SCOTTISH MORTGAGE INVESTMENT TRUST

Horizon Robotics: The Microsoft of Robotics

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Claire Shaw (CS): What is it about Kai that increases the company's chances of success?

Lawrence Burns (LB): He is one of the world's leading AI scientists.

Dr. Kai Yu (DKY): The cars are being transformed from purely mechanical things to somewhat like computers running on wheels.

LB: There's no other market for EVs quite like China. Incredibly crowded, incredibly competitive, but it's also poised to lead the world with EVs at good quality and incredibly low prices.

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DKY: The kind of enabling platform for all kinds of robotics applications. I want to be like Microsoft for robots.

CS: Hello and welcome to season three of Invest in Progress, brought to you by the Scottish Mortgage Team. I'm Claire Shaw, Portfolio Director.

In this podcast, we take you behind the scenes to hear the conversations that take place between the Scottish Mortgage managers and the leaders of some of the world's most exceptional growth companies.

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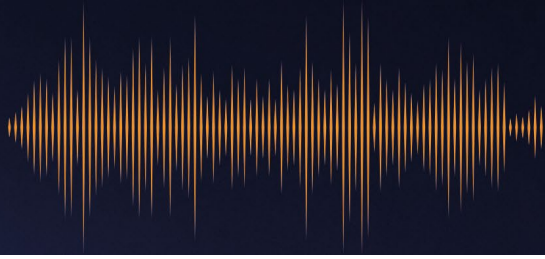
Today we're joined by Dr. Kai Yu, founder and CEO of Horizon Robotics. This company is leading China's autonomous driving revolution. In just a decade, Horizon has become China's top provider of computing and robotic solutions in the sector.



As vehicles transform from mechanical machines to computers on wheels, Horizon has gained an edge by mastering both hardware and software development.

Their product line-up includes computing solutions, algorithms, and software that help vehicles understand their surroundings and perform functions like automated parking, lane keeping and various levels of autonomous driving.

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Horizon's “Journey Together” mantra has enabled strong relationships with both Chinese and global automakers, and attracted major partnerships, including a $2bn investment from Volkswagen. The company foresees hands-off driving within three years, eyes-off in five, and fully autonomous mind-off driving within a decade.

But automotive is just the beginning. Horizon ultimately aims to become the foundational platform for all robotics applications. Or, as our guest puts it, the Microsoft for robotics.

So without further ado, I'll hand over to Scottish Mortgage manager, Lawrence Burns and Dr. Kai Yu.

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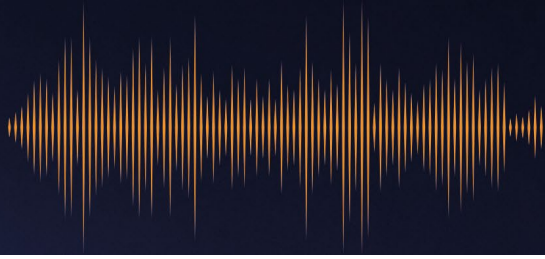
LB: Kai, I want to say thank you so much for joining us for this podcast from Shanghai. We really appreciate it. I just want to start by asking you the same question that we ask all of our guests, which is, can you explain what Horizon Robotics is, and what is the problem the company is trying to solve?

DKY: Thank you, Lawrence. It's my pleasure. And Horizon Robotics is an almost 10-year technology company. And we are developing the computing solutions for autonomous driving to enable all the passenger vehicles to be safer and more convenient for every ordinary people, from young to very senior.

So for all people, mobility, the driving, the commuting, the commute is going to be safe and more convenient. So you know, even during being stuck in the traffic jam, they won't need to handle the tedious, you know, the control – the car can actually drive by itself.

So we are developing the software and the hardware, everything together, integrating together as the system. And today in China, we are the number one supplier in this business. And last year we covered 3 million cars, 3 million new cars actually encrypted with our solutions.



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LB: And if we go back, I mean, you've been very passionate about machine learning now for 30 years. Can we go back to those early days? I mean, you received your bachelor's and master's degree in electrical and electronics engineering from Nanjing University in China before pursuing a PhD in computer science from the University of Munich in Germany. Where did your own initial passion come from for this field?

