



# CB DIGEST FOR TECHNOLOGY

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### **Facebook Sees Oculus VR Content Sales Top \$100 Million**

Content sales for Facebook's latest Oculus virtual reality headset, the \$400 Quest, topped \$100 million over the past year, the company said Monday (May 18, 2020). While Facebook has yet to disclose sales numbers for the headset itself, it's an impressive stat for a still-nascent platform and a rare peek into how the VR industry is maturing. Facebook also noted that more than 10 titles for the Quest have generated over \$2 million in revenue in the past year. To put those numbers in perspective, S&P Global Market Intelligence told Protocol it estimates there to be roughly 4 million Oculus headsets, including past models, installed globally. While VR has improved dramatically in recent years with the introduction of devices like the Quest, it hasn't captured mainstream attention like video calling tech during coronavirus lockdowns. Devices being pricey and hard to come by are likely inhibitors. Compelling content that can draw in new users to VR is another piece of the puzzle, and likely the reason Facebook put out these numbers in the first place: to woo more developers.

### **Apple to Make New Headphones in Vietnam in Shift From China**

Apple is about to face a big test of its ability to manufacture its devices outside China—by making a brand-new product in Vietnam. Apple has tapped factories in Vietnam to make its own forthcoming over-ear headphones, a new phase in its effort to diversify manufacturing away from China amid political and trade tensions between Washington and Beijing, The Information has learned. The move would be the first time Apple has used factories in Vietnam to produce an entirely new product, instead of relying on them to supplement manufacturing of an older model already produced in China. The company is working with contract manufacturers, who will also build some of the headphones in factories in China, said a person briefed on Apple's plans.

### **Coinbase to Make Working From Home Permanent**

Crypto firm Coinbase became the latest Bay Area company to make working from home permanent, saying that it would become a "remote-first" organization that would let employees decide where to work. CEO Brian Armstrong said in a blog post that the transition to working from home as the pandemic took hold was "less complicated" than expected. While any employee who wants to work from an office after the pandemic subsides will be able to do so, Armstrong said the shift toward remote work would broaden the company's access to talent and give Coinbase an edge in recruiting.

Coinbase is following similar decisions by Twitter and Square to adopt a permanent work-from-home plans. While they are still in the minority among big tech businesses, the changes could have big implications for real estate markets in places like downtown San Francisco. Meanwhile, the pressure on other companies to bring more flexibility into their workplace arrangements is only likely to grow.

### **Apple and Google Release Contact Tracing Technology**

Apple and Google's contact tracing technology is now available for public health agencies to start using, the companies said on Wednesday. The rare, joint effort was first announced last month. Now, public health agencies will be able to start building contact tracing apps on top of the APIs created by Apple and Google. iOS and Android users will be able to opt in to the system, which uses Bluetooth to track whether a person has been exposed to someone who has tested positive for Covid-19. The companies said health departments from Alabama, North Dakota, and South Carolina are the first states to commit to building apps that leverage their technology. Outside the U.S., 22 countries have requested access to the APIs as well.

### **Facebook to Limit Office Capacity, Require Temperature Checks**

Facebook will limit its offices to 25% occupancy and require temperature checks when some employees begin returning to work in early July. The changes, first reported by Bloomberg and confirmed to The Information by a Facebook spokesperson, also mean that certain office areas will require the wearing of masks at all times.

As one of the first big companies to send its workers home due to the coronavirus pandemic, how Facebook plans to reopen is being closely watched. Other changes to office life will include six-foot spaces between desks, the replacement of cafeteria buffets with to-go meals, the temporary closure of gyms, and no outside visitors for a while. Facebook previously said it would also prohibit all company events of 50 or more people through mid-2021.

### **BitFlow Introduces 6th Generation Camera Link Frame Grabber: The Axion**

BitFlow has offered a Camera Link frame grabbers for almost 15 years. This latest offering, our 6th generation combines the power of CoaXPress with the requirements of Camera Link 2.0. Enabling a single or two camera system to operate at up to 850 MB/S per camera, the Axion-CL family is the best choice for CL frame grabber. Like the Cyton-CXP frame grabber, the Axion-CL leverages features such as the new StreamSync system, a highly optimized DMA engine, and expanded I/O capabilities that provide unprecedented flexibility in routing. There are two options available; Axion 1xE & Axion 2xE. The Axion 1xE is compatible with one base, medium, full or 80-bit camera offering PoCL, Power over Camera Link, on both connectors. The Axion 2xE is compatible with two base, medium, full or 80-bit cameras offering PoCL on both connectors for both cameras. The Axion-CL is a culmination of the continuous improvements and updates BitFlow has made to Camera Link frame grabbers.

### **Nvidia's Data Center Chip Sales Jump 80%**

Nvidia, the top provider of chips for artificial intelligence work, is getting a sizable boost from companies working from home during the Covid-19 pandemic. Its two biggest businesses—graphics chips for gaming and for servers that run AI projects in data centers—grew healthily during its fiscal first quarter. Sales of chips for data centers jumped 80% to \$1.14 billion compared to last year, surpassing the \$1 billion mark for the first time and reflecting the growing adoption of machine learning in large companies. Gaming chip revenue was \$1.34 billion, up 27% from last year. Nvidia's overall sales for the quarter ended April 26 were \$3.08 billion, up 39% from last year. For years, Nvidia has been known primarily as a gaming chip company and has generated most of its revenue from these products. But after closing its \$7 billion acquisition of Mellanox, which sells chips for cloud provider servers, it's likely that data center chips will soon be its largest business.

### **Bain Capital backs sports video platform**

Bain Capital has announced a growth investment in Hudl, a Lincoln, Neb.-based provider of video analysis and data software for the sports industry. Funds for the investment came via the firm's Bain Capital Tech Opportunities unit, which typically targets late-stage growth deals and buyouts in healthcare IT, digital media, application software and other tech-related verticals.

### **Radiant Presents at the 2020 AWE Online Conference and Expo Introducing AR/VR Display Test Systems that Replicate Human Vision within Headsets**

Radiant Vision Systems, a leading provider of photometric imaging solutions for light and display measurement, announces that it will exhibit and speak as part of AWE (Augmented World Expo) Online, taking place May 26-29, 2020. For the first time, AWE will be held as a fully virtual event featuring both an online Conference and Expo. In addition to engaging with attendees of the live virtual Expo, Davis Bowling—member of the Radiant Vision Systems sales leadership team and liaison to the company's augmented (AR), virtual (VR), and mixed reality (MR) customers— will present “Replicating Human Vision for Accurate Testing of AR/VR Displays” as part of the AWE Conference “XR Enablement” track. The presentation will be broadcast Wednesday, May 27, from 11:30 to 11:50 A.M. PDT, followed by a live Q&A with Bowling and members of the Radiant display test solutions team.

### **Google CEO Cautious About Major Shift to Remote Work**

Google CEO Sundar Pichai isn't ready to commit to moving his employees to a work-from-home model forever.

In a wide-ranging interview with Wired's Steven Levy on Friday, Pichai said he believed some changes to the way employees work will stick, but that “it's still too early to tell how much.” His comments come one day after Facebook CEO Mark Zuckerberg said he expected half of his workforce to be remote within five to 10 years.

Pichai's reason for being cautious is fair. Employees today are mostly working on projects and with people they were familiar with before the pandemic struck. But can people be as effective in the long run?

"I'm curious to see what happens as we get into that three-to-six-month window and we get into things where we are doing something for the first time," Pichai said.

### **Fly Now Pay Later secures \$42.6M**

Fly Now Pay Later, a London-based payment provider for the travel sector, has raised £35 million (\$42.6 million) in a Series A round led by Revenio Capital. The startup offers travelers the option of paying for their bookings over monthly installments.

### **Holmusk raises \$21.5M for health tech**

Holmusk, a Singapore-based data science and health technology company, closed on a \$21.5 million Series A round led by Optum Ventures and Health Catalyst Capital. The startup provides an analytics platform for behavior health data to help make treatment decisions and to research new therapies.

### **Contentsquare raises \$190M Series D**

Contentsquare announced it has closed on a \$190 million Series D funding to invest heavily in innovation, including AI-based and predictive analytics, and expand its business across the Americas, Europe, Asia and Middle East. The round, which brings total funding to date to \$310 million, was led by BlackRock's Private Equity Partners team, who joins existing investors Bpifrance (through their Large Venture fund), Eurazeo Growth, Canaan, GPE Hermes, Highland Europe, H14 and KKR, most of whom participated in this round. Sapiance Capital Limited is also providing credit to the company.

Founded in 2012 by Jonathan Cherki, ContentSquare helps organizations optimize their web and mobile sites. It was named by Gartner as one of the four most innovative e-commerce technologies in the world. Its digital experience insights platform is trusted by brands like AccorHotels, Sephora and Walma.

### **Amplix extends Series C to over \$90M**

San Diego-based Amplix Pharmaceuticals closed on an additional \$53 million toward its Series C round to raise it to more than \$90 million. Sofinnova Investments led the financing for Amplix, which focuses on therapies for debilitating and life-threatening diseases in patients with compromised immune systems.

### **Confluera raises \$20M for cybersecurity**

Cybersecurity startup Confluera announced that it has raised a \$20 million Series B round led by Icon Ventures. The Palo Alto-based company helps organizations find sophisticated security attacks going on inside of their infrastructures, detect attack signals, and visualize the big picture for analysts.

### **Big Sky Health secures \$8M for fasting app**

Montana-based Big Sky Health, developer of the app Zero, which is used for customizing fasting plans, announced it has raised \$8 million in a Series A funding round led by Greycroft.

### **CarTrawler takes on \$109M**

CarTrawler, a Dublin-based provider of car rentals and mobility services to the travel industry, has secured \$109 million in a controlling equity investment from TowerBrook Capital Partners.

### **Tapcart raises \$10 million in Series A funding for its mobile ecommerce app**

Tapcart, a Santa Monica, California-based tech startup and a provider of mobile commerce SaaS platform, today announced it that it has closed additional \$10M in funding. The Series A round was led by SignalFire with the participation of previous investors, Greycroft and Amplify. To date, Tapcart has raised \$15.1M in total funding. The funding will be used to accelerate the already rapid adoption of its existing platform, which has been used to create mobile apps for many of the world's top Shopify Plus brands including Fashion Nova, Chubbies, Urban Planet, and

more. With this new round of investment, Tapcart is also looking to further expand operations, bring on several key hires, and continue to build the product roadmap with exciting new features.

