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Design to Disrupt [Entire Talk]

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Dan Widmaier, co-founder and CEO at Bolt Threads, is on a mission to disrupt the garment industry through technology and science. He shares his perspective on sustainability, the future of the environment and how to focus on the task at hand instead of distractions.

Transcript

- [Announcer] Who you are defines how you build.. - Thank you for welcoming me for your last session of the quarter, uh, just before I start going with the presentation, I would recommend that you follow the wonderful team at Bolt Threads, I'm sorry if you have the misfortune of following me on Twitter, uh, you'll mostly get rage-tweets about the Seahawks games, and things like that.. Um, and so I'm gonna tell you about the company I started after graduate school called Bolt Threads, but before I can get into what Bolt is and some of the things I've learned, I kinda have to give you a little view on how I view the world, and why there's a problem that's worth solving here.. So, the planet we live on, Earth, about four, a little over four and a half billion years old, if we look at fossil records, life has been on this planet for, I'd say 4 billion years, it's actually like 3.8 is the current estimate, but, I always say, what's 200 million years between friends? And if you, uh, if you think about us, homo sapiens, we've been here for about 200,000 of those years, we've got some ratio, 23,000 to one up there, I actually like an analogy as a way to understand this a bit better, so if you say Earth is about one day old, humans are about 3.76 seconds old.. And the decimal points really matter on this, when you're talking about such a big ratio.. And, and what astounds me, is that in that time, that we've been here on this planet, in two human lifetimes, 150 years, humans have had a dramatic impact on every aspect of this planet.. Climate change is the one that comes to mind, but, whether it's changing the hurricane season to be more intense, wildfire season as we experienced here, just a week ago, or, covering the planet in pollution and waste products, we are having a big impact, and we've done it incredibly quickly.. And, adding to that problem, and then next, by the end of this century, we're going to add several billion more of us, to the planet.. This is baked into the pie, it's pretty much inevitable, and the truth is, a good chunk of those 11 billion-ish people that are here, are gonna become middle class consumers, and that's good, no poverty, all sorts of good stuff.. On the downside, they're gonna eat like middle class consumers, buy stuff like middle class consumers, and throw their crap away like middle class consumers..

Much like we do here in the United States.. And so the question a lot of people have to grapple with going forward is, can this planet support about three billion more middle class consumers, and about four billion more people? Uh, going forward? And it's, a, an honest question, and I think there's an interesting thing we can think about here, some of the limitations of resources.. So I'll use the arable land example.. So, right now arable land where we grow our food and we feed all of us, it's great, it works, we got about 5% more arable land that we can go, and and new crops to, and grow more food, but if you just take that population growth, and the number of middle class consumers and look at 2050, you need 70% more arable land.. And unfortunately, this is not like adding servers to your cloud infrastructure, this is like, land.. We don't make more of it, you know maybe someone will come up with a crazy idea, but it seems a little, little farfetched.. So I actually want to ask you guys a question, knowing this, how many of you, show of hands, are optimistic that humans will be here thriving 10,000 years from now? A couple of you.... Okay, we'll make it a little easier, a thousand years, hands, anyone else? Okay, now the easier question, hundred years, we gonna be here? Okay, so everyone's pretty .... I, I we'll be here in a hundred years, right? I'm actually incredibly optimistic, that we are smart enough, to be here and thriving, 10,000 years from now.. And it's not because I have blind faith, or I'm just a dreamer; it's that I'm trained as a scientist and I believe in the data, and I think there, that the example is there in front of us, of what we harness to be smart enough to do this..

I believe what we can measure and prove.. And here's, here's what I always come back to, for that 3.8 billion years that life has been here, we've done okay, like we just screwed it up in the last hundred and fifty, like, look at all these things that biology has done, it pervades the planet, huge amount of diversity, I'm showing you what's called a phylogenetic tree, here,

but the idea that everything comes down to a common ancestor, which, yet to be agreed upon, but everything from your fungi and your animals to your filamentus and cyanobacteria, your photosynthesizers there's a huge amount of diversity, and this all went along just fine, for, you know, basically, 3.8 billion years, minus a hundred and fifty, before we really came along with our modern society.. And the thing I find amazing about biology, this is like, it almost reads as a sci-fi tech, even something as boring as a flower, biology covers the planet with every possible range of ecosystems, from snowy and arctic, to subtropical or desert, uh, it self-reproduces.. All of our modern products that we've learned to make, widgets, devices, your iPhone, if you chuck it in some sugar water, your iPhone doesn't reproduce, it just shorts out.. You throw a seed in the ground, it grows, it makes more seeds and it makes more stuff, it repairs.. If I cut, and I'll show an example of this later, if you cut something off of a tree, it grows back, and can you imagine describing to someone, so I'm gonna show a short video here, this is forest floor, nothing really happening, oop, now it's moving a little bit, time lapse, not in real time, uh, oh look, something is growing out of the floor, growing to many times its height, it's then going to sprout some flowers, and look pretty, and blow in the breeze, and if you described this as a technology you were gonna invent out of a entry level engineering class, people would tell you you're crazy, it can't be done.. This CO 2, sunlight, time, don't freeze, it works.. That's absolutely amazing, biology is powerful.. And me, as a bioengineer, see this as an example of something that, can we figure out how it works? Not just watch it and say, wow that's pretty, but, use it to solve some of the problems we have on this planet.. And, here's what's really changed a lot, in the last 15 years, and to the lay person who's not a biologist, it's been less obvious, this is one of many things, ways to convey this, but uh, DNA sequencing is a really good way to show how this technology has changed, dramatically..

