RETHINK IT: DIGITAL IS NOT A THING, DIGITAL IS A MEANS

AUDIO TRANSCRIPT

Driving Digital in Biopharma Podcast: Jason Bronfeld, Bristol-Myers Squibb

[Beginning of Recorded Material]

Tom Lehmann: Hello and welcome to Driving Digital in Biopharma. I'm your host, Tom Lehmann. In this episode, we continue our podcast series through a conversation with Jason Bronfeld, who works in Pharmaceutical Development at Bristol-Myers Squibb. My conversation with Jason covers a wide range of topics, including the need for the biopharmaceutical industry to have a mindset shift with respect to digital, how patterns in evolutionary biology apply to innovation, and the importance of context to make data and information meaningful.
Thanks for listening. I'm excited for you to hear our conversation.
Jason, welcome to Driving Digital in Biopharma.

Jason Bronfeld: Hi Tom, thank you very much for having me.

Tom L: Can we start for the benefit of our listeners with a brief introduction?

Jason B: Sure. I've had a storied career. I've been in the digital business since the late '80s. So yes, I'm identifying myself as a fossil perhaps, or giving away my age

I currently work for Bristol Meyers Squibb, and I've been here for about 20 years, working for a group that provides all the I.T. for the section of research called Pharmaceutical Development. And prior to that, I had a career of 15 years living in Boston, writing software for mechanical engineers.

Tom L.: Well, I'd like to say a seasoned veteran not a fossil, as I hear that introduction. Just for the record.

Jason B.: There you go. I need a new pithy epithet. Old Testament has come up, but that's not particularly flattering really.

Tom L.: No, we'll find something a little more digital and modern oriented for you.

Jason B.: Sounds good (ha ha).

Tom L.: All right. So let's jump in. So on this series, we've talked a lot about the potential for digital within the biopharma industry. We've also talked a lot about the impediments to progress, which is getting in the way of companies moving forward. What's your perspective on what's preventing the industry from making real progress with digital?

Jason B.: I think there's a couple of barriers. One is that digital is not a thing, digital is a means. And it is not something that's extant. There's a lot of discussion. I think the hype started with Nicholas Negroponte 20, 25 years ago with his book, and it's just been a flow of sort of very pithy jargony buzzwords ever since,

going through industry 4.0 and digital, and digital transformation and gamification—and I could go on and on.

But what's interesting about all of those is that they're all retrospective, they're all trying to find ways to apply existing tech to problems. They're not trying to understand and innovate in the problem space. It's sort of looking at the tools in your toolbox and seeing if any of them can be used for something, rather than deciding what kind of home you want to build and then going and buying the tools.

So I think there's a lot of fascination with the topic, but I think it's cast as something that's real, but really isn't. We should start with much more concrete problem statements. I also think that people are stuck in their context, and so I'll just give two quick examples, they're converse examples.

One is in the house that I grew up in, we did not have cordless phones. We had corded phones, and one was on the wall near the kitchen, and growing up, if you wanted privacy, you stretched that cord as far as it would go and you know went down the hall and talked to your friends. And once we got a cordless phone, for probably a few years, my entire family continued to walk in the semicircle that was carved out by the cord, because it just wasn't in our way of thinking that you could go beyond that.

So I think one of the challenges of applying digital tech stuff, is the ability to actually let go of how you perceive the world, and attempt to switch your context and challenge the way you operate today. And that's very difficult to do.

The other example, sort of the counterpoint, is there's not a movie made today that isn't highly digital. And yet, I don't think anybody in Hollywood says phew, we finally made a digital transformation and we're there, or even thought about it. Hollywood is in the movie business, they always have been, and along the way, CGI and digital audio helped tremendously in them achieving their goals.

But they didn't think of it as the goal in its own right, it was an adjunct, it was an accelerator. And it transformed the way they approached their thinking about work. And so I think it's even less about digital, and it's more about changing the way you think about your work, and liberating yourself from the patterns that have been ingrained into you from working that way for a very long time.

And in the digital world, it just adds this element of magic, because you can do things that you cannot do in the physical world. But it's really no different than radio, where suddenly, I could be in one place speaking and halfway around the world, I could be heard.