Founded in 2017 by Eric Netsch and Sina Mobasser, Tapcart was launched with a simple premise to make mobile shopping easy, fun, and attainable for every brand. Native mobile app development was historically something that could only be done by developers and was only available to Enterprise businesses with resources.

### **Benchmark Raises \$425 Million Fund, This Time Without Bill Gurley**

Venture firm Benchmark has closed on \$425 million for its tenth fund, according to an SEC filing. Longtime general partner Bill Gurley is not listed on the filing, following a Wall Street Journal report he would not invest capital out of the firm's next fund. Partners in the new fund include Peter Fenton, Chetan Puttagunta, Steven Spurlock, Sarah Tavel and Eric Vishria. Benchmark is known for investments in Uber and Instagram. The firm raised the fund more quickly than expected to take advantage of prices depressed by the coronavirus epidemic, the WSJ previously reported.

### **Coalition secures \$90M for cyber insurance**

Coalition, a San Francisco-based cyber insurance and security company, announced this morning it has raised \$90 million in a Series C round led by Valor Equity Partners. The startup's current valuation of \$890 million is more than triple the value set at its last fundraiser a year ago.

### **Following sharp cuts, Vroom files for IPO**

Online used car retailer Vroom has filed to raise up to \$100 million in an initial public offering on Nasdaq, according to a securities filing. The New York-based company filed publicly for its IPO just after furloughing about one-third of its workforce and implementing salary reductions for remaining employees.

### **Truework nabs \$30M for ID verification**

Truework, developer of a consent-based identity verification platform, has raised \$30 million in a Series B funding round led by Activant Capital, with participation from existing investors Sequoia Capital and Khosla Ventures. The San Francisco-based company's technology has seen particularly high adoption for income and employment verification.

### **Strapi lands \$10M for content management**

Paris-based Strapi, a provider of an open source content management system, raised \$10 million in a Series A round led by Index Ventures. Strapi plans to use the funding to double its team, with an eye to expanding in the United States.

### **Arizona sees rise in venture dollars**

The past two years have set records for venture dollars going to Arizona-based startups, with funding rounds on the rise across stages. The trend indicates that Phoenix-well known as a popular spot for tech companies to set up secondary offices-is increasingly seen as a place for headquarters too.

### **States Title brings home \$123M**

San Francisco-based States Title has raised a \$123 million Series C led by Greenspring Associates. Founded in 2016, the company is the developer of a platform designed to process residential real estate transactions. Horizons Ventures, Eminence Capital and HSCM Bermuda also participated in the funding.

### **MakeSpace bags \$55M to reinvent storage**

On-demand storage company MakeSpace raised \$55 million in a Series E round backed by industry giant Iron Mountain. The startup aims to simplify storage by sending drivers and movers to pick up customer's items and take them back when needed, and lets customers see and manage their stuff through a custom app.

### **Ecwid lands \$42M for digital storefronts**

Ecwid, a San Diego-based startup that enables small businesses to establish digital storefronts, raised a \$42 million round of funding led by Morgan Stanley Expansion Capital and PeakSpan Capital. A portion of the new funds will be used to buy out previous and early-stage investors.

#### **Chief raises \$15M for female leaders network**

Chief, the private network for women leaders, has raised \$15 million in a new round of funding to expand into new cities. The startup offers peer group experiences, an online platform, and event programming meant to connect and support members.

#### **Human Interest rings up \$10M more for 401(k) plans**

Human Interest, a 401(k) provider for small and medium-sized businesses, announced a \$10 million extension to its Series C round, bringing its total to \$50 million. Glyn Capital led the financing for the San Francisco-based company, which currently provides retirement savings plans to over 2,200 companies and more than 100,000 employees.

#### **VergeSense closes on \$9M for workplace sensors**

San Francisco-based VergeSense, which has developed artificial intelligence-powered workplace sensors, announced this morning a \$9 million strategic investment led by Allegion Ventures.

#### **Magic Leap secures \$350M**

Augmented reality unicorn Magic Leap has reportedly received a \$350 million lifeline, a month after slashing 1,000 jobs and dropping its consumer business. Previously, the Florida-based company had raised a whopping \$2.6 billion in known funding.

#### **Run the World raises \$11M for virtual events**

Run the World, a platform for virtual networking events, has raised \$11 million in a Series A round led by Andreessen Horowitz and Founders Fund. A long list of other investors participated in the financing, including Will Smith's Dreamers VC and Kevin Hart's Heartbeat Capital.

#### **REX sells stake for \$25M**

REX, a licensed residential real estate brokerage using AI and big data, announced it has received a \$25 million investment from Lion Capital in exchange for a minority stake in the company. From January to April this year, REX said it has worked to move three times more homes into escrow compared to the same period in 2019.

#### **Aspiration banks \$135M**

Aspiration has raised a \$135 million Series C led by Alpha Edison, according to Fortune. Founded in 2013 and based near Los Angeles, the fintech company is the operator of a branchless banking and investment platform. Aspiration was valued at \$337 million in 2017, according to a PitchBook estimate.

#### **Mindstrong locks in \$100M**

Mental health startup Mindstrong has secured a \$100 million Series C from backers including General Catalyst, Arch Venture Partners, Foresite Capital, 8VC, Optum Ventures and What If Ventures. Based in San Francisco, the startup is the developer of an app that provides remote patient monitoring and mental health symptom measurement. It was valued at \$200 million after a \$45 million round in 2018.

#### **Nautilus Biotechnology brings in \$76M**

Vulcan Capital has led a \$76 million Series B round for Nautilus Biotechnology, which analyzes human proteins to improve the development of therapeutics and predictive medicine. Investors including Andreessen Horowitz, Madrona Venture Group and AME Cloud Ventures also participated in the funding.

#### **Rent the Runway seeks funds below last year's \$1B valuation**

Rent the Runway is looking for at least \$25 million in financing led by T. Rowe Price at a valuation of about \$750 million, according to Bloomberg. That would be a significant cut to the \$1 billion it was valued at after a \$125 million round last year, according to PitchBook data. The fashion company's plans reportedly aren't final and may change.

#### **L Catterton in discussions to back Tonal**

Tonal Systems, a home fitness startup, is seeking fresh financing that could value it at around \$250 million—and private equity firm L Catterton is a possible investor, according to Bloomberg. The San Francisco-based company is the creator of a wall-mounted home exercise system that includes personal training workouts.

#### **Vance Street seeks \$375M**

Vance Street Capital, a Los Angeles-based middle-market buyout shop, is raising \$375 million for its third fund. This vehicle's predecessor closed on \$250 million in 2017.

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## Facebook leads big tech in pandemic-era investment push

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By James Thorne

Big Tech hasn't let an economic meltdown dampen its appetite for startup investing. Dealmaking by the largest US tech companies for the second quarter is shaping up to be among the largest in recent years. In the first six weeks of Q2 2020, \$7.5 billion worth of deals involved Facebook, Apple, Amazon and Microsoft, according to PitchBook data—the most since Q4 2018, when Microsoft acquired GitHub for \$7.5 billion.

Much of those funds had a link to Facebook's mammoth \$5.7 billion stake in India's Jio Platforms in April. Since then, the deals have continued to roll in.

Last week, Facebook announced the acquisition of GIF-sharing platform provider Giphy, Microsoft agreed to buy virtual networking company Metaswitch Networks, and Apple reportedly bought NextVR, a virtual reality streaming startup.

The investments and acquisitions underscore the relative good fortunes of large tech firms amid the pandemic. The stocks of Facebook, Apple, Microsoft and Amazon have largely recovered from a March selloff and are trading close to or above pre-crisis levels. More coronavirus news: Continuing coverage from PitchBook.

By contrast, the pandemic has been less kind to startups, which have laid off workers in droves and have braced for declining valuations. Financial terms of Giphy's acquisition were withheld, but the price was roughly \$200 million less than the valuation it received in 2016, Axios reported.

"If these conditions linger and valuation multiples in aggregate move significantly lower, corporations—especially those with a strong liquidity position—may look to make acquisitions of quality assets at a discount," said Cameron Stanfill, a venture capital analyst at PitchBook.

Facing challenging economic prospects, many startups may soon need additional capital to stay afloat, he said.

The recent string of deals is unlikely to ignite fresh scrutiny among federal regulators, said Alec Stapp, director of technology policy at the Progressive Policy Institute, a think tank. The domestic acquisitions are relatively small and the target companies aren't direct competitors.

Uber's plan to acquire Grubhub is a better example of a deal that might attract scrutiny, said Stapp.

"Those are direct competitors in a market. After the merger, the combined Uber entity and DoorDash would have the vast majority of a market in almost every local market in the United States," he added.

In Washington, Sen. Elizabeth Warren and Rep. Alexandria Ocasio-Cortez proposed a temporary moratorium last month on "risky" mergers and acquisitions. The pair specifically mentioned big tech as a potential source of predatory mergers.

Facebook has also been the subject of scrutiny by the Federal Trade Commission and Department of Justice. And both agencies have additional open competition probes of Alphabet, Amazon, Microsoft and Apple.

Regardless of the attitude among politicians, the pandemic has bolstered public support for tech companies. Nearly two in five Americans said they view the tech industry more positively since the outbreak began, according to a Harris Poll last month.

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*Wells Fargo Innovation Incubator (IN2) is giving \$900,000 to help cleantech and sustainable agriculture startups retain staff and stay on path to commercialization*

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By Nickie Louise

According to a recent global survey, 74% of startups have seen revenues decline since the beginning of the COVID-19 crisis. Other tech startups have either laid off their employees or cutting cost to stay afloat. Wells Fargo Innovation Incubator (IN2) is a \$30 million technology incubator and platform funded by the Wells Fargo Foundation and co-administered by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL).

Today, IN2 announced that it has accelerated its awards program to provide \$900,000 to help cleantech and sustainable agriculture startups retain staff and stay on track to bring their potentially game-changing solutions to market in the face of impacts due to COVID-19. IN2 said it is expediting the funding phase from September 2020 in order to provide immediate support for pre- and post-revenue cleantech startups in markets across the country through its Channel Partners – a network of technology incubators, accelerators and university programs that refers promising startups to IN2.

“We know that small businesses across America are being hit especially hard right now. Our Channel Partner ecosystem represents a wide range of experts in cleantech, agtech, and finance who understand the challenges startups grapple with during a global economic and health crisis and how they might be mitigated. Innovation can and will persist — even during times of contraction — and this expedited funding is designed to support that,” said Trish Cozart, IN2 program manager at NREL.

The IN2 Channel Partner Awards program – a \$5 million total fund – aims to strengthen sustainable technology initiatives and address barriers that startups face on the path to commercialization. The new round of award funds will be allocated toward programming or operational assistance designed to address the unprecedented challenges that startups within the partners' portfolios are experiencing in the current business environment.

