it's everyone's job to represent the company. So if you see something, say something.

And he told stories that I don't necessarily have time to tell some of those stories, but just remarkable increase in customer engagement and customer satisfaction with the business, because people brought things to the attention of the company that they were able to address to help some customer needs that may have just been missed because it [00:07:00] wasn't, like, the person who was responsible. You know?

So I think once everyone realizes that everything is data ... I actually give courses on data literacy, and it starts with awareness that everything is data, right? Your phone, everything you do on your phone, it generates data, uses data, creates data. People are using your data to make money. Why aren't you using it too, okay? So that whole data intelligence is that there's some value in all of the stuff that we're doing in our digital lives to somebody.

[00:07:30] So part of that data intelligence starts with that data awareness, and then realizing that data science, for all the buzzwords and hype around it, it's really nothing more than what we normally already do as human beings, even as little children. We see patterns in things. We recognize our mother's voice, our father's voice. We recognize when we're hungry. We recognize when we touch the stove we burn our fingers. So we recognize patterns. Children sort their toys by color [00:08:00] and shape and all kinds of ... So these are common things that people do. So patterns in customers are, again, groups of customers, segmentation, grouping toys, grouping customers, right? And there's patterns in what they do.

So getting people informed about what it is that we do, stripping away the hype and the air of how cool am I, I'm a data scientist. Hey, it's no, this is something we naturally all do, so why don't you get onboard with it and do it to? So I think that really helps with the fluency aspect of data intelligence, [00:08:30] and that is once people become data literate, that is, they can recognize it, they understand what it is, then they can say, "Hey, I can identify patterns too. We're seeing a sudden increase in this, or a sudden increase in the number of calls in our call center about that product, or we're seeing a lot of returns here, or we're seeing a lot of upsell opportunities because other businesses are selling this other thing, which is like our thing." There's all kinds of things that people can recognize and bring to the attention of the right people in the business. But it's not that everyone's [00:09:00] role changes in the business. It's just that they still have the power to gather insights and to report those to the right people.

Paul Thies: That's interesting. In the world of strategic innovation, we see, I think, a similar kind of thing, where organizations tend to ... some organizations, and it's all on a scale, but some organizations in particular, people tend to think of innovation as there's a certain department that handles that, and that's not really my job, is [00:09:30] to innovate. But the reality is, it's everybody's job to innovate, right? In some degree. So everybody has to embrace that and internalize it, and then take action on that. It sounds like with data, it's a similar thing. Like you were saying, if you see something, you say something. So it's like, we're all responsible for our organization for data capture, and then for sharing that.

Michael, in tandem with that, [00:10:00] is the question about inertia. Organizations, they realize there's something in the data science, there's some magic involved, but I'm not really sure I want it to influence how I make strategic decisions or whatever. How can organizations overcome potential inertia, Michael, embrace greater confidence in the use of data analytics in their decision-making abilities?

Michael Brown: Yeah. Inertia is a very real thing, especially [00:10:30] for larger companies. It's challenging for them to be more progressive and to break the standard rules of engagement as the technology and as more advanced analytics come into play that can really disrupt the business-as-usual workflows that we have. Kirk touched on this a little bit. I think culture is really that first place to start. Overcoming the inertia is predominantly a people problem. It's not really a problem of the technology. So [00:11:00] to really recognize the true promise of what data science can do, advanced analytics can bring to the table, you've really got to create that cultural shift first in the organization.

What I mean by that is truly value and treat data as an asset in the organization. Like Kirk said, we're making data all the time, all over the place. If we're not thinking about what this data can actually mean in the organization, we're not capturing it, we're not storing it, we're not looking at how we can drive insights off of [00:11:30] it, if we don't create that cultural shift, we're not going to get there. So that really has to be the starting point in my mind, to make that change.

