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.

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European Privacy Breach Fines Hit 114 Million Euros
Regulators in Europe have imposed 114 million euros ($126 million) in fines for privacy breaches since the European Union's General Data Protection Regulation came into effect in mid-2018, Reuters reported, citing a report by a law firm examining the fines. The largest fine, of 50 million euros, was imposed by France on Google. The Netherlands, Britain and Germany had the highest number of notifications under the law. Britain has proposed the largest fine—$239 million—but it has yet to be levied against the parent company of British Airways.

The amounts of the fines are very small when compared to the multi billion dollar penalties that the EU has imposed on big U.S. companies for anticompetitive behavior. The results of hitting the companies with big fines has been mixed. They have appealed and the cases have lingered in court, sometimes for years. It's not clear that the GDPR's impact, especially when the fines are so much smaller, will be much different.

Alphabet's Pichai Says AI Should Be Regulated
Artificial intelligence is such an important technology and will have such a significant impact on society that it must be regulated, Alphabet and Google CEO Sundar Pichai said on Monday. "Companies such as ours cannot just build promising new technology and let market forces decide how it will be used," Pichai wrote in an opinion piece in the Financial Times. He made similar comments at a conference in Brussels on Monday that's taking place ahead of the start of the annual meeting of the World Economic Forum in Davos, Switzerland.

The piece doesn't suggest a specific regulatory structure, but said international agreement on core principles is a crucial element, and that Europe's GDPR privacy regulation could offer a starting point for negotiations. Good regulations should be easy to understand, fair and provide for privacy and user safety, Pichai wrote. He also said they should take care to balance risks and opportunities.

PIchai's speech and article came as the European Union is getting ready to issue new regulations on the use of AI.

It's arguably in the interest of companies working on AI to know what governments are willing to allow, especially with an emerging, and potentially lucrative technology that's proving hard to control. Pichai's piece was published as Google and other large tech companies face increasing scrutiny from regulators around the world over issues of privacy and anticompetitive behavior. Silicon Valley has long made a habit of asking for forgiveness rather than permission when it comes to deploying new technology. But the increased attention by the public and regulators to how things can go wrong may be pushing Pichai to change his approach, at least when it comes to AI.

Omnivision Aims to Close the Gap with Sony and Samsung and Lead the Market in 1 Year
IFNews quotes Laoyaoba interview with Omnivision's SVP of Global Sales Wu Xiaodong giving a lot of interesting info about the company plans:

- Omnivision's 64MP high-end smartphone sensor is expected to enter mass production soon this year
- Although in terms of global market share Omnivision ranks third with 12.4%, it scores first with 48% share in security, second with 30% share in autonomous vehicles, first with 50% in computing, first with 48% in emerging businesses such as IoT, and first with 81% share on medical CIS market
- From 2018 to 2019, the overall CIS market size grew at AAGR of 20%. After 2020, AAGR is expected to go down to 10%.
- In the end of August 2019, Will Semi has completed the acquisition of Omnivision and Superpix and officially renamed them to Omnivision Group
- Omnivision Group currently has more than 2,000 customers, with annual chip shipments exceeding 13 billion.
- Omnivision has R&D centers in the US, Japan, Europe, China, and Singapore.

- So far, Omnivision employs a total of 1,300 engineers and has more than 4,000 patents.
- Omnivision Group cooperates with TSMC, SMIC, Huali (HLMC), Dongfang (DDF), and other foundries.

"In the past, our gap [with Sony and Samsung has been,] may be, about one year. Last year, we were half a year behind, and our goal is to achieve new products to be leveled this year, and to achieve a lead next year," says Wu Xiaodong.

GM's Cruise unveils Origin driverless minivan, a Self-Driving Vehicle with No Steering Wheel or Pedals
Cruise Automation, a subsidiary of General Motors and a developer of driverless vehicles, today (01/21/20) unveiled a new vehicle that it designed to operate without a driver on-board in San Francisco. The all-electric minivan does not feature manual controls such as pedals or a steering wheel. The new autonomous electric minivan, which is meant to make Uber, Lyft, and commuting in a personal car obsolete, comes just six months after Cruise delayed the launch of a public self-driving vehicle service in San Francisco.

Founded in 2013, by Kyle Vogt and Dan Kan, Cruise tests and develops autonomous car technology, GM announced plans to invest $14 million to expand Cruise operations in California, adding an estimated 1,163 full-time employees by 2021. In May 2018, Cruise announced that Softbank's Vision Fund would invest $2.25 billion into the company, along with another $1.1 billion from GM itself followed by Honda investment of $750 million in October 2018. Cruise got a new CEO, Dan Ammann late last year.

Facebook is hiring 1,000 people to accelerate growth in the U.K. Facebook will hire 1,000 people in London this year in roles such as product development and safety as it continues to grow its biggest engineering center outside the United States after Britain leaves the European Union. Over half of the new jobs will be in technology, including software engineering and data science, Facebook's vice president for Europe, the Middle East and Africa Nicola Mendelsohn said in an interview.

Uber sold its loss-making online food-ordering business in India to local rival Zomato. Uber cuts losses from Eats business in India as it sold the business to rival Zomato in exchange for a 9.99% stake. Zomato, which is valued at around $3 billion after raising money from Ant this month, will take over Uber Eats' operations from Tuesday. Since launching in India in 2017, Uber Eats has struggled to gain market share and is a distant third to Tencent Holdings-backed Swiggy and Zomato. All three have spent heavily on deals and discounts to attract customers in a highly competitive market.

Hospitals are now granting tech giants access to private medical records. Deals with Microsoft, IBM and Google reveal the power medical providers have in deciding how patients' sensitive health data is shared, according to a report from Wall Street Journal. So far, hospitals have granted Microsoft Corp., International Business Machines Corp. and Amazon.com Inc. the ability to access identifiable patient information under deals to crunch millions of health records, the latest examples of hospitals' growing influence in the data economy.

Israeli IoT startup Veego AI drives auto-support into connected homes. Veego Software, a Tel Aviv, Israel-based startup that is putting an end to malfunctions in the connected homes, today announced the Veego Self-Care solution based on artificial intelligence (AI) and other advanced technologies, enabling real-time self-support in the connected home. The solution shifts costly and cumbersome subscriber-support actions from traditional customer care to the vigilant Veego AI, saving service providers vast technical support resources and expenses. Founded just about two years ago by Amir Kotler, Denis Sirov, and Reffael Caspi, Veego software resolves malfunctions in the connected home, autonomously discovering devices and services, and resolving problems before subscribers even experience them.

Apple announces a new incentive program to let gym-goers earn benefits for working out with Apple Watch. Apple today announced its new "Apple Watch Connected" gym initiative, a new series of partnerships with fitness facilities that makes it easier for people who own Apple Watches to track workouts, buy stuff and earn

rewards for working out. The new initiative lets you earn real-life rewards at four gym chains for hitting fitness goals, with tracking provided by the Watch. Rewards vary from discounts on gym membership fees, Nike and Apple gift cards, charitable donations — and even earning back the cost of your Apple Watch.

ISP and cloud tech startup CloudWyze raises $650,000 in equity
Cloudwyze, a full-service MSP and ISP focused on cloud migrations and implementations for small-medium enterprises, has raised $650,000 in equity, according to a securities filing on Friday. The new equity funding came from nine investors, which is capped at $2 million with $1.35 million remaining to be sold. The filing did not disclose how the company intends to use the funds. Since inception about 8 years ago, CloudWyze has raised over $2 M in funding in three rounds. Founded in 2012 by Shaun Olsen, the Wilmington, North Carolina-based CloudWyze provides high-speed access and managed services to urban and rural communities. CloudWyze empowers the communities it serves by partnering with local, state and federal government to deliver competitive high-speed internet service. Olsen is an entrepreneur and community leader who strives to empower businesses and consumers through technology. A veteran of the IT industry, Olsen started CloudWyze in 2012 after having played pivotal roles in several startups.

SoftBank, Richard Branson, Bill Gates, others invest $161 million in cell-based meat startup Memphis Meats. Memphis Meats, a food tech startup and leading cell-based meat, poultry and seafood company, announced today it has closed $161 million Series funding round. The round was led by tech heavyweights including SoftBank Group, Norwest and Temasek. Also joining the round are new and existing investors including Richard Branson, Bill Gates, Threshold Ventures, Cargill, Tyson Foods, Finistere, Future Ventures, Kimbal Musk, Fifty Years and CPT Capital. Based in Berkeley, CA, Memphis Meats is developing methods to produce meat directly from animal cells, without the need to breed or slaughter animals. The company released the world's first cell-based meatball in February 2016 and the world's first cell-based poultry in March 2017.

LumApps Raises $70M in Series C Funding. LumApps, a New York City-based SaaS provider of cloud-based enterprise communication solutions, raised $70m in Series C funding to accelerate its investment in R&D with a particular focus on Artificial Intelligence and Machine Learning, Product development, and Sales and Marketing. The round, which brought total funding raised to date to $100 million, was led by new investor Goldman Sachs Growth with participation from Bpifrance, through its Growth Fund Large Venture, alongside Idinvest Partners, Iris Capital, and Famille C (Courtin-Clarins' family office). Led by Sébastien Ricard, CEO, LumApps is a social and collaborative intranet platform designed to connect, inform, and engage employees.

Container security startup Sysdig scores $70M in late-stage funding round. Sysdig, a container security startup that enables companies to securely run cloud-native workloads in production, said today it has secured a massive $70 million in Series E round of funding that brings its total capital raised to $206 million. The round was led by Insight Venture Partners, with a participation from previous investors Bain Capital Ventures and Accel and new investors Glynn Capital and Goldman Sachs. Sysdig will use the funds to extend market presence and leadership in enabling enterprises to confidently run cloud-native workloads in production. Founded in 2013 by Loris Degioanni, the San Francisco, California-based Sysdig offers two main products designed to secure container environments, which are used to host modern software applications that can run on any platform.

Promethium raises $6M to let businesses use natural language processing to get answers to complex questions. Promethium, an augmented data management provider and the first company, has raised $6M in funding to accelerate its go-to-market strategies and continued innovation of its Data Navigation System™ (DNS), which the company officially announced last October. The round was led by .406 Ventures with participation from existing investor Zetta Venture Partners. In conjunction with the funding, Promethium also announced that Graham Brooks, Partner at .406 Ventures, has joined its Board of Directors. Founded in 2018 by Kaycee Lai, Promethium is the first augmented data management provider to allow users to tap their organization's entire data estate for answers to questions asked in plainspoken language, eliminating the dependence on manual SQL scripting and increasing innovation cycle time by 100x.

Robot Gripper startup Soft Robotics raises $23M Series B to accelerate growth and drive international expansion Soft Robotics *(* Chambiz DF 13 Oct 18 & 2nd Memo 1 Dec 18)*, a robotic automation startup for the factory of the future, has raised $23M Series B financing to accelerate growth and drive international expansion in core packaging and manufacturing markets. The round was co-led by Calibrate Ventures and Material Impact and includes additional existing investors Honeywell, Hyperplane, Scale, Tekfen Ventures, and Yamaha. With this round Soft Robotics also adds FANUC Corp., the world's largest industrial robot manufacturer, as a new investor.

Founded in 2013 by Carmichael Roberts and George Whitesides, the Boston, MA-based Soft Robotics is powered by advanced material science and AI, Soft Robotics' gripping solutions adapt to today's ever-changing manufacturing supply chain without the cost and complexity of traditional robotic systems. Since its inception, its technology platform has experienced substantial customer validation and adoption, with production installations running 24/7 for global customers in food & beverage, advanced manufacturing and e-commerce, and more.

Soft Robotics previously announced a strategic partnership with FANUC to integrate Soft Robotics' mGrip adaptable gripper system with any FANUC robot through the deployment of a new controller. The combined product was introduced at IREX in Tokyo, Japan in December 2019.

Skylo emerges from stealth with $116M led by SoftBank to deliver satellite internet for the masses. Today, Skylo, a tech startup that is providing a game-changing and affordable satellite solution with connectivity starting at just $1 per user and hardware, announced it has emerged from stealth with $116 million in total funding. The recent Series B was led by telecom giant SoftBank Group and joined by Series A co-leads DCM and Innovation Endeavors, alongside Moore Strategic Ventures. Founded in 2017 by CEO Parth Trivedi, Chief Technology Officer Dr. Andrew Nuttall and Chief Hub Architect Dr. Andrew Kalman, Skylo brings real-time, affordable and ubiquitous Internet of Things connectivity to millions of machines, sensors and devices, even in the most remote places on Earth. Skylo's $100 "hub" antennas can divvy up satellite signals among a bunch of Wi-Fi and Bluetooth connections.

DoctorLogic scores $7 million in Series A Financing. DoctorLogic, a Plano, Texas-based creator of a website marketing platform for healthcare providers, has raised $7 million Series A financing to expand its sales and marketing efforts as well as broaden and accelerate product development. The round was led by Unbundled Capital. Founded in 2013 by Stuart Lloyd and Ray Myers, DoctorLogic provides a software solution for large and small specialty medical professionals, which is based on a proprietary Content Creation Engine built to showcase healthcare providers' online presence, acquire new patients and measure the effectiveness of their marketing investments and a suite of additional managed services (Social Media, Google Ads (Pay-Per-Click), Content Marketing/Blog Services, Managed Chat and Video Production).

Warsaw-based startup Applica raises Series A funding to provide AI-based robotic solution to assist and replace the human workforce in a text-based work. Applica, an artificial intelligence startup that help companies to extract actionable information from unstructured and semi-structured documents using its proprietary AI platform, announced today it has closed undisclosed amount in Series A funding round led by Cogito Capital Partners, with participation of Barclays. Founded in 2013 by Adam Dancewicz and Piotr Surma, Applica provides AI-based robotic text automation solutions for enterprises. Applica's proprietary AI automates text-intensive work by extracting meaning from unstructured and semi-structured documents, regardless of language or layout; it is rapidly trained to new use-cases by non-experts with a minimum of customer data and continually self-learns from interactions with end users.

Adagene raises $69 million in Series D funding. Adagene, a Chinese clinical-stage oncology immunotherapy startup, has closed a $69m Series D financing to continue developing its lead clinical programs, ADG106 and ADG116, while extending its technology. The round was led by General Atlantic. Co-founded by CEO Peter Luo, Ph.D., Adagene is a biotechnology company that leverages Dynamic Precision Library platform, combined with its founders and management team, to advance assets ADG106, is a human agonistic anti-CD137 monoclonal IgG4 antibody that targets a unique conserved epitope of CD137 and is cross-reactive across human, monkey and mouse. It is being

evaluated in an ongoing Phase 1 clinical trial in the U.S. and China in patients with advanced or metastatic solid and liquid tumors.

BAE Announces Proposed Acquisition of Collins Aerospace's GPS, Raytheon's ATR Businesses. BAE Systems Inc. announced it has reached definitive agreements for the proposed acquisitions of Collins Aerospace's military Global Positioning System (GPS) business and Raytheon's Airborne Tactical Radios (ATR) business. The proposed acquisitions are structured as asset transactions with associated tax benefits, and they remain subject to customary closing adjustments. The asset purchase agreement for the Collins military GPS business calls for cash of $1.925 billion, with an expected tax benefit of approximately $365 million. For Raytheon's ATR business, the purchase agreement calls for cash of $275 million, with an expected tax benefit of approximately $50 million.

Front raises $59M to take on Gmail and Outlook with its collaborative and team-based email platform for work. Front, a San Francisco, California-based collaborative email platform reinventing the inbox so people can accomplish more together, announced it has raised $59 million in Series C funding to continue driving product innovation and scale go-to-market functions to accelerate Front's mission to help the half billion knowledge workers across the globe work happier. The round, which was led by workplace technology leaders from Atlassian, Okta, Qualtrics and Zoom, more than quadrupling the company's previous valuation. Founded in 2013 by CEO Mathilde Collin and CTO Laurent Perrin, Front is a collaborative email platform that replaces corporate email with an inbox that unites your team to do their best work.

Beacon Platform Raises $20 Million in Series B Funding Led by Centana Growth Partners. Beacon Platform, a provider of vendor of cloud-based enterprise technology and capital markets software solutions, announced today that it has closed a $20 million Series B funding round led by Centana Growth Partners, with participation from existing investors, PIMCO and Global Atlantic. Beacon will use the new capital to expand operations and product development. Founded in 2014, Beacon is the leading application development platform designed for capital markets which enables its customers to securely build, test and deploy applications in the cloud.

Canapi Venture Launches First $545 Million Funds to Boost Fintech Startups. Canapi Ventures, a Wilmington-based venture capital firm investing in early to growth-stage fintech companies, announced the launch of its inaugural $545 million fintech venture funds to support innovation in financial services. The funds, which are centered around early to growth-stage financial technology investment opportunities, drew supports from a wide range of investors, including banks and financial institutions as well as the American Bankers Association and the Independent Community Bankers Association. Included in the investor base is a group known collectively as the Canapi Alliance, which is made up of more than 35 banks and strategic investors seeking attractive investments and greater partnership with the fintech ecosystem.

Lighter Capital to sell up to $100 million of loans to emerging tech startups and provide alternative financing for startups. Lighter Capital, a lending firm that is revolutionizing startup finance, filling the gap between VCs and banks, today announced it has entered into an agreement to sell up to $100 million in credit assets to a private investment vehicle managed by HCG Fund Management, LP ("HCG"). Lighter Capital plans to use the proceeds to fund hundreds of early-stage companies in SaaS, tech services, and digital media with its non-dilutive forms of financing including Revenue-Based Financing, Term Loans, and Lines of Credit. Since 2012, Lighter Capital has invested over $200 Million in 350+ startups over 650 rounds of financing. Founded in 2010 by Andy Sack and Erik Benson, the Seattle, Washington-based Lighter Capital has transformed startup financing by making it easy for entrepreneurs to quickly raise up to $3 million in capital with zero dilution and full control over how to use the funds.

CloudKnox scores $12M funding to help enterprises protect their critical cloud infrastructure from accidents and malicious insiders. CloudKnox Security, a tech startup and a provider of identity authorization for hybrid and multi-cloud environments, today announced that it closed $12 million in a new round of funding to further accelerate the company's product and go-to-market plans. The round, which was led bySorenson Ventures with participation from early investors, including ClearSky Security, Dell Technologies Capital and Foundation Capital, brings the company's

total funding to $22.75 million. In conjunction with the funding, CloudKnox also announced several key additions to the company's board and executive team. Founded in 2015 by Balaji Parimi and Rao Cherukuri, the Sunnyvale, California-based CloudKnox provides a single platform that manages the entire identity privilege lifecycle across any private and public cloud infrastructure

What Apple's Xnor.ai deal says about its ambitions for privacy, battery life, and artificial intelligence

By Todd Bishop

Arm Holdings CEO Simon Segars shows an Xnor.ai board at a 2019 event.

Speaking on stage last year about the rise of artificial intelligence on devices, Arm Holdings CEO Simon Segars touted the capabilities of the chip giant's Cortex-M4 processor to help identify objects using image recognition technology. But the circuit board on the slide behind him showed another logo: Xnor.ai *(* Chambiz DF 17 July 17 & 25 Oct 19)*.

Not many people knew that name at the time, even inside the industry, but they do now. Xnor.ai is the Seattle-based startup that was acquired by Apple recently for around $200 million, as first reported by GeekWire last week.

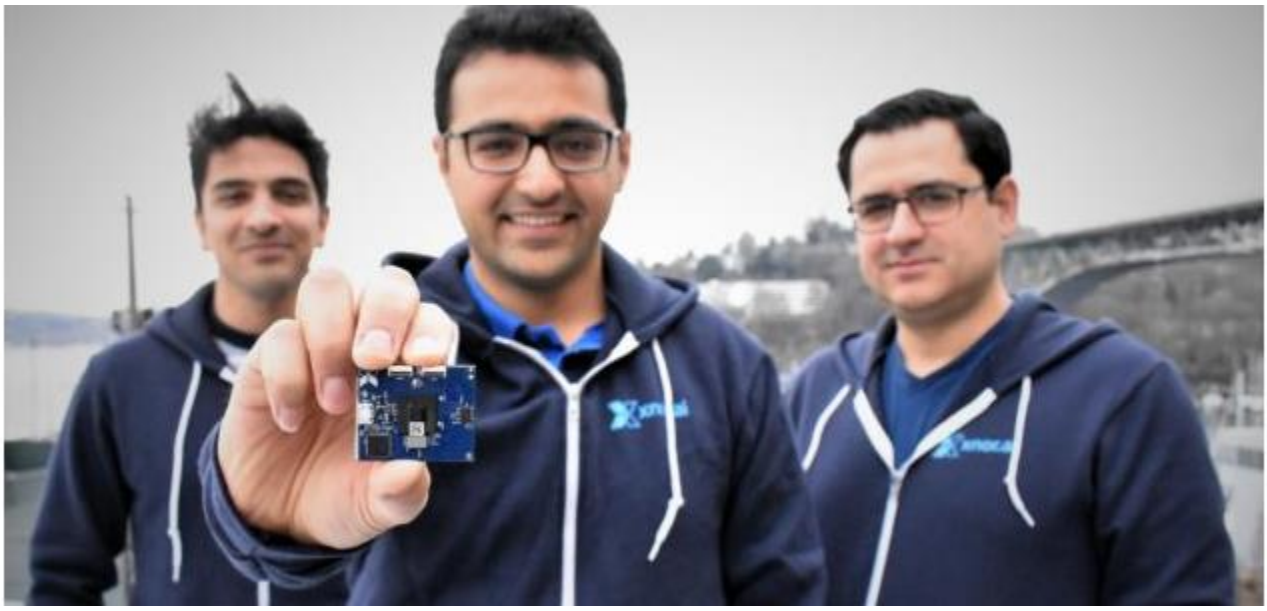
Its inclusion in the Arm CEO's presentation illustrated the growing attention for Xnor.ai at the time, fueled by the industry's rising fascination with artificial intelligence on "the edge," in the small cameras, sensors, and many other types of devices proliferating around the world.