You can talk about-- This is reading DNA technology, this is, you look at the A's, T's, C's, and G's, within the genome of every living organism on the planet, and understand, how it stores information, that makes it do everything, from eat and digest things, to make new versions of itself, to self-repair, and, as this cost has gone down from you know, hundred million dollars a genome to about a thousand bucks a genome, it's enabled a lot more engineering capabilities.. Design, build, test cycles, and there's analogous-- I can show you analogous data for writing DNA code, for synthesizing those A's, T's, C's, and G's, as well as some of the more esoteric tools and computational functionality that's critical there.. And so, I actually think, modern bioengineering is truly engineering, and going there quickly, and it liberates us from the canonical ways we think about materials, in particular, across our planet, and energy, so that we're not gonna be reliant on 18th century solutions to 21st century problems.. And so (long pause) one big problem here, is that, all of our modern economy is built on an absolutely amazing material, that is fundamental to everything we do, and that's oil.. And oil's amazing, I'll show you in the next slide when we get there, it's, we kinda need it, but there's no amount of optimizing that current economy to sustainability for 10,000 years.. We're either going to burn it all up, we're either gonna release enough greenhouse gases that we unleash the full fury of climate change, or, we're going to drown ourselves in pollution, of things that never degrade.. But as I said, it's actually quite useful, it's made some really awesome things.. You know, everything from-- You think about driving your cars and stuff like that, but, uh, everything from paving roads to making plastics and over the last, uh, 50 years, plastics unsurprisingly have grown, because they're cheap, they last a long time, and they're very good at what they do, in fact you find them touching every element of your life, including, I'd be willing to bet 95% of you are wearing plastic fibers right now.. The challenge with that, is that, it's designed for a product, used for a short time, but lasts a long time, and our future looks something like this.. When you create something out of a polyester, or a nylon or an acrylic plastic, you're putting something out there that you're gonna use for anywhere from, I don't know, a drinking straw for, a couple seconds to minutes, and it's gonna last for a few hundred years..

There's a big impedance mismatch between the material and the product, and how long it lives.. And that's actually, only the part you see.. Take your clothes.. Two thirds of the fibers made on this planet every year come from plastics, primarily polyesters.. We make and consume about 80 billion, I've heard it's about a hundred billion now, garments per year, across this planet, that is an insane number, and it's only gonna get worse.. And, those plastic fibers, when you look at your yoga pants, your tee shirts, your sneakers, they're all there and they take hundreds of years to degrade.. What's even worse, and our friends at Patagonia paid for this study, and we have a partnership with them, and we give them a lot of credit for calling out something where they are part of the problem as well, and they know it.. When you wash your garments that have polyester fibers in it small microfibers, smaller than a millimeter, break off and go down the drain, and there's data showing you, it's like, per six kilogram washload, how many, what the count is on those microfibers.. Not only do they come off in the water, but they actually go, slip through, all the way through the waste processing plant out into the ocean, where they're eaten by small organisms like plankton, which are eaten by fish, which are eaten by us.. And there was actually a great article, it came out about two months ago, quantifying the amount of plastic microfibers, in poop, of humans, across every continent on this planet, and it's like 95% of us have it..

And this is actually such a new problem, we don't even know if it's bad for us, or not, like I think it is, but we don't know, we just kind of know the problem is there now.. But, if you ask me, this seems kinda unsustainable, right? How do live on a planet where we consume 80 billion garments a year, that effectively never go away? Whereas, you turn around to look at how nature does things, and it makes materials that are designed, for four billion years, to biodegrade in the environment, and I found this one, I thought I'd throw this up here just to point out the absurdity of some of the things we do.. You know, fruit is great, there's a term, glad goes bad faster than fruit, because fruit actually biodegrades.. We've actually been so crazy as to make things like, things that look like fruit, out of plastic that will never go away.. This is absolutely absurd.. So, I think, you know, nature is incredible, there's a problem here with materials, nature's solved a lot of these problems, four billion years, that's a lot of like, what exists today, but everything that came before it, that we can find out there, uh, and when

nature makes a material, it stores it in the genetic code, like I kind of alluded to earlier.. And so I'm gonna give you an example, here, one that I think is, drives the point home a little bit, to show you a few things that nature makes.. So, this is a barnacle, I'll be surprised if none of you have seen one of these before, but maybe you haven't.. They, most of these little crustaceans, they stick to the hulls of ships and piers and things like that, and this is a blown up version here, they basically sit there and they're filter feeders trying to eat stuff that comes by.. They have no brain, effectively no way to move around, except for in the early part of their lifecycle, but they've essentially evolved and adapted over time, a glue, that they make and secrete, that cures within saltwater, which is actually a really rare feature, and they stick to the ship and not even, no hurricane, no amount of driving fast, takes them off..