I don't think we've ever talked about sort of the telecommunications or the communications revolution or the digital, in the same context as we talk about digital transformation. But it also comes back to being able to imagine that I don't have to be in the room with you to talk to you, that's where it starts. The technology to get there is not the point.

So I think pharma needs to re-imagine itself, and what it does and there's a quote apocryphally attributed to Peter Drucker which I like, and I'm not sure he actually said it, but it's that the pharmaceutical industry manufactures information in capsule form. And when I first heard that, I thought that nailed it.

The mindset among so many people in pharma today is still that we make tangible pharmaceutical products, we run clinical trials and that's my job, and we manufacture this material and I sell this material. But if you look one level deeper, R&D does not produce anything tangible, they are a knowledge generating enterprise, and clinical trials strictly exist to create information and knowledge, and physicians and healthcare providers don't look at the tablets and crack them open and smell them and taste them, they read the insert.

So I think the industry has to re-anchor the way it perceives itself as an information knowledge

generating enterprise, that by the way also manufactures some tangible product. And until we do that, we're going to be stuck on our adoption curve, because we're going to perceive our problems in this tangible world, rather than in this intangible knowledge generation, knowledge management world.

Tom L.:   And if you look at leadership within the industry, what prevents people from taking that step further? If it is a mindset shift, to your point, it's not a technology issue; there's plenty of technology that's likely out there to be utilized to address the problems.
But there's a mindset that has to shift. Is it just a perception of one taking personal risk? Is it the specter of regulation that prevents people from moving forward? Is it just a lack of ambition? What do you think really is holding leadership back then?

Jason B.:   That's an interesting question. I would certainly say it's not a lack of ambition. I think at every level of the industry, people are trapped by their context. I think we are a heavily regulated industry and that has inculcated in us a very risk averse posture in many areas. So we're not quick to embrace change.

I also think it works pretty well, successful companies make very good margins, and until there's really some necessity to challenge the status quo, it's really hard to do.

The other thing I've noticed in pharma, which I didn't notice in my prior career as a software developer, is we do an awful lot of benchmarking. And when you just compare yourself to your peers, right, then the whole cohort moves at the same pace.

It's not really a horse race, it's more like a parallel journey, because as long as you're in your peer group or leading your peer group that seems to be good enough. And so the appetite for true transformation in this world of risk aversion and benchmarking just seems to get muted, maybe that's the right term.

Tom L.:   Yes, make sense. And certainly I

have seen that, and again, it's relative comparison, right? A lot of conversation around wanting to be in the upper quartile. But again, when the spread within your peer group is not that great, getting to upper quartile may not be a huge jump forward for some organizations. And so again, that relative comparison becomes very important.

Jason B.:   And it's relative in every dimension. So there are all the subcategories of meetings to discuss how biologics are manufactured, and meetings to discuss manufacturing strategies for small molecule. And in every one of those, we're just really anchored on so what are my peers doing? Which sort of leads me to what I think is one of the most profound and influential ways to get out of this quagmire.

There's an evolutionary biologist, his name is Stephen Kaufman, and he has created a concept known as the adjacent possible. And it was picked up by a fellow named Stephen Johnson, who wrote a reasonable book, it's certainly worthy of being on your desk and worthy of reading the notes. But the name of the book was Where Good Ideas Come From: The Natural History of Innovation

And one of the things that gets synthesized out of that, is that evolution and innovation are driven by a shadow future of possibility. And that sounds a little bit abstract, let me just make it a little bit more concrete. If you go back to the 17th century, the greatest example of co-invention is calculus with Newton and Leibniz.

Within the same time frame, they both came up with a completely transformational idea, and it raises this question of why at that moment in time? Why not much earlier or much later? And it turns out that a whole bunch of other things had to mature and be in place, and Newton and Leibniz had to be aware of all of them before they could even conceive of something like calculus.

And it turns out, evolution works the same way. Organisms evolve, create new piece parts in

their current world that can then be reorganized in the future to create new piece parts in that world. It's even more fluid when you're talking about the adjacent future of ideas and concepts.

So, there's lots of examples. It turns out four people invented the telephone at the same time, within I'm going to say 20 years of each other, and Alexander Graham Bell gets all the credit. But all of the ideas, all of the awareness of the various technologies, all of the belief that you could communicate over wire had to exist and all of those ideas were known by all of those inventors, and they all matured roughly at the same time.

