



# CB DIGEST FOR TECHNOLOGY

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Every week CB DIGEST scours many of newspapers, magazines, and websites, searching for the most intriguing tech stories and the most thoughtful things – left, right, and in-between. The CT DIGEST also reports on what the smartest people are saying about the world.

**CHAMBIZ** 

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### **Asana said to plan direct listing**

Project management software unicorn Asana is reportedly expected to go public via a direct listing next year, which would make it the latest prominent technology company to favor that approach over a traditional IPO. The San Francisco-based company, led by Facebook co-founder Dustin Moskovitz, may also raise money with a private share

**HawkFish is a secretive tech startup helping Mike Bloomberg powering his 2020 presidential bid.** A technology startup called Hawkfish, founded by Mike Bloomberg along with former executives from Facebook and Foursquare, is helping Bloomberg in his 2020 presidential bid. According to a [report](#) from CNBC, the startup started working on races in Virginia and Kentucky, soon after Hawkfish incorporated in the spring. Hawkfish will be the “primary digital agency and technology services provider for the campaign,” Julie Wood, a Bloomberg campaign spokeswoman, told CNBC. She added that the firm “is now providing digital ad services, including content creation, ad placement and analytics” for their campaign.

**Boeing fires embattled CEO Dennis Muilenburg after series of missteps.** Boeing CEO Dennis Muilenburg has been fired, the company announced Monday morning. David Calhoun was named new CEO. The Muilenburg’s ousting announcement comes after series of missteps by the company in wake of 737 Max crisis and over the Boeing Starliner’s failed mission to the International Space Station. CFO Greg Smith will serve as interim CEO until Calhoun takes on the role on January 13, according to the [news release](#). With the “new leadership,” Boeing said in a statement, the company “will operate with a renewed commitment to full transparency, including effective and proactive communication with the FAA, other global regulators and its customers.”

### **E-Commerce Posts 18.8% Holiday Season Gain**

E-commerce sales posted another big gain this holiday shopping season as overall retail sales grew at a slower rate than a year ago. According to Mastercard, online sales rose 18.8% year-over-year from Nov. 1 through Christmas Eve, topping last year’s 18.4% growth rate even though Thanksgiving came a week later. Overall sales, excluding auto, increased 3.4% to nearly \$880 billion compared to a growth rate of 5.1% a year ago. Online spending accounted for 14.6% of the total, with gains of 17% and 10.7% in the specialty apparel and electronics categories, respectively.

“Due to a later than usual Thanksgiving holiday, we saw retailers offering omnichannel sales earlier in the season, meeting consumers’ demand for the best deals across all channels and devices,” said Steve Sadove, senior advisor for Mastercard, in a news release.

Amazon, meanwhile, reported a record-breaking holiday season as more online shoppers used its Prime service than in any previous year.

“The holiday season was challenging for retailers after Amazon expanded its free return policy to include products that were not previously eligible, giving consumers until January to return even small purchases bought on the website,” Reuters noted.

### **Online Sales Hit Record High for Holiday Season**

Online sales grew 18.8% this holiday season, a very slight increase on last year’s 18.4% growth, according to a report by Mastercard. Holiday sales overall increased 3.4%. Shoppers’ shift online is hurting brick and mortar sales. Department stores saw total sales fall by 1.8%, although they saw a 6.9% jump in online sales. That could be a bright spot for department stores working on boosting their presence in the ecommerce market. Certain categories are seeing particularly strong growth online. Apparel sales, for instance, grew 1% but ecommerce sales of apparel grew 17%. Electronic sales online grew 10.7%. The figures covered the period Nov. 1 through Dec. 24. Mastercard’s report came out a day after Amazon reported a strong holiday season.

### **New Patent Shows Microsoft's Plans for Cortana**

Microsoft's Cortana hasn't been a hit with digital assistant users, but a new patent suggests that a potential new feature could help Office users keep up with emails, texts, and workplace chat conversations, reported GeekWire. The new AI feature would allow Cortana to sift through large amounts of data and relay only the most important information to users. The patent shows how Cortana still has a role to play at Microsoft even though the software giant has not aggressively promoted the technology in recent years. It also underscores Microsoft's broad strategy for using AI as a type of seasoning to make its existing products more useful. Cortana could give Microsoft a leg up on workplace chat competitors like Slack, while also drawing more customers into the Office suite of apps. If that happens, Microsoft's decision to sit out the digital assistant wars in favor of applying AI to specific business challenges will look like a smart one.

### **Tesla Starts Delivering Cars From Shanghai Factory**

Tesla delivered its first China-made cars to 15 of its employees at a ceremony on Monday, Reuters reported. The cars made at Tesla's new factory in Shanghai are about 20% cheaper than imported models, Reuters said. Tesla's China general manager said the factory, which was up and running in just 357 days, has reached a production target of 1,000 units a week, according to Reuters. The company wants to begin delivering cars to customers before the Lunar New Year holiday, which begins Jan. 25, it said.

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### **Maxim to demo wireless automotive BMS at CES**

The solution is aimed at addressing the increasing trend toward vehicle electrification and the management of the lithium-ion battery packs that power them. Filled with hundreds or even thousands of individual battery cells, the battery packs require precise management of the voltages and temperatures of these battery cells for safe, efficient, and long-lasting operation, says the company.

*A wireless BMS solution provides many benefits:*

- *Reduces weight by reducing wires and connectors*
- *Reduces cost by eliminating inter-module isolation components*
- *Reduces manufacturing complexity and manufacturing time*
- *Increases flexibility of pack shape*

The CES demo will compare a wired and wireless BMS solution based on an ISM-band radio. The wireless architecture features an RF gateway client that acts as a central controller that communicates with all secondary nodes.

### **Bosch Infotainment Adopts Stripped-Down Address Tech**

Its in-car navigation is scheduled for introduction into Bosch's infotainment system offering in 2020. The system is built on global addressing that has divided the world into a grid of three-meter squares and assigned each a unique three-word address made of three dictionary words. Thus, ///fortune.resist.brawn, for example, will take a driver to the exact entrance of the Bosch Car Multimedia head office in Hildesheim, Germany. When a driver enters a three-word address by voice or text into the infotainment system, the what3words technology converts it to a GPS coordinate, which the car then routes to its navigation system.

The company claims that not only is the system accurate to within three-meters anywhere in the world, it could help to reduce driver distraction thanks to simple verbal instructions to the infotainment hardware. Naturally, the system will rely on a much wider uptake of what3words's global address book by both organizations and individuals to make real inroads into existing traditional addresses.

### **Apple Renews License With Chipmaker Imagination Technologies**

Apple has renewed a multi-year licensing agreement with Imagination Technologies that will give the U.S. consumer electronics giant access to the graphics chipmaker's intellectual property, Imagination said in a statement. The licensing agreement is a surprise given Apple had told Imagination in 2017 that it was moving development of graphics chips in-house and would eventually stop paying licensing fees. Apple hired dozens of employees away from Imagination as part of that effort, according to media reports in 2016. The announcement suggests Apple has struggled to design a graphics chip without infringing on Imagination's patents. It also could be the result of a confidential settlement between the two companies (Imagination's CEO at the time said the company would dispute Apple's claim, though it isn't clear whether a lawsuit was ever filed).

### **Google Health Reports AI Improvement in Breast Cancer Screening**

Google Health software engineers said they had come up with an AI system that was "capable of surpassing human experts in breast cancer predictions."

The software engineers, writing in a report in Nature published on Wednesday, noted that the interpretation of mammograms was affected by a high rate of false positives and false negatives. Its AI system had shown a 5.7% reduction in false positives in the U.S. and 9.4% reduction in false negatives, although the improvement was less in the UK part of the study. It added that results "paves the way for clinical trials to improve the accuracy and efficiency of breast cancer screening."

A report in the Wall Street Journal, which earlier reported on the Nature article, said the AI was trained with "thousands of mammograms" from women in the UK and the U.S. The Journal report said doctors did better than the machines in some cases.

### **5G market in APAC to reach \$125 bn by 2025: Frost & Sullivan**

The 5G market is estimated to be worth \$124.8 billion by 2025 in the Asia Pacific region, according to global research firm, Frost & Sullivan. The technology could provide operators the opportunity to offer new services to enterprises and consumers, the report titled 5G in Asia-Pacific forecast to 2025.

### **Top 10 Technologies of The Next Decade**

According to predictions from over 800 experts and executives surveyed by the World Economic Forum (WEF), the following technologies are going to define the next decade and revolutionize our world.

1. AI
2. IoT
3. Blockchain
4. 3D Print
5. Mobile
6. Autonomous Cars
7. Mobile Internet
8. Robotics
9. VR/AR
10. Wireless Power
11. Quantum Computing
12. 5G
13. Voice Assistant
14. Cybersecurity
15. Cloud

**Rivian raises \$1.3 billion in funding led by Amazon, others, for its electric utility and adventure vehicles.** Amazon among investors again as electric vehicle maker [Rivian](#) raises another \$1.3 billion. Back in February, we wrote about Rivian when Amazon led \$700 million investment in electric truck startup Rivian. With millions of gas guzzlers on the roads, Rivian believes it can reduce the Carbon dioxide emissions into the atmosphere, lower the carbon footprint and also make money doing good. Rivian wants to turn adventure vehicles—typically gas guzzlers—into fully electric cars. Late last year, the Plymouth, Michigan-based Rivian emerged from stealth mode with half a billion dollars in funding.

**Mark Cuban quietly offered to invest \$1 million in Backstage Capital after learning the founder was having trouble raising more funding.** Earlier this month, [Mark Cuban quietly offered to invest \\$1 million in Backstage Capital](#), a venture capital fund that invests in new companies led by underrepresented founders in the U.S., after learning the founder was having trouble raising more funding. Backstage Capital's founder, Arlan Hamilton, was homeless when she founded Backstage Capital in 2005 for underrepresented and overlooked entrepreneurs and startup founders. Today, less than 10% of all venture capital deals go to women, People of Color, and LGBTQ founders—exclusively funds women, people of color, and LGBT founders. In a [tweet](#) earlier today (Dec 23), Arlan Hamilton said this on Twitter: “Thank you Mark Cuban (@mcuban). This year, after learning that I was having trouble raising more funding, he quietly offered me \$1 million to invest how I see fit. He also met w/@Backstage\_Cap founders, remembered my mom’s name, & did a vid drop for my brother’s Dallas media co.”

**Fantasy sports startup DraftKings to go public at \$3.3 billion valuation.** [DraftKings](#), a Boston, Massachusetts-based fantasy sports startup that provides online daily and weekly fantasy sports contests for cash prizes in major sports, announced today it'll go public next year in a deal that values the company at \$3.3 billion. Founded in 2011 by Jason Robins, Matt Kalish, and Paul Liberman, DraftKings provides online daily and weekly fantasy sports contests for cash prizes in major sports in the United States and Canada. It offers daily leagues for fantasy football, baseball, basketball, hockey, golf, college football, and college basketball.

**Irish startup Aylien raises \$5.54 million for its AI-powered risk intelligence and financial analytics platform.** [Aylien](#), the Dublin, Ireland-based Aylien announced it has closed \$5.54 million (€5 million) Series A funding round to accelerate growth and expansion into the risk intelligence market, as well as the development of a new revenue channel and product line via a user-facing application. The round was led by Finch Capital, with participation from existing investors, Atlantic Bridge University Fund, SOSV, and Enterprise Ireland. In conjunction with the funding. Founded in 2010 by Parsa Ghaffari, Aylien is an AI-powered news intelligence platform that combs through millions of daily events and digests the world's news content while identifying and tracking what matters to business with human-level accuracy. Its solution is currently being used by tech giants including Microsoft and Moody's.

**Jenzy Jenzy, a female-founded e-commerce app closed \$1.25 million seed round.** Children's shoe app startup [Jenzy](#) has just raised \$1.25 seed fund to accelerate growth. The round was led by Morgan Stanley's Multicultural Innovation Lab (MCIL) and supported by angel investors around the US. The Philadelphia, PA-based Jenzy, which is on a mission to make kid shoe shopping as easy as 1, 2, 3, provides an easy and efficient solution for parents to size and purchase children's shoes. Users can take a photo of their child's foot to calculate measurements, then Jenzy will recommend the best brands and styles for the child, as well as provide personalized size recommendations based on brands.

**ProdPerfect Raises \$13 million in Series A funding to improve its operations.** [ProdPerfect](#), a San Francisco, CA-based tech startup that provides autonomous end-to-end application testing, has raised \$13 million in Series A funding to further maximize its impact on application quality, deployment speed, and developer productivity for technology

leaders. The round was led by Anthos Capital with participation from Fika Ventures, Eniac Ventures, Entrepreneurs Roundtable Accelerator, and Acrew Capital. Founded by CEO Dan Widing, ProdPerfect, which has over 50 customers, provides an E2E testing platform based on data-driven, machine-led analysis of anonymous live user traffic.

**Trifo unveils Lucy, a robot vacuum; also raises \$15 million.** Trifo, a full stack AI home robot startup, today announced the launch of Lucy, a smart home superhero, outfitted with an AI-powered brain that enables the robot to protect its home with advanced surveillance technology and also clean the home with one of the most powerful vacuums available. Trifo also announced Series B funding of \$15 million, raising total funding of \$26 million to date. Founded in 2016 and headquartered in Santa Clara, California, Trifo is a full stack AI home robot company. Focusing on indoor home environments, Trifo creates end-to-end integrated hardware/software systems with sensing, perception and decision-making capabilities. These robots help people live better lives by perceiving physics, geometry and semantics of home environments, communicating with humans in a natural way and continuously learning new skills with advanced AI technologies.

### **Snap Acquires Startup Behind Animated Selfie Feature**

Snap, the parent company of Snapchat, has acquired AI Factory, a Ukrainian startup that powers a new animated selfie feature in the Snapchat app. A Snap spokesperson confirmed the deal, which the Ukrainian news outlet AIN first reported. AI Factory was founded by Victor Shaburov, who sold his previous company, Lookstery, to Snap in 2015. That acquisition led to Snapchat's augmented reality filters, including a recent face-aging one that became so popular it contributed to quarterly user growth last year. Snap already uses AI Factory's technology for a recently-introduced feature called Cameos, which lets users replace faces in videos and goofy animations with their own selfies. While a spokesperson declined to disclose the price Snap paid for AI Factory, the deal was valued at \$166 million, according to AIN. Snap, which has yet to turn a profit, recently raised around \$1 billion in debt to help fund its operations and make acquisitions.

### **Uber Completes Acquisition of Careem**

Uber's \$3.1 acquisition of Careem, its Middle Eastern ride-hailing rival, closed on Thursday, the company said. The acquisition includes Careem's delivery and payments business as well as its ride hailing operations. Careem will continue to operate under its existing brand and co-founder and CEO Mudassir Sheikha will remain in his position. He'll report to a board made up of three representatives from Uber and two from Careem. The announcement was expected after Egypt's regulators approved the deal four days ago. However, authorities in Pakistan, Qatar and Morocco have not yet approved the deal and it won't close in those countries until they do. The deal should boost Uber's revenue, and allow it to save money on marketing and driver incentives. How much it helps Uber become profitable remains to be seen.

### **BlueConic scores \$13M Series B to accelerate growth of its customer data platform and expand global footprint**

The global customer data platform (CDP) market was valued at an estimated \$1B in 2019. The market is anticipated to grow with a healthy growth rate of more than 29.5% over the forecast period 2019-2025. Spending on CDPs is projected to be in the multi-billion dollars in the next 3 years according to several analyst firms, including the CDP Institute and International Data Corp. One of the leading companies in this space is BlueConic, a Boston, MA-based customer data platform startup that liberates marketers' first-party data from all the disparate systems in which it exists, and makes it accessible wherever and whenever it is required from marketing. BlueConic's platform is used by over 300 consumer and B2B brands, including Hearst Newspapers, Moen, T-Mobile, ING, America's Test Kitchen, and Franklin Sports, leverage BlueConic to unify their first-party customer data into persistent, person-level profiles, and then activate it across their marketing ecosystem.

BlueConic announced it has \$13 million Series B to meet increasing marketers' demand for first-party data liberation and expand its global footprint. The round, which brings BlueConic's total funding to \$25M to date, was led by new investor Spring Lake Equity Partners with contributions from existing investor Sigma Prime Ventures, as well as angel investors.

By Kevin Dugan

Tech companies lately have been hoarding cash, at least in part to arm them for potential acquisitions, according to Bob Blee, head of corporate finance at Silicon Valley Bank. At the same time, venture capital firms have plenty of dry powder, which gives them plenty of weaponry for investments.

In a wide-ranging interview about the state of finance in the tech market, Blee said that companies were conserving cash partly in response to a range of economic uncertainties, including the trade war with China, the direction of interest rates, and the election.

“I’ve had a lot more conversations where people are planning for the potential for gathering clouds,” Blee said. Then there is the chance to do deals. “I think a lot of folks are looking for a dip in price so they can come in and make some acquisitions.”

Blee has a unique vantage point from which to observe the tech industry. SVB banks about half of all venture-backed companies overall, including about 80% of the tech companies that went public in 2019, he said. Aside from lending to the companies and VC firms, it invests in startups and VC firms as a limited partner.

In the interview, he also talked about the debate among tech companies about the best way to go public. “There’s certainly a lot of will to try to find a better mousetrap than the current [initial public offering] structure,” Blee noted. Aside from direct listings, pursued so far by Slack and Spotify, he said some companies are considering another option—going public by merging with already public shell companies called special purpose acquisition companies.

Also referred to as blank check companies, these shell firms’ only purpose is to buy other companies. For tech firms looking to go public, they can be an attractive avenue because they have fewer disclosure requirements, he said. (Digital sports firm DraftKings said on Monday it would go public by merging with a SPAC called Diamond Eagle Acquisition Corp.)

Blee started at the bank, which is part of SVB Financial Group, 16 years ago, and now lends to and advises companies with \$75 million to \$10 billion in revenue. His group guides companies on going public, restructuring debt, and bringing on directors and board members. Previously, he headed banking for seed, early, and midstage companies in Southern California, as well as the bank’s Midwest group. Blee talked with The Information at his office in New York City in November. The following interview has been edited for length.

### **Can you give me an overview of Silicon Valley Bank?**

Silicon Valley Bank has been around for 35 years. We start with companies when they’re startups, two people in a garage, and before they get institutional funding—the wide end of the funnel—and try to keep them forever. So we do dramatically different things for companies depending on their stage, but in the end, the way we make money is we lend money, we take deposits, we make investments, and then we have core fee income, just like any other bank.

Right now it seems, starting in Q3, I’ve had a lot more conversations where people are planning for the potential for gathering clouds. On the [convertible debt] side, I think in August and September, was maybe the biggest two months ever [for tech companies.]...There’s an element of planning, where next year’s an election year, and who knows how everything is going to play out from a trade war standpoint. Interest rates. So people are building their cash reserves.

There's also an element of planning for acquisitions, and I have seen an increase in M&A activity in interest in making acquisitions in the last quarter. I think a lot of folks are looking for a dip in price so they can come in and make some acquisitions.

### **Where are you seeing the most interest in M&A activity? Consumer internet? Delivery?**

It would be the logical places. At first it was ad tech, then it was consumer, maybe it still is consumer. There's a lot of interest in [artificial intelligence–]related stuff. A lot of that's around talent. Some of it's around science. You're right about delivery. Any of these sectors or subsectors attract a lot of capital. But it seems intuitive that all the players aren't going to survive.

On the enterprise side, it feels more stable. Still, in all, there's increased activity there too around anticipating acquisitions.

### **Do you think we'll see a wave of consolidation?**

We're seeing the activity. It's not just conversations. We're actually seeing an increase of activity now. And these are the deals that will close, some of them before year-end. And some [of it] is anticipatory for a potential deal next year.

When there was a dip in '15, '16, when there was a market correction—and that's when you saw the crossover market investors pull out a little bit at that point in time—we saw a significant increase in acquisitions of our public clients. Because their valuations corrected more quickly, their boards recalibrated to the value, and there were quite a few more that were sold than we typically see. So we may see that again if there's a dip.

### **When you say a dip, do you mean a public market dip, an economic dip, or is it something specific to VC funding?**

I'm thinking about the price dip on some public equities. When it comes to the VC investing, there's a lag. It takes six months for the prices that happen in the public markets to really translate to the private markets. So I think more immediately you'll see it in the public markets. There definitely is a shadow, though. What happens in the public markets certainly gets reflected in the private.

### **What accounts for that lag?**

Founders generally don't want to calibrate to a lower value. So what happens is, term sheets come in at a lower value, it takes longer to close a deal, so it takes longer for a deal to happen. So that's what pushes it out. It does happen.

### **Are megafunds going to have to pull back on the amount of money they're giving to companies?**

Last year, there were either eight or nine new megafunds, billion-plus new funds, [that] were raised. This year I think it's three, year to date. So you see a little bit of slowing with that.

We've still got more dry powder than perhaps we've ever seen. This year's going to be another record year on total venture funds deployed. That's what we're seeing. That includes venture as well as the crossover funds. You add it all up together. But that should exceed last year, which was a record.

### **What do companies need to do to get ready for going public?**

Certainly they have to work on their controls, they have to build out their staffing, and they have to build out their board. They'll typically want to build out an audit chair that can take them public, be with them and advise them. The other thing is just getting their unit economics straight and make sure [that] it's a good story, it's a durable story, that they're measuring things in ways that will not just show the essence of the business but resonate with the street. Those things are new muscles.

**What controls?**

There's a whole range of requirements that the [Securities and Exchange Commission] has laid out for companies that want to go public. It's Sarbanes-Oxley compliance and other facets to your financial system. Most startups just aren't highly focused on that, because they're focused on growing and hiring staff and where do we spend our marketing dollars? They typically don't overinvest in their finance team either, until they really need to, which is in that prepublic phase. So what they'll typically do is bring in staff that's been through it before and can help drive that process—bring in auditors, lawyers. So the controls are put in place and the SEC needs to see that, along with risk factors and other things, and then they get the green light to go public. But not until that point.

**Some companies are looking for alternatives to direct listings, where they can raise primary shares. Are you aware of the discussions with the SEC about this?**

There's certainly a lot of will to try to find a better mousetrap than the current IPO structure. Direct listings is definitely a hot topic at the moment. I think it's not likely to replace IPOs, but it is likely to increase in popularity.

Certainly, there are many people that are trying to figure that out. You do have to solve the funding component. There are a number of people, including some folks who are talking to the SEC, saying "How do we solve that funding component, what would that need to look like, what would be rules around that?" and then there are other people, saying maybe SPACS are an avenue for some portion of these companies.