Feeding into that, I think the other area that's really, really important is empowerment of those who are maybe not the data scientists, but empowering and championing the decision makers and the big thinkers. If you see something, say something is perfectly in line with that. You need to make sure that everybody is empowered to know that they [00:12:00] can bring good ideas to the team. We need to make everybody comfortable with what that data science process looks like so they can better understand how we actually get to the results.

That's building and establishing trust with them. We're essentially developing robust algorithms is what is perceived as a black box to a lot of people. These are automating a lot of the thought processes and decisions that people have

been traditionally making. So we need to invite them into the process, embed [00:12:30] them into the teams, and really engage and educate and empower them.

One approach is to make them the owner of what's being developed, not the data science team itself, so that when we go to present the results of what's happened, they're the ones presenting it. They're the ones speaking the language of the other experts and engineers that they work with. I've found a lot of success with that approach, rather than just having myself or a data scientist come in and present the results.

The other element with empowerment that I think's important is we need the data science team ... We [00:13:00] as that team, we really need those domain experts and those people with those disruptive ideas. So we need them to establish the first principles of the problem we're going to be solving, and we need them to define that problem space we're working in, and ultimately determine if our results are actually meaningful and impactful.

I think one of the reasons organizations see friction in developing an influential data science practice is that it gets isolated, and the data science teams are not really situated correctly in the business to solve [00:13:30] and really create solutions. They end up creating solutions for problems that may not really exist. So we've explored ideas about this concept of residency. How can we bring in big thinkers and industry leaders into the data science team? It's kind of like your hub and spoke, but it's got more of that added goal, to Kirk's point, on literacy, on educating. And then when those people come into residence and they learn all of this and they leave, they're able to go back and [00:14:00] start instilling that cultural change with everybody that they work with, because they now see the light and they get it.

Paul Thies: Yeah. It's funny, I've seen that at our company with the pandemic. We started having CEO meetings, town hall meetings, virtually. Early on, the communications function engaged members of the data science community within our company to measure sentiment. It really helped inform messaging strategy [00:14:30] and addressing what it was that people wanted to hear about and what kind of information they needed more details, that sort of thing. It became very powerful, I think, for the C-suite to be able to leverage the data in that way at a time which, obviously, was very crucial for us.

Now, Michael, another thing just to touch on is data visualization. As a storyteller, I'm a big fan of data visualization because it allows you to do [00:15:00] things and show things that really bring a new dimension to what you're trying to communicate. I think it can be highly effective in telling stories. In the context of this discussion, how can data visualization help promote greater awareness and affinity in organizations for the power of data to influence decisions and to tell the organization's stories?

Michael Brown: Yeah, no, visualizations, like you're saying, are immensely [00:15:30] powerful. Oftentimes, the effectiveness of the visualization and the story it tells can really make or break the outcomes of what you're trying to achieve. I'd wager to say that data visualization can be one of the most important elements of data analytics, as it's sort of that endpoint to where a user or your audience is going to try to now learn from and make decisions off of all the work you've done. If you can't get that information communicated, it's not going to go anywhere.

I personally [00:16:00] love data visualization, mapping of data, and the science and art of making these beautiful and informative visualizations. It really is blending of creativity and data intelligence to develop not just infographics, but like you said, Paul, crafting that narrative to get to what you're trying to communicate.

But to get more to your question here, when we think about creating influence with our data analytics in an organization, one of the things about the word influence, it's really about resonating with as many people as possible. [00:16:30] Data visualization is the opportunity to take that very complicated process we're talking about, and the very complicated outcomes that are often based off of lots and lots and lots of data and information, and show that outcome and tell it in a story in a way that it will actually resonate with people so that they can understand it and have their own ah-hah moment.

So getting that ah-hah moment really quickly is very, very important. There's a colleague of mine, Alex [Maru 00:16:57]. I don't know if he's made this [00:17:00] quote or not, but he calls that reducing the time to insight. I really like that term. Effective data visualization can dramatically reduce that time to insight, and it can actually improve the accuracy in the decisions that people are making from it.