So innovation is really not driven by deep knowledge, but bilateral knowledge, by appropriating from all of the things that, all of the ideas and concepts that are happening outside of what you're most familiar with.

And those ideas get appropriated and reconfigured which creates another adjacent possible. And I think what pharma needs to do is actually sort of inculcate that more into the way they think about improving the way they work. I don't think it will change research. I think it's already the natural property of research, the ideas about biology are circulating and evolving, and we're tapped into them.

But particularly in the digital world, having ideas about what is possible should not be coming from within pharma, but should be appropriated from all the other places where digital magic is happening, and you can challenge your thoughts about where can I go when my phone doesn't have a cord. I don't know if that was clear enough.

Tom L.:　　Absolutely. Where I go with that is, as you think about, or just take the research space for right now, when you're saying okay, those ideas are that experience or that evolutionary possibility is happening, but not necessarily just within our industry.

Do you think—again, your experience of looking

across the industry that this industry is open to those possibilities, and therefore, actively pulling them in—that's this is where those innovative breakthroughs will actually happen? Or is there still a little bit of a, "Not invented here" that our industry suffers from?

Jason B.:　　I would go a step further. I would say it's not a little bit of "Not invented here." I think we still don't perceive ourselves as an information enterprise, and therefore, we're not organized around living in the information adjacent possible, or the adjacent digital future. There are lots of startups in the digital space, there are digital titans that have come and gone, we could rattle them off. And they attract a certain kind of people who are almost viscerally dissatisfied with the digital status quo and aware that in this world of digital, you can make dramatic change, and they set off to do that.

Until we start to perceive ourselves as being in that world or of that world, we're not going to accrete the right talent and the right mindsets. We're still stuck in our context of being pharmaceutical drug manufacturers, tangible product makers, rather than information generators who can tap into all of the adjacent possible of innovation that is intangible in the digital world.

Tom L.:　　Well, I heard a senior executive in our industry recently talk about the fact that what he was hearing within his organization, is they're hiring more computational scientists than biologists. Which is an interesting shift, and again, you think about that, if that's true, if that's sort of representative across the industry, that the shift is starting to happen.

As you're saying, now the question is, are we attracting the very best talent in this space? Or is that very best talent going elsewhere to solve other challenging problems and not necessarily coming to this industry? At the same time, we need more of those individuals than ever before?

Jason B.:　　I would say it slightly differently.

Well, I agree with you, that there is there is an uptake in sort of the computational nature of what we do. In my little sphere here, I asked the community that I support how many people in our organization consider themselves data scientists? And I asked that question about eight years ago, and the answer was about five and they were all computational biologists, computational chemists and a few computational fluid dynamicists.

But it was single digits. And here we are eight years later, and that number is now approaching a hundred, and this is in an organization of about two thousand. So I think we're moving in the right direction, but I think an appreciation for how much farther and how much faster we can go, is only going to come as we get more digital natives entering the workforce.

A little bit of a mixed metaphor there, but I think it will be driven by people who have grown up in the digital world, and will have an ability to question why we operate the way we do.

And I just wanted to come back to your comment about hiring the best talent. I think that's a big debate, and I think it might be, I just want to temper the notion of best talent, it's more about the mindset change.

There's plenty of great talent out there, it's not a competition for the best talent, it's the mindset change that we are an information enterprise that will then allow us to think about bringing in all this great talent that we don't think we need now, because we're stuck in our context.

Tom L.: I think that's fair. Again, at the end of the day, that mindset shift is going to become the requirement, alongside the technologies and the other pieces that we've talked about or that are essential to actually enable the outcome. But if the mindset's not there, you will continue to be stuck in where we've been with applying digital methods to traditional ways of working, similar to your corded and cordless telephone analogy.

Jason B.: And I think we have a conception

problem, right? It's if your corded phone is working really well, why would you ever think that phones wouldn't ever need cords, right? The innovative piece is not about retrospectively applying digital, it's about challenging your problem statements and being liberated from the way you work today. So we recently did an exercise with your people as a matter of fact around how to improve working in a laboratory.