With a SPAC you still have a public component, though.

You still have a public component, but since it's a shell, you don't have all this disclosure because you haven't identified your operating company yet. So it's another way to get there.

I do believe there's going to be innovation...with the SEC, because certainly I think the government wants it too. We've seen a dramatic decrease in the total number of equity issuers in the world. Every year for the last several years, we've had more unicorns at the end than at the beginning. They're being created at an almost five-time clip going public, so something's got to give.

**Are you saying more and more companies don't want to go through the trouble of going public?**

The process is disruptive. They're trying to build a business. They're trying to really focus on everything they need to do that. There are great benefits to being public, including the marketing event, including what it does to attract and retain talent. So there [are] motivations to do it. [But] you've got quarterly earnings and you have that shorter time horizon you have to calibrate to. So that's painful for some. Given the option to do that or not, you've seen obviously many who are choosing not to.

By Alex Heath

Five to 10 years. That's how long Michael Abrash, chief scientist at Facebook, predicts it will take before augmented reality glasses—which will display digital images and data on wearable devices that people view through—is ready for the masses.

Abrash leads Facebook Reality Labs, a Redmond, Washington–based research group that includes teams of academics and engineers working on new generations of consumer hardware devices, including virtual reality and AR products. His cautious timeline for AR eyewear reflects a series of technical breakthroughs in everything from batteries to user interfaces that will need to happen before large numbers of people are willing to wear computers on their faces.

Abrash has a lot of credibility in programming circles. He worked on early versions of the Windows operating system and Xbox game console at Microsoft, and he helped create the seminal video game Quake at id Software in the 1990s. He came to Facebook after it paid about \$2 billion to acquire Oculus VR, the VR startup he joined less than a week before the 2014 deal.

The following has been edited for length and clarity.

***For AR glasses, there are some key technical hurdles that everyone is waiting to overcome. What needs to happen before this technology can be wearable?***

For AR, you really do need to have all the core pieces or else what you have isn't what I would call AR. What caused mobile to really start that ramp to the point where it's dominant? You had PDAs, you had BlackBerries, but those weren't that thing.

Unless you can have a display that meets the weight limits for something you can wear all day, meets the form factor requirements, most importantly meets the thermals, because you can only dissipate so much heat out of a glasses-like structure on your head, and gives you see-through quality that is comparable to normal glasses...because even when AR is something that everybody uses, 99% of the photons that hit your eyes or your retinas are actually still going to come from the real world.

Then you need to be able to have truly world-blocked images [digital objects that appear to interact with the real world], which means your tracking has to be very good under all circumstances—which means you're out in a parking lot [and] it still has to work. That's quite a challenge.

Rather than just being a tracking system, it can start to become a system that understands your context. It can...help you be aware of things. When you want to ask a question—"What is that thing?"—you have to be able to identify what that thing is to the machine learning to be able to answer the question.

For the first time there will be this device that can have an egocentric view, meaning it sees what you see. I'll throw in audio, which also has to happen the same way video [does]. People tend to kind of dismiss it, but interestingly, one of the things audio can do is use microphone arrays to do beamforming to preferentially give you signal from certain areas.

Unlike hearing aids, which just amplify things, [AR audio] can actually pick out the meaningful signal for you. That by itself would be hugely beneficial to 30% of everybody who is hearing impaired. But even for people who aren't hearing impaired, if you're in a bar or a restaurant, all of a sudden you can just hear better.

**Now we come to what I consider to be actually the hardest part. Let's say we just made these magnificent glasses. How do you control them in a way that works with everything you do in your life?**

There is no way that the way we're going to interact with AR is going to be the way that we interact with our devices today. You're not going to take out your phone every time you want to do something. You're not going to use a keyboard and mouse. You're not going to just use your hands. What that interface is going to be, is multimodal. It will involve hands. I've talked about how we're also working on haptic gloves.

In the long run, what you really want is your interface to work the way that your brain works with your perceptions now. Rather than you having to say, "OK, I want to hear this person," imagine that when you're in a noisy environment, your glasses detect that it's noisy, they infer who are the people you're talking to, and they pick that signal out. You don't even know that it's happened any more than I think about the fact that my glasses gather light rays in a way that lets me see better.

**You just listed a ton of different, major technical challenges. Can Facebook solve all of that by itself?**

No. This [technology] is the wave of the future. It's going to really take a whole community, a whole society to solve all these [issues].

We are doing a bunch of academic collaborations. We're working with a ton of partners. What I fully expect is that this will be just like personal computers where there's no one company that does everything and keeps it to themselves, because that won't be powerful enough.

My goal in research is very specifically to build that substrate, that technology that enables the creativity of a million people to then jump in. I do not think about, ultimately, what this product is going to be and how it will target specific people or anything like that.

**Is your AR glasses research moving into the product development phase?**

A lot of it's in research. A lot of it is in product. It's hard to draw the line because so much of it is incubation at this point. All these things are coming together into what is really one of the most remarkably challenging and complex projects I have ever seen. It touches so many different areas.

**How unique is what you're doing versus the competition?**

On the VR side, I think it is very unique. No company has invested at anywhere near the level we have. When the next generation of VR shows up, it will be because we did it. I see no other way it'll happen.

I actually am remarkably impressed with [Facebook CEO Mark Zuckerberg] and Facebook's strong commitment to and belief in VR. Everybody sees that AR will replace the phone someday. That seems like a given. But I think that VR will be as important as AR. AR can replace the phone, but VR can replace the personal computer.

When you put on a VR headset, all of a sudden you have completely configurable environments that you can swap or anybody can pop in, pop out. I very much believe in VR as a collaborative workspace. I actually think it will be a better workspace than reality, ultimately.

**What's your timeline for AR glasses being consumer ready?**

The question is, what's the definition of AR glasses? You could look at Focals by North. If you thought those were AR glasses, you can say, "Well, we have them."

Something that doesn't just appeal to the very early adopter, developer-enthusiast crowd.

***A way you might frame it is to say, "When do we get to iPhone 1 of AR?"***

Or the BlackBerry.

Those are interesting distinctions because BlackBerry had so much more limited of an audience. I think within 10 years we will be at that point. I would be very surprised if we were at that point in five years.

Really? Apple's glasses are maybe three-ish years away. They might delay it, but that's their current timeline.

The question is, what glasses will be out there? My point is not that nothing will get out there. It's really what gets us to the BlackBerry point where you would have your glasses with you right now. Not a billion people, but you would because you're an information professional. That is a high bar.

You can talk about metrics like resolution and weight and all that. The only metric that matters is—are people using it by choice? The day that we're sitting here and we have this conversation and you're wearing AR glasses, then I will say that the answer is, "Yes, we are there."

***So at least five years?***

My personal opinion is five years. I could be wrong, because I also have a very high bar for what functionality is necessary to get to that point. I'm informed regularly that I set the bar very high. I actually think that's great. I should be the person out on the end pulling in that direction.

I don't think that there are problems here that are not solvable within ten years. I'm not talking about Facebook. I'm just talking about the industry as a whole. This is my interpretation of the trends.

***You feel it's inevitable that we get to a point where AR glasses at least augment phones greatly and then potentially one day replace them?***

Remember how Microsoft invested \$150 million in Apple preferred stock 22 years ago to keep Apple from going bankrupt? Seems a little amusing now that Apple is the most valuable company in the world. And there's only one thing that changed. It's that Apple nailed that platform shift.

So clearly that platform shift would—if we could build the glasses that I've talked about—displace the phone. It just would. Under those circumstances, it's hard to see how that doesn't happen. It's really the future. It's how we interact with technology.

**German sports car manufacturer will test out TriEye's advanced camera technology to help improve driving in poor weather conditions** By Shoshanna Solomon



Illustration of a Porsche car equipped with a TriEye SWIR camera (Dr Ing.h.c.F Porsche AG)

Israeli startup TriEye ([\\*Chambiz DF 10 Aug 19](#)), a developer of short-wave infrared (SWIR) sensing chips that enable drivers to see in adverse road conditions, said Thursday it will collaborate with German sports car manufacturer Porsche to test out and improve the performance of some of its products.

TriEye, which in August received an investment from Porsche in a Series A funding round, said the two firms will collaborate to improve the performance of its advanced driver assistance systems (ADAS) and autonomous vehicles (AV) products.

“The fact that Porsche, a leading car manufacturer, has decided to invest in TriEye and evaluate TriEye’s CMOS-based SWIR camera to help further improve advanced driver assistance systems is a significant vote of confidence in our technology,” said Avi Bakal, CEO and co-founder of TriEye.

The Israeli company has developed a high-definition SWIR camera that is smaller in size, has a higher resolution and costs a fraction of the price of current technologies, the company says. TriEye has also already proven that the technology works and can be mass-produced.

Once integrated, the camera allows ADAS technology and AVs to achieve high-resolution vision capabilities under common adverse weather and low-light conditions such as fog, dust, rain, and night, according to the firm.

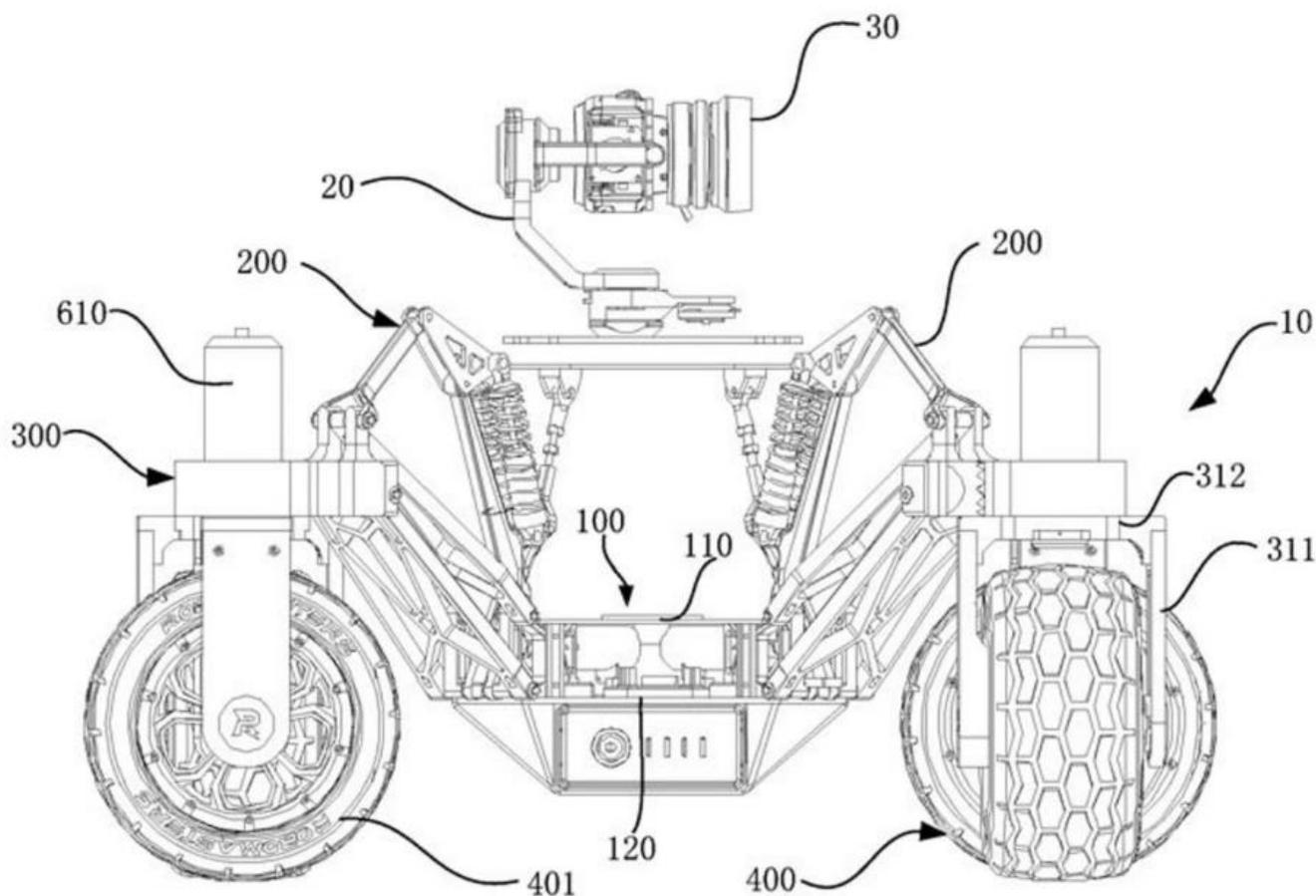
As ADAS systems are expected to operate under a wide range of scenarios, car manufacturers have recognized the need to integrate advanced sensing solutions. Even when combining several sensing solutions such as radar, lidar and standard cameras, it is not always possible to accurately detect and identify all objects on the road when visibility is limited.

To address this particular challenge, Porsche will test out TriEye’s CMOS-based SWIR camera in its cars to enable drivers to achieve better visibility capabilities, especially in adverse weather conditions, the Israeli firm said in a statement.

In August the firm said that it expanded its Series A funding round led by Intel Capital, with the participation of Porsche Ventures, Marius Nacht and existing investor Grove Ventures.

TriEye was founded by Bakal, Omer Kapach and Prof. Uriel Levy after years of advanced nanophotonics research by Levy at the Hebrew University in Jerusalem.

Devin Coldwey



DJI is easily the leading brand when it comes to camera drones, but few companies have even attempted a ground-based mobile camera platform. The company may be moving in that direction, though, if this patent for a small off-road vehicle with a stabilized camera is any indication.

The Chinese patent, first noted by DroneDJ, shows a rather serious-looking vehicle platform with chunky tires and a stabilized camera gimbal. As you can see in the image above, the camera mount is protected against shock by springs and pneumatics, which would no doubt react actively to sudden movements.

The image is no simple sketch like those you sometimes see of notional products and “just in case” patents — this looks like a fleshed-out mechanical drawing of a real device. Of course, that doesn’t mean it’s coming to market at all, let alone any time soon. But it does suggest that DJI’s engineers have dedicated real time and effort to making this thing a reality.

Why have a “drone” on the ground when there are perfectly good ones for the air? Battery life, for one. Drones can only be airborne for a short time, even less when they’re carrying decent cameras and lenses. A ground-based drone could operate for far longer — though naturally from a rather lower vantage.

Perhaps more importantly, however, a wheeled drone makes sense in places where an aerial one doesn't. Do you really want to fly a drone through narrow hallways in security sweeps, or in your own home? And what about areas where you might encounter people? It would be better not to have to land and take off constantly for safety's sake.

It's likely that DJI has done its homework and knows that there are plenty of niches to which they could extend if they diversified their offerings a bit. And like so many situations where drones have become commonplace, we'll all think of these robot-powered industries as obvious in retrospect. For instance, the winner of our Startup Battlefield at Disrupt Berlin, Scaled Robotics, which does painstaking automated inspections of construction sites.

In fact DJI already makes a ground-based robotic platform, the RoboMaster S1. This is more of an educational toy, but may have served as a test bed for technologies the company hopes to apply elsewhere.

Whether this little vehicle ever sees the light of day or not, it does make one think seriously about the possibility of a wheeled camera platform doing serious work around the home or office.

2019 has been a dramatic year for tech companies across the board—and perhaps nowhere more than in the executive ranks, which have seen their biggest shake-ups in years.

### Out:

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#### **Jony Ive**

Jony Ive was the single most influential person in the company when it came to the look and feel of Apple's products. A British-born designer who joined Apple in 1992, he saw his role expand after Steve Jobs returned in 1997. Over the past two decades he played a key role in designing the iPhone, iPad, and Apple Watch. Ive famously believed strongly in the centrality of design in building products. His importance only grew after Jobs died in 2011.

But as his power expanded, criticisms emerged that the user experience of Apple products had taken a backseat to industrial design. Critics cited the disastrous MacBook keyboard and redesign of iOS 7.0 as examples. Some have said Ive's approach to design emphasized minimalism and a cold, European style and wasn't as warm or humanistic as in the Jobs era. With Ive gone, all eyes will be on the company to see whether it can continue to match the success of its earlier years.

#### **Larry Page**

Larry Page's departure as Alphabet CEO signaled the end of an era. He and Sergey Brin co-founded Google in the late 1990s while graduate students at Stanford University. Page served as the company's first CEO, but stepped aside in 2001 to allow a more experienced executive, Eric Schmidt, to take the lead. In 2011, Page decided to take back the reins. In 2015, he reorganized Google by creating a holding company called Alphabet to house both the main business and an array of other ventures meant to operate as independent entities. Page became Alphabet's CEO and Sundar Pichai, a former product boss, became Google's CEO.

While Page remains a controlling shareholder, along with Brin, he is likely to take more of a back seat now in day-to-day management of Alphabet. That could mean a cutback in Alphabet's "other bet" investments in ventures that range from a self-driving car division (Waymo) to an anti-aging research unit (Calico). Page's departure likely came as a blow to employees at the company who hoped the co-founder would revitalize its storied culture of open debate and transparency. Over the past year, Google clamped down on the internal information employees can access and barred any conversation outside of business and product talk in its all-hands meetings—a far cry from the company's early days.

#### **Steve Burke**

Steve Burke of NBCUniversal announced this week that he would step down as CEO effective Jan. 1 and retire completely from NBCU next August when his contract expires. His departure comes at a time when NBCU is going through one of the greatest transitions in its business—the shift into streaming. NBCU launches its streaming service, Peacock, this spring.

Burke has run NBCUniversal since 2011 when Comcast acquired it. Previously he was a top executive at Comcast from 1998. At NBCUniversal, Burke helped to right the ship at the then-flailing broadcast network, improving its audience rankings. But as ratings declined across all television, NBCUniversal, with its large collection of cable channels, struggled. He focused some efforts on building up the company's connections to the tech and digital media industries, investing around \$1 billion in Snap, BuzzFeed, and Vox. Some of those companies, like Snap, have declined in value since the investment.

### **Adam Neumann**

Adam Neumann, a co-founder of WeWork, stepped down as CEO in late September as WeWork was struggling to survive. A 40-year-old Israel-born entrepreneur who founded WeWork in 2010, Neumann built the co-working provider into a global company that raised more than \$10 billion at a valuation of tens of billions of dollars. But he also ran the company like an extended frat party, smoking pot and drinking heavily on plane rides, hiring friends and family in an assortment of roles, and expanding WeWork into an array of ventures far afield from its core mission (including a school in New York). And when the time came to go public, Neumann wasn't prepared for the scrutiny. Investors poked holes in WeWork's IPO filing, which revealed a company with enormous losses, insider dealing, and a convoluted corporate structure. Media scrutiny was unrelenting.

WeWork canceled the IPO, forcing it to scramble to raise new funds. Neumann was voted out. He left the board of directors a month later. His wife, Rebekah, who was chief brand and impact officer, also left the company, and WeWork made a point to drive out the circle of executives who were close friends with Neumann. The former CEO walked away with the ability to sell nearly \$1 billion in stock, as well as a nearly \$200 million consulting fee. WeWork, now effectively owned by SoftBank, laid off thousands and will start on a long road to salvaging itself. What's next for Neumann is unclear. This year will live on for him in the inevitable movies and books to come on the WeWork saga.

### **Angela Ahrendts**

When Apple hired Ahrendts away from luxury retailer Burberry in 2014, she was seen as a possible successor to Tim Cook. A fashion industry veteran, she rose to be CEO of Burberry after senior executive stints at Liz Claiborne and Donna Karan International. In her five years at Apple, Ahrendts oversaw the expansion of its retail stores in China and also presided over the release of the Apple Watch, which the company positioned as a luxury item. She also launched the "Today at Apple" initiative, which offered educational sessions at Apple Stores and reinvented them as town squares where people could gather, adding more open spaces and seating.

But during Ahrendts' tenure, Apple's sales in China declined for three consecutive fiscal years, while the Apple Watch didn't achieve the wild success of the iPhone or even the iPad. Apple said Ahrendts left "for new personal and professional pursuits," and she hasn't resurfaced since.

### **Chris Cox**

Chris Cox left his position as chief product officer of Facebook in March after disagreeing with Mark Zuckerberg about the future direction of the company. His departure marked the end of an era at Facebook. Cox had joined Facebook more than 14 years previously as a software engineer and became a close lieutenant to Zuckerberg. Only last year Cox's oversight was broadened to include all of the company's apps, including Instagram and WhatsApp, as well as Facebook.

He parted ways with Facebook at a time when the company was beginning to undergo controversial shifts internally, namely the process of assembling the underpinnings of its apps and a heightened push to encrypt its services. With him gone, the respective product leaders of Facebook's apps now report to Zuckerberg directly.

### **UP:**

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### **Sundar Pichai**

Sundar Pichai was promoted to be CEO of Alphabet when Larry Page stepped down. Pichai had been CEO of Alphabet's main business, Google, since 2015. He joined Google in 2004 as a product manager and made a name for himself by spearheading major initiatives like Google's web browser, Chrome. By 2014, Pichai became the head of Google's most strategic product areas, including search, maps, and ads. The following year, when Alphabet was formed, he was tapped to become Google's CEO.

The new role is significant for Pichai. Alphabet owns 13 businesses aside from Google, although that group makes up a tiny percentage of the company's overall revenue. But Pichai will have to decide whether moon-shot initiatives like internet-beaming aerial balloons and designing futuristic cities are viable businesses and deserve their current investments. Also, with the company's co-founders removed from day-to-day operations, Pichai will be the point person for some of the toughest questions Alphabet currently faces, like how aggressively it should pursue government contracts and what to do about employee protests.

### **Alex Zhu**

Alex Zhu was promoted to oversee TikTok, reporting directly to Zhang Yiming, CEO of ByteDance. The co-founder of Musical.ly, which ByteDance bought and merged into TikTok, left the company after the deal. But ByteDance brought Zhu back in late last year to help run TikTok, which became wildly popular in the U.S. and many other parts of the world. Before the promotion, Zhu reported to Zhang Nan, who oversaw multiple ByteDance products, including Chinese ones. The change in reporting line is an indication of how ByteDance is trying to operate TikTok independently from its Chinese businesses, at a time when some U.S. lawmakers are raising concerns about TikTok's Chinese ownership. Zhu, a Chinese engineer who worked at enterprise software giant SAP in the U.S. for more than four years before he created Musical.ly.

### **Thomas Kurian**

Google Cloud nabbed Thomas Kurian to succeed Diane Greene as CEO shortly after Kurian left Oracle. Kurian, who spent 22 years at Oracle in a variety of product management roles, brought a fresh set of eyes to the challenges Google Cloud is facing. His roles at Oracle involved spending countless hours meeting with large customers and listening to their needs, making him arguably just as qualified as Greene to continue building Google Cloud's relationships with these firms.

