“Chip War” Author & Tufts University History Professor, Chris Miller: Navigating A.I. & Chip Tech with Future-Ready Leadership Skills

Jacob Morgan 00:00
Hey everyone, welcome to another episode of great leadership. My guest today, Chris Miller. He is the Associate Professor of International history at The Fletcher School of Law and Diplomacy at Tufts University, Jean Kirkpatrick visiting fellow at the American Enterprise Institute, best selling author of several books, including his recent mega bestseller called chip war, the fight for the world's most critical technology. Chris, thank you for joining me. Thank you for having me. So I have to admit that history is one of those areas that I wish I spent more time and attention focusing on when I was in school. And it's something that I neglected. I was like, ah, you know, I'll focus on math and science, I don't need history. And now it's like one of my big regrets to the point where I'm actually buying history books, and trying to learn all the things that I wasn't paying attention to earlier. Specifically, even Russian history, Ukrainian history, because that's where my my family's from, and even American history. So your book was fascinating, because it has that historical perspective on chips, which is not something that most people would probably think about. Why do you focus on chips? Well, I actually came to the topic. From the study of Russian history, I wanted to understand how is it that nations develop technology over time, specifically technology they need for defense systems. And one of the puzzles to me was why it was that Russia was so bad at producing cutting edge military systems, given that it had such an extraordinary suite of smart scientists and lots of money that it plowed into its defense industry over the course of the Cold War. And I came to realize that what went wrong in Russia is they couldn't build a computing industry. And that was an interesting conclusion. But then I asked, Well, why is that? What was the issue? And it turns out, the biggest challenge they face is that they couldn't establish a semiconductor industry, they couldn't build chips, which it turns out is one of the hardest things that humans have learned to build. Now, I'm sure a lot of people who have some sort of technical, roughly high level technical understanding are familiar with chips and semiconductors. But for a lot of people out there, they probably are not even sure. What are we talking about? When we say chips? When we say semiconductors? Where do these things exist? How many of them do we have in our house? Can you give us a little bit of context and perspective around how prevalent these things are in our daily lives.

Chris Miller 02:25
We all rely on chips. And we know they're inside of our phones and our PCs, but we never see them. And therefore we never think about them. And most people don't know that they can't live their lives without relying on 1000s and 1000s of chips every single day. So they're there in your phone and a computer, but they're also in your dishwasher and your microwave, in your car, if it's a new car, it'll have 1000 chips on average inside of it. And they're in the telecom network lets you send data back and forth through the air. They're in data centers that increasingly store and process all of your data. So they're

everywhere. None of us is actually almost the one that if you bought a chip, we buy chips that are embedded deep in the devices we rely on. But they're all around us.

Jacob Morgan 03:05
Yeah. And so you mentioned Russia. So I'm particularly interested in that, because my parents came from the Republic of Georgia, so the former USSR. So even as of late, I've been looking at Wikipedia, Wikipedia articles around the history of the Republic of Georgia, the history of Ukraine, which is where my grandparents are from, and just getting as much information on that as I could, because my kids are asking me about, you know, where did we come from? Can you tell me about Ukraine and the Republic of Georgia, and I'm sitting there thinking like, wow, I really don't know much about these places. And so I love that you trace the history back there. And now for Russia, you mentioned that they weren't able to build a successful semiconductor industry, which might shock some people because they have a lot of money. They have a lot of smart people there. You know, Russians are known for math or science. What was the challenge specifically with Russia as far as why they were not able to build the industry that so many other countries have been able to

Chris Miller 03:59
build? Well, you know, it turns out that it actually wasn't a Russia specific problem is that chips are the hardest thing humans have ever manufactured. There's nothing more complex than an advanced semiconductor. And so if you go to the Apple store, buy an iPhone, for example, a new iPhone will have dozens of chips inside of it. But just the primary processor chip that runs the iOS operating system has carved into it roughly 15 billion transistors, which are tiny switches that turn circuits on and off and 15 billion was a billion B with a b That's right, and sort of fit all them on a piece of silicon the size of your fingernail. Each one of them is smaller than the size of a Coronavirus. That's

Jacob Morgan 04:37
insane. It just like it's hard to imagine how that stuff even gets manufactured in a facility like how, and I don't know, if you went into like, did you get a chance to tour some of these places? Like how do you actually create a technology that is that tiny?

