



Transcript for the WLEI Podcast:

Talking with Natan Linder of Tulip about Tapping Augmented Lean for a More Human-Centric Framework on the Frontlines

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*Lean practice has always coexisted with technology that enables the human operators to do their job better—in the service of delivering more value with less waste to the customer. But do today's digitized, information-saturated, workplaces provide so much assistance that the machines actually get in the way? In his new book, *Augmented Lean*, co-author Natan Linder explores how the Tulip, the company he co-founded to provide a “human-centric framework for managing frontline operations,” seeks to delegate technology and improvement to the operators doing the key lean work.*

Tom Ehrenfeld:

Welcome to WLEI, the podcast of Lean Enterprise Institute. I'm your host, Tom Ehrenfeld, and today we have Natan Linder, the co-author of a new book titled *Augmented Lean: A Human-Centric Framework for Managing Frontline Operations*. There's quite a lot here, and I'm going to give you first crack to tell us what you mean by "augmented lean," and explain how this provides a human-centric framework for managing frontline operations.

Natan Linder:

So, I'll try and summarize what... People characterize the book as pretty dense and I think it's... First of all, it's a tough question, but let me start by saying it's great to be here and I'm thrilled to talk to you today about lean and specifically lean enterprise. I think the history of the work y'all been doing is well known and so it's very meaningful to me to have this opportunity to chat today. Thanks for having me.

Tom Ehrenfeld:

Thank you.

Natan Linder:

Lean has been around for about, depending how you count, 30, 40 years, and it has been practiced widely and whether formally or not formally. I was actually reading one of your pieces, and I think at some point you talk about is Apple a lean company? So, my point is that

whether we like it or not, the principles of lean work and they're here and they're not wrong. They're actually great and they make us build better organizations and companies and supply chains, and I'm talking about all the good known principles that we all are familiar with like from the Gemba walks to Kaizen to eliminating waste and moving that value to the customer, all that good stuff.

The premise of the book in a nutshell is not that lean is out of date or that we need to revive those core principles. Lean was defined when we had a very, very different technology environment. Before we went live, we were talking a little bit about the values, about system dynamics and things like that, and the first principle is you can't improve what you can't measure. Well, guess what? There was no internet and big data systems and all that kind of good stuff that we take for granted in the sense of what today we call knowledge work 30, 40 years ago.

I'm not saying that lean practitioners were completely divorced and ignored the digital revolution. Absolutely not, but the focus because of how massive internet systems took over our life, both on the back end. Think about our banking system, but also on the consumer side. So, having a mobile phone today is a necessity. You cannot survive in the Western world and sometimes even in the non-Western world or of developing world, without a smartphone, and you take it for granted. So, high availability of networks and compute in your pocket make you live your life and that centers fundamentally on humans and what humans can do with that kind of tech, and when we wrote this book, I think it tries to capture a moment in time, and this is why we call it Augmented Lean.

I think augmented has two main traits to it. One is saying, "Hey, lean is great, but we have to augment our thinking on it a little bit because of this evolution of technology over the years that contributed." So, that's the first factor, and the second thing, it's augmented in the sense of giving humans superpowers to do things on the shop floors with technology, and it's really tough to talk about this and I force myself to talk about this stuff without a single buzzword because then very quickly, it becomes like some technology mumbo jumbo that is not really great, but what I mean by that is if we think that you give people spreadsheets and PowerPoint presentations and all sorts of databases that are disparate and siloed from 20 years ago and you expect them to do the best work on shop floors and operational environments.

So, this could be labs or warehouses or places like people do frontline work. It's almost obvious that it doesn't cut it. Now, when we built Tulip, our company that is focused on a platform for frontline operations, which we can discuss, we just met a lot of organizations and individuals, practitioners, researchers, executives, venture capitalists, you name it, and they're all seeing the same phenomena from different perspective. Obviously, some want to invest and some want to change the organization and some want to build the best production line and some want to research the next generation of human operation studies and whatnot, and they're all experiencing the same moment that this technology now has a point of no return.