And if you ask people for concrete suggestions about what could be improved, you will get them, but they're all articulated in their context, and your organization proposed anthropomorphizing the lab, to force people to think differently and ask questions like what would be different if the lab could speak? And now, suddenly people are liberated from well, I have to have any ELN. Well, why do you have to have an ELN if you can just talk to the lab and it can understand you? Or what would happen if the lab could think or could respond to questions? And when you start to think about what 3D printing might do in terms of consumables, it's a very simple example. But shaking people out of their context is the hard part, and having frameworks for doing that is really important.

Tom L.: Do you think from your experience, just with that last part there, that that's a generational difference? That there are different generations that are much easier to move out of that status quo or move out of that context? Or it's not so much a generational piece, there's other factors at play?

Jason B.: I would elaborate that slightly, I think it is generational, but it's only because of the context in which, the time framing into which we're born. So there's no way that Isaac Newton and Leibniz were going to conceive the cell phone, because there weren't enough piece parts in any adjacent possible at that time for them to think about that. So they were trapped in their little slice of time.

I do think generation over generation, what you're really seeing are people who grew up or came of age with a different collection of things

in their adjacent possible, that makes it easier to conceive of the next wave of innovation. So yes, it's generational, but it's really not a years on this planet thing, it's more about what slice of time adjacent possible do you exist in.

Tom L.:   Okay, that's helpful. Now maybe if I can make a jump…so if you think about part of this adjacent possible, is just the ability to do something with all of the data that's there. So certainly as we have seen the industry evolve, there's no shortage of data at this point, and it could be either generated within the four walls of any biopharma organization, it could be through external partnerships, in   t could be acquired data.

But as you were saying before, R&D is a knowledge generating enterprise. Talk to me, if you can, a little bit about sort of the data to knowledge transition? Because I don't think we have a data problem, it goes beyond that, so give us your perspective on that.

Jason B.:   Yes, I completely agree with you. I think, actually, talking about it in the context of data gets in the way. So first, the pharmaceutical industry manufactures knowledge and information in capsule form. The side effect of doing that is that you have to create data, but data is not the starting point, data is just a sub-component of knowledge. I can almost feel the listener's eyes rolling as they're anticipating, "Oh my god, here comes another knowledge management discussion" and I'm not going there.

I don't believe that the wisdom triangle creates a lot of tangible value, but it's a great epistemological exercise. But I would say that facts and figures without context are not meaningful. So if we can justify knowledge or understanding, if you need a new word, as not as the data the facts and figures, and everything else that gives it meaning and helps a human understand what it is intended to communicate, then that's what we should be focused on.

And by starting with data, you wind up going

down the rat hole of aggregating data and aggregating metadata, and getting distracted by things like the enterprise data model. And what you really want is to capture the knowledge and be able to keep the data and context together, so that any moment in time someone can consume it.

Tom L.:   And where do organizations that you've seen do it well struggle with? So where have you seen it play out?

Jason B.:   Okay, here's an interesting example. We continue to think about data sources, and when we talk about managing our data, we talk about managing data sources. But the consumers of that data don't care a whit about the data sources, nobody would ever conceive of organizing their data in a particular way to facilitate storing it on a hard drive, because it's incomprehensible to a human.

So what people are really interested in, and I'm oversimplifying a little bit, are data sets. I want to understand the collection of data that was generated and the purpose for which it was generated. But we're distracted by managing our data sources, and we then ask the consumers to do the archeology into all of the ways that it's stored, to find what they need, to answer the question they're asking, and I see that in pharma a lot.

If you pivot to some place like Wall Street, they have a completely sort of inverted process for managing that, where the most important thing is quick access to data sets, and the actual physical embodiment of the bits and bytes and where they live needs to be abstracted away, and people don't hunt for data they hunt for data sets, and those data sets are dynamically available.

Now it's a little bit of an oversimplification, but a data set could be conceived of the cohesive collection of information that was generated to answer a unique question, and that fits into this envelope of meaning around understanding or knowledge. So why do we want to impose bits

and bytes archeology on data scientists, when what they really want is to understand every experiment that was ever done with certain parameters, so that they can look at all the data related to the experimentation.