Chris Miller 04:56
Well, it's it's, as you probably guess it's an extraordinarily complex An expensive manufacturing process. And so basically, to make an advanced chip like the one inside of your phone, you need to acquire machine tools from a number of different companies in the Netherlands and Japan and in the US. And these machine tools are capable of undertaking manufacturing at almost the atomic level. So for example, there are machines, machine tools called deposition tools that can deposit thin films of materials, as thin as four atoms thick. Then there are cryptography tools and know it. So the tools themselves are from monuments of engineering capabilities. And the best example is a tool called the EU V lithography tool, all of which are produced by a single company in the world ASML in the Netherlands, from these tools have inside of them the flattest mirrors humans have ever made necessary to make the tool work, they have one of the most powerful lasers ever deployed in a commercial device. And then they have power, the way they create the light that these machines use is by pulverizing a tiny ball of tin with a laser that explodes into a plasma that is 40, or 50 times hotter than the surface of the sun. This is happening constantly on site and one of these tools.

Jacob Morgan 06:10
Yeah, most people never think about that. I mean, even like when I'm turning on my camera here to do this recording, and you know, there's a lot of chips in there. But nobody ever thinks about the complexity of how, how all of that operates and how that works. And I think it was was one of the first Apollo missions, I believe, right were when they were with the supercomputer that they had to launch that wasn't at the size of like several minivans, and it was barely able to have any kind of processing power and speed. And in just a couple of decades, the the amount of computing power that we've been able to crank out of these things, and that technology advancements just been completely mind blowing.

Chris Miller 06:48
When the best way to characterize it is by what's known as Moore's law. So named after a chemist named Gordon Moore, who founded Intel, the biggest US chipmaker. And in 1965, he noticed that the number of transistors per chip, so roughly, the computing power of a chip was doubling every year or two. And from 1965, all the way up to the present. That trend has continued every two years, we've doubled computing power, keeping costs the same or even watching costs decline in many years. And so what that's meant is that the capabilities of chips have progressed far more rapidly than anything else in all human history, nothing else can remotely close to that rate of improvement. I like to, you know, imagine what the world would look like if airplanes flew twice as fast every two years, they'd be calculated this way, because they fly at six times the speed of light, physically impossible. The chip industry has done it. Yeah.

Jacob Morgan 07:39
And I think in your book, you're talking about that it started off it for what was it four transistors per chip?

Chris Miller 07:45
That was the first commercially available chip? Yeah, for now we're at the billions. That's right. That's right. Any of us can buy a 10 or 15 billion transistor, Chip. That's,

Jacob Morgan 07:54
it's totally wild. In so before we talk a little bit more about that, because I had a couple of follow up questions on that and wanted to get back to to Russia and some of these other countries which had or maybe were not able to create the semiconductor industry that some other parts of the world were what was it that was keeping them back? Was it leadership was it technology was a policy, maybe mix of all three?

Chris Miller 08:20
It was a mix of all three, I think, on the on the leadership front that the mistake that Russia made early on is that they decided they're going to try to copy other countries technologies. And the last few years copying actually works pretty well. If technology changes slowly copying can get you something that's pretty close to cutting edge. So nuclear weapons, the Russians had spies and Los Alamos they copied US nuclear weapons designs, and more or less replicated them. And that was a pretty good strategy.

They had nuclear weapons at the end of it. But in in other technologies, where the rate of change is rapid copying doesn't work, because by the time you've figured out how to copy, begun deploying in your system, you're far behind because the progress is moving too fast. And the chip industry, which moves faster than everything else, because of the exponential rate of Moore's law, copying was just a bad strategy from day one. And so Soviet leadership didn't realize it, they didn't understand the Moore's Law dynamic. And they decided to copy and it proved a horrible error.

Jacob Morgan 09:15
I think one of the examples that you talked about was, for example, in the Ukraine war, of why so many people thought Russia was just gonna obliterate Ukraine. And I think this was an interview that you did October of last year. And you were alluding to the fact that because the United States was giving some of their powerful weapons and defense systems to Ukraine that were equipped with these far superior chips and pieces of technology, we were able to hit targets more accurately, we were able to just do things more efficiently and better than the Russians were, even though they have far more tanks and far more weapons. So it's so fascinating that it's the quality, not the quantity, which is what makes all the difference. Whereas if you were to go back several decades, what won a lot of war As usually was quantity it was who had the most men it was who had the most number of tanks. And now it's really that that power of the computing chip, that's just wild.