So, in other words, back to the smartphone, no one is going to put the smartphone away and stop thinking about this and the behaviors that come along with it and no one can ignore technology and what it's doing on those operational environments because if you do that, like your organization is not going to remain competitive for a long period of time. So, it's an

imperative. So, that's the premise of the book and it's a collection of stories that we tried to show and say like, "Hey, this is happening and this is how different moments like that look like and emerge," and that's the main thread of the book.

Tom Ehrenfeld:

So, historically, there's all types of definitions of what lean is, and I would stretch that back to let's say the emergence of modern lean with the Toyota Production System that was formed in the '50s, and one that I like, I think Taichi Ohno said it's just the reduction of time between getting an order and delivering an order.

Natan Linder:

That's a very Ohno reductionism.

Tom Ehrenfeld:

And that's where this well-understood notion of eliminating waste comes from because waste is... Out of necessity, Toyota had to eliminate waste from where they were in time, but that would slow things down and cost more, but it's interesting. I think companies that have taken lean very seriously have an ambivalence about incorporating technology because one of the main precepts of lean is that you reduce the time to deliver something to customers and you base everything on customer value by providing the people who are doing the work the means to improve the work. That includes eliminating waste and boosting quality, and most efforts to speed things up or make work easier end up doing the opposite. So, MRP systems that try to schedule materials or so many efforts to accelerate work end up having an unintended consequence that ends up mucking things up.

You go into this somewhat in the book by talking about augmented lean as compared to automated lean. The question is like how does this... You've done work with Tulip, a platform for-

Natan Linder:

Frontline operations.

Tom Ehrenfeld:

... frontline operations. So, how does this type of work handle this tension between using IT or any other form of tech to make things better? And then the second part is, and to make them better for the people doing the work, but please start with the first one.

Natan Linder:

Yeah, so there is a tension between our manufacturing technology, and by large people... There's many manufacturing technologies that you use to build things. It could be CNC machines or injection molding or 3D printers, but it can also be the test jigs that you have to use to collect information. Make sure your product is working well, and automation, I think it's just a collective term both to things like conveyor belts and robots and PLCs and things that

work in the physical domain to move material, to make sure things that are either repetitive or dangerous become simpler and require less human, and as a result, like potentially less error prone, but it doesn't mean they come free and doesn't require tending and things like that.

So, this is for people that often talk about our robots taking over. I personally think that generally we're still missing 2.53 million people in operations of all sorts. So, probably they're coming, but the humans are not going away either. They're just doing other jobs. We need them. Automation is automation and manufacturing technology is manufacturing technology and will be there. The question is what do you do with the people who are stuck between our IT backends, namely the big ERP/MRP style systems that you touched on that run the organization, that need to deal with POs and billing and HR and all the things that we know that without IT, our modern companies structure just halt, and they're stuck on the frontline operations with those spreadsheets or sometime even just paper and pen, and obviously, that doesn't cut it, mostly, if you want them to behave like knowledge workers.

So, to me, to empower those people, and that's where the tension lies is like how do you give those folks on frontline operation the means to become knowledge workers on their own? A big part of the answer is lies in software. Now, historically, software is a very complex human invention that we never had in the history of humanity, and I don't have the statistics on it. I need to find it. Maybe I'll send you after the show. It's like we're lacking software developers. There's not enough and also software developers are lazy. So, if we can use software to make software, we will do that. Why? Because there's just not enough software development capacity and to manipulate large amounts of data to make it do all to things, like from using sophisticated machine learning algorithms to help assist a human make a decision or even simpler things like find the right information on a lot number to figure out what to do.

You need different kinds of software other than the normal retrieve type database systems that, in my biased view, and that's why I started Tulip, doesn't cut it anymore, and there lies the anomaly of using these kind of complex systems in pure lean environments. You go into environments where you say, "Well, I need to introduce change because there's value to be passed on to the customer," but if passing the change involves like RFPs and getting system integrators and three months later, that's where you can implement the change, that's not fast enough.

