Keys to Intelligent Industry

with Caroline Segerstéen Runervik and Fredrik Gunnarsson

EP 20

How to rethink the industrial ecosystem, with **Peter Carlsson**, Co-founder, and **Sid Khullar**, Co-founder and CEO, of Aris Machina

EP20

How to rethink the industrial ecosystem, with **Peter Carlsson**, Co-founder, and **Sid Khullar**, Co-founder and CEO, of Aris Machina

Disclaimer: Please be aware that this transcript from the Keys to Intelligent Industry podcast has been automatically generated, so errors may occur.

[Guest] **Sid Khullar**

Similar problem in manufacturing, you look for a needle in the haystack there, which one signal out of the 80,000 is indicating a yield loss. I think one of the core power is being able to point AI in the right direction where a human is hitting their limits.

00:00:23 [Host] **Caroline Segerstéen Runervik**

Welcome to our next episode of Keys to Intelligent Industry, which is the pod about how technology is reshaping the industry to become more and more intelligent. How companies can transform operations, products, and of course, business models. And in the end, how to navigate the convergence of physical and digital world. And of course, today with me as usual, I have my great co-host, Fredrik. How are you today?

[Host] **Fredrik Gunnarsson**

Very well, thank you, Caroline. Very well. We're sitting in a very sunny and warm Stockholm today, so you really feel this summer coming.

[Host] **Caroline Segerstéen Runervik**

And you see all the people outside, right? It's like the Swedes are opening up. They're on the streets, happy, having BBQ, talking. It's a great time of the year.

[Host] **Fredrik Gunnarsson**

Yeah, no, I mean, really. It's like we're coming out of our little nests and all of a sudden come alive with, as you say, the BBQ and the sporting and everything. But talking about sport, actually, we used to have a marathon here in Stockholm just a few days ago, and then there's Vätternrundan this weekend. I know, Caroline, that you used to run the Vätternrundan a couple of times. Are you going to Motala this weekend for the run around the lake?

[Host] **Caroline Segerstéen Runervik**

Thanks for telling that story. So, for people who does not know, it's basically a race around the lake, 300 kilometres biking. So yes, both Fredrik and I have done it. It's a long time. It's basically too long, Fredrik.

[Host] **Fredrik Gunnarsson**

Yeah, no, I'm not going to do it this weekend, no. It's too painful.

00:01:47 [Host] **Caroline Segerstéen Runervik**

I think we go to the archipelago instead, right? Anyway, so today, we have two great tech leaders with us here, which comes with a unique perspective on how to build, scale, and rethink the industrial ecosystem. Two engineers with experience of large-scale industrial transformation, but also truly entrepreneurs. And you have had an ambition, you started to really build the greenest battery of the world, a story we will come back to. And now, gentlemen, you have joined forces again, to build something very exciting to talk about more. So welcome, Sid Khullar, CEO of Aris Machina, and Peter Carlsson, co-founder and previous CEO of Northvolt. Welcome.

[Guest] **Sid Khullar**

Thank you.

[Guest] **Peter Carlsson**

Thank you very much.

[Host] **Caroline Segerstéen Runervik**

Maybe we should start a bit with your personal story and how you actually met. But I'll start with you, Sid. So, from Apple to Northvolt and now Aris Machina, from San Francisco to Stockholm, maybe you tell a little bit your journey and what made you take this journey?

00:03:02 [Guest] **Sid Khullar**

My journey, so I grew up in India, in New Delhi. I did my early education there and then moved to the US. I studied a lot of sensor physics and sensing, signal processing, AI. And that was the common thread across the career, even now. Yeah, and worked at Apple the longest throughout all my jobs before. I was working on a few different projects. I got very comfortable working with hardware, even though I was building software. But there was just this like constant love for doing something physical or touching something that, is in people's hands. And it came from my work in that company. It got deeper. Yeah, and then again migrated second time to Europe. So 2 time migrant, I sort of have a FAQ on migration. And met Peter, and I will let Peter tell that story, how we met. Peter had this grand, ambitious vision, still does, on how do you build a home grown, deep technology company. And that kept me really fascinated. And one thing led to another, learned about manufacturing. And we joined forces to start this company and raised around last year and got going.