Chris Miller 10:10
We I think that the best way to characterize this is is looking at aerial bombings, when planes dropped bombs often hit their target and World War Two, the best estimates are that roughly half of bombs dropped by US planes over Germany fell within 1000 feet of their target, she's, which means that half of the missed by over 1000 feet, if not more, worse, is today, we assume that a weapon is going to hit its target a Tomahawk missile, for example, or a laser guided bomb. And if they missed, and it's a surprise, then we do an investigation as to what went wrong. And and that illustrates the, the way in which weaponry has been transformed by computing. But you know, I think if you, if you think about the ramifications of that in the Russia, Ukraine war, it's not just that you can guide a weapon to its target, because you've got to also know where is the target. And that's what I think people often miss is that it's not just the computing and the sensing, in weapon systems. It's also in the satellites in the electronic and signals intelligence monitoring systems. And now we're, they need to apply AI. So you can have computers look at satellite pictures and say, What's a truck? And what's a tank. And that all requires even more processing power, and therefore, even more advanced semiconductors.

Jacob Morgan 11:20
Hey, sorry to interrupt. But do you want to hear something really crazy 96% of the people who watch these videos are not subscribed to the channel. If you want to get access to more content, just like this on a leadership and the future of work, make sure to hit that subscribe button, so you can get notified when new videos are released. You know, I think, so I play a lot of chess. And it's the whole analogy of why falling behind means you get left behind and the whole first mover advantage and speed. In the game of chess, for example, if you make a move, and your opponent keeps copying you so for example, you move your knight in a position and your opponent does the exact same moves that you do, what ends up happening is the person who moves first is ultimately who's the one who's gonna get checkmate. And so you can't just keep copying your opponent in a game of chess, because you're

always going to lose. And it seems like this is now becoming very true in the technology space. Whereas before, it was okay to let somebody else do something, and you can kind of wait a little bit copy. But today, things are moving so quickly that if you do fall behind, you're just gonna keep losing. But a lot of people might be wondering, why can't a country like Russia, just develop these things yourself? I mean, are these technologies so secretive, so expensive, so unique? That it's just not possible for another country to develop these things? Like, what is it that's keeping another country from Russia or India or China from being able to do these things?

Chris Miller 12:51
Well, you know, I think China is the real puzzle today, because we think of China as the manufacturing workshop of the world. And that's true in most technologies. But when it comes to semiconductors, China is a tiny player, because it has to import buy from abroad, almost all of the semiconductors that it produces. So today, China spends as much money each year importing chips as it spends importing oil, there is no product on which China is more dependent from foreign suppliers. That's not because they haven't tried to produce advanced chips domestically is because they haven't figured out how to do it. And there's two reasons one is that it's It's brutally expensive. And two is that it's really, really hard. on the expensive side, just to put some numbers to it, a single cutting edge chip making facility costs $20 billion. So the most expensive factories in human history. And even if you're trying to get a big budget, lots of money, the costs are still tremendous.

Jacob Morgan 13:41
And do you see Moore's Law slowing down at all? Because I remember even over I think it was even a few years ago, right? There were articles that were written that were basically saying that Moore's law is going to come to an end, there is no way it can keep continuing to double, but so far doesn't seem to have slowed down. Do you see that we're eventually going to get to a point where it's just not possible to keep pace with it.

Chris Miller 14:03
Well, I think to frame the discussion about whether Moore's law is going to slow down, it's worth remembering that predictions of the death of Moore's law have been made since then. They've always been wrong, thus far. So, you know, it's certainly true that we can't currently say in 10 years time, here's how we'll keep Moore's Law alive. But it's never been the case that if you look 10 years out, you know, it takes Science and Research and Engineering over the course of those 10 years to figure out what is the right pathway forward. There certainly is a point where though, right now, if a transistor is Coronavirus, sized at some point, it will be impossible to shrink them further when they're measured in individual atoms. It will just be extraordinary difficult to have them function in the way they've traditionally been designed to do. And so there are physical limits out there. But I think the rate of innovation is something that's been so tremendous and there's so much money in r&d and brilliant minds trying to figure out how to keep this rate of profit. As alive, I'd be optimistic about the overall rate of improvement. One

Jacob Morgan 15:04
of the things I'm also really interested in is the political side of this, because most of us just assume that has everything to do with technology. But when especially when you think about the relationships

between or the relations between China and the United States, you have Taiwan there, you have a lot of political candidates, like vac Ramaswamy, who's saying that he wants to make the United States, you know, create its own chips here and not become dependent on places like Taiwan and China. So there's this whole like, geopolitical aspect of chips. That is just so interesting. Can you give a little bit of a little bit of context or unpack exactly what's going on between the politics side and the technology side when we think about chips?

Chris Miller 15:45
Well, I think that the central political issue is this that across the world, 90% of the most advanced chips, the chips in your phone, chips, in most people's computers, the chips in the telecom network, the chips in the data centers, that process, and remember all of your data, the chips that are used to train AI systems, 90% of them are produced by one company on one island, in Taiwan. So there's extraordinary concentration, far more concentration than, for example, we have in the oil market, which we're used to thinking about as being a highly politicized market. And as risk grown, Taiwan grows as China continues to threaten it build up its military power, people are asking how secure is our supply of chips, given the growing Chinese military threat?