Since taking over as CEO in January, Kurian has shaken up senior sales leadership, hiring sales veterans from companies like Oracle and SAP to lead large areas of business. At Google Cloud's annual customer conference in April, he laid out a strategy that includes targeting customers in specific industry segments, such as retail, healthcare, and financial services.

### **John Stankey**

John Stankey, chief operating officer of AT&T, was promoted to the No. 2 position at the telecom giant this past fall. At the time, it was a clear sign that he was the front-runner to succeed CEO Randall Stephenson when he retires, which could be next year. Stankey has been with AT&T for more than 33 years, holding a variety of senior positions across many of its different businesses. That makes him a strong contender to ascend to the top position.

But Stankey is under pressure now to demonstrate that AT&T's \$79 billion acquisition of Time Warner will succeed. That in turn partly depends on whether the media enterprise's forthcoming streaming service, HBO Max, can become a growth sector to offset the steady declines in its core cable TV business. Stankey comes to the entertainment arena with little experience in Hollywood, which means he has been willing to break with convention at times. But the streaming market has become extremely crowded and there's no guarantee HBO Max can stand out against a field that includes Netflix, Amazon, Disney, and Apple.

### **Fidji Simo**

Fidji Simo was promoted to run Facebook's flagship app after Chris Cox left as chief product officer. An eight-year veteran of Facebook, Simo ran several product teams for the main Facebook app, including monetization and Watch, the company's attempt to take on YouTube. Before joining Facebook, the French native worked for eBay as a strategy manager for four years.

Simo has taken the reigns of the Facebook app as the company is seeking to diversify its revenue streams through commerce, Instagram ads, and nascent efforts to monetize WhatsApp and sell consumer hardware. As the only

woman who reports to CEO Zuckerberg besides Sheryl Sandberg, she brings needed diversity to Facebook's upper ranks.

### **Brett Taylor**

Brett Taylor was promoted to chief operating officer of Salesforce earlier this month. Taylor joined Salesforce in 2016 when it acquired his startup Quip, which developed office productivity applications, for \$750 million. Taylor, 40, brought an impressive resume that included stints at Google, where he co-created Google Maps, and Facebook, where as chief technology officer he developed the social network's "Like" button. Since November 2017 he had been president and chief product officer.

The latest promotion puts Taylor on track to be CEO of Salesforce someday. He is already a fixture on Salesforce's quarterly earnings calls, where CEO Marc Benioff often hands off questions from Wall Street analysts. That exposure, along with his board roles at Twitter and Axon (formerly known as Taser), could set up Taylor to one day be the public face of Salesforce.

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## *Why the 5G Rollout Will Fall Short of Expectations*

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By Christopher Stern

After years of escalating hype, the wireless industry is finally rolling out 5G. And next year, with many more 5G-capable phones expected to hit the market, the new technology should become a reality for consumers.

Yet despite promises of blazing speeds and coast-to-coast coverage, the leading mobile phone providers are on track to deliver little more than incremental improvements in service in 2020.

I predict that wireless carriers will spend the coming year pointing fingers at each other and at federal bureaucrats for the failure of 5G to live up to its high-flying promises of turbocharged mobile internet speeds.

The squabbling is poised to undermine the rollout of fifth-generation wireless technology, as potentially disappointing performance deters consumers from forking over \$1,000 or more for a 5G-capable phone.

In the lead-up to the 5G launch, AT&T, Verizon, Sprint, and T-Mobile have promoted download speeds 100 times faster than what is available on the current 4G standard.

They promised that their networks will have enough capacity and speed to compete head-to-head with cable companies for streaming video customers, while connecting millions of consumer products such as home security cameras, toys, and automobiles.

In the last few months, each of the four major mobile carriers has launched its version of 5G. As consumers begin to acquire 5G-enabled devices, they will be able to evaluate whether the hype was warranted. In the near term, it doesn't look good.

Take Verizon. It is likely to make good on its promise to launch its 5G service in 30 cities in 2019. But in most cases, 5G will only be available for the time being in a small part of each city.

In New York, Verizon's 5G launch is limited to a few sections of Manhattan and a single neighborhood in the Bronx, according to a map on the company's website. The case is similar for launches in cities including Atlanta, Detroit, and Houston, where the 5G signal is confined to a few blocks in a few neighborhoods.

And those with access to 5G might be surprised to learn that they can only receive a signal when outdoors. That's because the frequencies Verizon is using for now can't penetrate walls and only travel a few hundred yards.

Some 70% of wireless usage occurs indoors, according to Roger Entner, founder and lead analyst of Recon Analytics. Entner said mobile companies probably overpromised in the run-up to the 5G launch. "Now when people have to deliver, it's a little bit more challenging," he concluded.

Verizon eventually plans to add frequencies that will give its network broader reach, although at slower speeds while providing less bandwidth.

On the positive side, Verizon's 5G offering has the potential to be transformational. Users can download a full-length movie in three seconds—as long as they are standing outside and on one of the few blocks covered by a signal. Verizon's strategy is to highlight the differences between 4G and 5G, even if 5G availability is confined to a few areas. "It's the stuff people dream about when they talk about 5G," said Verizon spokesperson Kevin King.

AT&T is rolling out a 5G service using the same high-frequency airwaves as Verizon, but it is only available to some business customers. Consumers are being offered a much slower, less robust service that uses AT&T's low-band spectrum. Igal Elbaz, AT&T's senior vice president for wireless technology, described the increase in speed as "marginal" at a recent Morgan Stanley investor conference.

Sprint and T-Mobile also have unveiled 5G service, on different slices of the spectrum. T-Mobile, like AT&T, is using low-band frequencies for consumers that should deliver more capacity and reliability but will offer only modest improvements in speed. While speed is important, said Karri Kuoppamaki, T-Mobile's vice president for technology development and strategy, 5G is also going to deliver a more reliable signal and a higher bandwidth that will allow more consumer devices to be connected.

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*Users can download a full-length movie in three seconds —as long as they are standing outside and on one of the few blocks covered by a signal.*

Sprint, in contrast, relies on midband airwaves. These are sometimes described as "Goldilocks" frequencies because they occupy an ideal middle ground of fast speed and longer range, as well as having the ability to penetrate walls.

Those midband airwaves were a key selling point in the pending merger of Sprint and T-Mobile. In their bid for regulatory approval, the companies said the deal would create the one company in the U.S. with the ability to launch a nationwide 5G network that had both the speed and the capacity to match the hype that has been building for the last several years.

Their argument worked. Despite competition concerns, in decisions that cited 5G both the Department of Justice and the Federal Communications Commission approved the deal. A dozen states are still seeking to block the deal in a case currently playing out in federal court.

All four major carriers have said that their networks are still in the early stages. As the networks are built out, their speeds and coverage should increase.

A key to the expansion of 5G service will be increasing mobile carriers' access to the midband spectrum. For now, the satellite industry controls much of that spectrum.

The FCC is currently negotiating with the three major satellite providers—Intelsat, SES, and Telesat—to reclaim a large swath of midband spectrum, but those negotiations could take years to resolve. In the meantime, consumers are likely to get frustrated with watching movies on street corners. Wireless companies in turn are likely to blame regulators for not moving faster with the satellite operators.

Another cloud hanging over the 5G rollout is the phones themselves. As an Ars Technica story earlier this month pointed out, Android phones hitting the market with Qualcomm's new 5G chips will be power hungry, which may mean the fancier and pricier devices won't last very long before the batteries run down. That's likely to dampen early consumer enthusiasm for the new technology.

The pressure of the 5G rollout has injected a new, harsher tone into cellular company rivalries. When AT&T launched its 5GE (the E is for Evolution) signal earlier this year, which offered only incremental improvements over its current 4G service, other carriers mocked it for presenting an upgrade of the current 4G network as a move to 5G.

T-Mobile and Verizon publicly ridiculed the gambit, calling it little more than a label change for an existing service. Sprint actually filed a lawsuit against AT&T, claiming it was damaging the reputation of 5G. (Sprint didn't comment for this article.) In a news release announcing its own network launch earlier this month, T-Mobile called Verizon's launch of 5G as "made-up" and AT&T's as "fake."

AT&T referred 5G questions to recent comments by senior executives and declined further comment. AT&T officials have said the company expects to have a nationwide 5G network by mid-2020.

We can expect brand bashing among the carriers to continue as each company boosts the strengths of its own 5G while disparaging its rivals' versions. The stakes will get higher if consumers start making decisions on which company they believe actually offers the best 5G service. It might take until 2021 or later before the industry gets its 5G story straight.

By Alan Boyle

The Federal Aviation Administration [has issued proposed regulations](#) that would require virtually all drones to transmit electronic identification codes while in flight.

“Remote ID technologies will enhance safety and security by allowing the FAA, law enforcement, and federal security agencies to identify drones flying in their jurisdiction,” Transportation Secretary Elaine Chao [said today in a news release](#) about the plan.

The FAA established a registration system for recreational drones back in 2015, and since then, nearly 1.5 million drones and 160,000 remote pilots have been registered. Earlier this year, the agency [set up an automated system](#) to authorize recreational flights in controlled airspace.

The newly proposed Remote ID system would build upon those earlier steps. It calls upon drone manufacturers to make their products capable of sending out identification codes as well as their location. The rules would apply to all drones heavier than 0.55 pounds (8.8 ounces), and manufacturers would have to comply two years after the regulations go into effect. Drone operators would have three years to phase out non-complying devices. There'd be three approved modes of operation for drones:

- If the operator keeps the drone within a 400-foot radius, the Remote ID could be sent via a wireless internet connection to a monitoring service.
- Beyond that radius, the drone would have to broadcast its identifying information over a yet-to-be-specified radio frequency.
- Drones that don't have the Remote ID system installed could be operated only within special FAA-designated zones — usually the same sorts of places where hobbyists fly model airplanes.

### 3 Ways of Remotely Identifying



Plenty of details still have to be filled in: The FAA is leaving it up to the drone industry to come up with standards and frequencies, and it plans to work with contractors to develop online monitoring systems. Once the regulations are approved, probably sometime next year, all drones would have to be registered. And issues surrounding enforcement of the rules are, as usual, still up in the air.

Establishing a regulatory framework should open the way for companies to move into the Remote ID market, which some analysts say could be a \$1.25 billion business by 2029. Among the players in that market is Kittyhawk.io, which is one of the ventures in Boeing HorizonX's investment portfolio.

Such a system could also smooth the way for Amazon and other companies to move forward with far-ranging drone delivery systems under the FAA's watchful eye. During Amazon's re:MARS conference in June, Worldwide Consumer CEO Jeff Wilke said he expected the Seattle-based retailer to start drone deliveries "within months."



For the first time, researchers and scientists from the University of Bristol, in collaboration with the Technical University of Denmark (DTU), have achieved quantum teleportation between two computer chips. The team successfully developed chip-scale devices that are able to harness the applications of quantum physics by generating and manipulating single particles of light within programmable nano-scale circuits.

Unlike regular or science fiction teleportation which transfer particles from one place to another, with quantum teleportation, nothing physical is being transported. Rather, the information necessary to prepare a target system in the same quantum state as the source system is transmitted from one location to another, with the help of classical communication and previously shared quantum entanglement between the sending and receiving location.

In a feat that opens the door for quantum computers and quantum internet, the team managed to send information from one chip to another instantly without them being physically or electronically connected. Their work, published in the journal *Nature Physics*, contains a range of other quantum demonstrations. This chip-to-chip quantum teleportation was made possible by a phenomenon called quantum entanglement. The entanglement happens between two photons (two light particles) with the interaction taking place for a brief moment and the two photons sharing physical states. Quantum entanglement phenomenon is so strange that physicist Albert Einstein famously described it as ‘spooky action at a distance’.

“We were able to demonstrate a high-quality entanglement link across two chips in the lab, where photons on either chip share a single quantum state,” says Dan Llewellyn, co-author of the study. “Each chip was then fully programmed to perform a range of demonstrations which utilize the entanglement. The flagship demonstration was a two-chip teleportation experiment, whereby the individual quantum state of a particle is transmitted across the two chips after a quantum measurement is performed. This measurement utilizes the strange behavior of quantum physics, which simultaneously collapses the entanglement link and transfers the particle state to another particle already on the receiver chip.”

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Another co-author, Dr Imad Faruque, also from Bristol, added: “Based on our previous result of on-chip high quality single-photon sources, we have built an even more complex circuit containing four sources.

“All of these sources are tested and found to be nearly identical emitting nearly identical photons, which is an essential criterion for the set of experiments we had performed, such as entanglement swapping.”

By Gene Teare

In 2019, unicorns were far from mythical and Crunchbase followed them every step of the way. This year (as of Dec. 25, 2019) 142 companies joined the Crunchbase Unicorn Board.

This is less than the 2018 all time high of 158 companies, and above 2017 (102 companies), 2016 (87 companies) and 2015 (106 companies). To qualify for this distinction, venture-backed privately held companies were valued in a funding round at \$1 billion or more.

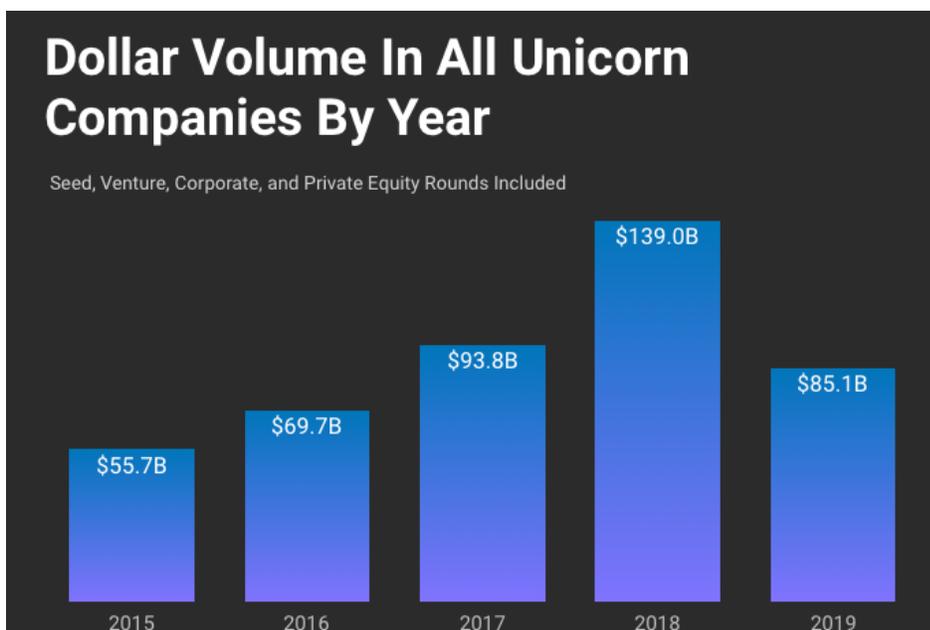
In the US, 78 new unicorns emerged in 2019, 11 more than in 2018. China unicorn creation slowed down substantially in 2019 with 22 new unicorns from a high of 58 in 2018. The next highest count of new unicorns is Germany and Brazil with five, a record for both countries. Israel, India, and the UK all report four new unicorns this year.



#### Unicorn Funding By Year

To understand 2019 through a different lens, let's switch gears from the 2019 new unicorn cohort to funding to all unicorn companies. In 2019 unicorn companies raised \$85.1 billion — down from 2018 at \$139 billion, and 2017 at \$93.8 billion.

Despite concerns about a changed venture funding market after WeWork pulled their IPO on Sept. 30 2019, funding to unicorns was up quarter over quarter by 11 percent, but the quarter was down year over year by 54 percent. It is worth noting that 2018 included two of the largest rounds ever to unicorn companies with \$14 billion invested in Ant Financial, and \$12.8 billion in Juul. However, these two rounds alone do not account for all the increased funding to unicorns in 2018. We fully expect 2019 invested dollars to increase at a greater rate than prior years as new unicorns are minted in 2020.



## 2019 Unicorn Cohort

2019 new unicorn companies collectively added \$216 billion to unicorn valuations, and \$50.5 billion in equity funding in total over time. The leading sectors for 2019 unicorns were in Financial Services, Commerce and Shopping, Data and Analytics, Transportation, SaaS, and Health Care.

The five most highly valued new unicorns include:

- Uber Advanced Technologies Group (\$7.3 billion) the autonomous vehicles subsidiary from Uber
- JD Health (\$7 billion) an e-commerce platform for pharmaceutical products
- Databricks (\$6.2 billion) unifying customer analytics
- CloudKitchens (\$5 billion) Travis Kalanick's smart kitchens for food delivery
- Rivian (\$5 billion) a sustainable automotive technology company

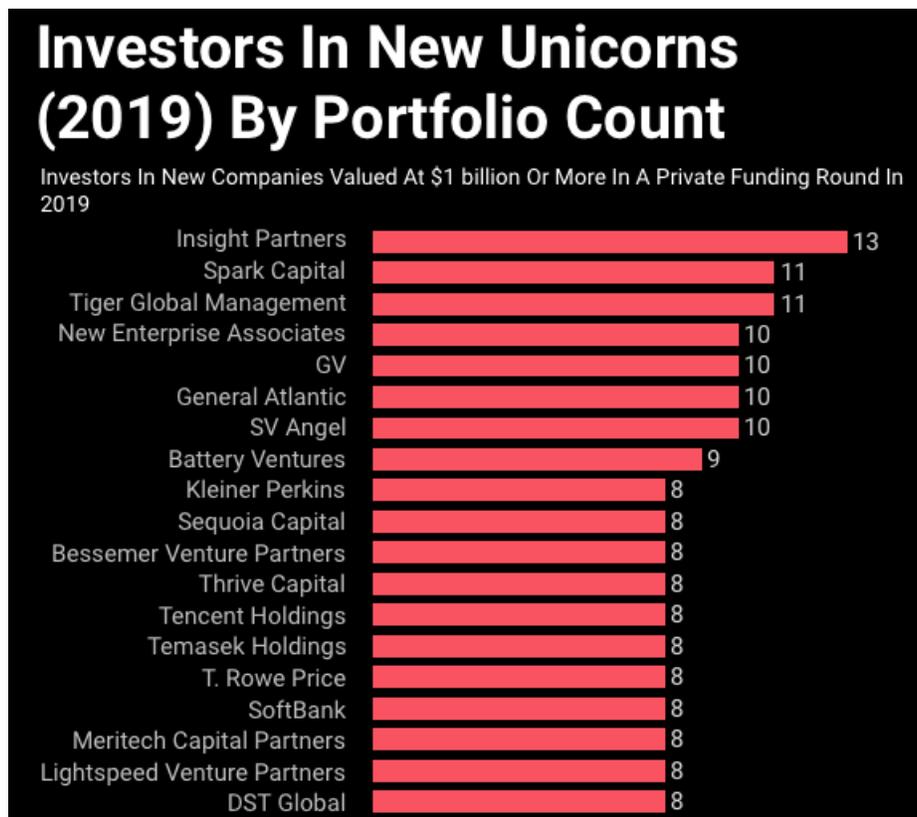
Six companies that became unicorns in 2019 and also went public in the same year, listed in order of IPO valuation, are:

- 10X Genomics (\$3.7 billion) a genomics platform
- Vir Biotechnology (\$1.7 billion) targeted at treating infectious diseases
- The RealReal (\$1.7 billion) a marketplace for luxury goods
- Bill.com (\$1.6 billion) which automates back office financial operations
- Canaan Creative (\$1.4 billion) a producer of Blockchain servers
- Health Catalyst (\$1.3 billion) to manage healthcare data

All of these companies had an increased valuation at their IPO over their last private funding round in 2019, ranging from 25 percent for Health Catalyst to 189 percent for 10X Genomics.

## Investors In The 2019 Unicorn Cohort

With \$50 billion invested in this new unicorn cohort, it is interesting to look at the investors fueling the growth of these companies. The most active investors in companies that became unicorns in 2019 by portfolio count include the following:



Insight Partners with 13 portfolio companies, Spark Capital and Tiger Global Management with 11, New Enterprise Associates, GV, General Atlantic, and SV Angel at 10. This list of investors includes a mix of early and late stage venture, corporate venture, and private equity/alternative investors all actively seeking stakes in highly valued venture backed companies.



The most active investors by deal count, which showcases investors who are in multiple rounds for companies who joined the unicorn ranks in 2019 include the following: New Enterprise Associates in 30 rounds, Insight Partners (26), Kleiner Perkins and GV (25), Accel and Spark Capital (24).

### 2019 Unicorns By Founders

While there is no shortage in funding for these high-value companies, there remains a discrepancy between the number of male and female founders that reach the coveted unicorn status. Five (4 percent) of new unicorns in 2019 had female-only founders and 16 (12 percent) were co-founded by a female-male team. Overall, 114 (84 percent) unicorns in 2019 had male-only founders.

By Mark Albertson

This article wasn't written by a robot, but it could have been. That, along with literally thousands of other uses, is why automation will be big news in 2020.

Over the course of 2019, it was nearly impossible to cover any major tech conference without discussing an innovation in robotics, artificial intelligence or a similar automation solution. Not every automated advance will be a surefire winner, but the body of evidence offers a convincing case that the field is moving rapidly and adoption will only continue to grow.

The global automation industry is expected to generate \$238 billion by 2021, with sectors such as artificial intelligence predicted to double over the three-year span.

Rapid advances in AI and machine learning have propelled automation out of the research lab and into daily lives. The chances are fairly high now that customer service requests via online query or a phone call are being handled by a chatbot.

Here are five key reasons why automation will continue to be a significant story in 2020:

### **1. Robotic process automation**

Two of the leading companies in the RPA space — UiPath Inc. and Automation Anywhere Inc. — raised a combined \$858 million in 2019 alone, bringing their total combined valuation to nearly \$14 billion. Gartner Inc. has called RPA the fastest-growing software subsegment that it tracks.

What is propelling this segment of the tech market is a realization in the enterprise world that RPA really can handle mundane tasks and free up people to focus on other areas of the business. Companies are using RPA to process invoices and generate price comparisons, but the expectation is that RPA will move inexorably into medical, pharmaceuticals, and even the public sector.

“Of the 2,800-plus customers we have, I have visited hundreds of them and talked to thousands of people on the ground who use this technology, and there's not a single one of them who would go back,” said Mihir Shukla, co-founder and chief executive officer of Automation Anywhere, during a 2019 interview with SiliconANGLE.

### **2. Artificial intelligence and machine learning**

Venture capital funding reached nearly \$10 billion in AI businesses last year, a doubling of investment from the previous period. When Microsoft Corp. surveyed senior executives, it found that 94% viewed AI as an important tool.