DKY: Well, it was about in 1995 when I was in the second year of my college. And by chance, I read a book which is about neural networks. And I was so fascinated by this whole thing. Building computer programmes which can behave like a human brain can evolve our experience. Namely data, and getting smarter and smarter. So they keep learning. So I was so amazed by this idea, and I was like kind of immediately telling myself, I have to devote my whole career, my whole life into this single one topic. And it's like magic. I cannot say exactly why.

But, you know what, I did exactly, you know, devoted my whole career into this one topic, machine learning – for dissertation for my bachelor degree, and also my first paper during my master programme and also my dissertation for my master's degree and then I went to Germany for my PhD.

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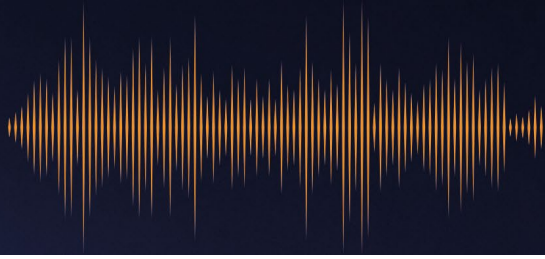
And also my first job with Siemens, the second job I guess in Silicon Valley, NEC Labs, and then third job of Baidu, and the fourth job of Horizon Robotics.

Change place to place and the change of the companies, but one thing actually never changed, which is machine learning and my passion on machine learning and developing the machines which can learn by itself and evolving over experiences and getting smarter and smarter. So this is exactly what I'm doing right now.

LB: So you were working a corporate job in the research laboratory at NEC, as well as spending some time at Microsoft. And I think it was there that you would have caught the eye of Robin Li, the CEO and founder of Baidu, the company sort of renowned for its dominant search engine within China.

And Baidu also used to be a holding for us at the time that you would have joined them back then, and for a number of years. Could you just tell us, what was it in your research that they found particularly compelling and led to you making that move back to China?



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I think that was around 2011, I think 14 years ago, I was in Silicon Valley and I got a call from a head-hunter who was representing Baidu, trying to find some talent or leading figure to join Baidu and lead the newly established multimedia team. At that time, Baidu was already almost the number one, not only just search engine, but in terms of entire internet business, Baidu was the leading company. And Baidu already attracted a huge number of user base and huge data.

And then I think the idea Robin Lee had at that time was to develop technology, machine technology, machine learning technology to utilise the data and the beauty of machines and algorithms to train this data, to get smarter and smarter and provide better internet service and the search engine result to the users.

So at that time, actually, even though Baidu and Alibaba, Tencent, all already were very successful, it turned out that in the entire China internet business, there was almost no machine learning technology or machine learning team back to 40 years ago.
And then I thought, 'Wow, that's a great idea'. You know, I can utilise my knowledge in machine learning and benefit billions, one billion, over one billion Chinese internet users. So then I decided to join Baidu and I went back to China in 2012.

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And then actually I expanded the multimedia team later to this Institute of Deep Learning, 'Baidu IDL', and it was the very first deep learning lab of China. So one year later in 2013, I established Baidu Autonomous Driving, which was also the very first autonomous driving project of China. So I think Robin Lee, he was very impressed by the progress we made.

Actually, we developed the deep learning algorithms for speech recognition, voice search, for the mobile search, and also the image search functions. And also, we used the deep learning algorithm to significantly improve the search engine relevance. And also we built the models, very gigantic models, to predict the click-through rate of the advertisement system. It's all actually contributed a lot to Baidu's main business.

And Robin, he was very, very impressed. And once, actually, I think six months after I joined Baidu officially and I gave a report to Robin Li and showed him a bunch of demos my team already built using deep learning and he was so impressed. And guess what, he wrote an email to the entire company and said basically there's a revolutionary technology called deep learning. It's going to

change everything about our internet business. And every technology team and every product manager should get to learn deep learning. And please talk to Kai. Talk to Kai.

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LB: I mean, I suppose in some ways, Baidu was a natural place for someone with a passion for machine learning to go because they had huge amounts of data. They specialised in algorithms. And so that made a natural sandbox in some ways for a lot of the early stuff on AI.

And I remember a decade or so ago, meeting Robin Lee and him being quite bored, frankly, by some of our questions on the core business until we sort of stumbled upon asking what he was excited about. And that's where some of the passion for AI and deep learning came through.

What led you to then leave Baidu and start up what is today Horizon Robotics, given that sandbox, and I suppose, particularly the pull that led you to found your own business?