Jacob Morgan 16:27
What would happen if we lost that supply of chips in Taiwan? So let's say hypothetically, China, one day comes over and they say, you know, what, Taiwan is ours, chips are ours, or you guys aren't getting access to anything anymore? How would that impact? I mean, I'm not talking about, you know, geopolitical, war, stuff like that. But as far as our daily lives, do you think the average citizen would notice changes in their daily daily life if we lost access to those chips coming from Taiwan, and we just, I don't know many things in the States or in other parts of the world?

Chris Miller 16:56
Well, the problem is that it would take years to build up the capacity you'd lose in Taiwan. So it should make them was knocked offline in Taiwan because of a blockade or because of war. It would take a very long time huge investments to build up capacity elsewhere. There's no spirit capacity today not. And it takes years to bring new facilities online, and you got a ton of expertise in Taiwan as well, right now, are you assuming that we were somewhere else maybe, but I'm not sure how confident we are in that assumption. And in the interim, between when you lost access to Taiwan, and you built it up elsewhere, the cost would be catastrophically large, it's not just that you'd struggle to produce a single smartphone anywhere in the world. And I think you would struggle to produce a single smartphone is that you throw the Prusa computers datacenters telecoms networks, but then also dishwashers, microwaves, coffeemakers. Cars, because everything today with an on off switch has at least one and often dozens or hundreds of chips inside. And there's no spare capacity. We all rely on Taiwan. Yeah,

Jacob Morgan 17:55
it's, it's again, I keep saying how crazy it is to think about but the fact that we're so reliant on one island in one part of the world that produces 90% of the chip, this is just, it's just like a shocking thing for a lot of people to probably hear because you would think that especially a country like the United States, we would have some, some backup, some better investments and smarter business decisions that we made along the way. Instead, we put literally all of the eggs into one basket. And there's a proverb,

which actually teaches us not to do that yet. There we are. So it sounds like if that happened, we would just be what, unlike iPhone 15, for the next five years, we just wouldn't see upgrades or changes or you saying that we would actually lose access to these technologies, and probably the prices would skyrocket. And we would just be, I don't know, knock it back, maybe a couple of decades, you'd

Chris Miller 18:46
have your iPhone 15, so long as you didn't break in trouble. And if you wanted to buy a new refrigerator, you'd be in trouble or new car, you'd be in trouble. And so if you think of global manufacturing output, what's the stuff we can produce without chips, very, very little, especially very little value. And so it would be extraordinarily costly for firms to try to find alternative sources of supply to build them up over time and the interim, the key here, here's the irony, the key challenge for manufacturers in the US and Europe and Japan, if they lost access to chips made in Taiwan, their initial strategy would be to make all their devices dumber, they'd be pulling out their blueprints from the 1960s. And trying to remember how it is you can build a dishwasher without chips inside, it'd be easier to do that than it would be to wait for new chip supplies to come online. So we can't even think begin to comprehend the the extraordinary costs involved.

Jacob Morgan 19:35
Yeah, and you know, one of the other things that we haven't talked about is also the role that these things play in the development of something like AI, right? I mean, we see something like, chat GPT generative AI we see all these really crazy technology advancements that we're seeing in our personal lives too. I mean, I use chat GPT I use things like mid journey. I use a lot of these AI tools in my business and I know a lot of people do, and all that stuff. is powered by these chips. So it seems like it would also really halt our development capacity in the realm of AI and technology. When

Chris Miller 20:11
here's the thing, basically, all of the chips that are used for training cutting edge AI systems are made in Taiwan. That's true for Nvidia, which produces the most advanced GPUs on which 90% of AI systems are estimated to be trained. That's true of the small number of other firms that also produce AI chips. So AI training just come to a halt, there's wouldn't be aI training for multiple years as we struggled to build up alternative sources of supply. And I think that speaks to the fact that people think about AI as being algorithms about data. You know, that there's, there's truth to that. But the key driver of advances in AI systems is that they're trained on larger and larger datasets. So there's been great empirical research on this the most advanced AI systems, they've been doubling the amount of data, they're trained on every six to nine months, huge increases in data.