Is this indeed the “eternal spring” of AI, as former Google Brain leader and industry pioneer Andrew Ng speculated in an interview?

There is plenty of evidence to suggest that the field is blooming. AI-powered robots are already hard at work on manufacturing assembly lines, side-by-side with human workers. The healthcare industry is using AI to streamline drug discovery and monitor patients with virtual assistants. And 3,700 corporate earnings reports are being produced by the Associated Press per quarter without a single human reporter writing a word.

However, the focus on AI and machine learning may also shift strongly in 2020 from what the technology does to

what it shouldn't. Providing guardrails for AI was a hotly debated subject in 2019, and governments, such as the state legislature in Illinois, are becoming more active in limiting use of the technology in the workplace.

“Every product that we're building is seeking to change a behavior,” said Charna Parkey, an applied scientist at Textio Inc., during a SiliconANGLE interview in November. “If you've got unmanned aerial vehicles and you're trying to make a decision about where to drop the bomb, you need a human in the loop.”

### **3. Cybersecurity**

The cybersecurity industry is facing a basic math problem. There are too many threats and not enough people to deal with them.

A study by the largest nonprofit group in the security industry found that there was a gap of nearly 3 million cybersecurity jobs worldwide. Meanwhile, according to a report from SelfKey, at least 5.3 billion records were exposed through data breaches in 2019 alone.

This may explain why investments in automated cybersecurity solution companies have been soaring, according to a study from Pitchbook and Dell Technologies Capital. Will this be enough to help businesses protect crucial data?

The answer is still to be determined, but enterprises are taking steps to confront the harsh reality.

In the same week this year that Pat Gelsinger, chief executive of VMware Inc., declared that the security industry had “failed its customers,” his company completed the acquisition of Carbon Black Inc., a security platform with an AI-powered data lake. And in December, Amazon.com Inc. Chief Technology Officer Werner Vogels, who frequently appeared at AWS events during the year wearing a shirt with the slogan “Encrypt Everything,” announced the release of several new automation tools for cloud security.

“We can't just keep using brute force and throwing tools at the problem,” said Dave Vellante, chief analyst at SiliconANGLE's sister market research firm Wikibon. “The focus really has to be on automation. So machine intelligence and analytics will definitely be part of the answer.”

### **4. Voice and digital assistants**

It started with voice interface built into smartphones, and the technology has now shifted to the smart home thanks to the popularity of digital assistants such as Amazon Alexa and Google Home. The U.S. installed base of home smart speaker devices grew from 50 million units to 76 million over the past year.

There are signs that the coming year will see the deployment of voice technology for a variety of use cases well outside of the home. McDonald's Corp. is testing voice-activated drive-throughs in Chicago, and Domino's Pizza is developing a voice-recognition application to take telephone orders.

And the enterprise is headed down the voice technology road in 2020. Salesforce.com Inc. devoted much of its annual Dreamforce conference in November to the roll out of an AI-powered voice technology for the company's business products and systems.

“This is the end of data entry and the beginning of data conversations,” Richard Socher, chief scientist at Salesforce, said during a Dreamforce conference presentation. “Voice is finally here.”

### **5. Autonomous cars**

The year 2019 was not a promising one for the future of autonomous driving. Chief executives at Daimler AG and Ford Motor Co. conceded that deploying self-driving cars was proving to be a difficult task. The state of Arizona was sued after an Uber Inc. self-driving car killed a pedestrian in 2018.

ver, there are also signs that 2020 may be a year of small yet significant steps for autonomous cars.

In December, the California Department of Motor Vehicles announced a permitting process for companies seeking to deploy small autonomous trucks for commercial use. Nvidia Inc. also launched a new set of advanced processors specifically designed for self-driving vehicles.

And Volkswagen declared its intention to put a fleet of electric self-driving cars on the road during the 2022 FIFA World Cup in Qatar.

Even the coming 2020 presidential election in the U.S. has not been insulated from the automation discussion. One recent story documented how automation is perhaps the least understood issue on the part of both candidates and voters.

“Artificial intelligence, deep learning, machine learning — whatever you’re doing, if you don’t understand it — learn it,” said Mark Cuban, the tech entrepreneur and reality TV star. “Because otherwise you’re going to be a dinosaur within three years.”

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## *The Growing Importance of Data Democratization*

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By Dina Kholkar

Data democratization — the process of making data accessible enterprise-wide — is a topic that's been bandied about the boardroom for some time.

Data, and universal access to it, is recognized as the key to transforming companies, creating new opportunities, and unlocking the value embedded within organizations — all of which can positively impact a company's top and bottom line. But companies haven't progressed as planned.

In fact, recent studies suggest that rather than making progress, many firms are actually falling behind in meeting their data goals.

In a 2019 Big Data and AI Executive [Survey](#) by NewVantage Partners, executives from corporations such as American Express, Ford, General Electric, and Johnson & Johnson admitted they weren't where they wanted to be on the road to data democratization.

Almost three-fourths (72%) of those surveyed said they didn't feel they had created a data culture yet. Furthermore, 53% said weren't yet treating data as a business asset and consequently felt their enterprises were not competing effectively on the analytics front.

So, how can CFOs help democratize data and empower more than just C-suite leaders to leverage data to create new opportunities, revenue streams, and drive business growth? The answer lies in managing the human side of the equation.

Data democratization pushes organizations to rethink how they manage, distribute, and consume data. That often means driving a dramatic cultural change in order to realize a financial gain. It also means freeing information from the silos created by internal departmental data, customer data, and external data and turning it into a borderless ecosystem of information.

To achieve this, CFOs have to adopt a new perspective. They need to actively mitigate — and even embrace — the risks involved with increasing accessibility. To do that and limit financial liability, CFOs need to champion better data governance practices to ensure data privacy and security, data quality, data ownership, and compliance with regulatory bodies.

### Big Benefits to Democratization

No field today may better exemplify the benefits of achieving data democratization than health care. Drug development is one of the world's most regulated, expensive, and risk-laden processes. On average, it costs roughly \$2.7 billion to bring a new drug to market, according to a Tufts University study.

Democratizing data by creating a shared framework of metadata across clinical trial phases can give researchers real-time data and ensure a seamless exchange of information across all phases of this process.

Pharmaceutical company Boehringer Ingelheim has used such techniques to achieve better, faster data flow in its clinical trials processes to accelerate its drug pipeline. So democratizing data can be used as a tool to ensure privacy and security of data, even while bringing life-saving therapies to market faster.

To achieve such benefits, progressive CFOs need to consider far more than just finance, says Michael Schmelter, finance chief at Boehringer Ingelheim.

“If we talk about transformation and digitalization we talk about it in research and in customer interactions, in customer engagement, and in the patient interaction, but less in finance,” he says.

### **Science Degree Not Required**

A successful data democratization program shouldn't require employees to have data science degrees. Micro services and dashboards now provide plug-and-play options for non-data specialists to understand different data stores.

Visual analytics such as infographics, interactive reports, and even augmented and virtual reality are growing in popularity among non-data experts. And conversational, voice-based systems are making data access even easier by allowing employees to simply ask for information they need. In fact, voice assistants are changing our expectations and interactions with machines, further expanding the democratization of data.

Data democratization pushes organizations to rethink how they manage, distribute, and consume data. That often means driving a dramatic cultural change in the organization in order to realize a financial gain.

There are many examples of how making data accessible is creating unique business opportunities. A major B-to-B steel company, for example, recognized it was going to have to shift to more of a B-to-C model. Driven by a government program to build 20 million affordable homes over three years, as well as a growing base of digitally oriented consumers, the company realized it had unique insights into potential market demands. More importantly, it identified a whole new market of underserved customers.

The company launched a revamped online steel retail store, giving the company and employees across departments improved customer insights thanks to the information gleaned from the store.

As a result, the organization was able to make more informed business decisions achieving higher profit margins. In fact, the company's new consumer-facing platform generated more than \$14 million in sales during its first year of operation — gains that could not be realized without data democratization.

### **The Future is Bright When Not Siloed**

There is always room for improvement. According to a Gartner data and analytics study last year, about 87% of organizations have low business intelligence and analytics maturity. That means most CFOs and their CEOs are supporting individual business units that are pursuing their own data and analytics initiatives as stand-alone projects.

What's required for democratization to reach its full potential is a more coordinated and holistic approach that delivers enterprise-wide intelligence that drives revenue growth. That means it's the CFO who needs to champion this effort and take a hands-on approach in order for it to succeed.

By Kevin Dowd

It's the holiday season, which means it's time for family, friends, food and fun. If it's your job to read and write about venture capital and private equity—ahem—it's also time to try to figure out what the heck happened this year.

We knew 2019 could be a wild year before it even began, with a potentially historic slate of unicorn IPOs on the docket and a long-running bull market that's left LPs flush with cash, helping contribute to floods of new capital coming into VC and PE. And wild it was. More than ever before, it seemed like news from the private markets permeated the broader zeitgeist, whether it was famous politicians taking buyout firms to task, a pro football league backed by VCs or one of the biggest pop stars in the world calling out The Carlyle Group.

Startups, venture capitalists and buyout firms were busy. And the world took notice.

With the year (and the decade) almost done, I wanted to look back at my favorite moments from our latest trip around the sun—not necessarily the biggest deals and funds, but the events that fascinated and entertained me the most. So without further ado, here are 12 things you need to know from 2019:

### 1. WeWork's meltdown

In early August, WeWork was marching toward a massive public offering that was to be the capstone on a record-setting year of unicorn IPOs. In the less than five months since, it all fell apart in truly spectacular fashion. The co-working company collapsed into a puddle of palace intrigue and schadenfreude, losing more than 80% of its value (as well as its CEO) in a self-inflicted catastrophe the likes of which the VC world has rarely seen. The company is now owned by SoftBank, and it has a newfound aversion to setting piles of money on fire. Adam Neumann now has a lot more time to surf.



It proved to be a seismic event throughout Silicon Valley, causing many VCs to question whether they'd grown too comfortable with heavy losses and granting concessions to founders that in some cases made those founders close to untouchable. The year began with boundless optimism about potential IPOs from names like Uber, Lyft, Slack, Pinterest and WeWork. It ended with a whimper.

### 2. Pols pick on PE

Political progressives have never been big fans of private equity. But this year, with more leftward-leaning members of the Democratic Party gaining sway both in Congress and in the ongoing slog to determine the party's presidential nominee, calls to increase regulation of PE were louder than ever.

The clearest example came in July, when Elizabeth Warren announced her Stop Wall Street Looting Act of 2019, proposed legislation that both critics and proponents agree would present an existential risk to the private equity industry as we know it. A Congressional PE hearing followed in November, and Warren, Bernie Sanders and

Alexandria Ocasio-Cortez have all made other very public criticisms of PE. It seems likely that buyout billionaires will continue to be a political talking point into 2020.

### **3. The Beyond Meat bubble**

Before WeWork stopped the music, some of the unicorns that went public earlier in 2019 had been having a rollicking year. None more so than Beyond Meat, the maker of plant-based alternative meat products that went public in May and, by late July, had seen the price of its stock rise by more than 800%. Investors were infatuated with the company's promise to change the future of food, so they started paying astronomical prices to get in on the action.

In the second half of the year, though, Beyond came back to Earth. Its stock declined from a high of nearly \$240 per share on July 26 to \$76.84 at Friday's close—still good for a \$4.7 billion market cap and enough to result in plentiful profits for shareholders, but not quite the once-in-a-lifetime winner it had briefly appeared to be. Meat alternatives probably aren't going anywhere, though, and Beyond is well-positioned to continue growing its presence.

### **4. Mega-fund mania**

Both VC and PE firms spent much of 2019 raising enormous pools of capital. Blackstone raised \$26 billion for the biggest buyout fund ever, while names like Advent International, Vista Equity Partners and Thoma Bravo all closed funds with well over \$10 billion in commitments. Venture firms, meanwhile, pursued larger vehicles than ever before as a way to keep up with all their late-stage portfolio companies that want to raise capital without going public. Andreessen Horowitz, TCV, Lightspeed and Founders Fund were some of the investors that banked more than \$1 billion for new funds.

### **5. The big get bigger**

At the same time progressive politicians were challenging PE, they were also calling to break up tech giants like Google, Amazon and Facebook on antitrust grounds, probably the most high-profile concerns about monopolization in tech since Microsoft went on trial in the late 1990s. But it didn't stop those companies from making some major acquisitions aimed at increasing their industry dominance.

In June, Google agreed to buy cloud analytics specialist Looker for \$2.6 billion, and in November, the company announced a \$2.1 billion takeover of wearables maker Fitbit. Reports have emerged that UK regulators are planning to look into the Looker deal, while US regulators could challenge the Fitbit acquisition. Amazon, meanwhile, teamed with Sinclair Broadcast, Blackstone and the New York Yankees to buy the YES Network, extending its media reach; Amazon also made major investments in the auto space, helping pump hundreds of millions into autonomous driving companies Aurora and Rivian.

### **6. The brief reign of the AAF**

Between February and early April, the Alliance of American Football played eight weeks of VC-backed professional football. Then it all crashed and burned in a mess of broken promises, missing money and angry millionaires, a strange saga that involved VCs, furious football players, frozen bank accounts, Vince McMahon and a bitcoin scandal. I felt awful for the players and other employees that were left in the lurch, but in terms of entertainment, what more can you ask for?

### **7. Flying things**

VCs had their eyes on the skies in 2019. It started in the first days of January, when Boom Supersonic raised \$100 million at an \$850 million valuation for its Concorde-style passenger jets. It continued in the ensuing 12 months, as names like Lilium, BlackBird and Jetpack Aviation raised venture capital for things like flying taxis, plane-sharing and personal jetpacks. The year was also a busy one for companies that want to fly away from the Earth entirely, as SpaceX raised more than \$1 billion and Virgin Galactic became a public company by means of a reverse merger. Billionaire-backed space

companies SpaceX, Virgin Galactic and Blue Origin all continue to pledge that space tourism is right around the corner.

### **8. High-tech hamburgers**

The Golden Arches are fully embracing the digital age. After decades of rarely investing in other companies, McDonald's lined up a pair of notable acquisitions this year, first agreeing to buy Dynamic Yield in March (reportedly for more than \$300 million) and then agreeing to take over Apprente in September. Dynamic Yield makes digital display technology, while Apprente develops voice-ordering services; together, the two deals look like an attempt to revamp the entire ordering process at McDonald's.

They weren't the highest-profile moves, but in addition to changing the way I'll buy french fries in the future, they also signify the degree to which tech startups have saturated the entire business world. Every major corporation must at least keep an eye on Silicon Valley these days, even ones whose main business concerns are quite literally meat and potatoes.

### **9. Public PE stocks skyrocket**

After the past couple of years, all of the biggest publicly traded private equity firms converted from partnerships to corporations, moves born in no small part of those firms' desire to increase the value of their stock. Well, mission accomplished. Apollo Global Management, Blackstone and The Carlyle Group all saw their share prices increase by more than 85% during 2019, and KKR's value leapt by more than 50%. Apollo, Blackstone and KKR shares are now trading at all-time highs. Maybe all that time in the political spotlight wasn't such a bad thing after all.

### **10. Startups helping startups**

You can barely turn your head in San Francisco without seeing an advertisement for Brex, a fintech startup that provides corporate credit cards for other companies. It raised \$100 million this year at a \$2.6 billion valuation, one of a few different startups to bring in bundles of capital on the promise of making life easier for their peers. There was also Carta, a maker of software for managing startup cap tables and other areas of corporate finance, which raised \$318 million at a \$1.6 billion valuation. And Vouch, which makes insurance services designed specifically for startups, brought in \$45 million at a \$210 million valuation.

### **11. Peloton's wild ride**

When Peloton went public in September, there was a certain degree of skepticism—some of it sparked by the then-unfolding WeWork debacle, some by the unusual nature of the home-cycling company's business model and some by a \$300 million lawsuit related to music rights. But the early returns on the public market were promising, as Peloton saw its market cap inch past \$10 billion, compared to the \$4.15 billion valuation it attained with its final round of VC funding in 2018.

And then that advertisement aired. Peloton released a widely ridiculed new holiday commercial in late November, and throughout the first few weeks of December, its stock price steadily declined. Is it a coincidence? Will it continue? Either way, Peloton will keep on peddling its pedaling machines.

### **12. Look what they made her do**

I am going to guess that, until November, there weren't a whole lot of die-hard Taylor Swift fans who had an opinion about The Carlyle Group. But that all changed when Swift went public with a feud over the rights to her music with Big Machine Label Group, a record label in which Carlyle portfolio company Ithaca Holdings acquired a stake earlier this year.

The primary battle is between Swift and producer-slash-archrival Scooter Braun. But Swift has specifically named Carlyle in her complaints, and I find it absolutely delightful that Carlyle co-CEO Kewsong Lee is being forced to make pronouncements that Swift is "an incredibly talented performer and wonderful artist." What a strange world. What a strange year.

Source by ID TecheEx



Last mile delivery is the most expensive part of the delivery chain, often representing more than 50% of the overall cost. This is mainly because it is the least productive and automated step. As such, many are seeking to bring automation into the last mile.

In recent years, many companies around the world have been innovating to utilize autonomous mobile robots, drones, and autonomous vehicle technology. In this article, we focus on ground-based autonomous robots.

This report "Mobile Robots, Autonomous Vehicles, and Drones in Logistics, Warehousing, and Delivery 2020-2040" covers the use of mobile robots, drones, and autonomous vehicles in delivery, warehousing, and logistics. It provides a comprehensive analysis of all the key players, technologies, and markets.

It covers automated as well as autonomous carts and robots, automated goods-to-person robots, autonomous and collaborative robots, delivery robots, mobile picking robots, autonomous material handling vehicles such as tuggers and forklifts, autonomous trucks, vans, and last mile delivery robots and drones.

The image below shows various autonomous robots and vehicles (sometimes called pods) developed around the world. These come in a variety of shapes and forms, reflecting the diversity and breadth of design and technology choices which must be made to create such products.

### **Sidewalk delivery robots vs autonomous delivery vans**

These robots, pods, and vehicles are mainly designed from the scratch to be unmanned. They are also almost always battery-powered and electrically-driven. This is for various reasons, including: (1) electronic drive gives better control of motion especially when each wheel can be independently controlled; (2) the interface between the electronic control system and the electrical drive train is simpler, eliminating the need for complex by-wire systems found in autonomous ICE vehicles; and (3) their production process needs to handle vastly fewer parts, and as such could be taken on by smaller manufacturers.

Another key technology and business choice is where to navigate. Many robots are designed to travel on sidewalks and pedestrian pavements, while the van-looking pods and vehicles are often designed to be road-going. This choice of where to travel has determining consequences for the design, technology choice, target markets, and business model. In this article, we focus on sidewalk ground robots, leaving the discussion of road-going pods to a follow-on article.

The sidewalk robots are an interesting proposition. They are often designed to travel slowly at 4-6 km/hr. This is to increase safety, to give robots more thinking time, to give remote teleoperators the chance to intervene, and to enable categorizing the robot as a personal device (vs. a vehicle), thus easing legislative challenges.

These robots also come with various hardware choices. For example, some are few-wheeled while many are six-wheeled. Some include a single small-payload compartment, whilst others carry larger multi-item storage compartments. The key choice however is in what perception sensors to use.

### **Navigation technology choices**

Almost all have HD cameras around the robot to give teleoperators the ability to intervene (more on this later). All also have IMUs and GPS and most have ultrasound sensors for near-field sensing. The main choice is whether to use lidar-only, stereo-vision-only, or hybrid.

Lidar can give excellent 360 degree ranging information. The spatial resolution is also very high, beating even the emerging 4D imaging radar. The point cloud is also fairly dense (depending on the lidar choice), enabling good signal processing. Indeed, in recent years, there have been excellent progress in creating labeled training data and deep learning techniques based on lidar data. Lidars however have two major drawbacks: (a) they are expensive and (b) they can have near-field (a few cm) blindspot.

The first is critical. The current high cost of lidar puts the business model at risk. This is because for the business model to succeed the cost of the robots needs be very low, regardless of whether the model is to offer RaaS delivery service or to sell robot units with some maintenance and support. Therefore, the choice to use lidars will represent a bet for the cost of lidar technology to dramatically fall.

Most robots deploying lidars use 16-channel RoboSense or Velodyne lidars. These are mechanical rotating lidars, giving surround viewing. The technology of lidars is evolving with the likes of MEMS or OPA emerging. These could enable cost reduction, but will reduce FoV (field of view), thus mandating the use of more lidar units per robot. We project that the cost of lidars is to significantly fall over the coming years. This has the potential to put such robots on the path towards business viability. The other challenge is near-field blindspots. This is not an issue with cars, but can be in a sidewalk, where many low-lying objects can reside closely to the robot. To resolve these, complementary sensors will be needed.

The other approach is to go lidar-free, using stereo camera as the main perception-for-navigation sensor. This will require the development of camera-based algorithms for localization, object detection, classification, semantic segmentation, and path planning.

No off-the-shelf software solution exists. Indeed, no labeled training dataset exists that would allow training lidar-based, camera-based or hybrid deep neural networks (DNNs) for sidewalk navigation. The sidewalk environment is vastly different to that of the on-road vehicles. As such, companies will need to collect, calibrate, and meticulously label their own datasets. Furthermore, the datasets will require great diversity to accommodate different light, perception, and local conditions. As such, deployments in many sites even as pilot programs is essential in further improving the robots and can indeed represent a competitive advantage.

The robots are energy constrained. As such, the number of on-board processors and GPUs should be kept to a minimum, and heavy-duty computational tasks such as 3D map-making and edge-extraction should be carried off-

line in powerful services. This almost always happens when robots are deployed to a new environment: they are walked around to capture data, the data is sent to servers for processing so it can be converted into a suitable map, earmarking edges, many classes of fixed objects, drivable paths, and so on.

These sidewalk robots are still far from being totally autonomous. First, they are often deployed in environments such as US university campuses where there is little sidewalk traffic and where the sidewalks are well-structured. Many robots are also restricted to daylight and perception-free conditions.

Critically, the suppliers also have remote teleoperator centres. These remote human operators take over, via the internet, when the robots encounter situations they cannot handle with high confidence. Furthermore, they still operate the road-crossings. This step is very dangerous, and the robots are still not able to always perform this independently. The ratio of operators to robots will need to be kept to an absolute minimum if such businesses, which essentially propose to eliminate wage overheads, are to become viable and sustainable.