"You need to push intelligence to the edge," explained Alexei Andreev, co-founder and managing director at Autotech Ventures, which was an early investor in Xnor.ai. "You cannot move data in and out to the data centers anymore if you want to make fast decisions, if you don't want to overload your data networks."

Xnor.ai's capabilities are a big part of what makes Apple's acquisition of the company so intriguing.

Based on technology developed at the University of Washington, and incubated at the Allen Institute for Artificial Intelligence (AI2), the startup streamlined and simplified the calculations needed for image recognition and other components of artificial intelligence. Devices using Xnor.ai's technology, for example, are able to identify objects such as people, backpacks and vehicles without needing to rely on a network connection to a data center, or a device's resource-intensive graphics processing unit. Instead, they can use a CPU on devices.

"You just can't afford to take all of the data to where the processing can be done," said Arm's Segars at a separate event. "You need to take the processing to the data."



Xnor machine learning engineer Hessam Bagherinezhad, hardware engineer Saman Nderiparizi and CEO Ali Farhadi show off a chip that can use solar-powered AI to detect people.

Andreev and others we spoke with for this story were careful to say that they don't know exactly what Apple plans to do with Xnor.ai's technology.

Before news of the deal broke, Apple appeared determined to keep even the fact that it acquired Xnor.ai a secret, creating a company called Xylophone Capital Corp. to complete the transaction, according to Delaware corporations filings obtained by GeekWire in the course of reporting the story. Xnor.ai's full website was also taken taken offline in recent weeks, replaced with a bare-bones placeholder page.

But the nature of the Xnor.ai technology suggests a few areas where Apple's acquisition of Xnor.ai could come into play.

- Better battery life: The ability to implement AI without using a GPU could translate into longer battery life on existing Apple devices such as the iPhone, Apple Watch, iPad and others, while improving the company's Siri virtual assistant.
- More private and secure: The ability to keep images and other data on device, without transferring over a network connection to the cloud, reduces the chances of privacy leaks or hacks.
- Developer tools: Xnor.ai offers a platform for developers to implement AI in their apps, using its on-device approach. This could become the basis of new Apple developer tools.
- New products: Apart from implementing Xnor.ai's technology in its existing products, the ability to conduct AI in low-powered devices raises the possibility of entirely new Apple products.

In one example of the technology's potential, Xnor last year demonstrated the ability to run its AI technology on a solar-powered AI chip that could run without other power for more than 30 years. "To us, this is as big as when somebody invented a light bulb," Xnor.ai's co-founder, Ali Farhadi, said the time.

The key to Xnor's edge technology is a chip that can run AI software on mere milliwatts of power, so that a coin-sized battery could theoretically keep the chip running for 30 years. The system takes advantage of low-power wireless technologies such as Narrowband IoT and LoRa.

Madrona Venture Group and AI2 put $2.6 million in seed funding into Xnor.ai in 2017, and Madrona led a $12 million Series A financing round in 2018 with additional backing from Autotech, NGP Capital and Catapult Ventures. When the venture was spun out, it had just six employees, but that has since grown to about 70 people.

Apple has made 20 artificial intelligence acquisitions in the last decade, more than any other tech company, and it has sought to position itself as a bastion of user privacy and security. The company acquired another company specializing in on-device AI, Silk Labs, in November 2018.

In 2016, Apple acquired Turi, another Seattle startup specializing in machine learning and AI, which also has roots at the University of Washington, and for a similar price, about $200 million. Apple has since released developer tools based on Turi's platform and incorporated Turi's technology into its own products.

However, Apple wasn't the only company knocking on Xnor.ai's door. Sources told GeekWire last week that Intel and Amazon had formal discussions with Xnor.ai about a possible acquisition. The Financial Times reported that Microsoft also approached the company.

Baraja's unique and ingenious take on lidar shines in a crowded industry

By Devin Coldewey

It seems like every company making lidar has a new and clever approach, but Baraja takes the cake. Its method is not only elegant and powerful, but fundamentally avoids many issues that nag other lidar technologies. But it'll need more than smart tech to make headway in this complex and evolving industry.

To understand how lidar works in general, consult my handy introduction to the topic. Essentially a laser emitted by a device skims across or otherwise very quickly illuminates the scene, and the time it takes for that laser's photons to return allows it to quite precisely determine the distance of every spot it points at.

But to picture how Baraja's lidar works, you need to picture the cover of Pink Floyd's "Dark Side of the Moon."

Imagine a flashlight shooting through a prism like that, illuminating the scene in front of it — now imagine you could focus that flashlight by selecting which color came out of the prism, sending more light to the top part of the scene (red and orange) or middle (yellow and green). That's what Baraja's lidar does, except naturally it's a bit more complicated than that.

The company has been developing its tech for years with the backing of Sequoia and Australian VC outfit Blackbird, which led a $32 million round late in 2018 — Baraja only revealed its tech the next year and was exhibiting it at CES, where I met with co-founder and CEO Federico Collarte.

"We've stayed in stealth for a long, long time," he told me. "The people who needed to know already knew about us."

The idea for the tech came out of the telecommunications industry, where Collarte and co-founder Cibby Pulikkaseril thought of a novel use for a fiber optic laser that could reconfigure itself extremely quickly.

"We thought if we could set the light free, send it through prism-like optics, then we could steer a laser beam without moving parts. The idea seemed too simple — we thought, 'if it worked, then everybody would be doing it this way,' " he told me, but they quit their jobs and worked on it for a few months with a friends and family round, anyway. "It turns out it does work, and the invention is very novel and hence we've been successful in patenting it."

Rather than send a coherent laser at a single wavelength (1550 nanometers, well into the infrared, is the lidar standard), Baraja uses a set of fixed lenses to refract that beam into a spectrum spread vertically over its field of view. Yet it isn't one single beam being split but a series of coded pulses, each at a slightly different wavelength that travels ever so slightly differently through the lenses. It returns the same way, the lenses bending it the opposite direction to return to its origin for detection.

It's a bit difficult to grasp this concept, but once one does it's hard to see it as anything but astonishingly clever. Not just because of the fascinating optics (something I'm partial to, if it isn't obvious), but because it obviates a number of serious problems other lidars are facing or about to face.

First, there are next to no moving parts whatsoever in the entire Baraja system. Spinning lidars like the popular early devices from Velodyne are being replaced at large by ones using metamaterials, MEMS, and other methods that don't have bearings or hinges that can wear out.

Baraja's "head" unit, connected by fiber optic to the brain.

In Baraja's system, there are two units, a "dumb" head and an "engine." The head has no moving parts and no electronics; it's all glass, just a set of lenses. The engine, which can be located nearby or a foot or two away, produces the laser and sends it to the head via a fiber-optic cable (and some kind of proprietary mechanism that rotates slowly enough that it could theoretically work for years continuously). This means it's not only very robust physically, but its volume can be spread out wherever is convenient in the car's body. The head itself also can be resized more or less arbitrarily without significantly altering the optical design, Collarte said.

Second, the method of diffracting the beam gives the system considerable leeway in how it covers the scene. Different wavelengths are sent out at different vertical angles; a shorter wavelength goes out toward the top of the scene and a slightly longer one goes a little lower. But the band of 1550 +/- 20 nanometers allows for millions of fractional wavelengths that the system can choose between, giving it the ability to set its own vertical resolution.

It could for instance (these numbers are imaginary) send out a beam every quarter of a nanometer in wavelength, corresponding to a beam going out every quarter of a degree vertically, and by going from the bottom to the top of its frequency range cover the top to the bottom of the scene with equally spaced beams at reasonable intervals.

But why waste a bunch of beams on the sky, say, when you know most of the action is taking place in the middle part of the scene, where the street and roads are? In that case you can send out a few high frequency beams to check up there, then skip down to the middle frequencies, where you can then send out beams with intervals of a thousandth of a nanometer, emerging correspondingly close together to create a denser picture of that central region.

If this is making your brain hurt a little, don't worry. Just think of Dark Side of the Moon and imagine if you could skip red, orange and purple, and send out more beams in green and blue — and because you're only using those colors, you can send out more shades of green-blue and deep blue than before.

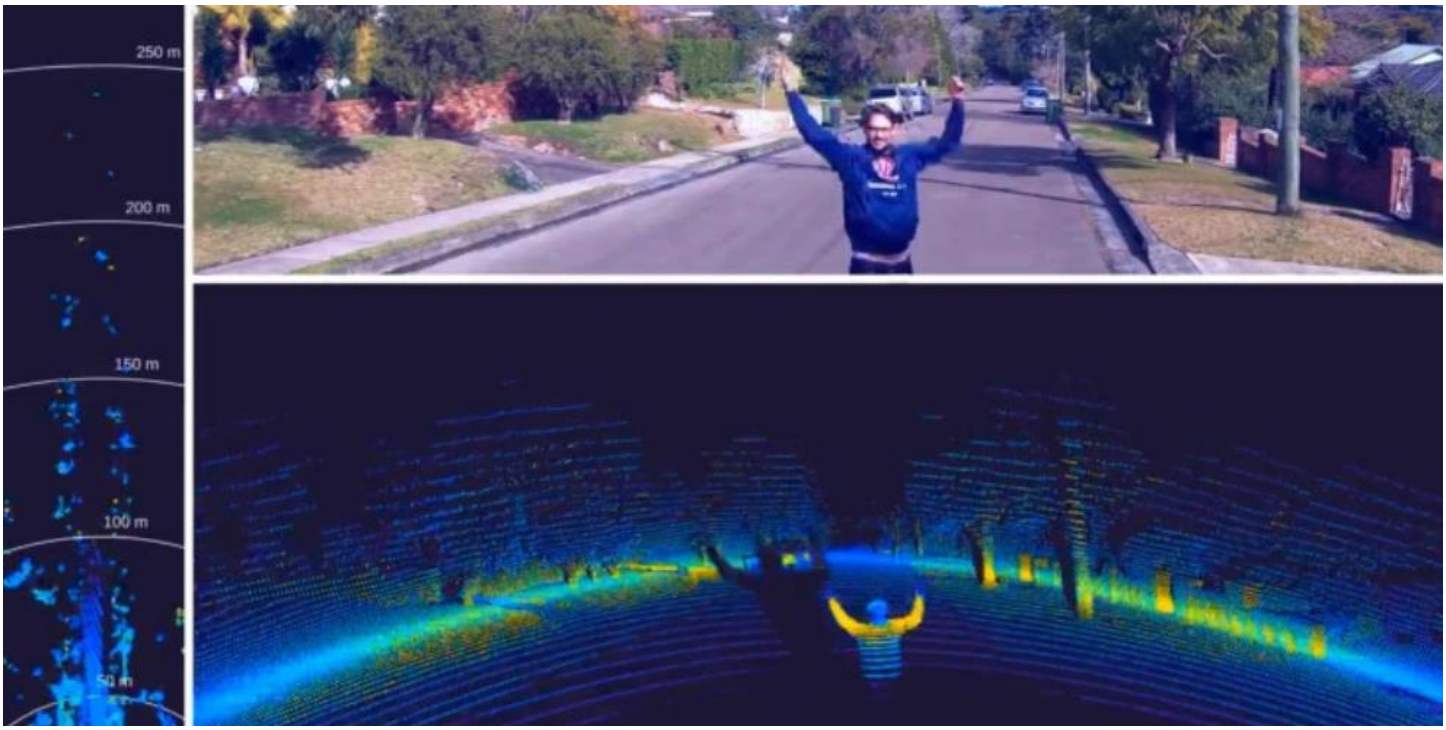
Third, the method of creating the spectrum beam provides against interference from other lidar systems. It is an emerging concern that lidar systems of a type could inadvertently send or reflect beams into one another, producing noise and hindering normal operation. Most companies are attempting to mitigate this by some means or another, but Baraja's method avoids the possibility altogether.

"The interference problem — they're living with it. We solved it," said Collarte.

The spectrum system means that for a beam to interfere with the sensor it would have to be both a perfect frequency match and come in at the precise angle at which that frequency emerges from and returns to the lens. That's already vanishingly unlikely, but to make it astronomically so, each beam from the Baraja device is not a single pulse but a coded set of pulses that can be individually identified. The company's core technology and secret sauce is the ability to modulate and pulse the laser millions of times per second, and it puts this to good use here.

Collarte acknowledged that competition is fierce in the lidar space, but not necessarily competition for customers. “They have not solved the autonomy problem,” he points out, “so the volumes are too small. Many are running out of money. So if you don’t differentiate, you die.” And some have.

Instead companies are competing for partners and investors, and must show that their solution is not merely a good idea technically, but that it is a sound investment and reasonable to deploy at volume. Collarte praised his investors, Sequoia and Blackbird, but also said that the company will be announcing significant partnerships soon, both in automotive and beyond.



Here's how Amazon's rumored pay-by-hand tech could work

By Nat Levy

A new report sheds light on Amazon's thinking about the rumored plan to let customers pay for purchases by scanning their palms.

The Wall Street Journal reported that Amazon may sell pay-by-hand kiosks to other businesses. Previous reports linked the technology primarily to Amazon's own retail stores, including Whole Foods and Amazon Go.

Amazon plans to pitch the terminals to businesses with a lot of repeat customers, such as coffee shops and fast-food restaurants, according to WSJ. Customers would use the terminals to link their palm print to a credit or debit card.

Customers could establish the link between their bank accounts and palm prints by inserting a card the first time they use the terminal and then scan their hands. After that, the terminals would be able to charge customers with a wave of the hand.

WSJ reports that Amazon's pay-by-hand ambitions remain in early stages. The tech giant is reportedly working with credit card companies, rather than trying to cut them out, because it values their ability to protect customer information.

Rumblings of the technology first appeared in September, when the New York Post reported Amazon was testing hand-waving payments at Whole Foods stores. In late December Amazon filed a patent application for a "biometric identification system" that includes a hand scanner that can read characteristics such as veins, bones or soft tissue.

An Amazon spokesperson declined to comment.

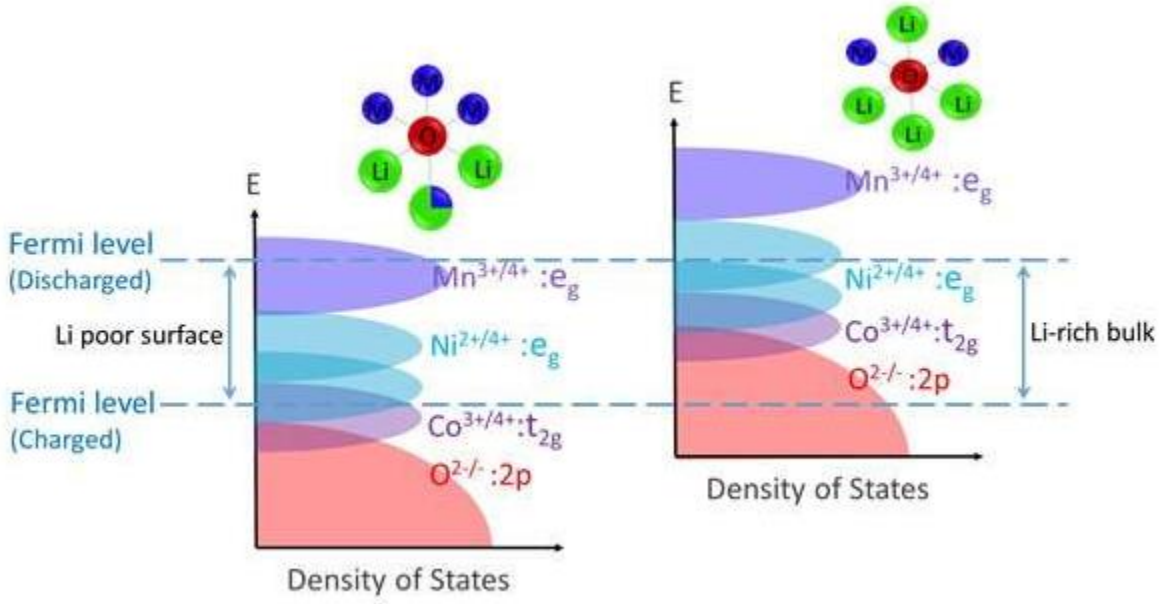
The terminals could be a boon to several Amazon businesses, WSJ notes. Amazon could store the data in the cloud and use it to track when, where and how much customers spend. It could link that spending to Amazon.com purchases as well, painting a more detailed picture of how customers spend money that the tech giant could use to court advertisers.

Though it hasn't become mainstream, palm-scanning is not exactly a new technology. Consumer advocates were warning about how the use of biometric data like hand-scanning could put people in danger of identity theft years ago. And it has been used in a variety of areas, from school lunch rooms to doctors offices.

Payments represent an important priority for Amazon, and the tech giant has in recent months uncorked some interesting new financial features. In October, Amazon unveiled the ability for customers in India to pay utility, cable and cell phone bills through the digital assistant Alexa. At CES in Las Vegas, Amazon debuted a way for customers to use Alexa to pay for gas at the pump.

Gradient Li-rich oxide cathode particles for batteries with minimum oxygen release

By Ingrid Fadelli



Lithium-rich transition metal oxide (Li1+XM1-XO2) cathodes have potential for use in Li-ion batteries, powering electronic devices and electric vehicles. These cathodes have a high energy density, typically above 900 Wh kg-1, yet they currently also come with significant limitations.

The most crucial problem observed in most Li-rich cathodes is that they release oxygen to electrolytes, and thus, their voltage decays while they are being used. This significant limitation has prevented their widespread use for years.

Researchers at the Massachusetts Institute of Technology (MIT) have recently devised a strategy that could help to overcome this issue, immunizing Li-rich oxide cathode particles against oxygen release. This new strategy, outlined in a paper published in Nature Energy, involves a molten salt treatment that eliminates the release of oxygen from Li-rich single crystals to electrolytes by making the surface region Li-poor, while still enabling stable oxygen redox contributions inside the particles.

"Our main objective was to utilize oxygen's capacity for redox reactions without making the reduced oxygen ions (i.e., "peroxo" and "superoxo"-like) globally mobile, which means that they can escape from the cathode particle surface and react with the electrolyte inside a battery," Ju Li, one of the researchers who carried out the study, told TechXplore.

The reduced oxygen ions inside Li-rich cathodes somewhat resemble metal-peroxo and metal-superoxo complexes; compounds through which blood transports oxygen in animals. The peroxo (O-) and superoxo (O0.5-) species, while contributing capacity, have much higher mobility than the standard O2-. In Li1+XM1-XO2 cathodes. These oxygen ions can move around freely and ultimately escape from the cathode particles, reacting with and contaminating the liquid electrolyte.

To prevent this from happening, Li and his colleagues implemented a treatment involving the extraction of lithium oxide (LiO) using molten molybdate salt at high temperatures. They found that this treatment allows the surface to gain the composition Li1-X'M1+X'O2 without disrupting the lattice continuity or creating excess defects (epitaxial), thus removing peroxo (O-) and superoxo (O0.5-) species near the surface, preventing the Li-rich single crystals from releasing oxygen to electrolytes.

"We performed an immunization treatment, so a surface regions about ~10nm thick are depleted of oxygen, and therefore would be extra stable in battery cycling," Li said. "The immunization treatment was performed at a high temperature of 700°C, so as we extract oxygen and lithium the lattice repairs itself by thermal annealing and goes smoothly from Li-rich to Li-poor, without additional defects and without losing the perfect lattice coherence of the single-crystalline particle."