Jacob Morgan 20:56
Yeah, I mean, Nvidia, I mean, their stock completely took off fairly recently. And I can't remember what the exact number was, but I think they were saying that the first version of chat GPT was basically trade on a trained on maybe like a million or a couple million pieces of data, then the next version was maybe like 10 or 100 million. And then the most recent version of chat GPT, what was it like? Billions 10s of billions of pieces of data and information? And obviously, that wouldn't have been possible, if they didn't have access to those latest Nvidia chips, which meant Nvidia had to get access to those latest transistors and chips from Taiwan. So exactly right. Yes. Oh, whole stepping stone, where if one, it's

almost like the foundation of a house of cards where the chips are not there. And then everything else that sits on top of that will crumble. And I don't know if you would agree with this. So kind of the analogy that I think of as chips as the new and then you currency. So for us in the day to day, our currency is if we're in the United States, if dollars. But if you were to think of countries as people, the currency that they trade in, it seems like is moving towards chips, it's moving towards technology instead of a, you know, traditional currency like $1. Is it becoming that integral and that crucial that it chips are the new currency for the modern world?

Chris Miller 22:16
You know, I think that's, that's right in two different ways. One is that if you look at international trade today, what goods are actually sent back and forth, you find that chips are absolutely at the center of, you know, some trading systems. So I mentioned that China's spends as much money each year importing chips as it spends importing oil. It's an extraordinary fact. But it's also the case that lots of other countries have a huge share of their trade. We're not exporting chips to China, like Taiwan, like Korea, like Vietnam, like Malaysia, like the Philippines. And so you can't understand international economy without understanding the central role that chips play. But I think you're right in the second sentence to which is that metaphorically, governments are realizing that chips are a tool for leverage on the international stage. They're a tool to coerce your adversaries and reward your allies. And you see every major government right now trying to build up their own chip industry. So they can use it as a as a tool of leverage. I

Jacob Morgan 23:08
want to shift gears a little bit and talk about one of the I guess you can call it a character in your book. William Shockley. And particularly, I'm interested in him from the leadership standpoint, because, you know, I write books on leadership. And there's oftentimes this debate between being really good at your job in terms of just being smart and brilliant and capable, versus being able to lead and manage people effectively. And it seems like in the case of William Shockley, which I find fascinating, he was a he was brilliant, right, a brilliant scientist. And you would think that somebody like him would have been the, you know, the Elon Musk of the time, he would have been this very successful entrepreneur, he would have been a multibillionaire created these startups. But unfortunately, he failed in a lot of those endeavors. Can you share the story of William Shockley a little bit, maybe give some context for people who are not familiar with him. And why did he fail, even though he was so scientifically brilliant.

Chris Miller 24:11
So Shockley was recognized at the time to be one of the most brilliant physicists of his generation, he worked at Bell Labs, which was part of a TN t, which is one of the leading centers of physics and scientific research at the time. And he was one of the individuals who won share the Nobel Prize for inventing the transistor. So the thing that your iPhone ship has 10 billion of he invented the first one of those and he played a really critical role. Lesson, the experimentation in the theorizing of how to transistors actually work. No one else could figure it out. Before he did, and by all accounts, he on his own, deduced the mechanism by which they were so there was a there was a widespread recognition that he had. He had done this on his own. And so he thought that, you know, sort of like Elon Musk, he would he would take the his new scientific idea and parlayed into a billion dollar company, he told his friends, he wanted to see his name, not only in academic journals, but also in the Wall Street Journal.

And he set up a small company, a startup in Palo Alto, California, which at the time was just a sleepy village, but his mother lived there. That's why he chose to move there and hired a bunch of very smart, young physicists out of universities like MIT. And he was a horrific manager and a horrific business leader, he treated his employees terribly, they all immediately started looking for other jobs. But what was worse than that, actually, is that he never had a sense for business. He had a brilliant mind for science, but had no clue how to devise a product, to win customers, and to bring it to market. And so his employees very rapidly fled his farm and set up their own shop called Fairchild Semiconductor, which would go on to, to really build the US chip industry. And he himself, his company went bankrupt. And he returned to academic life for the rest of his career.

Jacob Morgan 26:02
The topic of vulnerability is front and center inside of a lot of organizations today, but should you actually be vulnerable at work? In my brand new book leading with vulnerability, I actually say that you should not be vulnerable at work. But instead, you should lead with vulnerability, the difference. Vulnerability is about exposing a gap, whereas leading with vulnerability is about exposing a gap that you have and then demonstrating what you are trying to do to close that gap. To figure out how to make all of this happen. I interviewed over 100 CEOs and surveyed 14,000 employees around the world. And I put all of that into my brand new book, which just came out, you can learn more by heading over to lead with vulnerability.com. Again, that is lead with vulnerability.com. Wow, so his employees actually went and became successful and created Fairchild while he went back to academic life. And so when you say treated employees poorly, what are we talking about? Are we talking about like, Jack Welch style? Oh, you know, just yelling at you and screaming at you and making you work hard. What exactly do you mean when you say treated employees poorly?