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DKY: Well, you know, actually, I had this personal history in 2010, the first year of the ImageNet challenge. And I led my team to win the number one position. And Jeff Hinton actually won the ImageNet Challenge in the third year, 2012. And I think that the ImageNet Challenge had to make two things later get very, very popular. One is deep learning. Second, guess what? GPU.

Right. So because the older guys, they tried to get the higher score in the image recognition competition, they all leverage GPUs. So I think in the year of 2012, I think I left my lab in Baidu. We were pretty much one of the biggest customers of NVIDIA's GPU business for deep learning.

Even at that time, I don't think Jensen Huang realized how big his business could be. I think probably three years later, 2014, he realised that GPU was not only good for gaming, video gaming, but also it's a powerful machine for machine learning. So that actually already inspired me.

You know, in order to develop a very good system, we should not only be working on just the software algorithms, we should also design, you know, dedicated hardware and integrate the software and hardware together.

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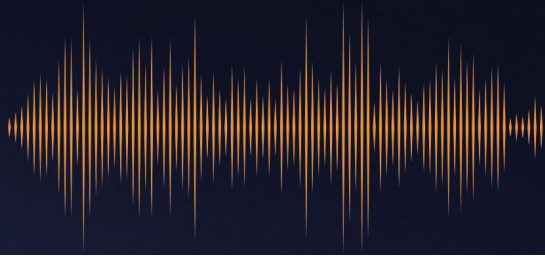

So that actually inspired me to think about 'can they develop a dedicated hardware architecture for autonomous driving and also for robotics?'. Because at that time, I already kicked off this autonomous driving project within Baidu. And then if you open up the trunk of the autonomous driving cars, it's a huge machinery and a big mess with all the cables, making the machine extremely unreliable. And also, the power consumption is huge.

And I think the testing car, I remember running on the road for 30 minutes, then the car has to be stopped somewhere. And, you know, because the cooling, to wait in the temperature, you know, cooling down. So it was very, very unreliable.

So that's actually urged me to think about, 'Can we develop a dedicated hardware and squeeze the whole big, messy machinery into a small, you know, small box and a small computer?'

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And yes, the performance is still high, but the power consumption is low. And I thought, it is definitely in the future. So I talked to Baidu executives about building this dedicated hardware. And I think in general, at that time, it was difficult to be accepted because Baidu was a very, very software-driven culture.

And at that time, China, I think on the whole, let's say, the industry was very, very software-driven. And they all thought building hardware is a terrible idea. And the business is, you know, it's very slow to get the return back, you know, and get the investment back. So no one wanted to, you know, bother, be bothered to develop hardware. So then I decided, OK.

LB: In some ways, that was a very brave decision, as you say, to do hardware and software, because that's not what a lot of people were doing at that time. That put you in many ways in contests with quite a number of formidable competitors in what you were doing, because you had the automotive companies themselves that were trying to do this.

You now have Huawei, one of the biggest private Chinese companies. It also brings you into some degree of competition with NVIDIA. How should those listening think about Horizon's Edge versus different types of players that are within this space?

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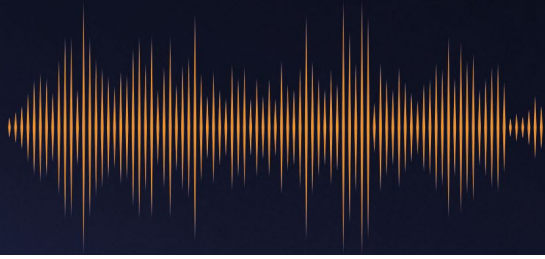

DKY: Yeah, I think we entered this space from a very unique perspective because I think among all the hardware companies, we are very strong on software, on developing the algorithms and software system. But also among all the software guys, we are very strong for the hardware design.

So that's actually positioned us into a very unique perspective. I think, well, to develop a dedicated hardware for autonomous driving, you definitely need to have a better and a deep, profound understanding about the autonomous driving algorithm. If you have zero knowledge, you don't have profound knowledge about the algorithm side, you are not able to develop very capable, competitive hardware that is the best to facilitate the computation for the autonomous driving software.

So I think many of the companies, let's say the semiconductor companies, I think they took the wrong approach. They develop the hardware and then they are waiting for a software team, like a software company to work together with them. and to develop the software. But it turned out this process is too slow. It's too slow. And also, the pace of the innovation is too slow.