### **Long road to profitability lies ahead**

In general, there is still much work to do to improve the navigation technology. The robots will need to learn to operate in more complex and varied environments with minimal intervention. This requires extensive investment in software development. This ranges from gathering data, defining object classes, labeling the data, and training the DNNs in many environments and conditions. It also requires writing algorithms for the many challenges the robots encounter in their autonomous operation.

Furthermore, capital is also essential. The businesses are heavy on development costs, especially software costs. The end markets are also highly competitive, imposing tough price constraints. The hardware itself is likely to be commoditized and many will outsource manufacturing once they have settled on a suitable final design. The payback for many will be having a large fleet to offer robots as a delivery service.

### **Future outlook: significant robot sale and delivery services opportunity**

However, even such firms are likely to have a long road ahead of them before they reach profitability. They should improve the robots to work in more scenarios beyond well-structured neighborhoods and campuses, to extend their operation to all-day and all-weather conditions, and to extend autonomous operation with little error to nearly all scenarios to drive down the remote operator-to-fleet size ratio. The deployed fleet size will need to dramatically increase to expand income from delivery services and allow the amortization of the software development costs over many units sold.

We have analyzed all the key companies and technologies in this emerging field. We have also constructed a forecast model, considering how the productivity of last mile mobile robots is likely to evolve over the years. We have developed various scenarios, assessing the current and future addressable market size in terms of total accumulated fleet size. Our fleet deployment forecasts and penetration rate forecasts are based upon on reasonable market and technology assessments and roadmaps.

In general, we forecast a 200k unit fleet size until 2035 (accounting for replacement). The inflection point will not occur until around the 2025 period given the readiness level of the technology. This suggests both a large robot sales market and an even larger annual delivery services market provided asset utilization can be high (the services income could reach \$1.6Bn by 2035 in a reasonable scenario).

Consequently, our forecasts suggest, that despite the upfront technology and market challenges, the market will grow and those who plant their seeds today will reap the benefits tomorrow. To learn more about the companies active in this field, the technology challenges, approaches, and roadmap, and detailed 20-year market forecasts please visit [www.IDTechEx.com/Mobile](http://www.IDTechEx.com/Mobile).

*This report covers the use of mobile robots, drones, and autonomous vehicles in delivery, warehousing, and logistics. It provides a comprehensive analysis of all the key players, technologies, and markets. It covers automated as well as autonomous carts and robots, automated goods-to-person robots, autonomous and collaborative robots, delivery robots, mobile picking robots, autonomous material handling vehicles such as tuggers and forklifts, autonomous trucks, vans, and last mile delivery robots and drones. It provides technology analysis, market analysis and forecasts, and player overviews.*

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## *Volkswagen launches new mobile charging robots for electric cars*

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With more than 5.1 million electric cars on the roads globally, there is increasing need for infrastructure and charging stations to keep these cars moving. However, Volkswagen seems to have the solution. This week, Volkswagen unveiled a new visionary for a mobile charging robot that can charge electric vehicles in a parking garage using mobile battery packs.

Developed to revolutionize the underground car park, Volkswagen Volkswagen Group Components presents a new and visionary charging concept with mobile robots that will charge electric vehicles completely autonomously in future that one day could turn every parking space can become a charging point. The German car manufacturer provides a glimpse into the future in which the search for charging stations for electric cars comes to an end. Volkswagen Group Components' mobile charging robot takes over this task – and drives to the electric car completely autonomously.

After it is started via app or V2X communication, the mobile robot drives itself to the vehicle that needs charging and communicates with it. From opening the charging socket flap to connecting the plug to decoupling – the entire charging process occurs without any human interaction. The highlight: the mobile robot brings a trailer in the form of a mobile energy storage device to the vehicle and connects them; it then uses this energy storage device to charge the battery of the electric vehicle. The mobile energy storage device stays with the vehicle during the whole charging process. The robot, in the meantime, charges other electric vehicles. Once the charging service is complete, the robot collects the energy storage device and brings it back to the charging station.



“The mobile charging robot will spark a revolution when it comes to charging in different parking facilities, such as multistory car parks, parking spaces and underground car parks because we bring the charging infrastructure to the car and not the other way around. With this, we are making almost every car park electric, without any complex individual infrastructural measures”, summarizes Mark Möller, Head of Development at Volkswagen Group Components.

“It’s a visionary prototype, which can be made into reality quite quickly, if the general conditions are right”, Möller continues. Volkswagen Group Components is researching different approaches to the assembly of charging infrastructure and has already developed several successful products. The flexible quick charging station and DC wall boxes are already part of a future charging family. Customer-oriented, intelligent and flexible approaches to charging are at the center of the research. Other innovative products such as the charging robot are currently being developed.

### Autonomous, compact and flexible

The prototype consists of a compact, self-driving robot as well as flexible and agile energy storage devices, also known as battery wagons. When fully charged, these are equipped with an energy content of around 25 kWh each. A charging robot can move several battery wagons at the same time. When called via app or V2X communication, it brings the energy storage device to the electric vehicle and connects them both autonomously. With its integrated charging electronics, the energy storage device allows for DC quick charging with up to 50 kW on the vehicle.

The robot, which can drive autonomously, is fitted with cameras, laser scanners and ultrasonic sensors. The combination of these systems not only allows the robot to carry out the charging process completely autonomously but also to move around freely in the parking area, to recognise possible obstacles and to react to these. Depending on the size of the parking area or the underground car park, several charging robots can be employed simultaneously so that several vehicles can be attended to.

### Every parking lot can become a flexible charging point

The mobile charging robot can be put to use in various ways. It isn’t just a robot arm that connects a car to a fixed charging station. Instead, drivers have the choice to park in any available space, independent of whether a charging station is free or not. The robot brings the charging station in the form of a mobile energy storage device directly to the vehicle. For operators of different parking facilities this is a quick and easy solution to electrify every parking space. “This approach has an enormous economic potential”, says Möller. “The constructional work as well as the costs for the assembly of the charging infrastructure can be reduced considerably through the use of the robots.”

The compact design of the charging robot is perfectly suited for use in restricted parking areas without charging infrastructures, such as underground car parks. Möller continues: “Even the well-known problem of a charging station being blocked by another vehicle will no longer exist with our concept. You simply choose any parking space as usual. You can leave the rest to our electronic helper.”

The mobile charging robot is a prototype by Volkswagen Group Components, which gives an insight into the future of charging infrastructure. A possible date for the market launch of the charging robot has not been set yet.

Below is a video of it works.



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## Amazon Spawns a Wave of Logistics Startups

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By Priya Anand

Amazon has become a logistics and transportation powerhouse, so much so that the company now handles half of its own deliveries worldwide. And numerous Amazon employees are taking the expertise they've developed at the e-commerce giant to startups that aim to help other companies ship products to customers faster.

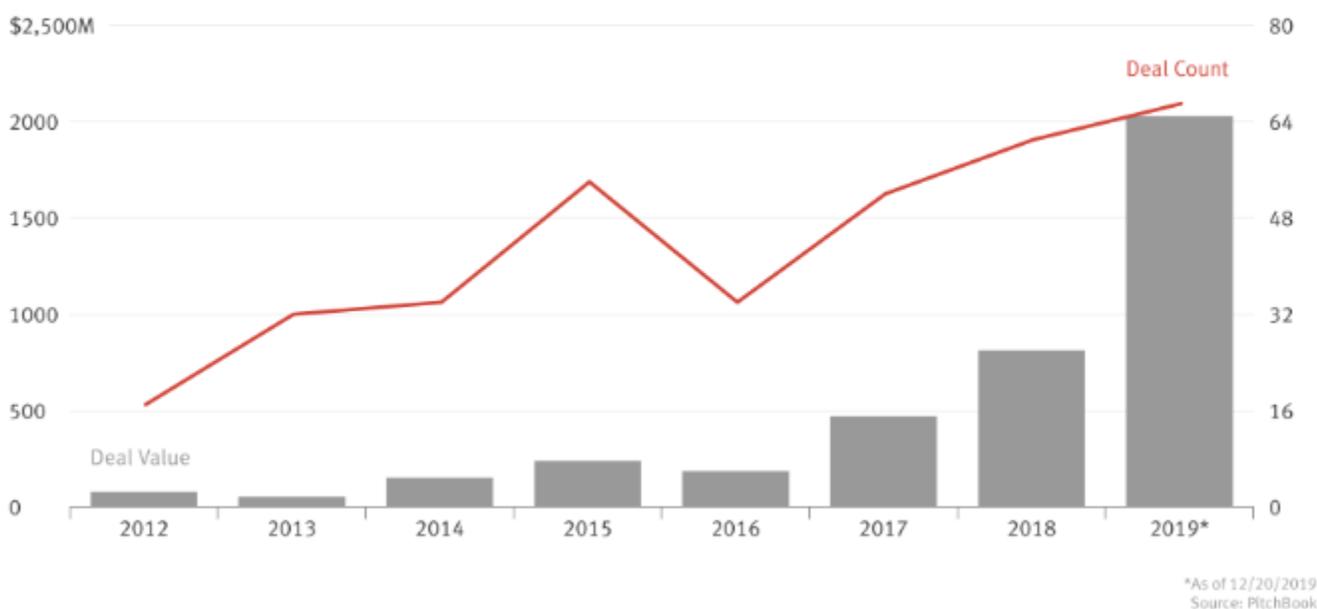
Those startups, which include FreightWeb, Convoy, and Flexe, are drawing a fast-growing amount of venture capital investment. VC firms poured \$2.03 billion into logistics startups this year, according to PitchBook. That's more money than in the prior seven years combined. The number of deals has nearly quadrupled in the same time frame as well.

Logistics is a trillion-dollar category, said Scott Jacobson, a managing director at Madrona Venture Group, which has invested in startups like Freightweb. Revenue in the trucking industry alone neared \$800 billion in 2018, according to the American Trucking Associations. And then there's the Amazon effect.

"As Amazon pushes the boundary of next-day and same-day [delivery], it creates massive disruption for everyone else who's trying to match it or compete with it, and that creates opportunities for new companies," Jacobson said.

### Growing Operations

U.S. venture capital investments in logistics startups, in millions



Competing with Amazon in speed of delivery will be tough. "There's a question of whether or not an open community, or network of providers, can compete with the owned and controlled infrastructure that Amazon has built and is building," said Eric Best, CEO of the company SoundCommerce, which is among the startups profiled in this piece.

Here are seven startups focused on the logistics space that were founded by ex-Amazonians or have Amazon DNA in their leadership ranks.

## Convoy

- Founders: Dan Lewis, Grant Goodale
- Total raised: \$668 million
- Investors: Notable investors include Jeff Bezos, U2's Bono, T. Rowe Price Associates, Greylock Partners, and Y Combinator
- What it's doing: Convoy is a trucking software company that matches companies with truckers who have the space to move their stuff.

Dan Lewis, Convoy's CEO, worked for Amazon for two years in a part of the retail operation that focused on new ways for people to shop. While he didn't work on logistics, he said he was inspired by the shift in consumer behavior as a result of the introduction and growth of Amazon Prime.

"The profile of logistics and supply chain companies has been higher since Amazon prioritized delivery as a differentiator years ago with Prime," Lewis said in an interview.

## Deliverr

- Founders: Harish Abbott, Michael Krakaris
- Total raised: \$30.1 million
- Investors: 8VC, GLP, 9Yards Capital, Activant Capital, DHVC, Flexport founder Ryan Petersen, Shan-Lyn Ma of Zola
- What it's doing: Deliverr handles e-commerce fulfillment for merchants that sell through their own websites or on platforms like Walmart, eBay, and Amazon.

Abbott, one of Deliverr's co-founders, spent several years in Amazon's retail group in the early 2000s, partly focused on fulfillment. He later started the commerce software company Symphony Commerce, which Krakaris joined as a product manager. The two started Deliverr in 2017.

The company rents space in warehouses to store inventory for clients. It offers two-day shipping and sometimes can deliver faster if needed. Krakaris said the company mostly focuses on smaller merchants but has some larger brands among its customers. This holiday season, it delivered 30,000 fried chicken-scented fire logs for Walmart and Kentucky Fried Chicken within two days to customers.

"We're not directly competing with Amazon. Amazon's a huge channel we fulfill for," Krakaris said. "What we're competing for is the huge e-commerce space."

## Flexe

- Founders: Karl Siebrecht, Francis Duong, Edmond Yue
- Total raised: \$64 million
- Investors: Activate Capital, Madrona Venture Group, Prologis Ventures, Redpoint Ventures, Tiger Global Management
- What it's doing: Flexe provides on-demand warehouses for customers.

Flexe's customers include companies that simply need more space during peak times, such as the holiday season. Others want to offer customers fast shipping but don't want to or cannot build out their own warehouses quickly enough to meet demand.

"You can come to us and we can stand up some of the buildings for you with...no startup costs," said David Glick, the company's chief technology officer, in an interview earlier this year. He spent nearly two decades at Amazon before joining Flexe earlier this year.

## FreightWeb

- Founders: William Payson, Marty Sinicrope, Farah Ali
- Total raised: \$3 million
- Investors: Madrona Venture Group, 8VC
- What it's doing: FreightWeb helps companies that want to move small amounts of freight.

William Payson started FreightWeb in late September after spending nearly three years at Amazon and more than a dozen at FedEx before that. He realized there were few options for companies that didn't have enough freight to fill an entire truck. Oftentimes, he said, companies in that position are stuck paying for an entire truck, leaving space inside the truck wasted and spending extra money.

"Suppose you want four slices of pizza, but the whole pizza's cheaper. You're going to buy the whole pizza and then you're going to have half a pizza. And you're deciding, what the heck do I do with this now? If it's a truck, you can't put the rest in the refrigerator," Payson said. "That's the problem we're trying to fix."

## Mochila Fulfillment

- Founder: Jim Sharkey
- Total raised: \$1 million
- Investors: Friends and family
- What it's doing: Mochila offers Amazon-like warehousing and shipping services to other retailers.

Sharkey spent eight years at Amazon in fulfillment and operations, working on its early grocery delivery efforts as well as Fulfillment by Amazon, a service that allowed merchants to pay Amazon to store, pack, and ship their products and handle returns. Sharkey left Amazon and about a year later, in 2013, launched Mochila Fulfillment, which offers a similar service. But instead of packing items in standard brown boxes as Amazon does, Mochila offers customized packaging, return service, and refurbishment for returned items so they can be resold.

"Think of it contrasted with Amazon. Something comes in the Amazon box and that's pretty much it," Sharkey said. "We're on the opposite end."

The company has two warehouses, one in New Jersey and one in California, to offer speedy delivery to customers in New York and San Francisco. Sharkey said he is looking to expand to a third warehouse in the middle of the country. He said the company's clients include Marine Layer and Balsam Hill, maker of artificial Christmas trees. Mochila Fulfillment has about 50 full-time employees and has been profitable since 2016, Sharkey said.

## Shipium

- Founders: Jason Murray, Mac Brown
- Total raised: \$2 million
- Investor: PSL Ventures
- What it's doing: Shipium aims to help e-commerce companies ship products as quickly as Amazon.

Murray, Shipium's CEO, spent nearly 20 years at Amazon, mostly in retail and supply chain. While he is coy about what exactly Shipium is doing, he said his vision is to help other e-commerce companies compete with Amazon on shipping. Asked how companies much smaller than Amazon can match its logistics prowess without its scale, Murray said that size is not the issue. Amazon provided customers a better e-commerce experience even before it became a massive company, he noted.

"You don't need as much sheer size as Amazon to give an excellent, top-of-the-line logistics experience," Murray said.

**From self-driving vehicles to chips that deliver information faster to spine surgery robots, we take a look at the mega-bucks acquisitions of the past 10 years**

By Shoshanna Solomon

To celebrate the end of the twenty-tens, a booming time for Israel's tech industry, The Times of Israel presents a list of the 10 biggest tech acquisition deals of the past decade.

According to data compiled by PwC Israel, the country saw 587 exit deals — defined as initial public offering of shares, or merger and acquisitions of Israeli startups — over the past 10 years, for a total of \$70 billion. These helped put Israel's tech scene on the global map in a whole variety of fields, including auto technologies, semiconductors and processors, health technologies, medical devices, and navigation apps.

**The biggest deal of the decade**, and actually the biggest deal ever for Israel, was of course the acquisition by US tech giant Intel Corp. of Israel's Mobileye, a Jerusalem-based maker of self-driving technologies, for a whopping \$15.3 billion in 2017.

Mobileye's tech emerged from the Hebrew University's department for computer vision. The firm is a maker of vision technology for advanced driver assistance systems and autonomous driving technologies. The firm, founded in 1999 by Prof. Amnon Shashua and Ziv Aviram, had its shares traded in the US before Intel acquired it.



Prime Minister Benjamin Netanyahu (third left) meets with Intel Corp. CEO Brian Krzanich (to his left) and Mobileye founders Amnon Shashua and Ziv Aviram, respectively first left and first right (Courtesy Haim Zach, GPO)

**The second largest tech deal of the decade** — though it is still awaiting regulatory permits for completion — was the acquisition by US chip maker Nvidia of Mellanox Technologies Ltd. in 2019 for \$6.9 billion.

Mellanox, with headquarters in Yokne'am, Israel, and Sunnyvale, California, is a maker of high-speed servers and storage switching solutions. The products developed by the firm, a pioneer in InfiniBand and Ethernet technologies, are used in supercomputers globally. The firm was founded in 1999 by Eyal Waldman and Roni Ashuri.



Eyal Waldman, left, founder and CEO of Mellanox and Jensen Huang, the founder and CEO of Nvidia Corp. at a press conference in Yokne'am, Israel on March 25, 2019 (Shoshanna Solomon/Times of Israel)

**The third largest deal** was the acquisition by Cisco of NDS in 2012 for \$5 billion.

UK-based NDS was a digital security firm with a large research and development lab in Israel. Although not an Israeli company, NDS has its roots in research conducted at the Weizmann Institute of Science. The company was established in Israel in 1988 as News Datacom and was acquired by Rupert Murdoch's News Corp for \$15 million in 1992, becoming NDS.

The firm then held an initial public offering of shares in 1999, and was later sold to private equity firm Permira in 2009. In 2012, Permira sold the firm to Cisco for \$5 billion, and in 2018, Cisco resold NDS back to private equity firm Permira. NDS is now called Synamedia. The original firm, News Datacom, was founded by Dov Rubin, Jonathan Hashkes, Michael Dick and Yishai Sered.

**The fourth largest deal** of the decade was the acquisition by a Chinese consortium of Playtika, an Israeli online gaming company, for \$4.4 billion in cash in 2016. The members of the consortium included Giant Investment (HK) Limited, China Oceanwide Holdings Group Co. Ltd., China Minsheng Trust Co. Ltd., CDH China HF Holdings Company Limited, the Hony Capital Fund, and Yunfeng Capital — a private equity firm co-founded by Alibaba's Jack Ma.

Founded in 2010, Playtika was a pioneer in the free-to-play games on social networks and mobile platforms and is the creator of popular titles such as Slotomania, House of Fun and Bingo Blitz. Playtika's founder is Robert Antokol.

**The fifth largest deal** of the decade was the acquisition by the California-based semiconductor equipment maker KLA-Tencor Corporation of electronics manufacturer Orbotech Ltd., a provider of systems for circuit boards and chips, in 2018 for \$3.4 billion. The Yavne, Israel-based Orbotech was founded in 1981 by a team of engineers at Electro-Optical Industry Ltd. (El-Op) led by Shlomo Barak, who was developing electro-optical systems for military use, but saw commercial use for them as well.

**The sixth largest tech deal** of the decade was the acquisition by private equity firm Thoma Bravo of cybersecurity firm Imperva Inc. for \$2.1 billion in October 2018. The Tel Aviv-based Imperva creates solutions that proactively identify, evaluate, and eliminate current and emerging threats wherever they reside in organizations, whether in the cloud, on-premises, or in hybrid environments.

The firm was founded in 2002 by tech entrepreneur Shlomo Kramer, the co-founder of another cybersecurity firm, Check Point Software Technologies Ltd. Other co-founders were Mickey Boodaei and Amichai Shulman.

**The seventh largest tech deal** of the decade was the acquisition by Intel Corp. of Habana Labs, for \$2 billion in December 2019. The deal marked Intel's second-largest acquisition in Israel after the acquisition of Mobileye (see above) in 2017.

Habana Labs, founded in 2016 by David Dahan and Ran Halutz, uses artificial intelligence to improve chips' processing performance and power consumption and lower the costs of production. The processors are aimed at the specific needs of training deep neural networks. The firm's first investor and its chairman was serial entrepreneur Avigdor Willenz, co-founder of Galileo Technologies, which he sold in 2001 to Marvell Technology Group Ltd. for \$2.7 billion, and of Annapurna Labs, which was sold to Amazon in 2015 for \$370 million.

**The eighth largest acquisition** was the acquisition by Irish-American medical devices maker Medtronic of Mazor Robotics Ltd., a maker of robotic surgical systems, for \$1.6 billion in 2018. The deal marked the biggest-ever exit in the biotech sector. The Caesarea, Israel-based Mazor provides a suite of software that includes image processing and computerized anatomy recognition. The technology enables preoperative planning, helping surgeons better plan spinal procedures. Mazor was founded in 2001 by Eli Zehavi and Moshe Shoham.

**The ninth largest deal** was the acquisition in 2019 by US cloud computing company Salesforce of Israeli-founded firm ClickSoftware in a deal valued at \$1.35 billion. Petah Tikvah-based ClickSoftware Technologies was taken private in 2015 when it was purchased by California-based investment firm Francisco Partners Management for \$438 million. It is now headquartered in Burlington, Massachusetts.

ClickSoftware is the world's largest service management company, with its software used by hundreds of utilities, police and fire departments, and emergency rescue organizations to help them prioritize work orders, repairs, and emergency responses. The firm was founded in 2000 by Moshe BenBassat.

**The 10th largest tech deal** was the acquisition by Canadian firm DH Corporation, a payments technology provider, of Israel's Fundtech, in 2015 for \$1.25 billion. Fundtech is a provider of software products for banks to automate such activities as payment, cash management, and other banking services. The Herzliya, Israel-based firm, founded in 1993, had its shares traded on the Nasdaq and the Tel Aviv Stock Exchange after it held initial public offerings of shares in 1998 and 2003 respectively. The firm was founded by Reuven Ben Menachem.

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## What Happened To Consumer Device Startups?

