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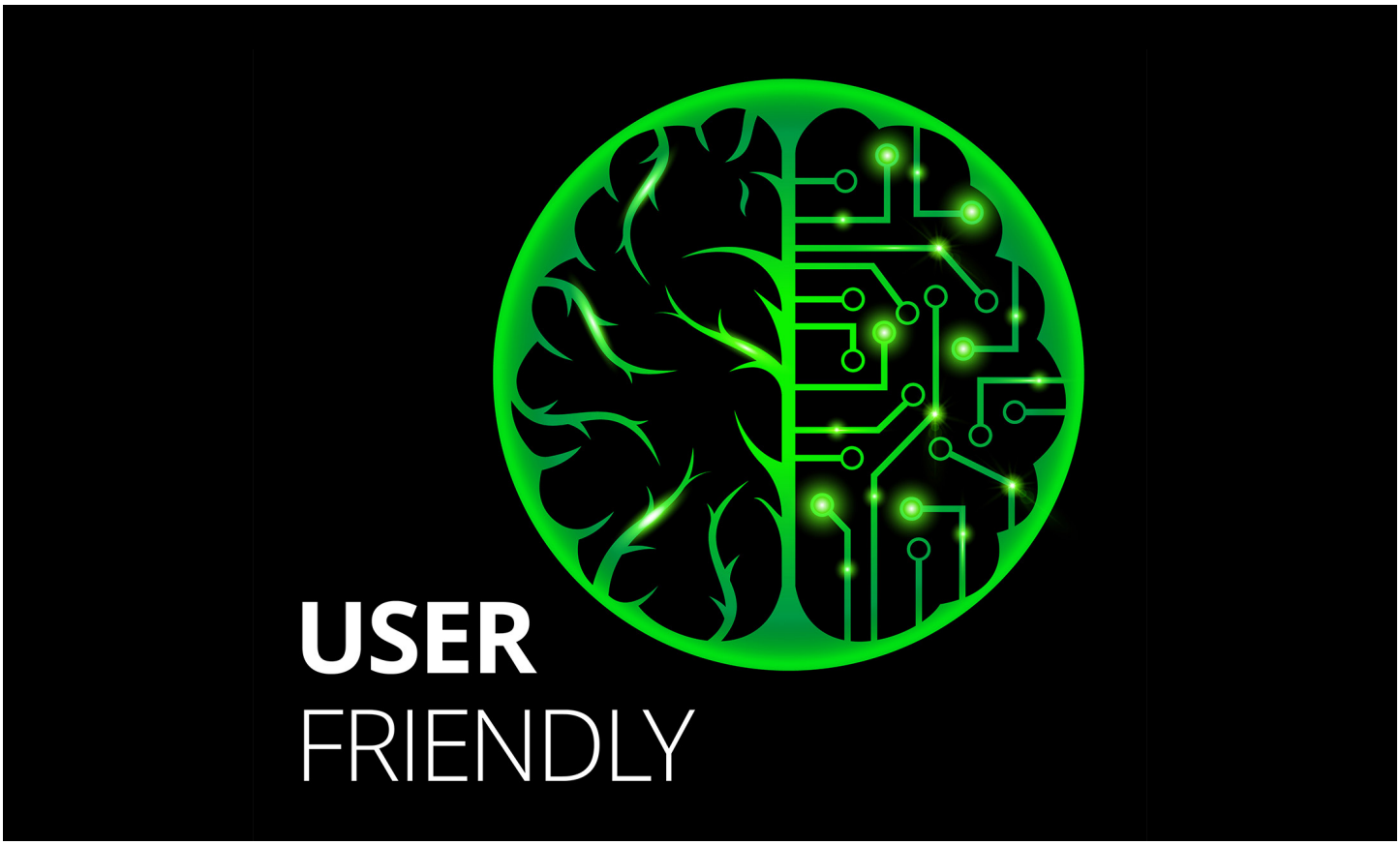

Semiconductor trends to watch

Host: Hanish Patel, User Friendly host and Digital Transformation leader, Deloitte Consulting

Guests: Christie Simons, Audit & Assurance TMT industry leader, Deloitte & Touche LLP
Duncan Stewart, Director of TMT Research, Deloitte Canada

Hanish Patel:
In 2022, the global semiconductor chip industry is expected to reach about $600 billion, driven by the increasing need for chips in everything, from cars to appliances and factories. And with the proliferation of consumer and manufacturing products, chips will just continue to grow in importance.