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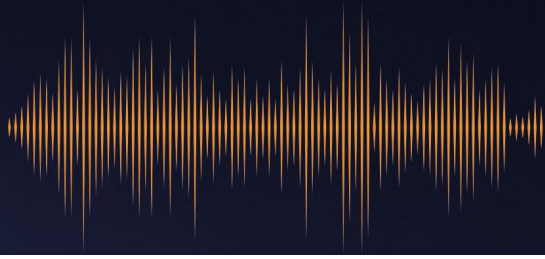
So typically, guess what? For automotive semiconductor, normally, I think once the hardware was done, in the traditional semiconductor industry, when the first automotive chip was launched they're going to wait, let's say five to ten years to get this product commercialised, deployed onto millions of cars. Like ten years, so it was too slow.

And then we actually work on the software hardware together and then our pace is much faster than any competitor. That's why, actually, in a very short period, we, as a newcomer, now we become the leading player in China.

LB: And it's very evident from our meetings with you and listening to you in the past that you view the OEMs, the automakers, very much as partners, not customers. And they're the partners that you're solving, I suppose, two problems for, both the hardware and the software, and therefore becoming somewhat of a one-stop solution.

And the slogan of Horizon, I think, is “Journey Together”. So you have this approach of open collaboration. Volkswagen are a partner and have invested about $2 billion within Horizon, and I love the quote where you said it was a partnership that combined “German quality with Chinese speed”.

How did you go about the difficulty of building trust, especially with the non-Chinese auto OEMs, to get them to really embrace some of these partnerships?



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DKY: Well, I think, yes, indeed, our company slogan is “Journey Together”, because we believe to build an enduring business is not like a party. It's a really long-term journey. And we need to be committed and also stay persistent. We're going to come across many challenges. So I think staying persistent is a very good attitude.

And also, journey together means we believe in a win-win strategy. That means to win together with our investors, to win together with our customers, to win together with our team members. So I think fundamentally, the great businesses must come from a sense of empathy. You know, we must understand what's the pain of our customers and what kind of thing they need us to help them. And I think if we can help them, actually, they're going to help us. So we're going to build a very enduring business and also partnership.

And also, I think in the current stage of this automotive industry, the cars are being transformed from purely mechanical thing to somewhat like computers running on wheels. Then the software, the computing is becoming more and more important. So that means that during this transformation, nothing is well-defined.

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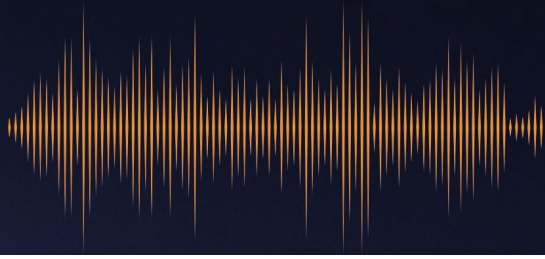
And that means it's hard to say, ‘Oh, this is the component and we can standardise the component that we can ship to the OEM’. So many of the things need to be co-defined together by Horizon and OEM customers. So many things need to be customised. So I think we need to have this kind of a mentality you know, open-minded, and also we position ourselves as an enabling partner, rather than a kind of traditional supplier, which typically supplies a standardised component to the car makers.

This is currently not the case. So I think by having this business mentality, we really gain the trust from OEMs. And I think today we are doing business with almost all the major OEMs in China. And as you mentioned, we are also tapping into global OEMs like Volkswagen and also many others. I think this is our philosophy, you know, a journey together, not like a short party.

LB: And the Chinese OEM market itself is huge. It's the world's largest EV market by far. And whenever I travel to China, the picture I receive is an auto industry, an EV industry that's incredibly crowded, incredibly competitive, but it's also poised to lead the world with EVs at good quality and incredibly low prices, which really means there's no other market for EVs quite like China.



Does that make China a particularly good market for your technology, that you have consumers that are eager to adopt new technology, you have fragmentation around automakers that particularly in the EV space are desperate to stand out in this quite crowded field?

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DKY: Yeah, definitely. I think we are very lucky. You know, the company was founded in China. I think China probably is very unique in many senses. I think the Chinese user is very open-minded to adopt technology, and also the Chinese society, I think, compared to many Western countries, probably is more digitalised. I think the people embracing the digital experience and the EV penetration rate in China is really, really high. It's getting higher and higher.