The immunization strategy devised by Li and his colleagues does not affect the metal valence states and the structure of Li-rich crystals inside the cathode, thus maintaining a stable oxygen anion-redox (O2-↔O-) capacity contribution while a battery is operating. In tests evaluating their strategy, the researchers found that it resulted in a gradient hybrid anion- and cation-redox (HACR) cathode with a specific density or 843 Wh kg-1 after 200 cycles at 0.2C and 808 Wh kg-1 after 100 cycles at 1C, with a minimum oxygen release and thus lower consumption of the electrolyte in the battery.

"Our study proves that cycling a battery full cell with very little amount of electrolyte (industrial level of 2g(electrolyte)/Ah) is possible, indicating that we have stopped oxygen loss while utilizing the oxygen's redox capacity," Li said. "This so-called 'solid oxygen' battery concept has the potential to double the energy density of cathodes."

By reducing the oxygen release typically observed in Li-rich cathodes, the strategy devised by Li and his colleagues could eventually facilitate the commercialization and widespread use of lithium-based batteries powered by these cathodes. Interestingly, the immunization treatment outlined in their study could also be applied to other elements, helping to suppress or prevent unexpected surface reactions in batteries. In their next studies, the researchers plan to scale up the synthesis in the Li-rich cathode-based battery and further improve the compressed density of HACR cathodes.

More information: *Zhi Zhu et al. Gradient Li-rich oxide cathode particles immunized against oxygen release by a molten salt treatment, Nature Energy (2019).* *DOI: 10.1038/s41560-019-0508-x*

Journal information: *Nature Energy*

'Universal memory' research passes new milestone

By Lancaster University

Physicists at Lancaster University have demonstrated that their invention of a new type of memory device could transform the way computers, smartphones and other gadgets work.

"Universal memory" is, in essence, a memory where the data is very robustly stored, but can also easily be changed; something that was widely considered to be unachievable—until now.

Currently, the two main types of memory, dynamic RAM (DRAM) and flash, have complementary characteristics and roles. DRAM is fast, so used for active (working) memory but it is volatile, meaning that information is lost when power is removed. Indeed, DRAM continually 'forgets' and needs to be constantly refreshed. Flash is non-volatile, allowing you to carry data in your pocket, but is very slow. It is well-suited for data storage but can't be used for active memory.

The article, published in the January edition of the journal IEEE Transactions on Electron Devices, shows how individual memory cells can be connected together in arrays to make a RAM. It predicts that such chips would at least match the speed performance of DRAM, but do so 100 times more efficiently, and with the additional advantage of non-volatility.

This new non-volatile RAM, called ULTRARAM, would be a working implementation of so-called 'universal memory', combining all the advantages of DRAM and flash, with none of the drawbacks.

Professor Manus Hayne, who is leading the research, said: "The work published in this new paper represents a significant advance, providing a clear blueprint for the implementation of ULTRARAM memory."

The Lancaster team solved the paradox of universal memory by exploiting a quantum mechanical effect called resonant tunnelling that allows a barrier to switch from opaque to transparent by applying a small voltage.

The new work describes sophisticated simulations of this process; and proposes a readout mechanism for the memory cells that should improve the contrast between logical states by many orders of magnitude, allowing cells to be connected in large arrays. It also shows that the sharp transition between opacity and transparency of the resonant tunnelling barrier facilitates a highly compact architecture with a high bit density.

Ongoing work is targeted at the manufacturability of working memory chips, including fabrication of arrays of devices, development of readout logic, scaling of devices and implementation on silicon.

More information: *Dominic Lane et al. Simulations of Ultralow-Power Nonvolatile Cells for Random-Access Memory, IEEE Transactions on Electron Devices (2020).* *DOI: 10.1109/TED.2019.2957037*

12 big things: Airbnb & BlackRock pick up their pens

By Kevin Dowd

You've probably seen my favorite cartoon. A man in a battered suit sits next to three children around a campfire. Behind them is a cave wall covered with etchings of an apocalyptic landscape. "Yes, the planet got destroyed," the man says. "But for a beautiful moment in time we created a lot of value for shareholders."

It epitomizes an era in which corporate executives believe they have one duty above all others: to maximize shareholder value. It's an ethos that's driven the stock market to unseen heights, creating massive wealth for investors, pensioners and CEOs alike. It's an ethos that's helped contribute to a widening wealth disparity, the potential for climate catastrophe, and a whole generation of young people who are entirely unconvinced that capitalism is a good thing.

Two years ago, one of the most powerful men in finance wrote a letter arguing it was an ethos that had to be defeated. This week, one of the most valuable venture-backed companies in the world took up the torch. The multibillion-dollar question: Will it make any difference?

It's letter-writing season in corporate America, which is one of 12 things you need to know from the past week:

1. Corporate conscience
Every January, BlackRock chief executive Laurence Fink sends a note to his company's many, many clients. BlackRock manages about $7 trillion in assets, so when he speaks (or writes, I suppose), people tend to listen (or read).

His 2018 missive argued that corporations had become "too focused on quarterly results," making the case that the dollar shouldn't be quite so almighty. "To prosper over time," Fink writes, "every company must not only deliver financial performance, but also show how it makes a positive contribution to society."

Some thought a new day had dawned. The New York Times wrote that the note was "likely to cause a firestorm in the corner offices of companies everywhere and a debate over social responsibility that stretches from Wall Street to Washington." And sure, it made a few headlines and sparked a few conversations. Perhaps it inspired some new charitable donations and corporate governance practices. But there was nothing at all resembling a widespread change in the wake of Fink's call to action.

This week brought a sign that Fink's ideas could be spreading. On Friday morning, Airbnb—the vacation rental company that was valued at more than $30 billion with its latest round of venture capital—published a note outlining a new set of corporate priorities. Instead of just shareholder value, Airbnb wants to maximize the good it does to all stakeholders in the company, which it identifies as the people who use its platform, its employees, the communities where it operates, and yes, its investors.

It's a call back to the mid-century idea that there was more to running a public company than earning as much money for oneself as humanly possible. With announced plans to go public this year, it's perhaps also an effort by Airbnb to get ahead of the sorts of corporate governance issues that so plagued WeWork during the fall of 2019.

And intentional or not, the language of the letter has clear echoes of Fink: "We believe that building an enduringly successful business goes hand-in-hand with making a positive contribution to society."

This isn't the first time Airbnb has indicated an interest in moving governance practices away from the shareholder-centric model that's dominated Wall Street since the go-go 1980s. Back in 2018, CEO Brian Chesky authored a similar note emphasizing the company's desire to benefit all stakeholders. Later that year, reports emerged that Airbnb was exploring ways it could offer equity to its hosts, a concept that could reshape the way various gig-economy companies compensate their workers—sorry, "contractors."

The ideas are good ones, in my opinion. A near-sociopathic focus on stock price and quarterly numbers seems unhealthy both for society at large and for the long-term health of companies themselves. But theory is one thing. How much of an impact will BlackRock and Airbnb's letters make?

In terms of forcing changes at the companies it invests in, BlackRock's reliance on passive funds paints the firm into something of a corner. Fink's 2018 note admits as much: "In managing our index funds," he writes, "BlackRock cannot express its disapproval by selling the company's securities as long as that company remains in the relevant index." This was not an order to portfolio companies who must follow Fink's wishes or see their investment dry up; it was more of a suggestion.

Airbnb has more power over its own operations, but the changes the company announced are far from wholesale. Airbnb will now consider metrics like guest safety when doling out employee bonuses. It will host a stakeholder day to report on its progress. It announced plans for a stakeholder committee led by current COO Belinda Johnson that will offer its opinions to the Airbnb board about the ongoing effectiveness of this "multi-stakeholder approach."

In short, it's not like Airbnb is going to become a user-owned co-op, or that it's going to start donating 10% of its profits to a charity that would help those affected by the Bay Area housing crisis (although the company has pledged cash to the problem before). I suppose a committee could in some way be construed as "a positive contribution to society," but there's a bit of a difference in scope between Airbnb's words and its actions.

I should probably mention at this point that Fink published the latest letter of his own this week, setting his sights on a new problem: our warming world. "The evidence on climate risk is compelling investors to reassess core assumptions about modern finance," he writes, pledging that environmental sustainability will be a key consideration in BlackRock's investments going forward.

In the letter, it appears to be more of a financial issue for Fink than a moral one. The concerns he lists aren't about wildfires decimating ecological diversity or rising sea levels turning hundreds of millions of people into climate refugees; they're about the future of the 30-year mortgage and the market for flood insurance. When Fink envisions a future in which "the cost of food climbs from drought and flooding," his main concern in the letter isn't with starving people; instead, he asks, "What happens to inflation, and in turn interest rates"?

This, I think, gets at the core of this whole discussion about investors and companies pledging to look beyond maximizing shareholder value. Really, it's just changing the definition. Instead of emphasizing profits on a three-month time frame, they're doing so in the very long term. As Chesky wrote back in his 2018 note on Airbnb's future: "We will have an infinite time horizon."

BlackRock and Airbnb are emphasizing social responsibility and climate change in their public communications because they think doing so is the best way to maximize their own worth in the future, not because they want to save the world. And really, that shouldn't come as a surprise.

2. Plaid gets paid

Visa shook up the fintech world this week with an agreement to pay $5.3 billion for Plaid, a San Francisco-based startup whose services help users connect their bank accounts to apps like Acorns and Venmo. The deal comes a little more than a year after Plaid last raised VC, a $250 million round at a $2.65 billion valuation. The sale to Visa

marks a major exit for some of the biggest names in VC, including Andreessen Horowitz, NEA, Norwest Venture Partners and Spark Capital.

3. Founder drama
Barely a month after stepping down amid intense criticism of her management style sparked by an investigation from The Verge, co-founder Steph Korey is back in the C-suite at Away, a trendy luggage startup valued at $1.45 billion. This time, instead of being the company's sole chief executive, she'll be co-CEO alongside Stuart Haselden, the man brought in to replace her. For the co-founders of Juul, meanwhile, the hits keep coming: Reports emerged this week that a minority shareholder is suing Adam Bowen and James Monsees over $1 billion in total stock sales that allegedly amounted to self-dealing.

4. Automakers investing
Companies that dominated the automotive industry during the 20th century continue to put hundreds of millions of dollars to work in hopes of ensuring their position in the decades to come. This week, Toyota put $394 million into a round totaling $590 million for Joby Aviation, which is building electric flying taxis. And a day later, a UK-based startup called Arrival announced €100 million (about $111 million) in new funding from Hyundai and Kia to help continue developing its electric delivery vans.

5. KKR's activist bent
Hedge funds like Elliott Management and Two Sigma are raising private equity funds. So why shouldn't KKR behave a bit more like a hedge fund? On Friday, the firm disclosed a 10.7% stake in Dave & Buster's and also indicated that it could attempt to influence dealmaking and management decisions at the restaurant and arcade operator—the sorts of activist actions that private equity firms have normally eschewed. There's reason to believe PE's attitudes toward the public market could be changing, including new public equities funds said to be in the works at Bain Capital and TPG.

6. Big tech takeovers
The same week that parent company Alphabet saw its market cap top $1 trillion for the first time, Google struck deals to acquire Pointy (which makes online shopping and advertising software) and AppSheet (the creator of an app-development platform). Not to be outdone, Apple—whose market cap now sits at about $1.4 trillion—announced on Wednesday the purchase of AI startup Xnor.ai *(* Chambiz DF 17 July 17 & 25 Oct 19)* , paying about $200 million to the company's prior VC backers.

7. Startup shakeups
Eaze was one of the first marijuana startups to enter the public eye, raising well over $100 million in VC to power its delivery services. But the company may now be in trouble, according to a TechCrunch report, with layoffs in the works and cash reserves dwindling. The week also brought a change of direction for Atrium, a company formed by Twitch co-founder Justin Kan to provide lawyers and legal services to startups. Now, with an eye toward "sustainability"—i.e. profits—Atrium is reportedly laying off most of its lawyers and focusing solely on legal software.

8. Defense developments
Israel's Cellebrite this week agreed to acquire BlackBag Technologies, a creator of forensic software used by law enforcement to track down digital crimes, in a deal that marks an exit for In-Q-Tel—the venture arm of the Central Intelligence Agency. Elsewhere, Lux Capital brought on Tony Thomas as a venture partner, adding to its operations a retired four-star Army general who once commanded all US and NATO special forces in Afghanistan.

9. Plant-based everything
Califia Foods raised $225 million this week from a roster of global investors to fund its plant-based offerings, including dairy alternatives like almond milk, oat milk and dairy-free yogurt. Another plant-based dairy company, Perfect Day, closed a $140 million round last month. Also this week, Beyond Meat continued its rollercoaster life on

the stock market, with its share price shooting up more than 25% in one 24-hour span after prior reports that rival Impossible Foods had pulled out of talks to supply its products to McDonald's.

10. Fun with numbers
Obvious Ventures was one of the investors following Beyond Meat's ups and downs. The firm also closed its third fund this week, hitting an unusually precise sum: $271,828,182. If you spend much time calculating compound interest (or teaching high-school math), you might recognize those numbers as the first nine digits of e, also known as Euler's number, a mathematical constant that's quite useful in calculus.

11. Busy, busy Blackstone
Blackstone's biggest development of the past seven days was probably an agreement to purchase a major stake in the real estate of the MGM Grand and Mandalay Bay hotels, reportedly valuing the combined properties at $4.6 billion. But as always, the firm stayed busy on several fronts, leading an $850 million recapitalization of solar power provider Altus Power, agreeing to acquire a warehouse business in India and registering nearly $4 billion in commitments for a new energy fund with the SEC.

12. Flattery
The ostensible point of this Bloomberg story was that a Chinese ridehailing startup called Dida Chuxing is trying to raise $300 million. I, however, could not get past the fact that there is a Chinese ridehailing startup called Dida Chuxing—not to be confused with industry giant Didi Chuxing, of course. Actually, what am I saying: It seems like the entire point of naming your company Dida Chuxing is hoping that people will mistake it for Didi Chuxing.

8 mobile robot applications that will grow in 2020

By Kayla Matthews

Thanks to cheaper sensors, advanced navigation software and communications, and growing user awareness, deployments of mobile platforms grew last year. 2020 will be no different, as developers refine mobile robot applications in manufacturing, retail, customer service, and more.

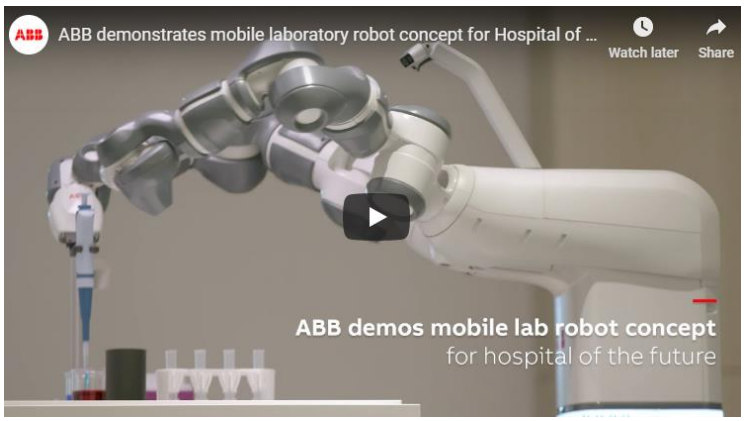
Broadly speaking, autonomous mobile robots can carry out a variety of tasks with a minimum of human input, and many are designed to operate safely around people. Amazon's Kiva robots are a well-known example. They play a crucial role in the e-commerce giant's order-fulfillment process, zooming around company warehouses to find products and bringing them to the necessary drop-off stations.

Thanks to these market-defining robots, Amazon can fill more orders faster than ever before, with a remarkable degree of accuracy.

2020 is sure to be an incredible year for robotics adoption, especially for mobile platforms. Amazon will be using 120,000 robots by the end of this year, and the global market for mobile robots will surpass $3 billion, predicts Ash Sharma, research director at Interact Analysis.

Here are just some of the places where one can expect to see mobile robots in 2020.

1. Mobile robot applications in medical facilities



Nurses and other medical professionals spend a lot of time running back and forth around medical facilities, doing things like tending to patients, grabbing supplies, and answering doctors' calls.

Mobile robots can alleviate much of this legwork. They could move patients, gather and transport supplies, assist with surgical procedures, and even disinfect rooms. Robots could reduce the amount of tedious tasks, reduce workplace strain and injuries, and ensure more consistent quality of care.

For instance, the Texas Medical Research Innovation Institute in Houston has tested ABB's YuMi collaborative robot as a roving laboratory technician. The two-armed mobile robot can carry out tasks like pipetting liquids, sorting test tubes and carrying equipment.

According to ABB's performance data, YuMi can help speed up hospital and research lab operations by as much as 50%, working a full 24 hours a day.

Not only can mobile robots accelerate healthcare operations, but they could pave the way for genuinely continuous, all-hour coverage. Nurses and doctors need to rest, but mobile robots do not.

2. Hospitality and customer service

While chatbots and software-based communication tools have been a staple of the hospitality and retail industries for years now, the technology has leaped into more physical forms. From Japan's robot-staffed hotel to Rollbot, which can bring guests a roll of toilet paper, mobile robot applications promise to improve customer experiences.

With shortages of personnel, such robots can help attend to customer needs. Imagine robotic bellhops that can bring your luggage to your room, round-the-clock room service (perhaps supplied by a robotic kitchen), or autonomous shopping carts that will drive themselves around a store.

For another real-world example, Travelmate has created a robot suitcase that will follow on your heels, allowing for hands-free travel experiences.

At CES 2020, Ubtech's Cruzr service robot was among the many designed for customer service robot applications.

3. Mobile robot applications in agriculture

In the past year, farmers and agribusinesses have started turning to mobile robots to maintain, measure, and harvest fresh produce, among many other applications.

Cambridge Consultants' Mamut autonomous robot is one such machine, designed to explore active fields and capture useful data, which can help improve crop yield. Because the data collection process is fully automated, it eliminates the need for farmers and crews to pore over fields.

Mamut is more useful than drones because it's ground-based for greater endurance, and it can collect more information.

Whether on their own, as enhancements to existing equipment, or in combination with aerial drones, mobile agriculture robots can help handle pest infestations, measure soil quality and pesticides, and harvest fruits and vegetables.

4. Warehousing and order fulfillment

From the factory to order delivery, many links in supply chains are being automated. After Amazon acquired Kiva Systems, many other robots offer to serve warehouses and order-fulfillment businesses. They include 6 River Systems *(*Chambiz DF 17 Feb 17 & 27 Apr 19)*' Chuck, Locus Robotics *(*Chambiz DF 17 Feb 17)*' LocusBots, Swisslog's CarryPick, and Hitachi's Racrew.

From mobile carts that accompany human pickers to more autonomous systems that move around warehouses on their own, there is an incredible variety of mobile robots in supply chain and logistics today.

In addition to retailers such as Best Buy, Shopify, and Walmart gaining greater efficiency and visibility into their operations, customers can also reap the benefits of robotics. They include shorter e-commerce order fulfillment, more

accurate picking, and possibly even decreased shipping prices.

5. Package delivery

For a couple of years now, companies such as Alphabet, Amazon, FedEx, and UPS have been working on drones for local package deliveries. Safety and regulatory concerns, a variety of competing alternatives, and technical challenges have slowed progress.

Still, mobile robots and drones could not only speed up delivery times, but they could also reduce the environmental impact of the many trucks on the road.

For instance, Amazon has unleashed a small army of wheel-based delivery robots called Amazon Scout. It's not a stretch to predict that there will be much more of this over the coming year, particularly from some of the other companies in the shipping field.

FedEx already has an autonomous delivery robot in use, and it first appeared in the summer of 2019. While UPS has not yet followed suit, other companies have, including Starship Technologies, grocery brand Kroger, General Motors, and DoorDash's Nuro *(* Chambiz DF 23 Nov 18)*.

6. Mobile robots for education

A wide variety of STEM (science, technology, engineering, and mathematics) kits are intended to inspire young people (and adults) and help them learn how to code.

Ozobot, for example, is designed for use in educational environments, aimed at teachers and students alike. The robot will react to colors and lines drawn on a tablet, paper, or even custom surfaces. It can also play games with users, many of which explore the concepts above.

As technology has become an incredibly vital part of modern life, many more educational applications will appear over the coming year.

