WE ARE ETH – Episode 14

With Luca Di Tizio, CTO, Microcaps AG

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[00:00:00] **Luca Di Tizio:** You have this tube… You have Elon Musk that just arrived 20 minutes earlier… and you press the button and everything just crashes. That was the moment my team looked at me and said, "you sort this out!"

[00:00:20] **Susan Kish:** In this episode, I'm talking with CTO, engineer, ETH Zurich alumni, and recently retired decathlete Luca Tio, who led the 2017 Swiss Loop student team to a third place finish in Elon Musk's global Hyperloop Competition in California. This is the WE ARE ETH podcast, and I'm Susan Kish, your host.

[00:00:49] Luca, amongst the folks we've talked to on We Are ETH, alumni, the folks I've interviewed, you happen to be the most recent graduate, just finished your masters back in 2020. What stood out? What is ETH 2020 like? What is the 21st century feeling like at ETH?

[00:01:10] **Luca Di Tizio:** Well, that's maybe a mean question with the Covid generation of students, because that was a really, really different feel probably to what I experienced. For me, ETH in the 21st century, as compared to my grandfather, who was already a graduate in mechanical engineer…

[00:01:28] **Susan Kish:** Oh, is that right?

[00:01:29] **Luca Di Tizio:** Yeah.

[00:01:29] **Susan Kish:** Oh, that's so cool.

[00:01:31] **Luca Di Tizio:** And, and so I mean, for us, it's really the technology age and, being able to access resources like, you know, Google Scholar and having a laptop and a cell phone and, a lot of knowledge at your fingertips. That probably made a huge difference when compared to the 20th century.

[00:01:49] **Susan Kish:** Just to make sure I understand, you graduated as an undergraduate and mechanical engineer, and then you did your masters in bioengineering, and it sounds like along the way you did a whole lot of sports. How did you, those are not usually overlapping worlds?

[00:02:04] **Luca Di Tizio:** No. Sports was really the family business. My mother was a heptathlete, so in track and field there's decathlon for the men and heptathlon, which is seven events, for women. And she used to do that during her act of time, and my father's actually a track and field coach.

[00:02:23] **Susan Kish:** So you're telling me you had like no choice, like you were running when you were two.

[00:02:29] **Luca Di Tizio:** absolutely! So I really grew up on the track. When I was two years old, I was carrying two kilogram discus around on the field. And that was really what I did.

[00:02:38] **Susan Kish:** I can visualize this.

[00:02:39] **Luca Di Tizio:** Yeah, I had a few stints in tennis and handball and golf, but then with like six- or seventeen, I really started to invest in track.

[00:02:48] **Susan Kish:** And then how did you have enough time to be a mechanical engineer? I mean, because you have to practice a lot if you do that at the professional level or competitive level.

[00:02:57] **Luca Di Tizio:** Yeah, I like the American, you know, terminology of "student athletes". So I was a student first, an athlete second. When I started with ETH, I really told myself, you know, I will only keep on doing sports if I can get it to work with it, not the other way around. That's maybe very Swiss, I don't know. Probably risk averse because you know, out in the world if you're a decathlete you tend to very quickly try and do this at the professional level. And if you cannot then you'll probably end up doing it at some point, you know, in your, in your late twenties or mid-twenties. But yeah, it's, it's absolutely, it's challenging. You're on the track six to seven times a week, sometimes two to three hours at a time, different events. And, and then having to study with that is tricky. And it showed, you know, I was sadly always a bit injured. Had one or two great decathlons that I was able to do, but took a toll.

[00:03:51] **Susan Kish:** All right. I have to ask a really basic question. A decathlon, that sounds like Latin, that sounds like 10 events. What are the 10?

[00:04:00] **Luca Di Tizio:** So the 10 are solely out of track and field. So it's throwing, jumping and running.

[00:04:05] **Susan Kish:** Throwing, and it's jumping, running. Okay.

[00:04:08] **Luca Di Tizio:** Correct. And it's differences in these, so it's two days, five events each. And you start off with the 100 meters flat, so it's a sprint. Okay. And then you go on to long jump.

[00:04:20] **Susan Kish:** Okay. Long jump just means that's where you run and then you jump over that big pole thing?

[00:04:26] **Luca Di Tizio:** No, we do that on the second day. Long jump is literally just jumping in the sandpit. So you jump and you got it exactly, and you take a long jump into a sandpit. And then there's shot put, so that's the seven kilogram shot, uh, iron ball that we try to, to throw. Then we do high jump that's jumping over the bar without a stick. And then we end the first day with a 400 meters. So that's one lap on a track.