Now, if you map it to what's happening in IT, and I'm making a very generalized claim here, but I think that if you would talk to IT people that have a perspective of, say, the past 15 years of what happened in cloud-based software-as-a-service platforms, the likes of Salesforce for marketing and sales, the likes of Workday for human resource management. Like the way the practitioners, the people who set up those system. It's not to say that there's not effort on IT side to do that, but at the end of the day, the business users get those systems and they're able themselves to come up with new workflows and change the way it works and create all these things. You call this, oh, these are like business users who are trained and they're knowledge workers. So, they can do it and they have the guardrails and IT's watching them and we have great digital... We have digitally transformed that side of the organization. Super. I'm, "Where's that for operations?"

If the answer is like you take the smartest set of people in the room and you try and come up with a perfect model of what the world and the production lines and the factories and the demand is going to be, and you come up on the other end with some software systems or a stack, and you try and bolt it down to the ground, and then what happens? Change happens, and if you don't have that agility, and this is where these notions of applying new names, and here again, I'm sorry for the buzzword alert, no-code, low-code systems.

Tom Ehrenfeld:

I was going to ask you about that.

Natan Linder:

In citizen development and democratizing the software, that's where it lies, and I think Augmented Lean tries to capture this phenomena, and others, where you introduce those things that by now we take for granted in IT land and bring them to the OT land, and as a result, you're seeing this agility and that's what we have seen with people who really empowered the people on the shop floor, and I can tell you that in a story, and I think it's in the book and one day, we see a post from one of Stanley Black & Decker, a process engineer named Sophia Balan, and she's building workflows for machinists in a factory, in Massachusetts, and her challenge is to do manual data management and she's not a software developer per se, but she's a very competent engineer.

She understands the data flows. She understands the machine performance. She understands the operator. The fact that she could use a tool to translate her intimate knowledge of the work, her discussions with the operators, and with management, and to turn it into software in a matter of days and test it out and perfect it, and then launch it, and then collect data, and then do it again and create a continuous improvement loop in the classical lean sense that is based on a tool that she built made a difference. She basically built a digitized job scheduler, an AP to track missing materials, and how to create a few command tools like to feed the material flow and so on.

If you had to think about it through the lens of classic software development or manufacturing execution systems, as we called them, it was impossible for her to do, but when you look at the motion that she did, it's like getting the input from the people who do the work that have the context of the work, that's herself, but think about the operator. So, what does that do? They did make a piece of software, but they're not really thinking about it as like I'm developing software. They're thinking about it as much as someone maybe when lean got introduced and saw the first spreadsheet, told themselves like, "Hey, guess what, I can move from the... " whatever. Clipboard and a Xerox paper to a spreadsheet and that's great because I can manipulate the numbers. It's like that, but only in a world where your apps on the phone are packages of what? Logic data information, and you're like, "Oh, there's just an app that does things," and you stop thinking about things like documents. So, that is what's happening, and I think that's super exciting.

Tom Ehrenfeld:

The way you're describing the usage of software in this context strikes a very deep lean chord, which is inculcating a situational approach to improvement by enabling the people who are doing the work to think through, reflect on and find root cause approaches to problems and to build from the ground up. I think you mentioned Gemba walk, which is famous lean trope of going where the work is and observing it instead of imposing solutions from afar.

Natan Linder:

This is where Womack... I don't remember the quote exactly, but he talks a lot about the difference between having knowledge of a problem and the ability and dedication, desire to solve it versus you need to be separated a little bit from the problem. If you're too close, you may be biased and you don't have context, and I think he's super right. In like this play, between letting the people who are close to the work come up with like, well, how do we model the data and how do we collect it and how we can decipher it, but if they do that. So, first of all, they create objectivity for themselves, but for other stakeholders, they create context. So, in a way, I think this approach of creating those tools and letting, so to speak, the power of the people doing the work to create those kind of tools that I'm talking about with the no-code, low-code, and the form of apps is very, very lean and it doesn't forego this notion of governance.