Chris Miller 27:18
Yeah, he was he was seen by everyone he worked with to be a misanthropic character, someone who was in it for himself and, and enjoyed in some ways, even watching other people get beaten down. But I think had he been a a an inspiring leader who had a product that he could have brought to market that might have been okay, people might have tolerated and obnoxious manager had there been a pathway to build something. But his employees realized that he was a smart physicist, but they were actually better business people. And so the reason that they also rapidly banded together eight of them called the traitorous eight is what they're known in Silicon Valley. History. The reason why they'll work degree so rapidly is because they all saw there was a product there that could be sold, just that Shockley had no clue what it was. And so they very quickly abandoned him after just a couple of years months, in the case of some of them, and set up their own company that would go on to transform the US tech sector.

Jacob Morgan 28:13
Do you see any parallels between somebody like chalk we versus Elon Musk, or Mark Zuckerberg or Sergey Brin, or any of the modern day? You know, tech Titans that we see?

Chris Miller 28:25
Well, I think there probably are some parallels in terms of their management styles, in some cases, but there's a glaring difference, which is that all of the names that you mentioned, are people who have built viable businesses. And Shockley could never understand what it took to conceptualize a product to

understand how it would fit in the market, and then bring it to customers, which is why he's developed almost no products and sold almost nothing to customers.

Jacob Morgan 28:53
It's crazy to think that he had such an impact on on the world yet, he basically just ended up going back to academic life. And you know, probably if it weren't for books like yours, or stories or podcasts that talk about him, a lot of people would have no idea who he is or the impact that he had and the legacy that he left on the tech world. So when you think about the chip war, I mean, obviously, you know, the book came out What was the date of the actual book? Last October? You last October? That's right. So it's been almost a year. And even in that year, so much has changed. Where do you foresee this going? I mean, when you think about the chip war if I mean, I'm assuming you probably played out maybe a couple of different scenarios. What can some of those potential scenarios and outcomes actually look like?

Chris Miller 29:49
Well, I think there are three key trends we see right now. One is that every major government is pouring billions of dollars into its chip industry. The US is doing that via the chips act. The European Union has an EU chips act, Japan is spending large sums of money. China's spending as much money as everyone else.

Jacob Morgan 30:06
What's the chipset, by the way for people not familiar with it.

Chris Miller 30:09
So the chips Act is a program to subsidize chip making in the US. So the concern is that there's not enough chips made in the US, we discussed the China Taiwan challenges. And so the US government is going to be helping to pay for the cost, we should make them facilities to get companies to build more of them in the US. And so every government's doing this, everyone is trying to get more chip making in their countries. And that's gonna continue for for some time, but then that that's happening alongside this period of China, US and China, Taiwan, tension. Today, this China, US and China, Taiwan tension. And as that escalates, what you find is that companies that previously produced a lot of their devices in China. So for example, Apple assembles most of the iPhones in China, it brings chips from abroad from Taiwan to China and puts them together in China now. We're moving there. That's exactly right. Yeah, yeah, that's a key trend. It's not just smartphones, PCs, its servers across electronic space, there's a bifurcation China focus supply chain on the one hand, and in a non China supply chain, on the other side, that's going to change how we produce electronic devices and computers.

Jacob Morgan 31:19
So what what do you see the outcome being over the coming years? And kind of a two part question, I'm curious what you actually think will happen. And let's say you were the president, or you could wave a wand and create a desired outcome that you wanted to see that would be most beneficial for a country like the United States. What would you like to see actually happen?

Chris Miller 31:41

Well, I think the US right now is in a race with China to produce the most advanced chips. And and China's on its own in this race was the US is working together with Taiwan with Japan, with some European countries that have this collective international supply chain that produces advanced semiconductors. And what you, what you find is that both sides are pouring lots of money into the race, both sides are trying to cut the other one off from access to the technology. So for example, the US is no longer selling advanced GPU chips for AI training, you can't sell those to China anymore. As part of an effort to hold back China's technological development, and so it's becoming much more conflictual. There's a lot more politics a lot more regulatory burdens that are placed on chip makers and tech firms in general, because all the government's involved are are jockeying for power and trying to reshape supply chains in the production of computing power, in ways that suit their interests.

Jacob Morgan 32:38
It's hard to imagine enemy, and I hope there would be a good outcome. But I mean, especially if you look at what's going on now, between Russia and Ukraine and Russia and their relationships with China getting closer. Like, it's, I'm trying to imagine an outcome in which everything just ends up being okay. You know, maybe there's some, like magical negotiating techniques that we pull out. And everybody's just like, Alright, everyone's all good. But to me, it sounds like it's moving towards the direction, where there would potentially be issues with a country like China and us not being able to get access to the chips that we need, from Taiwan. I mean, especially you see all the drills that China is now doing, they're kind of just like, you know, letting people know that they're there in a very aggressive way. Do you see a, you know, a happy positive outcome? I mean, I don't know if you're probably in the weeds with some of the policies and some of the things that are going on there, but moving towards the right direction?