[00:04:51] **Susan Kish:** Okay, that sounds like a lot. Then you're exhausted.

[00:04:55] **Luca Di Tizio:** Then you're usually quite exhausted. You have very heavy legs and a lightheaded head. And then that's time usually for recovery. You go and, and you sleep. And the next morning decently early, you start with the 110 meter hurdles. So that's 10 hurdles in your way. And you run over those. You don't jump, you run over those. That's very important. And you go on to discus. So that's the round implement that you throw, kind of like the ancient Greeks.

[00:05:29] **Susan Kish:** Oh, like the pictures of the ancient Greek statues?

[00:05:32] **Luca Di Tizio:** Correct. So that's one of the oldest disciplines. So that's a two-kilogram implement. And then comes your favorite. Then we jump over a bar with a stick. So that's pole vault.

[00:05:43] **Susan Kish:** Pole vault. Okay, good. You could tell I'm not really an athlete…

[00:05:48] **Luca Di Tizio:** That's not an issue at all. It's a crazy thing to do anyway. And we go the penultimate. The second to last is javelin throw, so that's also pretty ancient. And then it's the 1500 meters. So that's three quarters of a lap. And we run that really, really slowly, as you can imagine, after nine events as compared to the specialists. So , we tend to run those one and a half kilometers, and then we're exhausted and we have to relax for two weeks.

[00:06:15] **Susan Kish:** Why did you pick decathlon to compete in?

[00:06:18] **Luca Di Tizio:** It's pretty standard for young people in track and field to not yet specialize. So maybe that's a good thing for life. Generally, a lot of athletes that after a certain time, you know, it really, really shows what they're not good at and that never happened to me, so it, it never really showed where I lack and, and so I was one of these decathletes that did everything decently, but not greatly. And that's okay. If you're not a sprinter, you're not a jumper, you, you tend to stay in this, in this more generalist sort of sport. We have two decathletes here in Switzerland at the moment, one of which won a bronze medal in long jump, Simon Ehammer. And, and that's with the specialist. So he is able to really compete at a world class level

with the long jumpers, despite doing other nine things, which is really, really mind blowing. So there's different cases of decathletes.

[00:07:17] **Susan Kish:** How does that, those lessons learned – because my assumption is you didn't win all the time, but you had to sort of pick yourself up, do it again, pick yourself up, do it again – how does that kind of learning translate over to your studies and to what you're doing right now?

[00:07:33] **Luca Di Tizio:** That's actually a great carryover from even the competition of decathlon to general life. You have to imagine that, well, in training it's one thing, but then even in competition, you have days where some of these events just really don't work out and you don't have time to dwell. The next one's coming right up. You don't have time to just, you know, shut off and be like, oh, and, and sulk in that moment, you have to get that behind you and go to the next one right away. And that I think is a lesson that I carry with me to this day that if something didn't go according to plan, you can't change that. So you can learn for next time. And that's what we have to do, right? We adapt our training. If we saw, hey, this and that didn't work out, we adapt this. But you can only do that in hindsight, but in the moment, be there and just go on. And so I think that is, that is something that I carry with me.

[00:08:28] **Susan Kish:** That feels like it would be very applicable to R and D (research and development), to trying a product and going like, uh, this didn't really work, but not being depressed and going off and railing at whatever the system, the environment, but just saying, okay, let's try this again. What did we figure out?

[00:08:47] **Luca Di Tizio:** Absolutely, with maybe the sole distinction that if you're doing R and D, you're doing the same thing over and over again and here at least you have some change right in you're going from jumping to throwing to running; with R and D, you're probably gonna hit your head multiple times on the same ceiling, but I've learned that as well and that is probably the ETH part that contributed.

[00:09:10] **Susan Kish:** How does sports and ETH connect?

[00:09:13] **Luca Di Tizio:** Too little, in my opinion. You know, I think sports is maybe not the direct driver of the economy or the large problems that we're dealing with in our world, but I still believe that it is a great, great opportunity to connect people, to create a shared understanding of values and, and to really show young people passionate role models that, that want to go after and, and being the best versions of themselves.

[00:09:42] **Susan Kish:** Nowadays, it sounds like your main focus is at Microcaps, which is a prize-winning Swiss startup. Really interesting. I've watched the video about all those little tiny sized capsules. Can you tell us what Microcaps is and what it does and what you do there?

[00:10:02] **Luca Di Tizio:** So, I describe Microcaps as a deep tech startup. So we have a technology that's been in the making for, you could probably go 15 or 25 years. So it's based on microfluidics, a field where we use very, very small channels

to do fluid chemistry. And by using those very, very small channels, we can really differentiate the physics in such a way to yield some beneficial effects.

