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Driverless cars are here – we need to move on them now

Transport as we know it is about to change. Here's how to profit.

Eoin Treacy, Investment Director

My wife and I have driven about 20,000 miles in the last three years. For a family of four living in Los Angeles, the land of the car, that's really not very much. We both work from home, our kids go to school about a ten minute walk away and we go almost everywhere together. Our excursions are to our daughters' extra-curriculars, supermarkets, restaurants, malls, dry cleaners and occasionally over to Palm Springs, Las Vegas, Santa Barbara or San Diego. On many days, our cars simply sit idly in the driveway.

In recent weeks I've been thinking hard about the future of our cars. In fact, not just our cars all cars. I think we're on the verge of a step change. And it means opportunity for us as tech investors.

I'll start with my own personal reasons. When my car started playing up about three weeks ago, we started talking about how much we really use our cars. I did the maths and we could easily save money by simply using Uber to go anywhere locally and by renting a car for road trips.

That's not the biggest benefit though. Saving $3,000 a year would pay for a good many fencing and tennis classes for my family. But it's the time and responsibility saved that really has me intrigued by the idea of doing away with our cars altogether.

There's nothing like living it, so we decided to ditch our cars on 20 December. We are three weeks into the experiment right now. Google and Amazon both offer delivery services from our favourite supermarkets, and even though we much prefer picking fruit ourselves we have taken to having just about everything else delivered.

I've allowed myself a glass of wine with dinner while out at restaurants since I don't have to worry about driving home. And

Uber is certainly benefiting since before three weeks ago I had never used it. I haven't waited more than two minutes for a car, which I am guessing is a factor of my location and the number of drivers plying their trade around here. Chalk that down to the benefits of living in the technology capital of the world.

Even with everything we've tried, the experience is not seamless. We've certainly got more free time since outsourcing some of the most mundane chores. I know many families who use Uber to ferry their kids to extra-curricular events, but I'm not comfortable with someone I don't know taking charge of my children regardless of how well vetted they may or may not be. I think in the end we're going to go down to a single vehicle and will probably use it even less than we had.

What becomes abundantly clear is how alluring the promise of autonomous vehicles is. I think as soon as you lease a car, you accept that you have to devote a certain proportion of your monthly budget to transportation. It really isn't such a leap to give up the idea of ownership and simply pay for transportation on a per-use basis, particularly in an urban area. It is not at all beyond the bounds of possibility that autonomous vehicle transportation companies will eventually offer a travel card type arrangement where you get unlimited use for a fixed monthly fee.

Today I want to introduce you to a firm that's a direct play on the move towards driverless cars. It's entering our portfolio as a "moonshot" opportunity (the higher risk end). As I write that, it strikes me that the concept of driverless cars themselves was once a "moonshot", where now it seems virtually inevitable. Let's start by looking at why that is.

Driverless cars are no longer a "moonshot" – they're inevitable

The technology is there and the benefits are obvious: it's happening

The first point to make about driverless cars is the technology is more or less fully developed. Virtually every major car manufacturer is working on one. And for many, the "work" is testing. They're out on the roads every day clocking up driverless miles. This is true in Britain too.

Why are so many firms working on them? Many reasons. But it comes back to three words: safer, faster, cheaper. Those are the ultimate benefits of driverless cars. And there are signs those benefits are already being realised.

Perhaps you saw the footage of Tesla's autodrive system stopping a car before an accident last week? If not, watch this.

That's just one data point. Ultimately, driverless cars will seek to eliminate human error altogether – which is a key cause of lots of accidents.

But there are other reasons the move to driverless cars feels inevitable. One is the economic benefit. The biggest cost for most transportation companies is drivers. The vehicles get amortised down as they are used and the loads they carry eventually pay for the initial capital outlay. However, you can't amortise staff. In fact they tend to get more expensive the longer you have them, not least because of pension costs. Autonomy is just about the only way companies like Uber and Lyft can ever hope to be profitable, which is of course why they are so eager to pioneer the evolution of this market.