And also the car driving and also the digital cockpit, I think here the penetration rate is also much higher than other regions. So then as a native company in China, we are very close to the customers and we are very close to this technological transformation. And then we certainly enjoy an advantage because we keep listening to the demand from the users – it's very important for technology company, right?

And so I think we really, really benefit from our position. Actually, we were, you know, from day one born in China. But I think eventually, I believe this EV and the smart EV, and also the concept, the idea of transforming cars into computers running on wheels, I think it's not just a China thing. I think it's the first that happened in China, probably.

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But I think once the technology gets more and more widely adopted in China, and also during the process – you know, the technology getting more and more mature – I think eventually this will become the next global trend.

Just to remind myself, this is like smartphone business. Also at the very beginning, it was very well adapted in China. I think later, Europe, Japan, I think many other regions then all embraces the smartphone product.

LB: And you should be well positioned to take Horizon increasingly global because you have the partnership with the European OEMs and automakers but also you've got Chinese EV companies that are very ambitious in terms of their international expansion which presumably gives you a good springboard.

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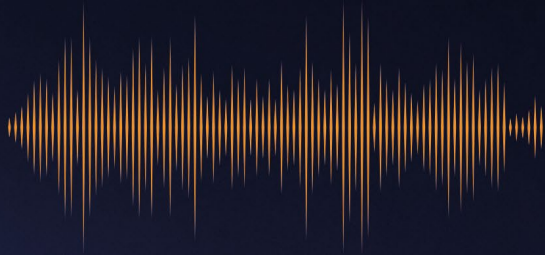

DKY: Yeah, I think we position ourselves as an enabling partner for all the OEMs, including China OEMs, and the European OEMs, and the Japanese OEMs, and many other OEMs. So I think, well, I'm quite happy. I think we are in a much more interesting position to make friends with all the OEMs. And I think we've built a strong partnership. And we also built a very strong partnership with some of the global tier one suppliers, like Bosch, Continental, Denso, ZF. So we work together to help our customers to deliver amazing products.

LB: And you talked a couple of times about cars becoming like computers, or computers on wheels, and Horizon are obviously key in helping that transformation of the automobile.

What's already been achieved by you and others in autonomous driving has been incredible, but at the same time, around the world, it's been subject also to a degree of overpromising in terms of when full autonomy will arrive and when we'll hit different stages. In your opinion, where are we in the journey to universal adoption of this technology? And how do you think about that over the next five, 10 years?

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DKY: Well, I think over the last four or five years, the China industry was already evolving from this limited scenario, highway, lane keeping, AEB, towards today... I think, this is a full scenario, even in busy, urban traffic, driving, autonomous driving technology. And the adoption rate is getting higher and higher.

So I think also given the recent, the advance, the amazing advance of this end-to-end training using this gigantic neural network for imitation learning, reinforcement learning, I think the pace of technology progress is being significantly accelerated year by year. So we really see the turning point. I think the turning point is this year or next year.

So I think my agenda is like in three years from this year, in three years, we can achieve like 100% hands off for daily commute. And then in five years, for 100%, the eyes are off for driving. And in 10 years, it's going to be completely minds off. That means that you can sleep in the cars while the car is driving.

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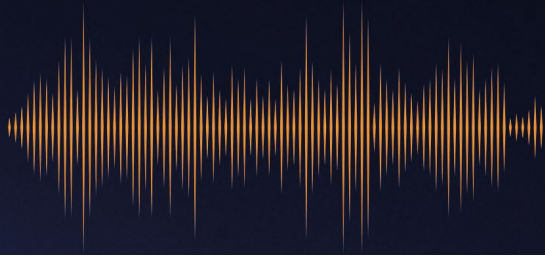
So I think, well, I'm not super optimistic about RoboTaxi. Let's say, I don't think it's going to happen this year or next year. I think it's still a long time to go to battle against the other cases. I think RoboTaxi basically is like minds off. So I think I label myself always as a conservative optimist. So taking, you know, a step-by-step



approach to achieve a fully autonomous. Yeah, but I think along the way, we build, you know, a very solid business.

LB: Well, I do look forward to the stage where, whether in Shanghai or London, you can sort of get some reading done on your commute rather than having to focus on the road and freeing up all those hours for productivity. Cars are the first application for a lot of this technology and robotics, with future applications presumably in terms of broader robotics. So if Horizon 1.0 is focusing on the automotive industry, can we talk about what you think it can solve in terms of future problems beyond that in the future?