8. Disaster recovery and emergency response

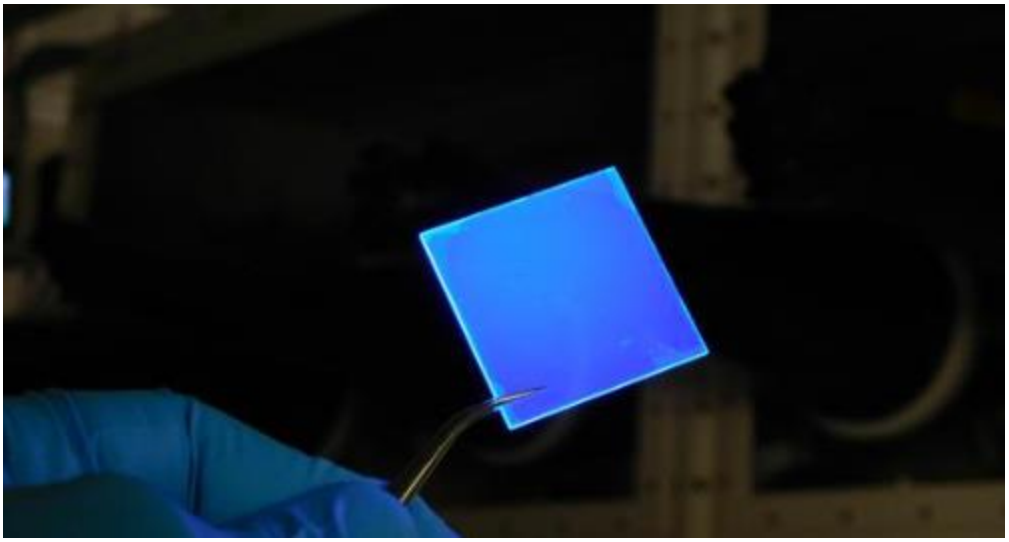
Australia's massive fires are just the latest disaster to remind us of the need for societal resilience and the possibilities for automated threat response. Mobile robots can enter spaces the average human cannot, as well as endure direct exposure to hazardous chemicals, heat and flames, and even widespread debris. Robotics is ideally suited for disaster recovery and emergency rescue situations.

From underwater recovery and firefighting to ambulatory operations — much like Zebro can do — autonomous robots could swarm into the field to save human lives. The deployment of mobile robots in 2020 could enhance human survivability.

Designing for mobile robot applications in 2020
Based on the sheer number of applications that currently exist for mobile robots, the future is bright. While many mobile robot applications share the same bases, robotics developers should be aware of each one's needs for precision and safety, the degree of uncertainty in its environment, and intended payloads and interoperability.

Nanoplates make QLED screens more energy efficient

By Christoph Hammerschmidt



Scientists at ETH Zurich (Switzerland) have developed a new light source for QLED screens. This reduces scattering losses by focusing a beam of light at high intensity. This makes it possible to produce very energy-efficient screens.

QLED screens have been available for a few years now. They are known for their bright, intense colors, which are produced with the so-called quantum dot technology. QLED stands for Quantum Dot Light Emitting Diode. Researchers at ETH Zurich now have developed a technology that increases the energy efficiency of QLEDs. The researchers achieved this by minimizing the scattering losses of light inside the diodes. As a result, a larger proportion of the light generated is emitted to the outside.

Conventional QLEDs consist of a high number of spherical semiconductor nanocrystals, also known as quantum dots. In a screen, these nanocrystals are excited from behind with UV light. The crystals convert this into coloured light in the visible range. Depending on the material composition of the nanocrystal, a different colour is generated.

However, these spherical nanocrystals scatter the generated light inside the screen to all sides. As a result, only around one-fifth of the light generated escapes the screen and becomes visible to the user. To increase the energy efficiency of the technology, scientists have been trying for years to develop nanocrystals that emit light only in the direction of the viewer. The first such light sources already exist. They do not consist of spherical crystals, but of ultra-thin nanoplates. These emit light in only one direction - perpendicular to the plane of the platelets.

If these nanoplates are arranged next to each other in a layer, they generate a relatively weak light that is not sufficient for screens. In order to increase the light intensity, scientists are pursuing the approach of superimposing several layers of such platelets. However, the plates begin to interact with each other, and the light is emitted not only in one direction but on all sides.

The researchers, led by Chih-Jen Shih, Professor of Technical Chemistry at ETH Zurich, have now stacked extremely thin (2.4 nm) semiconductor wafers so that they are separated from each other by an even thinner (0.65 nm) insulating layer of organic molecules. This layer prevents quantum-physical interactions, so that the wafers emit light predominantly in only one direction, even when stacked.

"The more platelets we stack on top of each other, the more intense the light becomes. We can thus influence the light intensity without losing the preferred direction of emission," says Jakub Jagielski, PhD student in Sith's group and first author of the report. This is the first time scientists have produced a material that emits light at high intensity in only one direction.

The researchers were able to create sources of blue, green, yellow and orange light. However, the red colour component, which is also required for screens, cannot yet be realised with the new technology, according to the scientists.

For the newly created blue light, the following applies: instead of one-fifth of the light generated as with conventional QLED technology, around two-fifths of it now reaches the eye of the observer. To generate light of a certain intensity, this technology requires only half as much energy as conventional QLED technology. For other colours, however, the gain in efficiency is currently even smaller. The scientists are therefore attempting to increase this gain there as well in further research work.

Compared to conventional LEDs, the new technology has another advantage, as the scientists emphasize: The novel stacked QLEDs are very easy to manufacture in a single step. With conventional LEDs, it is also possible to increase the intensity by arranging several light-emitting layers on top of each other. However, their production is layer by layer and is therefore more complex.

Original Publication: Nature Communications, Please find enclosed "ScablePhotonicSources" pdf file.

"HOW MUCH SHOULD I RESEARCH THE MARKET?"

By Kevin R Smith

One of the very common themes that I come across with entrepreneurs and founders is that they are generally over confident. About everything! That goes from the valuation of their business to how quick and easy it will be to raise funding.

The other day I overheard in a startup a conversation that reflected this over confidence but in a very specific, and very fundamental, way. The conversation went something along the lines of 'How much should I actually research the market? I know that my new product is great and that people will want it and will pay for it'. There seemed to be a suggestion that because the founder thought he was onto something, that he did not need to actually do any research to prove if he was correct or not.

I was left wondering if he had ever heard of steps such as proof of concept or market validation, and almost by definition it would seem that he thought that focus groups and other tried and tested methods prior to product launch were a waste of time. But without doing market research how is it possible to answer any of the following questions:

- What problem does it solve?
- What is the competition?
- What are the barriers to entry?
- What are your products unique selling points and why is it better than any alternatives?
- Who will you sell it to and how?
- What will the price be and what profit will you make on each product?
- What are the fixed and variable costs to get your product to market?
- How much investment will it take and how long will it be before your first sale?
- How long will it be until you break even and start to earn real net profits
- Will you need to recruit staff and when, and at what cost?

I have just mentioned some of the more obvious questions but there are many, many more. Even with some simple desk based research it is possible to start to answer those and other questions.

According to UK government statistics the biggest reason that companies fail in the UK is that they failed to investigate the market properly. Even major companies sometimes make major errors with a new product that fails and this causes them considerable embarrassment, but for an early-stage business with just one product or closely linked products, failure to research the market is much more likely to result in failure of the company rather than just embarrassment.

In my experience, most founders find that everything will take at least two times as long to achieve and cost twice as much as expected even when the underlying market has been well researched.

But I want to return to the comment I made in the opening paragraph about being over confident. To be an entrepreneur needs high levels of confidence and even higher levels of tenacity. But it is important that this is tempered with a sense of realism and being open to listen to advice and even constructive criticism.

I have lost count of how many times that I have heard a founder claim that their product is unique only to find very easily any number of much bigger, well established competitors offering an almost identical product or service and often even on a more competitive basis. So confidence should not mean blind faith, but rather it should mean an

honesty to conduct in depth market research so that your product can be tailored to make sure that it truly does solve a problem in a unique way and that you will be able to grow a successful business. And should the research reveal too many difficult truths about your product or the market then that same confidence should mean that you can make the sensible decision to drop that product and build your new business around something else before it is too expensive and too late.

Be confident, be bold, but do solid market research, and be successful!

This year, MWC Barcelona 2020 in Barcelona from 24-27 February. With the world seeing fast-paced growth in technology innovations and usage, MWC this year will focus on seven core topics that are set to define the future of limitless intelligent connectivity. We have listed the 7 Topics below:

Artificial Intelligence (AI)
With a market projected to reach $70 billion by 2020, Artificial Intelligence (AI) is poised to have a transformative effect on consumers, enterprises, and governments around the world. MWC will explore the real potential of AI, how such a profound technological revolution must be managed and its impact on professional and personal lives.

Connectivity in the 5G Era
The 5G Era at MWC 2020 aims to highlight how next-generation networks will form the basis of wide-reaching value creation and economic impact. The event will see a broad look at the enterprise connectivity ecosystem, from implementation, to use cases, scalable platforms, business models, spectrum, regulation, and investment to the business and cultural challenges of working with new and diverse markets/industries. Realizing the full potential of global connectivity is both complex and challenging, but the opportunity is near limitless in its application and impact.

Customer Engagement
Customer engagement has been a key battleground for brands, service providers and governments for decades, but its evolution and importance has accelerated in recent years driven by the internet, mobile and then smartphones. Customer Engagement at MWC will look at examples across all industries, to understand how you can set the benchmark for customer engagement, retain and gain customers and grow revenue.

Industry X: IoT
Using a blend of new technologies like industrial IoT, big data, analytics, AI, robotics, 3D printing and machine learning, industries can unlock new revenue and engagement models with customers, employees and

partners. Industry X: IoT will examine the challenges, opportunities, scalability and limitless potential of Industrial IoT and Digital Transformation.

Media & Entertainment
As the appetite and expectation for AR, VR and other forms of richer immersive content grows, the impact on networks, event venues and overall consumer engagement will grow, presenting huge challenges to everyone involved in these now intertwined industries. Media & Entertainment examines the challenges, the revenue models, as well as the relationship between consumption growth and network capacity.

Our Planet
The world needs, now more than ever, our sector to be a fundamental contributor to creating a safe, clean and equitable world for all. The Our Planet agenda will discuss the connected technology industries responsibilities to the environment and underserved people, including the unconnected and accessibility for the disabled, among others.

Security & Privacy
Recent scandals have eroded trust in the digital ecosystem. Coupled with the growing introduction and interest in legislation around privacy and the ethics of data usage as we enter the AI era, we are at a pivotal juncture in the evolution of the Internet. Security & Privacy analyses the growing responsibilities required to create the right balance with consumers, governments, regulators and industries.

Click here to sort through the event topics in MWC 2020 agenda to find the conference keynotes, track sessions, partner events, tours, and seminars.

Cruise doubles down on hardware

The GM-back self-driving car company to dedicate its 140,000-square-foot Bryant Street building to hardware team

By Kristen Korosec

Ten months ago, Cruise declared it would hire at least 1,000 engineers by the end of the year, an aggressive target — even for a company with a $7.25 billion war chest — in the cutthroat autonomous vehicle industry, where startups, automakers and tech giants are battling over talent.

What Cruise didn't talk about then — or since — was who it planned to hire. The assumption was that Cruise was aiming for software engineers, the perception, planning and controls, simulation and mapping experts who would help build the "brain" of its self-driving cars. And that has certainly been one objective.

Cruise, a subsidiary of GM that also has backing from SoftBank Vision Fund, automaker Honda and T. Rowe Price & Associates, now employs more than 1,700 people, a considerable chunk of whom are software engineers.

Cruise has embarked on another initiative over the past 18 months that isn't as well known. The company is building out a team of hardware engineers so large that, if successful, it will get its own building. Today, the first fruits of that mission are toiling away in an ever-expanding lab located in the basement of Cruise's Bryant Street building in San Francisco.

The basement won't hold them for long — if Cruise gets its way. The company plans to dedicate the Bryant Street location, a 140,000-square-foot building that once served as its headquarters, to the hardware team, according to sources familiar with Cruise's plans.

Some software engineers will remain at Bryant Street. But the bulk of Cruise's software team and other employees will move to 333 Brannan Street, the former Dropbox headquarters that the company took over in 2019.

Cruise wouldn't provide specific employment numbers for its hardware or software teams. A glimpse at its current job openings, as well as other resources such as LinkedIn, suggests that it has amassed more than 300 employees dedicated to hardware. At least 10% of those people were hired in the past 90 days, according to a review of LinkedIn's database.

And it's not done hiring. There are more than 160 open positions posted on Cruise's website. About 106 are for software-related jobs and 35 are for hardware engineers. The remaining 24 positions are for other departments, including government, communications, office and security.

Hardware HQ

Below the airy, sunlit dining hall and the garage that houses Cruise's self-driving test vehicles, hundreds of hardware engineers are developing everything from sensors and network systems to the compute and infotainment system for its present and future vehicles.

The upshot: Cruise is developing hardware as aggressively as its software with an eye toward future vehicles. The world will likely get the first glimpse of that future-looking hardware handiwork at Cruise's "Beyond the Car" event that will be held late Tuesday in San Francisco.

Cruise's value has largely been wrapped up in its software. Even six years ago, when the company was founded with a plan to develop an aftermarket kit that could be retrofitted to existing cars to give them automated highway driving capabilities, Cruise was a software company.

GM's venture team had been tracking Cruise since early 2014, according to sources familiar with the company's early history. But it wouldn't be until Cruise abandoned its aftermarket kit to focus on developing an autonomous vehicle capable of city driving that the relationship would bloom.

It was then that Cruise realized it needed deeper expertise in integrating hardware and software. By late 2015, talks with GM had progressed beyond fact-finding. GM announced it acquired Cruise in March 2016.

With GM as its parent, Cruise suddenly had access to a manufacturing giant. GM's Chevrolet Bolt EV would become the platform Cruise would use for its self-driving test vehicles. Today, Cruise has about 180 test vehicles, most of which can be seen on public roads in San Francisco.

Cruise has always employed hardware engineers. But a more focused effort on hardware development and systems integration began in early 2018 after Cruise hired Carl Jenkins as vice president of hardware and Brendan Hermalyn as director of autonomous hardware systems.

Around the same time, GM announced it would build production versions of the Cruise AV — a vehicle that would be built from the ground up to operate on its own with no driver, steering wheel, pedals or manual controls — at its Orion Township assembly plant in Michigan. Roof modules for the self-driving vehicles would be assembled at its Brownstown plant. The automaker said it would invest $100 million in the two Michigan plants to prepare for production. GM's Orion factory already produces the Chevy Bolt EV and the third-generation test versions of Cruise's autonomous vehicle.

Six months later, the companies announced that Honda would commit $2.75 billion as part of an exclusive agreement with GM and Cruise to develop and produce a new kind of autonomous vehicle.

Systems approach

Systems integration would become more important than ever. Hermalyn, who previously worked as the camera lead at Waymo, is one of the primary drivers of this pursuit.

To say Hermalyn is passionate about systems integration might be an understatement. In an hour-long interview last year, he frequently leaned on the term, exclaiming at one point, while standing amongst a row of test vehicles, that the "most exciting thing is the integration." He has also published a blog post that describes Cruise's philosophy and approach to building a system that can conduct real-time, safety-critical sensing and perception tasks at scale.

The ability to integrate hardware and software is critical for the safe operation of autonomous vehicles, and it is a common pursuit among AV developers. But the scale of Cruise's effort, along with the fact that the team is developing much of these hardware components in house, illustrates how important this area has become for the company.

Cruise hardware development is focused on the entire AV topology, which includes the sensors, compute, network systems, connectivity, infotainment and UX. While Cruise does some early-stage manufacturing in house, Hermalyn stressed that Cruise isn't trying to go it alone.

"We're lucky to have General Motors and Honda as partners," he said during TechCrunch's interview with him in October. "We're able to leverage their expertise in vehicle engineering, and collaborate with them throughout the development process to seamlessly integrate that AV topology into the completed vehicles assembled on the factory production line."

The baffle on the camera system on Cruise's vehicle is just one tiny example of this partnership developed with GM. It's here that a self-cleaning system has been developed and installed. Other hardware development included a bumper that better integrates sensors, mounts and lidar. Cruise acquired lidar startup Strobe in 2017.

"Our goal is to make it the fastest, not to make everything," Hermalyn later added. "We obviously use a supplier to manufacture them, we don't want to have the Geppetto problem where we're stuck making one by one."

Back in October when TechCrunch visited Cruise's office, the basement lab was in flux. Certain areas were jammed and preparations to expand had clearly begun.

That lab build-out has continued. The hardware team is particularly focused on sensor development and is conducting some "low volume manufacturing capabilities for rapid maturation of hardware," he said in a followup email.

"It's not that different from what the aerospace industry has done," Hermalyn said of the systems approach. But how you solve that I think is the unique part. With our partners, we're able to go after these systems problems and be able to address that in the marketplace."

Facebook speeds up AI training by culling the weak

By Devin Coldewey

Training an artificial intelligence agent to do something like navigate a complex 3D world is computationally expensive and time-consuming. In order to better create these potentially useful systems, Facebook engineers derived huge efficiency benefits from, essentially, leaving the slowest of the pack behind.

It's part of the company's new focus on "embodied AI," meaning machine learning systems that interact intelligently with their surroundings. That could mean lots of things — responding to a voice command using conversational context, for instance, but also more subtle things like a robot knowing it has entered the wrong room of a house. Exactly why Facebook is so interested in that I'll leave to your own speculation, but the fact is they've recruited and funded serious researchers to look into this and related domains of AI work.

To create such "embodied" systems, you need to train them using a reasonable facsimile of the real world. One can't expect an AI that's never seen an actual hallway to know what walls and doors are. And given how slow real robots actually move in real life you can't expect them to learn their lessons here. That's what led Facebook to create Habitat, a set of simulated real-world environments meant to be photorealistic enough that what an AI learns by navigating them could also be applied to the real world.

Such simulators, which are common in robotics and AI training, are also useful because, being simulators, you can run many instances of them at the same time — for simple ones, thousands simultaneously, each one with an agent in it attempting to solve a problem and eventually reporting back its findings to the central system that dispatched it.

Unfortunately, photorealistic 3D environments use a lot of computation compared to simpler virtual ones, meaning that researchers are limited to a handful of simultaneous instances, slowing learning to a comparative crawl.

The Facebook researchers, led by Dhruv Batra and Erik Wijmans, the former a professor and the latter a PhD student at Georgia Tech, found a way to speed up this process by an order of magnitude or more. And the result is an AI system that can navigate a 3D environment from a starting point to goal with a 99.9% success rate and few mistakes.

Simple navigation is foundational to a working "embodied AI" or robot, which is why the team chose to pursue it without adding any extra difficulties.

"It's the first task. Forget the question answering, forget the context — can you just get from point A to point B? When the agent has a map this is easy, but with no map it's an open problem," said Batra. "Failing at navigation means whatever stack is built on top of it is going to come tumbling down."

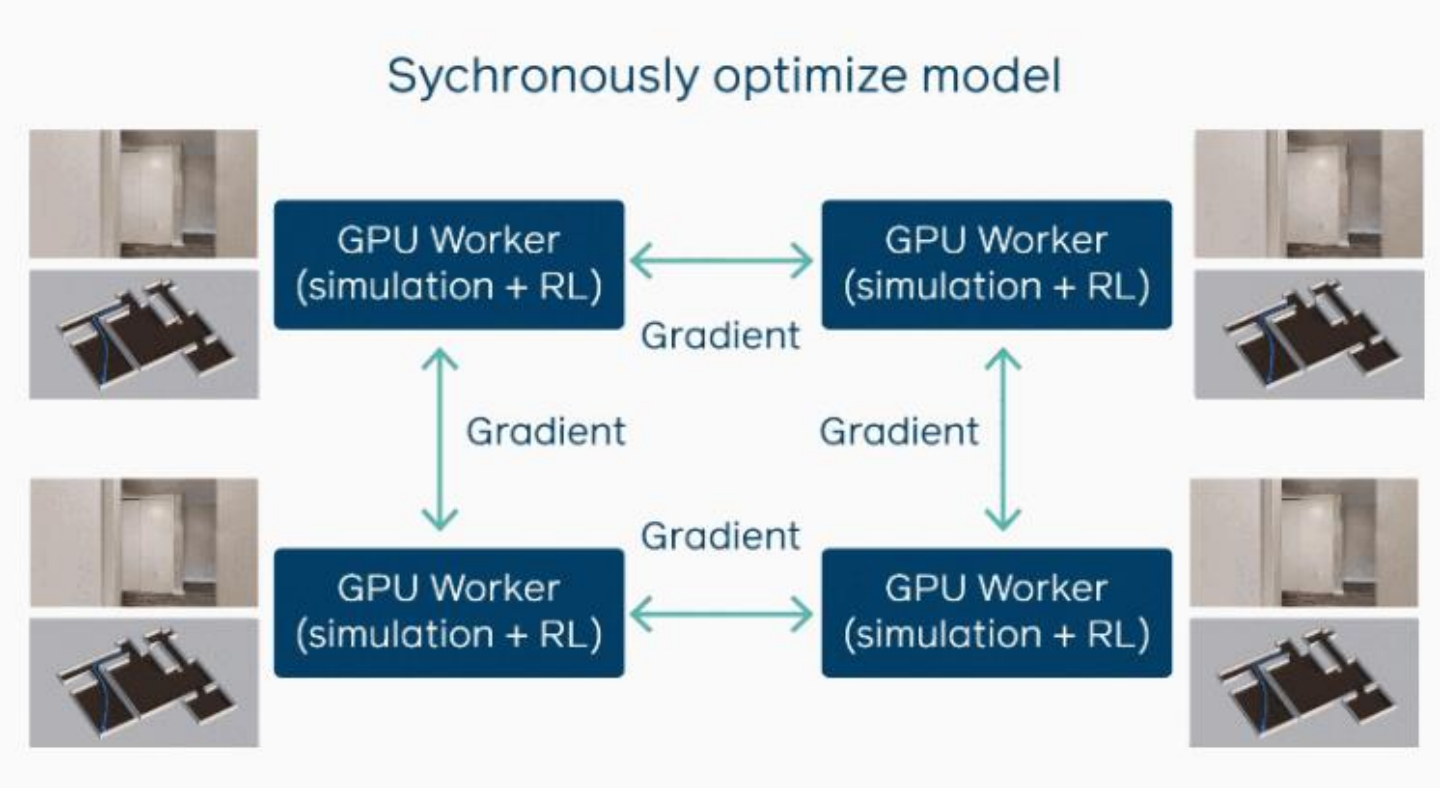
The problem, they found, was that the training systems were spending too much time waiting on slowpokes. Perhaps it's unfair to call them that — these are AI agents that for whatever reason are simply unable to complete their task quickly.