And in a way, like in the book, if everyone trying to write a book, we try to create a framework, and our framework is... It's called Leader HG, which the leader translate to principles. We don't have time to go over them right now, but it's about learning, emergence, augmentation, decentralization and power, respect. That's a leader.

Tom Ehrenfeld:

But also something called hoops was for the principles.

Natan Linder:

Right, but I want to focus on-

Tom Ehrenfeld:

H-O-O... Go ahead.

Natan Linder:

I want to focus on the... The HG is about hacking and governing. So, that's the difference between, like I'm creating knowledge. I'm hacking to create knowledge, and then you're governing to standardize it and you make it into a reusable artifact, which is also very lean, and that's where things like what happens when you bring app libraries to the world of operations, which to me is obvious. It's like how many apps have you downloaded the past, I don't know, six months that you're not even thinking about it.

Tom Ehrenfeld:

It just raises an interesting question that for one, the book is maybe arguably dense in the sense that it is fearless in discussing technology and using technology, and the question is you guys are clearly influenced by this desire to have a more human-centric workforce. Is this something that you recommend tackling as a social issue, a governance issue or a technical issue?

Natan Linder:

I have a few angles to look at this. If I look at this purely from the lens of how do we have a better industrial force than in... as a better manufacturing base, that as a result, it produces a better economy and I think the research shows... I think the last statistics I saw from National Association of Manufacturers, you put a dollar into manufacturing, you get \$1.87 back in the economy. So, it's actually important to do that and I think we have enough empirical and hard evidence from years of internet, like how it created tons of economic value to have all this digital stuff in our services, in our finance insurance, what have you, and I don't think that's should be any difference in operations. So, I think that there's a social imperative there.

I also think that when you think about the folks on the frontline operations who on one hand have those smartphones and computers at home and their kids are educated in the same system that our kids are educated in and they're exposed to technology, but they go to work and they're supposed to let go of that and go back to pen and paper and spreadsheet and that just doesn't compute. So, there's a lot about social mobility where you give those people the access to this stuff and you say, "Not only your voice counts," because we're going to translate it into the next version of the application we're building together, but also you expose them to data and teach them how to make decisions based on data and that I think introduces social mobility. So, that's society aspect number one.

The second one is that when you're trying to... And our problem, and it's a problem in the United States and certainly in Europe and Japan and all the Westernized economies. If you want to have a... COVID gave us something very obvious. We saw the gaps and the limitations of very, very efficient supply chains. So, they were very efficient, but not so resilient. So, that's how we lost the chips and lead times went through the roof and all that, what that did to the way to inflation, but let's not go into a macro rant here. But my point is that if you want to build close to your customer and you want a more resilient supply chains, what you need to do is you need to first attract a lot more people who are as smart as the people going to work for the IT sector like the Googles and the Facebooks of the world and make them work on operation problems, like building the next best production line that can deal with build to order, customized order and what have you, and what are the skills required to do that?

You need to collect a lot of data and you need to understand maybe some machine learning algorithms and you need to build frontline applications. You need all those things, and if we don't make manufacturing cool again, then they're not going to come. So, that's another aspect and on the business side, I touched on it. I don't think... and to be clear, this is not a Tulip issue. I don't think Tulip is the... or I'll say it differently. I see Tulip as one type of platform of many other folks that who are doing great work that together form the new stack of operation technology and organizations who don't go that way, it's like saying, well, we're looking into this thing called the database.

We are considering if it's important for a business and this ERP thing, and it's like if you had this conversation of people like trying to... Oh, you really need a CRM and an ERP. 20 years ago, maybe, but today, it's like why are we even talking about it? It's obvious. So, to me, it's the same, but maybe I'm a little bit early in that realization.

Tom Ehrenfeld:

Well, one of the things that stuck with me is there's a brilliant guy who worked at Toyota and ran LEI for a while named John Shook, and he described TPS lean as a socio-technical system on steroids.

Natan Linder:

That's a good one.

