RBC Global Technology, Internet, Media and Telecommunications Conference

Company Participants

- Thomas Kurian, Chief Executive Officer, Google Cloud

Other Participants

- David I. McKay, Analyst, Royal Bank of Canada

Presentation

Operator

Welcome to our afternoon keynote session featuring Thomas Kurian, Chief Executive Officer of Google Cloud and Dave McKay, Chief Executive Officer of Royal Bank of Canada. Some of the statements that Mr. Kurian may make today could be considered forward-looking. These statements involve a number of risks and uncertainties that could cause actual results to differ materially. Any forward-looking statements that Mr. Kurian makes are based on assumptions as of today and Alphabet undertakes no obligation to update them. Please refer to Alphabet's Form 10-K and most recent 10-Q for a discussion of the risk factors that may affect its results.

It is now my pleasure to introduce Thomas and Dave.

David I. McKay {BIO 15435549 <GO>}

Good. Well hello everyone, and welcome to our keynote session this afternoon. I'm very excited today as I'm joined by Thomas Kurian, CEO of Google Cloud. And Thomas took over as CEO of Google Cloud almost exactly 2 years ago in November 2018. We're going to explore Thomas' strategy, we're going to explore some of the transformations that we're seeing in the world of technology, particularly around cloud. And certainly incredible track record of success already in 2 years, I'm really looking forward to talking about.

Thomas, you've been described as a strategist, a technologist and an operator all at once. Some of this by your competitors, by your peers, by the market, that's quite an achievement to do all three. And certainly, I'm sure, one of the big drivers while you've been so successful in so many roles. You were at Oracle for 22 years, heading up product development before you moved over to lead Google Cloud. You're a graduate of both Princeton and Engineering and -- your science degree and an MBA from Stanford. So certainly enormous credentials to take on the lead of a technology

that's transforming business, transforming our world. So welcome, we're so excited to have you here today.

Thomas Kurian {BIO 3811076 <GO>}

Thank you for having me Dave. It's a pleasure to be joining you for this discussion.

David I. McKay {BIO 15435549 <GO>}

We have lots of ground to cover, so I'm going to start maybe broad and we're going to explore different areas of your cloud strategy. But maybe it would help the audience if we talked initially -- you talked initially about your strategy, you came into the job 2 years ago, you have a vision, you have a perspective certainly on where Cloud is going and where you're taking Google. Maybe you start kind of with a bigger description of your Google Cloud strategy.

Thomas Kurian {BIO 3811076 <GO>}

Yes, we started with a simple understanding, what's driving the shift to cloud. If you went back to early 2000 and looked at it, a lot of it was software as a service. And the value proposition was really around convenience, get something done much more conveniently. And then the next phase was really data center as a service, put stuff in my data center and a lot of it was around cost efficiency. And when we looked at it and talk to customers, we saw the biggest shift that was driving the adoption of cloud was around digitization, how do you use data? How do you serve customers in new ways digitally? And so our strategy is very simple. We wanted to enable the digitization of business processes using data in a very different way in different industries. We wanted to do that by offering high scale infrastructure, a platform for data and analytics and solutions for specific industries because each industry had a different need. And we wanted to do that online for small and medium businesses to reach and use our capabilities online as well as to build a world-class sales and customer service organization to support large customers and we've been super-focused on that, on executing that strategy.

David I. McKay {BIO 15435549 <GO>}

You have and you've seen kind of as you disclosed now to investors, revenues grow significantly 2019 over '18, very, very impressive. So just we started to dig into your strategy building more capabilities for customers to use. I know partners are a big part of that strategy as you try to bring more value, and I think I've read that you talked about whoever creates more value and capabilities along the value chain for large enterprise and small enterprise is going to win at the end of the day. So can you talk about how you brought partners into that whole concept of creating value and bringing more services to the cloud?