We all know organizations are only generating more and more data, like we've been saying, and more data does mean more potential for insights. But without an effective way to digest that and present it to decision makers, it can actually be counterproductive due [00:17:30] to things like information overload. If we present too much information at once, or it's too cumbersome to wade through to develop that answer, then that whole decision-making process gets tied down, and we start to really lose the value in the data that we have.

By taking all that data and displaying it simply and clearly, it can be very obvious to the audience what decisions need to be made. A really dumbed down example is trying to have somebody make a decision off of countless rows in an Excel spreadsheet, [00:18:00] versus looking at a pie chart or a bar graph. You can immediately see the distribution in the data, and you can see what's going on in there, and in a very short amount of time make a decision off of that, rather than having to comb through all of those rows and try to make sense of what you've been reading for the last hour in the spreadsheet.

So I think that gets to the crux of it. It's really important, if you want to create this affinity for data science and what data can bring and how it expands its roles and influence in the organization, by effectively visualizing [00:18:30] data for decision makers, they will make better decisions, which will in turn create more desire and emphasis on the power of the data in the organization. I think that's really where you see it.

Paul Thies: Okay. And then Kirk, what should enterprises be doing to ensure that their data assets are properly assessed and leveraged, to create great value for themselves and their clients? I don't know, maybe it's something like bolstering their strategic decision-making opportunities, identifying product enhancements, merging [00:19:00] consumer sentiments, and things like that. What should they be doing, they being enterprises, to ensure their data assets are being properly assessed and leveraged?

Kirk Borne: Well, after what Mike was saying, I think they should all get an undergraduate degree, like me, in physics. Okay, that was sort of a joke, but not, because as he was talking, I wrote down ... I do have a degree in physics. Multiple concepts from physics that we're talking about here. Friction, inertia, momentum, [00:19:30] data gravity. The flywheel effect, which is get this thing running. Affinity, resonance. Even diffusion of the knowledge across the organization. But all those concepts apply in this case, where you need to overcome the inertia, overcome the friction, to get things moving. And then once you get that flywheel effect going ... So small successes breed big successes.

One thing that enterprises could do is just to encourage small steps, these small successes, [00:20:00] right? It's business gospel now, right? Agile, devops, all these things. Those small incremental proofs of value, not just proof of concepts but proofs of value. Those small incremental steps will build confidence that this is cool, this is the right thing to do, and that anybody can contribute, anybody can be a success, and reward those successes. And they'll build advocacy across the organization for bigger things.

That's important, because [00:20:30] I would often tell people that some of the friction comes from all different levels of the organization, right? The people in the trenches feel like, well, this AI thing's going to take my job away, because some robot's going to do what I do. Or the middle manager's afraid, because all the decision making that I used to make is being handled by some decision agent. And the people at the executive level say, "Well, where's my power now? Because all this stuff is being done by the data scientist," right?

But the fact is, is [00:21:00] that everyone's contributing, because that domain knowledge still resides in humans. Some of the best pattern detectors are children, because they don't have biases built in. Okay? So I think having some very young people at the table is a very clever thing to do. I've seen some organizations do that when they have those executive meetings with the CEO and his executive staff. That happened to me when I was very young. I worked

at the Hubble Space Telescope [00:21:30] project, and I was just fresh out of grad school, right? And the senior executive scientist on the project had weekly meetings, and they decided they needed a junior staff member to represent the junior staff's perspective, and I was the guy. I went in there with trepidation, because these were Nobel Prize winners, and I was fresh out of ...

Anyway. So there's a lot of things you could do about that democratization. But it really is set by example. [00:22:00] You don't just set a culture by just coming out with a policy statement about a culture. You have to live it. You have to demonstrate it. So if someone finds an interesting insight from data that brings value to the business, then celebrate that, no matter who that is.

Another thing which ... I've had so many wonderful thoughts after what Mike said. I feel like I could go on for another hour here. But I'll just say one thing, is that I had experience working in a company where we did a lot of analytics, where we sold analytics. We were consultants. That's what we did. [00:22:30] We consulted and provided analytics services to our clients. So that's what our job was.