You need to come there with a hammer to bust them off.. We as scientists, chemists, chemical engineers, we haven't made things as good as that in our hundred years of supposedly being the smartest in the world.. This next one I'll show you is another different material where nature has evolved something cool um, and I'll do this in two phases, one, a gratuitous hummingbird video because I like hummingbirds, so, this hummingbird is flapping its wings 60 times a second, that is kinda crazy, right? Has anyone tried to move their arms 60 times a second? No, no, don't do it, you'll hurt yourself.. Um, it's a-- It's absolutely amazing, so how did, how did nature solve this problem? And the better example to show you guys is, we'll take this dragonfly, does the same thing, but it's a better understood system, so this dragonfly, fairly small, has wings that are about the length of its body, giant lever arms.. I don't see big burly muscles to move its wings 60 times a second, and it's-- In her short lifespan she'll flap her wings about 300 million times.. What she's done, is gone and evolved effectively, protein-based rubber bands, that sit in the joints of the wing, that are 99% energy efficient.. So she's not actually putting a lot of energy in, she's just kinda keeping them bouncing over time.. That uh, that keeps her aloft, and that's absolutely incredible, we don't make rubber nearly that good, anywhere on the planet, from petrochemicals.. So my personal favorite, where Bolt started, the silk that spiders make, so what you're looking at here is a video I'm gonna show you, this is called a Darwin Bark Spider, um, she's about a gram, not the smartest critter in the world, spins this protein-based fiber that we call silk.. It's very similar to the silk we've used for apparel, over the years, um, and it's fine, it's biodegradable-- I'm gonna actually back up and play this again, um....

Okay, it's fine, biodegradable, it's actually stronger or tougher than Kevlar, by about sevenfold, it's an absolutely incredible material.. She's not intelligent about it, she's just had a 400 million year head start.. And so what she's doing here actually, this is a really cool feature that spiders do, this is called ballooning, she's releasing this silk, it's wafting across a river, it's gonna catch on the other side, it's about 30 meters wide, and she's gonna build a web over that river to catch bugs that come up, to make more baby spiders.. That's the power-- That's one of the most powerful things you can imagine, on the planet, when you look at biology.. And it actually gets far better than that, because this silk is, actually out of one of six or seven kinds, depends on the species, that she makes, that have different features.. One, stretchy like spandex.. Another, you think of a spider's web, it's sticky.. That silk is not sticky, she actually makes a glue, from a different gland, that she coats onto those fibers.. There's another one that's super soft, there's one that's very very fine, but all in, she's already provided a roadmap for how you would make a wide array of fiber-based polymers.. And so, I think about the technology that makes these guys tick, they-- They make our modern devices look like rocks, that we carry around and talk into..

Like this is amazing, everything that they can do.. And spiders are really where the Bolt story started.. So, we came along and said, you know what, there's a lot of these features out in nature, they're often made from proteins, much like the fiber we have here, from the spiders.. The glue the barnacles make, the rubber in the insect wings, all incredible materials, all made from proteins, and proteins are kinda the core competency of biology.. When you study biology, there's something called The Central Dogma, it's about information stored in DNA, to functionality largely in proteins.. The search spaces are basically 20 to the end is the number of amino acids you have in there.. This effectively, quickly becomes basically infinite.. So I founded Bolt Threads in 2009, with two of my buddies, out of graduate school, with the idea of using proteins to replace the plastics and other materials we find out there, in the environment.. And so I'm gonna tell you a little bit about how we do that before I talk about some of the things we've learned along the way.. So, step one, everything's stored in DNA, find the information you want, and copy it out..

Now I no longer get to do this, because I've been able to find people much smarter than me, who work at Bolt, probably many of your colleagues over the years, who come and work with us, so, Rena here kind of typifies what happens in a biology lab, ranging from finding the information in an organism, doing a little bit of tweaking and coding to make it work better in a new organism, we use yeast, that's actually what she's looking at here, on these plates, single-celled organism, actually we as humans have a very long and passionate love affair with yeast, for several thousand years we've used it to make cheese, bread, beer, wine, things we love, all over the world, and then we have, essentially, yeasts that are tuned to make the spider silk protein without any spiders.. Then we need to make a lot of it, turns out that growing, scale up is always a thing, for start ups, growing a lot of these plates is a real bad idea, so we turned to another yeast kind of technology, called fermentation, where we used large stainless steel tanks, and there was a time when I used to say this was a giant 300 liter stainless steel tank, now in Bolt parlance, this is a baby, little fermentor that's cute, and we run it around our place.. Normally, when we're doing scale up now, these things are about 20 feet in diameter, about six stories tall, and that's where we mass-produce metric ton scale quantities of spider silk protein.. Then, and I'm not gonna show you here, cause it's kinda distracting, we take it, take the protein, make it into a powder, much like a powered milk or a whey protein, like after a workout.. Dissolve it into a viscous liquid, and extrude it like you'd make rayon or polyester, into fibers, and one of the things we've learned over the years, is that, if you give people a pile of polymer, or a pile of fiber, they don't really know how to interpret it, so you make