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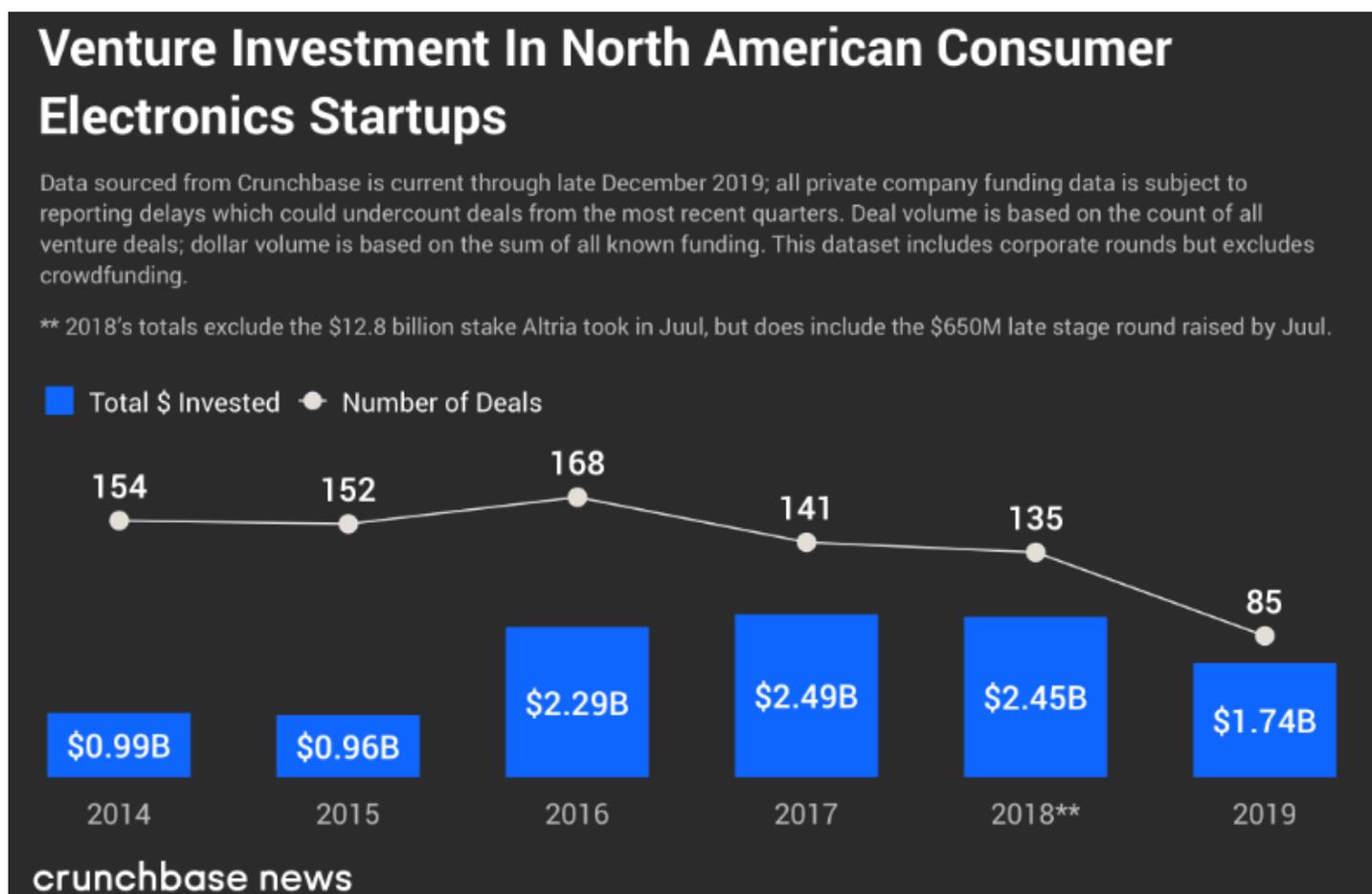
By Joanna Glasner

Venture investors love technology. But lately they've been much less keen on the kind you buy in a box and take home from the store.

While software continues to eat the world and VC checkbooks, venture investment in consumer electronics startups is poised to decline year-over-year in 2019. That marks the third year in a row of contracting investment for the North American startups in the space, per Crunchbase data. And even hardware investors are sounding bearish.

"It's a down window right now," said Eric Klein, partner at Lemnos, a hardware-focused seed and early stage investor that has been largely staying out of new deal flow in consumer electronics for the past couple years.

Lemnos isn't alone this year. A Crunchbase analysis of investment in North American consumer electronics startups shows total known funding of \$1.74 billion in 2019, down from \$2.45 billion in 2018. Round counts have slipped as well. We break down totals for the past five years below:



### The Drivers

Klein pointed to three main drivers for the decline in consumer device investment.

The first is the growing dominance of the “Big Four” — Apple, Samsung, Google and Amazon. These corporate giants are cornering a growing number of consumer electronics categories, leaving startups hard-pressed to compete.

The second is the disappointing aftermath of the Kickstarter revolution. When crowdfunding platforms began gaining traction early in the decade, there was optimism in venture circles that developers of popular products would go on to serve massive markets. That hasn’t panned out as expected, with early follower enthusiasm rarely germinating future mass-market hits and instead bringing a lot of flops.

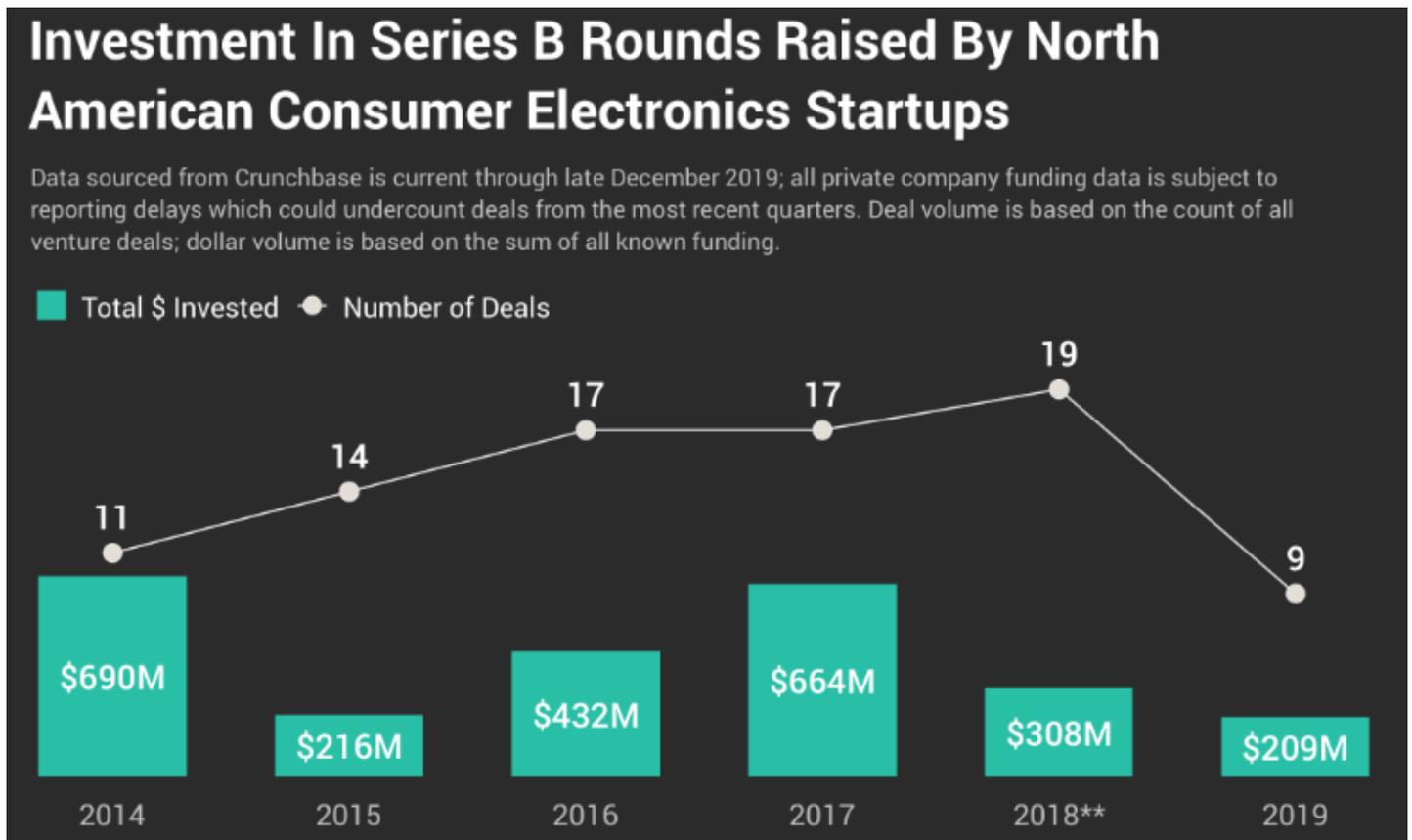
The third factor is the so-far unimpressive strategy of writing large early checks to more experienced entrepreneurs.

“Those deals haven’t done as well as everyone thought they might,” Klein said. It’s particularly challenging because founders have to build both a product and a marketable brand. Both of those are expensive and risky propositions.

Klein didn’t name names, but startups that come to mind include Essential, the mobile phone and device maker that raised \$330 million across two early stage rounds, and Magic Leap, the VR wearables unicorn that has raised over \$2.6 billion to date.

### Series B Was Particularly Weak

It’s noteworthy that of all stages of consumer device investment, Series B was particularly weak this year. Per Crunchbase data, just nine North American consumer electronics companies announced Series B rounds in 2019, bringing in \$209 million (more details in chart below). That’s less than a single company – Essential – raised in its 2019 Series B.



This slowdown is significant because if we visualize where Series B lands in a company’s development, it’s a bit like the final on-ramp to a highway. As we noted in a prior analysis, companies are expected at that point to have proven

technology, early indications of market demand, and, at least some revenue. The next stop is Series C, where the scaling accelerates.

Because the bulk of really big startup financings happen at the later stage, after Series B, a slowdown here indicates the likelihood of fewer supergiant fundings for consumer electronics down the road.

### **Hits And Flops**

Since consumer electronics success requires a recognizable brand, we're more likely to hear about the companies that prevail, as well as those that didn't live up to early hype. So, let's look at some of the biggest names in both categories.

On the success side, probably the standout for 2019 is Peloton, the maker of connected fitness equipment that went public in September and has cinched a market capitalization around \$8 billion. Founded in 2012, the New York-based company raised just shy of a billion dollars prior to its IPO.

Other deals involved smaller numbers, including Amazon's purchase of venture-backed home router startup, Eero, for an undisclosed sum, and Google's purchase of publicly traded fitness wearables maker Fitbit for \$2.1 billion.

As for flops, among the most prominent closures of 2019 was Anki, the maker of robotic toys that raised more than \$200 million in venture funding. The list of smaller startup shutdowns for the year includes Halo Smart Labs, a connected home device developer, and Naya Health, which wanted to modernize the breast pump.

### **Scant Funding Portends Fewer Future Flops**

Of course, you can only have big flops if startups get enough money with which to flop bigly. The scarcity of supergiant consumer electronics fundings in recent quarters means there is a smaller pool of companies poised to become either the next big success or notorious failure.

Part of the challenge, Klein said, is finding niches where the Big Four don't already exert market dominance. Connected fitness represented one such area, and that helped push Peloton's valuation up and fuel investment for others in the space. Another example is Molekule, a startup that makes air purifiers.

In coming years — new sensors, maturation of the VR space, and other developing technologies will also likely open up new use cases for consumer electronics. But it may take a while said Klein, noting:

“History always teaches us that what goes down will go back up. It's just really hard to tell when.”

By Zoë Bernard

At first, employees at Bluume were skeptical.

In July, the marketing software startup's co-founders sent out an email inviting employees to cut back on their drinking as a part of several daily fitness goals. With that in mind, Bluume's management stopped organizing outings to the Taco Tuesday Happy Hour at the Mexican bar near Bluume's Tempe, Arizona, offices. The company replaced wine and vodka in the company kitchen with sparkling water. Even company social events were affected. If employees want to get together as part of a company event, Bluume's managers now suggest they climb a mountain together, said Jonathan Brooks, the company's chief operating officer.

"There was a lot of suspicion. Like, 'Is this real? What's going on? What's happening?'" said Brooks, adding that its staff eventually came around to the change. "It wasn't resistance, but it was more of an eyebrow raise."

As 2019 draws to a close, it's time to pour one out for a fixture of tech startup culture: the office happy hour. For years, startups have made kegerators and liquor cabinets mainstays of their offices, seeing booze-filled parties as perks that attract young employees. But as tales of toxic workplaces and rowdy office parties at companies like WeWork grab headlines, a growing number of startups are ditching their corporate bacchanals in favor of meditation courses, SoulCycle sessions, and other wellness events.

While startups may be quick to innovate, they are relative latecomers to booze bans, following in the footsteps of larger, more buttoned-up companies in tech and other industries. Some of the more reckless forms of drinking—for example, the legendary three-martini lunches of Madison Avenue's Mad Men era—long ago fell out of favor. Still, it was only last year that the ad agency group WPP prohibited office drink trolleys and the consumption of alcohol at employees' desks.

Walmart doesn't allow office drinking at its headquarters, though it has made exceptions for some of the internet startups it has acquired. Insurance giant Lloyd's of London in 2017 banned drinking during work hours.

That same year, after Salesforce's then-CEO Marc Benioff saw kegs and other alcoholic beverages around company offices, he issued a stern reminder to employees about an earlier ban on alcohol on its premises (Benioff is now co-CEO of the company). The reckoning on sexual harassment that sparked the MeToo movement in late 2017 appears to be a key factor in the wider move to discourage drinking in workplaces.

But for tech startups, which have long prided themselves on their looser, more unconventional office environments, it has taken longer to clamp down on drinking.

Silicon Valley's "drunken parties went along with workplaces where there were Ping-Pong tables, but no place for a woman to pump milk except in the bathroom," said Huffington Post founder Arianna Huffington, whose latest venture is a wellness startup, Thrive Global. "It was part and parcel of the macho, bro-bravado mindset we saw exemplified in companies with major crises."

Huffington would know. Until earlier this year, she served on the board of Uber, the ride-sharing giant, which in 2017 commissioned a formal investigation, led by former U.S. attorney general Eric Holder, of its raucous work culture. Among his recommendations were de-emphasizing alcohol at work-related events and limiting the budget available to managers for booze purchases.

Some young tech companies have avoided introducing alcohol into their workplaces from the beginning. At Brex, a fintech startup founded in 2017 by Brazilian friends Pedro Franceschi, 23, and Henrique Dubugras, 24, there are no happy hours or refrigerators jammed with beers, despite the abundance of millennials who work there.

“When we looked at the problems that were happening in Silicon Valley, a lot of it seemed a result of excess drinking in the workplace and people doing stupid stuff they regret,” said Dubugras, Brex’s CEO. “It just seemed easier not to do it.”

Instead, Brex has organized scavenger hunts and outings to bowling alleys and the San Francisco Exploratorium, a science and technology museum. At company events and holiday parties, Brex allows employees to drink, but it doesn’t pick up the tab for alcoholic beverages.

“Wine is expensive,” said Dubugras.

Not everyone at Brex is a fan of the company’s strict alcohol policy, though, including some employees who regularly challenge the rule, according to Dubugras. “Maybe we’re more boring than others, but we like social activities that aren’t just drinking,” he said.

Something entirely different happened at Monday.com, a workplace software company headquartered in Tel Aviv, Israel. After employees stopped showing up for a weekly happy hour in its offices, the company cut it back to a quarterly event. According to Debbie Sharvit, who oversees the company’s human resources department, employees have shown little interest in alcohol in the office and instead requested kombucha, fitness classes, and other health-oriented perks, which the company agreed to provide.

At Mind Candy, a London-based creator of digital entertainment for children, the company provides employees with meditation courses, lectures on good posture, and running sessions in lieu of drinking events. The initiatives have strengthened bonds and renewed energy at the company, said Mind Candy’s COO, Rich Keen.

*‘When we looked at the problems that were happening in Silicon Valley, a lot of it seemed a result of excess drinking in the workplace and people doing stupid stuff they regret.’*

Meanwhile, leaders at Charity Water, a nonprofit that has received financial support from Alphabet and a number of tech luminaries, recently began debating whether to continue a Friday five o’clock beer and pizza happy hour.

“What is really being gained there?” said Lauren Letta, COO of Charity Water, which brings clean water to people in developing nations.

The partying at tech companies has long been a challenge for people struggling with addiction. Holly Whitaker, who worked at a Silicon Valley startup until 2014, in the wee hours one morning in early 2013 came to the realization that her company’s drinking culture was problematic, after a night of revelry with co-workers in Chicago that included doing simultaneous shots out of glasses attached to a ski.

“It simply normalized my own abuse of alcohol and my exceeding tolerance to it,” she said. “These were people that reported to me that I was drinking like that with.”

After getting sober in April 2013, Whitaker founded Tempest, which describes itself as an online sobriety school for people who are addicted to alcohol or who are merely “sober curious.” Whitaker believes many Silicon Valley companies use alcohol to foster an artificial sense of intimacy between employees.

“It’s such an easy thing for a company to do, to pour alcohol on it,” she said. “You don’t tend to use much creativity for that.”

The Information has previously reported on the CEO of a startup called Intercom, Eoghan McCabe, who was accused of harassing a female employee during a night of heavy drinking. A female Uber employee who once dated Uber's Travis Kalanick said she was with him and other Uber employees at an escort bar in South Korea.

“Even though being drunk is no excuse for sexual misbehavior, the truth is that there was a great correlation,” said Huffington of Thrive Global.

There are financial motivations to encourage employees to cut back on drinking. At Bluume, the marketing company, workers routinely showed up at the office hung over the morning after happy hour events. At a startup, said COO Brooks, “‘being off’ a single day could set you back weeks.”

“When your employees are healthy, not only are they more productive; they’re using their insurance less, and so their insurance premiums go down,” said Daniel Gartenberg, a co-founder of Sonic Sleep Coach, a company that seeks to improve people’s sleep through coaching and an app.

But there are unintended consequences, too, to pushing healthier lifestyles on workers.

In August, Upstream, a social networking application for professionals, began including a workout at SoulCycle, the indoor cycling chain, as part of a company gathering. One out-of-shape employee developed a painful muscle injury from the grueling workout. The morning after the workout, the employee, who asked not to be named for this story, found that he couldn’t stand up from his subway seat while on the way into the office, Upstream founder Alex Taub said.

“His wife needed to come get him from the stop,” Taub said.

By Christopher Budd



The arrival of 2020 is a chance to look back on the past decade and what it has meant for the world of technology. Recent security problems with security cameras sum up where we are today: technology designed to protect us has made us vulnerable instead. Pessimism, dread, and anxiety have replaced the optimism and progress that defined technology from its inception.

And yet the decade has also been defined by unprecedented advances, changing our lives and the world on a scale we might not yet even comprehend.

What happened? What can we learn from it? And how can we turn it around?

### 1. Social Media: Propaganda, Disinformation and Discord

Social media first emerged in the latter part of the 2000s. YouTube debuted in 2005, Facebook and Twitter really hit the mainstream around 2007. So technically these are innovations from the previous decade. But as we stood on the cusp of 2010, these and other social media platforms were new enough that we were all still figuring out what they could do. It was still a time of infatuation with the new technology.

This infatuation has now passed. Hopes and dreams have been replaced by reality: these platforms have caused harm that no one in 2010 could have imagined.

An obvious example is interference in the 2016 U.S. election. The leaders of Western democracies and social media companies were, like the rest of us, slow to understand how social media could be harnessed for malicious, manipulative purposes. Many of us looked at social media and saw ways to share cat memes and food pictures. Others saw the most advanced and efficient means ever devised to distribute propaganda and misinformation.

In addition to its role in election interference, social media has failed to live up to its potential to support human rights, democracy and positive social change. In 2009, Twitter was credited for helping protesters in Iran stand up to the regime. In 2019, we've seen authoritarian regimes shut down internet access and use Twitter and Facebook in malicious ways. The use of Facebook in the Rohingya genocide in Myanmar is one alarming example.

Even outside the realm of governments and propaganda, social media in the past decade has arguably driven people apart more than bringing them together. Social-media fights over politics, religion and a host of other issues have become commonplace to the point of cliché.

All of this makes social media — one of the most pervasive technologies in everyday life — at best a net neutral, and at worst a net negative.

## **2. Devices as Addiction**

Speaking of pervasive, let's examine the impact of mobile devices.

Make no mistake, the iPhone in 2007 was revolutionary, and Android soon followed. Similar to the introduction of social media, at the start of the 2010s, the role of mobile devices was still unknown and held great potential. Over the course of the past decade, however, we came to better understand what mobile devices could do for us, and to us. And it's the "to us" that is the problem.

In an [article](#) in The Guardian in October 2017, Loren Brichter (who created the iPhone's "pull to refresh" feature) admits and expresses regret that this capability has helped make mobile devices addictive, much like slot machines. Take a moment and look around at a restaurant and you'll see many people sitting at a table together, all glued to their mobile devices at the expense of conversation and interactions.

We read regularly about the challenges of kids being addicted to "screen time" and the resulting negative social and cognitive impacts. And we've seen the rise of technology meant to mitigate addiction (for kids at least) in the form of parental controls that limit screen time.

The place of mobile devices in our lives now is far from where it was in 2010. We don't talk about the promise it holds, but about the dangers and the problems.

Along with social media, mobile devices are the most common way people connect with tech in their daily life. And now, that connection is viewed as addictive, on par with tobacco, gambling, or opioids.

## **3. Data Breaches Everywhere**

The number and scale of data breaches since 2010 has skyrocketed in ways that even the most pessimistic among us wouldn't have predicted. It may well go down as the "Decade of Data Breaches."

You only have to go to [haveibeenpwned.com](http://haveibeenpwned.com), type in your email and see how many times your credentials have been exposed. At the time of this writing, that site alone counts more than 9 BILLION compromised accounts.

In conjunction with this, credit card fraud has skyrocketed, and identity theft is rampant.

The situation has gotten so bad that we're numb to it. A steady drumbeat of data breaches, compromising millions of accounts at a time, has bludgeoned us all into a sense of defeated resignation.

All of this has fundamentally and deeply eroded trust in the internet to the point where many people just assume that their data can and will be lost if it hasn't been already.

#### 4. Rise of “Big Tech”

In the United States, the label “Big” on anything is never good. Whether it’s “Big Government,” “Big Business,” “Big Oil,” or “Big Tobacco,” the “Big” moniker is a sign that an industry or institution has reached a size that violates American populist sensibilities.

Microsoft may have been “the Borg” or even “the Evil Empire” in its worst days, but it was never “Big Microsoft.”