But one day my boss, we called them career managers there, so my career manager, she came to me and she said, "Oh, I'm not going to be your career manager anymore, because I'm going into enterprise services, as opposed to client-facing stuff." I said, "Well, what's that mean?" And she said, "You know, stuff like HR and training and human resources and finance." I said, "Oh, that's [00:23:00] interesting." And then she explained what she did, that they're going to apply analytics to the internal functions of our company. So I said to her, "Oh, so we're going to drink our own Kool-Aid now." Instead of just selling these things, we were actually going to do them ourselves.

So even in organizations that are heavily drenched in analytics already, sometimes their internal processes or internal enterprise functions, like HR and finance, communications ... There's an example you were just talking about, right? Why don't we get sentiment from [00:23:30] our employees after they have a training course? Did they really like this training course? Did they really like this meeting with the senior executives, that little retreat we had? Did that work for people? I mean, just ask those questions. So I think showing that we believe what we're doing is a real thing that brings value, let's prove it to ourselves as well, is selling it. This works for all organizations in my mind.

And then I just want to go back to that data storytelling thing, because I'm a massive, big [00:24:00] proponent of data storytelling, because that connects with people in a different way, right? I always like to quote Maya Angelou, who said, "People will forget what you said and what you did, but they'll never forget how you made them feel." Data storytelling engages people in such a way that it also reminds me of another quote from another person who's not quite as famous, but some guy who wrote one time, he said, "People don't make a decision based upon a number. They base it upon ... They feel it." They just

know in their knower, as my mother used to say. You know in your knower it's the right thing to do.

[00:24:30] So that doesn't come by just showing me a graph, even though the graph is powerful, because I can see it when you show me that graphic. But if you tell me the story behind that graphic, like what is it that I'm learning from this, what insight are you telling me about when you show me this, that I can remember. That I can take away from it. Whoever that stakeholder is, whether it's a boss or a client or even the people in the trenches who you're trying to sell this idea to, that the rest of the business, [00:25:00] hey, we really do mean it when we say we want to democratize data science.

So the data storytelling is part of that diffusion, process of diffusing, like in physics, right? Diffusion is when you have oxygen atoms here and hydrogen atoms there, and you put the two gasses together, and then eventually it all merges into a good mixture. So now you don't have just data scientists over there and non-data scientists over there. It's now diffused across the business.

And then what happens there is then you get another physics concept, which is laser, right? [00:25:30] The laser is light amplification by stimulated emission of radiation. Yeah, I remembered it. So you get this resonant effect that more people want to do it, so it stimulates more, all right? So that's where those small victories grow into larger victories.

Paul Thies: In essence, people internalize their own contributions to data science, and they want to be a part of it. And then the more they share and the more data is generated, then the more [00:26:00] that the pool of knowledge grows.

Michael, as a follow-up to the question about enterprises assessing and leveraging their data, what should they be doing to ensure their data is optimally monetized? I.e., the money question.

Michael Brown: Yeah, yeah. No, it's such a tricky one, I think. Where I always try to start is that data in and of itself [00:26:30] may not be valuable. So we have to often know what the true value of the data is. To get there, we have to actually go develop some kind of value from it, right? So when it's not very meaningful, we need to then look at how can we enrich it, how can we contextualize it, and really apply it? And that, I think, is where companies and organizations need to be focusing on the monetization of data.

When I think about monetizing data, I tend to steer that way, into the broader ecosystem [00:27:00] that constructs value from the data. A couple more obvious, bigger principled ones around that. I just talked about enrichment a little bit. That's really where we can, I think, start to instill value in the data in and of itself, because you start to take these disparate data streams, you combine them, contextualize, and generate more informed datasets. So now you're actually creating much higher-value data. When you create that data,

that's when it can be monetized, because it's directly applicable to [00:27:30] a client problem, some kind of customer challenge, an internal business need. So I think starting there, how can we make the data smarter, insert real value, take our own thinking and intelligence and insert that into the data, that's a good way to start the monetization process.