things that people actually interact with.. So, uh, in-- about a year ago, we did this, it was a limited edition drop this is a wool spider silk blend, 60% wool, 40% spider silk, that we did in combination with friends of ours at BestMade company.. And it basically makes this beautiful, soft yarn, that we knit into a product, that actually turns out to be about 30% warmer than wool by itself, while being about 10% lighter.. And so we made this, make a new product, and we actually took it all the way, this was the idea of getting minimum viable product all the way in the hands of consumers, by making something, putting it in a FedEx box and it showing up at a doorstep.. Turns out, the hardest part of the whole thing? Getting through customs in Russia (laughs).. Another example, so we work with the designer Stella McCartney, um, and-- Early last year, the Museum of Modern Art in New York commissioned a piece for an exhibit they were doing, where Stella designed this dress, and then we came along and made it, out of 100% spider silk, and the museum displays it as a piece of art for about six months, before, now I think it's probably gonna end up on display in one of Stella's shops, at some point, but..

Absolutely incredible, and what it does, it starts to ignite the imagination, of what can be, and that this can become real product, that it's not just a science experiment, that it's gonna turn into things that people can interact with and buy, and as we continue going forward, the mantra is scale, you're gonna see this in a lot more places, starting next year and beyond.. So the good news about this, it kinda sounds sci-fi, like Tom said in the beginning, it sounds like you're venturing into the unknown, and that you're gonna try and launch a-- Put a man on the moon for the first time, or do something absolutely crazy, and it is a bit crazy, I won't deny that, but.... We're following a playbook that's been optimized over billions of years.. You're copying something that already exists.. So when I look at this, the beauty of biology, and the four billion years of evolution, to use as your crib notes, is that you get two big advantages that other product developers Camus, and others before you, never had, and this should never go understated: you have a working prototype, like in your hands.. I can, well not right now, it's too cold, the spiders are all dead.. But, uh, it's Charlotte's Web, Fall, the whole thing.. Um, but we can go out there when there's spiders and webs, we can take a piece of the silk, we can put it in a mechanical tester, and we can test those properties, right? There is a working, functional, 3D, composition of matter that works for this stuff.. So like, you know that, and second, you know that biology can manufacture it.. So if you can engineer biology, you too can manufacture it..

What that small caveat there, is it doesn't tell you how hard or how long it's gonna be, or how many millions of dollars it's gonna take, but it can be done.. And I would venture to say, that that is a massive cheat when you're going off and starting something new.. So we have another product we announced earlier this year that I'll talk about briefly, a problem material on the planet, for sustainability, this is one that actually is from nature, leather, everybody loves leather, who doesn't love leather? Uh, there's some reasons not to love leather, I'll cut to the chase, there, but uh-- A wonderful material has evolved, effectively with humans over the years, um, I love a leather jacket as much as the next guy, although it has some problems.. I'm not a vegan, but from a sustainable materials point of view, besides just killing a cow, that is a really inefficient way, to make that material.. You could do far better.. So if I have a jacket like this, raising the cow to make the leather, to make the hide to make the leather, is a three year process.. The economics of leather, of the hides, is absolutely terrible, it's actually considered a waste product.. And during that three years, that cow is taking up pasture space, it's eating a couple tons of grasses that are using water and land and all sorts of stuff.. Cows are expelling greenhouse gasses, in the form of methane from their belches, which is about 20ish, 25-times-ish, more potent than CO 2 alone, and it's essentially fueling global warming.. Let alone, once you have the hide of a dead cow, you have to go through a tanning process, to do what's called de-putrification, it's the word of the day, um, and tanning hasn't changed much, in the last 600 years..