DKY: I think our long-term passion is really to develop the computing solutions software and hardware for all robotics, for all generic robotics. I think cars are probably the first, you know, application of the robotics technology. But definitely, we can expand the technology to enable many, many other forms of robots, like nursing homes, elderly care, and home service.

I think agriculture, manufacturing, logistics, and many other things. So I think definitely our passion, Horizon 2.0 is definitely for generic robots. We're going to be like the kind of enabling platform for all kinds of robotics applications.

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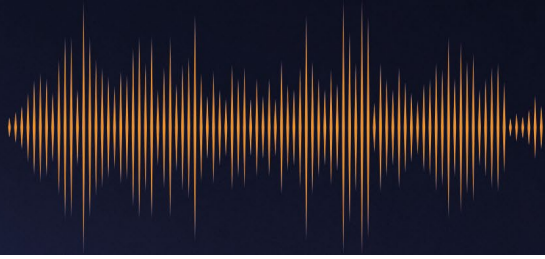
LB: And how big is the jump from successfully getting a fully autonomous car, which is sort of a machine or robot on wheels, to going into those other applications? And how much right to win does solving the car give you in broader robotics?

DKY: Well, basically, I think the application, the computing paradigm are very, very... are almost the same, right, from the perception of the environment and mapping, localisation, human-computer interaction, decision-making under sophisticated circumstances, and the control. So I think, first, we need to build the software, the hardware for the moving robots.

But I think for the humanoid robots, even though it's not like a speed as high as cars, I think the kind of complexity in terms of the degrees of freedom is actually higher than moving cars. So that will request some advance, some breakthrough also from the theory side, from the software side.

And I believe down the road in the next 10 to 20 years, we're going to be, we're going to see continued progress, continuous progress for the theory of the software and also the hardware architecture. And by the way, also battery is going to be a challenge, right? And you need to carry a very compact battery.



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But I think, unlike the human brain...the human brain actually, we use like, we consume 20 watt, but we can keep running and doing really amazing things. I think currently the computing architecture is still too energy consuming.

So I think there's some way to go and we need innovations from software and hardware, and maybe entirely change the traditional architecture and to move towards more biology-inspired hardware and software architecture.

LB: I mean, it's always quite stunning when you think about how efficient the human brain and body is in terms of energy consumption in those terms.

I mean, I think in some ways we've started to paint the picture around this. But the final question we ask our guests is, what does the world look like if Horizon succeeds?

DKY: Well, I think, first of all, we want to make the world...you know, because of our work and the contribution, the world becomes a place where a human can really enjoy being a human. Because today, I think, driving during the traffic jam is really tedious. It doesn't give you the freedom.

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And if you're stuck in the traffic jam in Beijing or London, basically, you are not master of the car. You are a slave of the car, because you have to do something. You are forced to do something. I think, in general, the autonomous driving and the robots, I think the technology will give people the kind of freedom, the freedom to choose to do whatever you love, to create, not doing a tedious work like in a factory, in an assembly line. It's kind of tedious. I don't think it's suitable for humans.

So I think I really want to push the whole world into the way of doing human work. And all the other work is done by machines. And Horizon Robotics want to be the kind of key technology enabler. And put it in this way, I want to be like Microsoft for robots.

LB: Well, that sounds like a good outcome for humanity and a very good outcome in terms of an investment. Kai, conscious of your time, but thank you so much for joining us today from Shanghai.

DKY: Thank you, Lawrence. And I hope sometime I meet you in China to demonstrate to you our latest technology.

LB: Yeah, no, that'd be fantastic. Thank you.

DKY: Take care.

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CS: Well, Lawrence, I said in that last episode of the podcast that we get a lot of questions about our investments in China. And I really hope that this conversation really brings to life the opportunities that we see in the region. And as always, this portion of the podcast is to discuss the investment case. So let's start at the beginning. How did you initially come across Horizon?

LB: So Kai has been one of China's leading AI scientists for a very long time. And we actually first got to know him when he was at Baidu, which was many years ago a holding of SM, Baidu being sort of the leading search engine in China. And he founded and ran its Deep Learning Institute. And so we built a relationship from there.