[Host] **Caroline Segerstéen Runervik**

So Peter, over to you. So now maybe tell a little bit, how did you then meet?

00:04:35 [Guest] **Peter Carlsson**

We met in Helsinki in Slush 2021. I was there to give a keynote, but the Slush event is around the side events. There was a couple of people that I trust a lot that said, you know, you should meet this guy. He's probably one of the most AI native, most skilled persons in machine learning in the Nordics right now. And we met, had a very interesting conversation, and then I worked for a couple of months with persuasion and managed to get him on board on the Northvolt journey, starting with the task of trying to build an agentic support to our R&D process, even though we had several 100 people in the R&D organization we were very bottlenecked by these exceptional system architects. And we needed to unleash that bottleneck and we thought that technology could do it. And Sid built a team, made such a good job that he got responsibility for the entire digitalization effort. My kind of pivot moment where, you know, which later brought us to start Aris Machina was the fact that when we were struggling with ramping up that factory up in Skellefteå and I knew that we were pulling so much data up in the cloud, I couldn't see a behavior change on the manufacturing floor. And it was actually at that point of time where I called Sid, asked him to bring a big bag for a long stay up in Skellefteå and to bring some of his best people. And I basically asked him, I want to see physically on these walls, I want to see every parameter that we're that we're dragging out of the process in a structured way. Sid kind of looked at me with, you know, this is weird. Is this legal? But 3 weeks later we were looking at the massive chart of Ishikawa diagrams showing how it all hanged together. And we realized that I think we were pulling something like 80,000 signals, but somewhere around 13,000 product-related signaling was done, pulled out in the cloud. While we on the manufacturing floor, we're still working on a control plan that was focused on the cognitive capability of operators, et cetera, which is, two or three critical parameters per process step. That was like, one of these moments where you're realizing, yes, we've worked for decades to simplify manufacturing based on, you know, the human capability with system, quality systems, control plans, et cetera. But we're moving into a new era where we can unleash new computing capabilities and, really drive computer-aided manufacturing support.

00:08:06 [Host] **Caroline Segerstéen Runervik**

One of your most important...sort of task as a CEO was to attract the best team, right? And you found a star, a change agent, and you even got him to Skellefteå with a bag and there he stayed. But putting joke aside, I also hear you made a lot of good learnings, which is of course important for you coming into your next adventure, which is Aris Machina. How could you build a factory which is truly smart, which is sort of, in a way adapting, resonating, becoming more and more intelligent in an automatic way? Maybe I'm simplifying it too much, but what is Aris Machina for you and what is your sort of vision?

00:08:53 [Guest] **Sid Khullar**

We're trying to build hopefully a generational company that the best analogy is compared to Linux for factories, Linux for industry. It's an operating system that you can start using the way you want to use it the day you have an idea to build an industrial company. And if you get to a point where you have a product which can be manufactured, we also are there with you to help you scale that factory in coexistence of everything that exists today, all the MESs, the SCADA, because those are, that's the, muscular system of building a factory. And we are trying to build the brain.

[Host] **Caroline Segerstéen Runervik**

To truly enable that smart factory.

[Guest] **Sid Khullar**

Exactly.

00:09:40 [Guest] **Peter Carlsson**

And I think, a core philosophy is to enhance the capability of the key roles in both the R&D process as well as in the manufacturing process. What we normally talk about internally is, you know, for an operator, how can you create a system behind the scenes that in one way works as a helper where you can basically send a helper out asking pretty much anything about the manufacturing process and get a very rapid response. But in another way, also having on their other shoulder an advisor that catches a signal, an error signal, a slip in variation on a parameter that is not tracked on the floor and is giving you an indication to focus somewhere else because the process is drifting and thereby you can enhance productivity, you can enhance quality and unleash a wealth of further knowledge to optimize manufacturing and R&D.

[Guest] **Sid Khullar**

The reactive and the proactive.

