



DRIVING DIGITAL IN BIOPHERMA

AUDIO TRANSCRIPT

Lars Fogh Iversen: “I think we are still in a situation where we have to build trust and confidence in AI and in machine learning in the pharmaceutical industry and in biopharma. And that trust is then being generated now as we speak, and that trust will increase over the next couple of years. So, in five years' time we won't question the validity of in silico predictions anymore.”

Tom Lehmann: Hello and welcome to Driving Digital in Biopharma. I'm your host, Tom Lehmann.

Our guest for today's episode is Lars Fogh Iversen. With a tenure spanning 25 years at Novo Nordisk, Lars began as a research scientist and joins us today as the Senior Vice President for Digital Science & Innovation. In his current position, Lars and his team are looking to improve and accelerate research and early development through the innovative use of data and digital tools.

In my conversation with Lars, we discussed three areas of particular focus at Novo Nordisk. Number one, innovative laboratory automation. Second, data management. And finally, AI and digital research. I'm excited to welcome Lars and his enthusiasm for how digital will transform research and early development.

Welcome Lars to Driving Digital in Biopharma. It's great to have you here today.

Lars Fogh Iversen: Thank you, and it's a pleasure for me to be here.

Tom Lehmann: Let's start our discussion, if we can, with a big picture view of what's happening at Novo Nordisk. You recently made a very public announcement about a newly established area

called Digital Science and Innovation. Can we start with the broader vision for that group?

Lars Fogh Iversen: Absolutely. It's a new area that we have established where we will try to accelerate our digital journey at Novo Nordisk, especially focused on Research and Early Development. We realized that we had done significant investments in our digital journey, but has been a little bit too scattered and a little bit maybe too bottom-up. And we found that this was the moment to invest more and accelerate some of our investments and our digital journey. And that's why we formed this new unit.

Tom Lehmann: And so besides the focus on Research and Early Development, so from a life cycle standpoint, are there other areas of very specific focus for this group as you bring together, as you said, some of the things that were perhaps a little more scattered or bottom-up? What's the focus of it?

Lars Fogh Iversen: Yeah, I think we have established three focus points that are actually connected. One focus point is around laboratory automatization where we'll have a unit that will try to drive further and faster automatization of all our laboratories in Research and Early Development. I think this is crucial because this is our data intake and our data generation, and we need to accelerate that part. And we do believe that we'll get more data, more high-quality data and better annotated data by doing more automatization. So that is one focus point. We also want to focus on getting other data types that we purchase or collaborate on into our system as also as a focus point in getting data in.



Then the second focus point is around our data management and infrastructure that we want to have built out to being state of the art. And I think what we realize is that, especially in Research, the infrastructure and data management systems that you need to have is a little bit special compared to what the needs are in the rest of the company. And that's why we are focusing on making a special branch out of this to cater for research needs.

The third focus point is a unit that will focus on AI and digital research. And that is just a major collection of all disciplines in data science that you need in research to actually progress your project portfolio. So that is the three layers: generating data, keeping good control and optimizing your data, and then utilizing your data with state of the art, data science.

Tom Lehmann: So maybe if we walk through those three, then that'll be interesting. And I like almost the layers, if you will, starting with the base automation and where the data is generated. Talk a little bit more, if you can, about that to say, how far are you on that automation journey? Because we've certainly have seen in the research space, lots of good examples of automation, but in may be very specific areas, how does this start to connect and extend beyond where we have been over the past, whatever it is, five to ten years?

Lars Fogh Iversen: Yeah, I think we have tried and we are currently building larger end-to-end automatization systems for us, especially in the protein and peptide space, where we do a full end-to-end automatization to generate more proteins and peptides and collect all the data surrounding our proteins and peptides in an end-to-end fashion. So, we have these very big projects where we do really end-to-end automatization as one part. Then we have other parts where we can call that more distributed automatization, where we would have single cells that is fully automated, not end-to-end, but for single tasks. And then finally, what we see is a level of automatization where we go in and work more with the cobots in the laboratory, working

closely together with the bench scientists and the research associates. So, I would say that's the three layers of automatization that we are embarking on in our laboratories.

Tom Lehmann: And are you finding on that journey that, I guess the examples and the inspiration exist within our industry, or is there opportunities to look outside the industry to really push the envelope here, if you will?