“Startups have a difficult time getting from prototype to market even under the best of circumstances, and countless promising technologies focused on solutions to pressing global issues are at risk of being lost without immediate help,” said Ramsay Huntley, Sustainable Finance Strategist at Wells Fargo. “Startups need to be able to adapt quickly to changing realities. IN2 is showing that it is prepared to do the same by being nimble in our support.”

The winners include: ACRE — New York University, AgLaunch, AgStart, Austin Technology Incubator — University of Texas, BRITE, CCIA, Clean Energy Trust, Cleantech Open (West), Daugherty Water for Food — University of Nebraska, Imagine H2O, Launch Alaska, Los Angeles Cleantech Incubator (LACI), MaRS DD, NCBiotech, NECEC, New Energy Nexus, Texas A&M TEES, and VertueLab.

The awards program was established in 2017, with \$5 million of committed funding from Wells Fargo to be distributed over four years to the nationwide network of 63 cleantech and agtech stakeholders within the Channel Partner ecosystem. Since inception, over 200 grants have been allocated toward nationwide

Launched in 2014, the IN2 facilitates the commercialization and adoption of clean energy technologies. With resources from Wells Fargo and the National Renewable Energy Laboratory, IN2 provides funding, technical assistance and real-world beta testing opportunities that help companies uniquely understand their customers. As an invitation-only program, IN2 finds and selects companies through its Channel Partners, a curated network of incubators, accelerators and universities across the U.S. that refer startups to the program. Once referred, companies participate in a highly competitive application and selection process to determine which will be invited into the next round of participants.

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## What SoftBank's Vision Fund results tell us about troubled startup sectors

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By Alex Wilhelm

A famous investor published notes today concerning its startup investments, detailing where they excelled and where they struggled. To understand why we care about this particular investor's results, a little context helps.

The investor in question is Japanese telecom giant and startup benefactor SoftBank, which reported its fiscal year results this morning. SoftBank's investments are famous because of its \$100 billion Vision Fund effort, which saw it put capital to work in a host of private companies around the world in an aggressive manner.

The information it shared this morning included a slide deck detailing the conglomerate's view of the future of unicorn health, and notes on the conclusion of the SoftBank Vision Fund's investment into net-new companies.

SoftBank's earnings have made headlines around the financial and technology press, especially regarding the performance of its investments into Uber, an American ride-hailing company, and WeWork, an American coworking startup. The former's post-IPO performance has led to a lackluster outcome for SoftBank, while the implosion of WeWork after its failed IPO has continued; SoftBank's results noted a new, lower value for WeWork.

The rest of the information painted a picture of mixed outcomes, with SoftBank recording wins in enterprise-focused deals and "Health Tech" investments. Other invested sectors saw less salubrious results, including the three we'll focus on today: consumer-focused deals, transit-related investments and real estate-related outlays.

Let's explore what SoftBank had to say about each. Then we'll see what we can infer about the broader startup market itself.

### Results

SoftBank's Vision Fund made big bets into Uber and WeWork, two companies that fit into the sectors we are exploring. To provide investors with clarity of its outcomes outside of those two outsized and troubled bets, the company broke out sector performances less their outcomes.

Here's how SoftBank described those results, first discussing some business wins in the COVID-19 era before getting to the bad news:

*Following the outbreak of COVID-19 from the beginning of 2020, although the fair values of some portfolio companies in e-commerce, health care and other businesses increased as a result of their strong business performance, many portfolio companies' fair values decreased because their business activities have been disrupted and outlook for cash flows has deteriorated due to stagnant economic activity and lockdowns implemented globally. In particular, the total fair values of the Consumer sector, the Transportation & Logistics sector (excluding Uber), and the Real Estate & Construction sector (excluding WeWork and its three affiliates) declined by \$3,257 million, \$2,381 million, and \$2,196 million, respectively, and consequently the same amounts were recorded as losses.*

What are the winners? Guardant Health generated nearly \$1.7 billion in wins for the company (its sales were roaring even before it began working on COVID-19 related efforts), Slack (which has recovered from lows thanks to a COVID-19 driven surge in usage), and several other health-related investments. Then there are the firms who saw their "fair values" fall.

### Losses

It is not surprising that SoftBank's diverse and large Vision Fund portfolio had some companies take hits due to COVID-19; many firms large and small are struggling. But the scale of the adjusted sector performance (each would be worse if they included the outsized-losses driven by Uber and WeWork) is notable.

Thankfully, the Vision Fund details which companies fall into each group so we can tell what's up.

Starting with consumer, SoftBank has some winners. ByteDance, for example, is a Vision Fund investment and has seen its TikTok app become a global phenom. But SoftBank's investment in OYO is struggling, and it put money into Klook (a travel-related investment), Fanatics (sports apparel when sports are largely on hold), and GetYourGuide (another travel-related consumer deal). You can start to color in where the SoftBank and the Vision Fund sees weakness.

Repeating the same effort for the transport and logistics group, we might anticipate valuation issues at Didi (ride-hailing, similar to Uber), Fair (flexible car ownership), Getaround (flexible car share), Grab (ride-hailing and other services, similar to Uber), among other firms.

There are winners in these groups as well, of course, but since we know their net value change was negative we can highlight weaker areas without being rude.

Finally, real estate and construction. The firm has investments into Clutter (self-storage), Compass (software for real estate folks), Katerra (prefab construction materials and logistics), OpenDoor (home selling and buying software), View (high-tech glass), and, of course, WeWork. It's a little harder to point to potential weakness in this group. We'll leave it to you. But, we know that there are some stragglers in the group, given its non-WeWork losses.

### **So what?**

The sectors that SoftBank detailed are the same that we would have guessed might struggle. But the conglomerate's write-downs show that even the best-funded outfits in those areas are no exception; capital won't save their business in the short-term, except for perhaps providing more runway than other, less-wealthy startups might have.

To some degree this feels counter-narrative. Tech shares have rebounded in recent weeks, rebuilding sentiment in the sector — perhaps the COVID-19 downturn won't be that bad, the thinking seems to go. The SoftBank Vision Fund's results paint a more negative picture of the economy: It's bad in many areas, lots of companies are impacted and the value of many unicorns is too high, even if the scale of write-downs that private investors like venture capitalists will have to endure is not yet clear.

The private market can, therefore, expect a host of down-rounds if unicorns need to raise capital in the short-term. And many will.

The Vision Fund report card, then, is an indication that enterprise software is doing as well as we might have thought, that there are some winners in the health-tech space and that, aside from those exceptions, the rule appears to be a downturn in startup land.

### **How does it know?**

The Vision Fund invests in "high-growth-potential companies that are leveraging AI, particularly in private companies valued at over \$1 billion, colloquially known as 'unicorns,'" SoftBank notes in its earnings report.

How did it determine the new value of its equity? After all, if the companies it owns pieces of do not trade, how can it know? Here's how the company described its technique, first describing what went wrong, and then how it came up with new numbers:

The stagnation in economic activity, restrictions on social outings, and stock market disruptions in various countries due to the outbreak of COVID-19, have had, and are expected to continue to have, a significant impact on the business activities and fair value measurement of the portfolio companies of SoftBank Vision Fund. While this has had a positive impact on the operations of some of the portfolio companies in businesses such as e-commerce and health care, it has disrupted the business activities of many of the portfolio companies and caused a deterioration in their results of operations and, ultimately, the fair value measured in the Company's consolidated financial statements. The fair value measurement of portfolio companies as of March 31, 2020 was based on current expected company-specific COVID-19 impact, liquidity positions of each company, market conditions and comparables, and increased market volatility.

We raise this to point out that the valuations presented are generated in a way different than how stocks are valued. You could argue that SoftBank is being either too harsh, or too generous, with its own portfolio companies.

Sadly, given that the IPO window appears to be mostly closed, it will take a long time to figure out. Today SoftBank investors were given the results of the parent company's investments through the first weeks of the COVID-19 era. If SoftBank has to execute more write-downs in the current quarter, that would make it even harder for the Vision Fund to live up to its financial goals.

Perhaps Slack can go up a few more points.

By Ann Miura-Ko

Talk of an economic downturn can be frightening, especially one precipitated by a pervasive health crisis. At times, I'm overwhelmed by the images of countless patients on life-support and the near-endless streams of statistics regurgitating bad news.

Having started in venture at the beginning of two recessions, I've seen how the startup industry functions during economic trouble. My second day of work at Charles River Ventures was September 11th, 2001. My first project, analyzing the VC industry, propelled the firm to return more than 60% of its fund to investors, going from a \$1.2 billion fund to \$450 million. In May 2008, Mike Maples and I founded Floodgate in the midst of the Great Recession. We learned that great founders won't wait for a better economic moment to start a company.

While we are currently embroiled in personal and professional circumstances unimaginable even three months ago, these very challenges will form the basis of incredibly innovative ideas. In order for the world to move forward, we need our greatest minds to imagine a brighter future and create solutions to make it a reality.

When I analyze our society and novel health situation, one thing is certain: COVID-19 is a paradigm-shifting event, creating massively accelerated social and economic change.

### **The Great Reset is not just another economic event**

Our current situation is unique. It's not merely a cyclical economic event, nor is it a stand-alone health crisis. What we are experiencing is not just an inflection point: it's a societal phase-change unlike anything we have ever seen. We face an epic choice of how we move forward, and the decisions we make today will shape an entire generation.

Here's why: COVID-19 is prompting us to reset many of our most fundamental behaviors. These changes are impacting our financial system, with effects visible throughout our homes, businesses and even the concept of "workplace" itself.

### **COVID-19 is pervasive**

As a global pandemic, the virus itself has spread to nearly every country in the world.

Between February 20 and March 26, 100% of the world's 20 largest economies implemented government-mandated social distancing. Globally, the number of scheduled airline flights is down 64%. In some countries, like Spain and Germany, flight numbers are down by more than 90%.

Since the timeline for lifting government restrictions is unclear — and even then, scientists are uncertain how the virus will spread — the question lingers: How long will this go on?

COVID-19's impact is uncertain, long-term and potentially undulating, affecting every facet of our lives. You can't simply wait it out with the expectation that industries will rebound. In 2001, September 11 felt pervasive, but its economic impact ultimately stemmed from just a single incident and the resulting fear — and that single incident still cost more than three trillion dollars. How much larger will COVID-19 be?

### **COVID-19 is a behavioral reset**

Most people are quarantined with immediate family at home. This behavioral change calls into question everything we do:

- How do we spend our money?
- How do we spend our time?
- And with whom do we spend this time?