Over the past few years, we’ve seen the term “Big Tech” emerge and be used with increasing frequency, bordering now on regularity. As a phrase, “Big Tech” puts Amazon, Facebook and Google into a single category. Sometimes Apple and/or Microsoft are included, but not as reliably as those three.

The label “Big Tech” has stuck as people have come to increasingly distrust and resent the power and influence of these large, successful tech companies. And the cultural resonance between “Big Tobacco” and “Big Tech,” as purveyors of something enjoyable but addictive and unhealthy, shouldn’t be underestimated.

This rise of “Big Tech” also impacts those within the industry. Many people went into technology over the decades not just out of personal excitement and enthusiasm but from a true desire to make a better world. Finding yourself working in an industry that is viewed as harmful on par with Big Tobacco runs directly counter to that sentiment, and has a real and deep impact.

#### 5. Loss of Optimism

Technology itself is the final problem. The engine that has driven the industry and its optimism since the 1970s has been innovation.

In 1980, we knew processors were coming that would make computers like the Apple II even more useful and powerful. In 1990, we knew that the Mac and Windows would be made better in the next versions. In 2000, the internet was new, and we knew more exciting things were coming. And in 2010, mobile devices and social media were still new enough that we knew (or thought we knew) that more, better technology was yet to come.

At the end of the 2010s, we just don’t have that same sense that something new, bigger and better is coming.



Partly, this reflects the march of time. Bill Gates is focused on philanthropy; Steve Jobs has passed away. Satya Nadella and Tim Cook have done good things for Microsoft and Apple respectively. And they're both rightly viewed as more "caretaker" than visionary CEOs. You have to go digging to see what Marc Andreessen is up to these days. The generation of visionaries has passed, and there's not a new generation to take its place.

This also reflects business realities. The goal for startups these days isn't necessarily to go public, like it was in the past, but instead to be bought up by a Microsoft or Google or Facebook. And while that's a perfectly valid business strategy, it does represent a literal focus on "selling out" rather than making it big on your own.

But ultimately this reflects the basic technical reality. Smartphones and social media, as noted above, came out in the last decade. The internet, the World Wide Web and web browsers are products of the 1990s. The personal computer is still around despite predictions of its demise, and that comes from the 1970s. In a lot of ways, the decades of optimism in tech have been fueled by early adopters, hobbyists, geeks and hackers. And as we come to the end of the 2010s, there's not much new for those audiences to build or buy, take home and try to build something new and revolutionary.

Indeed, in a poetic and prophetic sign, we just heard that Fry's Electronics in Palo Alto is closing.

Even where we do see promise of new technologies, in areas like artificial intelligence or quantum computing, those increasingly have a shadow of doubt and concern in light of the past decade. More importantly, these are technologies that look and feel more like something that would come out of IBM than Steve Jobs' and Steve Wozniak's garage.

Historians say it often takes a few decades before you can write history, so making pronouncements on the 2010s now could be premature. But I've heard a common refrain from my colleagues in tech these past few years: "It's just not fun anymore." And while that may seem like a shallow complaint, it points to a greater truth under the surface. The nature of the tech world has changed, people's attitudes towards it have changed, and it has lost the optimism and promise it once had.

Can that optimism come back? Yes, I believe so, and this is how.

First, the issues that impact trust must be addressed. Whether it's through regulation or self-regulation, the concerns around social media abuse, device addiction and data breaches must be resolved. Otherwise, tech will continue its trajectory towards "Big Tech."

Second, there must be a new generation of truly disruptive innovators who look at tech as a tool for individual liberation and have a determination to take on the IBMs of today and win. Turning this around requires the next generation of geeks, hackers and hobbyists to find their own inner Jobs and Gates, follow their own paths, and bring a renewed sense of hope and progress to the decade ahead.

By Nat Levy & Taylor Soper

It was a big 2019 for startups across the Pacific Northwest.

Venture capital dollars flowed into the region at record pace, minting several new unicorns — companies valued at more than \$1 billion — and fueling growth for a flurry of other early-stage startups.

Nearly \$4 billion went to startups based in the Pacific Northwest, according to GeekWire’s funding deal tracker. A big chunk of that went to fast-growing unicorns such as Convoy, Outreach, Autho, Icertis, and others who remain atop the GeekWire 200, our ranking of the Pacific Northwest’s privately held tech startups.

But investor cash doesn’t tell the whole story of the bubbling activity in the region.

There were some key exits, including Prudential’s massive \$2.3 billion acquisition of insurance tech startup Assurance, which bootstrapped its way to success. Business cloud software giant Workday acquired Seattle-based Trusted Key, which spun out of Kernel Labs, one of several startup studios in Seattle.

Biotech company Adaptive Biotechnologies went public this past summer, and employee wellness platform Limeade just did the same. Nike swooped up TraceMe, a Seattle startup founded by Seahawks star Russell Wilson and backed by Jeff Bezos, helping to set up a new “Nike Seattle” tech office.

Amid the growth, there were downfalls.

Multiple Seattle startups including wellness company Arivale and high-tech football helmet maker Vicis shut down. Just this week, another startup, Magic AI, closed its AI-powered horse monitoring tool.

In between it all, there were a bevy of early-stage startups — many led by veterans of local tech giants such as Amazon and Microsoft — working away at their potentially game-changing ideas that could be the region’s next Expedia, Zillow, or Tableau.

### **A year of big deals**



From left: GeekWire co-founder John Cook, Autho CEO Eugenio Pace, Convoy CEO Dan Lewis, and Outreach CEO Manny Medina

This year saw seven deals in excess of \$100 million, compared to four last year. These deals alone totaled \$1.44 billion in investment in the Pacific Northwest's top startups.

On-demand trucking startup Convoy led the way, raising a massive \$400 million round at a \$2.7 billion valuation in November. It was the biggest round in for a Seattle-area company in more than a decade and brought total funding for the company to \$668 million.

Here are the other major deals of 2019:

**Vacasa:** The Portland, Ore.-based vacation rental platform raised \$319 million in October.

**Clio:** The Vancouver, B.C.-based company aims to infuse law firms with technology and raised \$250 million in September.

**Remitly:** One of Seattle's top startups that uses mobile technology to help people send and receive money across borders, including immigrants who support families back home. Remitly raised \$220 million in July, including \$135 million in equity and \$85 million in debt.

**Icertis:** The Bellevue, Wash. contract management startup joined the unicorn club in July when it raised \$115 million.

**Outreach:** Another new unicorn, the sales automation startup reeled in a huge \$114 million round in April.

**Autho:** The startup that helps developers build identity authentication capabilities into their applications raised \$103 million.

### Waiting in the wings

Seattle is becoming a key hub for life sciences and biotech innovation. There were several related startups that are poised for growth and raised cash in 2019, including Icosavax, Viome, Bardy Diagnostics, Navigating Cancer, Faraday, KenSci, Immusoft, Magnolia Medical, and others.

Real estate is also a theme for the Pacific Northwest tech scene, anchored by longtime industry leaders Zillow and Redfin. Startups including Crowdstreet, Modus, Flyhomes, Blokable, Knock, and Pro.com all raised capital this year.

And you can't talk about the Seattle tech industry without mentioning Amazon. Much like veterans of Microsoft have done over the past several decades, Amazon is slowly but surely spawning entrepreneurs who are taking lessons learned and spinning out their own startups across industries such as retail, logistics, and media. Some examples of newer Seattle companies led by Amazon vets include Ideoclick; Shipium; Downstream; Spiral; Veeve; and others.

### Women-led startups

Companies with all leadership teams made up entirely of women raised \$3.3 billion nationwide in 2019, according to PitchBook. That may sound like a lot, but it represents a paltry 2.8 percent of all VC funding across the U.S., reflecting ongoing challenges of bias and inequality in the larger world of investing and venture capital.

The numbers are a little better when looking at startups with at least one woman co-founder. In 2018, these companies raised \$46.3 billion, more than double the prior year, or roughly 18 percent of VC funds invested nationally, per PitchBook data. It doesn't look like we will see a similar jump this year, as companies with at least one woman leader raised \$18.7 billion through the end of August.

At the beginning of the year, we reported that 16 companies on the GeekWire 200, our ranking of the top Pacific Northwest tech startups, are led by women, or 8 percent. That's a little better than the larger business world, where

women made up 5 percent (24 CEOs) of the annual Fortune 500 list in 2018, down from an all-time high of 32 women CEOs on the 2017 list.

Last year, DreamBox Learning, led by the Big Tech CEO of the Year winner at the 2019 GeekWire Awards Jessie Woolley Wilson, raised \$130 million in one of the biggest rounds of 2018.

This year, the biggest deal for a woman-led startup was a \$33 million round for nutPods, a maker of plant-based dairy alternatives. Founded by Madeline Haydon, the company was named Small Business of the Year as part of Amazon's Small Business Spotlight Awards earlier this year. Haydon was also a EY Entrepreneur of the Year award winner.

Here are a few other notable deals for women-led startups in the Pacific Northwest in 2019:

- In January, Seattle startup Modumetal reeled in a \$14 million investment round led by Vulcan Capital to scale up production of a unique metal that the company says offers better performance at a cheaper price than conventional steel.
- High-tech clothing rental startup Armoire completed a \$3.9 million seed round in June and at the same time scooped up a new 7,500 square-foot office in Seattle's Pioneer Square neighborhood that serves as headquarters, warehouse, and retail space all in one.
- Evrnu makes technology that takes discarded consumer apparel waste and converts it into renewable fiber. The startup raised \$9.1 million in October and is licensing its technology to companies like Levi's, Adidas, and Target.
- In October, IOTAS, a Portland, Ore.-based startup that helps landlords install and manage smart home devices raised \$8.5 million.

By Anne-Françoise Pelé

The internet of things (IoT) is becoming the internet of everything. More industries are looking to connect their machines and applications, and more users are enjoying the functionality of their smart devices. Market research firm McKinsey predicts IoT's economic impact will be in the range of \$4 trillion to \$11 trillion per year by 2025. Microelectromechanical systems (MEMS) and sensors are an essential part of the IoT phenomenon.

The best way to grasp the nature of this growing market is to look back at the world events and trends that topped the news in 2019 and are most likely to change the course of action in 2020, if not over the next several decades. The five most influential events in sensors this year were a long-debated acquisition, the resurfacing of a compute concept that's set to become the cornerstone of artificial intelligence (AI), the launch of a promising new player by sensor industry veterans, a market-rejuvenating technology based on an effect discovered more than 100 years ago, and a push to think and act "locally."

### 1. AMS acquires 59% of Osram shares

After months of negotiations and speculation, Austrian sensor company AMS AG finally acquired enough shares to take over photonics specialist Osram Light AG.

In December, AMS said the acceptance rate in its \$5.1 billion (€4.6 billion) takeover offer was 59.3 percent and exceeded the minimum acceptance threshold of 55 percent.

"Our goal is to create a global leader in sensor solutions and photonics, based on European technology," Amy Flécher, vice president marketing communications for AMS, told EE Times. Stressing the complementary nature of the two businesses, she added: "Osram is the leader in visible- and invisible-light emitters and aspires to develop IC-design, optics, and optical-packaging capabilities," while AMS has "IC-design, optics, and optical-packaging capabilities and aspires to add a leadership position in emitters."

An underlying reason for the takeover bid is that AMS is heavily reliant on a single customer: Apple. Acquiring Osram expands AMS's business and diversifies its revenue mix. In the first half of 2019, AMS's consumer business accounted for 75% of its total revenue, while the automotive business and the industrial and medical businesses accounted for 10% and 15%, respectively. The long-term goal is to generate 35% to 40% revenue in both the automotive and consumer businesses and 20% to 30% in the industrial/medical business.

Calling the deal "a Christmas tale in which the rising star is acquiring the falling giant," research and strategy consulting firm Yole Développement said AMS would now be able to take a strategic foothold on the European semiconductor scene. The companies' revenue was a combined \$6 billion in 2019, comparable to other big European players such as Infineon, STMicroelectronics, and NXP.

AMS said it aims to close the transaction in the first half of 2020.

### 2. Neuromorphic sensing: A brainy direction

Deep learning is "not actually learning," said Mike Davies, head of Intel's neuromorphic computing unit, at this year's International Solid-State Circuits Conference. His words revived the neuromorphic-compute debate in the AI community at a time when both data-bandwidth constraints and computational requirements are escalating.

Neuromorphic means "taking the form of the brain." Introduced by Carver Mead in the 1980s, neuromorphic

engineering, also known as neuromorphic computing, uses very large-scale–integration systems containing analog circuits to mimic neurobiological architectures present in the human nervous system.

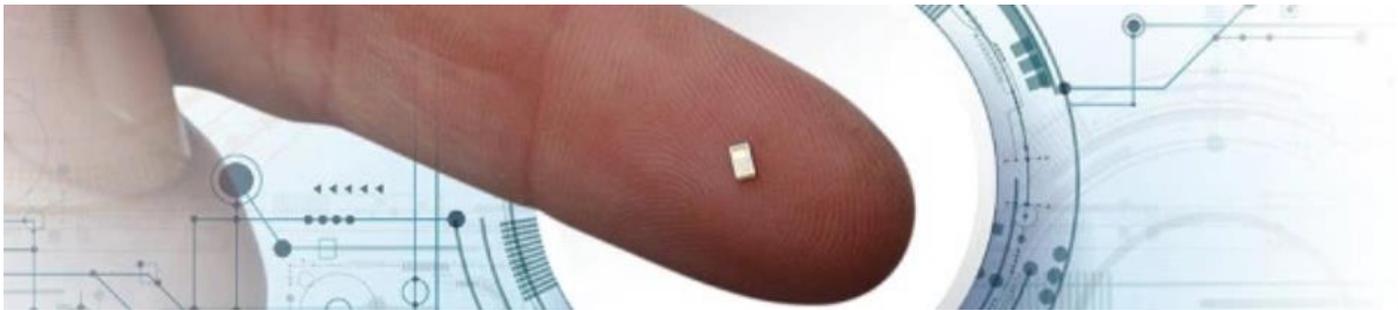
In an interview with EE Times, Pierre Cambou, principal analyst for imaging at Yole, said that neuromorphic sensing and computing could solve most of AI’s current issues while opening new application perspectives in the next decades. “Neuromorphic engineering is the next step toward biomimicry and drives the progress toward AI,” he said.

An ecosystem of neuromorphic-sensing startups has indeed emerged, with roots that date back to the invention of a silicon retina by Carver Mead’s student Misha Mahowald at the Institute of Neuroinformatics and ETH Zurich in 1991. Insightness was founded in 2014 as a spinoff of ETH Zurich and the University of Zurich. It designs vision sensors that allow motion detection within milliseconds even if the sensor itself is moving. Other spinoffs from ETH Zurich include iniLabs, an event-driven–camera developer, and iniVation, a developer of neuromorphic event-driven vision systems.

Similarly, Prophesee, formerly known as Chronocam, bloomed from breakthrough research conducted by France’s Vision Institute (CNRS, UPMC, INSERM) on the human brain and eye over the past 20 years. Prophesee recently rolled out what it claims is the first event-based vision sensor, in an industry-standard package.

At the packaged-semiconductor level, Yole said it expects neuromorphic sensing to grow from \$43 million in 2024 to \$2 billion in 2029 and \$4.7 billion in 2034.

### 3. Ex-InvenSense execs form UltraSense



Mo Maghsoudnia, Dan Goehl, Sina Akhbari, Stan Liu, and Hao-Yen Tang have more than 10 years of experience in commercializing ultrasonic products and own more than four technology patents. They all worked for InvenSense and left the company around the time of its acquisition by TDK Corp. for \$1.3 billion. In mid-December, they formally announced the launch of UltraSense Systems Inc. and introduced what they claim is the smallest ultrasound sensor-on-chip for touch and gestures through any material of any thickness, including metal, glass, wood, ceramic, and plastic.

UltraSense has made mobile handsets its primary focus because “adoption is relatively quick, and we are hitting the market at the right time with the launch of 5G technology, in particular millimeter-wave 5G,” said Dan Goehl, chief business officer at UltraSense. The startup also sees prospects in the consumer and automotive spheres, with “a lot of proofs-of-concept going on with several automotive suppliers for various types of applications,” he said.

Although UltraSense is not the only one to develop this kind of ultrasound technology, its contributions could hasten the demise of mechanical buttons and shape the future of user interfaces.

### 4. The influence of the piezo effect

The universe of applications for piezoelectricity has been expanding ever since French brothers Paul-Jacques and Pierre Curie discovered the piezoelectric effect more than a century ago. According to Yole Développement, the market for piezoelectric sensors, actuators, and transducers is expected to reach \$48.5 billion in 2024, with a 12.6% CAGR from 2018 to 2024.

“Piezoelectric MEMS are disrupting the traditional, capacitive-microphone approach thanks to [piezo MEMS]’ waterproof, dust-proof and ultra-low power consumption” characteristics, Dimitrios Damianos, technology market analyst with Yole Développement, told EE Times. What’s more, “piezoelectric MEMS technology has started rejuvenating the MEMS market, spreading to other devices such as micro-speakers, piezoelectric micromachined ultrasonic transducers, autofocus, etc.”

Vesper Technologies Inc., a Boston-based provider of piezoelectric MEMS microphones, recently announced that its ZeroPower Listening technology had been certified by Amazon for extended battery life and far-field voice interactions. The certification follows Amazon’s financial backing of Vesper’s technology in 2018 and underscores the tech giant’s faith in the piezoelectric approach.

On the research front, thin-film piezoelectric architectures are seen as promising candidates as they offer enhanced process uniformity, higher reliability and yields, and a smaller footprint and chip size. The Fraunhofer Institute for Silicon Technology is focusing on multilayer aluminum nitride, a material with very high piezoelectric coefficient, and CEA-Leti has figured out a way to transfer thin-film PZT to a transparent glass substrate in order to obtain a transparent piezoelectric structure.



(Image: Yole Développement)

## 5. At the edge

Sensors are getting smaller and smarter. They can now perform much more than just converting physical parameters such as moisture, dust, heat, and motion to analog electrical signals or digital data.

For example, Vayyar claims it has designed a small, sensor-based chip that, with its 72 transmitters and 72 receivers, tracks and maps everything without a camera. The technology can detect obstacles and monitor people’s location, movement, height, posture, and vital signs wirelessly, in all lighting and weather conditions and in real time. A key differentiator is its ability to “see” through walls, closed doors, and other solid objects, the company said. And because Vayyar’s approach uses radio-frequency waves — rather than cameras and optics — to detect objects, its sensors do not collect any optical data, protecting users’ privacy.

Because sensors collect massive amounts of unstructured data, it often makes more sense to process the data locally rather than send it to the cloud. Running AI algorithms at the edge, directly in the sensor, indeed offers several user benefits, Markus Ulm, CTO of Bosch Sensortec, told EE Times. The first one is personalization; because the calculation is performed locally, it can be optimized for the user based on that person's behavior. Second, edge data processing without cloud involvement safeguards the privacy of user data, Ulm noted.

The third benefit is real-time feedback, said Ulm. "By passing stuff to the cloud and getting it back, you experience some latency and, in many cases, it is unwanted." Executing at the edge avoids data transfer and thereby reduces latency. Fourth, local processing extends battery life.

Edge AI is still at an early stage of development. Various challenges have not yet been overcome, as the machine-learning community has been mainly focused on cloud-based solutions to address big-data requirements and large-scale problems. But the potential is there.

By Eugene Demaitre

For the past decade, robotics has been one of the most interesting areas for developers, industry analysts, and startups to focus on. From emerging technologies and new applications to ongoing challenges, both innovators and entrepreneurs will have a lot to watch in 2020.

The Robot Report spoke with the following executives at robotics and artificial intelligence companies about their observations of 2019's trends, as well as their expectations for the new year:

- Sudhir Jha, senior vice president and head of Brighterion Inc., a Mastercard company that uses artificial intelligence and machine learning to provide mission-critical business intelligence in real time, regardless of type, complexity, or volume
- Max Versace, co-founder and CEO of Neurala Inc., whose Brain Builder software platform applies AI to visual inspections
- Thomas Visti, CEO of Mobile Industrial Robots ApS, which makes collaborative autonomous mobile robots (AMRs)

Which technologies do you expect to mature the most in 2020, such as the Industrial Internet of Things (IIoT), edge computing, 5G wireless networks, or autonomous vehicles?

Visti: In 2020, Industry 4.0 will become more of a reality than a vision. Smart machines keep getting smarter as they get access to more data, and they keep getting better at connecting to other machines and systems, and therefore they become truly useful for manufacturers.



*Thomas Visti, Mobile Industrial Robots*

While many companies have been hesitant and seen Industry 4.0 as merely a buzzword, we're starting to see connected supply chains where MES [manufacturing execution systems], robots, and picking systems are connected.

We also see the connectivity between robots and ERP [enterprise resource planning] systems within production environments.

The entire process — from ordering to producing and then transporting goods — can now be fully automated. Industry 4.0 is still evolving, and it will not reach its full potential in 2020, but we will see more companies adopting the enabling technologies. This will also influence the workforce, as we will see the same companies wanting to upskill their current workforce and recruit new employees with Industry 4.0 skills.

Versace: We'll see more demand for AI that can be trained, deployed, and refined at the edge. 2019 has shown us that many organizations, robotics companies included, are saying "No" to giving up their data and having to ping the cloud.

I believe that in 2020, AI will need to live and learn at the edge, so that processing occurs where the data is being generated. As a result, robotics companies will see reduced latency problems while mitigating privacy issues and massive cloud fees for manufacturers.



Sudhir Jha, Brighterion

Jha: Enterprises will transition into deploying complex AI models in production at scale. So far, most AI applications are experiments but not in production, simple recommendation/prediction/regression models, or applied to smaller problems.

In 2020, we will see more enterprises getting bolder with their AI ambitions and requiring their vendors to support large deployments.

There will be an acceleration from automation to autonomy, and AI will play the most crucial role in this. Also, robotics will move further from industrial arena to consumer arena, where they will act as personal coaches, instructors for children, conversational buddies for elders, and guides for the disabled.

Which market or application represents the biggest area of growth potential in 2020?

Visti: We expect to see an increase in the use of robotics in all our existing markets such as automotive, electronics, FMCG [fast-moving consumer goods], pharmaceuticals, and more.

There is still a huge focus on optimization, and with the lack of qualified workers, the need for automation across industries has never been higher.

We expect big growth in the use of AMRs by the 3PL [third-party logistics] segment, which has not been an early adopter of AMRs. In fact, our recent survey showed that only around 50% of 3PLs are currently considering automating internal logistics with AMRs. We expect to see this figure increase significantly in 2020 and the years ahead.