Lars Fogh Iversen: I think there's for sure inspiration within the industry, but also outside of the industry. I find most of my inspiration in the startups. I think if you can do a new biotech greenfield and build it around a digital foundation then you have a great opportunity to do the right automatization that you need to cater for your purpose. So, I find it that as a big source of inspiration. Then naturally, we're also looking into other industries, and no doubt that I'm a Tesla fanboy, to see how they collect data to facilitate self-driving cars and how they orchestra that and how they use AI in a very smart way. That's also a point of inspiration. So, I think there's multiple layers of inspiration both inside the industry but also outside of our industry.

Tom Lehmann: And I imagine with that, or as you move from your first layer to that second layer, that the inherent challenges of that, the data management, the data infrastructure, as you said, become very apparent as you increase the variety of the data that's out there, whether it's internally derived or whether it's external data sources. So maybe if you can, talk a little bit more about what that second layer might look like and how do you think what the future might include around solving that challenge?

Lars Fogh Iversen: Yeah, I think one of the key discussions that we already undertook was to have a bespoke IT organization to support us. We didn't really have that before, but I think in research because we have really a large and diverse data pool and it keeps diversifying. Our researchers will find a



new data source every single day, they will plug in new instruments every single day, and we have to cater for that flexibility and that diversity which makes our needs special. And that's why we have focused a little bit on trying to make a bespoke IT organization for research needs. We are coming from a situation where maybe they want to—in a large corporation like Novo Nordisk—they want to box in research from an IT perspective together with the product supply and commercial units that have very different needs from ours. So one part of the solution for us is to go in and allow ourselves to do more bespoke models for our key data and work hard on that. So, we need to increase our flexibility in how we organize our data and also our infrastructure.

Tom Lehmann: And are you finding just organizationally then that those worlds become almost one, whereas historically there might be the business and IT, because technology is so core and central to what's happening in research and early development, that the distinction between those two groups is getting smaller and smaller, and it's almost becoming one connected group, if you will?

Lars Fogh Iversen: Yeah, that's my hope. We have to see this work because this setup is brand new for us. But it is my hope that it will be a seamless partnership. And also, I think it's something that we need to review. We have also agreed with our IT organization that we need to review our organizational set-up, our roles and responsibility maybe four times a year to see if we are actually tracking right. It's not something that you can go in and say, "This is how we do it." And then leave it be for one or two years and then it will work. I think it will require constant reviews.

Tom Lehmann: And I suspect that's connected to just the pace of evolution we're seeing in this area?

Lars Fogh Iversen: Absolutely, and that's the

dynamics. And I think, at least at Novo Nordisk, we have not been used to this kind of pace and this kind of technology development, but I think we are adapting right now.

Tom Lehmann: All right. So that takes us to the top layer - if you will. So, when you laid out three things at the beginning part here and just speaking of the pace of evolution here around AI and ML, which is a topic we've talked about in other episodes here in this series. If I step back, as an industry, we've been exploring a variety of different type of in silico methods for decades, quite frankly with, I'd say, some degree of success and probably a lot of disappointment of just hoping it was going to achieve more than it has. What's your sense here? Are we in another hype cycle with artificial intelligence and machine learning in your area? Or is it going to have the disruptive impact that we all hope that it could?

Lars Fogh Iversen: I don't think we are living in a bubble. I think it's real. I might question whether it is going to be disruption compared to transformation. Because I think where we see real disruption is where you can go in and do a full digital value chain around an industry like banking, and that we cannot do in the pharma industry because we're bound to physical products, the drug, the tablet that the patients need to take. So that's why I think it will be transformative rather than disruptive. So we'll see that these methods will transform the way we work, but it will not be overnight, and that's why it will not be a disruption. But I'm really a strong believer in that AI and machine learning will transform our industry over the next decade.

Tom Lehmann: And do you see it be more an augmentation or replacement of things that are happening today?

Lars Fogh Iversen: Yeah, I think, again, it will start as an augmentation and then it will be more than that going down the road. But I think we are still in a situation where we have to build trust and



confidence in AI and in machine learning in the pharmaceutical industry and in biopharma. And that trust is then being generated now as we speak, and that trust will increase over the next couple of years. So, in five years' time we won't question the validity of in silico predictions anymore.