Tom Ehrenfeld:

Yeah, and he produced outstanding work on the structures and practices within Toyota. He worked at Toyota for a time that instantiate the kind of principles of people-based improvement, and one of the things I learned from John is this real serious approach of respect for people, that there's established practices and methods of working within a lean system that practice respect, not out of some show of etiquette or being cordial, which is fine, but which assumes the most out of people and constantly creates a tension on them to do their best work and to develop a meta awareness of the work so that they own the processes and improve them. They're expected to write their own standard work and use that as a basis for understanding the work and improving it and taking responsibility for it.

Natan Linder:

I don't think that this idea of building apps or having citizen developers is fundamentally different. It's just the output is not those sort of... Sometimes, I see standard work instruction and the people in factories tell me this is like wallpaper. So-and-so did it whatever years ago and since then changed a million times.

Tom Ehrenfeld:

No, I think that shows that the misapplication of lean in any sense is egregiously wrong, and I think the question I'm asking is what are the established kind of practices and tools and methods that are put to work in an augmented lean system where that, again, respect the people that I'm using your phrase of human-centric, that increase the human-centric nature of the work people are doing. What do you see? How does it show up?

Natan Linder:

It shows up with how we specifically go into an organization and help it transform and a typical thing is starts whether it's us directly, our partners or combination, us and the customer and the partners like walk lines and find problems because everybody wants the utopian end state of a fully digitalized shop floor. Everything's connected. You snap your finger and you get

amazing analysis, but really, usually, there's a huge problem they're trying to solve, whether it's like get that new production line up and running quick, fix a huge quality issue, get yields of 50%, higher. Deal with like, I don't know, some crisis or a bunch of engineering management or something.

Tom Ehrenfeld:

Few of them sound like classic lean problems per se.

Natan Linder:

They're all classic lean problems. If you think about one of my other favorite books, *The Goal*, and that they condensed into the storyline, like all these problems in one and where the big boss is, what they need to do and how much they need to get. It's a very capitalistic sort of novel in that sense because that introduces the pressure to change, but a lot of the pressure to change is just like people want to do a kick job and build great companies and products and they also think about profits, but maybe not as pronounced as in the goal, but look, my point is what we are seeing is that you show people in a train the trainer and you put them through online training of like how do you go about making applications and suddenly the same way they made 5S on a piece of paper or a spreadsheet, they do it in a different form that feels very similar, but in fact, the artifact is something that feels like, look like an app on your smartphone, and suddenly they're collecting data.

You know what happens? First of all, they feel empowered. They're like, "Oh my God. I created this software," and these are people who don't necessarily think about them themselves as software engineers, but they're not less engineers. They understand their process, input, output and logic of how things actually work, and then they start caring for that piece of software because when you think about what do software engineers do? Software is our baby. We put it out there, and then what do we do? We make it better. We fix the bugs. We have another release, and say, "Oh, did you get the last version of blah, blah, blah? It's so good." The same thing happens, and I think there's a very human thing there and I can tell you like my own personal experience because I'm an engineer. I come from a better software background, but I remember if I go back to my early experiences in software, if I have to pin it down to what got me hooked, it's like software is an amazing thing with people with short attention span for immediate satisfaction. So, you do something and you immediately see the result more or less.

Tom Ehrenfeld:

I hear you. I mean, I think software is dangerous and you discuss this somewhat in the book. It's one of those things where by the time you've got it into place, it's a legacy issue that's hard to improve upon or rip up and start-

Natan Linder:

And then complexity creeps and it's time and money and knowledge, but the world runs on consume software on a regular basis and that's, like to me, when you're asking like, "How do we see this?" It's like teaching people a language and sometimes people describe Tulip like, "Oh, it's a bunch of technical Legos that you know can put together the right thing for you," and

I'll tell you this through a concrete feature. So, we have the ability to hook up cameras to Tulip, and why do we do that? Because camera's obviously an important sensor to capture stuff, like evidence of what happened and maybe you can help detect the human way of building things, or you can do a safety zone detection. There's like a whole bunch of applications, but if you want to do that and everybody understand what a camera is.