Chris Miller 33:36
Well, I think there's the the technology front, and then there's the politics front. And I think you're right on the politics, it's it's looking like it's getting much more dangerous when it comes to China's intentions with regard to Taiwan, in the desires of key Chinese leaders. But then on the technology front, you got this extraordinary rate of progress that is completely unchanged, as racing forward as fast as ever, despite the political tensions. And so that's, that's the dilemma is, on the one hand, governments are going to inevitably try our government, the Chinese government, every government will inevitably try to take whatever technologies they can muster to apply them to military systems, which they always do. And so that's, that's the downside of technology, if you will, then you got all the upside, which is the extraordinary rate of change producing all sorts of new products and capabilities, that that computing, and therefore semiconductors enable, and that's, that's the positive side of the story. There's a race between whether we get more positive or more negative aspects.

Jacob Morgan 34:30
Obviously, you've written a couple books. This one by far became this ridiculous mega best seller. So clearly, you hit a nerve with it. Why do you think that's the case? I mean, why, why should the average person I mean, I get obviously if you're running a business, you're in the technology space. Why understanding this is so crucial, but it seems like this is a book that has caught the attention of just everybody whether you're in the tech space or not. Why do we in general need to be aware of what's going on with this chip war? You know, just the the average person, why should they care?

Chris Miller 35:07
Well, the reason I wrote the book was when I learned that my life was so fundamentally dependent on lots of tiny silicon chips that were produced by a tiny number of companies, often located in geopolitical hotspots. And I had never thought about semiconductors. Before I started the research, I'd never considered how dependent the world economy or my daily life was. And I think the past couple of years, I've illustrated both how dependent we are, how great it is that we're able to harness the capabilities that semiconductors enabled, but also how fragile their production is, because of the complexities, the cost and the concentration and just a small number of locations. And I, I think everyone is beginning to slowly realize that. So we realized that our entire lives, our entire society is built on a very fragile foundation of 1000s and 1000s of silicon chips.

Jacob Morgan 35:56
I'm actually curious now that you mentioned that, where did this actual realization and idea come from? Are you just like looking at your iPhone one day? And you're like, Hmm, it'd be interesting to write a book about the pieces that are inside this iPhone, or how did you make that connection? And actually, can you even share a little bit about the research that went into this book in terms of the people that you had to talk to the exploration you had to do to put together this this really fascinating book?

Chris Miller 36:21
Well, the research was, was really quite fun, because I had the chance to talk to well over 100 engineers, business people, government officials, academics who work on semiconductors, and have built the industry over the past 70 years. And so I conducted interviews from California to Texas, to Taiwan to Japan to Europe and and elsewhere to understand how is it that this industry was born? How does their technology develop? And one of the reasons why we went from a situation not so long ago, where the typical person relied on zero chips to a situation today, where just walking around my house, I interact with dozens and dozens of them, even though I'm only dimly aware of it.

Jacob Morgan 37:04
Yeah, I mean, it's fascinating. And the idea just came from you, just walking around your house, and just paying attention to all the different tech devices that you have in there.

Chris Miller 37:11
Well, as I, as I began to learn all of the things that had chips inside, I began to see that in fact, they're everywhere, we don't see them. Unless we're we're instructed just how many chips there are, but into your car, for example, I mentioned that to political cars, 1000 chips inside their chips everywhere, and the button that moves your window down when you press it, in the fuel injection in your engine, if you have a gasoline powered car, and any sort of autonomous driving features you have and communication systems in your cars, we think the cars is a 20th century technology, Henry Ford and an iron and steel. But today cars are about tech. And therefore cars are about chips.

Jacob Morgan 37:49
Yeah, I mean, I like to say that every company is a technology company today. I mean, they really are. I've talked to companies that even do woodworking, and then you do a tour of those organizations, and

they have huge data centers, they have these huge tech facilities. And it's crazy, like a woodworking facility would have this much technology in there. So it's it's really, I think, such an integral part of our lives. Maybe last few questions for you before we wrap up. One of them is just in general, obviously, you've studied a lot of history, not just in terms of chips, but it's obviously international history has been a big, big thing you focused on for the majority of your life. When you look at some crucial leadership lessons that you can pull out from history. Are there any in particular, in particular, that really stands out to you that you think we can apply in today's modern business world?