[00:10:33] **Susan Kish:** What are fluid chemicals, fluid chemistry? What does that mean?

[00:10:37] **Luca Di Tizio:** So we work with fluids, not with solids, right? So it can be water, it can be blood. There are many applications for microfluidics, for example, in bioengineering, so in what I really enjoy. You can imagine an interesting term of lab or organ on a chip. So what that really means is that you bring together living cells. For example, with an active pharmaceutical ingredient on a chip sized smaller than a credit card, and you're able to mimic an organ or an entire living body on that little small chip just by combining these living cells, fluids, like water or blood, and connect them through microfluids.

[00:11:26] **Susan Kish:** Got it! Which would probably let you test things like how it would react to a drug or how it would react to certain conditions at a probably exponentially faster, exponentially more option, you know, variations in permutations.

[00:11:41] **Luca Di Tizio:** …fascinating and extremely ethical way. Exactly. Because you're not doing animal models, right? That's an important driver in part as well. Because you're not doing animal models, you're not doing human experiments.

[00:11:52] **Susan Kish:** Oh, very interesting.

[00:11:54] **Luca Di Tizio:** And the FDA (U.S. Food and Drug Administration) has approved quite many of these in the past years. So back to Microcaps, we take microfluidics and the issue with microfluidics, as you can imagine, these channels made out of glass are usually in the micrometer scales on the size range of hair. And that's really, really tricky to do in a large scale. And so what we were able to do at Microcaps is scale the benefits of microfluidics. So parallelizing these channels without losing the pros of the technology. And we ended up with a glass device. And this glass device creates these ever so similar droplets that you just talked about, and it creates them in an extremely good environment, meaning there are no sheer forces.

[00:12:45] **Susan Kish:** What's a sheer force?

[00:12:46] **Luca Di Tizio:** It's a force that you usually have in chemistry where you apply force to particles and that tends to damage those particles. So if you think of a mixer in your kitchen, when you make mayonnaise, right? You're applying sheer force to those molecules that you mix together with the egg and the vinegar. And that creates your emulsion.

[00:13:11] **Susan Kish:** So are you able to do it at you said a large scale. Are you able to do it at industrial scale so that the pharmaceuticals are interested?

[00:13:18] **Luca Di Tizio:** So, pharmaceuticals is actually interesting. That's a, a smaller scale than some people might imagine. The largest scale applications that we're looking at are food, so nutrition or health applications. The topics or the words that come into mind there are fortification of food. So think of the third world, right, where you have staple foods that are fortified with vitamins, minerals, and important nutrients that you wouldn't get out of a diet. And so these are fields where microencapsulation becomes really, really important on the large scale. So we've proven that we're able to do this at a hundred kilograms per day, which is many orders of magnitude larger than what microfluidics usually does. Still some orders of magnitude smaller than what some of these, you know, food industrial processes require. But we're confident that we can scale.

[00:14:13] **Susan Kish:** One of the things that comes up when you talk about Luca Di Tizio is your cover on the 2017 ETH Annual Report. I noticed you were on the cover and the president of the university was only on page four. That was because of the Swiss Loop team and that global competition. How did you start that and what did you take away from that experience? What was the Swissloop in the hyperloop?

[00:14:40] **Luca Di Tizio:** So, the hyperloop concept in general is a train at very high speeds in a vacuum tube. So by accelerating this, we call them pods, in an environment where there's no air resistance, you're able to achieve very, very high speeds in a decently environmental and efficient way. I say decently because we can talk about, you know, the requirements of the technology further and why it's not a reality yet. But that's the main principle and the goal of the technology is to really fill a gap between transportation, by train and transportation by airplane. There's a golden spot of around a thousand kilometers where traveling in a hyperloop is first of all, is much quicker than traveling by train, but also more efficient than traveling by airplane. And so for kind of pan-European travel from, you know, from France to Germany and into Switzerland and Italy, those are really hyperloop destinations that could be interesting to develop. The idea is, is very old. The idea came up in the early 1900s as a form of transportation for goods. You can still see them in some American factories where it's actually this air-propelled messaging system.

[00:16:02] **Susan Kish:** Oh, those tubes. I've seen those.

[00:16:04] **Luca Di Tizio:** Exactly. So that was the start of it. And they tried to do that in New York underground for people very early in the 20th century.

[00:16:13] **Susan Kish:** Oh, that's wild.