Tom Lehmann: If you were to pick a few places where you think it is likely to have a bigger impact, what do you think those will be?

Lars Fogh Iversen: I think it would be, from a research perspective, it will be on the entire value chain. We will be able to pick out better targets pointing to the right modalities to address those targets, using AI and machine learning. It will affect...and we see that already, the way we do compound design, where we can do much more in silico and less in the wet labs. So that will accelerate the hit to lead to development candidate generation. It will decrease the amount of in vivo animal experimentations leading to better timelines. And it will also accelerate biomarker identification leading to better outcomes of our Phase I studies, so we'll be able to save resources by only progressing the right assets into Phase II and III. So I think it will have impact on basically all of our disciplines that we need to have in biopharma, in research and early development, but also in development.

Tom Lehmann: So I certainly heard acceleration in there, a couple examples of that. And I think towards the end, also talking about maybe the quality of the clinical candidates, do you see it being a combination of both? So, on one hand, it is going to create the opportunity to go faster, but it's also going to create the opportunity to create notably better clinical candidates?

Lars Fogh Iversen: Absolutely. I think there's two major things here. One is to increase the innovation bar for what we bring forward to the patients. I think AI and machine learning will do that. So we will see

better drugs with a higher innovation level coming forward to the patients, being able to address undruggable targets, but also with higher precision than we've ever seen before. And that's increasing the innovation bar.

And then the second point is to accelerate and make us more efficient in what we are doing. So, we are doing this with these two purposes: to increase the innovations and also to become more efficient. And I think the innovation part is especially important in research. You see in other parts of the organization is more for gaining efficiencies, but for us in research, raising the innovation bar is extremely important.

Tom Lehmann: So, what gets in the way of that? What do you see as the blockers?

Lars Fogh Iversen: I would say, speaking from a Novo Nordisk point of view, I think that there are some blockers surrounding culture. The way we have been conducting research historically is still a blocker on how fast we can progress within the digital methods. So, to overcome these cultural barriers, we need to work hard and efficiently to accelerate. So that is one thing that we have to take quite seriously, the cultural parts in our organization to embrace the new digital agenda. And it's not a small thing, it's actually a big thing. And so that is a major thing.

The second one is access to talent. I think we see that the whole and entire industry are competing for the same talent. And not only are we competing within the industry but we are also competing with other industries around these talents. So that would be the second major blocker.

And then thirdly is really to generate enough high-quality and relevant data. Can we do that? And I think the winner in the industry will be the ones who can actually overcome these three blockers.

Tom Lehmann: Let's go through each of those if we can. Because I think that there are recurring themes



in some form in previous episodes here and it's something we broadly see across the industry. So maybe if we can, start with culture, which is an interesting one of itself. And maybe I'll ask the question in the sense of, is there a difference that you're seeing between some of, maybe the cultural challenges that would exist in research versus early development? Is one further along on that journey? Is one, do you think, going to be easier to work your way through?

Lars Fogh Iversen: No. What I see is that certain disciplines in research are actually further ahead than others. So, if you take, for example, medicinal chemists, they have a longer track record for using digital tools and automatization to do their research than what I find in pharmacology. So, within research, I think there are different groupings that are more adapted and have used digital tools for longer than others. And likewise, in early development, you see some groups have been doing PK/PD modeling for a long time, but the guys who maybe have been working in biomarker identification has been working by more traditional methods. So, I wouldn't say that research are further ahead than early development or developing, but I will say that different factions within these groupings are further ahead than others. So there are different maturity levels between the different groupings.

Tom Lehmann: And would you then make the connection...You mentioned the talent side to say, where does the talent sit in helping to progress the culture? You can set the tone as an organization, but the individuals themselves and their behaviors are going to drive a lot of what that culture is going to look like. So maybe talk a little bit the talent side to say, where is that challenge coming from? And how do you break free from that? Because as you said, everyone is dealing with the same challenge here, but what can you do to stand up and be a little bit different here?