Some of them look a little nicer than this, we used to do a lot of hide-tanning in the US, it's terrible; toxic chemicals, lots of salt, smells awful, and so what was essentially done in the US was export all of this pollution to other parts of the world, that look something like this.. And there are fancier versions, but largely that.. So, when I look at it from a renewable resources point of view, what you have is a 600 year old solution that just makes no sense.. So at Bolt, we actually announced earlier this year, that we're making a leather product, and I've got one that you guys can touch up here if you want, and this is a leather, looks like leather, feels like leather, but it's made from growing mushrooms.. So, we grow, take a mushroom, and the part you eat is called the fruiting body, most of the organism grows in a dense network of roots called mycelia, we grow these mycelia, on waste products, actually from the silk process, and create a leather that grows in nine days, not three years, and eliminates all the harmful chemistries in the tanning process.. It's durable, it's functional, no animal involved.. And mushrooms are kinda, kinda fascinating, right? These are things that grow on waste products, like celluosic biomass, they're some of the biggest organisms on the planet, I find this actually pretty incredible, and if you go, you can actually take a road trip up to Oregon and see this 2,000 acre, single organism; pop quiz trivia for pub night, is largest organism on the planet it's not a blue whale, it's a fungus.. And so what we do, actually, is grow it in a tray, so this is, essentially wood chips, or manure or something like that, uh, corn stover is what we use, in particular, and then what happens is this mycelium, the fine root structure, we trick it, and it grows above the air, we create a foam, in about nine days, and then we use that, compress it, cook it, dye it, and you get something that looks like this, looks like cow leather, but like the silk is completely circular material.. Comes from products from nature, can be redigested by natural processes across ecosystems on the planet.. And that's pretty incredible, and at Bolt we have a whole series of new things that will come after this, and so....

These two are just the beginning, of what we're doing, we really started as three science-obsessed nerds who were driven to avoid getting full-time jobs, when we were gonna graduate, and what we've evolved into is a company looking to solve some of the most vexing materials science problems on the planet, and the best news of this whole thing, in my opinion, is you don't actually have to trust me, you have to look at a working functioning system that has been here for four billion years, and trust that track record.. And so far, we only have nine years of experience, but I'm gonna go into a short section where I talk

about some of the things we've learned about reinventing a category, so Bolt's a weird company, we blend consumer meets molecular biology, and effectively no one else on the planet really does that.. So, here's a couple of things I've learned: One, and this is, this seems dumb, and it feels a little, maybe even overused, but everyone forgets it.. That when you're starting a startup, I think the most important thing you can decide on, as early as possible, is why we call, what's your North Star? And that's to say, what's the thing you want more than anything, that you're willing to sacrifice on other things, to get there? A really really smart person in startup land once told me that the true strategy is the things you decide not to do, not the things you decide to do, because, it's easy to say yes to a lot of things, it's hard to say no and give up the things that come with it so first and foremost, simple point, but, absolutely pivotal, and at Bolt, for us, it's actually about our mission-driven nature.. Most people join Bolt because of the ability to take amazing new technology, in an exciting new commercial space, and do some real good in the world, if we make it work, and so we actually reduced that down to a little, little slogan we have that we're inspired by nature, devoted to science, and driven by an optimism that the best days of the planet remain ahead of us.. And that's something that everyone who comes to Bolt really buys into, and it makes it easy to say no to all of the other things along the way, because we know what we're saying yes to.. The second thing I'll point out is about recognizing opportunities, I think oftentimes people think that like, opportunities are, either, they have to be completely obvious, or that people get lucky, I would say that each of you are smart enough, you know amazing opportunities, and it's all about the execution to get there, and so I'm gonna show you, this is a vintage, 2011, Bolt Threads, then called Refactored Materials, uh, Series A pitch slide, we raised five million dollars, in our Series A back then, and it was about the benefits of why you'd wanna make silk this way, and were, mostly wrong, but whatever.. The idea here is that you can make, with a-- An automated process you make more consistent fibers than when nature makes them, you can control cross section, we thought, mmm, we now know, you can make these fibers machine washable, and then I added these two things, I was like, people should care about this, sustainability, and the fact that they don't come from animals.. I got laughed at, like literally laughed out of venture capital pitches, because of this, right? They were like, I might be as green as the next guy, but I've never heard of a vegan material.. Today, there's like a billion dollars of demand coming through Bolt's door, asking for these things, and no one cares about these things..

So the, the point here is not that venture capitalists were dumb, it's that there was an opportunity, it just wasn't clear that the market and the need had all lined up in a way that everyone understood it, yet.. And that, that we had the right idea, just the right timing.. And that by being flexible and knowing there was an opportunity there, we were able to harness that later on.. The second part of this was, where do you use silk? And so my slides are a little backwards here, but the way that I'll explain this is, if I-- When I tell people we're making spider silk, the first thing they say is, "Make bulletproof vests." and it's probably because I seeded it in your mind by comparing it to Kevlar, and being tougher, earlier.. Turns out, that's probably a terrible idea.. You're taking a business risk on a market space application that literally no one's ever done with that material before and so you're compounding risk upon risk that's serial.. Whereas, if you look back for about five centuries, or sorry, five millennia, sorry, silk's been used as a beloved material in consumer products and apparel.. It doesn't have the long timeline in technical and regulatory risks that come with some of the other spaces, and it simply required us, as a bunch of engineers, to kind of check our egos at the door, and say, this isn't what feels like the most technical application out of the gate, but it turns out silk's about a five billion dollar a year market, which is not really what we go after right now, silk fiber itself, we go after other stuff, within the fibers market, but, there are-- And as you dig into it, there were really interesting technical problems to solve, and really interesting sustainability problems to solve.. And then after we solve that, we can always come back and do these other crazy things people asked us to do, like make semi-conductor dielectrics, sail boat sails, medical devices, beauty, and automotive.. Nothing stops us from doing that in the future, if we get the business right in the beginning..