Thomas Kurian {BIO 3811076 <GO>}

Our general view was cloud provider that's going to succeed in the end as the one that's differentiated, not just based on their solutions that they offer, but also the

ecosystem of partners solutions that are on top of it. And so, we've taken a very partner-friendly and partner-focused effort. We've got -- we identify specific places where we think partners complement us. And we work closely with the partners to enable it. I'll give you just a couple of examples, we have -- every large companies typically move partners to help implement solutions, we are a products and solutions company, we're not a services company. So, we have great relationships with many of the largest services companies in the world, Accenture, Deloitte, TCS, Wipro, Infosys, and others. And it's taken a lot of work to train their teams, enable them to deliver solutions. We've identified in many industries, the best application providers for that industry. An example in your neck of the woods Dave is, Shopify, retail, we felt that retailers really were going to look at e-commerce as the center piece, we felt that Shopify was a great platform that many retailers were focused on. We work with them to provide the capabilities of the underlying platform. And we've been very successful jointly with them. So we've been very thoughtful on the approach to enable a broad breadth of solutions and we went along with our partners.

David I. McKay {BIO 15435549 <GO>}

When you think about the IP that you create together, this is a lot -- you started partnership at certain place and as we all know, they end up at very different places a year, 2 years, 3 years. And how do you think about IP and what you look for in a partner as you're co-developing many things and many client solutions?

Thomas Kurian {BIO 3811076 <GO>}

We have three different models of IP that we work with. There are places where we build a solution, a partner will be an early adopter in that solution, but we'll retain the IP. But the customer gets, for example, the partner gets benefits for that as part of being the first to experience that solution. There is work we're doing at a large telecommunications company to modernize their contact center, as an example, using our voice technology and our artificial intelligence, that's a model we've done for them.

A second way that we work is where the partner retains the IP exclusively, meaning, we'll build a platform and what we are learning from that is, we're learning about that industry, or that solution or that domain. But that particular customer owns the IP. And the third thing we've done is in some cases we have built a joint platform that we can take to market together in the medical field, for example, we're working with the Mayo Clinic on a bunch of joint initiatives that we will take to the broader medical community together around digital health. So we have all three models and we are flexible depending on what industry, what the partner wants and working together on these.

David I. McKay {BIO 15435549 <GO>}

And that makes complete sense. I guess, your partner strategy would also and maybe you can touch on how it would change between trying to use a partner to attract an enterprise client versus medium-size and small business client?

Thomas Kurian {BIO 3811076 <GO>}

Yeah, we have a very focused strategy by geography, by industry and size of client. For example, there are specific partners who have great experience in public sector institutions, serving governments. And so, we have a set of partners there. There are different ones in Latin America versus North America versus Europe, for instance. And we have country-specific partners. For example, have very strong presence in a particular country. And then definitely we have differences between small and medium enterprise versus large enterprises. Their needs are quite different, their delivery models for solutions are quite different, and we have very focused approach on that.

David I. McKay {BIO 15435549 <GO>}

And something that drives so many core economies was the Canadian economy, the U.S. economy, small business drives the economy. And one thing I found through this pandemic and I'll pivot there next with you. But just a question on how do we bring small business with us. They don't have the resources to access AI capabilities with the data sets, but they need cloud-based services, they need them tailored. And how do you respond to that element of the market where there is an unmet need for sure?

Thomas Kurian {BIO 3811076 <GO>}

We have a very, very significant business with small and medium enterprises. We want to make it super easy for a small and medium enterprise to go to our website, log in with the username or credential, and get access to our services. And we have done a lot of work to continue to optimize the ease with which they can adopt it. Some of it for example, we see a lot of people building their online presence, small retailers, small restaurant chains, small delivery companies. Because during the pandemic, they are just as the large ones are jostling for presence online. Even the small and medium businesses need online, and our focus is on how quickly and easily can we give them the tool-set to get online, to communicate with their customers, to collaborate with one another. And we've been incredibly pleased with the results we're seeing with the adoption of these tools.

David I. McKay {BIO 15435549 <GO>}

What are some of the biggest barriers to them taking advantage of these tools because I certainly see a movement to scale, a movement brand scale company-size, yet so much employment rests with small business, is there one thing we can do together or we can think about in helping small business along. I know you're part of the solution is the cloud and allowing them to access data and insights and capabilities that they can't afford themselves. Is there anything else that's stopping them from really competing and being successful in a more digital world?