00:10:48 [Host] **Fredrik Gunnarsson**

If you take a few steps back to the Northvolt and the battery, and there's been a lot of discussions lately about what went wrong, the idea was not to spend too much time on that now, but rather for the sake of the battery industry, let's get back to the original pitch and the original idea. Do you want to just briefly, the logic and the pitch behind the reason why you started Northvolt, and then we're going to put that into perspective of where we are now?

00:11:16 [Guest] **Peter Carlsson**

Yeah, I think actually we need to go back to somewhere around 2013, 2014, where I was together with my co-founder Paolo, we were both at Tesla. We've realized that if we want to build scale, we need to lower the cost of electric vehicles. You know, the batteries, which was, you know, 30, 40% of the cost. So how do you basically cut that cost in half? That was problem number one. Problem number two is if we would succeed with this vehicle, we would need all the world's battery production at that point of time just to produce one model. So we had kind of two major problems. The first one with cost we resolved basically both by design. We designed a new cell format and it basically had a 30% larger electrode and thereby 30% more energy with almost the same cost. And then by integrating and scaling up the manufacturing, you achieved another level of economy of scale. The second problem with, how do you unleash a supply chain where you would need the world's production? We very rapidly realized that if the world should be electrifying, which is 100 million vehicles a year, we need to build a massive amount of gigafactories in the world. And at that point of time, Europe and the world have just signed the Paris Treaty, basically defining an 80% CO_2 reduction over a couple of decades. That really needed to drive this transition into electrification of a vehicle, but also into power generation. That was kind of, okay, the world is at least going to need 100, perhaps 150 gigafactories. A few of these have to be in Europe. Europe didn't have any scaled manufacturing of batteries at that point of time. So that became the starting point of the

concept study that later led to the startup of Northvolt. The main thing that we saw when we did that concept study was that if we could utilize the energy advantage that we do have in the Nordics with renewable energy at very low cost, at very massive scale, then we could offset the differences we had in salaries, higher salaries versus the Asian competitors. So that was the concept that we then started to build the whole business plan on.

[Host] **Caroline Segerstéen Runervik**

And I assume making, Europe self-independent, right?

[Guest] **Peter Carlsson**

I mean, the thesis was that, you know, batteries is so physical, And, we're going to go also into recycling loops of batteries, et cetera. So the battery industry over time needs to be regional. And then comes the question, what would we need to do in order to drive that regional competitiveness? And that was the foundation of Northvolt.

00:14:55 [Host] **Fredrik Gunnarsson**

Clear economics and clear rationales, but it didn't work out for different reasons, both external and internal factors. But is the possibility still there for your battery players?

[Guest] **Peter Carlsson**

100%. I still believe it needs to be a regional industry. But being European or being American is not sufficient for long-term strength and competitiveness. So it needs to be a combination of being regional, but also having technical or cost advantages in order to be long-term profitable companies. And this is a little bit where I felt Northvolt was on the right path to build that. We didn't unfortunately get it all the way and where Europe is a little bit struggling right now, where we have built up a number of assets, but they are not very differentiating in their technology and setup. And if it is just a par-to-par competition with super effective supply chains and manufacturing in China, that's a very, very tough competition. All core chemistries that we're working on, that the NMC that Northvolt was building, the LFP chemistries, the sodium chemistries, they were all developed or innovated in Europe or the US and to some extent in Japan. Then, you have to give it that the Chinese have taken these into productification, making larger packages. The blade cells and the vehicle integration, they've done really, really well, much better than the rest of the world, as well as, just scaling, which they have just done so much better, which have given them a leading position.

[Host] **Fredrik Gunnarsson**

Yeah, I mean, clearly leading and it will be tough, right, in the next years for catching up if possible.

[Guest] **Peter Carlsson**

Yeah.

00:17:14 [Host] **Caroline Segerstéen Runervik**

So out of Northvolt, you now created a new company. So you took some of the assets, some of the knowledge to create something new. So maybe a couple of learnings that you took from this adventure and which was really the essence of what is Aris Machina today?

00:17:33 [Guest] **Sid Khullar**

You have to look at the next opportunity, and that's what both of us did. Within a couple of months of Peter leaving Northvolt, we were off to thinking about this. I think two or three learnings that are really core to this, I think Peter touched upon this, is technology like AI is not about replacing humans. So I think it's a lot about people who will use AI will likely, and sorry for sounding blunt, will take most of the jobs in the future, and replace the people who will not use AI or refuse to rely on AI.