The other one that we hear a lot about is analytics or insights as a service, where we're taking that data and development some kind of interpretation of it and a model that we can plug into a workflow [00:28:00] and people can use. That's also another more generally obvious monetization strategy.

But I do think it's important when we think about these business models that we think a little bit bigger than just these purely data as a service, insights as a service approach. There's so much more that can be done. Sometimes I think a little bit about the platform business model. I think that's a really interesting way to think about how we monetize all the transactions that are occurring in and around the data that's [00:28:30] going on, and really the platform supporting all of those integration points with the data.

If you're not familiar with the platform business model, the analogy I've seen used is the art gallery, essentially. The art gallery provides the physical space and is monetizing all those different transactions that occur in it. You think about somebody getting charged for admission, and then an artist being charged to showcase their work, and then a percentage of the art sale, and a percentage of the concession sales. You can start to see [00:29:00] how that works. So there's all these transactions that are occurring in there, and how can we monetize every little piece of that?

If you swap out art in that scenario and you insert data and analytics, you can begin to get the picture. By thinking a little bit bigger than just the data as a service and providing that platform that's going to ingest the disparate data, enrich it to be more informed and valuable data, and then create insights off of that that are going to be directly applicable to the customer problem, that's, I think, where you holistically [00:29:30] create more value from data. And those monetization strategies, I think, end up being more valuable to the customer in and of themselves, because it gets to the root of the problem, and it's this one-stop shop for them.

Paul Thies: Fascinating. I like that. I like that idea of the art gallery. Kirk, let me ask you, where do you see the role of the chief data officer headed in the next couple of years? And then Michael, I'm going to ask you to talk a little bit about the field as well after that. [00:30:00] But you're starting to see more and more, Kirk, where ... You know, you're a chief science officer at DataPrime, for instance. That's a relatively new role, I think, in the professional landscape, it seems, or at least in my experience that's something that has been created in, say, the last 10 years or less. You're seeing more chief data officers, chief science officers, that kind of thing. Obviously, organizations are starting to see the importance of

putting a seat at the table [00:30:30] in the executive suite for that. But where do you see the role of chief data officer headed in the next three to five years?

Kirk Borne:

That's a really interesting prelude to that question there, because there has been this proliferation of C titles, right? Chief analytics officer, chief data officer, chief risk officer, chief algorithm officer, chief analytics officer. We've heard a lot of different ones over the recent years. And CSO, that's normally chief security officer, so I don't call [00:31:00] myself a CSO, because people will think that's what I do. It's chief science officer. I was actually talking with my boss today, and I was seeing how I was creating all these different synergies between our clients and different vendors and stuff, and I said, "Well, maybe I just should be the chief synergy officer. That's still CSO, right?"

But anyway. I think what's happening with the chief data officer is, early in the revolution ... And Again, the data revolution's only like nine years old, right? In 2012, you saw multiple things happen. You saw the McKinsey report come out, which said there was going to be this enormous [00:31:30] talent gap. You saw the president, the administration announce in the United States a \$600 million investment in data, which got everybody's attention. Then there was this crazy paper that came out in the Harvard Business Review saying sexiest job of the 21st century, data scientist. So right in 2012, all of a sudden there was this explosion of interest at all levels. Government, business, universities, everywhere.

So everything just was put under the umbrella of chief data officer, right? And they were doing [00:32:00] these different things. They were doing data science, they were doing analytics, they were doing risk. They were doing all kinds of different ... A lot of data governance, a lot of projects around open data. Certainly chief data officers and government were focusing a lot on open data, right? We were creating open government and open data. Right?