Thomas Kurian {BIO 3811076 <GO>}

Some of them just don't have the physical resources to compete. When I look at small retailers for example, one of the big things they struggle with is supply chain, delivery capability et cetera. Because large companies have scale and part of what we're trying to do on our side by enabling a digital business model, the cost of scaling a digital business model is much lower than cost of scaling a physical business model. So part of our effort to help smaller and medium enterprises is, giving them access to technology that the same technology that large enterprises get access to, made easier for them to pick up and use. But it also gives them the ability to scale their digital business model, which is a big competitive advantage for them if they can do that successfully.

David I. McKay {BIO 15435549 <GO>}

Right. Great point. We started touching on, obviously the pandemic that we're operating in and the changes and the challenges to different segments of our economy, different size organizations. Can you first talk about, just as a leader, some of the challenges in operating this world and technology side, and how you lead Google Clouds in all the different things coming at you. Obviously an increase in demand for your services, but how you're responding as the leader to these challenges?

Thomas Kurian {BIO 3811076 <GO>}

I've seen that you have -- we broad brush this -- I don't think we've been perfect in our response, we've been as moving as quickly as we can. I would say there are -- we've learned a few things by observing and understanding how could we do better. The first one is being adaptive, there's lots of discussions that we've had as a leadership team at Alphabet on how do we manage our global workforce, our employees. And the reality is, the pandemic has hit different countries at different times. So we've delegated a lot of decisions to the local country leaders, or office leaders because a situation in New Zealand, for example, may look very different than here in the United States or even in Asia, in different parts of Asia.

So one was doing that. The second I think is, keeping the employees engaged throughout. There's a variety of different things that we've done. But most importantly, I think is giving them a sense of purpose. And our purpose is focused around our customers because that's what keeps people unified as we go forward. We've had to -- on the customer side, there's many new things we've introduced, and we've been very, very focused on evolving the technology quickly. Our web conferencing technology for example has had a huge, huge growth in users, in minutes and we have to scale the technology to support that. We've had people in financial services, in retail, in gaming, have huge spikes in traffic and our -- a big part of our work has been working side-by-side with them to enable them to be able to deal with that, and support it. And we're very proud of the employees who have done that, we focused on making sure they understand how committed we are to their success as well.

So a lot of different parameters, but generally being adaptive, looking ahead and planning ahead and then recognizing that purpose is what keeps employees even

during this difficult time focused on serving the customers. Those are some of the lessons we've taken away. And I'm sure there are many more things that we need to do better at.

David I. McKay {BIO 15435549 <GO>}

Do you think we're better as leaders and humans in a hybrid world or in a purely physical -- or purely digital world? Do you have any insight to -- now what I think today versus what I thought in April is very different. And I'm sure I'll think very differently a year from now, as we continue to learn. What have you learned about how we're innovative, how we work best as humans?

Thomas Kurian {BIO 3811076 <GO>}

I think it's a combination of things that I've seen. When we listen to our teams, for example, and engineers, for example, one of the things we've seen is, there are certain things that we find that they are actually much more productive when they work at home because they have less disruption. At the same time, a lot of the, what people say, the design sessions and the sort of one-off ideas that they wanted to discuss with the colleagues that they used to grab them around a water cooler, we've talked about for example, with some of our teams this notion of what we call an on-site, off-site because when everybody was in the office, in off-site by, in order to brainstorm, they went to an off-site. And now we have people at home we've done an on-site off-site where we bring people together into a socially distanced office environment so that they can be a bit more cohesive. And I think everybody will learn as this continues. There are good things about working in an office setting, there are really good things about working in a home environment, and blending the two will be the art of the future, mind you.