[00:16:14] **Luca Di Tizio:** Yeah. And they recouped the idea back in the seventies and sixties for science fiction. So there are quite a lot of comics where these tubes travel through those tubes at very, very high speeds. And so it was 50 years later was recycled and now we're another 50 years later. And how could it be differently? It was Elon Musk who then wrote a white paper and said, guys, the technology should be ready now and we should make this a reality. And, and that's when he launched a student competition and led us to, to found Swissloop.

[00:16:48] **Susan Kish:** So it sounds like it wasn't three students in a part-time lab doing this five hours a week. It sounds like it was really intense and a lot of students from a lot of different disciplines. Can you give a bit more context on it? Because your role was the lead, you were the project lead, the CEO of the venture.

[00:17:07] **Luca Di Tizio:** Project lead I think fits very well. The project was actually started extremely grassroots by Doré de Morsier, who is a friend that is still involved through Eurotube with the entire hyperloop field. And how could it be differently? He took the idea from the US. So he visited MIT over summer and he saw that MIT was actually developing a pod for this student competition and said, you know, how is it that ETH doesn't have a team? And when he came back, he started looking for students and very quickly, I think there was over 30 people that were interested. We met at the Student Project House. This has to be in September of 2016. And we kind of weeded out the people that didn't wanna invest enough time into this project. And we were left with, at the end, towards the beginning of the new year in 2017 with about a team of 18 people I'd say. This was really white sheet of paper in front of us. We didn't have anything. We had to found an association. Which is the same form as FIFA has here in Switzerland. So we are just as incorporated. We had to find funding in the second year where I was part of Swiss Loop. This amounted to about 150 to 200,000.

[00:18:25] **Susan Kish:** Okay. Not insignificant.

[00:18:27] **Luca Di Tizio:** Not insignificant, fine for a couple of students. And we had most importantly, you know, to build a prototype that we could then present in the US. And the presentation of this was in summer of 2017.

[00:18:42] **Susan Kish:** Well, you're under pressure for time.

[00:18:44] **Luca Di Tizio:** Absolutely. And so you can imagine from February of 17 to August, those six months were hell, that was really tight. And I remember the time vividly. It's, it's, it was a good time. It, I made a lot of good friends. And we finally made it. And as you said in the introduction, we, we came third there and, and I think that was a great success.

[00:19:05] **Susan Kish:** It wasn't third outta three, if I read correctly. There were like 1200 applicants.

[00:19:11] **Luca Di Tizio:** Yeah. So it, it's a staggered process. So SpaceX doesn't just accept 1200 people to be in Hawthorne in LA, they start off with 1200 applications. And they go along the way of selecting, I think it was around 20 that were allowed to present their pods. There in LA out of these 20, only three were allowed to go into the tube, so another 17 failed all of the, all of the safety tests. That were done a week before on site.

[00:19:41] **Susan Kish:** So you were one of the three who were in the tube?

[00:19:43] **Luca Di Tizio:** We were one of the three that kind of won that won those first 17 out. And then we were, sadly for that time we were the slowest, but at least we made it in the tube and everything worked and everything was safe.

[00:19:54] **Susan Kish:** And there's a wonderful picture of you with Elon Musk.

[00:19:57] **Luca Di Tizio:** Yes. That was quite interesting, stressful, up to the very last minute. What happened with us there is we did this in six months, and so you can imagine not everything was thought through and tested the way it could or should have been. And our communications broke up completely the moment we should have launched. So it could have been a comic, really. We pushed the button, we entered space, and instead of the pod going and accelerating, all we had was no connection.

[00:20:27] **Susan Kish:** Oh God!

[00:20:29] **Luca Di Tizio:** And you, you have this tube. You have Elon that just arrived 20 minutes earlier, and you pressed the button and everything just crashes. And that was the moment and it, it was interesting. That was the moment my team looked at me and said, you sort this out.

[00:20:51] **Susan Kish:** And what did you do?

[00:20:52] **Luca Di Tizio:** Well, my first reaction was to get more time right? Because it could have been, you know, oh no, screw this. You guys failed. We'll just open up the tube and the next team's gonna come in. And so I somehow convinced SpaceX and Elon as well to give us another 20 minutes and to try and sort it out. And we rebooted the entire system and I think it was really sad, but I think what had happened is, we had to limit. That was a, a terrible prototype, but we had to limit the power, let's say, of our prototype for it to work. And so the second time we pushed that button, it worked, but it was really slow, so it, it only went 40 kilometers per hour instead of the 200 we had aimed at. That, that's the pain after six months of, of hard work, you know.

[00:21:41] **Susan Kish:** Yeah. But you got it to go and it did the 40 kilometers and it didn't explode. And probably from their perspective managing that situation was probably as important as the actual test run.