On today's episode, we'll discuss how the semiconductor industry is managing the continued demand for chips. Challenges, such as supply chain disruptions, and talent shortages, as well as the opportunities for growth in the future. Joining me to discuss the trends, impact in the industry, and the implications for TMT companies, are Christie Simons, Audit and Assurance TMT industry leader at Deloitte, and Duncan Stewart, director of TMT research at Deloitte Canada. Christie, Duncan, welcome to the show.

Duncan Stewart:
Great to be here.

Christie Simons:
Thank you very much.

Hanish Patel:
So let's just dive straight in. The chip shortage of 2020, and frankly 2021, really brought semiconductors to the fore and established their place as truly essential to so many parts of our lives. So I want to open up in a bit of a two-part question, if I may. And that being, firstly, Christie, can you explain why we're seeing this level of demand from consumers, companies, and governments? And then, Duncan, what is the impact this will have on the semiconductor industry?

Christie Simons:
Sure, Hanish. Semiconductors, or chips, as we call them, really power every aspect of our lives, which is exasperated by COVID, as everyone migrated work and school into their home. And we saw that the demand for technology really resulted from that migration. I mean, one can look at your desk and your home, and imagine the number of chips that are within your environment. You think about your laptop, your phone, your printer, the car you drive, if you wear a smart watch. Many of the appliances in your home, the temperature gauges, remote controls, TVs, maybe even a new refrigerator or washer or dryer, and definitely the new digital sports equipment that you might have purchased during COVID.

All of these, quote, things really can't operate without a chip, or even multiples of chips. So, we've seen that chips have actually become even more important now, and probably will be over the next 20 years than what they've been in the last 20 years, as all of us as consumers really lust for more technology, and actually want technology to do even more, which is probably going to require even more chips being used in our devices, as well as creating chips that are even more efficient. So, that's really what's fueling the demand, and the, quote, shortage that we hear about in the news almost every day.

Duncan Stewart:
Just to chime in with what Christie said, this is really much more about demand than about supply. Normally, when we have a shortage of something, whether it's coffee or corn, it's because, oh, there was a drought, or the crop failed and there wasn't enough stuff there. It's not that everybody started drinking more coffee. The chip shortage of '21, '20, and maybe even 2022, looks like it's more on the side of crazy-high levels of demand.

As an example, you started off the podcast by saying that global industry is going to be about $600 billion in 2022. That's up from $400 billion in 2019. This industry is 50% larger than it was three years ago. So the industry is doing the best it can to keep up with hyper growth in demand. And that's actually being manifested in a rising percentage of GDP. When you take a look at the chip industry from where it was 30 years ago, every decade or so it keeps getting bigger and bigger as a percentage of global GDP.

Hanish Patel:
Thinking about what you both said there, Christie, as you mentioned, the demand for the next 20 years versus what we saw in the last 20. And Duncan, as you've just highlighted, just that 50% growth, literally in the last three years. So if we think of it from that perspective, as demand for chips just continues to grow, what can companies, governments, and, frankly, the players in the semiconductor ecosystem do to meet that demand and actually help reduce the severity of future shortages like the ones we're experiencing right now?

Duncan Stewart:
What an excellent question. I wish I had written a paper about—oh, wait, I did. So Deloitte actually published an article called, "The Five Fixes for the Semiconductor Chip Shortage," which I wrote with some

colleagues. And we talk about five things that can be done, need to be done, are being done by chip makers, distributors, customers, and governments. The first one is building overall capacity around the world. That's going on, but that takes a couple of years and hundreds of billions of dollars.