For many Americans, COVID-19 is also the first time they've experienced shortages of anything — whether it's flour, hand sanitizer or toilet paper. These will impact our feelings of security for years to come, as well as how we relate to brands. Many conveniences (e.g., Amazon/delivery) are now essentials, while some essentials (e.g., kids at school) are no longer reliable.

These behavioral changes have altered our conceptions of core habits and practices, changes that will continue well after the pandemic ends. For example:

- Will students ever again take an introductory art class with 400 other students?
- How will we socialize on a Friday night?
- Can we ever imagine a family-style dinner packed into a loud, crowded dinner joint?
- Will we ever cheer on our favorite sports team at a stadium, shoulder-to-shoulder with other fans?
- How will we relate to strangers? (Have we forever shifted in favor of those who are trusted/familiar/regular in our lives?)
- When will my eight-year-old jump on a yellow school bus again to go on a field trip with 25 of his closest friends?
- When will it be okay to hug a friend?

We're changing some of our core behaviors, often by developing entirely novel habits or breaking new societal ground.

### **COVID-19 is a financial reset**

COVID-19 has shocked our financial system to its core. The U.S. is experiencing its highest unemployment rate since the Great Depression. The localized impact is tremendous. The whole economic swath has been affected, from large corporations and financial institutions to small businesses, artists and contract workers.

Consumption is drastically down, causing the biggest demand shock any of us have ever seen. We're also witnessing the greatest central bank and government intervention of all time. We have effectively put the economy into a shelter-in-place-induced coma. Some questions that arise:

- When will we be able to resuscitate the economy, and how quickly?
- Will our recovery look V, U or L-shaped? Will the multifaceted stimulus, grants and loans provided by the Fed be sufficient to drive the economy back to stability?
- With a growing deficit, record spending and a shrinking economy, how will we bridge the gap? What concessions will need to be made and will we have the courage to make them?
- How much will the reopening of the economy bring back consumption and economic activity? Will the reopening create a resurgence in the spread of COVID-19, requiring yet another shut down?

### **COVID-19 is a business reset**

If you had product-market fit in January, you might not have it in June. This is true of both startups and Main Street businesses: gym chains, restaurants, movie theaters and live performance venues won't return to their former product-market fit in the coming months. Any businesses requiring in-person interactions must adapt to the current reality (or our society needs to develop new, socially distanced behaviors to support their business models). Gabrielle Hamilton wrote a particularly poignant piece about this dilemma for the restaurant industry.

Tech companies are not immune to these changes either. For many, their core customers or their customers' customers are severely impacted by these transformations. We have also taken a hairpin turn from a growth-led economy (fueled by multi-billion-dollar growth funds) to a profit-first sentiment in which the best companies will

outlast (not outspend) their competitors. The companies that emerge on the best footing from these difficult times will be the ones that provide real value with viable economics to customers willing to pay.

For many companies, this is a fundamental reset, a return to the basics of what it is to make money.

### **COVID-19 is a workplace reset**

Workplaces have undergone a forced paradigm shift that parallels the one businesses have undergone. Over the last decade, we have embraced the open and shared workspace. However, as personal health concerns arise, the look and feel of our workspaces, as well as with how people will operate at work (full teams or partial teams, full-time or part-time, commuting, etc.) remains an open question. The resulting rise in remote work is one obvious, tangible change.

But in a broader sense, we've reset what we're working on as individuals and organizations reevaluate their priorities. Whether it's the pace at which it's possible to work when combining work with homeschooling or dealing with the stresses of our current reality, we are being forced to focus on the essentials of work. Being busy is being replaced with an effort to be effective. We're resetting workplaces, replacing them with structures that will become the new normal.

### **Massively accelerated change**

Even amidst the terrible news and life changes, huge opportunities exist within this Great Reset. With such a shock to the system, inertia no longer explains why things are the way they are. We're now explicitly asking questions that have been lingering in our psyche for years, such as:

- Do we need to educate our children the way we do today?
- Are we investing in a future we want to see?
- Are these the people with whom we want to live or work?
- Are we spending our time and resources the way we should?

These questions are manifesting incredibly rapidly, transforming our world in the recent weeks to incorporate changes that usually would take years.

Some of these activities are permanent improvements over the previous, in-person models (e.g., telemedicine, digital fitness) while others are highlighting the need for human interaction (e.g., real estate transactions, elementary school education). Some of these changes will continue after COVID-19, while others will return to baseline.

Among the many shifts society is experiencing, we've highlighted two for analysis in this article: consumer spending and communication.

### **Consumer spending shake-up**

COVID-19 has changed consumer spending unlike any event in recent history.

In general, consumer spending habits don't change. Over the last 20 years, the share of wallet spent across different consumer categories is incredibly consistent. Consumers rarely shift their spending from one category to another, and they certainly don't do it in a short period of time. It's also exceedingly rare for a new category of spending to emerge.

COVID-19 has dramatically shifted consumer spending. In response to the uncertainty, American consumers are proactively reducing their spending. Within categories, consumers are switching to new brands where they previously showed brand loyalty (like grocery stores) and indicating these switches may stick. Between categories, consumers are significantly reducing their spending on in-person experiences (concerts, travel, etc.) and spending more time online (watching videos, engaging in online fitness, etc.).

Digital content is also seeing a resurgence, with millennials, Gen X and high-income earners spending more time on TV and news, while Gen Z consumes more video content.

While no one knows the exact outcomes, these changes raise important questions as we seek to better understand what the future could look like:

- What new consumer categories will open up?
- What will replace the in-person experiences that consumers previously spent money on?
- As content consumption increases, will consumers finally be willing to pay for digital content?
- Will consumer fitness move outdoors and/or online? Will additional hardware or software emerge to capture that audience (à la Peloton)?
- After changing notoriously sticky behaviors (e.g., changing brick-and-mortar retailers & grocery stores), will these new behaviors stick or shift back after COVID-19?

The VCs and founders who successfully answer these questions will adjust to this Great Reset while others flounder.

### **Communication shift**

COVID-19 has caused mass adoption of communication tools that were previously resisted. Zoom, for instance, has introduced video communication to a segment of the population that was previously reticent to embrace it. Video conferencing has become commonplace for more than workplace meetings. Now, its uses range from elementary school education to senior citizen fitness classes. My 73-year-old mother asked me how to operate Zoom so she could log onto her Zumba class for seniors. A mere month ago, she would have questioned my sanity had I asked her to get on a Zoom with anyone, least of all her Zumba instructor!

While questions still remain around ease-of-use or interface design, video conversations are now an integral part of online experiences. Looking forward, how will these new modes of digital communication change the fundamentals of human interaction?

- Will Zoom create a developer-oriented ecosystem like Salesforce, where venture-scale business can be created, or will they operate more like Twitter, ultimately suffocating all developer efforts?
- What applications will enable new communities? Which ones will scale?
- Will additional apps incorporate video-chat features? Will this happen on Zoom or another platform?
- Will increases in communication cause permanent decreases in travel?
- Will other forms of digital communication (e.g., voice-first) take off?

The communication shift goes beyond the integration of Zoom into our lives. Who we speak with now has fundamentally been affected by the pandemic — we’re reviving old connections, regularly calling family members and even sheltering-in-place with relatives we haven’t seen in years. Some of these new or rediscovered relationships will become important parts of our lives in the new normal. How will these relationships differ from the ones we’re developing while Zooming over dinner or from our home offices?

While I’ve been out of the dating circuit for too long to have any credibility speaking on this topic, it also seems like this particular element of our social lives has seen a pretty large disruption. The motherly side of me hopes that we are undergoing an anti-Tinder moment in which people are rediscovering the joys of getting to know each other as part of the dating dance. Will we return to a “swipe left or right?” world of transactional dating, or will relationships hold more meaning in the new normal? Which apps will appeal to Gen Z to help them find these desired connections?

In some ways, the buzzy new app Clubhouse (the digital Soho House for the technorati) may give us a taste of how new social connections might be increasingly based on ideas and conversations. A friend mentioned that it feels like entering a favorite bar where people have common professional interests and you can listen in on interesting

conversations. I wonder if this can translate beyond professional interests — that’s the kind of bar I’d like to hang out at, especially today when everything feels professional.

These changes have profound societal shifts. Those who separate the temporary from the permanent will be the most helpful as we direct our effort and resources to the tools we will need.

### **Looking forward**

As venture capitalists, we’re always looking for inflection points, and COVID-19 has created many. In addition to the impacts on spending and communications, we’re also curious about these other shifts and what role technology plays in building abundance in a world full of disruption. The following are just a few.

### **Business model shifts**

Business models have changed across the board. For a demonstrative example, look at healthcare, food and travel:

- As telemedicine improves, along with the integration of everyday hardware to patient health monitoring, doctors can increasingly observe their patients at home. Hospitals — which are currently losing millions every day — can’t sustain this change. They’ll need a new business model for the long-term. How can telemedicine and other technologies enable people living anywhere to get the care they need while providing doctors and hospitals a sustainable business practice?
- Similarly, restaurants have been operating on razor-thin margins for a long time. Given social distancing, are restaurants really destined to become mere cloud kitchens that provide food for delivery to be eaten at home 15-30 minutes later? Or are there ways, even with reduced clientele, that we will once again hear the pop of a champagne bottle, inhale the heady scent of spices simmering, overhear a quiet conversation from a nearby table or be welcomed warmly by a waiter who knows your son’s favorite dish? I hope for the latter, but it seems something will have to change above and beyond our current restrictions to enable restaurants to recapture the social value they provide our community (in addition to the economic one).
- Airlines, whether legacy carriers, regional carriers or low-cost carriers, have universally felt the pain of a complete halt in the demand for their product. It’s unclear if business travel will ever return to previous levels and whether consumers will henceforth choose a car over a regional jet. As one of our CEOs said, “COVID broke travel. When we put it back together, it may never look the same.”

Clearly this is only a small list of the business models that we know will have to change. Which ones are most pressing to you?

### **Demographic-level shifts**

Population-wide government mandates (like shelter-in-place) have prompted the same behavioral changes across different demographic groups. When those restrictions are lifted, however, these different groups will each respond in their own unique ways. For example:

- How will vulnerable populations respond differently from the general populace? (e.g., when will groups with varying levels of risk tolerance again be comfortable taking public transportation or flying?)
- In 2019, net worth for Gen Z and millennials was decreasing dramatically, mainly driven by increases in student debt. This economic burden was causing people to delay life milestones. With the increased financial burden from COVID-19, will they delay their life milestones even more?
- COVID-19 has had a dramatically different impact on rural and suburban regions versus urban centers. If recovery looks different for these regions, how will it impact both the economy as a whole and the different groups’ outlook on the future? Further, will Gen Z, which was largely moving to urban centers, now change their plans?
- Due to chronic health conditions and social factors, Hispanic, African American and other minority communities have been disproportionately impacted by COVID-19. What will be the resulting consequence over the next 18-24 months?