That initial relationship was built by a close colleague of Tom and mine. It was built by Linda Lin, who's Baillie Gifford's China head. And then after he left Baidu, Linda did a really good job of staying in touch with him. And one of the main trips that me and Linda, as well as James Anderson, former SM manager, did in China was to actually go and visit Horizon Robotics. It's really early days. So we actually visited it, I think in the year it was founded, in 2015.

And at that point, it was more focused on chips and robotics and the ADAS stuff (the assisted driving) came later. But it gave us a chance to continue to build up this relationship with Kai over many years and over different roles. And then eventually we invested in 2021. And I think that's a good example sometimes of how long the process is and how early the seeds are planted before an investment can sometimes be made with a person or a company.

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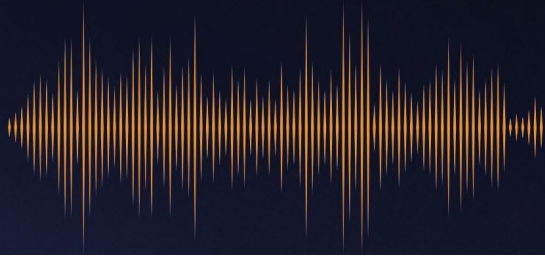
CS: And as we heard in the discussion Lawrence, Kai has basically dedicated his life for the last 30 years to machine learning. But he's also contributed quite a lot to academic research. He is very much a thought leader in this field. But I've listened to you and Tom talk a lot about founders.

But more so recently, you've talked a lot about the importance of technical founders, especially with the advances being made in AI, people that really



understand this technology. Just with that sort of hat on, what is it about Kai that increases the company's chances of success?

You know, the fact we can see he is one of these technical founders that we're talking about a lot right now.

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LB: Yeah, I mean, in some ways, my answer to that goes back to the previous answer. I think it matters that he is one of the world's leading AI scientists. I think it matters because it means he has his own technical abilities, but also because those technical abilities attract AI talent, people that want to work with him. And that, I think, has allowed them to build one of the most serious teams in the world that are doing this.

I also think he's very long-term focused. It's quite clear from what we've heard about his background that not only has he been thinking several steps ahead in terms of where AI is going to take the world, but he isn't someone that's jumped on the AI bandwagon in the last three or four years. This has been his life's work and focus.

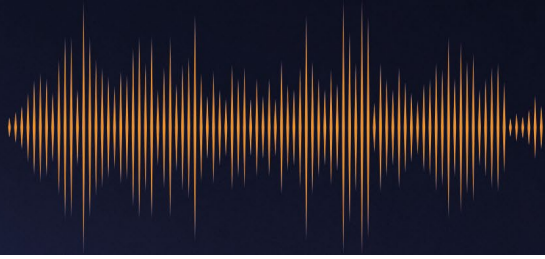
And again, I think that really matters, that where you're trying to back people that are following their passion and trying to do something very serious in the world rather than just trying to make money.

00:37:45

CS: And then maybe just pivoting slightly to sort of the competitive dynamics around Horizon. I mean, it's positioned itself quite uniquely in the market by developing both hardware and software, whereas competitors have tended to focus on one or the other. You know, they've built these great relationships across the sector. But what is it that you think is the company's competitive edge?

LB: So the company's done a good job of taking share in China and taking share as well from Western advanced driver assistance system providers. They have over 50 per cent of the market today. And I do think, as you alluded to, and as Kai alluded to, that creating a scalable solution requires co-design of both the hardware and the software.

And it's that combination that Horizon excels at. And that matters, I think, because the complexity of the task makes it less likely that over the long run, individual car brands or the tier one automotive vendors are able to build their own multi-capacity and capabilities in-house.



And beyond that, I'd probably highlight two factors. The first is they've shown themselves to think, to be more flexible and more willing to provide significant support to their automotive partners relative to their competitors. And I think this attitude and approach has been really helpful.

The second, and again this does go back but these points are interlinking, is that I think it is an advantage in terms of Kai and in terms of the AI talent they've been able to assemble on this.

00:39:07

CS: And I think the company is really leading the charge, as you say. You can see that with their market shares. But when you see the pace of progress in this field, there are numerous challenges we have to think about, whether they're technological hurdles, regulatory concerns, competition.

So we have to always think about what the potential threats are to any business? So what do you think is the most significant threat that Horizon faces? And how is a company placed to overcome this in your eyes, Lawrence?