If you can't simplify it to drag a widget with an area of interest and tell it what to do, which is possible to do today technologically in tools like Tulip and others. Then those people on the shop floor, those engineers I'm talking about that like they're not going to do it or they're going to do it just in a place where they need a lot of what we call machine vision, like get a very sophisticated system to not miss a single beat of a single barcode that runs on a automated line, and that is fine too. That is where automation lies.

Tom Ehrenfeld:

Well, just for the reader or listener, and thank you listener for hanging out with us. Out of fairness, you've mentioned Tulip a number of times and I don't think we've really fully introduced it. It's a frontline operations platform that a company you've co-founded with others, and you do cite them frequently in the book as proof of what you're doing and validation of your argument. Can you just give us a quick, just a description of Tulip and perhaps also tell us about Tulip in action. What we see when we see folks using it?

Natan Linder:

Yeah, so Tulip is a platform that gives those engineers and the operators the means to build those low-code, no-code applications for various operations' use cases. It could be your standard working structures or training or quality, provide a ton of production visibility, can facilitate data collection on shop floors. It helps people transform the operations bottom up and in a very lean way, get what I would define as a more sustainable digital transformation. Adding up to what I like to believe we're helping people build, which is like a modern production system based on this new stack, given that we are fundamentally cloud first and have what technically people define as edge stack.

So, the ability to connect to things. This could be your CNC machines or a barcode gun or an RFID sensor and stitch all this data together and dish it up to the applications such that the people using it on production lines can make those effective decisions on what to do with their production and have continuous improvement. That's what Tulip does.

Tom Ehrenfeld:

It simplifies the creation of software through no code, low code.

Natan Linder:

Yes.

Tom Ehrenfeld:

So, the people who are doing the work have more control over the systems and processes, delivering the value.

Natan Linder:

Exactly, and it relies on an ecosystem of all these folks who build whatever manufacturing technology you can imagine that we support a high variety of protocols, like get the data and send the data and so on, and it also has a library in the same ecosystem. So, you can go on a website that looks like your classic B2B marketplace and pick some best practice or a fully working app and start from there, and the reason that's important is because solving for the heterogeneous nature of operations and that's the hard thing about the difference between IT and OT. As a software engineer, again, like if I download the compression library and I want to use it, then everything is very clear. I mean, I might wrap it up and make it-

Tom Ehrenfeld:

Well to you, but sure.

Natan Linder:

... specific to my use, but pretty much that box, I can trust that compression algorithm and all that kind of stuff. In operations, like your 5S... We can both be doing 5S, but yours is slightly different than mine and mine is tweaked. So, there's more customization on the needs of operations that are inherent because of the heterogeneous nature of operations and this is trying to borrow or bring back... Maybe it's payback to the software engineers who are still agile and scrum and all those lean things to their world of how software is developed to operations and give them the best tools because in software development or in general in engineering, like we are used to sharing and there's obviously a very massive movement of open source that enabled that and the internet enabled that and that has proved as the more faster, robust, better way of building things and bringing them to market. Where is that for operations? So, in a way, Tulip is also trying to usher that.

Tom Ehrenfeld:

It's pre-contextualizing the use of software. It's trying to present it as something that's fungible and developable by the people doing the work so that it's augmented. Thank you. As a way to improve it as opposed to this isolated massive project that all the geniuses poured resources into creating and which is already a legacy challenge by the time it gets implemented.

Natan Linder:

Right, and that's why we're seeing... Why did IT pick up so quickly? Because IT solve problems that are almost, by definition, more regular. Pipeline in a CRM is a pipeline in the CRM. You need maybe to customize it a little bit, but more or less, a pipeline is a pipeline. Same is true for a ledger, but a production line and the abstractions for a production lines are just... I think it's a very open-ended problem if you're trying to map it to computer science because how do you model it with all the parameters that can go into a production line? You know? You can have some abstractions, but-

Tom Ehrenfeld:

Well, one fascinating thing... I mean, I don't know if this is related, but the guy who's now in charge at LEI really mastered lean through work at Starbucks in terms of delivering coffee drink and-

Natan Linder:

Totally.