And I think we, the I.T. groups, get distracted into managing data and trying to think about it as this massive collection of data, rather than being a collection of atoms known as data sets specific to pockets of knowledge or packets of knowledge.

Tom L.: And so does this become then just a search challenge? To go as you said data sets, not data. So with good search technologies are all problems fixed, or is it much bigger than that?

Jason B.: No, this is great, great question. If you think about the current paradigm, and I'll just pick on Google. You go to Google, you put in your natural language question, and you get a bunch of responses back some of which are ads, and the rest are links which you can dive into to determine if your question has been answered.

And if that doesn't work, you change your search and you do it again. And so search is sort of this iterative process of looking for answers, but it is not the be-all and end-all, the question that arises is what comes after search.

And I think what comes after search is something much more powerful, which is take that iterative piece and go synthesize all of that and give me an answer. Don't give me links to potential answers, answer my question and then expose to me the sources of information you used to synthesize that answer.

So another way of thinking about this is instead of searching for documents or searching for websites, you're actually searching for concepts which are embedded in myriad documents and websites, and what comes after search is the synthesis of concepts into something that is much more useful the first time around, but then provides links to where the synthesis came from,

so that if you want to follow the path to the source material, you can get there.

I think everybody in the tech world is really trying to figure out what comes after search. And some of the reasons we know that it's not right are by the awareness that most young people now don't search on Google, they actually search on Tik-Tok, and behind Tik-Tok is Instagram, and Google as a powerhouse at least searching as a powerhouse is slipping behind, because there's clearly something else beyond what we conceive of as search that is more powerful.

Tom L.: And what do you think enables that, has that become just a massive higher-end, leading-edge technology challenge? Is there a lot of just individual insight and experience that has to help enable that? What do you think moves that forward?

Jason B.: So I think we live in an age where there is a staggering amount of compute and storage that is available very inexpensively. For somebody of my ilk, it's just mind-blowing how inexpensive storage is and the power of compute that's available on your phone. But when you think about the power of compute that is available to gargantuan companies in that sphere like Google and Facebook and Amazon and IBM and Microsoft, it's staggering.

So I think one challenge is it is a massive computational problem, but we live in the age of massive computational resources, so it is solvable. We need to learn how to extract concepts from the collection of the world's information and re-represent them back to consumers and that's solvable, it's just massive. So it would be challenging to do that from solely within a Pharma company or any non-gargantuan technology player.

I think the other piece is this notion of the actual algorithms for synthesis. And the few things that I can see from where I sit are that databases which reorganize data so that it can be found in the future, is not the way this is going to happen. But knowledge graphs that allow you to quickly

assess relationships between things, is clearly a component of this.

So massive graph technology that can keep track of relationship between myriad things, and effectively, when I switch context, I'm just looking at a different sub set of this massive knowledge graph, so that's one big component. The other component is going to be clearly machine learning models that help curate and maintain the knowledge graph.

But somewhere in there, at enormous scale, which we now have available to us, that is a solvable problem. And I think you know trying to look forward another five or ten years, what we think of as big computational problems will seem small. The directionality of the capacity to take on enormous problems like this just keeps getting bigger.

Tom L.: How much do you think that there also is just an implicit level of trust that people are willing to your point before, there's a mindset shift, part of that mindset shifts is just trusting that there is a—when I mentally get to a place that could be fundamentally different than today—I trust that the methods, everything you've just described is actually in place, so I'm going to take that leap, I feel comfortable where I'm going to land. Do we also have a bit of a trust issue that we have to work through?

Jason B.: I think less so in the sciences, more so in the non-science areas. I think if you're a scientist, and you are trying to understand concepts for a particular chemical synthesis, or a biological reaction, I think the amount of knowledge required to live and breathe in that domain helps you weed out the noise much more effectively, and see sort of the incremental insight as you're cursing through the concepts, than more opinionated things like policy and politics, and we won't go there in this podcast.

Tom L.: Fair enough. Probably better to stay away from that.

Jason B.: I also think science has the

advantage of, as a requirement, being verifiable and repeatable. And if it's not, it quickly becomes questionable. I don't want to say wrong, but people question it. So I think the sciences, in the sciences, it's easier than in the non-sciences.