Lars Fogh Iversen: I think we've tried different tools. One is to build these beacons or lighthouses, if you will, of digital examples and let them inspire others. The other ones are to make more bottom-up initiatives to let people get rid of boring work so they can actually spend their time on more productive tasks. And so, there are different ways to do it, but I think the best way is to inspire by example and try to inspire the organization to use the tools and try to tell a story that they know there's also something in it for them. And if you can see that you are not only doing it for accelerating the things we need to do for the company, but also there's something in it for you, then we will move faster.

But it is extremely difficult. The best organizations that I've heard really making it right is when you do a greenfield approach where you can actually build it from the ground as with digital core. But I think when I look into the different parts of pharma and biopharma with established companies, we are basically struggling with the same problems and the same cultural problems. And I haven't really heard of any of the major companies out there giving us a recipe on this is how we do it, unfortunately.

Tom Lehmann: No, I think that's right. I think various companies are at a different state of their journey -if you will. And then with that, the culture is either embracing that or in some places resisting it. But you're right. I don't think that standard isn't out there yet. And I think as an industry, I think we're starting to move in that direction. And I think as you said, the examples are what's going to move people along on this. And then certainly the talent, right? Beginning to have more digital natives or more people who are just comfortable with these tools. So maybe if we can jump there to say, what's different in this era around acquiring and retaining and developing talent in this new digital age?

Lars Fogh Iversen: Yeah, I think we'll have to get used to that these talents will come and go quite easily, because there's great opportunity space but also because I think they will work differently from



say what I have done. I've been with the company for 25 years, and I think that will not be something that we'll see with these new digital talents. They will probably have shorter journeys within the companies for maybe two or three years. So, our approach to get them onboarded and being productive and thrive fast will be very different from what we have done in the past, because we need to get them on board fast and let them do what they need to do faster than ever before.

And then I would like a situation where when they leave us, we will not look at it as a loss, but as a new alumni that will carry some of our culture into the next position. So, we'll build networks, more or less, just like the universities have done over time, that they will come to us, stay with us, they will learn things, they will have great resource, and then they will be part of our future network when they move on to the next job

Tom Lehmann: And do you see in that network, you mentioned the university, is part of that network, the feeding side of the talent, meaning it's coming out of university into industry, places like Novo Nordisk where you've got a different level of connection upstream? And then ultimately, as you said, there's an alumni network that develops. But before you get to the point they're an alumni, they're coming from somewhere. So, does that create an opportunity for a different connection with universities?

Lars Fogh Iversen: Yeah, I think so. I think we have to be fast out of the block to connect with these talents than we have been ever before. And I think we have to make ourselves attractive in a whole new way. I think that the pandemic have actually helped us a little bit to be more modern in the way we work, and have a different view on what we can call a flexible work culture, that have been accelerated in the pharma industry over the past two years, that makes us a little bit more attractive. But I think we have to step up in the way we handle the new talents compared to what we have done in the past.

Tom Lehmann: And if you were to look across the industry, do you think the industry is attractive enough for this type of talent, or is there real work to be done? Because as you said, there's lots of other options that are out there for individuals at this point.

Lars Fogh Iversen: Yeah, I think so. On the positive side, I think we have a strong purpose to offer. What could be more exciting than curing chronic disease? Really doing something fantastic for humanity. I think in biopharma and in pharma, we do have a super attractive purpose on what we are doing compared to some of the other industries. And I think that is going to be extremely meaningful for a lot of talents out there to work on curing and preventing disease. So, I think we have something good going for us compared to other industries in that respect.

Tom Lehmann: Absolutely. And I think that's something that we're seeing, particularly from a talent standpoint, that mission and purpose, they're looking for something more than just the job they're doing or the compensation they receive for doing that job. And I do think that that is something unique about this industry that has to be a huge part of that value proposition, not only to come into the industry, but also to stay and actually make that type of human impact. But, I think, over time it's going to be something that will allow this industry to differentiate.

Lars Fogh Iversen: Yeah, absolutely. I think that this is something really strong that could work for us as an industry compared to other industries. Because the compensation packages that these talents will receive will bring them into a situation where the monetary part of a job will not be an issue, it's more the purpose that will be appealing to them. And there, I think we have really something to offer that the other industries will envy.