Host] **Caroline Segerstéen Runervik**

But there will still be humans in the loop.

[Guest] **Sid Khullar**

There will still be people and the intelligence and the human genius will still be there. AI is at a very early stage. And having come from Apple and done, worked on the watch, designed algorithms to detect sleep apnea, sleep staging, very minute signals, right? You look for needle in the haystack. Similar problem in manufacturing, you look for a needle in the haystack there, which one signal out of the 80,000 is indicating a yield loss. I think one of the core power is being able to point AI in the right direction where a human is hitting their limits. The second learning is people who work in this area who are dealing with a very complex system are craving to do better. They don't want to be stuck with their limited number of equations. They want to discover more. And it takes time to discover. And this was the two learnings we really saw, the cognitive capacity of an operator and the cognitive capacity of the system architect. And how do you expand that? And this is where the company's soul comes from. Is how do you do more with these experts? It's like, they're doing the same thing again and again with the same tool. You just give them a little bit more and they can turn that 10x is our belief and we are counting on that. Is how, and you know, the outcome is the business has. Your people are able to do more and find more problems much faster and solve them. You will be able to make better profits. On the data side, just coming back to your original question, how do you handle so much data? And one other belief that we are starting to really realize is a lot of AI for factories, on-prem is going to be the new cloud, near the machine. And we are slowly learning that as we go along, is what is the size of a AI system that you need in relative to a large language model that is running on the cloud or a big data center. What is it that you need to do to solve the problem for this machine or this line or this factory? And how can you intelligently engineer a system to solve that problem? And there we are discovering more and more that it's going to be interesting how this whole narrative of on-prem or edge is the new cloud plays out in AI because the past industry 4.0 narrative was collect, collect, collect, because we need a cloud to store it. You don't have enough physical space in a factory to put a data center. So let's just push it all up to the cloud. I think that is switching because you don't need to collect, you just need to compress. And you have a compression system and select. And I think this is where AI models are getting really good.

[Transition Sound]

00:21:24 [Host] **Caroline Segerstéen Runervik**

You're on a discovery journey right now, and I can assume you talk to a lot of different companies, a lot of different industries. You are also discovering different countries' maturity, et cetera. Anything you want to share in terms of which are the industries to go fastest in this?

[Guest] **Peter Carlsson**

One of the things that many, especially complex manufacturing, are facing is that it's difficult to oversee if, something, that you're not controlling is changing in your process step, but the effects of that is only seen three process steps down the road or, actually at the final testing of a product. And to understand how, a variation somewhere in the process can affect the end product. These are very many times correlations that requires a lot of human analysis and where agentic support can be very, very effective in much, much more rapid discovery in this. It is also so when we're going into a world where changeover of products, replacing an old product, upgrading it with a new one, is always a very, very painful moment for setting up the production and getting the yields up where they need to be. And obviously, if you can have 50 helpers that is analyzing all the different parameters in behind, supporting you in that process, it is a very strong belief that this will drive faster ramps of new products. But then going back to what are the different user cases where we're working on one of our first pilots right now, it's a big first tier automotive who is having fairly large yield losses and productivity problems with the key process in one of their key factories. It's around die casting, high pressure die casting, it's complex, where we are building and working on, you know, how can we support him to find all the critical process windows that will enable him to push the yields and increase the productivity in that factory. And if we're successful with that, then there is a big rollout. We have another pilot where it is about creating a real-time

traceability. So at the end of the process, they get the finished product. And what they are kind of looking for is I would just like to scan the barcode of this product. And in an instant, I would like to see under what conditions did I produce this part and where did all the incoming parts, with countries over regions and, batches, et cetera, how does it all come together, which also allows you to follow that product out in the field and when something is then not performing in the field, very rapidly understand, what's their deviations under which this was produced, that I can see correlations and work with.