Then you have the benefits to the transportation network as a whole. Alphabet's free Waze app already logs the whereabouts of users so that it can plot individual routes for every user based on the traffic data it receives. It represents a taste of what is possible when cars are autonomous and constantly realign with one another as well as reporting their position to a central hub. In my opinion, herding patterns in autonomous vehicles, like the wildebeest on the Serengeti, is inevitable given the trajectory of technological development.

And once they're on the road, people quickly get used to them. At the Emerging Tech Conference at MIT last October, the CEO of nuTonomy, which is trialling autonomous vehicles in Singapore, spoke about how quickly people get over their initial jitters once they enter the vehicles. That's a testament to how comfortable we all are with technology and how quickly we are willing to put our faith in what is essentially an unknown quantity.

That's good to know. People's objections to driverless cars often melt away once they've actually had some experience with them. The parallels between the adoption of the first automobiles is an obvious one.

As the technology develops, expect the very idea of the car to start changing. I think many of us are still wedded to the idea of a sedan car. At the Consumer Electronics Show this week, Faraday Future unveiled its vision for what its car will look like. Despite the hoopla about its malfunctioning sensors, its long wheel base gives us a better idea of what a future autonomous vehicle will look like. Think of a future transportation as more like a limousine than a car, and when all cars are autonomous then we should be able to get up and move around while on the motorway since the ride will be so smooth. That means cars can be both longer and taller.

Rather than a mode of transportation, future vehicles will simply be a mobile room or rooms from your home. That will give new meaning to living in your car, and yet it is entirely possible that ground transportation will be cheaper than air travel because the sleeper option will be more convenient.

The Jevons paradox

In coming to an understanding of how it will play out, I am reminded of the Jevons paradox. Two hundred years ago, William Stanley Jevons predicted the UK would run out of coal because he believed the available resource was being exhausted. He failed to account for technological innovation, which allowed for deeper mines at even lower costs – with the result that a 100 years later, the UK was producing multiples more coal than was ever previously thought possible.

This relationship between technology cost and demand is what ensures that our economy has continued to become more energy intensive. It moves in cycles so when energy is expensive we invest in efficiencies, while producers invest in new supply. That eventually sends prices lower. When prices are low, we give up on efficiency and think of all the things we would like to do that weren't possible because prices were high. Producers then have to think about how to be more efficient, and that drives innovation on the supply side and eventually demand outstrips supply and prices rise again.

I know there have been a lot of predictions that the number of vehicles on the roads will decrease with autonomous vehicles, but I'm not at all convinced by that argument. The Jevons paradox suggests that with abundant, cheap transport we will use it even more and we'll come up with even more ways to use it. It could change the whole way we think about real estate because instead of the vehicle picking you up to go home, your home could come and pick you up.

Either parking garages are going to become even bigger business or they will become completely obsolete. With autonomy we have the potential for vehicles to either park and recharge or circle until they are needed. In any case, central city parking will be obsolete but serviced parking on the outskirts of cities will be in demand. Autonomous vehicles could change the meaning of "trailer park" forever.

I can think of a number of ways we can make money from all

Mobileye helps cars see – which is vital

of this over the coming decade. Today I want to introduce my number one pick, and why now is the perfect time to buy it.

Introducing our top driverless cars pick

When Mrs Treacy and I spent a few days shopping for cars, what became abundantly clear is that we look for different things in a car. For example, she is much more focused on safety than I am. I tend to rely on my faith in the state's regulatory standards to inform my sense of safety while driving. However, she is from China where no one has any faith in regulatory standards. They simply assume the company has bribed the officials concerned to get their certificates and credentials.

She relies on hard figures and asks probing questions about air bags, the manufacturing process that goes into the chassis and the number of sensors arranged to help prevent collisions. It was the solidity of the Cayenne rather than any other factor that informed her decision to make the original purchase. What became clear following test drives of Porsches, Land Rovers, Mercedes, BMWs and Cadillacs is that new cars are stuffed full of sensors for everything from monitoring the health of the engine to airbags and the outside environment. Safety is much more about other drivers than the car you drive yourself.