David I. McKay {BIO 15435549 <GO>}

Yes well said. Absolutely. And it's an evolving, and listening to our employees is going to be critical as we try to build the most engaged productive workforces for the future. And it's a brave new world, that's for sure. Maybe we can pivot then to -- certainly we're learning a lot about online business, online commerce, it's accelerated the trends in so many areas. Can you talk about how you think about clouds role in that future and even bigger opportunities for cloud-based capabilities and how your perspectives changed over the coming -- over past year?

Thomas Kurian {BIO 3811076 <GO>}

You know, it's interesting. When we look at what we're seeing in different industries, almost every place of work has been digitized. So if you look at it, the way that people went to a hospital to meet a doctor, now they do tele-medicine. People used to go to a bank branch to do certain things, now they want to do it online. People used to go to a store to buy things, now they're buying things online. So the first phase of change that we saw was this notion of a digital front door in every industry. The way that governments distribute unemployment insurance and small business loans and benefits have also gone online.

So that was the first phase. The second phase was help me use my data and understand how to serve these customers better. What products and services to put in front of them? How do I manage my inventory better if I'm a retailer? How do you optimize my supply chain? And the third was, now that you have that, how do you take a lot of your physical processes and make them more efficient. If you're in manufacturing, how do you do quality assurance better because people cannot stand next to one another at the end of a manufacturing line to inspect products and services. And so, we've seen sort of every phase of this has accelerated significantly because of the pandemic. And we're seeing that being a long-term shift in the use of technology to solve some of these problems.

David I. McKay {BIO 15435549 <GO>}

Every time I think about the potential of technology and moving -- using data for knowledge and for value, we always stumble over the quality of data first. And getting data into a place where it can create knowledge and then value, how big of a barrier and what are you trying to do to help largest enterprise firms, improve the quality of data, so it can lead to -- and use the tools that you've built to really harness as far.

Thomas Kurian {BIO 3811076 <GO>}

Our approach is qualitative data, you're right on, is probably the biggest impediment to being able to use some of the new technology. And so, our focus has been make it easier for the software to understand the data at a fundamental level. And so, some of the things that we have done understanding, for instance, looking at documents, there's still a lot of people floating in the world. How do you really be able to understand the text on this paper at a really fundamental level. Historically, people used to talk about natural language processing and they really thought it's about understanding sentences or words, in reality human beings expect you to understand conversations. And when they have a conversation, they leave off a lot of things because they assume implicitly that you remembered it. And so, we are pushing the boundaries constantly on being able to understand data at a fundamental level both structured and unstructured to be able to describe it, and to provide tools to be able to analyze and process that in a much more easy way than people could do before.

David I. McKay {BIO 15435549 <GO>}

To me, a massive amount of data organization manages from the capital market side through to the consumer side, those are truly differentiating capabilities. If you can -- where they are large enterprise or small enterprise, if you can more seamlessly extract value from data, derive different data points, and then apply tools that you've built to that and the capabilities in the cloud, there is a huge differentiating capability there. But to me, that plays to, as Google's Cloud is as an enterprise solution product capability is different than Google advertising, Google mail type capabilities. But that's where you bring to meet the two worlds together and leverage that incredible horsepower and the original Google capability.

Thomas Kurian {BIO 3811076 <GO>}

And that's a lot of what we're trying to do is apply some of the technology to solve some fundamental problems. I'll give you just two examples. One is in retail, a problem that retailers face a lot today is that, when people went to the store to buy things, demand was very easy to forecast from a store by store basis. Now as people now buy online, but want to pick up in the store, they buy in the store, but want the things shipped to their home, it becomes extremely difficult to forecast and manage inventory. And inventory is a big part of the capital that's tied up in retailers. So we worked on a set of tools to help people really forecast inventory much more accurately using some of the expertise we have in artificial intelligence, and allows retailers to plan for example inventory in a very differentiated way.

A similar example we do in financial services. Everybody is worried about fraud and things like anti-money laundering. And one of the things we seen is that, when you look at anti-money laundering, there are many different tools that are used today they have a tenancy to generate a lot of false positives. And when we look at it, it's because they are largely using older technology that was based on rules rather than some of the newer tools and technology. So we're applying some of our expertise in artificial intelligence, in large-scale data processing to help solve some of these business problems that are central in retail, in financial services, in manufacturing and other things. And to assist people on some of these problems that they couldn't solve very elegantly before.