A health crisis that actually impacts the look and feel of a community on the scale of COVID-19 is completely new. What other demographic shifts do you see?

### **Regulatory shifts**

The governmental stimulus in response to COVID-19 is larger than any previously, including a never-before-seen direct-to-taxpayer transfer. Many countries and cities are on lockdown to prevent the virus' spread. These changes are having profound effects on our regulatory systems, with many specific effects to be determined.

The novel areas of government regulatory action prompted by COVID-19 include:

- Direct financial intervention, raising questions including: Who gets assistance? Who doesn't? And how does it change their view of the government?
- Business shutdown, wherein some businesses are permitted to be open and others aren't. (For an example of an impassioned response, see Elon Musk's comments on Tesla's forced closure.)
- Intervention in corporate business models, including both bailouts and restrictions on private sector business models (such as New York City's caps on delivery service fees).
- Taxation changes to make up for losses caused by COVID-19 (which some San Francisco companies are predicting and proactively moving out to avoid).
- The federal government's financial deficit itself, which includes a loss of tax revenue, record-high deficit and government spending on a level we have never seen.

In the future, consumers will certainly be more familiar with government financial intervention and mandated stay-at-home orders (and therefore likely to be either more comfortable with both or stridently distrustful of government policy in general). COVID-19's other regulatory effects remain to be seen.

### **Shifts in work**

Let's be honest. The future of work is here today. Our economy is unstable during COVID-19, but the dangers it highlights may go beyond this temporary time. For instance: COVID-19's impacts are disproportionately impacting service industry workers (compared to, say, knowledge workers). As education goes online, we're finding a similar effect: broadband access and endpoint devices aren't universal — in fact, they're quite expensive — increasing the digital and wealth divide. Will COVID-19 increase these divides, or will it prompt structural changes to even out the opportunity gap?

By April 26, more than half of all Americans under the age of 45 had lost hours, been laid off or were furloughed. Even if U.S. manufacturing increased, many of these people wouldn't simply get factory jobs. What will employment look like for this large swath of the economy after COVID-19?

### **Increased opportunities**

COVID-19's changes are pervasive and permanent, but the people who create companies in this time can still have impact. Many great companies — including Lyft, Twitch and Microsoft — were founded during recessions. Lyft's impressive growth was partially fueled by a spike in the number of people who were out of work and needed a gig job to get by.

We're entering a new paradigm, and that brings possibilities. Now, founders, is the time to build.

**For the past decade, people have flocked to the Bay Area to take advantage of seemingly endless professional opportunities in the tech industry. But the coronavirus pandemic has brought an abrupt end to the hiring bonanza and derailed the careers of thousands of people. While the tech sector might be better positioned than many industries to recover, it is unclear how long a recovery will take.**

By Cory Weinberg

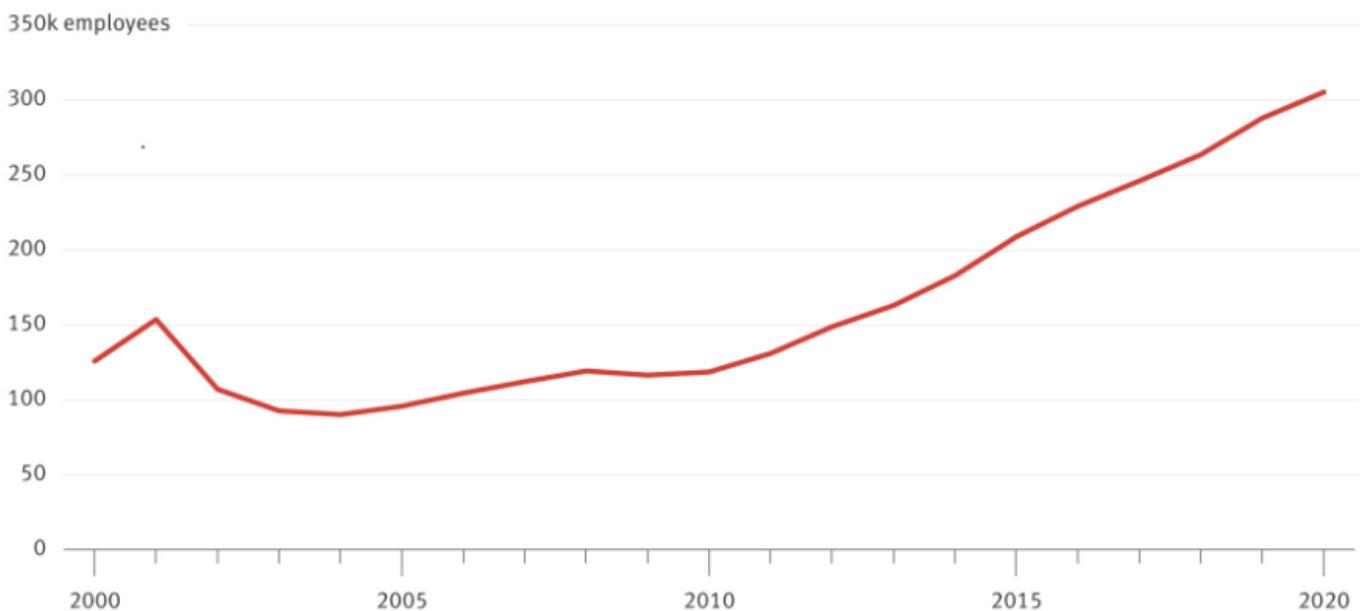
Tim McLaughlin cheered alongside doctors and nurses at an Oakland, Calif., children’s hospital one evening in late April as his 3-year-old son rang a bell to celebrate major progress with his cancer treatment. The next day, McLaughlin opened his email to find scooter startup Lime had laid him off.

McLaughlin, a 43-year-old Missouri native who found work in the tech industry after taking computer coding classes, is one of the tens of thousands of people who have seen their professional dreams shattered overnight.

In the last decade, ambitious people from around the world have flocked to Silicon Valley, drawn by the seemingly endless professional opportunities and the easygoing lifestyle. Many are now scrambling for new jobs to cover health care costs, pay rent or renew temporary immigration visas. Some have little financial cushion, with cash-strapped startups handing out severance packages that offer little more than a few weeks’ pay.

Major cuts have hit household names including Airbnb, Lyft and Yelp, as well as hundreds of smaller tech firms. Some 430 companies have laid off more than 50,000 employees since early March, according to Layoffs.fyi, a site set up to track the cuts. Uber alone has already laid off more 3,000 employees, with thousands more cuts expected this week.

## Total Bay Area tech employment, 2000-2020



Note: Employment numbers are from March of each year  
Source: California Employment Development Department

While the cuts have been steep, it is too early to tell whether they will rival the vast layoffs that resulted from the dot-com crash of 20 years ago, which saw hundreds of thousands of tech jobs eliminated as dubious businesses flamed out and investment dried up. Tech companies in the U.S. cut nearly 300,000 jobs across 2001 and 2002, according to outplacement firm Challenger, Gray & Christmas Inc.

Today, the tech industry is much larger, and has squeezed into nearly every corner of the U.S. economy, from hospitality and education, to finance and real estate. In San Francisco, the tech sector made up about 15% of private sector employment in March, up from 7% in 2000, according to an analysis of data compiled by the California Employment Development Department.

The industry's sheer size is likely to make the current wave of job losses that much more dramatic, said Ted Egan, chief economist of the San Francisco Office of Economic Analysis. That is especially the case with fast-growing tech companies that hired "on spec," he said, with an eye toward expansion. Over time, he added, "you'll see a gigantic amount of layoffs, because the tech industry has hired a gigantic amount of people."

The cuts are already taking a profound human toll. McLaughlin said he needs to get a job within the next few months so he can afford further treatment for his son. If he doesn't, he said, he is considering moving from his home in Oakland to a less expensive city, near a good children's hospital. Wanting more control over his fate, he might start his own business.

Speaking by phone recently from his son's hospital room, McLaughlin said he knew working for a young company came with risks.

"It's unprecedented what's going on. If you're going to work for a startup that hasn't figured out how to make money yet, you are rolling the dice. You have to be OK with that. No matter what the situation is, you need to be ready for the worst," he said.

### **End of an Era**

The job losses have brought an end to a decadelong hiring frenzy in the tech industry. In 2018 alone, more than 50,000 people between the ages 25 and 44 moved to the region to work in tech jobs, more than to Seattle and New York combined, according to the Silicon Valley Institute for Regional Studies, based on U.S. census data. Even in the hot U.S. economy of the last decade, job growth in San Francisco and Silicon Valley hovered at around two to three times the national average.

To compete for workers in a tight labor market, businesses often paid substantial salaries and offered perks including free meals and fitness classes that soon became commonplace. Workers who took jobs at fast-growing companies sometimes did so at reduced salaries in exchange for equity in the business, banking on an eventual payday when the company went public or was acquired. Plenty of businesses failed, but there usually were other jobs.

One of the young people drawn to the region was Sharissa Staples, 25, who grew up just south of Silicon Valley in Monterey, Calif. She was the first person in her family to go to college, where she studied history and ethnic studies. The jobs in her hometown were mostly in hotels and schools, so she moved closer to San Francisco. "It becomes clear the older you get where the jobs are," she said.