The other thing though, and this is more new, is more local capacity. Historically, the chip industry has been highly concentrated in East Asia, and around the world, governments, companies, buyers are saying, "No, I want more chips built close to me." Now, that's growth in the US, but also in Europe, in mid East, in Singapore.

One of the other things that can happen is that the industry can perhaps focus a little less on just being lean. Instead of just trying to drive inventories and so forth as low as possible, maybe build in a little more buffer to the system. The other thing is what we call breaking the bullwhip. The bullwhip is this thing in the supply chain where a lack of transparency between layers of the different parts of the supply chain, that lack of visibility means that small perturbations end up being exaggerated by the end, so tiny little gaps in information sharing can lead to much bigger shortages.

The final thing that can happen is that companies, especially chip companies, can embark or accelerate digital transformation. I think Christie has some thoughts on that.

Christie Simons:
Yeah, that's right, Duncan. And digital transformation within semiconductor companies is happening currently, and it's going to continue to accelerate. And what do we mean by digital transformation? A lot of it is key operational transformation within manufacturing of these companies, or the IT organization, or other business functions, really figuring out how to do more with the same resources, or even less, in order to stay cost competitive, in order to help with some of this demand and providing additional supply.

So we're seeing clients look even at new markets, and even new go-to-market strategies, to create new revenue models, as they think about how to meet some of this demand and some of these new offerings, and even providing something as a service and integrating solutions on a chip to do more in a smaller package, which is also real transformation of an industry that's really been around for 40 years or so.

We did partner with the global semiconductor association on a survey that noted that nearly three out of five chip companies have already begun their transformation journey, and yet over half of those are modifying their transformation process as they think about manufacturing, which is really in response to some of the changes that we've seen in the market during COVID, and also the increased competitive pressures.

Hanish Patel:
I want to dig in a bit more about what you've mentioned there, Christie. In terms of how they're on that transformation journey, and the changes that they're making, and no doubt that's going to require investment. That's going to require some change. And, Duncan, you mentioned about a POV, so I'm actually going to bring one up around a prediction that Deloitte actually put forward, that we put forward, that venture capital firms are globally going to be investing more than $6 billion in the industry alone in 2022.

Do you see a big reason for that investment around that transformation? Or is there other focus, or efficiency, or all of the above that you're seeing where that investment's likely to go?

Christie Simons:
I love this new stat, as we think about venture capital investments and to start up semiconductor companies, because that is something that has really not happened in the last 20 years. And so, as we think about the transformation of the industry, what we're really seeing today is that venture capital investments into companies that are thinking about how to design better chips, chips that are more secure, that are faster, maybe more energy efficient. Also, the newer designs have new and existing chips.

As you think about how human beings are really engaging more and more with technology, there's going to be an increase in demand for the functionality of these chips. And we want our technology to do more, we want it to be more secure, we want it to move faster. So I think that's really what's going to fuel a lot of these start-up companies.

And these start-up companies are fabless semiconductor companies, which really focus on the design of the chips. They don't necessarily do the manufacturing of the chips, which is what you hear a lot about in the news today in some of the supply chain shortages. It's really pretty sophisticated technology and allows start-ups that typically have a lot more agility than some of the larger chip companies and can provide development of some of the niche applications, and some of the chip enhancements that I mentioned, they can provide that much more timely and more quickly than maybe some of the larger companies.

In addition, there's some new design architectures out there making it easier for start-up companies to design chips. And the risk five architecture, Duncan is very familiar with, so I'm just going to let him talk and give a little bit more description about this exciting new architecture that's out there.

Hanish Patel:
So actually, firstly, thank you for that. And, Duncan, before you jump in on that risk five, let's break that down for our listeners, if you could?

Duncan Stewart:
So it's a board game you play, where you take over—no, it's not that one.