The hospital sector is also looking to automate internal transportation worldwide. For MiR, we have many customers within this segment in Scandinavia and China, but we expect it to grow even more.

Jha: Verticals like healthcare will see expanded AI-based applications, not only in the areas of diagnosis and personalized medicine, but also on the operational side like customer service, payment processing, and FWA (fraud, waste, and abuse).

How will trade conflicts or the slowdown in automotive manufacturing affect robotics in 2020?

Visti: While the automotive manufacturing market may have slowed, the latest statistics from the Robotic Industries Association actually shows what looks like an uptick in ordering of industrial robots by automotive OEMs, up 47% for 2019 over 2018.

We're also experiencing increased growth in that market and overall, with companies like Toyota and Ford purchasing fleets of our AMRs.

We expect this is due to these manufacturers realizing how automation can help fill difficult-to-fill jobs; increase overall productivity; and enable humans to focus on higher-skilled, higher-quality, and higher-paid tasks. These are all benefits that can lead to growth and new job opportunities, which could help turn the automotive industry back around.

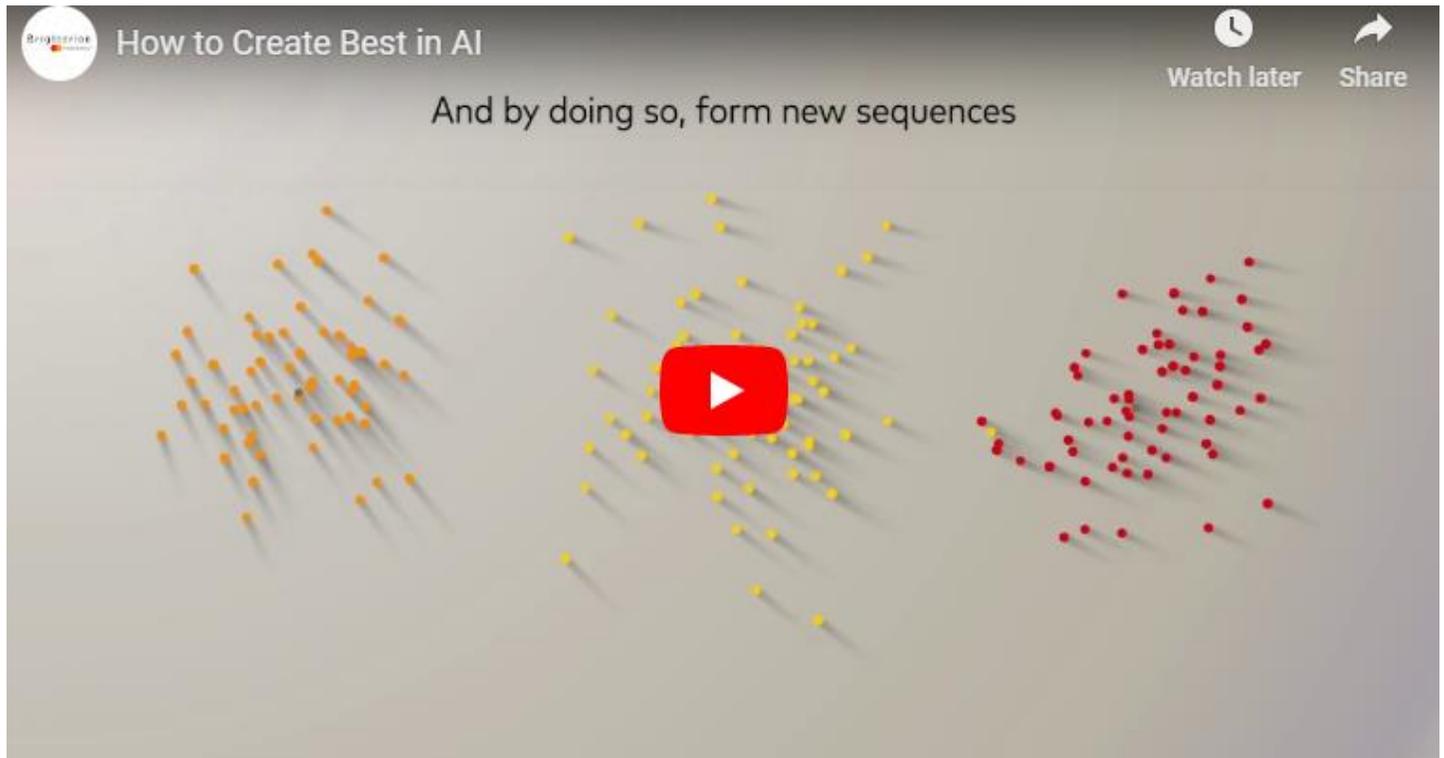
Versace: We will always be faced with some degree of socioeconomic uncertainty around the world. In terms of manufacturing, possible decoupling of Chinese and Western economies may actually bolster manufacturing in the U.S. and make it less reliant on overseas production in the long run. This may indirectly boost robotic deployments in the U.S. and Europe.

But at Neurala, we're focused on what we can control, which is first and foremost to provide robotics and other companies with an AI platform that they can apply to solve real-world challenges. Our Brain Builder platform is helping organizations accelerate the process of building, deploying, and analyzing AI so they can focus on improving visual inspections.



What challenges and opportunities do you expect for AI in 2020?

Jha: As AI-based solutions become more mainstream across industries, we need to carve out a handful domain where our technology provides sustainable differentiation and allows us to be a leader



We have focused on risk and compliance areas in financial services and are looking to diversify in other verticals. Also our strength in building mission-critical applications in highly regulated industries will serve us well to ensure data privacy and ethical use of AI which is a growing trend globally.



Max Versace, Neurala

Versace: I'm thinking of 2020 as the "Year of Productization and the Customer."

At Neurala, we'll continue to work with customers so that they can independently build and deploy custom AI applications for the real world.

Furthermore, AI products such as Brain Builder will enable customers with little or no expertise in AI to build an end-to-end application from scratch, on their proprietary data. This means that enterprises will no longer be restricted by their size or resources when it comes to implementing AI as a part of their business strategies.

By Karen Field

Less expensive, computationally less demanding, and impervious to almost all environmental conditions, radar technology offers a compelling advantage in many automotive safety applications. Little wonder, then, that it accounts for more than one third of the automotive collision avoidance sensor market, according to Grandview Research.

Key applications where radar is currently being used are in adaptive cruise control, blind spot detection, forward collision warning, intelligent parking assistance, autonomous emergency braking, and other advanced driver-assistance systems (ADAS).

And its market share is on the rise: The National Highway Traffic Safety Administration (NHTSA) announced that all automakers will supply collision avoidance by 2022, and further development of autonomous vehicles will present even more opportunities.

But as the usage of radar technology in cars increases—and thereby the number of sensors operating in proximity to each other at the same time—so does the potential for increased levels of interference. And interference can impact the very thing that is critical to get right in safety applications: detection performance.

Concern over this specific issue prompted NHTSA to conduct a study on radar congestion. Published in September 2018, the results of the study show that levels of interference based on operation of current systems in congested environments will be significant.

Here's how it works: Assume, for example, two cars approach an intersection, facing each other. Both cars have a front-looking radar sensor operating in the 76-77 GHz band. Both sensors are expected to send signals in the 76-77 GHz band, and the reflected signals from the objects (metal body of the other car, in this case) come back to each sensor for processing to confirm the detection of the car in the front.

Interference or cross-talk occurs when one sensor captures signals from the other sensor along with its own reflections from the object. If the interference is ignored, the result could be a missed object, false detection, or the manifestation of a ghost target, which is a reflection of the actual target.

The NHTSA report noted that “Up to this point, attention has been paid to making the technology operate, and not much consideration has been given to the mutual impact of the highway infrastructure and safety systems when deployed.”

But that doesn't mean various strategies are not under active investigation.

Today component suppliers and radar sensor designers are looking at different approaches to detect and mitigate interference. The report noted several, including:

- A technique focused on detecting interference and repairing receiver results in time domain
- Stretch processing, which lowers the systems' overall signal-to-noise ratio
- Digital Beam Forming, which allows the radar to restrict the receiver's spatial field of view

To get an industry perspective on current thinking around interference detection mitigation, we talked with Sneha Narnakaje, Business Manager and Director of Marketing, Automotive Radar, at Texas Instruments.

"As the number of radar sensors per car increases and the number of cars with ADAS functionality increases, TI also agrees that there would be potential risk of interference or cross talk," said Narnakaje.

Namakaje noted that there are approaches within region/country specific regulation bodies to deploy radar more efficiently depending on the application. "The FCC has expanded the spectrum available for vehicular radars, to include the entire 76-81 GHz band, with 76-77 GHz regulated for moving vehicles and ADAS functions," Namakaje said.

For long range detections and highway conditions, 76-77 GHz could be used, she noted, while for short range detections and urban conditions, 77-81 GHz could be used. "Traffic management or monitoring could use the unlicensed 60 GHz band, so the sensor usage is distributed across frequency bands and the environment becomes less prone to interference or crosstalk. Even the sensor installation orientation on the car will also play role in the interference environment."

She noted there are also developments in chip architectures targeted at helping to mitigate interference.

TI, for example, said there are performance advantages to using its complex-baseband architecture in Frequency Modulated Continuous Waveform (FMCW) radar systems. ADAS uses this type of sensor, which is less prone (although not immune) to interference due to the continuous waves.

The technology was designed mainly for RF performance reasons, but TI engineers found a way to exploit this architecture to detect interference more accurately and efficiently and deal with it.

And that's exactly what industry is focusing its efforts on now.

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## SoftBank is still writing big checks—even after the WeWork debacle

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By James Thorne

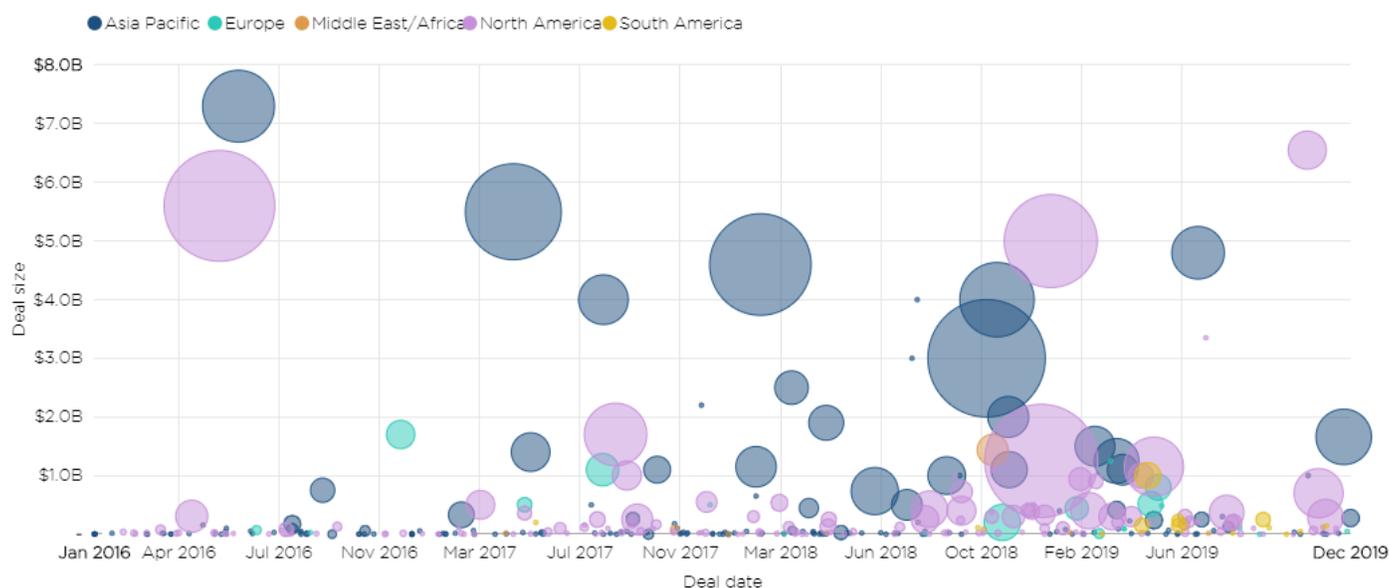
After WeWork's IPO went bust, the investment world's attention zeroed in on its chief backer, SoftBank. In the wake of such a disaster, would the tech industry's most prominent investor continue to back money-losing startups with extraordinary sums? Or would SoftBank CEO Masayoshi Son go from gutsy to gun-shy?

SoftBank is back to its old, bold ways after a brief lull. But to keep up the pace, it will need major new commitments from the world's largest investors.

The Japanese conglomerate closed out 2019 with a slew of funding rounds that showed it continues to hunt for big deals in daring startups. In November and December, SoftBank participated in rounds worth more than \$4 billion, including billion-dollar-plus rounds for Indian financial technology startup Paytm and Chinese real estate tech company Beike, as well as six other mega-rounds of more than \$100 million, according to PitchBook data.

The recent activity shows that SoftBank was busy placing new bets even as it orchestrated a \$9 billion bailout for WeWork, a period during which it announced few deals.

### SoftBank investment timeline



Exactly how long SoftBank can continue this pace remains unclear. The company has reportedly deployed 85% of the Vision Fund and plans to use what's left on follow-on investments rather than new deals.

Meanwhile, SoftBank has reportedly only closed \$2 billion of its second Vision Fund. The two sovereign wealth funds that contributed nearly half of the original Vision Fund—Saudi Arabia's Public Investment Fund and Abu Dhabi's Mubadala Investment Company—have yet to commit to the new fund.

The Vision Fund reported an operating loss of \$8.9 billion in October related to WeWork and Uber. The losses are especially concerning because of the financial structure of the fund, 40% of which takes the form of preferred stock that promises investors 7% per year. That interest works out to as much as \$2.8 billion annually.

When SoftBank announced that it expected to raise more than \$100 billion for Vision Fund 2 in July, the firm touted corporate backers Microsoft, Amazon, Foxconn and several financial institutions. But it only mentioned one sovereign wealth fund, from the government of Kazakhstan, which has roughly \$60 billion in assets—a far cry from the hundreds of billions controlled by PIF and Mubadala.

If SoftBank wants to keep the good times rolling, it will most likely need to convince the world's largest sovereign wealth funds that the strategy is working.

**In 2020, key technology building blocks in ambient computing will be ready for broader adoption and start to appear in consumer products.**

By Patrick Workfolk

Straddling the border between two decades, it's now clear that the most impactful technological development of the past 10 years was the evolution of the smartphone into the most widely used computing platform in the world. Looking forward, the next decade will be marked by ubiquitous ambient computing, with sensors, displays, processors, and communications capabilities embedded throughout the physical environment.

In 2020, a couple of technologies that are essential building blocks in ambient computing will be ready for broader adoption and will start popping up in consumer products. Here are the four emerging developments I think will have the biggest impact:

### **1. Edge processors with artificial-intelligence engines**

Putting processors with powerful neural-network compute accelerators in smart speakers, smart displays, security cameras, and other Internet of Things (IoT) devices will make them faster, more reliable, and more private. Right now, if you ask Alexa to turn on the living-room lamp, the trigger word will be detected in your device and then your voice will be streamed to a data center in the cloud for speech recognition and interpretation. Subsequently, a message is typically sent to a second cloud facility that will communicate instructions back to the lightbulb.

New, efficient neural-network compute technology and new methods to compress hugely complex neural networks will give these devices the power to recognize speech, interpret images, and identify patterns without sending data to the cloud. Thus, video and audio of every intimate moment at your home will stay in your home, rather than being transmitted to an unknown data center in the cloud.

Many high-end smartphones already contain chips with specialized circuitry to efficiently process the huge computations required for computing using neural-network algorithms. Advances in this technology now allow it to be implemented in processors that are economical to deploy in devices that retail for less than \$100.

### **2. Perception through computer vision**

Thanks to the combination of low-cost, high-performance image sensors and advances in computer vision through the use of deep-learning algorithms, a multitude of devices now can interpret images, not just capture them. Your doorbell will have different sounds for your neighbor, the UPS carrier, and a stranger, as well as recognizing different vehicles in your driveway.

Instead of simply receiving a stream of motion events that may or may not contain anything interesting, you will only get notified when a meaningful event occurs. Furthermore, the AI engine technology previously mentioned will allow these compute-vision algorithms to be run in edge devices, maintaining your privacy while perceiving the world around them.

In addition to working on live camera streams, computer-vision technology can be applied to video. Your streaming video box will be able to skip or select scenes based on their content. Imagine, for example, watching the highlights of a baseball game using a computer-vision system that zooms past everything but plays where the ball is hit. Alternatively, perhaps you want to just watch clips of the game that include your favorite player. Your smart video device will be able to create an endless assortment of personalized, individual highlight reels.

### **3. Proactive interaction with devices**

Today, to interact with a smart device, you need to wake it and issue an explicit command. “Hey Siri, show me the video from the baby monitor.” Increasingly, the technology will be able to take the initiative, handling some tasks automatically and alerting you only when necessary. You won’t have to check on the baby every 10 minutes; the computer-vision system will notify you if she wakes up.

Your tea kettle might notice a pattern when you come home from work and ask you, “Would you like to heat water every weekday afternoon when the garage door is opened?” These proactive capabilities are enabled by advances in computer vision and the ability to run the algorithms in the edge devices.

### **4. Ambient computing at work**

Most of the innovation in the IoT has been around the development of smart-home devices. Workplaces already have security, communications, and computing infrastructures, using older generations of technology. This year expect to see more companies deploying sensor, voice interface, and edge processing technology to embed connected intelligence into the physical environment of their offices.

Think about the time you’d save if you didn’t have to set up the slides and video conference for a presentation. As soon as you walked into the meeting room, your face will be recognized, the people on the invite list will be connected, and your presentation will appear on the screen. If you need to change something, just ask. “Office assistant, connect to Chris in accounting and bring up the third-quarter sales projection.”

In 2010, you could already see the rapid evolution of smartphones with touchscreen interfaces, selfie and world-facing cameras, and always-connected data. Nevertheless, few could imagine all of the ways those technologies would be woven together and applied. This leads me to one final prediction: Prepare to be surprised by what the IoT does for you over the next year.

We’re at an exciting point in time when lower costs and higher performance enable widespread deployment of smart connected sensors and interface devices. We’re also learning a great deal about how to build useful applications, many employing artificial intelligence, that take advantage of these technologies. As much as these four developments are going to impress people in 2020, remember that the decade of ambient computing is only just beginning.

By Anna Escher



Loft may have better product market fit in Brazil than Opendoor does in the U.S. And now the São Paulo-based property tech company has growth funding to prove it.

Andreessen Horowitz is doubling down on its first Brazil investment with Loft, a two-year-old real estate marketplace. The \$175 million Series C was co-led by Vulcan Capital.

In the U.S., sites like Opendoor give us visibility into how much your house or properties you're interested in are worth. That transparency doesn't exist in Latin America.

Loft founder and co-CEO Mate Pencz describes the residential real estate market in Latin America as a \$6 trillion opportunity. As it exists now, lack of data transparency around property listings results in low-quality listings, disproportionately high asking prices and prolonged selling times. This creates a painful experience for buyers, sellers and brokers. The market is locked up, but Loft thinks it can create transparency and liquidity with open data sets for property value.

Loft has been supported by some pretty big Silicon Valley names since its genesis in 2018. Loft raised equity capital from angel investors such as Max Levchin of PayPal, Joe Lonsdale of Palantir, Opendoor founder Eric Wu, Mike Krieger of Instagram, David Vélez of Nubank and Josh Kushner of Thrive Capital, whom Pencz met during undergrad studies at Harvard. It helped that Loft was not Pencz's first entrepreneurial rodeo — the founder started web-printing company Printi, which exited to Vistaprint in 2014 for a \$25 million stake.

### **Growth-stage funding will enable Loft to scale**

Pencz says they've transacted on 1,000 properties in their key market of São Paulo, and plans to tackle new cities with the "Uber growth model" of replicating the same service in new cities, like Mexico City. Loft is currently operative in Brazil, and has big plans for Mexico in 2020. Pencz has poached the Latin American head of Uber Eats, Juan Pablo Ramos, to launch Loft's services in Mexico City within the next two to four months. As Loft mobilizes in Mexico, this could mean trouble for Flat, an existing Opendoor clone in Mexico, which will now fight for market share against a heavily funded competitor.

When it comes to marketing, Loft isn't thinking about Facebook or SEO performance advertising. Pencz sees more value in physically integrating the Loft brand into the fabric of new neighborhoods through festival sponsorships and community events, while leveraging broker channels. "Partnering with brokers and being perceived as a positive brand with a high NPS are the two key pillars of Loft's expansion strategy," says Pencz.

The founders began by physically measuring buildings and making estimates about how much houses and apartments were worth. The founders didn't stop there — they envision the future of Loft as a one-stop shop with services like renovations, property financing for mortgages and insurance through banks. The company wants to completely upend real estate in Latin America, and those big ambitions have piqued investor interest.

Andreessen Horowitz and Vulcan Capital co-led the Series C, with participation from QED Investors, Fifth Wall Ventures, Thrive Capital, Valor Capital and Monashees.

### **So, what is a16z’s Latin America strategy?**

Andreessen Horowitz general partner Alex Rampell notes that while Loft marked the firm’s entry into Brazil, the fund has been active in Latin America for a few years: a16z invested in Colombia’s delivery unicorn Rappi, Uruguayan restaurant management platform Meitre and Colombian point of sale lender ADDI. And, a16z joined in Loft’s \$70 million Series B that closed in March 2019.

Rampell, who previously invested in Opendoor and sits on the board of TransferWise, says that a16z doesn’t really have an investment strategy when it comes to Latin America. Instead, the idea with Loft was that while the iBuyer Opendoor for transactional multiple listing services isn’t by any means a proprietary business model, it may work better in a country like Brazil — where buyers and sellers are slowed down by bureaucratic policies and lack of fair market value data — than in the U.S. To put it simply, Loft has better product market fit in Brazil than Opendoor does in the U.S.

Rampell references the U.S.’s Groupon and Korea’s Coupang for comparison. The Groupon model blew up in Asia as Coupang’s valuation reached \$9 billion. Groupon rose fast and fell hard, and now its founders are on to their next entrepreneurial ventures.

“There’s a lot of value in multiple listings services, and the opportunity might be better for a market like Brazil, especially if you back the right entrepreneurs — because that’s all that really matters in the end,” says Rampell.

Loft monetizes through the sale of properties and ancillary products. Cuts from referral and partnership fees from banks or insurance companies will continue to help Loft monetize, in addition to the \$275 million in capital it has raised during its two short years in existence.

Pencz declined to comment on Loft’s valuation.