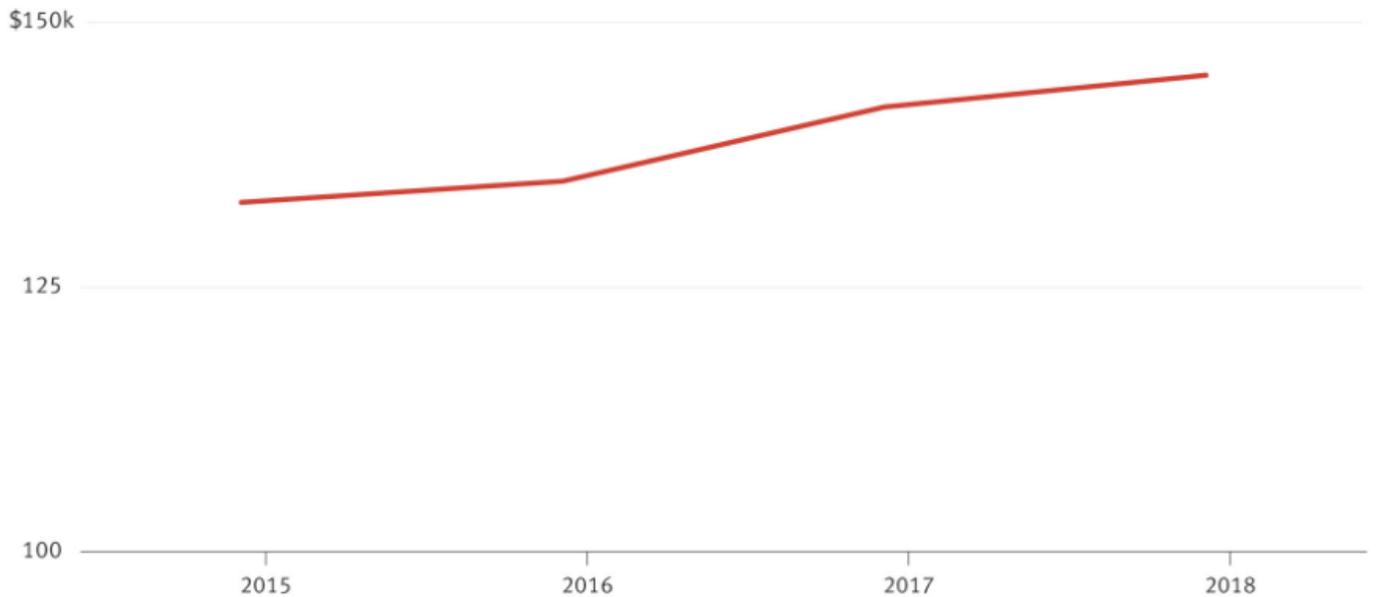
She briefly worked at a hospital, but quit in part because she was afraid of blood. She worked at a nonprofit that helped homeless youth after that, where she explained to volunteers from companies like LinkedIn and Salesforce that they should acknowledge homeless people when they pass them in the street.

Last January, Staples joined a startup, the corporate housing firm Zeus Living. She was the company's second recruiter, helping it grow from about 90 people to nearly 300. The company later raised \$55 million in December

from investors such as Airbnb and Comcast. It used the money to lease apartment units around the country that traveling employees could use for monthlong stays.

As the travel industry nose-dived, Zeus laid off a third of its staff in March, including Staples. Zeus gave them two weeks' severance, another former employee said. It had a second wave of cuts last week.

## Average Bay Area tech worker salaries, 2015-2018



Note: Tech workers include software engineers, product managers, devOps, designers, and data analytics roles  
Source: Hired.com data and surveys

Staples had been saving up to buy a house in Richmond, Calif., a more affordable alternative to San Francisco and other surrounding towns. She expects to put those plans on hold. She received an unemployment check last week, nearly two months after filing for benefits. She is taking online courses and looking after her grandparents in Monterey as she searches for work.

But competition for new roles is intense. Even prolific recruiters like Google and LinkedIn have said they will hire fewer people this year or pause hiring altogether as they brace for a prolonged downturn.

“You’re competing against so many talented people,” Staples said. “You’re constantly dealing with rejection. It’s hard.”

### Underlying Advantages

Despite the shock to the economy, parts of the tech industry could emerge relatively unscathed. Some e-commerce and software companies offer services that are in high demand right now, and many companies can operate with their employees working remotely. That will likely help tech-focused regions like the Bay Area recover more quickly, said Egan, the San Francisco economist. He cited the growing popularity of services such as streaming TV, online meeting platforms and social media.

How soon that recovery will happen is hard to know. “You can safely say the tech boom is over. We’re in a recession,” Egan said. The question “is [whether] this [is] the quarter that is the worst in 100 years, or the next three quarters [will be]?”

In the near term, executives and investors expect the capital going into employee hires to shrivel. Already, the number of postings for new software development jobs around the U.S. was down by one-third compared with the same time last year, according to the job-posting site Indeed.com.

The tech industry has flourished far beyond Silicon Valley, and the layoffs have cut a swath through those places, too. In the three years since Emily Harris joined restaurant software firm Toast as a product analyst in 2017, the company has been expanding at a breathtaking clip. Flush with venture capital, the Boston-based startup swelled from a valuation of about \$500 million to nearly \$4 billion as its workforce more than quadrupled to over 2,000. Revenue more than doubled last year.

Harris was one of more than 1,000 employees laid off or furloughed last month.

More stress followed when she also lost her part-time position as a singer in the Boston Baroque chorus and her husband was laid off from his job as a liquor salesman.

To conserve cash, Harris started cutting small items from her budget: feel-good online purchases she was making unthinkingly only weeks before. She bought less-expensive food as well: canned goods and generic brands. When she received an alert that her iCloud storage was running low, she spent two hours manually deleting image after image from her phone rather than pay \$3 for additional space.

“I don’t think of money as money anymore,” she said last week. “I look at it as weeks of survival.”

But Harris received good news on Monday: a job offer for a marketing operations role at a digital marketing startup in Boston. She has accepted, she said.

### Losing a Dream Job

McLaughlin, the former Lime employee, set out to remake his career two years ago in order to get a job in tech.

After moving to the San Francisco Bay Area 20 years ago, he spent much of the last decade running a popular guided bike tour business in San Francisco, leading tourists past popular sites like the Castro Theatre and the Victorian homes in Alamo Square. It was a top-rated activity on TripAdvisor. But as competition intensified, he looked to change course. McLaughlin sold the business in early 2018.

He spent the next year at home in Oakland with his newborn son, taking online classes on data analysis, where he learned the coding languages SQL and Python. “I wanted to adapt to the new world out there,” he said. McLaughlin searched for jobs in the tech industry where he could apply his new skills to areas that interested him, such as improving cities. He wanted to help reduce car traffic and pollution.

He landed an operations job at Uber last spring, which had a new bike and scooter rental division that was planning to expand into Oakland and San Jose, Calif. At first, McLaughlin, who grew up an hour west of St. Louis, said he “felt like a fish out of water” at the tech giant. He didn’t understand the jargon. He kept hearing acronyms like “TLDR” (short for “too long, didn’t read”), and noticed sentences peppered with words like “aligned” or “leverage.” But he was a quick study. “I know what words to use to make myself sound like I’m in the crowd,” he said.

Two months after joining Uber, McLaughlin’s young son was diagnosed with an aggressive form of cancer called rhabdomyosarcoma. He needed heavy doses of chemotherapy, radiation and surgery to shrink a tumor in his stomach. McLaughlin and his wife, who had paused her work on a doctorate in education policy at University of California, Berkeley, were expecting another baby.

Meanwhile, Uber reversed course on bringing scooter rentals to Oakland. Last fall, Uber laid off McLaughlin, along with more than 1,000 other employees, sending him scrambling to find a new job so he could have health insurance

to cover his son's treatments. He used connections he had made at Uber to quickly get a similar job at Lime, a scooter rental firm backed by more than \$700 million from the likes of Google parent Alphabet and venture firm Andreessen Horowitz.

McLaughlin loved the job at Lime. He was on a team of operations managers overseeing fleets made up of a couple thousand scooters in Oakland.

At the start of this year, Lime faced pressure to cut staff. The company, which lost hundreds of millions of dollars in 2019, had failed to raise more venture capital. Lime laid off about 100 people in January, but McLaughlin was spared. His son's health started improving as his tumor shrank. Doctors prescribed a lighter radiation treatment.

After the coronavirus started shutting down cities in early March, Lime pulled its scooters off the streets. Little revenue came in the door, sending the company searching for more cuts. McLaughlin didn't think he would be let go. He was contributing heavily to internal data analysis tools the company was developing.

On April 29, Lime's then-CEO Brad Bao emailed staff: "I'm sorry that we have no choice but to say goodbye today to about 80 employees," McLaughlin among them.

McLaughlin said the chances of finding a new role at a tech company are "fairly slim" for him at this point. "Maybe I'll get lucky and get a job—maybe," McLaughlin said. But last week he feared his prospects were shrinking as layoffs piled up. "Today, Airbnb lays off 1,900 people. That's another 1,900 people that don't have a job."

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## Case Study At-A-Glance: Flexible Conveyor Manufacturer Glide-Line Overcomes Space, Size, & Product Handling Constraints for Aerospace Industry Integrator

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*Their client needed a conveying solution integrated into their current facility. The over-sized product, an aircraft wing support beam, needed to be handled incredibly carefully to avoid product damage.*

### Case Study from Glide-Line

Here at Glide-Line, we make conveyors - specifically, flexible, configurable conveyors built to very specific measurements to fit limited spaces which can be configured with a “zero product to product contact” design philosophy, all with impressively short lead times. We’ve noticed three trends in the past year that are creating demand for what we have to offer:

#### **Manufacturers need completely configurable, not singular-use, equipment.**

“People have been asking for versatile equipment they can use for a variety of products in various sizes and shapes. Within the same facility, they’re integrating conveyors to suit multiple product shapes, carton, pallet and tote sizes, and packaging types, and it is easiest for manufacturers to use equipment from a single manufacturer that can meet these varying product demands,” says Trevor Price, Lead Application Engineer for Glide-Line.

As a manufacturer of highly configurable, flexible conveyors suitable for conveying a huge variety of product and pallet sizes, we’ve seen demand increase in line with this trend. Our conveyors are all configurable to one-millimeter increments, with no set standard sizes our customers need to adhere to.

#### **Manufacturers are looking for ways to reduce costs by preventing product damage.**

Preventing product damage during the manufacturing process is one way integrators are being asked to impact ROI. We’re able to best assist in meeting this demand with our conveyor that implements individually-controlled conveyor sections to eliminate product-to-product contact, control product distance, and efficiently operate each zone only as required. This is achieved using our DC motor/controller set-up or using VFDs with our AC motors. Each individual zone has its own motor, so the ability to transport heavy loads is uncompromised.

#### **Manufacturers are pivoting to meet demands faster, so they need speedy delivery.**

Integrators have always been impressed with our fast lead times, but in the past year, we’ve seen an uptick in requirements for meeting quick turnaround times that can enable integrator clients to deliver solutions quickly, allowing for the client to pivot and meet demands much faster than in the past. Our lead times are always 6 to 8 weeks, significantly faster than those of our competitors.

#### **About the client: aerospace industry automation systems integrator**

These trending demands recently came into play for a project we worked on for a large automation systems integrator working in the aerospace industry. Their client needed a conveying solution integrated into their current facility. The over-sized product, an aircraft wing support beam, needed to be handled incredibly carefully to avoid product damage.