"It's not necessarily that they're learning slowly," explained Wijmans. "But if you're simulating navigating a one-bedroom apartment, it's much easier to do that than navigate a 10-bedroom mansion."

The central system is designed to wait for all its dispatched agents to complete their virtual tasks and report back. If a single agent takes 10 times longer than the rest, that means there's a huge amount of wasted time while the system sits around waiting so it can update its information and send out a new batch.

The innovation of the Facebook team is to intelligently cut off these unfortunate laggards before they finish. After a certain amount of time in simulation, they're done, and whatever data they've collected gets added to the hoard.

"You have all these workers running, and they're all doing their thing, and they all talk to each other," said Wijmans. "One will tell the others, 'okay, I'm almost done,' and they'll all report in on their progress. Any ones that see they're lagging behind the rest will reduce the amount of work that they do before the big synchronization that happens."



In this case you can see that each worker stops at the same time and shares simultaneously.

If a machine learning agent could feel bad, I'm sure it would at this point, and indeed that agent does get "punished" by the system, in that it doesn't get as much virtual "reinforcement" as the others. The anthropomorphic terms make this out to be more human than it is — essentially inefficient algorithms or

ones placed in difficult circumstances get downgraded in importance. But their contributions are still valuable.

“We leverage all the experience that the workers accumulate, no matter how much, whether it’s a success or failure — we still learn from it,” Wijmans explained.

What this means is that there are no wasted cycles where some workers are waiting for others to finish. Bringing more experience on the task at hand in on time means the next batch of slightly better workers goes out that much earlier, a self-reinforcing cycle that produces serious gains.

In the experiments they ran, the researchers found that the system, catchily named Decentralized Distributed Proximal Policy Optimization or DD-PPO, appeared to scale almost ideally, with performance increasing nearly linearly to more computing power dedicated to the task. That is to say, increasing the computing power 10x resulted in nearly 10x the results. On the other hand, standard algorithms led to very limited scaling, where 10x or 100x the computing power only results in a small boost to results because of how these sophisticated simulators hamstring themselves.

These efficient methods let the Facebook researchers produce agents that could solve a point to point navigation task in a virtual environment within their allotted time with 99.9% reliability. They even demonstrated robustness to mistakes, finding a way to quickly recognize they’d taken a wrong turn and go back the other way.

The researchers speculated that the agents had learned to “exploit the structural regularities,” a phrase that in some circumstances means the AI figured out how to cheat. But Wijmans clarified that it’s more likely that the environments they used have some real-world layout rules.

“These are real houses that we digitized, so they’re learning things about how western-style houses tend to be laid out,” he said. Just as you wouldn’t expect the kitchen to enter directly into a bedroom, the AI has learned to recognize other patterns and make other “assumptions.”

The next goal is to find a way to let these agents accomplish their task with fewer resources. Each agent had a virtual camera it navigated with that provided it ordinary and depth imagery, but also an infallible coordinate system to tell where it traveled and a compass that always pointed toward the goal. If only it were always so easy! But until this experiment, even with those resources the success rate was considerably lower even with far more training time.

Habitat itself is also getting a fresh coat of paint with some interactivity and customizability.

“Before these improvements, Habitat was a static universe,” explained Wijmans. “The agent can move and bump into walls, but it can’t open a drawer or knock over a table. We built it this way because we wanted fast, large-scale simulation — but if you want to solve tasks like ‘go pick up my laptop from my desk,’ you’d better be able to actually pick up that laptop.”

Therefore, now Habitat lets users add objects to rooms, apply forces to those objects, check for collisions and so on. After all, there’s more to real life than disembodied gliding around a frictionless 3D construct.

The improvements should make Habitat a more robust platform for experimentation, and will also make it possible for agents trained in it to directly transfer their learning to the real world — something the team has already begun work on and will publish a paper on soon.

Habitat as seen through a variety of virtualized vision systems.

IBM surprises with revenue growth and offers bullish 2020 outlook

By Paul Gillin

IBM Corp. defied critics and a handful of Wall Street analysts who have recently gone negative on its stock by reporting earnings per share two cents better than consensus estimates and breaking a five-quarter string of declining revenues with a 3% currency-adjusted rise in sales.

Fourth-quarter earnings of $4.71 per share beat analysts' expectations of of $4.69, while revenue of $21.78 billion squeaked past estimates of $21.62. The results were the first signs that Big Blue is beginning to see the bottom-line benefits of its acquisition of Red Hat Inc., which was consummated last July.

Red Hat revenue rose 24%, eclipsing $1 billion in the quarter for the first time. Red Hat-related contracts accelerated from the third to the fourth quarter and 21 new Red Hat-related deals of more than $10 million each were closed in the quarter, the company said. "We continued to take share with [Red Hat Enterprise Linux] as clients put more of their enterprise workloads on Linux," said Chief Financial Officer James Kavanaugh.

Red Hat also contributed to currency-adjusted revenue growth of 23% in IBM's cloud business, up from 14% growth the previous quarter. "This is one area where we're seeing the synergies with Red Hat come together," Kavanaugh said, citing strong acceptance of the integrated Cloud Pak suites of task-specific containerized software that were introduced last fall and that run on top of a Red Hat OpenShift base.

With full-year revenues of $21.2 billion, IBM Cloud now accounts for some 30% of the IBM's revenues, noted Charles King, principal analyst at Pund-IT Inc. "That's more than a seven-fold increase from the 4% of IBM revenues cloud represented when Ginni Rometty become CEO," he said. "Their cloud strategy appears to be working fine."

IBM stock roared ahead more than 5.5% in early after-hours trading. Shares are up nearly 10% from the low reached after the company missed estimates in its previous quarter.

The Red Hat effects

"I believe Red Hat synergies are starting to kick in based on the sharp revenue gains," said analyst Patrick Moorhead of Moor Insights & Strategy. "It's likely we have seen the trough and I believe the next one or two quarters could show revenue growth."

IBM apparently agrees. It raised full-year earnings guidance for 2020 to $13.35, above analyst expectations of $13.29. Kavanaugh said revenues are expected to grow for at least the next "couple of quarters."

The earnings surprise is all the more notable given that enterprise suppliers like Cisco Systems Inc., Dell Technologies Inc., Hewlett Packard Enterprise Inc. and NetApp Inc. have recently reported weakening demand. IBM was able to buck the trend in part thanks to the rollout of its new line of Z 15 mainframes, "which drives growth from pent-up demand," Moorhead said.

IBM recent shed a half billion dollars in undervalued software assets, so "that drag on earnings will disappear," King said. "All in all, I believe IBM's optimism is warranted."
IBM's systems segment, which includes the new big iron, grew 16% year-over-year on greater than 60% growth in mainframe sales. Storage revenues grew 3% and sales of the company's line of Power processors declined an unspecified amount.

Services, which make up more than half of Big Blue's revenues, declined slightly. The Global Business Services segment, which encompasses application development and cloud migration, was flat, while revenue declined 4% in Global Technology Services. However, Kavanaugh blamed the slide in part on a tightening focus of IBM's services business. He said the company nearly doubled the number of new cloud migration contracts across both units and has a backlog of more than an $8.5 billion in unrecognized services revenue.

"We are going to take aggressive actions across our GTS business model," focused on hybrid cloud, cybersecurity, multicloud management and OpenShift, he said.

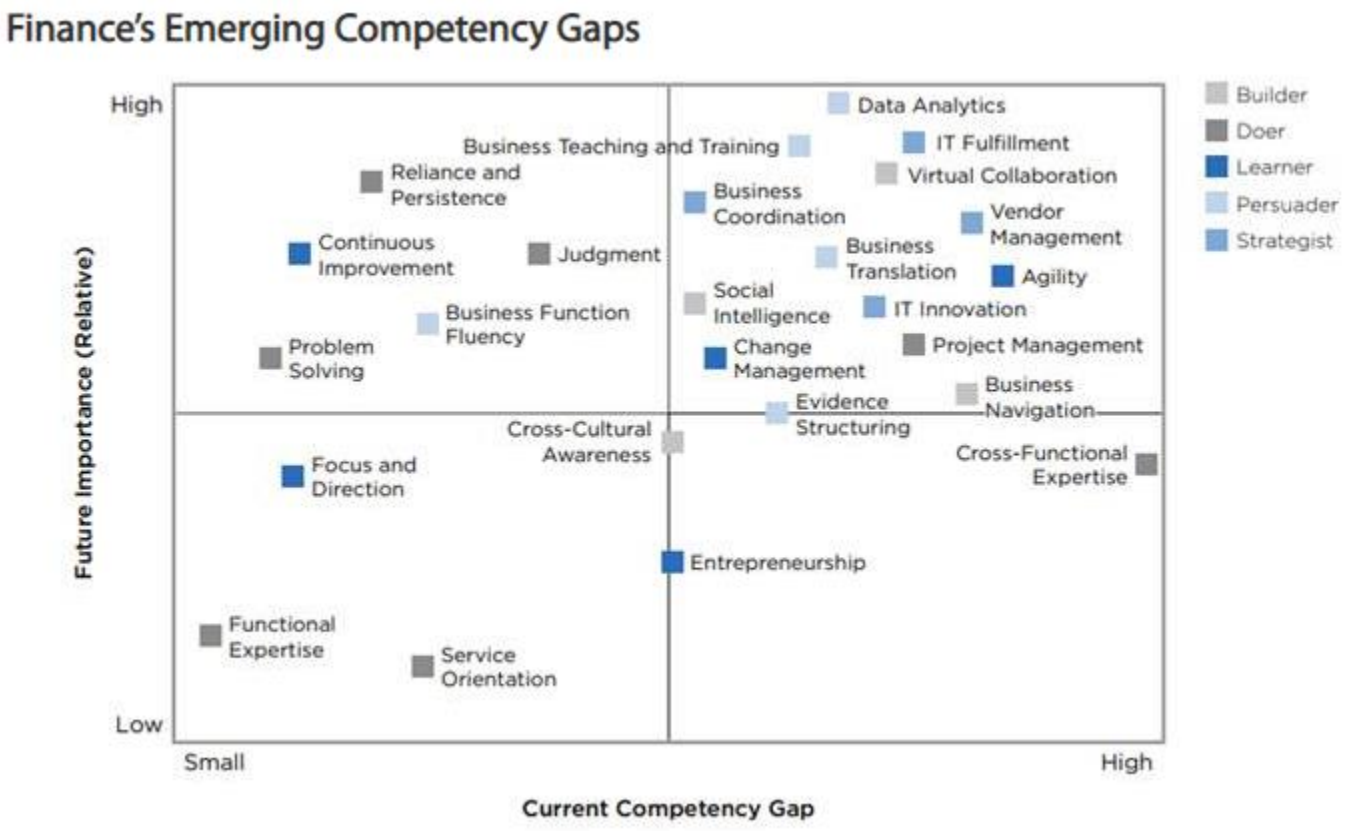
Gartner identifies the skills that will more valued going forward and the personas that may be capable of delivering them.

By David McCann

The skills gaps that corporate finance leaders have been grappling with for some time will stand out even more in 2020 and beyond, according to Gartner.

Based on a survey of more than 1,000 finance employees, Gartner has placed finance competencies into five categories, each one most ably performed by one of five distinct personas: "builders," "doers," "learners," "persuaders," and "strategists."

The chart below shows that some skills, such as those relating to functional expertise, are already well-covered and relatively unlikely to be in high demand in the future. On the other hand, skills relating to IT fulfillment and finance analytics are already in demand and likely to be more so in the future.



"Although it's probably no surprise to most finance leaders that technical skills relating to data analytics, IT fulfillment, and IT innovation are in short supply, it's not time to be complacent," says Melanie O'Brien, a vice president at Gartner. "Finance leaders should review the competencies of their current teams to understand what personas they have and where they need to build capability. The more pronounced these

skill gaps become, the harder the impact will be to mitigate."

Here is a summary of the five personas and the kind of tasks they may carry out:

Builders
The CFO with a builder persona possesses skills relating to business navigation, cross-cultural awareness, social intelligence, and virtual collaboration. Builders know how to get things done, using both formal and informal channels.

They understand the nuances that drive the engagement of different kinds of employees (e.g., millennials and Gen Z) and champion diversity by distributing opportunities across a global team. They achieve this by connecting with others in a direct way that stimulates reactions and intelligent debate.

Builders are also adept at virtual collaboration: able to set priorities, establish workflows, and monitor progress remotely.

Doers
Doers have solid cross-functional expertise and good judgment. They can balance the need for timeliness against the need for a good decision. These skills enable good problem-solving ability; doers can ask the right questions and break a complex problem into simpler and more manageable tasks.

In turn, this makes them good project managers, able to delegate effectively and balance multiple responsibilities. Moreover, they demonstrate a service orientation by reliably meeting deadlines. They show resilience and persistence, encouraging others to stick with a problem until it is solved.

Learners
This individual can be invaluable during times of change. Learners are agile. They are able to adapt quickly to new environments and act confidently in them. They are open to new ideas, visibly support organizational change initiatives, and even help communicate such changes to colleagues.

Learners enshrine principles of continuous improvement by implementing mechanisms to monitor processes for continuous quality improvements and keep up to date on industry best practices. They tend to demonstrate entrepreneurship by suggesting changes in the department and understanding the risks and probabilities of success.

Persuaders
Persuaders demonstrate a fluency with multiple business functions, allowing them to effectively communicate the ideas of one department to another.

They are typically good candidates for finding meaningful insights from data analytics and are adept at the business translation required to keep such reporting finely tuned to the KPIs of the audience. They also understand evidence structuring: how to build a comprehensive body of evidence when creating insights and solutions.

Strategists

This persona excels in the areas of business coordination, IT innovation, IT fulfillment, and vendor management. Strategists easily connect finance's multiyear plan to business objectives and can suggest useful system implementations or upgrades as a result.

They are also able to build mutually beneficial relationships with IT vendors and maintain the kind of finance IT know-how that enables them to negotiate vendor contracts based on sound cost-benefit analysis.

"These five personas may not apply to every finance department, but they do provide a template for finance leaders to think about what types of people and skills they will need in the future and compare that to what they have available now," says O'Brien. "This lays the groundwork for building the finance function of the future."

The lines between biology and computing are becoming increasingly blurred, something that was predicted by Saint Steve Jobs before his untimely demise. It's now been more than 17 years since George Dubyah Bush created the 21st Century Nanotechnology Research and Development Act which brought nanotechnology into the limelight. Since then, the terminology has changed, but the underlying ideas haven't.

The notion of nanobots – tiny machines that are programmed to do things at a nanoscale – is now a reality. Just recently, scientists used a frog's DNA to create the world's first living, self-healing robots. From an article by CNN:

> *Named xenobots after the African clawed frog (Xenopus laevis) from which they take their stem cells, the machines are less than a millimeter (0.04 inches) wide — small enough to travel inside human bodies. They can walk and swim, survive for weeks without food, and work together in groups.*

Incredibly, these are living programmable organisms, biological machines that can be programmed to do things like deliver medicines in the human body. These nanobots were designed using artificial intelligence, and the sky is the limit when it comes to what we might be able to do in the future.

TechCrunch recently interviewed a few venture capitalists about their thoughts on "deep tech" startups that are trying to solve big problems and consequently produce big returns. Seth Bannon from seed fund Fifty Years talked about how synthetic biology is "deep technology" that's now becoming so broad that it needs to be subdivided into various categories. He spoke about "directed evolution, technology that allows biologists to use the power of evolution to get microbes or other biological machines to do what they want them to do that would have been impossible before." And one startup in his portfolio that's having some great commercial success in directed evolution is Solugen.

About Solugen

Founded in 2016, Houston, Texas startup Solugen has taken in just over $55 million in funding to create "innovative, bio-based processes for the production of chemicals like hydrogen peroxide, chelating agents, surfactants and scale/corrosion inhibitors." The company's main product being produced is hydrogen peroxide, something that's long been produced using hydrocarbons from oil. One of the co-founders, Gaurab Chakrabarti, was researching the role of chemicals in cancer progression while in medical school when he stumbled upon an enzyme that turned sugar into hydrogen peroxide. Using computational protein design methods, the co-founders worked together to genetically modify the enzyme so that it could produce hydrogen peroxide at room temperature when combined with cheap organic compounds such as sugar.

The company's first product, Bioperoxide®, was created using this patented enzymatic technology which converts plant sugars into hydrogen peroxide. Today, they're manufacturing a comprehensive line of

products such as their flagship BioSol™ and ScavSol™ solutions which "help treat, clean and oxidize water uses within the oil and gas, water treatment, cleaning, agriculture, soil and ground remediation, and food industries."

Solugen's factory in Houston – Credit: Solugen

A great article by MIT News talks about how the company progressed from selling their product to a Facebook group of float spa enthusiasts to selling their products to the oil and gas industry.

Selling to Big Oil

It's ironic that Solugen sells their product to the very industry they're attempting to disrupt. One byproduct of oil production is contaminated water, billions of gallons of which needs to be treated or disposed of. Historically, the process of treating the water with hydrogen peroxide wasn't environmentally friendly because the traditional methods of producing hydrogen peroxide left such a large carbon footprint. With Solugen's product, this isn't an issue. In order to improve sustainability even more, the company plans to produce little "mini factories" that can produce the hydrogen peroxide right at the locations where it's needed which reduces the impact of shipping as well and consequently reduces the carbon footprint even more.

Last year, Solugen was recognized by the industry standard that rewards excellence in the oil and gas industry for demonstrating best practices in water management through the use of innovative methods or technologies to improve conscientious water use and minimize environmental impact. That's exactly the sort of PR that big oil could use right about now.

Green is Good

Larry Fink, CEO of Blackrock, is one of 180 CEOs who now thinks that maximizing shareholder value is no longer the raison d'etre for companies. It's a slap in the face of fiduciary responsibility, and particularly concerning for those of us who rely on dividends for income. More recently, Mr. Fink talked about how he now wants his firm to decide what investments you ought to be making based on what his firm views as "sustainable."

While not everyone agrees about what ESG criteria we ought to be using, or even if socially responsible investing generates alpha, nobody is arguing against making the world a better place to live in by reducing things that are harmful to the environment. We may not be able to do anything about Bangladeshi brick kilns, but we can start to look at ways in which technology can be used to reduce environmental impact. As

the Larry Fink's of the world start to decide what is good and what is bad, companies like Exxon (one of our core dividend growth investing stocks) will be scrambling to find bolt-on acquisitions like Solugen which can immediately provide some much needed green points to pacify the activists.

Barring interest from Exxon, there are any number of companies out there that might be interested in acquiring Solugen. One of these is Evonik, one of the world's largest producers of hydrogen peroxide, which is on a mission "to futurize peroxide and to challenge the status quo of existing applications." Their website is riddled with mentions of how environmentally friendly they are and what better way to become environmentally friendly than to stop using petroleum products entirely.