[00:21:54] **Luca Di Tizio:** Sure. No, and I think, you know, the, the great thing is we built the foundation for a really, really successful group of people that is still ongoing. The project is five years old now, and there's still motivated students that I think are having a great time. Developing new prototypes and bringing them further along the way and seeing all of these sponsors, you know, that have stayed on board and that are contributing in kind and also monetarily. I think that is really, really awesome to see.

[00:22:27] **Susan Kish:** So let's just go back to the ETH for a moment. Um, first off, why did you pick, to go to the ETH?

[00:22:34] **Luca Di Tizio:** I skipped a generation, so my grandfather graduated from ETH in mechanical engineering. My parents, not at all. They, they were into sports. And me, originally I actually wanted to study medicine, so I really, really enjoy helping people and I thought medicine would be a great profession to, you know, go after that, uh, trait of mine. But the other trait that I had was that I was extremely unorganized. And so in Switzerland you have limited spaces, limited slots for studying medicine, and I missed out on even applying for the exams for those slots in time. So the application was in February, and then in April, I even noticed that, you know, these, these exams took place. I didn't want to go and travel and try to find myself 'cause I felt very found and I decided, you know, what, what sort of other profession brings together my love for technology and my love for helping and the human body and bioengineering, I think came up very, very quickly and, and very swiftly on that list. And that's why I chose mechanical engineering, cuz I went down and checked, you know, where I kind of start as a generalist and then kind of go more into this. I didn't wanna study biology, but I also wanted to have something that would open the doors and go towards helping people on the healthcare aspect and well that's, that's what I've found.

[00:24:02] **Susan Kish:** With all this, where do you see yourself in let's say 20 years?

[00:24:08] **Luca Di Tizio:** I'm really passionate where technology intersects with health and with helping people on living better lives. And so wherever my journey might go, I see myself in that field in 20 years. Obviously I'd like to continue to grow. I am still quite young and I think I have a lot to learn and to seek out those opportunities where the learnings can be maximized and I can do the most in the least time. That will be my priority.

[00:24:40] **Susan Kish:** Fantastic. Fantastic. So I'm gonna close by asking a couple questions that we often ask here. But first of all, what is your favorite place in Zurich?

[00:24:52] **Luca Di Tizio:** My favorite place has to be anything along the river Limmat. I really enjoy walking along the river, especially in summer. Maybe not so much for winter, but that will be it.

[00:25:04] **Susan Kish:** So when you were small, you and you were thinking of what you wanted to be when you grow up. That was a doctor that was in medicine?

[00:25:12] **Luca Di Tizio:** Yes. For a very long time. And then seeing technology and how technology could affect people's lives. That switched a bit. And that changed and I really enjoyed, know, the more measurable and the more scientific aspect of including technology in healthcare. And so that struck me as really interesting and I've kept that interest for ever since.

[00:25:35] **Susan Kish:** Do you have a specific memory, a place or a time from your years at the ETH that you could share?

[00:25:44] **Luca Di Tizio:** I think the most intense, and that's probably why they stick out, were with Swissloop. I remember the countless nights, actually ML, so that's the Maschinenlaboratorium. It's a building in the Centrum of ETH where we had our first office. And this was really when there was nothing set up. So we had a little cubicle inside an office and it would be dark outside and we would be working on association, on logo, on raising funds, on designing the equipment and I think that's, probably still, it's not the nicest, but it's my favorite place.

[00:26:21] **Susan Kish:** And then finally, looking forward, what are you curious about? What is it that's sparked your interest right now?

[00:26:27] **Luca Di Tizio:** Very recently it's not a new field, but I've started reading up on the science behind longevity and you know how aging as recently by the WHO (World Health Organisation) actually been determined as a disease, which will allow much more research to go into the processes that cause us to age. And that brings me back on a daily basis with Microcaps also in encapsulating certain supplements and going that way. So that's a full circle.

[00:26:53] **Susan Kish:** Very, very cool. Luca, thank you so much for your time this morning. This has been a great conversation. Really appreciate it.

[00:27:01] **Luca Di Tizio:** It has. Thank you so much, Susan.

[00:27:06] **Susan Kish:** I'm Susan Kish, host of the We Are ETH Zurich series, telling the story of the alumni and friends of the ETH Zurich, the Swiss Federal Institute of Technology. ETH regularly ranks amongst the top universities in the world, with cutting edge research science and people: the people who were there, the people who are there, and the people who will be there. Please subscribe to this podcast and join us wherever you listen and give us a good rating on Spotify or Apple if you enjoyed today's conversation. To close I'd like to thank our producers at ETH Circle and Ellie Media, and most of all to thank you, our listeners, for joining us.