“We chose Glide-Line because of their customizable conveyor products and world-class customer service. Their engineering team solved the issues we faced without batting an eye, and our customer was thrilled with the result.”  
- Project Engineer

#### **The client’s request**

Our integrator client was challenged with:

- Unique product size/weight: At 12 feet long and 150 pounds(!), our biggest challenge was providing a conveyance solution for a very long product. This product exceeded any standard pallet size, so a custom solution was required. Because our whole line of conveyors is configurable, including sizing available in one-millimeter increments, we were able to accommodate this build with some simple modifications.
- Space limitations: Our system was being placed between existing systems, so we had a little over the width of the pallet (~1.5 feet) in which to incorporate a solution. We recommended an over/under-style conveyor to maximize the space. We configured our conveyor to match the width of the product to safely transport it along the way.
- Ensuring no product-to-product contact: We needed to provide a solution that would eliminate product contact to ensure the product is not damaged during the automation process. Our Zero Contact Zoned Conveyor configuration was perfect for this demand, since its individually-managed accumulation zones ensure there is always a gap between products. With the use of VFD controls on the motors, the conveyors could transport product to each stop location, without the use of a physical stop, which could otherwise cause damage to the product.

### The solution

The flexibility of our conveyors was the key to solving these challenges. Our solution combined three variations on our equipment to create the conveyor system their client was looking for.

1. Our configurable designs allowed for the footprint of the over/under-style conveyor to be optimal for the space.
2. We integrated our zero contact individually-managed accumulation zones, without the use of a physical stop, to control acceleration and deceleration.
3. We configured a conveyor system with our Vertical Transport Units (VTUs) to act as the elevator between an upper and a lower conveyor section. (Yes, we designed a VTU for a 12-foot long pallet.)

### Unforeseen obstacles

It became clear that traditional Lift and Transfer Units (LTUs) would need major modifications to work with this size and weight product. Since we were already using Vertical Transport Units (VTUs) as an elevator, we adapted our VTU to act as a 90-degree Lift and Transfer at the same time. By rotating the deck conveyor of the VTU 90 degrees, this VTU can also function as a transfer by lifting the product up, off the main line, and conveying it onto a perpendicular spur line for station work.

Due to the large size and weight of the product, we added additional bracketry and support to prevent sagging of the conveyor deck. We also changed to custom shafting due to the extra length. Our engineering team worked quickly to increase the capacity of the unit--in a single day. With the approval from the customer, we fabricated the parts less than 24 hours later.



Additionally, we were asked if we could supply a particular brand of bearing that our customer wanted to use, as opposed to our standard bearing. We provided all the information needed for them to properly determine the appropriate bearing model. They supplied us with the bearings to use during the build. This is just one example of the collaboration we needed to help make the project a success.

### **Bringing it together**

A last-minute change in our customer's production schedule led to a final hurdle: we were asked to ship a portion of the system even earlier than the original contract date. Though we were already on a tight time schedule, our team worked hard to produce the partial shipment ahead of schedule to allow our customer a head start in assembly before shipping the rest of the project on time.

In just eight short weeks from initial conversation to the first product completion, we were able to collaborate with our integrator customer and their client to make the project a resounding success. We faced unique challenges in the product size, space limitations, and product handling needs, and our proven flexibility, configurable product line, and ingenuity in providing solutions for manufacturers made for an enthusiastic customer. "Glide-Line is based on innovation, excellent customer service, high quality and real speed," said Kevin Mauger, President of Glide-Line. "This type of project is the reason we exist, and we're happy to help them see success."

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### **About Glide-Line**

*Glide-Line, an employee-owned company, offers the most versatile multi-strand pallet and panel-handling solution available for the automation industry. We are the future of conveyor system manufacturing. We pride ourselves on making our integrator clients' automation layout design process as easy as possible*

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## Researchers show coordination polymer glass membranes can produce as much energy as liquid-based counterparts in fuel cells

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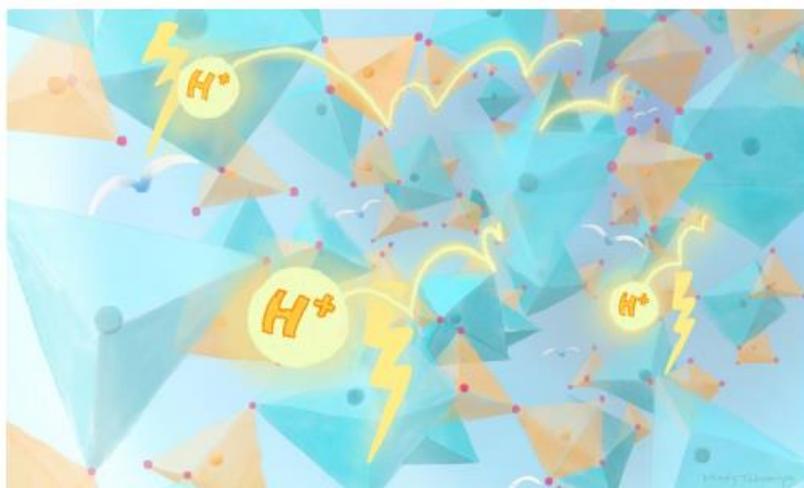
Scientists at Kyoto University's Institute for Integrated Cell-Material Sciences (iCeMS) have developed a new coordination polymer glass membrane for hydrogen fuel cells that works just as well as its liquid counterparts with added strength and flexibility. A paper on the work is published in the journal *Chemical Science*.

PEM hydrogen fuel cells are fed hydrogen and oxygen to produce electricity, with water as their only by-product. These fuel cells contain proton-conducting membranes that facilitate the separation of hydrogen's positive and negative particles, protons and electrons, a process that ultimately leads to the production of electricity. Protons need to easily move across these membranes for the process to be efficient.

Current proton conducting membranes are made from liquids and cannot operate effectively under dry conditions, making their fabrication complicated and expensive. Scientists are looking for ways to fabricate solid membranes made from water-free electrolytes that provide better mechanical and thermal stability than their liquid counterparts, but are also cost-effective and still conduct protons well.

*Proton conductive materials are important components of various electrochemical devices. One of the significant devices is the fuel cell, and the anhydrous proton conductors as electrolyte working at 120–200 °C have long been strongly demanded. In the past decade, a number of studies on the proton conductivity of coordination polymers (CPs) and metal-organic frameworks (MOFs) were reported. The crystalline CP/MOFs have advantages for high proton conductivity because of their tailorable pore and accommodation ability of guest molecules. However, they are intrinsically non-moldable because of crystalline nature, and the grain boundary causes gas leaking and additional resistance in electrolyte layers. The preparation of mechanically stable membranes is one of the bottlenecks of the electrolytes developments.*

*More recently, liquid and glassy states of CP/MOFs have received attention as moldable amorphous materials. The phase transitions from crystals to liquids and glasses of CP/MOFs provide a choice to use grain boundary-free monolith, which is one promising property for the solid electrolytes. In spite of their potentials, there are still a limited number of reports on proton-conductive CP/MOFs glass, and there is no report of CP/MOFs to satisfy criteria for sufficient proton conductivity (above 10 mS cm<sup>-1</sup>) under the anhydrous condition.*



*To develop a CP glass with high intrinsic proton conductivity, we focused on protic ionic liquids which are known as representative anhydrous proton conducting liquids. ... In this study, we propose a new approach for the design of a proton conductor based on a CP glass synthesized from protic ionic liquid and metal ions. Appropriately selected metal ions can interact with the anions to form a CP toward desirable characteristics of moldability, proton conductivity, as well as high transport number.*

—Ogawa et al.

The molecular structure of the new polymer glass facilitated the movement of protons (H<sup>+</sup>) across it under dry conditions at 120 °C. Credit: Mindy Takamiya/Kyoto University iCeMS

Horike, Tomohiro Ogawa and colleagues in Japan fabricated their coordination polymer glass membrane by mixing a protic ionic liquid with zinc ions. Protic ionic liquids are liquid salts made by mixing an acid and a base. The team used a protic ionic liquid called diethylmethylammonium dihydrogen phosphate. Adding zinc to this liquid led to the formation of a solid, elastic polymer glass.

The molecular structure of the coordination polymer glass facilitated the movement of protons across it under dry conditions at 120 °C. When tested in a hydrogen fuel cell, it produced high voltage (0.96 volts), well within the range of typical polymer electrolyte membranes. Its power output was also similar to commonly used Nafion membranes. Ogawa believes their findings offer an interesting approach for using glass polymers in fuel cell applications. The team plans to continue their work with the aim of achieving fuel cell membranes with higher performance and long-term stability.

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### Resources

- Tomohiro Ogawa, Kazuki Takahashi, Sanjog S. Nagarkar, Koji Ohara, You-lee Hong, Yusuke Nishiyama and Satoshi Horike (2020) “Coordination polymer glass from a protic ionic liquid: proton conductivity and mechanical properties as an electrolyte” *Chem Sci*. doi: [10.1039/d0sc01737j](https://doi.org/10.1039/d0sc01737j)

By Kyle Wiggers

In a recent technical paper, researchers affiliated with the University of Southern California and Amazon Robotics explored a solution to the problem of lifelong multi-agent path finding (MAPF), where a team of agents must be moved to constantly changing goal locations without collisions. They say that in experiments, it produces “high-quality” solutions for up to 1,000 agents, significantly outperforming existing methods.

MAPF is a core part of a number of autonomous systems, like driverless vehicles, drone swarms, and even video game character AI. No doubt of interest to Amazon is its applicability to warehouse robots — as of December, Amazon had more than 200,000 mobile machines inside its fulfillment network. Drive units automatically move inventory pods or flat packages from one location to another, and they must continue moving — they’re assigned new goal locations on a continuous basis.

The researchers’ solution models the MAPF problem as a graph containing vertices (nodes) connected by a series of edges (lines). The vertices correspond to locations, while the edges correspond to connections between two neighboring locations and a set of agents (e.g., drive units). At each timestep, every agent can either move to a neighboring location or wait at its current location. A collision occurs if two agents plan to occupy the same location at the same timestep.



The proposed solution aims to plan collision-free paths that move agents to their goal locations while maximizing the average number of locations visited. Given the time horizon within which collisions have to be resolved and the frequency at which the paths need to be replanned, the solution updates each agents’ start and goal locations at every timestep and calculates the number of steps the agents need to visit all locations. It also continually assigns new goal locations to agents and then finds collision-free paths, and it moves the agents along those generated paths and removes the visited goal locations from a sequence.