Conclusion

Technology has proven to be extremely effective in solving mankind's problems. The platform that Solugen has developed could be used to produce a whole slew of industrial chemicals by performing additional modifications to enzymes. Expecting investors to subsidize environmental problems doesn't scale, but when you can make production processes greener and cheaper, adoption becomes a no-brainer. Companies like Solugen are not only making the world a better place but they're also – hopefully – going to show their investors outsized returns when they inevitably reach an exit. It's truly a situation where everyone wins.

Customers across the supply chain are now demanding that their suppliers are sustainable. How can these organisations commit to going green?

By Nick Ismail

Following Microsoft's announcement that it intends to be carbon negative by 2030, it's clear that meeting sustainability demands will top boardroom priorities moving forward.

Leaders must now recognise that failure to prioritise this issue will result in significant profit loss. Why? Increasingly, customers across the supply chain are choosing to distance themselves from third parties or suppliers that don't function in a sustainable manner.

But how can organisation's change the way they operate and meet their customer's sustainability demands?

Information Age spoke to Dave Crew, commercial director EMEA at Targus, to find out.

"Building to last: the industrial internet of things and sustainability"

How can the industrial internet of things improve their sustainability? Olivier Vicaire from Orange Business Services explores the subject. Read here

Becoming sustainable: start with the product

Targus, the consumer electronics company, has been on a sustainability drive. "It's now what we describe as table stakes," said Crew.

"We operate across many diverse markets and some, that are perhaps as less developed, do not prioritise sustainability as highly compared to others.

"However, for us as an organisation, we're passionate about delivering good quality products that meets strong corporate social responsibility targets."

Famed for supplying laptop bags (and more recently backpacks and dockers), Targus' sustainability mission began with its products, from development to how it shipped them.

"As we went through this process [of making the products more sustainable], we really started taking lessons for ourselves, internally," continued Crew. "And we began looking at how we could recycle within

our offices and get more collaboration when it comes to conferencing, rather than having to fly people all over the world."

The need to travel significantly contributes to an organisation's environmental footprint — remote working solutions can facilitate better collaboration between employers and employees in different geographies — decreasing the need to travel, while saving costs.

Organisations need a universal solution to meet their customers' sustainability demands

Optimising space: key for sustainability success

Analysing workspace data is really important when it comes to understanding the environmental impact of an organisation and its employees.

Having a expansive view of an organisation, what workspaces are used more than others, when users are at their most and least productive, will allow employers to allocate resources inline with a sustainable strategy.

Providing an example, Crew said: "One of our customers had 30,000 unit users, but only 8000 desks.

"They could have got more real estate space with more costs, which also has a bigger impact and environment. But, instead, we looked at how we could help them utilise those 8000 desks more effectively through different technology solutions."

Targus' Miralogic Workplace Intelligence System is such a solution. The IoT-based platform, that integrates with any software, can collect real-time and lifetime data on when and how often desks are used or atmospheric data, while enabling cloud-based management that can be configured to measure and track energy usage.

"Using this solution during a proof-of-concept, we found there were 25 desks that were underutilised within another client's workspace because of 'extreme' temperatures due to their location within the office," continued Crew.

When leaders start looking at space utilisation, and being able to get more from less space, that's incredibly useful. This is certainly the case when considering consumption, the amount of real estate that organisations need to operate and run the business.

Power and consumption

One of the key benefits of our Miralogic solution surrounds power and consumption.

Anything that gets plugged into the smart power strip that links up to the software, businesses can start to control.

"Normally, everyone leaves the office at 7pm. But, often people leave monitors on, they're not switching things down and not closing things off. With Miralogic, you can remotely start to start to switch those things off and you can start to look at consumption trends," explained Crew.

“From the tests we’ve ran, we can see that from 8am to 7pm there’s lots of consumption. After that, consumption significantly drops, but machines are still on standby mode. The solution switches those machines off, which saves cost and also supports improving sustainability.

"Corporate sustainability moving beyond company’s own environmental footprint"

Corporate sustainability is moving beyond a company’s own environmental footprint, to the positive action it can take for society. Read here

Collaboration across all parts of the business

A strict top down approach does not work in improving an organisation’s sustainability levels. Instead, it has to be a collaborative view across all parts of the business — “good employee engagement and going through different workshops to understand what’s important is very useful,” explained Crew.

When looking to build a sustainable culture, improving the HR and education element is just as important as the IT solutions that facilitate change — there has to be a multi-departmental focus.

The end goal

A sustainability drive is no different from any other business critical mission. Employers and employees need to have an end goal in mind.

Organisations will need to ask what’s the ‘scope creep‘ from all the different stakeholders, while understanding in advance if there’s going to be any integration challenges between software solutions and the hardware that’s already in place.

As more and more hardware devices enter a workspace, whether employee’s work on their personal device or workstation, the universality of a solution (one that can traverse a diverse hardware real estate) is key.

Why Uber's Stock Rally Doesn't Make Sense

By Amir Efrati and Martin Peers

Uber proved countless doubters wrong by showing, when it reported its third-quarter results last fall, that its ride-hailing business can make money. And as investors await the fourth-quarter numbers scheduled to be released Feb. 6, they've sent the stock soaring. It's as though they think the worst is over for the ride-hailing giant.

Those optimists should think again. Even if Uber's core ride-hailing business were to make significant financial strides going forward, our assessment is that it could take years before the cash generated from the business can justify the company's current stock price of above $37.

That might seem like a harsh assessment. Even after the stock's recent rally from its low of $26 in mid-November to its close on Tuesday of $37.60, Uber stock is trading 16% below its IPO price. That in turn was well below what investors expected the company to be worth when it went public. Most Wall Street analysts are much more bullish—among 39 analysts, the average and median near-term "price target" for the stock is $44 per share, according to S&P Capital IQ.

Of course, Wall Street analysts as a rule look for reasons for investors to buy stocks, not for reasons for them not to. But to be fair, based on some measures, shares of Uber look reasonably valued. At the current price, Uber is trading at about three times projected 2020 revenue to enterprise value. Lyft, its smaller U.S. ride-hailing rival, is trading at around 2.4 times the same multiple. Grubhub, probably the other closest comparison, is trading at 3.6 times.

But valuing stocks based on comparisons to other companies in similar businesses makes sense when there's a decent number of comparisons—at least some of which have demonstrated a path to making money. Neither Lyft nor Uber has done that, so justifying one company's valuation by referring to another's isn't the way to go in this case.

Grubhub may be a decent comp, but it is part of a crowded on-demand food-delivery market supercharged by venture capital, which is not a rational market. Also, the possibility that it may get bought is elevating its valuation.

On a related note, valuing Uber on a multiple of its total revenue is in our view a mistake. Uber's food-delivery business, for instance, is losing money at an alarming rate. It's not clear when Uber Eats will be able to make money, at least unless it merges with one or more of its competitors.

Ride Hailing Focus

That argues in favor of valuing Uber in segments, starting with its ride-hailing business—and doing so by calculating the present value per share of the cash it's likely to generate over the next few years. That's what we did. It has the virtue of honing in on what Wall Street sentiment doesn't like about ride hailing: its giant losses and uncertainty about when they will come to an end.

The good news is that Uber has started to make money in ride hailing—not much, but a little bit. In the third quarter, it reported $631 million in earnings before interest, taxes, depreciation and amortization from ride hailing. This was excluding corporate overhead and technology costs to power its services. Uber reported $623 million of those overhead expenses overall. But ride-hailing accounts for only 82% of its overall revenue. So assuming that 82% of its overhead and technology is attributable to ride-hailing—$511 million—implies that Uber's ride-hailing business had Ebitda of $120 million in the quarter.

Thus, Uber's third-quarter performance translates to a net operating profit margin of 1% for the ride-hailing business, the first quarter in the black since the start of 2018—the earliest period for which Uber has disclosed such information. But to justify a price around $37-38, Uber would need at least a 13% to 14% net operating profit margin from around $20 billion in revenue, while growing at close to 20%, according to a valuation model known as a "reverse discounted cash flow" developed by equity research firm New Constructs, based in Nashville, Tennessee. We estimate Uber will get there in 2023, assuming it makes progress toward the long-term profit goals its executives outlined before the offering.

The New Constructs model calculates the economic earnings a company must generate to support a stock's current market price. Economic earnings are basically a measure of profitability known as free cash flow—the cash generated from a company's operations minus the cost of capital expenditures such as buying computer servers to run the business. New Constructs based the model on its analysis of the historical earnings and corresponding stock prices of thousands of companies.

We used the model and made some assumptions about the next few years to estimate when Uber's per-share value would get close to where the stock is now. We assumed that revenue growth would slow from 25% in the coming 12 months to 18% by 2023—and that may be generous. One way Uber has maintained revenue growth lately is through raising prices, which has had the impact of slowing growth in terms of number of rides in the U.S. market.

We also assume a steady increase in the net operating profit margin to 16% by 023. That also may be generous. Recent legal and regulatory hits, as well as threats to its business, have raised questions about Uber's ability to expand profit margins in the long run. For instance, the California law requiring companies to treat contractors as employees prompted Uber to experiment with letting drivers set their own prices and see the destination before accepting a trip. If widely adopted, this approach could mess with the efficiency of Uber's service and squeeze its profit margin.

One reason why many Wall Street analysts argue Uber stock is undervalued is because they're optimistic about Uber's revenue and profit growth potential. For Uber executives and stock analysts, "the underlying assumption...is that if a company can achieve break-even, it obviously can continue profitable growth. But why?" said Len Sherman, an adjunct professor at Columbia Business School who has been a longtime critic of Uber's valuation.

"No company has ever pulled off the epic turnaround on the scale Uber requires" to get to "sizable positive cash flows" without first shrinking itself by cutting unprofitable operations, Sherman added.

Uber Eats

For this analysis, The Information put a $6 billion value for Uber's minority equity stakes in other, privately held ride-hailing companies. That is down from the $12 billion or so value that Uber placed on those stakes

around the time of its IPO. Uncertainties about some of those businesses, including Grab and Didi Chuxing, justify halving the earlier value.

The biggest hole in The Information's analysis concerns Uber Eats, the food delivery app that makes up about 12% of Uber's revenue. It's extremely difficult to put a value on Uber Eats, given its growing losses and uncertainty about when those will end. The service likely lost $1.2 billion before taxes, depreciation and amortization in 2019, according to Uber's results for the first three quarters of the year. The company said that in the third quarter of 2019, 15% of Uber Eats' gross sales occurred in competitive regions and accounted for half of its Ebitda loss.

Uber is looking to offload its worst-performing Uber Eats operations, as it just did in India, so if we eliminate those poorly performing regions, that shrinks Uber Eats' revenue by about $200 million for the year. That would mean the service could have generated nearly $1.2 billion in revenue and lost roughly $600 million in Ebitda terms. But applying 12% of Uber's corporate overhead and tech costs to Uber Eats would increase that annual loss amount to at least $800 million.

So the question is, how much future value should we ascribe to Eats? One approach would be to play out some consolidation in its biggest market, the U.S., and assume that that would lessen the amount of money Uber Eats must spend to compete. It would be easier to assign a value to Uber Eats if it were to merge with a rival such as online food-ordering pioneer Grubhub. It is roughly the same size as Uber Eats in terms of revenue (though most of its business is based on the commission from taking orders rather than fulfilling the delivery), is marginally profitable, is growing half as fast as Uber Eats, and has a $5 billion market capitalization.

Considering that a merger might help both entities save money because they would primarily be competing with DoorDash, it could make sense to put a $2.5 billion to $5 billion value on Uber Eats as part of the combined entity, for the moment. We split the difference and assumed Uber owned a minority stake, worth $3.7 billion, in a food delivery unit.

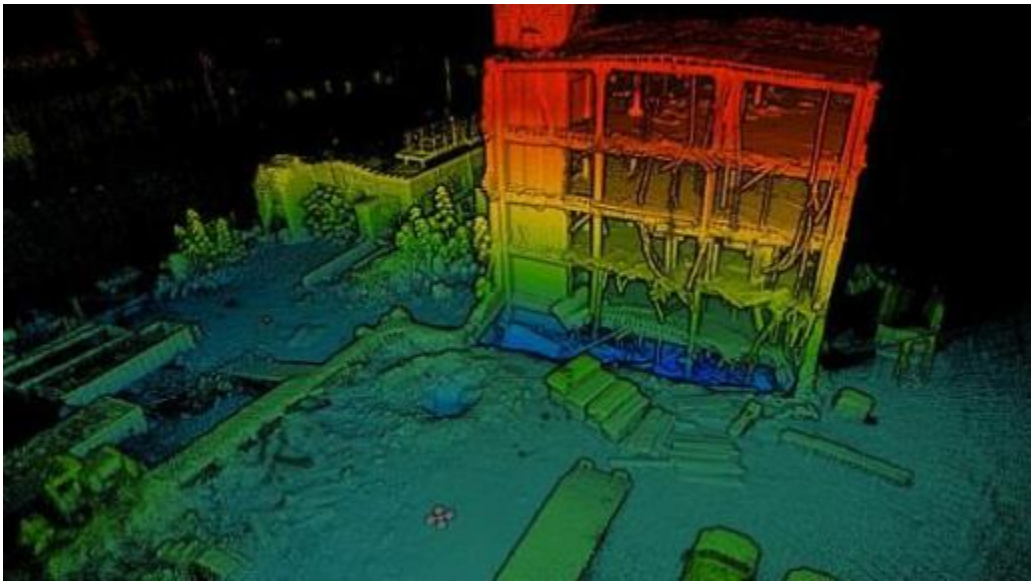
Some analysts also have placed a combined value of more than $10 billion on Uber's autonomous vehicle R&D and scooter and bike rental divisions. But we'd argue it is pointless to ascribe any value to these businesses, given how they're performing. New data show that Uber's rental divisions have lost money at a much faster rate than the startups it is competing against. And recent reporting shows the R&D group has no clear path to commercializing the nascent technology.

The only other question mark concerns the fast-growing Uber Freight business, which recently accounted for 6% of Uber's revenue. But in the first nine months of 2019, its loss before interest, taxes, depreciation and amortization amounted to 31% of the Freight revenue. So it may be too early to calculate the potential value of Uber Freight.

Uber has had some success in shifting the perception of its core ride-hailing business from "can it ever make money?" to "how much money can it make?" Now the doubters will focus on its long-term value as a public stock—and for good reason. Given how much cash Uber's core business will need to generate in the future, the company still has a mountain to climb to justify its stock valuation today.

Autonomous drone maps 3D models of dense urban environments

By Rich Pell



Defense contractor and industrial corporation Raytheon (Waltham, MA) and aerial robotics company Exyn Technologies (Philadelphia, PA) have co-developed a mapping autonomous drone (MAD) - a fully autonomous aerial robot that uses artificial intelligence (AI) and can operate in GPS-denied environments to map dense urban environments in 3D.

The drone, which can travel deep to reveal tunnels, urban undergrounds, and natural cave networks, has been demonstrated to the U.S. Department of Defense, says Raytheon.

"Operators will have to do very little, because most of the reasoning is done on board with artificial intelligence," says Mark Bigham, chief innovation officer at Raytheon's Intelligence, Information and Services business. "They simply set the boundaries for the robot to explore and press 'go.'"

While most drones use GPS to navigate, the MAD is able to approximate its position on the map while flying through GPS-denied environments such as fortified buildings and underground facilities. Using its own estimate, says the company, it can maneuver over the terrain without GPS, indoors and out.

The drone uses a variety of sensors to gather 300,000 data points per second, mapping as it moves along its pathway. The system uses lidar - which measures distance to a target by illuminating the target with infrared laser light and measuring the reflected light with a sensor - to navigate and build a 3-D map.
"The drone detects obstructions and obstacles like rubble and rebar, dangling wires, then methodically works around them," says Bigham.

Raytheon installed its proprietary technology to georegister maps and objects where GPS is not available - a feature that can be critical to the success of certain missions, says the company.
"Forces and first responders are going to need to know where things are down to the centimeter," says Bigham.

MAD, says the company, has achieved three "firsts":

- the first time an autonomous drone has gone from mapping the outside of a building to the inside;

- the first floor-by-floor mapping of a multi-level building;
- and the first time machine learning has been used to locate objects in a three-dimensional space, all in real time.

"Terrorists and guerillas have literally gone underground to hide from satellites, larger drones, and patrols," says Bigham. "This system can help us identify the good guys and the bad guys so we can either rescue them or prevent our troops from being ambushed."

The company says it is now creating a secure drone platform for U.S forces, and has manufactured two prototypes using 3D printing.

Claudeliah Roze, Raytheon's principal investigator on the project says, "There are different payloads and sensors that can be mounted on this new, autonomous platform – acoustic, cameras, electro-optical/infrared and cyber, to name a few. We built our own prototypes because many of our customer's missions involve national security."

In addition to national security applications, says the company, the drone could have commercial applications, such as inspecting construction sites and cell towers, or searching for survivors and surveying damage immediately after disasters.

"In harsh and dangerous environments, this technology is ideal because you can quickly assess the damage without having to send people into harm"s way," says Roze. "Think of Hurricane Harvey that hit Houston in 2017. A swarm of drones such as these could autonomously navigate an area of interest, capturing a detailed 3D map, and feed it in real time to an operator."

While the project is still in its internal research and development phase, says the company, it hopes to have production-level platforms ready for evaluation by the DoD in 12 to 18 months.

MIRAIT Corporation, a leading information & communication engineering solutions provider and Metawave Corporation, developer of data communication antenna and in-vehicle millimeter-wave radar, have conducted radio wave propagation experiments in the quasi-millimeter wave band (20 to 30 GHz) using metamaterial reflectors. They confirmed that the result reached the expected performance level.

MIRAIT is working to accelerate the technological development of the next-generation 5G mobile communication system, and emerging enterprise local 5G, which will start in earnest in the spring of 2020. Metawave has state-of-the-art technology in this field. Since last December, MIRAIT has been evaluating to confirm the practicality of Metawave's metamaterial reflectors, which are attracting attention as an effective tool for building 5G areas. In this experiment, basic electromagnetic coupling and radiation characteristics such as the reflectance of the metamaterial reflector were confirmed. From here on, the two companies will confirm the effectiveness of metamaterial reflectors in 5G area construction based on a series of processes such as 3D data conversion of indoor space, radio wave propagation simulation, and reflector design.

MIRAIT has been engaged in the electrical equipment business, software business, and ICT business for many years, focusing on the construction of fixed communication equipment and mobile network equipment. MIRAIT strives to provide new solutions that meet the demands of society with the aim of realizing smart offices and smart towns by strengthening the business base with the engineering skills in each field. Metawave is a U.S. startup with state-of-the-art technology in the field of developing 5G radar platforms that enhance the performance of radars used in 5G area expansion and autonomous driving.

Metawave ECHO passive reflectors enable faster, more efficient 5G and fixed wireless deployments to bring high-speed connectivity to billions of users as they connect indoors and outdoors around the world.

Metawave ECHO Passive Reflector Features and Characteristics:

- Fully passive with no power supply required, can be installed anywhere, indoors and outdoors
- Beamforming technology using proprietary technology
- Extension of 5G NR
- Coverage for indoor dead zones and shadowed areas
- Supports high-density areas such as stadiums, shopping malls, office buildings, and airports
- Advertisement, messaging, or concealment film on cover is available as an option

Based on this experiment, MIRAIT and Metawave will continue to actively accumulate knowledge on the practical application of new technologies for building 5G areas. Both companies aim to create efficient and detailed areas using quasi-millimeter waves in 5G, which is expected to be widely used, for building private networks such as construction sites, logistics/warehouses, stadiums, hotels, office buildings, and the like as well as telecommunications carriers. Metamaterials are artificial materials that behave in response to electromagnetic waves including light, which are not found in natural materials. The purpose of applying the metamaterial reflectors for constructing 5G areas using millimeter waves and quasi-millimeter waves is to expand areas (outdoors / indoors), where otherwise impossible due to the effects of shielding.

The higher frequencies - 20 GHz to 30 GHz - are often called quasi-millimeter waves. Until now, it has not been used in the field of mobile communications, so there is room in the frequency bandwidth, and it is suitable for ultra-high-speed, large-capacity communications. On the other hand, there is a problem that the straightness is higher than the frequency band used conventionally and the amount of attenuation due to rainfall or shielding is large, but this has been solved by utilizing a reflector using metamaterial technology.

Click here to read more about METAWAVE ECHO Reflector.

Self-Moisturising Smart Contact Lenses – Electroosmotic Flow Used to Keep Eyes Moist

By Tohoku University

Researchers at Tohoku University have developed a new type of smart contact lenses that can prevent dry eyes. The self-moisturizing system, which is described in the journal Advanced Materials Technologies, maintains a layer of fluid between the contact lens and the eye using a novel mechanism.

Smart contact lenses are wearable devices that could accelerate vision beyond natural human capabilities. They are being developed for a wide range of applications from non-invasive monitoring to vision correction to augmented reality display.