Risk five is an instruction set architecture or ISA. And people's eyes always glaze over at the second I say ISA. It's simple. Do you have a laptop? Do you walk by a data center? Inside there are a bunch of chips with processors that run on an instruction set architecture or ISA. And inside computers, or data centers, those are mainly the X86 ISA. Meanwhile, in our smart phones and tablets, and a lot of other smaller devices, we've got the arm ISA.

For both of those markets, those two ISAs, which are closed and proprietary and cost money, at the end of the day, most of the processors that people are going to run into run on one of those two. Risk five is a third open source ISA. It's been around for a few years, but it's really taking off now. A quarter of all new chip designs in 2020 actually were built on the risk five ISA. The number of cores, the dollar value, this is a market that's growing at well over 100% per year.

Hanish Patel:
Brilliant. And thank you for that description around that. You both highlighted the significant growth and where it's going, and new architectures that are brought in. I want to pivot slightly in terms of what some of the impacts of that we're actually seeing in the industry. And certainly, one of the biggest challenges that I think just about every industry is facing right now is the talent shortage.

But despite this being a widespread concern, and rightly so, are there specific issues that are really impacting the US chip companies when you think about all this growth, think about the incredible amount of demand that's being put on them, what are those specific issues? I'd love to dig into that. And, Christie, if you could discuss some of those, and how companies can maybe even help address some of those challenges that they're facing?

Christie Simons:
Sure. Happy to share some thoughts. Obviously, the ongoing talent shortage has been made even more severe with the increased semiconductor manufacturing facilities that are being built in the US, that we hear about as well. Even in other countries that are outside of Taiwan, China, and South Korea, these new fabs that are being built are going to need thousands of experienced workers. And it's not going to be just the recent college grads, but those workers who've really got experience with complex manufacturing.

And what I find really interesting about this is that we've essentially come full circle. You think about 40 years ago when the semiconductor industry was started, the early manufacturing of these chips in the '80s was in the US, and then was moved to Asia to reduce cost and, along with it, the manufacturing talent has been developed in Asia for the last few decades. So, there's definitely going to be a need in the US for additional manufacturing talent capabilities.

Also, you think about competition for this talent from other technology companies, who are aggressively expanding in high-growth areas like AI, Edge, Robotics, 5G, smart devices. All of these industries are adopting technology, which is also increasing the demand for much of the same technology pools.

What's interesting today about the demand for talent is the software skills that are going to be needed in order to program and integrate some of these chips into the markets for electric vehicles, robotics, home automation, AI that I mentioned, and 5G, as well as a shift from fossil fuels to green energy. Some of that's going to further exasperate the shortage of labor and the needs.

Our TMT semiconductor outlook actually noted that revenue specific to EDA software is anticipated to double from $10 billion in 2020, to almost $19 billion by 2027. So, essentially, those software skills, as well as the manufacturing skills, are really going to fuel a demand for talent.

So, if we think about the demand for talent and the future of the workforce, companies can proactively engage with high schools, with junior colleges, universities, to advance the STEM program and to advance the STEM skills of graduates and bolster some of the innovation, as well as tapping directly into some of the international alliances and ecosystems that are out there.

The third thing to think about is just nurturing the talent with benefits and initiatives, foster greater collaboration between the core manufacturing, the technical abilities of the design, R&D that can cater to the hybrid work model. We see a lot of people who really want that hybrid work model and being able to work from home and work on site, but being able to adapt the industry to that work model is really important as well.

Hanish Patel:
Thinking about what you said there about some of the, I'll call them opportunities, for these companies to evolve when they're considering the talent shortages and the focus around talent, and rightly so. And I think as they continue to become more agile and continue to meet demand, sustain their competitive advantage in the future, what are they specifically doing when it comes

to really increasing their commitment to environmental issues such as sustainability? And I ask that because earlier we talked about efficiency of the chip itself and you touched upon moving from say fossil fuels to green energy. So I'd love to get a sense of what they're doing, where they need to go, and specifically, Duncan, is the industry really meeting those expectations, or do they have a ways to go?