00:25:01 [Host] **Caroline Segerstéen Runervik**

So great use cases showing traceability, but also how you clearly get the benefit from connecting the end-to-end process, right? We also see a lot of smart factory use cases, which is connected to using agents making it easier for the operator to understand when they need to do maintenance on the machines, understand better how to maximize the usage of the machines. So how do you now work with your software, the agents, and the human in the loop? How do you look upon that, Sid?

Guest] **Sid Khullar**

Data is very fragmented on the shop floor. And if you try to go after, you know, just using telemetry to predict when to maintain, and so on, you miss a whole bunch of nuanced information that is either in people's heads or in some Excel sheet because there was some construction log and someone wrote down something, opened a hole in the ceiling, there's moisture changes, the dehumidifier unit is not spinning at the same RPM, all these different systems. There is tons of fragmented knowledge. And one thing that I realized learning is data is not knowledge right? Data is information. Knowledge is usually derived from associating context with information. And the word ontology has been thrown around a lot. Knowledge graphs have been thrown around a lot. And we've been really deeply thinking about it. First six months of the company we spent researching how do agents behave with real factory data. And we have a big data set that we acquired. It's a little factory data, not a little factory, it's a gigafactory data set. And that was the first learning for us, that most of it, you really need to give these AI models, AI agents, a map. So we have spent a lot of time building that map, the technology that helps our customers trust that map, and us building that map very fast. Because then once you've built the map, you can build the agents very, very quickly. And now we are going to the next phase. And we have been building the Ontology platform for a year now. And now it's being tried and tested. And we're making it simpler to use for our customers. And you've seen it. Your team has seen it based on our partnership. So we're very excited about that as one of the differentiators as compared to everything else that's going on in the space.

00:27:33 [Host] **Fredrik Gunnarsson**

No, I can just echo that because as you say, we're working with you when we experience your product and discussion with the customers. And I think the one thing is really impressive is the speed on which you are able to implement and really create value, which is also from us as an advisor and implementer sort of driving transformation is really demanded now from our customers. We want things to be we're not going to go through a 12, 18 month implementation project and then maybe get a value out of it. You can really show value quickly, which is really impressive. And building that trust, because there's, you need to show that you can really trust the data, trust the learns, trust the decisions, recommendations. And I think you worked a lot on that as well.

Guest] **Sid Khullar**

I think product development, the power of innovation that Peter was talking about earlier in the US and the Europe, really amplifies and compounds if you can build and manufacture that product even faster. So you're absolutely right. The 12 to 18 month cycles of implementing and ramping factories, we should be more physical atoms coming together constrained, not software working with the fact that should be pretty fast once the hard work on getting the machines tuned in is done.

[Music]

00:28:55 [Host] **Fredrik Gunnarsson**

If we look even further ahead, how can a factory look like a few years from now? How far can we get into, I don't know, a dark factory or industry 5.0, whatever we call it, whatever buzzword we use? How far can we get and what's the future of a factory?

[Guest] **Peter Carlsson**

The key thing that we're thinking is the starting point is building a platform, a digital characterization of the manufacturing process so that you can then work on the data and you can get others agentic support on analyzing the data with different applications. Then, we're still, and I'm, very honest here, we're still trying to work out exactly how do we interact with the manufacturing floor, because one of the big learnings also from our previous is doing fancy dashboards doesn't change behavior. Massive amounts of information, even if it's relevant, does not change and drive productivity. So it needs to be curated to the right people on the floor. When, there is a trust between the system and the people on the floor, then I think you can start taking the next step, which is actually allowing for auto correcting, auto adjusting, different processes based on the boundaries that you've set. And I think you're then taking step by step towards more and more autonomous manufacturing, higher productivity per operator, et cetera. And in a later stage, you will also see, you know, humanoids and different types of robotics also moving in on the manufacturing floor and where you need to interact with an integrated operating system for this. But, we're still talking a few years in the future.

00:31:10 [Host] **Fredrik Gunnarsson**

And when looking into the future, we have ourselves studied both the last years, but also trying to understand if the re-industrialization, meaning moving supply chains and manufacturing back to Europe and US, actually happens or will happen. Is this the key for making that happen? Do you think it will happen? Do you see it when you talk to your customers that this is one of the drivers?