"Although there have been many recent advancements in new functions for smart contact lenses, there has been little progress in solving the drawbacks associated with wearing contact lenses day to day," says Professor Matsuhiko Nishizawa, an engineer at Tohoku University.

One of the biggest problems with contact lenses is they can cause "dry eye syndrome" due to reduced blinking and increased moisture evaporation. Dry eye syndrome can lead to corneal wounds and inflammation as well as a feeling of discomfort.

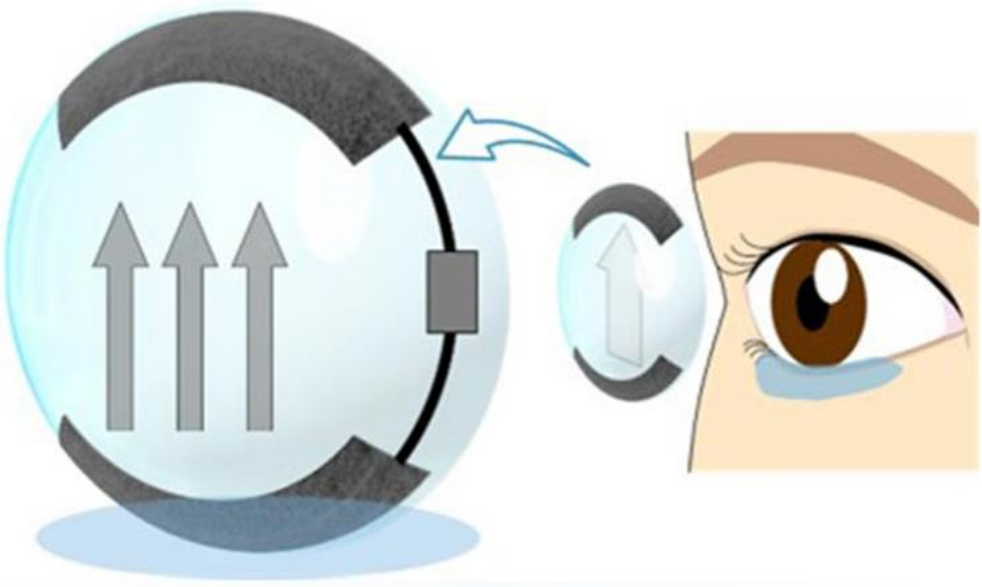


Illustration of a self-moisturizing soft contact lens that supplies tears via electroosmotic flow from the temporary tear reservoir behind the lower eyelid. Credit: Tohoku University

In order to tackle this important problem, the researchers developed a new mechanism that keeps the lens moist. The system uses electroosmotic flow (EOF), which causes liquid to flow when a voltage is applied across a charged surface. In this case, a current applied to a hydrogel causes fluid to flow upwards from the patient's temporary tear reservoir behind the lower eyelid to the surface of the eye.

"This is the first demonstration that EOF in a soft contact lens can keep the lens moist," says Nishizawa.

The researchers also explored the possibility of using a wireless power supply for the contact lenses. They tested two types of battery, a magnesium-oxygen battery and an enzymatic fructose-oxygen fuel cell, both of which are known to be safe and non-toxic for living cells. They showed that the system can be successfully powered by these biobatteries, which can be mounted directly on the charged contact lens.

Further research is needed to develop improved self-moisturizing contact lenses that are tougher and capable of operating at smaller currents.

“In the future, there is scope to expand this technology for other applications, such as drug delivery,” says Nishizawa.

John Deere selects tech startup companies for its 2020 Startup Collaborator program

Deere & Company announced the list of tech startup companies that will be part of the 2020 cohort of the Startup Collaborator program in its Intelligent Solutions Group. This program was launched last year to enhance and deepen collaborative relationships with startup companies whose technology could add value for John Deere customers.

"Our focus for the Startup Collaborator is specifically on startups that want to work with John Deere in real-world customer environments to determine the technology readiness of their innovations," said John Stone, senior vice president of Deere's Intelligent Solutions Group.

Stone said the Startup Collaborator provides flexibility for Deere and startup companies to test innovative technologies with customers and dealers without a more formal business relationship. Startups also gain affiliation with and mentoring from a world leader in precision agriculture.

"Innovation has been at the heart of John Deere for more than 180 years," Stone added. "The Startup Collaborator welcomes innovative companies into a program that could help us drive improved results for our customers."

"The first year of the John Deere Startup Collaborator program showed us and the start-ups involved the tremendous mutual value of working closely together," says Julian Sanchez, director of strategy and business development at Deere's Intelligent Solutions Group. "We're excited to continue building on the program's success."

The four companies chosen for the 2020 program include:

- ***DataFarm*** – This Brazilian company is developing digital tools to recommend climate-smart agricultural practices to optimize a farmer's return on investment.
- ***FaunaPhotonics*** – Based in Denmark, this start-up is building technology for real-time pest detection to ensure sustainable crop management and improve tools for pest control.
- ***Fieldin*** – An Israeli company, FieldIn is working on data management tools for specialty crops.
- ***EarthSense*** – Located in Champaign, Illinois, this start-up is creating novel sensing methods to improve in-field data collection.

The Startup Collaborator enables Deere and start-ups to test innovative technologies with customers and dealers in a less formal setting. In turn, start-ups gain the expertise and mentoring from Deere's precision agriculture division.

By Priya Anand

When mattress maker Casper filed paperwork to go public earlier this month, it said it had lost $92 million in 2018 and was on track to lose more than that in 2019. But that's not how direct-to-consumer startups have to operate, according to the author of a new book on the industry. He says at least two of Casper's mattress startup rivals, Purple and Tuft & Needle, are profitable.

Tuft & Needle, in particular, holds a lesson for the sector. It didn't raise venture capital money, which meant that unlike Casper, it couldn't afford to burn through cash trying to build market share, according to Larry Ingrassia, a veteran business journalist whose book "Billion Dollar Brand Club" comes out Jan. 28. "Basically those guys bootstrapped [themselves] and so they had to make money from the start," he told in an interview this week.

Ingrassia, a former top business editor at The Wall Street Journal, The New York Times and the Los Angeles Times, spent about 18 months working on the book. He spoke with about 50 DTC companies, conducting nearly 200 interviews for the book overall.

One of the most important conclusions he came to is that "it is possible for DTC companies to make money and to be profitable. They have to be run well and they have to be very focused on the bottom line."

In the interview, Ingrassia talked about how DTC companies have changed the playbook for building a brand, and how low-cost manufacturing is bringing a flood of copycat DTC startups that will make it tough for each company to build market share. The following interview has been edited for length and clarity.

These companies—Dollar Shave Club, Warby Parker, Quip and Away—tend to follow similar formulas for success in their early stages, as you detailed. What's the playbook?

IIf you go to 10,000 feet, technology has leveled the playing field. It made it possible for new brands to go from zero to 60 on a national basis in very short order.

So in the past you used to have to have retail store shelf space. You don't need that [now]. You could sell directly on the internet. You don't need a very expensive TV or radio or newspaper advertising campaign. You could use Facebook and Instagram to reach your target customer for actually very little money initially. And the other thing is, while outsourcing...existed for a long time, it became easier and easier to get high-quality outsourced products no matter what we wanted to make.

And so all these things came together to make it possible for these brands to start, when it would have cost a lot more in the past. And the final thing: They were selling directly to consumers. They got the data online that [would] help them figure out what their customers wanted and to not only market better to them, but actually...fine-tune their product offerings much more quickly than a company that sold mostly [in] retail stores.

Many DTC brands are not profitable. Casper, which recently filed to go public, is a prominent example of this. And some of the flashy acquisitions are, years later inside their parent companies, reportedly also not profitable yet. What do you make of that?

Those were pretty scary numbers. I think everybody would have to say, you know, [Casper's] sales are very high, but the losses were quite heavy.

Casper isn't the only mattress startup. There are others—in fact, dozens of others. A couple of them—Purple, for one, and Tuft & Needle—are...profitable. So Casper in some ways is a little bit of an underperformer among the big companies.

Tuft & Needle was sold about a year, year and a half ago. And they told me at the time that they were profitable. One of the reasons they had to be profitable is that unlike Casper, they did not raise venture capital money. Basically those guys bootstrapped [themselves] and so they had to make money from the start.

It is possible for DTC companies to make money and to be profitable. They have to be run well and they have to be very focused on the bottom line. Casper, I think, was very focused on winning market share, and when you had a flood of new competitors, they kept spending more and more [on marketing].

Do you think venture funding effectively becomes a curse for these companies?

Like everything, I think venture capital money tends to follow the herd for a while, and sometimes you get to a point where there's too much money going into a category. I think that's a question here.

You're going to have some big winners here. Look at Harry's, for example. I was actually surprised they got sold for so much [Harry's sold for $1.37 billion]. They were the second company to enter that [field] after Dollar Shave Club, and they actually raised more money, but they also sold for more than a billion dollars.

That's a sign that there is some appetite there for these companies that can build a strong brand identity.

But I think that probably going forward, venture capitalists are going to be a little bit more careful about where they put their money and how much money, because...doling it out at the right pace is important. People will catch their breath and see how some of these companies do and what the exit is going to be for more of these companies.

Should they be valued as tech companies or retail companies? Everyone wants to be considered a tech company.
I would say they're hybrid companies. They use technology to create a new model and to build a strategy that would have been difficult to build in the past, but in the end they're consumer product companies who will succeed based on a combination of the value offered to customers on the consumer product. I certainly wouldn't put them in a clear technology category. I think that would be wrong.

How many of these brands are really going to be able to become massive companies that endure over time? Your book outlines how manufacturing has become so simple now that entrepreneurs can quickly spring up companies, flooding a market with competitors if a new product takes off.

It's going to be hard to build big market share. You're going to have a lot of niche players who take different pieces of the market.

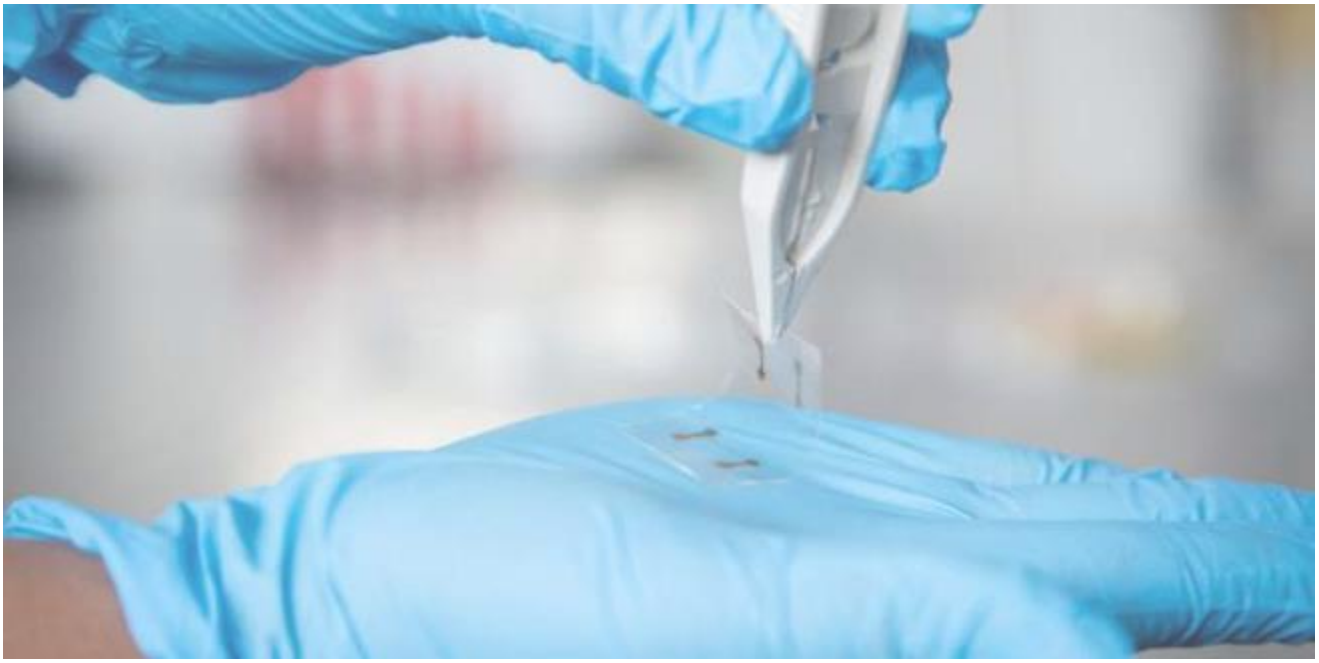
Warby Parker obviously has been very successful. So you think, oh, is there any space for more eyeglasses startups? They take a lot of the oxygen out of the room. It turns out there are eyeglass startups that are launching all the time. They generally tend to be niche players. Some of them are me-too players. [For example,] there's one company called Lensabl. They will make prescription lenses for your favorite frames.

You're going to continue to get a lot of new players...in niche categories. One of the critical changes that's happened is a lot of the Asian manufacturers have developed a lot of expertise because they've made so many products for so many companies. They can help you with your design and make it better. They can do small-batch manufacturing much more efficiently than they did in the past. In the past, they only wanted to do business with you if you were a big outsourcing customer.

It's been clear that traditional consumer product companies tend to view DTC upstarts as fountains of youth and that's why they've bought several of them. Do you think that perception is going to change as it becomes clear not all of these businesses are profitable or disciplined enough to get close?

P&G just bought another small razor startup—Billie, women's razors. Still, there is a bit of an appetite for some of these companies. I think the answer is [what is] the price, what is the fit, what is the growth potential, what can I learn from these companies if I'm a big company? I think this final chapter is still to be written.

The ability to easily introduce new brands and kind of get to the market and build a following—that is something that won't change. The question is, how many will become billion-dollar brands? Some will, but I don't think it's going to be hundreds of them, at least not in the near future.



A sample of the ultra-thin and ultra-flexible electronic material that could be printed and rolled out like newspaper, for the touchscreens of the future.

By RMIT University

Researchers have developed an ultra-thin and ultra-flexible electronic material that could be printed and rolled out like newspaper, for the touchscreens of the future. The touch-responsive technology is 100 times thinner than existing touchscreen materials and so pliable it can be rolled up like a tube.

To create the new conductive sheet, an RMIT University-led team used a thin film common in cell phone touchscreens and shrunk it from 3-D to 2-D, using liquid metal chemistry.

The nano-thin sheets are readily compatible with existing electronic technologies and because of their incredible flexibility, could potentially be manufactured through roll-to-roll (R2R) processing just like a newspaper.

The research, with collaborators from UNSW, Monash University and the ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET), is published in the journal Nature Electronics. Lead researcher Dr. Torben Daeneke said most cell phone touchscreens were made of a transparent material, indium-tin oxide, that was very conductive but also very brittle.

"We've taken an old material and transformed it from the inside to create a new version that's supremely thin and flexible," said Daeneke, an Australian Research Council DECRA Fellow at RMIT.

"You can bend it, you can twist it, and you could make it far more cheaply and efficiently that the slow and expensive way that we currently manufacture touchscreens.

"Turning it two-dimensional also makes it more transparent, so it lets through more light.

"This means a cell phone with a touchscreen made of our material would use less power, extending the battery life by roughly 10%."

DIY: a touchscreen you can make at home

The current way of manufacturing the transparent thin film material used in standard touchscreens is a slow, energy-intensive and expensive batch process, conducted in a vacuum chamber.

"The beauty is that our approach doesn't require expensive or specialised equipment—it could even be done in a home kitchen," Daeneke said.

"We've shown its possible to create printable, cheaper electronics using ingredients you could buy from a hardware store, printing onto plastics to make touchscreens of the future."

Thick and thin: how to turn an old material new

To create the new type of atomically-thin indium-tin oxide (ITO), the researchers used a liquid metal printing approach. An indium-tin alloy is heated to 200C, where it becomes liquid, and then rolled over a surface to print off nano-thin sheets of indium tin oxide.

These 2-D nano-sheets have the same chemical make-up as standard ITO but a different crystal structure, giving them exciting new mechanical and optical properties. As well as being fully flexible, the new type of ITO absorbs just 0.7% of light, compared with the 5-10% of standard conductive glass. To make it more electronically conductive, you just add more layers.

It's a pioneering approach that cracks a challenge that was considered unsolvable, Daeneke said.

"There's no other way of making this fully flexible, conductive and transparent material aside from our new liquid metal method," he said.

"It was impossible up to now—people just assumed that it couldn't be done."

Patent pending: bringing the tech to market

The research team have now used the new material to create a working touchscreen, as a proof-of-concept, and have applied for a patent for the technology.

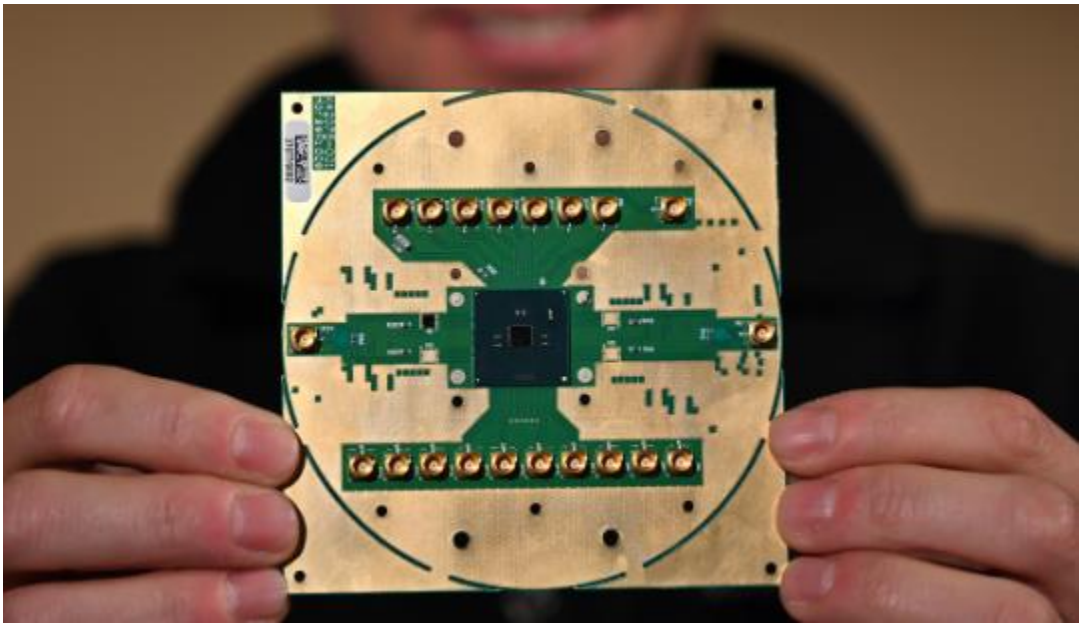
The material could also be used in many other optoelectronic applications, such as LEDs and touch displays, as well as potentially in future solar cells and smart windows.

"We're excited to be at the stage now where we can explore commercial collaboration opportunities and work with the relevant industries to bring this technology to market," Daeneke said.

More information: *Liquid metal derived ultrathin, highly flexible printed two-dimensional ITO, Nature Electronics (2020). DOI: 10.1038/s41928-019-0353-8*
Journal information: *Nature Electronics*

Cryochips by Intel, Seeqc, and others could help quantum computers scale

By Samuel K. Moore



Deep Freeze: Intel Labs principal engineer Stefano Pellerano holds Horse Ridge, a new cryogenic control chip for quantum computers.

As researchers strive to boost the capacity of quantum computers, they've run into a problem that many people have after a big holiday: There's just not enough room in the fridge.

Today's quantum-computer processors must operate inside cryogenic enclosures at near absolute zero, but the electronics needed for readout and control don't work at such temperatures. So those circuits must reside outside the refrigerator. For today's sub-100-qubit systems, there's still enough space for specialized cabling to make the connection. But for future million-qubit systems, there just won't be enough room. Such systems will need ultralow-power control chips that can operate inside the refrigerator. Engineers unveiled some potential solutions in December during the IEEE International Electron Devices Meeting (IEDM), in San Francisco. They ranged from the familiar to the truly exotic.

CryoCMOS

Perhaps the most straightforward way to make cryogenic controls for quantum computers is to modify CMOS technology. Unsurprisingly, that's Intel's solution. The company unveiled a cryogenic CMOS chip called Horse Ridge that translates quantum-computer instructions into basic qubit operations, which it delivers to the processor as microwave signals.

Horse Ridge is designed to work at 4 kelvins, a slightly higher temperature than the qubit chip itself, but low enough to sit inside the refrigerator with it. The company used its 22-nanometer FinFET manufacturing process to build the chip, but the transistors that make up the control circuitry needed substantial reengineering.