LB: Companies always face a multitude of threats and risks because no investment is ever 100 per cent likely to work. The future is inherently uncertain. And when companies are trying to do big and new things, they're difficult, but that makes them more valuable.

I think there's two threats you could talk about here. The first would be a little bit what I just alluded to, which is automotive companies try and do this in-house, particularly the larger ones. I think looking to do that to save money is part of the reason.

But being vertically integrated, mastering both the chip and the algorithm is hard. And I don't think it makes sense at least for every vehicle brand to develop their own autonomous capabilities. I think it makes far more sense for this to be something that a partner helps them with, and we hope that partner will be Horizon.

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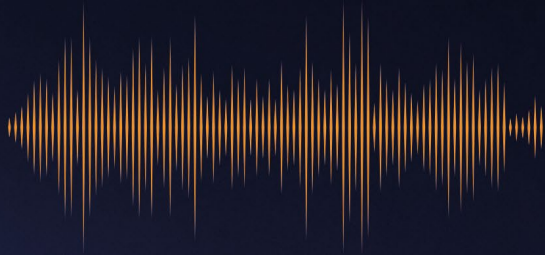
Another challenge is going global. And that's always been an ambition for Kai. And I think they do have the opportunity to reach most markets around the world, with the exception of the US.



And they have various partners with Western brands that speak to that. The Volkswagen investment is particularly important, not just because it validates them, but because it provides that pathway to a global presence.

And being global is something that Kai has really put a lot of thought into, how he thinks about the company's identity, how he thinks about sort of locations and headquarters. And so I think that is something he's very much deeply thinking about.

CS: And Kai painted this ambitious vision, if you like, for autonomous driving, suggesting what he called “minds-off” driving within a decade. But he also sort of envisaged Horizon expanding its robotic solutions into healthcare, home services, agriculture, manufacturing.

I think he put it at the end there. “The Microsoft for robotics”, I think was a phrase that he used. So Lawrence, the final question for me is, how would you describe the scale of the opportunity for Horizon Robotics from here?

00:41:22

LB: I don't think I can do it in more interesting terms than the Microsoft one. But the scale of the opportunity is large. The widest framing I've used has been that it's an opportunity to both create the hardware and the operating system of AI. And that's broad and that's grand, but we want people with big and ambitious targets.

The first step is turning the car into an AI robot, making cars increasingly autonomous. And it sold 2.9 million chips last year and plans to reach over 10 million this year. Put some of that in context, China sells 30 million cars a year, so you're quite far from saturation. And then globally, outside the US, there are about 60 million car sales each year.

And you would expect that over time, as the autonomous and the assistant driving features get better, that the average selling price of those chips can potentially also go up as well. And then the second step is that once you have a car that becomes a robot, it then extends that capability to, as you were alluding, a broader range of robots.

And then the opportunity does become dramatically larger. I think the first opportunity is enough for this to be a very good investment. But the second one is interesting because of that power of second acts that we've talked about. The biggest outliers are those that leverage one thing to do another. And there is at least a possibility of that here with Horizon.

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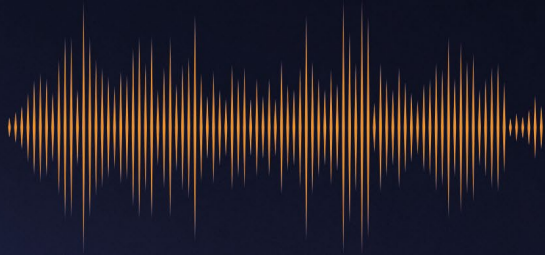

CS: That feels like a pretty good note to end on, Lawrence. So thank you very much, as always, for giving us the Scottish Mortgage angle on Horizon Robotics.

So thanks, as always, to Scottish Mortgage manager Lawrence Burns and our guest today, Dr. Kai Yu from Horizon Robotics.

We are nearing the end of season three of Invest in Progress. Thank you to all those who have listened so far. And don't forget, season one and two are available on all streaming platforms.

And if you haven't already, check out the rest of season three, during which we have welcomed biochemical company Solugen, crypto platform Blockchain.com, healthcare pioneer Tempus AI, and the Latin American banking giant NuBank.

You can also learn more about Scottish Mortgage by visiting our website, scottishMortgage.com. You've been listening to Invest in Progress. Thank you for joining us.

Please note, OEM stands for Original Equipment Manufacturer.

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