Tom L.: Okay, that's fair enough. Would you also then maybe compare and contrast how this might play out if you were to look at something to say clinical development, which is maybe less complex, some might argue, than just say research as far as the nature of the questions you're trying to answer, the challenges you have ahead of you. Would you draw a difference then also between what you see in clinical versus upstream in the research space?

Jason B.: Oh, another very good question. There's some concepts that come directly out of complex systems theory, which is a fascinating subject, and there's multiple resources. There's an interesting sort of overview in a book called The Quark and the Jaguar by Murray Gelman about what happens at the Santa Fe Institute.

But in any event, one of the things that complex systems theory can illustrate is that in order to manage complexity, you must do it at small scale, and if you want to have large impact, you can do it at large scale. And sadly, all the examples are, or most of the examples are military, but they really do make the point. So imagine if you will, a modern naval warship out at sea, it is exquisitely designed for a relatively low complexity environment. It can see threats over the horizon, it's bristling with electronics, it really doesn't need to worry about the water, or what's going on inside it from the microbes and biology of what's going on.

And its complexity matches the environment that it's in. And the minute you bring that warship into the littoral region, into a harbor, where the complexity of the environment goes up, but the battleship cannot adjust, where there's cars and traffic on roads and buildings and small boats all over the place. Not only can't the ship navigate into the harbor, but it becomes very easy for a situation like the USS Cole. Where few people in a rubber raft can do serious damage, because of

the complexity mismatch.

So how does this tie back to your question? I think one of the things that I.T. or digital or technology does very well is manage complexity and encapsulate it. So you can see digital as a way of encapsulating complexity which must be managed with equal complexity, such that one level above it your problem domain is now lower complexity and can operate at a much bigger scale.

So fine point, if you want to go find new biological targets in R&D and pharma, you do that at very small scale with very sophisticated equipment, working on very small teams. If you want to test a drug and see if it works, that's actually a low complexity problem, but it's done at massive scale. So you're getting enormous impact, and you have the challenge of managing it at large scale, and therefore, in order to be able to do that, you have to keep its complexity commiserate with the scale in which it's going to operate.

So I do think there is a complexity scale awareness that can be applied to what we do, and it will help us avoid oversimplifying or unnecessarily "complexifying" if there is such a word.

Tom L.: I think we can go with it. We'll coin that new word if it wasn't already in existence.

All right, let's close if we can with a look to the future. So we covered a lot of ground today, we started on the point around what's getting in the way of progress, and there's a theme through today's discussion around just the mindset shift that I think it becomes important.

So imagine if you will that mindset shift has occurred, what does the future then hold for our industry? Again, thinking about digital as a thread throughout this. What's on the horizon for us?

Jason B.: A couple of things, so first, the

digital world has its own evolutionary pace and its own adjacent possible. And I think that innovation will continue to accelerate non-linearly the way it is right now. I think people over credit the industry. When the iPad first came out, I clearly remember people saying oh my gosh, amazing to think that you could run a computer without a keyboard.

And what I think people didn't appreciate was that there have been touch screens and keyboardless interfaces for 50 years, going back to fluke screens on manufacturing equipment. The real breakthrough that enabled the iPad was the revolution in battery technology. And people suddenly forgot that the Apple Newton was the exact same experiment 25 years earlier, but could not do it because of battery technology. So it's really hard to see what's going to be in the pharmaceutical adjacent possible in the near future in terms of digital.

But with that said, first, we live in the disposable world where people buy an iPhone and three years later, they're ready to recycle it or discard it and go get the next iPhone. But in our pharmaceutical world, we do not have that kind of digital agility, and I am in no way saying that we should be, but our cycles are much longer and our costs are much higher, and the number of people who need the solutions that we need are much smaller. So the whole environment moves differently, but I think one of the lessons there is to think about building digital solutions with less rigidity.

Being able to componentize the way we operate such that the cost of change comes down. And that that will require some evolution in the vendor space and some evolution in our thinking, and the evolution of interfaces between things. But I think the next big thing that we'll see is the ability to knit together more seamlessly, pharmaceutically related digital components, to give you more agility and to reduce the cost of changing the piece parts, rather than being locked into a rigid end-to-end solution.