[Guest] **Peter Carlsson**

I think it's a little bit too early to say, but our view is that utilizing this power can definitely enable western factories to take that step change in further productivity that will for sure prolong their effectiveness and long-term competitiveness. So yes, from that aspect. But then, of course, it also becomes really, really important that we are building the new factories for the new technologies, which is maybe a bigger topic to talk about.

[Transition Sound]

00:32:13 [Host] **Caroline Segerstéen Runervik**

For us here in Europe, and Sid, you're coming from India. What do we need to change here to take, because we are leading from many perspectives in terms of inventing new technology. And the big discussion, how do we make it stay here? How do we make it less regulated for the companies? How do we attract the right talents, et cetera? What's your view on how do we make sure that Sweden, Europe, really take a leading position in, for example, the smart factory domain?

[Guest] **Sid Khullar**

To really move the ball forward, and this is a new analogy that Peter and I both are talking about, is a lot of these companies are sitting at the edge of this innovator's dilemma, is you have a very well-functioning business, like Google did, like Apple did, that you don't want to mess with the cash cow. It's making cash, and it's giving you enough money. But how do you grow? How do you get right the next hockey stick? And it's really hard for a business to do that, to convince their shareholders so we have to find a way. And India has just done that in some ways, where these big companies have broken records at how fast can you bring together solar farms and battery parks, can do it in six months, 8 months. It's incredible. So I think there is that little irrational impatience attitude that we can use to break the innovator's dilemma. And especially the companies with a lot of cash need to really dedicate 5, 10 years of capital to take those bets and work with startups, work with the risk. Eventually, it will pay out, even if one out of 10 bets pay out for a company that still gets them on a different trajectory.

00:34:07 [Host] **Caroline Segerstéen Runervik**

So where will intelligent industry be five years from now?

[Guest] **Peter Carlsson**

What we are doing and what many others are doing is looking at how to supercharge the different manufacturing processes that is today. You're also seeing enormous resources that is put on building different types of robotics and humanoids and to support and make even more efficient setups. And I think the combination of these two will be very, very interesting to follow and to see how fast we can adopt and to some extent regain competitiveness with our regional manufacturing.

[Guest] **Sid Khullar**

I think metrics like tokens per percent yield, tokens per hours of downtime will likely become a metric that we look at. Definitely. Tokens per watt in a factory is going to be a metric because you're going to need energy to power AI systems. And I think if you put some targets out, I would like to see the RS platform processing a trillion tokens a day in a large factory. That would be a good outcome. And a trillion tokens is not that much for a factory. If you really are looking at a very large factory, whether it's a battery factory or an automotive tier one supplier factory, that would be an interesting outcome in five years if you're sitting again here. So, move fast and break things is kind of the software of our side. I think we should start with move fast and shake things. So we start with the shaking, then maybe we go to the breaking.

[Host] **Caroline Segerstéen Runervik**

Move fast and shake things and change things.

[Guest] **Sid Khullar**

Move fast and change things.

00:35:59 [Host] **Caroline Segerstéen Runervik**

And change things. So what you guys cannot see, there is a team here, a lot of passion, strong teamwork. That's what we feel here in the studio. Thanks for coming. Thanks for sharing some key lessons learned, but also for sharing your optimism about Sweden as an industry nation. And we have assets, we have skills, we have entrepreneurs who are willing to invest. And there are some key learnings for us to bring to the next adventure. So best of luck in this adventure. And looking forward to catching up soon.

[Guest] **Sid Khullar**

Thank you so much. Great to be here. Thank you.

[Host] **Fredrik Gunnarsson**

Thank you.

About Capgemini

Capgemini is an AI-powered global business and technology transformation partner, delivering tangible business value. We imagine the future of organizations and make it real with AI, technology and people. With our strong heritage of nearly 60 years, we are a responsible and diverse group of 420,000 team members in more than 50 countries. We deliver end-to-end services and solutions with our deep industry expertise and strong partner ecosystem, leveraging our capabilities across strategy, technology, design, engineering, and business operations. The Group reported 2024 global revenues of €22.1 billion.

Make it real. | www.capgemini.com