So I think even though we're getting more titles now, I think it makes more sense, because the titles now become more reflective of what people are asked to do. So I think the chief data officer's heading more into the governance role. It's been doing governance for a long time, but I think the [00:32:30] governance in the sense of what risk and compliance require, okay? There's a lot of requirements on the government side, not just in Europe, but some of those that get absorbed in this country, and then of course in California there's different data privacy laws. So knowing how data's used, who's using it, what are they using it for, how is the data protected, what are the privacy rules around particular types of data?

So that person's going to be responsible, I think, for having an inventory, maintaining oversight [00:33:00] of how and where and who and what and when the different datasets are going to be used. So it's going to be less in the analytics sense, but there will be analytics on that role. That is analytics on ... Again, drinking your own Kool-Aid. So doing analytics on how the data's being

used. What are the patterns and insights I can get for how the data are being used in my organization? So it's an analytics activity within that office of data compliance, data risk, data governance. [00:33:30] I personally see that's the direction it's going, because I think people who are doing more data sciencey things are going to get a chief data scientist title, more than a chief data officer title, which eight or nine years ago they were all considered the same title.

Paul Thies: That shows, I think, a greater maturation of the field, and a greater understanding of the varying disciplines that go into it. So out of respect for that, we're starting to see greater specialization, whereas before data was just this ... [00:34:00] Like Michael was saying, it's a black box. It's just kind of like, what is that, and how does that work?

Kirk Borne: It's the chief black box officer [crosstalk 00:34:06]

Paul Thies: Yeah. Now we're starting to get more sophisticated understanding, I would say. Michael, my last question for today, kind of as a follow-up on that, is where do you see data analytics headed in the next couple of years, and what are some of its developing aspects that you're the most excited about?

Michael Brown: Yeah. I think we actually touched on where at least I'm saying trends [00:34:30] in just my day-to-day with our data science teams. Democratization is the word Kirk used earlier. That is really where I see data analytics just continuing to expand. It's a current trend, and it's only getting more prominent with some of the developments in auto ML software. It's just making it easier and easier for people to get engaged in data science. It operates more quickly than maybe traditional teams would've been able to [00:35:00] do, at least in the exploratory data analysis space, that is.

So as that software gets better and better, I see it just democratizing the space even more. I'm not saying that the person who really understands data and has high data intelligence is not going to have a job anymore. In fact, I think they're going to be even more empowered. They're going to be able to make an impact more broadly with the use of this technology. So auto ML and democratization is a really big trend. We're already [00:35:30] seeing it now, and I just think that that's going to continue to expand.

I also think we'll start to see a bit of a blend in trends. There's this idea that machine learning and AI is going to get better with smaller amounts of data. So as auto ML begins to bring that into it, we're going to see just a very powerful blending of those two into something friendlier, easier to use by people, that can be dramatically expanded upon, because you don't need all of that data that maybe have been traditionally required. [00:36:00] So as that matures, I just think we're going to see an explosion in that, because everybody's ... you know, your citizen data scientist, your person who saw it and brought the problem to the team, might be able to even go self-serve now.

So that does make me very, very excited. The absolute best analytic projects I've ever been involved with, it started from somebody else's idea. Somebody who had a challenge in their business and came to me and wanted to collaborate. How can we use data [00:36:30] to answer this question in a better way? If we can empower those people with the big ideas and these challenges that they see day in, day out, if they can self-serve more in this space, I just think we're going to have an all-around more informed business, and achieve the goal of the culture that we're after, this culture of data as an asset. I'm excited by that and what some of these developments are going to bring.

Paul Thies: [00:37:00] That's fascinating. Well, Kirk and Michael, thank you both very much for your time today and your insights, and your obvious passion for data analytics and data science. It's very fascinating. It's very technical, but I am not a technical person, and I was fascinated and engaged, because just the possibilities that data and the smart application of data science are endless. I see it as a storyteller, and I think that decision makers would do well [00:37:30] to see the asset that it truly is. I want to thank you both so much for your time today.

Kirk Borne: Great. Thank you.

Michael Brown: Thank you.