That's five, ten years down the road. But it's also

sort of an awareness that is a big problem statement today. We tend to build solutions that are sort of anti-agile, and therefore, they become, the flipside of that, is they become fragile because slightest change in their environment, a la the complexity of the environment that they're in makes them very difficult to change.

I do think looking ahead, we will see more and more and more citizen data scientists in pharma, and I think that is a really healthy and exciting world, and we will see more and more and more modeling and simulation and scientific assertion without having to do wet science, and I think we're just scratching the surface of that.

I'm trying very hard not to use jargony buzzwords like digital twins, when what we're really talking about is modeling and simulation. And some of that will be derivative, and some of that will be machine learning AI-like, but I think the next big wave is the emergence of empowered citizen data scientists in the various communities within pharma research, clinical development, and manufacturing.

I also think there's an opportunity to really revolutionize what happens in laboratories, and it's a very complicated space right now with dominant players carving out various ownership of different things. But I actually think in the future, in a highly compartmentalized agile world, where all devices in the lab are IOT devices and can talk to each other much more seamlessly, we'll be able to, my favorite phrase, we will be able to create self-documenting processes.

The goal for transforming the lab is to eliminate the need to document your work after you've done your work. The act of doing your work should document it for you, and that's absolutely achievable. But again, it requires rethinking how we work, rethinking the history of lab notebooks that were then incarnated into electronic lab notebooks, when the lab notebooks, you have to ask the question, do you really need an electronic lab notebook if your process

documents itself.

And so I think self-documenting processes will be an anchor point for transforming the labs. I think modeling and simulation across the board will be incredibly powerful, I think there will be more and more in silico science and in silico scientists, driven by its value and driven by the generation of people who've grown up with it, and driven by the digital adjacent possible that enables those people to do those things that were just not possible 20 years ago.

Tom L.:   Well, great insights, and a good look into the future. Again, I agree with the perspectives there, and I think it's a great way to sum this up.

Along the path to get to the point is that the first part of our conversation, but a very helpful perspective as you look forward and certainly seems within reach, but certainly things obviously need to happen in order for it to come to fruition. And it just comes down to the time frame, right? All those are possible, but when will we get there?

Jason B.:   And it's the recognition also that we are coupled to the evolution of all the things that enable it, and when all of those things are ripe, it will explode across the community. When all of those things aren't ripe, it just continues to percolate.

Tom L.:   Yes, and slows that evolutionary pace.

Jason B.:   Exactly. We will all invent the phone for pharma at some point when all of the pieces are right, and we'll be amazed that we all thought of this at the same time. But it's because all of the adjacent things that are evolving ideas, concepts, technologies are evolving with us.

Tom L.:   Yes, well said, and a good way to close this discussion. I appreciate the insights and perspectives, and again, that look into the future. So thank you Jason for joining, and again, really appreciate having you as a guest.

Jason B.:   It's genuinely my pleasure, thank you so much for inviting me. I love to talk about the history of innovation, it's great. Thank you again, very much appreciate it.

Tom L.:   A huge thank you to Jason for joining me in this discussion. As I reflect on it, we began with a common sentiment across all industries, which is a need for a mindset shift as a critical requirement to continue the evolution of how we do what we do.

The digital world has its own evolutionary pace and its own adjacent possible - innovation will likely continue to accelerate non-linearly the way it is right now. Specific to the biopharmaceutical industry, Jason talked about our industry as information generators rather than tangible product makers. With an ever-growing volume of data, our collective knowledge continues to grow. However, a persistent challenge is how data is managed and utilized. Looking to Wall Street for inspiration, Jason shared that quick access to data sets, rather than an emphasis on managing data sources, is a process biopharma can borrow to help answer unique questions faster.

Two forward looking perspectives on the industry from Jason for us to consider include:

 (1) the empowerment of citizen data scientists leading to more modeling and simulation and less wet science and

 (2) the creation of self-documenting processes that challenge the need for things like electronic lab notebooks.

Once again, thank you Jason for a wide ranging and informative discussion infused with a historical references!

Connect with me on LinkedIn and share your thoughts and takeaways from the episode. As always, remember to like and subscribe to Driving Digital in Biopharma on your favorite podcast platforms so you don't miss an episode. And until next time, this is Tom Lehmann with Driving Digital in Biopharma.