David I. McKay {BIO 15435549 <GO>}

And maybe I'll just pivot there, as you've taken this route to the next key element I think of your strategy, as I remember, it is certainly around industry verticals as you talked about. And talked a bit about -- bit more broadly and then you mentioned retail and financial services. Specifically I'd like to jump into financial services, it's most relevant to us. But certainly, can you talk about vertical strategies, how you chose them, to arrange them and how you're building them out and how they compete?

Thomas Kurian {BIO 3811076 <GO>}

Yeah we -- our technology applies to all industries, but we see different industries focused on different needs and we're trying to deliver solutions for those industries. Our primary industries are public sector, financial services, retail, healthcare, manufacturing and communications and media. If you look at financial services, we break financial services into consumer and institutional banking, wealth management, capital markets and insurance. And there are different requirements in each of them. Just to give you an illustration. Our goal is to use large-scale data processing to streamline business processes within an organization, to transform the customer interface, and to allow people to build new products and sources of revenue.

So when we look at, for example, insurance, we're working with a number of the leading insurance companies around the world, around some of their important processes. One example is, how do you change underwriting? How do you streamline how claims are processed? And the third is, how do you put a digital agent in front of the consumer, because they may not feel comfortable going to an insurance agent office still. And so, these are examples of how we're taking our base technology and then applying it to different domains and different industries and we are seeing because of that -- enterprise customers always want their problems solved, the more applied you can make it, the easier it is for them to adopt it. And we're very focused on that kind of an approach.

David I. McKay {BIO 15435549 <GO>}

How big it was a challenge to say, when you're working with an enterprise client to say, yes, thanks for helping me re-engineer this process, it saved time and money, but you're not allowed to sell it to the next competitor out there. Is that something that's more and more part of agreements with enterprise clients or you're (inaudible) premises, the cloud is going to be available to all industry participants and our IP will be separated out and kind of repackaged is...

Thomas Kurian {BIO 3811076 <GO>}

The vast majority of clients recognize that, if we maintain the IP and are able to enhance it, it will move faster than it was for just for them. So vast majority of cases people say, as long as you work and give me an advantage by starting with me, and I'm part of your Early Adopter Programs and other things, they recognize the value that comes from having shared innovation with other people, and they find the benefits of that. So we've been generally pleased with how we're able to solve our major customer problems as well (Technical Difficulty) at the same time maintaining an overall curve of innovation that helps all the players in that industry.

David I. McKay {BIO 15435549 <GO>}

If I jump to financial services. And obviously a heavily regulated industry, how are you thinking about dealing with regulators as you move more and more banks or insurance companies onto Google Cloud Services, the regulator will look at, those operations, (Technical Difficulty) system with regulator?

Thomas Kurian {BIO 3811076 <GO>}

We convince, one is evolving our platform to address some of the requirements that regulators have. A lot of the work that we've done on this notion of multi-cloud, being able to use Google's technology on other cloud platforms and in a data center of a customer has provided a significant benefit in financial services around this notion of concentration risk, which regulators are very concerned about. The second is, we put in place operational practices and policies. For example, many European financial institutions want their data to be maintained in Europe. Many financial institutions have certain access requirements to who has access to their

data, and we put in place lots of operational practices to govern the use of data, particularly financial services data.

And then lastly, we go through regular audits with regulators both financial regulators in a country or in the case of Europe, also with the European Central Bank, and we have people in our policy organization that work super closely with them to understand where they want regulation to go, and then evolving our technology to be able to support those regulatory requirements. In general, as cloud becomes a more and more important part of the IT landscape in industries and in different countries, we expect to get more requirements of this kind and we are very committed to meeting that.