The other part I'll point out is Mylo, so a year ago, this was not really a big part of Bolt at all and it was a recognition that there was a massive opportunity in the market here, that the right technology at the right time, with our team, could be huge.. And today, the demand, I actually had to stop taking calls on Mylo, um, because.... The demand is just through the roof, and people will pay anything for it.. This one, it's a little self-serving, cause I'm a scientist, but I would argue that, treat entrepreneurship like science, make sure you're learning from everything you do, every, everything you do can be designed to learn something.. As a failure-- Even in failure.. And so I would, give a couple of basic examples, I think of, I've got a four year old son, and a little past blocks in holes, but um, trying things, actually ask the question, gather the data, analyze it, and use that to inform your decisions, running off of other people's wisdom and instinct is rarely the right option, and usually you can design good experiments, that allow you to make data-driven decisions on how to build your company, and how to go forward.. I'll skip over this one.. Competition, so, when you're kind of labeled out there, in the world of startups, you can think about what exists with similar materials, you've got your natural materials, your synthetic, and as we think about it, the bioengineered, and we're not the only ones who thought of this idea of using biology to engineer materials, in fact if you start Googling around you'll kick up companies like these ones, and you'll say, oh, they're your competition you could like fight them and block them with IP, and like all these other things, and they've got like pretty pictures, kinda like ours, and maybe this is a-- This is all our stuff, over here, but maybe this is a problem, right? The reality is, most startups don't die because you have competitors, like we're all a bunch of startups who are burning cash and trying to figure it out, the biggest competitor, is ourselves.. The most likely chance a startup fails, in my opinion, is the team makes bad decisions and runs out of money and can't make payroll, and so.... That's like the most obvious thing, but everyone forgets it, so like, I often advise everyone at Bolt, look internal, not external, for where the worst competition is, and make sure that we're testing the right things, and being prudent with our path forward, so that we can make our product and our technology real..

Turning a technology into a business, this is a tricky one, especially for scientists and engineers, you know, we're all good with technology, but at some point you have to find a way to make money doing it.. The, "Dan just go raise more money" answer only works for so long, even though I've heard people say that at Bolt, "Dan we'll just raise more money." And so, so you know, the question here is I would argue that Netflix did this brilliantly, of finding a way to take a technology, and marry it with a business model in a way, to devastating effect to the rest of the marketplace.. And so when we look at this at Bolt, we have a business model that, in the traditional sense, what many people told us to do, was, Bolt makes stuff, and then we give it to someone who's like a middleman, who makes things like fabrics and materials, and then they'll sell it to brands, and you'll monetize by sort of feeding the pipeline and these people will eventually pull.. That turns out to be terrible, and there are a million reasons that doesn't work, and there's no incentive, great technologies die all the time here.. So what we did at Bolt was kind of hybridize the business model, where not only do we make things, we take it all the way to the consumer, like that hat I showed you, we made a series of neckties, we actually, like this bag, actually we had on Kickstarter a little while ago, a few examples here, of stuff we've done, and like I said I really love being a scientist, these are all experiments.. We designed these to learn a lot, in everything we do, from how do you design packaging, how do you ship something, to what archetype of customer is interested and following us, how does it map across social media space, and uh, e-commerce, and it's all about getting out there and doing lots of tests really really quickly.. I often tell people within the company, that humans are worse than random at predicting the future, but we are far better at seeing it and recognizing it.. And so, let's just make a lot of things, and let's recognize where it's working.. What you should care about, this is a little nebulous, but, if you start a startup, this is what the headlines are gonna tell you you should care about.. These are some things that were written about Bolt Threads..

It's all about dollars, right, everyone cares about money, no one cares about the rest of it, in public perception.. But much like that North Star argument I made in the beginning, you need to know what you're going for, and learn to ignore this, and it's harder than you think.. It's really difficult, everyone gets caught up in this.. Raising money, financing, because we all understand money and the fungibility, and being able to do things with that, but in reality it all comes back to this.. We care about this, internally, and if we do this right, all the capital, all of the money will be there.. And the last thing, and this is just small, as an entrepreneur, no one is gonna tell you how to do your job, better than yourself, and the great entrepreneurs, in my opinion, find a way to self-motivate.. For myself it's how you cause enough anxiety, enough motivation, to channel all of your energy into making the business go forward.. So the example here is, you know, if you put yourself in a boring office situation every day, it's pretty hard to motivate yourself to do extreme things, to make risk-based decisions, cause, you know, Bolt, no amount-- Or day one at your startup, no amount of cutting costs will get you to profitability, you're gonna have to make risky decisions and take chances, to get there.. Which I imagine, if I was hanging upside down on a rock like this, you're pretty motivated to make some risky decisions if you have to.. So, those are the, a handful of the things I've learned, I'd actually like to take some of your questions now, about what we've done at Bolt, how we've gotten here, and where we're going next..