Duncan Stewart:
Well, I mean, it's always a journey. You can always do better. The industry needs to do better, is doing better, and is making significant gains. One of the problems is that about a year ago there was this article that was published that kind of went viral. And a lot of people quote this one at me, and they say, "Isn't the chip industry using an awful lot of power, and they're producing an awful lot of CO_2?"

And so what I did is, the major companies, the big three, actually disclosed in 2020 their annual CO_2 footprint. And I added up A and B and C, and it's 31 megatons. And oh my gosh, 31 megatons, let's shut them all down. We're destroying the planet. And then I looked up the global emissions for the year, and it's 36 gigatons. Which means that the three largest chip manufacturers in the world's combined carbon footprint is 0.09%. So not 9%, but 0.09%.

So, could the industry do better? Yes, and they are. However, I really think that, Christie talked about how chips are found at the heart of almost every product these days, for an industry that is growing as fast and is as important as the chip industry to be less than a tenth of 1% of the global CO_2 footprint, I think means that we really need to put their contributions to global climate change in the right perspective.

Christie Simons:
This is absolutely top of mind of a lot of these large semiconductor manufacturers. When you think that millions of gallons of water is actually used in semiconductor manufacturing, there's a focus that these large fab manufacturers need to innovate the actual manufacturing process, or the fab process, to reduce the amount of water usage and to also maybe even be able to recycle the water that is used.

And the same holds true for the energy that's used for the equipment to manufacture these chips. You highlighted a little bit, Duncan, about the CO_2 emissions because of the energy that's used for that. But I think, as they look at energy efficiency, as they look at the number of chips that are being used in devices, is there a way to put more systems and more software on a chip rather than have multiple chips in a device? Can a chip have more functionality, which also goes to the sustainability and the efficiency that can be done in the manufacturing process.

Hanish Patel:
So that answers the environmental side of it. Christie, from a social perspective, and let's specifically say diversity, equity, inclusion, is the industry making strides in the right direction?

Christie Simons:
Yes, I think they are. It's historically been a pretty male-dominated industry. But I think DE&I is a topic really for every industry and for every company. And it's not only important to increase gender diversity, but also racial diversity. So, we mentioned some of the STEM programs in high schools and colleges, and how important that is to not only get the future engineering talent that's going to be needed to fuel some of this growth, but it's also going to increase the diversity of talent in the industry.
When you think about the generation of millennials and Gen-Zs, stats would say that that's the most diverse generation in history. So, really to nurture and mentor and inspire that next generation to the semiconductor industry is going to be very, very important. But then also, mentoring and sponsoring women and people of diverse backgrounds that are currently in the industry to take on some leadership roles within these organizations is also going to be very important.

Hanish Patel:
I want to anchor in on the innovation part. And you touched upon like say from a talent perspective, but also the design of chips, the manufacturing. And if I think of innovation, certainly I think about just what recently happened at the consumer electronics show, and unfortunately this is the second year in a row that I didn't make it. But certainly from a decade of visiting in prior years, I know there's a lot of innovation and a lot of tech on show that's really reliant on semiconductors.

And, Duncan, I remember seeing your summary of CES, so thank you for that, that was super insightful. I really felt I was there without being there. But for our listeners, any insights from this year's show, or indications on where you see the industry headed, based on what you saw at CES this year?

Duncan Stewart:
So, let's start with the thing that you said, or that we've been actually talking about this entire conversation. Chips are at the heart of everything, so let's just start with that. Look, CES is all about chips if you think

about it at that level. Which kinds of chips for which end markets? Auto. Wow, did we see a lot of automotive technologies. Screens in cars, technology on the outside of cars, technology to make us safer. A big, big impact there on the whole automotive space.

People had been using the phrase for a few years now that cars are increasingly becoming smartphones on wheels. Well, it's kind of come true in 2022. Hundreds of dollars of chips in cars, on average, and in higher value cars, probably thousands of dollars of chips. More and more screens, smarter screens, curved screens, lots of semiconductor technology behind that.