David I. McKay {BIO 15435549 <GO>}

So you've obviously thought that through. That's really good because I can see the questions coming in from our regulator as we start to move these services over. So, you started to pivot then again to another key component as I understand, the Google strategy around multi-cloud, and you kind of re-branded and re-launched Anthos, which I believe is the Latin derivation of, to flower. And it was a multi-cloud kind of management capability. Can you talk a little bit about your multi-cloud strategy and how that differentiates you from maybe some of the UniCloud competitors as they would maybe self describe out there?

Thomas Kurian {BIO 3811076 <GO>}

I use this example, imagine if you were back in 1997 and the Internet was happening, and you said, certain web pages were only available in Microsoft's browser, and other web pages were only available in Netscape's browser and other web pages were only available in Firefox's browser, you know, the Internet would not have succeeded because it would have been fragmented. So our approach has been, if you want to enable organizations, the primary barrier to adoption of cloud in organizations is skill-set. And a big part of it, I don't think organization say, I want to have three different cloud teams, one for Google, one for Amazon, and one from Microsoft, why don't I have one team and learn -- I give them the choice of where they want to deploy.

So our approach with multi-cloud is, there should be no complexity in providing customers, the ability to use the cloud provider of their choice, but you have them do it without being locked into that provider. And the way to do it is to build an open programming model for how people can build, deploy manage, and secure workloads. And that's a lot of the work we've done. We went taking our data and analytics technology that many, many people find very differentiated, our machine learning tools and made them available on other platforms. And the reason is, people said, can I use -- I've chosen someone else to put my data in, can you bring your data processing to my data as opposed to the other way around. And we feel that, if you do right by customers and give them the choice, it will eventually gets you more success as the regulatory landscape has evolved, and the notion of sovereignty comes up, you know, of hey, I want to have a regional presence even for example in the government -- in the public sector, depending on changes and the

classification of certain kinds of information, people have to use different clouds. The use of multi-cloud gives them choice and flexibility and we've seen really strong interest from customers to this approach we've taken.

David I. McKay {BIO 15435549 <GO>}

Can you talk a little bit more about some of the partners you've chosen to execute a multi-cloud containerization partners, kind of tenderization strategy, because obviously I think about those things here as we choose our cloud to partners.

Thomas Kurian {BIO 3811076 <GO>}

We have a broad set of partners, they fall in four buckets. The tools and developer tools that developers used to both deploy, but also package applications. Second, tools that allow them to run workloads. Third, tools to migrate data, it's a common requirement that people have when they want to move data around. And lastly, tools around security, how do you secure this environment. And we have partners in a number of these. An example, if you look at the security space, there is common requirements on how do I lockdown my container, how do I provide container security. We have a very good partnership with Palo Alto Networks in that area. So there's quite a few things that we can always clear on what do we want to enable, what tools do we provide of our own and what's the partner ecosystem that we want to bring to solve these problems?

David I. McKay {BIO 15435549 <GO>}

And I'm going beyond my technical ability, but can a UniCloud competitor kind of block that strategy or is it, you have the ability to run this multi-cloud environment independently?

Thomas Kurian {BIO 3811076 <GO>}

We can run the multi-cloud environment independently. It abstracts out the underlying cloud providers ability to block it.

David I. McKay {BIO 15435549 <GO>}

All right. Right. I'm sure you've thought of that. So that's great because I think as you talk about regulatory corporate strategy, small business strategy, the need to manage short and long-term risks, right, risks of porting and not being beholden to one development capability is something that we certainly think about in managing operational risk at the same time. So I think it's a fantastic strategy. You touched on another theme that I wanted to discuss. And as we -- and that's cybersecurity, something certainly that's omnipresent, but heightened during this pandemic, as we see this movement towards public cloud services and more processing capability, more data residing as we see a world with more endpoints, in a world of 5G, which we'll touch on after. Can you talk about your security strategy and how you're protecting data, protecting partners, customers in this omnipresent cyber world?