Tom Ehrenfeld:

... there turns out of the typical menu of say a dozen drinks, when you get to the various permutations, skinny caffè... whatever. It ends up becoming thousands of different potential products that get handed over to the customer and they needed a way of producing these that accommodated the many variations while adhering to basic principles that would empower the workers to make it right first time quickly, and above all, deliver it to the customer.

Natan Linder:

Yes, and I think that's... We're seeing exactly the same thing.

Tom Ehrenfeld:

On the line in automation, you're saying?

Natan Linder:

Yeah. Well, in augmentation and automation. So, one story I have, which we put out there with... There's a case study out there. So, I can share that. There's a company called Dentsply Sirona, which is one of the world's largest manufacturer of dental solutions. So, they make-

Tom Ehrenfeld:

Can you repeat the name slowly just so-

Natan Linder:

Dentsply Sirona.

Tom Ehrenfeld:

Okay.

Natan Linder:

And they make dental implants and instruments and all sorts of products that basically when you go to the dentist and they say like, "Hey Tom, come back in two weeks. We'll do the implant," or something like that. So, what happens is probably the dentist scanned your mouth and sent it over and said, "I need to do this process for Tom," and then they get a case back with the abutment and the tools and all the little screws and things like that. So, the

mathematical space of the amount of products that they can make given all your teeth, all the processes, all the material, all the finishes, different variations of the CAD. It's in the billions. You can try and start building software for it today and you'll never finish ever. Not our kind of software, not anybody's kind of software.

So, the only thing you can do is give people tools to share their knowledge of how to train on such lines where you sit down and imagine like a bench of quality or packaging bench with small trades with different kind of screws that your eye cannot distinguish the variations of the screw and the sizes. So, what do you do? You have to use things like very smart devices and pick the lights. You have to let the human intuition understand, "Well, if it's this kind of thing that I know about, what is the best next step and so on?" You got to give them the information just in time so they can make that decision based on data and the software is, so to speak, in their head, and guess what? Having low-code, no-code type of solutions is a way to codify this information such that you can do things like, and that's stuff we measured. This is why I'm very proud of that. There's two measurable things there.

It was like first we dropped dramatically the amount of time it takes to train people on those lines, something like 80 or 90% if I recall. Why? Because the way you train it is on-the-job training and there's another person watching you behind your back and seeing that you're doing things right, and the other thing that if you have that is you're dropping quality issues down and get it right the first time.

Tom Ehrenfeld:
Improving quality.

Natan Linder:

Yeah, improving quality, and those things and this little example, I think they're universal to so many discreet manufacturing operations that are... I would call them semi-automated. Back to automation, right? So, in this case, there's some machining, some human things, some quality jigs, some everything, but still humans are very, very much there. So, to ship that product. So, you go to your dentist and you get the exact case that fits you and there's no issue and of course this is like a regulated line because it's-

Tom Ehrenfeld:
It's probably produced even cheaper.

Natan Linder:

I believe so, yeah. I believe so. So, those are things that I think that this type of augmented lean mindset and technologies make a lot of difference because why was the problem they were trying to solve in this case. It's like, "Man, I need to train people faster on this super complex thing. How do we do that?" So, I think that's a nice example there.

Tom Ehrenfeld:

That's amazing. That's fantastic. I think with that, I'm going to wrap it up because we try to keep them a modest length.

Natan Linder:

Perfect.

Tom Ehrenfeld:

But Natan, this is really interesting. So, the book is titled *Augmented Lean: A Human-Centric Framework for Managing Frontline Operations*. It's by Natan Linder and Trond Arne Undheim.

Natan Linder:

Undheim.

Tom Ehrenfeld:

Undheim.

Natan Linder:

Yeah, my brave fierce co-writer.

Tom Ehrenfeld:

Excellent. Okay, great. Thank you for joining us on WLEI.

Natan Linder:

Thank you so much. I'd love being here and I appreciate the discussion and it was fun. We should do it again sometime.

Tom Ehrenfeld:

We always can.

Natan Linder:

All righty. Thanks a lot.