I've been looking at one particular firm because it represents a pure-play on one of the three primary research fields that are vital to the field of driverless cars. These are: motion, artificial intelligence and optics. The firm is **Mobileye** and I'm adding it to the portfolio today.

Elon Musk has helped give us a great entry point

The simple reason for this is that Mobileye has technology that provides a vital "skill" all cars need if they're to drive themselves. **It helps them see. Mobileye's primary business has been delivering sensors and cameras with the required artificial intelligence to power them.**

It's a firm with some impressive clients already. And it's going head-to-head with one of the biggest beasts in the tech world for supremacy. More on that in a second.

Teaching a computer to see is jolly difficult, which is why industrial robots have historically been confined to cages and every motion they perform has been strictly mapped. George Berkeley's "An Essay Towards a New Theory of Vision" (1709) deals with many of the same problems programmers and engineers are dealing with today. Vison is difficult to explain at the best of times. Trying to get computers to understand visual data and to relate that data to what is and isn't dangerous or interesting is a mammoth task.

Until recently the only way a computer could be taught how to "learn" an object was to annotate a large number of different examples of that object and allow the algorithm to identify the similarities. It's an enormously time consuming process to annotate photos, not to mention expensive. This process was why the expression "Life begins at 10,000" gained such popularity in artificial intelligence circles.

Apple released its first white paper into how it plans to teach computers to see in December. It is relying on a mix of annotation and direct perception to allow the computer to learn from non-annotated images. That speeds up the process considerably and does so in a cost-effective manner. At some stage Apple may come out with an automotive product, but if its history is any guide it will see what sells first and attempt to improve on it.

Mobileye has developed its computer visual learning program the old fashioned way. It's hired an army of cheap Asian labour to annotate images on which to train its artificial intelligence. Its sensors have been deployed on cars for years and have picked up a great deal

of data. Cars have functions like lane assist and automatic braking because of Mobileye sensors. That has been its business for a number of years already. The bet is on what it can achieve next.

It would be a mistake to think it is the only company which is attempting to break into this field. Alphabet's autonomous vehicle technology is well known, and it is moving slowly but surely towards developing a commercial product. Ultimately it has said it has no interest in manufacturing so it will need to find partners. From Mobileye's perspective, it is the laser remote sensing system (LiDAR) it is pioneering that represents the greatest threat. This is also being adopted by Delphi Automotive, which is one of the world's largest automotive parts suppliers.

I think from the above summary we can see that both LiDAR and cameras are viable ways of helping cars see. Regular radar is an additional solution, but ultimately we want cars to be able to have as many senses as possible. Therefore it is quite possible that the first commercially available autonomous vehicles will have a battery of different kinds of sensors.

Considering the hurry everyone is in to get autonomous vehicles on the road, there simply isn't time for Moore's Law to take care of the cost of developing LiDAR solutions. Cameras represent the best bet for what the solution to autonomous car vision is going to be, at least for the first few generations. That is why Mobileye is likely to be one of the greatest beneficiaries of the growth of autonomous vehicles.

BMW, Audi, Daimler: an impressive client list

I'm not the only person to have come to that conclusion. Mobileye's largest customer is ZF Friedrichshafen. Don't be surprised if you have not heard of it because it is privately held. However, it is one of the largest suppliers of parts to the German automotive sector. That fact alone tells us how intertwined the big German automotive manufacturers are.

They have made a collective decision to take on Tesla and beat it to the punch in getting fully autonomous vehicles on the road.

Last year BMW, Audi and Daimler agreed to buy Nokia's mapping unit in 2015 and this week Mobileye announced a deal with Here, the German automakers' mapping group. The partnership is designed to help develop the autonomous vehicle products for all three of these luxury car manufacturers. This deal with Mobileye is a further example of the Germans' intention to go head-to-head with Tesla and they are much better funded.