Thomas Kurian {BIO 3811076 <GO>}

Our philosophy around security, it boils down to some very basic tenets. Number one, make sure that security is easy to operationalize. Second, provide the tools to detect threats and risks. Third, make it easy to automatically remediate some of these problems because historically, that's also been challenging. And lastly, allow people to choose how to configure their systems to minimize all the way from the endpoint to the cloud. And so, I'll give you just a couple examples, one of the common things we felt was, people would really like to encrypt data. And if it's encrypted, it's much more difficult for malicious people to get access to it.

Historically, there has been two difficult things, one is making encryption possible was hard, you have to manage keys, there was a lot of complexity with that. The second is, data was encrypted only at rest or in transit. While it's in process, it was left wide open. So, somebody could always open the front door and get access to it. So, we came up with a solution to encrypt data all the time, at rest, in motion, and while it's been processed, and we also made its super-simple for people to do, so let's not complicate it for them to manage. Second example of something we felt very strongly about was making it easy to detect if you're in compliance with security practices.

So we've taken security and converted through configuration. So that an operator can just look at your system and say, is it secure or not. Historically, you have to use lots of tools. It was super difficult for a seesaw [ph] to get a sense, am I secure or not. And so, we made it much simpler through our threat detection capability to identify, you're running in a secure environment. (inaudible) a healthcare system, unloading healthcare data, are you maintaining HIPAA compliance, because that today is very difficult to do. And lastly, we're working on some advanced solutions around cyber protection even for external attacks. As you can imagine, we have lots of technology at Google that we're applying to this domain because we think that is a significant area of further work that needs to be done as part of the industry itself.

David I. McKay {BIO 15435549 <GO>}

Yes, it is really impressive that you've built out a capability not only to -- we do expect you protect data at rest as you say, and in motion, but also while being processed within the machine. And I think that's really, really important. So, you'd obviously thought that through. When you talk about kind of 5G and how that's going to change, where we're processing data, where we're making decisions, and how does that impact kind of the cloud-based and how you think about security and how you think about capabilities from a world of 5G?

Thomas Kurian {BIO 3811076 <GO>}

You know, 5G, given the investments telecommunications companies are making in 5G in the network itself, 5G networks provide not just lower latency, but also more bandwidth. And so, given that it's lower latency, we -- what we're doing is integrating what we call out mobile edge computing solution with many different carriers

around the world into the network. So in the carrier network, you can actually have computation that runs in the network. And it allows applications, new kinds of applications that have very low latency to be available right in the network. So we see a lot of different solutions. And what we're doing is, providing not just a technology platform with mobile edge, we're also providing a catalog of solutions for specific industries with a partner ecosystem to make it easy for customers to adopt it.

I'll give you just a practical example. We're working -- we have a large manufacturing company that runs a manufacturing shop floor. The robots that run the shop floor have to have a clean room environment. The control systems and the computers that talk to these robots therefore need to be close to the robots, but if they're in the factory floor, lot of the times you have these technicians have to go into repair the disks and replace the disk and other things. So, they wanted us to put that into the network itself. So working with the telecommunications partner we've built that into the network. It's very close to the factory. So you get a low latency, but you don't have the disruption of people walking in and repairing things in the factory floor. And allows them to get the combination of better value to the carrier because a carrier is now becoming -- the network is becoming a locus for application delivery and a better solution for the customer.

David I. McKay {BIO 15435549 <GO>}

Right. That's a great example, an exciting usage model. Can I just talk a little bit to artificial intelligence. I know we're running out of time here, and I got a couple of topics I may sort of squeeze in, in the last few minutes. AI is so much promise, so much capability. Can you talk about both some of the exciting applications you've seen in AI. Google has invested heavily outside of cloud in AI capability, reinforcement learning. Obviously, you'd think that some of that capability is going to be brought in to the cloud. And then what are some of the barriers you see to really leveraging this incredible technology? We talked about data earlier. And then a third question, and I'll probably remind you of the third question, a little bit about the ethical AI and how we have to think as a society about using these tools? (inaudible) we will step you through?