Yes, right here in the middle.. - [Audience Member] The leather suitcase, the not-real-leather suitcase that you're making, that's comparable, what is the cost analysis on that, to a comparable leather product, and how is the market reacting to it, on that basis, because I've never heard of it before today, but you say you're getting a lot of calls? - [Dan] So, the, for the people who are watching the video, how does the cost compare on the leather product today, and how does that drive market reaction? So, our biggest problem, by far today, Bolt's been around for eight years, is how much stuff we make, right, we've made 500 square feet total, of that stuff, probably? So it's not ubiquitous, we've made maybe a hundred kilograms of fiber, total, now, next year we're gonna go up 100x in leather and 10x in fiber, or more, um, what happens, and by taking stuff to market, what I've learned, is the people who would buy from some of your customers and partners, are the most attuned to the new stuff coming out.. So if I launch a hundred hats through BestMade, or 200 briefcases or tote bags through Kickstarter, the people who are designing and making purchasing decisions at the large partner companies are the most attuned to the news that comes out around that, and modern you know, modern advertising can be used for good or ill, and if you have something that's new, exciting, and has a great story behind it, you can broadcast your message further than you ever could two decades ago, and so that-- To answer your cost question, it's cost comparable will be less than leather, at scale, cause I mean you're feeding it dead plant matter, ground up trees, or horse manure, stuff like that; you're feeding it free stuff.. - [Audience member] (muffled followup question) - [Dan] Cause we're not at scale yet, cause we're not at scale yet, (mumbles) but a hundred billion dollar market, just, it takes time.. Yes, right here? - [Audience member] So what's your main obstacle to scale? - [Dan] What's my main obstacle to scale? No one's ever scaled advanced biotech processes, in this way before, so, if you take about, I'll give you a quick example of the silk problem.. In silk, we have to develop a brand new process to do fermentation of this modified yeast and purify out the polymer, and all that does is buy you tablestakes, to then use your pure polymer to figure out a new fiber-spinning process, that takes some tweaks as well, and it just takes time to work through.. People ask this in investment all the time, and it-- when you break it down it's very mundane things, it's like oh, you're waiting for that widget to show up from Argentina where they're making it, or whatever it is, but it's time, we're growing at about 10x per year right now in volume, and we will for several years to come.. Uh, right here? - [Audience member] Hi, how are your products durable while still being biodegradable? - [Dan] Uh, so how are the products durable while still being biodegradable? Oftentimes in the beginning, they're biodegradable but not durable, um, but biodegradability is not about, it goes away instantly, but that it does go away in less than hundreds of years.. So like, often with our silks, you're looking at something that if you-- and we're doing a bunch of biodegrading tests right now, it's proportional to the density of the material, and how enzymes and things like that, and microorganisms can infiltrate, if you bury it in nature, but your closet is not the optimal, biodegradable environment, compared to a compost heap, and so you can tune in that way, and

we shoot for something that lasts for roughly impedance match with how long you'd keep the piece of apparel, so, most humans buy a piece of clothing, you wear it for.... I think industry standards, industry would say, 50 washes, so 50 wears, almost no one goes that long anymore, but we basically have this idea of, if it lasts for 5-10 years, that's way better than hundreds, and long enough to last for the product lifespan..

Who else, uh, back there.. - [Audience member] So the fashion industry is kinda known for its, let's call it ethical issues, do you see in the future, replacing that, or ensuring that the materials that go into it are more healthy for the planet? - [Dan] So, uh, fashion's ethically challenged on a number of fronts, do we envision replacing the fashion industry, or changing the inputs to make it more sustainable with the planet? Um, my thesis, right now, you need to change-- If you want to change the output with plastic, change the inputs of the material, because recycling-- I'm a chemist, I'm biased in this, recycling's a terrible technology, it's just super lossy, uh, and you end up with this distributed pollution, all over the planet.. Um, so I think step one is that.. Step two is, and we don't talk a lot about this a whole lot externally, but we actively look for materials that could change the way you manufacture the product, because then maybe you could dramatically change some of the other impacts, in the industry, and we're-- It's still early in that, we're mostly focused on the longevity of the product and the waste product, but we've got some ideas kicking through, so it's a little bit of both.. Um, right here.. - [Audience member] Do they smell? - [Dan] Do they smell.. Um, well actually the leather smells like almost nothing, and you guys can come smell it if you want, we actually may end up adding a scent in the end.. If you don't do it right, it smells awful, so if you don't, uh, the same way that if you took a hide, and you didn't properly preserve it, it rots, the same thing happens with all natural materials, so you actually have to go through this process, of preserving it, so that it does last, for a long time, but odor is oftentimes a by-product of degradation, by microorganisms.. Uh, in the back here.. - [Audience member] So, you mentioned these other inspirations, that you want to like, disrupt middle class consumerism and consumption (ambient sounds drown out speaker) affordable to the middle class industry, so how do you plan on getting into that group, and would you consider like selling your threads to bigger companies that are part of that middle class consumer industry? - [Dan] So the question is, there's a vast mismatch between the scale we've done today, and if you actually want to make a difference, at a global scale, and yes..