: Let me take that to go back to a few things you said before, part of the value of a lot of what you're doing within DS&I is focused on acceleration, focused on bringing higher quality candidates into the clinic, which obviously is, again, the opportunity to connect to something purposeful here, if you're working in that space. You did mention though that one of the things that you believe is a blocker here is getting enough high-quality data to really drive a different type of outcome. And you also mentioned the need to increase trust and confidence. Let me try to connect those points of view. What's really going to be needed in order to increase the trust and confidence to actually apply these types of tools and really see the impact that we've talked about?

0000 : I think it is the results themselves that will convince the projects and the people working in the projects that this is actually reliable. Earlier today I had some fantastic interactions with a few projects, where we see that these methods are actually doing really nice predictions. And when you see those data, and these results, these predictions coming out, you really get excited. And I think everybody can see when you see some of the results coming out of these AI, machine learning based methods, that it will create excitement among scientists. And I think that's the way forward. Just to come forward with the good examples and being good to do the storytelling around them, and then people will be convinced that this is the future. I think this is absolutely the way forward.

000000 And do you see that same opportunity at more of a portfolio or governance level? So, lot of this conversation might be down within a project team, but at some point, raise it up a level or two, an organization's making really important go/no-go decisions, progression decisions, investment decisions, how does this connect into the ability to maybe make different types of decisions or augment decisions at that level?

000 /0 : Yeah, what we see now is that we do it on project by project, where we have decision frameworks, especially for Phase I, II, and III outcomes that will give us strong guidance whether to progress and/or accelerate a given project. And I think these frameworks are getting more and more useful. And I think we'll see more of that going forward. But the key question here is that, can that be done on a portfolio level? And right now, I would say no. Because again, you have to build trust in the methods. And now we are not talking about trust within the scientific community and in the company, but trust with senior leaders, because it is the senior leadership that normally takes portfolio decisions. And we are not there that they actually trust that AI and machine learning predictions on portfolio levels are good enough for them to even assist us in making decisions. So, I think that's a bit out in the future.

0000: And with that, I guess it comes down to, sitting in that room, you have years and years and years of experience of the individuals who are making those types of decisions. And these are really critical decisions for the overall company, so as you talked about before, that trust, the confidence, the examples, it all has to build up to a point where people feel like, "Okay, I can take my instincts and add to that what the computer tells me." And then from that make a better decision. And then it's just that we're not there yet, perhaps further out in the future...

0 &0000 Yeah, I think what's important is that we start now so that we actually start to make a portfolio picture and portfolio predictions that we can look at when we do decision making at a senior level in the company, thereby starting to build trust. And the predictions might be way off, or we don't trust them for a start, but as time move along and the prediction becomes better and more advanced and we gain trust, we will use it as a second opinion. And then from that second opinion, it might sometimes be turned into a first opinion. So, this is something I think that is important that we start



building, and then get used to having a digital-portfolio guidance along with us in our decision making. But we'll not use it for a start, we'll just use it for inspiration and see if there's something in there that we find that can support us in our decision making. But down the road, I think we will have a digital channel for us making decisions. Because we have it on a project-by-project basis now, and naturally it will go into a portfolio game, but we are not there yet. But I think it's important to get started.

Tom Lehmann: Well, and I think that that lesson probably exists across a lot of the different areas, so you got to get started somewhere. And maybe, again, you're not all the way there, maybe you're not handing it over to a different way of operating, but you're starting to build that fact base and that set of data in order to improve over time. But if you don't start now or don't start somewhere, you will continue to talk about it and five years from now, we'll still be talking about the same thing with making little progress.

Lars Fogh Iversen: Absolutely. And maybe you'll also start with certain parts of your portfolio and not the whole portfolio. Start with the areas where you have the most data and where you, from experience, know that this is an area where I can do more reliable prediction, not only on your own portfolio, but also on competitors' portfolio. So, make a tabulation of your portfolio where you want to start and then build from there.

Tom Lehmann: So what's your sense, if you look across the industry, a lot of what we talked about today and even this last topic, is something that is being looked at in various forms by most organizations and various different types of collaborations for the industry. Where do you find that balance point between something that is truly differentiated, competitive, proprietary, and you need to work on it without any collaborators, versus,

we need to come together as an industry and just solve some of these common challenges together. How were you thinking about that? And how do you find that balance point?