Thomas Kurian {BIO 3811076 <GO>}

We see AI being applied to support and augment humans in a variety of different industries and fields. As an example, we've done work using our image recognition to let radiologists have better tools to diagnose tumors because our image processing is so accurate, it can identify tumor cells. We've helped many manufacturing companies have image processing on top of their shop floor so that we can do quality inspection without human being standing next to one another, it reduces the risk to the humans having to be on the shop floor, it also speeds up the manufacturing line. There are many, many such examples of places where artificial intelligence, whether that's image processing, understanding data, helping people understand conversations are all going to change the way that organizations function and use the value of the data in different ways.

Now at the same time, we've also been very careful that the same technology can be very powerful in one context can also potentially have negative consequences. So as an example, we do work on object detection, object detection is for instance, if you got a human being who is in distress in the water for example, can you detect that so you can help the coastguard rescue them more easily. That's an example of a project we're doing in one part of the world. At the same time, the very same technology can be used to identify whether that person is a specific individual. And that technology of human identification is -- has a number of potentially negative consequences, for instance, it would lead to diversity in inclusion bias. So, we've been very careful on putting forward an ethical AI framework because we feel that when you have a very powerful technology, you have to have some principles that govern the use of that technology. And Google adopted something called ethical AI, we've put forward a set of principles that are meant to govern how we use AI in our products, how we expect people who are using our AI to use it. But also meant to be a foundation for discussion with other technology companies and policy makers on what's the right way that AI can be used in the world.

David I. McKay {BIO 15435549 <GO>}

Also it's a great example. It's fascinating. Double it, both sides of that equation, trying to help but also trying to protect confidentiality and the ethical side is just amazing. I'd like to just ask one more question, I know we have just a couple of minutes left, one of the most important issues that we've all dealt within our society and as leaders is building a fairer, more inclusive society going forward, you touched on it just now. And can you just talk a little bit about, I mean, your thoughts on building a fair inclusive society and how you're leading within Google through this?

Thomas Kurian {BIO 3811076 <GO>}

Our general view is technology is still something that does not distinguish, which person and what race and what nationality has, unique advantage to create the next technology. And so, our view is, we need to be representative and provide opportunities for people of all backgrounds to be able to create new technology in innovative Google. For us, it boils down to four things, are we recruiting a diverse and inclusive population? Are we helping develop people of diverse backgrounds? Are we promoting and rewarding them? And are we retaining them? And we have very specific work going on in every one of those areas, working with our people operations team, our employees and it's a matter of great importance to us because we want to be a place that represent -- that builds representative technology as well as it has a very representative organization.

Some of the things we've had to change for example, people often think about and we have to educate our managers that you don't hire for cultural fit, you hire to evolve the culture of the organization. And so, don't just hire people who make you feel comfortable, but hire something that makes our organization stronger because it's more representative of the broader community in which we live and work. And so, there is a lot of work that we're doing, we constantly are paying attention to it, to see if there are ways that we can improve further as an organization and we're

learning also by discussing with many universities, with different organizations. And this is a matter of great importance to us.

David I. McKay {BIO 15435549 <GO>}

Well said. I think that's the very definition of diversity right and different perspectives and not hiring in our likeness and challenging ourselves to think differently. It's such an important point. Thomas, we can go on for another hour, right, I know we've taken a lot of your time and we so appreciate the time you spent with us today. And I think you've -- we've covered a lot of topics. But I hope everyone can feel the power of a technology you're building, how you're going about it is different from multi-cloud and the verticals and the partners you've built will differentiate your capability. The future is going to transform small and large enterprises, bringing the power of AI, bringing the power processing data, re-engineering processes within verticals to put into your capability is transformational technology. And we are so excited that you were able to talk to the conference today about some of the things you're building and we can feel the future that's at your fingertips and that you're building. So, on behalf of everyone, a sincere thank you for a great conversation today.

Thomas Kurian {BIO 3811076 <GO>}

Thank you so much for having me, Dave. It's a pleasure to be joining you.

David I. McKay {BIO 15435549 <GO>}

Be well and I'm sure we'll see you soon. On behalf of the entire audience, a sincere thank you.

Thomas Kurian {BIO 3811076 <GO>}

Thank you very much.