We, part of this is a healthy tension that comes up in startups, between the perfect solution, and where you start.. And my philosophy is always, just start.. Just start doing things, and improving.. And so my metric, internal for Bolt is, and it's a somewhat arbitrary scale-- Everything we do, do it 2x better than the last time we did it, because if we do that, we'll get there.. And the long term goal is exactly that, we would love for the fiber we make right now to be a ubiquitous, every brand on the planet is using it, has replaced it, because the cost goes down and the scale comes up, but it comes back down to the slowness of scale, of making actual, physical things.. I'm putting plans in place.. Uh, over here.. - [Audience member] Off label, Bolt Threads has a deeptech startups, because venture capitalists are taking technical risks in investing you, but now they say that it's really trying to be, for bringing up a new hundred billion deeptech company, will you be the next hundred billion deeptech company? - [Dan] So, so deeptech is popular, it's been a popular buzzword recently, and will Bolt be the next one that is a hundred billion dollar-plus company? Um, I don't know if we will be, certainly if you look at the basic ingredients, you can put together a functional model, when you look at the market sizes and the TAM and all the important stuff you care about, where margin can be, there's no reason Bolt couldn't be a trillion dollar marketcap company one day, for the volume of stuff that's done, but you are taking real technical, like not even just technical risk, you're taking science risk, this is actually not even engineering risk in startup parlance, this is like, does the world work like we think it does, so that we can actually bring this to market? I, I'm hugely optimistic, I'm hugely biased-- (audience member shouting out) What, yes, I think that-- Okay, well, I hope that happens.. I actually hope our competitors do stunningly well, also, because when you look at the need to make a change on the sustainability of this planet, it has to happen on a timescale, that no one company can do itself, I mean you'd have to mobilize in some insane way, for Bolt, if Bolt's the only answer, I'm terrified, for the future, so I hope a lot of people do this really well, and actually, I put my money where my mouth is there, I actually actively help anyone who's working in this space whether I'm advising, opening up resources we have at Bolt, to teach people how to do things, there's a lot of things we've learned, that we should be sharing.. Right here..

- [Audience member] Why do you go for these products, ties, and hats? - [Dan] So the question is, how did we choose these products and specifically to make them? Um, again, it was the, we put ourselves in this uncomfortable position of saying, we're gonna launch something, so we did neck ties, for the first product we ever did, it was a knit tie, we did it at South X Southwest, in um, it was 2017, it was March 2017.. And in December, I went to the team and said, okay, my South X Southwest panel got approved, two thumbs up, aren't you excited, yay, clap clap clap.. Guess what, we're gonna launch our first product there, silence.. Like, there was literally nothing done, at that point, and so I left it, what I did is I put the challenge out there, and I left it to the team, and they did effectively something similar to an agile process, where it was a three month sprint, to figure out, what it was, what we could make, what we could scale, what we could produce, and put it out there, because the point was, you know, nothing infuriates me more about tech companies than vaporware, where it's like, oh it's coming, it's gonna be perfect, it's gonna be great, and then the perfect becomes the enemy of good enough, and ever making progress.. For us it's like, pick stuff, put it out there, learn from it, move on.. Right, uh, I had a picture here, we made some composite knife handles, it was kinda cool, we learned a lot about getting bubbles out, and wetting the polymer with epoxies and different resins, made about 25 of them, we're probably never-- We may or may not do that again, but we learned a lot doing it, about how you'd make a different type of product with the material, and find out where the killer application is, and you do that by repitition.. [Announcer] One more question.. - [Dan] Alright, last question, who's got the last question, here? Takers, takers? Right here again.. [Audience member] Why did you buy 2017, uh, BestMade? - [Dan] So at this company BestMade, the company we worked with, we acquired in 2017, part of that was again, as a learning, and it's-- I

believe that when you make new materials, that have wild new material properties, we've learned that no one knows what to do with them, and so we wanted to have the agency to take it all the way to the consumer, and see what happens.. And we've done, uh, we did one product last year with the hat, we've done about three or four this year, and we will continue to ramp that up, and it's made us really smart about not only how our products would work in the world, but also, how the current standard in the market is, for direct-to-consumer, because these are two things that normally don't exist together, molecular biology, direct-to-consumer retail, and everything in between, and at least now if we fail at it, we can say we had, it was our fault, the whole way through..

(applause) (electronic music)..