But the one that jumped out at me was health care. We actually have a prediction in our 2022 TMT predictions around wearable devices. These are smart watches and smart patches. Not counting how many breaths you take or how many steps you take in a day, but diagnosing very, very serious medical conditions like atrial fibrillation, blood glucose, blood oxygenation, blood pressure. We're seeing 320 million of those devices, and we saw that at CES for the first time ever, a major health care company gave one of the keynotes. So those were sort of the chip highlights for CES for me this year.

Hanish Patel:
Firstly, thank you for that. And you know, I could absolutely geek out at CES, so we could probably do multiple episodes on this. But, to contain myself, I'm going to try and close out the episode with a question to the both of you. And what I really want to know is, what excites you the most about the future when we think about the semiconductor industry, and chips, and the future of what it looks like?

Christie Simons:
I actually am pretty excited about the semiconductor industry and where it is. I've been playing in this market at Deloitte for almost 30 years now, and it's now cool to be in semiconductor.

I think the chip shortage has really increased the visibility of the semiconductor industry overall. When people aren't able to get the devices that they want because one or two chips isn't available. I mean, we saw that with automakers, right? Cars are in a supply shortage, and it's because the number of chips. You talked about it, Duncan, at CES. The number of chips that are going to be used in cars now, if you're missing one or two, you can't ship the car, you can't get it off the assembly line.

And so, that has really increased the visibility, I think, of the importance of chips to our economy. I've heard it said that semiconductors are the new oil in the digital age, as semiconductors become more critical to really fueling our economy with technology. So that's really what excites me about the future, there's just a lot of opportunity here. There's a lot of excitement. There's going to be a lot of new products, because of the semiconductor industry. So I just find that it's going to be a really exciting time for years to come.

Duncan Stewart:
So, Hanish, you said you wanted to geek out. Your wish is my command.

Hanish Patel:
Let's do it.

Christie Simons:
We can all geek out.

Duncan Stewart:
One of the coolest things that's happening right about now, and I'm going to be writing a prediction about this for 2023—historically, the chips that have been in space, that are up there in satellites and on spacecraft, have been very, very limited in capacity because of the harsh environment in space, the average computer that's on a spacecraft these days is about as powerful as a 1970s pocket calculator. I exaggerate, but only slightly. In the last little while, there has been remarkable progress at creating space-based computers that can actually do the processing hundreds of kilometers, or thousands of kilometers up. Why does this matter? Because that is what we call edge processing, and it will be edge processing at the edge of space. And by doing that, you can enable all kinds of amazing functionality. By doing the processing up there, you don't need to capture the data, send it down to earth and then back. Instead you can do the analysis and the machine learning and the AI, all of that rocket science, if you will, at the edge of space.

And I think this is just—it's so new, we really don't know how important it's going to be. But I think it's one of the most exciting things that I've seen in the chip industry in the last year or two.

Hanish Patel:
Wow. I love that. Calculations in space. I mean, just to kind of summarize it out, and I think you put it really nicely as well, the both of you, in terms of an industry that's 40 strong years, right? And for those who have been close to it, it has been a cool industry. But, Christie, you said it, it's become seriously cool now in terms of what it can achieve and what the future looks like, and you articulated there, Duncan, about space calculations.

And I think it's, as we said at the top, it has really brought everything to the fore for us all, with the increase in the demand, and the sheer demand that's going to continue to grow. This is definitely an industry to watch and observe, and see how it continues to evolve to make things faster, and make things more energy efficient, to frankly meet the demands that we all have as consumers for all these devices, for the products, across manufacturing, across appliances, and just personal consumption.

A phenomenal discussion. Thank you both for coming on and helping our listeners better understand what's going on in the industry, some of the challenges, and what the future really looks like. So, I want to thank the both of you, Christie and Duncan, for joining me today. And until next time, happy listening.

Christie Simons:
Thank you very much.

Duncan Stewart:
Thank you.

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