Chris Miller 38:43
We know what really struck me about the chip industry is I was expecting advances in semiconductors to be driven by scientists. First and foremost, Shockley is a good example. And that's sort of true. But actually, that's not the important part, the important part of the people who can connect scientific advances with business models that are viable, because ultimately, you need viable businesses to scale and scaling is what's made this all possible. It's what enabled us to produce chips cheap enough, and sophisticated enough to put in all sorts of devices. And so I became much more impressed with the people who had a very strong technical background, but were really talented at identifying products that could be in everyone's pocket or could be in everyone's home before anyone else in the world had ever thought of it. And I think that that is the that is the real rare skill is the ability to connect technological changes with products that most people don't even realize might exist.

Jacob Morgan 39:35
So I mean, for let's say modern day leaders, you're not in the tech space. It seems like a critical aspect of that is what storytelling, empathy kind of some of these human aspects that are so important in the in the leadership world.

Chris Miller 39:49
And that's right, and I think there's a an aspect of vision to be able to see further into the future. So if you go back to Moore's law, Gordon Moore set out the concept of Moore's law in 1965. So Well over half a century ago now. And he didn't a four page article. And in that article he predicted in 1965, personal portable communications devices, ie smartphones, he predicted that houses would have computers that were networked together, ie the internet. At a time when all of these things were for the rest of the world, totally inconceivable. And yet he was able to see far enough in the future as technology would change people's habits would change his businesses would change, that he imagined that these devices were possible. And so that that vision, I think, is what what really struck me is that the key differentiating factor between the transformative leaders and everyone else,

Jacob Morgan 40:40
I think that's one of the things that somebody like Elon Musk is really good at, right? The, for example, even the vision of being able to colonize Mars. And I remember there were there were so many articles, and so many media clips that came out when we were talking about the internet and smartphones. And people were like, That's crazy. That's stupid. Why would you want that and you don't need a computer. And And now look at the world that we're in now. So I'm actually gonna go find that article, you said it was a four page article that came out in 1965? That's right. I've never I never read it. I'm gonna actually Google that after this and try to it's a good read. Yeah, I want to find a read that article. And maybe one

more question for you. When you think about the technology world today? What advice would you give to employees who are entering the workforce, or maybe leaders inside of organizations, when you pay attention to what's going on in the tech world? Obviously, we need to do a better job of being more aware of it, paying attention to it, thinking about it, what advice do you have for people out there who are either entering the workforce, or who are seasoned professionals in the workforce when it comes to thinking about tech?

Chris Miller 41:46
The big error that we've all made about tech over the past couple of decades is that when we we hear the word Tech, we think of software, we think of social media, we think of search engines, rather than the hardware on which all tech is based. And that's a mistake, both because today there are extraordinary businesses like Nvidia, which is worth more than many, quote unquote, big tech firms today that produce the extraordinary hardware on which all the rest of the tech sector requires, but also because we need rapid advances in hardware to make the rest of it possible. And so I wish more people would spend more time thinking about how to make those hardware advances possible, because the rest of the tech stack depends on it. Yeah, I

Jacob Morgan 42:27
mean, we hear about quantum computing now, too, right? I'm sure we'd even touch on that, that's probably going to have some big implications. But yeah, it's interesting. It used to be all about hardware that everybody talked about software. And it was kind of like, well, we got to get back to talking about hardware a little bit too, and the impact that that's having in the world. So really, really fascinating and intriguing stuff. Chris, where can people go to learn more about you, your book, anything that you want to mention for people to check out?

Chris Miller 42:53
I publish everything I write on my website, Christopher Miller dotnet, Christopher

Jacob Morgan 42:58
Miller dotnet, and the book chip war. I'm assuming it's available anywhere people can find a book. So hopefully, people will go grab a copy of that as well. Chris, thank you so much for taking time out of your day. fascinating book. I learned a lot from this conversation. So thank you. Thanks for having me. Thanks, everyone, again, for tuning in my guest. Again, Chris Miller, make sure to check out his book chipper and I will see all of you next week. I hope you're enjoying this podcast. But don't you want a little bit more? This podcast might be like the appetizer that gives you some of the information that you need. But what if there was a place that you can go to where you can actually learn from CEOs get access to exclusive content, and leadership hacks, and in depth guides that teach you how to excel in your career, how to become a better leader, how to create an organization that is focused on employee experience, and how to build a future ready workplace. Well, if that sounds like something that you are interested in, then Remember to head over to great leadership.substack.com If you go over there and subscribe and you will get exclusive content from me every single week that will teach you all of those things and a lot more. Again, head over to great leadership.substack.com