Lars Fogh Iversen: I think there is a lot of things we can deem pre-competitive that we can collaborate on, going from building the right data management and infrastructure parts we could share there and no problem. We could also really collaborate on ontologies, taxonomies, not only between the industry, but also between the academicians. We should share all that so we can normalize our data more easily across the industry and exchange data and accumulate data more easily. I think all of that, we should go into collaboration about.

Then there is the data itself. I think there will be a rush for us to generate proprietary data that will give us a competitive advantage. And everybody is trying to figure out what are going to be our proprietary data sources that will make our company unique and distinct from the others. So that's where we'll see a fair amount of competition. But there will also be data sources that will say, that's not really a competitive edge, but we can see if we don't go together, we won't have data enough to actually go into having true AI/machine learning ready for us. And that's where we might want to collaborate where we can lump our data sources together to get something meaningful out of it. And if we don't lump it together, none of us will have AI or machine learning platform to accelerate our developments.

Tom Lehmann: And do you think the industry is moving fast enough to collaborate, or there is some opportunity to really rethink the way it's working today?

Lars Fogh Iversen: I think, and what I sense from my peers is there's great desire, we just have to get organized.



Tom Lehmann: Okay. Which, again, it starts with desire. So that's encouraging to say the least there's a recognition of it, there's a desire to do something, and then to your point, the catalyst to get organized and to actually move that along. And I think, again, a lot of what you just said, there is plenty of opportunity, things that are pre-competitive for this industry to work together for the betterment of the industry and then ultimately the patients that we serve, it's just a matter of, as you said, getting organized and getting real momentum behind it.

Lars Fogh Iversen: Yes, definitely. I see great opportunities also to share negative results. We have a great deal of waste in the industry because we don't share enough.

Tom Lehmann: Yep, indeed. All right. Well, let me bring our conversation to a close by looking out into the future. So we'll do some future-gazing and when Digital Science & Innovation, your newly established group, is wildly successful, what major scientific problems have you solved over the next five to ten years?

Lars Fogh Iversen: Well, I do hope that we have been part of bringing forward curative treatments for chronic disease, but also being able to contribute to more prevention in chronic disease. Our ambition will also be to come forward with what we at Novo Nordisk and maybe also other places called 5D offerings, where we take a more holistic approach towards our patients with the drug, the device, diagnostics, data from the patients, and then a digital solution on top, and hoping that we can be part of that 5D holistic care around the patients going forward. So, if we can do some of the three things I mentioned here, 5D, cure, and prevention, I **would be tremendously proud.**

Tom Lehmann: I think it's a great ambition to have, and certainly you're on the right path. And I think when we started the conversation, that

acknowledgement of needing to do something different, bringing together the scattered pieces and some of that bottom-up approach into something much more strategic and top down. And clearly a big vocal ambition for the organization is quite significant, so I do wish you the best of luck on that journey, and we'll be excited to watch and learn as you progress. So, thank you for joining today. I've really enjoyed the conversation.

Lars Fogh Iversen: Yeah - and thank you very much. It's been a pleasure for me to be in this conversation with you.

Tom Lehmann: A huge thank you to Lars for joining me on today's episode.

Our conversation focused on three areas for Novo Nordisk's new digital science and innovation group, spanning laboratory automation, data management, and AI and digital research.

With a growing volume of new data available and an increasing need for flexible and modular data infrastructure, it's interesting to hear how Novo Nordisk adapted their IT organization to a bespoke model for research. Similarly, as artificial intelligence (AI) and machine learning (ML) continue to transform all industries, I appreciate Lars' vision for the breadth of opportunity to apply AI and ML across the research and early development lifecycle, and also the realization that the various groups along that continuum are at notably different stages of their maturity and the impact they're having on the business.

Another theme we discussed—and a recurring theme in many of our episodes—was around talent. What I found interesting from Lars was his recognition that key talent may only be in an organization for a few years, and thus the consideration of an alumni network might need to be cultivated.

As I close today's episode, I'll leave you a few questions to consider: How are you building trust in the data used to make critical business decisions?



How can we extend the working relationship with people that have left our organization to pursue a new opportunity? Are you open to collaborations celebrating pre-competitive successes as well as sharing failures to promote industry progress?

I invite you to connect with me on LinkedIn and share your thoughts and takeaways. Remember to like and subscribe to Driving Digital in Bio Pharma 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.

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