Additionally, German auto manufacturers have a great deal of experience in producing large vehicles like trucks and buses. If I am correct in expecting bigger, more complete mobile living spaces that will be important because it is likely to develop into a booming sector and Mobileye is

LiDAR versus cameras:

LiDAR is basically light radar so you get a 3-D map of the area surrounding the car. It produces its own light so it doesn't rely on sunlight or streetlights to function, and it has pretty high resolution.

LiDAR was very expensive, but the cost has come down a lot and some options are now available for around $1,000. The technology can be expected to get better at refreshing, achieving better resolution pictures, and dealing with rain and snow. The greatest challenge it faces is with false positives where car exhausts, for example, are identified as obstacles. The problem is that these developments are in the future.

Cameras are really cheap, really small already and see in colour. They work like a human eye, observing the environment, and the artificial intelligence parses the data. They are great at reading road signs, traffic lights, etc.

The problem for cameras is that they rely on emitting their own light at night, just like headlights, and a very large amount of computing power is required to parse the data received. Due to the fact they rely on the visual spectrum, they are subject to the same limitations as the human eye on making sense of light and shadow as well as glare and reflections.

ideally placed to benefit from that growth.

Elon Musk just gave us a great entry point

Mobileye used to supply cameras and artificial intelligence to Tesla. However, following deterioration in the relationship, amid claims Elon Musk was actively trying to copy its technology in-house, Mobileye pulled the plug in July.

That drew a line under a relationship that had turned poisonous and which had contributed to the share dropping from a 2015 peak of $64.47 to a low last February near $23.57. From our point of view that's a good thing: the Musk controversy helped make the shares cheaper for us to buy. Mobileye spent most of 2016 drifting following an initial bounce. But is has perked up considering the implications that the majority of the German automotive industry is going to be using its parts and technology for everything from more advanced lane assist, to automatic braking and autonomous applications.

I recommend it as a buy in the moonshot category because we are still waiting on a viable product and this is already a competitive field. The share is a buy between $39 and $45 with an upside target of $65 this year if all goes according to plan. If it can in fact deliver the first autonomous vehicle solution that passes muster with regulators, it could go a lot higher.

The risk of course is that this is a high competitive field and that interlopers could come out with a better product. The short to medium-term bullish scenario is dependent on a fruitful relationship with German auto manufacturers so that will be a key metric of performance.

Name:	**Mobileye US**
Ticker:	**MBLY US**
Current Price (10/01/2017):	**$39.86**
Market Cap:	**$8,738.4M**
52 week high/low:	**$51.15/$23.57**
Buy between range:	**$39 and $45**

Data as of 10.01.17

Performance:

2015 +4.24% | 2016 (HY) -9.84%

Please note, 5 year performance data is not available for this company.

Energy

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Orocobre Ltd	ORE. AX	07/04/16	A$ 2.92	A$ 4.19	43.49

Technology

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Cyberdyne	7779	30/05/16	JPY 2,353	JPY 1607	-31.70
IBM	IBM LN	07/06/16	$153.33	$167.65	9.34
SAIC	SAIC US	05/07/16	$58.17	$84.37	44.97
Garmin	GRMN US	02/08/16	$55.75	$48.09	-13.74

Medical

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Intuitive Surgical	ISRG	07/04/16	$ 626.12	$ 641.30	2.42
Terra Tech Corp	TRTC	11/11/16	$0.41	$0.33	-20.63
Autodesk	ADSK	01/11/16	$70.10	$79.59	13.54

Moonshot

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
SolarWindow	WNDW	07/04/16	$3.08	$3.06	-22.22
Alkane Resources Ltd	ALK: AU	05/09/16	AU$ 0.305	AU$ 0.43	39.34
Mobileye US	MBLY	10/01/17	$39.86	£39.86	0

For the full portfolio including live prices, please visit the *Frontier Tech Investor* subscriber area. **You can view that by following this link.**