"If you take a transistor and cool it to 4 K, it's not a foregone conclusion that it will work," says Jim Clarke,

director of quantum hardware at Intel. “There are a lot of fundamental characteristics of devices that are temperature dependent.”

Others are working along the same lines. Google presented a cryogenic CMOS control circuit earlier in 2019. In research that was not yet peer-reviewed at press time, Microsoft and its collaborators say they have built a 100,000-transistor CMOS control chip that operates at 100 millikelvins.

Microrelays

In logic circuits, transistors act as switches, but they aren’t the only devices that do so. Engineers in Tsu-Jae King Liu’s laboratory at the University of California, Berkeley, have developed micrometer-scale electromechanical relays as ultralow-power alternatives to transistors. They were surprised to discover that their devices operate better at 4 K than at room temperature.

At room temperature, the devices suffer some mechanical peculiarities. First, ambient oxygen can react with the relay’s electrode surfaces. Over time, this reaction can form a high-resistance layer, limiting the device’s ability to conduct current. But at cryogenic temperatures, oxygen freezes out of the air, so that problem doesn’t exist.

Second, the contacts in microscale relays tend to stick together. This shows up as a hysteresis effect: The relay opens at a slightly different voltage than the one at which it closes. But because the adhesive forces are weaker at cryogenic temperatures, the hysteresis is less than 5 percent of what it is at room temperature.

“We didn’t suspect ahead of time that these devices would operate so well at cryogenic temperatures,” says Liu, who led the research presented at IEDM by her graduate student Xiaoer Hu. “In retrospect, we should have.”

Single-flux quantum logic

Hypres, in Elmsford, N.Y., has been commercializing cryogenic ICs for several years. Seeking to steer its rapid single-flux quantum (RSFQ) logic tech into the realm of quantum computing, the company recently spun out a startup called Seeqc.

In RSFQ and its quantum version, SFQuClass logic, quantized pulses of voltage are blocked, passed, or routed by Josephson junctions, the same type of superconducting devices that make up most of today’s quantum computer chips. In 2014 physicists at University of Wisconsin–Madison first suggested that these pulses could be used to program qubits, and Seeqc’s scientists have been collaborating with them and Syracuse University scientists since 2016.

Seeqc is now designing an entire system using the technology: a digital-control, error-correction, and readout chip designed to work at 3 to 4 K and a separate chip designed to work at 20 millikelvins to interface with the quantum processor.

Weyl semimetals

Quantum computing is already strange, but it might take some even stranger tech to make it work. Scientists at Lund University, in Sweden, and at IBM Research–Zurich have designed a new device called a Weyl semimetal amplifier that they say could bring readout electronics closer to the qubits. Don’t worry if

you don’t know what a Weyl semimetal is. There are things about these materials that even the scientists trying to make devices from them don’t fully understand.

What they do know is that these materials, such as tungsten diphosphide, exhibit extremely strong, temperature-dependent magnetoresistance when chilled to below about 50 K. The device they simulated has a gate electrode that produces a magnetic field inside the Weyl semimetal, causing its resistance to go from tiny to huge in a matter of picoseconds. Connecting the input from a qubit to the device could make a high-gain amplifier that dissipates a mere 40 microwatts. That could be low enough for the amplifier to live in the part of the fridge close to where the qubits themselves reside.

Coding Bootcamp Galvanize Agrees to $165 Million Acquisition

By Kate Clark

A wave of consolidation in the education technology market appears set to continue this year.

K12 Inc., a publicly-traded education company, has agreed to acquire Galvanize, a provider of coding bootcamps and co-working spaces across eight locations in the U.S., for $165 million in cash, according to an email addressed to Galvanize shareholders that was viewed by The Information. The email, sent earlier this week by Galvanize CEO Harsh Patel, said the companies intend to close the deal and announce it publicly on Monday.

Spokespeople for K12 and Galvanize didn't respond to requests for comment.

The deal follows a number of recent transactions in the growing "edtech" market. Earlier this week, language learning tool Busuu purchased video tutoring service Verbling for an undisclosed amount. Last year, venture-backed bootcamp business Trilogy Education Services sold for $750 million to 2U, which provides online degree programs. Also last year, media firm Advance Publications acquired Turnitin, a plagiarism detection tool backed by Norwest Venture Partners and Insight Partners, for $1.75 billion.

The Galvanize deal doesn't look like it will result in a big payoff for its shareholders. The transaction won't return "all invested capital for all classes of shareholders," Patel wrote in the shareholder email.

"Of course, I wish that was not the case, but I am very confident that this is the best strategic decision for the business and for Galvanize shareholders," Patel wrote in the email.

Galvanize raised at least $130 million in venture capital and private equity funding, from investors including ABS Capital Partners, Catalyst Investors and New Markets Venture Partners, according to PitchBook, a financial data firm. The business completed a round of layoffs last summer, when 27 employees were let go, according to the Denver Post.

The deal reflects the harsh reality of startup acquisitions. Venture investors are typically classified as preferred shareholders, who are more likely to profit from the sale of companies than current and former employees of startups, who are usually classified as common shareholders. Common shareholders in Galvanize won't be receiving proceeds from the sale, a former employee and shareholder told The Information.

Galvanize was founded in 2012 ahead of the boom in for-profit coding schools. The company raised a $32 million Series C round in 2018 and subsequently acquired a competing bootcamp called Hack Reactor.

Last fall, Galvanize announced it would allow students to finance their bootcamps with income share agreements, a financial contract that grants educational institutions a future portion of a student's income. Lambda School, a San Francisco-based online coding academy, helped raise the visibility of the agreements when it introduced its "pay nothing upfront" model in 2017. Under Galvanize's ISA, students can defer payments until they earn a salary of at least $50,000.

K12 focuses on curriculum development for online schools. The company, founded in 2000, had $37 million in net income on revenue of $1.02 billion during its most recent fiscal year, which ended June 30, according to regulatory filings.

Covestro, pressed by low pricing for its products, continues its focus on sustainability-oriented products that don't necessarily convert quickly to profit.

By David McCann

Think fast: What's the difference between cyclicality and circularity?

Both are key concepts in the business of Covestro, the big German chemical company and plastics maker that spun off from Bayer in 2015.

Many industries are subject to cyclical business patterns, of course. For Covestro and its competitors, cyclicality in the supply-and-demand equation is particularly important.

It typically takes seven years from a decision by the company to build a new production facility until the first products roll out, notes Thomas Toepfer, the company's finance chief.

"We're convinced that spending money on new installations is the basis for future profitable growth," Toepfer says. "But on the supply side, there are peaks, where, for example, two new plants hit the market at the same time."

That's just what happened at the end of 2018 when new production capacity in Asia caused a glut in the

supply of materials Covestro produces that are used in the manufacture of products as diverse as building insulation, electric vehicles, and mattresses. Consequently, market pricing for such materials fell sharply.

That put pressure on Covestro's margins — a situation that is likely to continue in 2020, with much excess supply still to be absorbed. In response, Toepfer has stepped-up attention to cash flow with new cost-control and working capital initiatives.

Covestro CFO Thomas Toepfer

"The trick is how to match a seven-year capex cycle with much shorter cyclicality in profitability, and maybe even shorter-term expectations from investors," says Toepfer.

Because of potential investor sensitivity, Covestro is committed to keeping its dividend at least stable, regardless of economic conditions and profitability.

Part of the messaging to investors is about the necessity to invest in research and development efforts that aren't quickly converted to profit. "It's a delicate balance that we have to strike, which is a challenge for all the leaders in our company," Toepfer says. "We're pressuring people on costs and, at the same time, telling them to come up with new ideas and projects."

As it happens, R&D is a critical element of what's known as economic circularity, which can be considered a subset of sustainability. The term refers to the creation of systems designed to minimize waste through the continual re-use of resources.

Covestro's strategy calls for 80% of its R&D spending to contribute in some way toward the United Nations' Sustainable Development Goals initiative.

An End-to-End Strategy

Considering that BlackRock, the world's largest asset manager, is changing its investment strategy because it considers sustainability to be a defining factor in companies' long-term prospects, Covestro may be quite well-positioned.

A core element of the company's purpose "is to find more applications for our materials that help save energy and make the world more sustainable and efficient," Toepfer tells CFO.

Covestro makes foam for the insulation used in energy-efficient buildings. Also, its polycarbonates are used in making high-performan lightweight materials that can replace steel and iron in electric vehicles.

And the company has a coatings and adhesives business that makes hundreds of products geared toward sustainability. For example, it makes coatings for windmill blades that allow the blades to be replaced less frequently. "If the blades last 12 years instead of 7 years, it changes the entire business case for wind energy," the CFO says.

The company is making increased use of wind energy itself. Much of the energy generated in Germany is still coal-based, so it has entered a power purchase agreement with a wind park in Denmark that so far is generating about 6% of the energy the company uses in Germany.

The wind deal was a perfect example of the tradeoffs Toepfer has to make in balancing short-term profitability with long-term attention to sustainability. "It was probably proposal No. 3 on wind energy, because Nos. 1 and 2 were declined — they weren't profitable enough," he says.

That's one of many efforts to promote sustainability in procurement, logistics, and production activities. Covestro also is working on a bio-based replacement for crude oil in the production of aniline, a vital precursor product to polyurethane and other industrial chemicals. And it's refining the energy-intensive process of breaking down saltwater into nitric acid and chlorine, another key precursor.

But true circularity involves more than sustainably producing products aimed at enhancing sustainability. Covestro is moving toward playing a meaningful role in the recycling of its materials.

The company doesn't produce any single-use plastics of the types that wind up in the ocean. Instead, all of its materials go into products designed for long-term use. "But they do come to the end of their lifetime at some point," Toepfer says. "What should happen with insulation material, for example, even 40 years after it was used?"

Covestro's customers are asking for help in figuring out how to recycle obsolete materials. "Somebody else has to collect the materials, and yet somebody else might have to do the actual recycling procedures, but with our knowledge about our products, we can contribute a lot to those solutions," says the finance chief. He notes that people tend to think simplistically about recycling as being all about mechanical recycling — in essence, shredding materials to make new products out of them. That works for only a small portion of plastics because product quality deteriorates with each round of recycling.

Potentially more useful is chemical recycling, which involves breaking down materials' molecular structure, which Toepfer calls "a great opportunity" that hasn't been tapped into much so far.

The Big Picture

About 8 million metric tons of plastic enters the world's oceans each year, according to experts. Even more is dumped into landfills. Almost all of that is single-use plastics, but Toepfer says that as part of the plastics industry Covestro has a responsibility to help address those problems.

"Plastic is a great material that can be super helpful in promoting energy efficiency, but it doesn't belong in the oceans or landfills," he says. "It's a way too valuable material to be thrown away. So we engage heavily with efforts like the Alliance to End Plastic Waste and German recycling initiatives."

At stake in the way Covestro sources, produces, and takes post-sale responsibility for its products and, more broadly, global environmental risk is nothing less than the company's viability, according to Toepfer.

"As a chemical company, a medium- to long-term view is that our [social] license to operate depends on our ability to be sustainable, and to be sustainable in the sense of being circular," he says. "The message from society is loud and clear. For us, there is no way around dealing with these issues."

Brain Corp reports record sales in 2019, citing demand for AMRs in retail

Brain Corp, which develops autonomy software for commercial vehicles and robots, today announced it achieved record sales and revenue growth in 2019 as retailers turn to robotic solutions to help reduce costs and enhance in-store experiences.

The Whiz cleaning robot uses BrainOS. Source: SoftBank Robotics North America

Fueled by a surge of interest for its BrainOS-powered floor care machines by major retailers, including Walmart, the company said it achieved more than a 300% increase in revenue last year. Brain Corp said it also saw a 760% increase in global deployments, and now provides the intelligent back end for one of the largest fleets of its kind in the world – approximately 10,000 robots deployed or enabled.

"A growing number of retailers are turning to next-generation mobile robots to drive better productivity and improved customer experiences within their physical stores," said Scott Carter, chief operating officer at Brain Corp. "Last year was a landmark year for our customers and the retail robotics industry. We are looking forward to working with our strategic partners to accelerate and lead this trend in 2020."

Brain Corp accomplishments

In addition to being named to the RBR50 in 2019, other corporate highlights for Brain include:

- Recognition by ABI Research as the No. 1 Autonomy Solution Provider for mobile robotics.
- Inclusion in Forbes magazine's top 50 list of America's most promising artificial intelligence companies.
- New technology agreements with Alfred Kärcher SE & Co. KG, RPS Corporation (which manufactures Factory Cat and Tomcat cleaning equipment), Nilfisk, and other OEMs to build intelligent machines at scale. Along with Tennant Company and Minuteman International, a subsidiary of the Hako Group, Brain Corp now counts the top four commercial floor care OEMs as partners. Last year, a number of major brands and retailers adopted Brain Corp technology, resulting in a 6X increase in units sold.
- The North American launch of Whiz commercial-grade autonomous vacuum sweepers from SoftBank Robotics America and ICE Robotics. Whiz is powered by BrainOS. This followed the successful rollout of Whiz machines in Japan in 2018.
- An expanded relationship with Walmart to more than quadruple the number of robotic floor scrubbers, showcasing the value of smart automation in retail.
- Surpassing 10 billion square feet cleaned autonomously across three continents.

- The opening of European headquarters in Amsterdam to support the sale and deployment of autonomous floor care machines from OEM partners.

A BrainOS-powered autonomous floor scrubber. | Credit: Brain Corp

Last month, ABI Research forecast than more than 150,000 mobile robots will be deployed in brick-and-mortar establishments within the next five years for cleaning, inventory management, and material handling tasks. Brain said it is enabling this trend by making it easier for strategic OEMs to produce, deploy, and support commercial robots at scale through its robotic AI platform.

After starting with floor care, the company said it is helping manufacturers expand into material handling, commercial vacuuming, shelf analytics, and more. The company said it has "helped manufacturers deploy more automated machines into the public spaces over the last three years than any other solution provider."

At the recent NRF 2020 show in New York, Brain displayed a prototype robot that it developed with Savioke, which provides retail store shelf analytics services. The company is expected to provide more details at the retail-focused StorePoint Fresh 2020 event in Austin, Texas. In addition, Brain will exhibit at MODEX 2020 in Atlanta in March, and at the Interclean Amsterdam show in May.

ST Plans $1.5bn Capex to Generate $12bn Revenue in 2020

By Nitin Dahad

The investments includes $400m strategic investments in the Agrate fab; and GaN and 200mm SiC wafer capacity

Following a flat 2019 in which full year revenue was $9.56 billion, STMicroelectronics plans to invest $1.5 billion in strategic initiatives to achieve its target of $12 billion revenue in fiscal year 2020.

The investment includes additional capacity for existing technologies, in mix evolution for 200mm fabs, in R&D support, and in maintenance of manufacturing operations. Some $400 million of the capex investment will be spent on fab upgrades and new substrate technology development. This includes work on the new Agrate fab to support BCD, IGBT and other power technologies; R&D for GaN power technologies; production ramp up for GaN; and investments in silicon carbide and substrate activities following the Norstel acquisition, particularly in driving the evolution of 200mm silicon carbide (SiC) wafers at the plant.

Speaking during the company's financial results webcast this week, president & CEO Jean-Marc Chery said its SiC revenue would grow to above $300 million in 2020. In 2019, STMicroelectronics generated 80% of its SiC revenue from just one customer, but with discussions ongoing for 50 projects with 26 customers, the company expects that in three years' time the dependence on that one customer will be reduced to 50%.

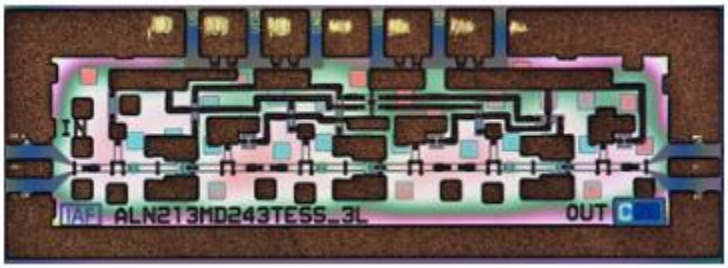
Chery said, "We plan to return to solid revenue growth, outperforming the markets we serve. Smart mobility, power and energy management, the IoT and 5G are driving demand for semiconductor content. ST is very well positioned to support its customers across these trends, thanks to our product portfolio, enabled by our differentiated technologies."

As highlighted in previous quarters, Chery emphasized the poor performance of automotive product sales driven by a soft automotive market, but on the other hand good demand for electrification and digitalization of car systems and platforms. He said, "The legacy automotive business, which is closely linked to the number of car registrations worldwide, faced a challenging situation, with global registrations down 5% in 2019." He continued, "Car registrations will continue to be flattish, but the movement to electric powertrains and hybrids is a solid trend." Marco Monti, president of the automotive and discrete group within ST, added, "This year, stabilization and increase of penetration of ADAS will help us grow."

In the industrial market, ST said that while Asia saw growth, the U.S. stopped declining and was flat, and Europe was declining. Meanwhile, it saw solid demand for its key products in personal electronics in all categories, such as smart phones, accessories and wearables, and with some early contribution from 5G smartphones. From its communications equipment group, ST saw growth in products for 5G infrastructure, which compensated for the wind-down of its legacy ASICs and set-top box business.

On the outlook for the first quarter of 2020, Chery said, "On a sequential basis, revenues from all of our three product groups are expected to decline in what will be a shorter and seasonally lower quarter, though we anticipate better than usual seasonality for personal electronics products. On a year-over-year

basis, main revenue growth drivers are expected to be personal electronics products — mainly imaging and analog products — general purpose microcontrollers and silicon carbide products."



Scientists at the Fraunhofer Institute for Applied Solid State Physics IAF have succeeded in developing a novel type of transistor with extremely high cut-off frequencies: metal oxide semiconductor HEMTs, in short MOSHEMTs. To achieve this, they have replaced the Schottky barrier of a conventional HEMT with an oxide. The result is a transistor that enables even smaller and more powerful devices. It has already reached record frequencies of 640 GHz. This technology is expected to advance next generation electronics.

The high frequency characteristics of high eElectron mobility transistors (HEMT) have been steadily improved in the past years. The transistors have become increasingly faster by downscaling the gate length to 20 nm. However, a HEMT encounters a problem at such small structure sizes: The thinner the barrier material of InAlAs (indium aluminum arsenide) becomes, the more electrons leak from the current carrying channel through the gate. These unwanted gate leakage currents have a negative impact on the efficiency and durability of the transistor, which renders further downscaling attempts impossible. The current transistor geometry of a conventional HEMT has reached its scaling limit. Silicon MOSFETs (metal oxide semiconductor field effect transistors) are no stranger to this problem, either. However, they possess an oxide layer that can prevent unwanted leakage currents for longer than it is the case with HEMTs.

Combining advantages of both transistor technologies

Researchers at Fraunhofer IAF have combined the advantages of III-V semiconductors and Si MOSFETs and have replaced the Schottky barrier of a HEMT with an isolating oxide layer. The result is a new type of transistor: the metal oxide semiconductor HEMT, in short MOSHEMT. "We have developed a new device which has the potential to exceed the efficiency of current HEMTs by far. The MOSHEMT allows us to downscale it even further, thus making it faster and more efficient," explains Dr. Arnulf Leuther, researcher in the field of high-frequency electronics at Fraunhofer IAF. With the new transistor technology, Leuther and his team have succeeded in achieving a record with a maximum oscillation frequency of 640 GHz. "This surpasses the global state of the art for any MOSFET technology, including silicon MOSFETs," adds Leuther.

High barrier to overcome leakage currents

To overcome the gate leakage currents, the scientists had to use a material with a significantly higher barrier than the conventional Schottky barrier. They replaced the semiconductor barrier material with a combination of isolating layers consisting of aluminum oxide (Al_2O_3) and hafnium oxide (HfO_2). "This enables us to reduce the gate leakage current by a factor of more than 1000. Our first MOSHEMTs show a very high development potential, while current field effect transistor technologies have already reached their limit," reports Dr. Axel Tessmann, scientist at Fraunhofer IAF.

The world's first integrated circuit with MOSHEMTs

The extremely fast MOSHEMT is designed for the frequency range above 100 GHz and is therefore especially promising for novel communication, radar and sensor applications. In the future, high-power devices will ensure a faster data transmission between radio towers and enable imaging radar systems for autonomous driving as well as higher resolution and precision of sensor systems. While it will take some years until the MOSHEMT finds its way into commercial application, the researchers at Fraunhofer IAF have already succeeded to realize the world's first amplifier MMIC based on INGaAs MOSHEMTs for the frequency range between 200 and 300 GHz.

Related Articles

DARPA-funded InP MMIC reaches record 1.03 THz, earns Guinness World Record