In simulated experiments involving a fulfillment warehouse mapped to a 33-by-46 grid with 16% obstacles, the researchers say their method outperformed all others in terms of throughput. And in a logistic sorting center mapped to a 37-by-77 grid with 10% obstacles, in which certain cells represented delivery chutes and workstations where humans put packages on the drive units, they report that a small number of timesteps sped up the framework by up to a factor of 6 without compromising throughput.

“[O]ur framework not only works for general graphs but also yields better throughput,” wrote the coauthors. “Overall, our framework works for general graphs, invokes replanning using a user-specified frequency, and is able to generate pliable plans that can not only adapt to an online setting but also avoid wasting computational effort in anticipating a distant future.”

By Mattias Andersson

Robots continue to play an essential role in the fight against COVID-19. Robots are assisting with testing, working in labs, sanitizing spaces, surveilling public areas, and helping fulfill supply chains, just to name a few examples. They will have an even greater role in the recovery from both the novel coronavirus and economic disruption.

It's a good time to be a robot — demand is high and there are compelling reasons to feel the future is bright. COVID-19 has exposed some real issues with the way things are currently done, which gives robotics developers the opportunity to step up and show exactly what can be achieved.

### **Challenges for manufacturers**

The post-pandemic world has many opportunities for robotics and automated systems, including manufacturing. Here are five challenges manufacturers are facing as a result of COVID-19:

#### 1. Less reliance on low-cost labor regions

There is a desire to adapt manufacturing supply chains to be less dependent on low-cost labor regions, like China. The so-called “re-shoring” trend started in 2018-19 courtesy of the trade war between China and the US and the associated tariffs. It is being accelerated by anti-China and anti-globalization sentiment generated from the supply and demand disruptions brought circumnavigating the world with the virus.

#### 2. Re-shoring

Governments are trying to reverse the trend of the last two decades. The same voices that recommended offshoring manufacturing are now asking why important supply chains are so dependent on China and how manufacturing jobs can be brought home. There is a desire to re-shore manufacturing jobs.

#### 3. Digital transformation

The need for digital transformation has been apparent for almost a decade. There have been many extolling the virtues of Industry 4.0, Industrial IoT and the Smart Factory for some time. But digital transformation has appeared overwhelming to many, resulting in paralysis. Most companies want to transform but don't know where to start.

#### 4. Competing regardless of labor rates

Regardless of the motivation, manufacturers need to create an environment where they are more efficient, and hence more competitive. What's more, this needs to be possible in any geography.

#### 5. Social distancing in workplaces

As factory workers return to their posts, they are faced with the dilemma of having to operate in an environment where rules dictate they are at least six apart. Traditionally, manufacturing facilities have relied on lines of operators spaced much closer together. Additionally, operators will need to wear personal protective equipment at their work workstations, which in many cases will make their jobs harder and impact productivity.

Many of the issues mentioned above relate directly to the geography in which manufacturing is carried out and, specifically, to cost of labor in those regions. The use of automation and robotics to remove the dependence on manual tasks is the only way manufacturing can be done as economically in San Francisco as it can in Shenzhen.

### **Must-have features of robots**

There are a number of key characteristics that robots will need to offer to ensure they play a pivotal role in the factory of the future.

First and foremost, they will need to be adaptable. In fact, only adaptable automation can solve the challenges of modern manufacturing. Those manufacturers that stepped up and helped in the crisis did so because they were able to adapt their production to the needs of a different product. The EMS (Electronics Manufacturing Services) industry is built on this ideal with lines changing product several times each shift. These large contract manufacturing companies are unlikely to install robotics, or any form of automation, if it can only support a single product.

As a result of the high-mix environment, almost all manufacturers operate in a world where changeovers need to happen often and fast. Huge investment has been made in the way SMT (Surface Mount Technology) lines are able to change from product to product. Robotics and automation will need to meet or better that performance.

Robotic solutions will also need to adapt to their surroundings, sensing what is close to them and adjusting instantly so they can continue to perform. This could be to a change in environment or to the proximity of an operator. Robots need to be collaborative, working seamlessly with their human coworkers.

In the past, programming robots has been difficult and time-consuming. This needs to change for modern, digitally-transformed manufacturing. Robotic solutions need to be quickly programmed with close to zero touch and with little or no dependence on skilled programmers. Tribal knowledge is the enemy of digital transformation.

Automation investments must provide a solid digital dividend. Every investment should have a simple return on investment (ROI) calculation that should be measurable. In simple terms, a robot will need to reduce the cost of manual labor in a way that can be easily measured and that quickly returns the capital investment required for the installation.

### **A new manufacturing world**

In the new the manufacturing world, cash for capital expenditure will be tight and those innovating robotic and automation solutions will need to be equally creative with their business models. Providing robotics-as-a-service and automation-as-a-service will make it possible to shift investment from capital expenditure to the operational budget.

Robots are an essential building block for the digital transformation of the manufacturing industry. They will need to be adaptable, collaborative, intelligent, and easy to program. Most importantly, perhaps, they need to provide real value and fast measurable ROI through creative business models.

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## Byte projects \$100 million in 2020 revenue without increasing marketing spend

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By Joran Crook

One usual characteristic of a bootstrapped company is that its growth is slower than its VC-backed competitors. Bootstrapped marketing spend relies on revenue, revenue often relies on marketing spend, and the tension between the two can force slower growth. VC-backed companies, in contrast, can afford to spend ahead of revenue, often allowing them to grow more quickly.

Byte has found a much faster bootstrapped path to growth. The company, which was founded in 2017 and launched its products at the beginning of 2019, is on track to reach a \$100 million revenue run rate in Q2 of this year, according to president Neeraj Gunsagar.



Unlike bootstrapped startups with first-time founders, byte (it's officially lowercase) was founded by serial entrepreneurs Scott Cohen and Blake Johnson. Cohen founded his last company in 2011 (acquired by Deluxe Corporation in 2016) and Johnson founded Currency which sold to a private equity firm in 2017.

The duo brought on Gunsagar, formerly CMO at TrueCar where he spent eight years, to help lead the next phase of growth at the company and prepare the organization for international expansion and the next product rollout.

But let's back up. Byte is an invisible-aligner-for-teeth company that has entered the ring with behemoths like Invisalign and SmileDirectClub, as well as a smattering of smaller at-home braces startups, like Candid. But there are several big differences between byte and its competition.

The first is its technology. Alongside impression kits and invisible aligners, byte also includes a device called HyperByte in all of its treatment plans. HyperByte is an extra in-mouth device that uses high-frequency vibrations (HFV) to send micropulses through the roots of the teeth and the surrounding bone, speeding up the process of alignment.

HFV treatment is FDA-cleared and offered in orthodontist offices around the country, but usually at a steep price.

HyperByte comes included with the cost of using byte's service, which comes out to \$1,895. (Folks can also pay via payment plan, called BytePay, which comes out to \$349 down and \$83/month for a little over two years.) The company also includes a whitening solution that can be used in conjunction with aligners.

Byte's treatment plans are overseen and reviewed by licensed orthodontists each and every time, and customers can be connected to an orthodontist or dentist should they run into any clinical issue during treatment.

In some cases, insurance may reimburse customers for their byte treatment.

In other words, byte is working to bring down both the cost of aligners and the time it takes to treat patients. Importantly, byte focuses exclusively on Phase 1 malocclusions, or small misalignments in the teeth like tiny gaps or slightly crooked teeth, and not complicated issues like overbites.

Most interestingly, byte saw explosive growth in the first quarter of 2020 — the company saw 10x revenue growth over the last three months, compared to the same period of 2019, and says that it is continuing at that 10x growth

rate through Q2. Byte also told TechCrunch that it generated “positive EBITDA business pre-[COVID-19].” (As is the case with all private companies, these numbers come from byte and are not independently verified by TechCrunch.)

Part of that profitability story is improving economics. Toward the end of 2019, byte’s cost to acquire customers (CAC) dropped by 50 percent from end of 2019 through April of this year. The sharp CAC decline is due to several factors. According to Gunsagar, the price of Google keywords dropped dramatically in the midst of the coronavirus pandemic and the company has seen its direct and organic traffic double, perhaps driven by the coronavirus pandemic spurring increased interest in self-improvement.

Byte isn’t the only company caught in the self-improvement updraft. “There’s sort of this trend toward self-improvement and using this time constructively,” Jaimee Minney, SVP of marketing and PR at Rakuten Intelligence, told CNBC. “Book sales increase, games and puzzles, and we have seen health and beauty start to grow as well, especially when you look at it on a year-over-year basis. That’s one I might keep an eye on, the self-improvement piece.”

Gunsagar explained that, historically, other companies may have thrown even more marketing money at this type of environment to boost growth even more.

“We won’t sacrifice our customer experience and we won’t sacrifice profitability as we grow the business,” said Gunsagar. “We don’t want to have too many impression kits going through the system because we want to make sure we can support it from a technology and experience standpoint. Every dollar we spend is still super profitable. I could go spend more money and still stay below our CAC goal of \$150 and blow past \$100 million in revenue this year, but I just wouldn’t be super confident that our NPS score or our customer experience wouldn’t be penalized.”

In formulating this careful growth strategy, Gunsagar and byte aren’t just looking at the broader tech ecosystem, where we’ve seen growth at all costs backfire on companies. They can find examples in their own industry — SmileDirectClub grew fantastically ahead of its initial public offering in September of 2019 only to feel backlash from some customers who were reportedly asked for an NDA in exchange for a refund.

One other important piece of byte’s strategy is an upcoming bytePro launch in conjunction with dentists and orthodontists. The idea is to grow alongside the dental and orthodontic industry, rather than cut these healthcare professionals out of the food chain.

With bytePro (launch TBD) dentists and orthodontists are included even more in the process. Incoming clients can ask to work with their own dentist or orthodontist as they go through the byte aligner process, and even get their impression kits in their dentist’s office rather than order them online. On the other side, dentists and orthodontists can join the bytePro network to be matched with new patients. Moreover, folks that purchase byte show an increased interest in caring for their teeth year round, according to the company, whether that be cleanings or other dental work. Byte aims to connect those folks with a good dentist or orthodontist to protect the investment they’ve made in their new smile.

Though byte is not venture-backed, the company has taken a small investment from actress and investor Kerry Washington, who has also invested in The Wing and Community. Washington serves as Creative Advisor at byte.

“When I was looking at ways to continue growing my portfolio, I focused on companies that I can be really proud to be associated with, and that pride comes from the quality of the product and how it improves the quality of people’s lives,” said Washington. “The idea of having a voice is really important. With byte, I said really early on ‘if you can’t open your mouth, you can’t find your voice’ and when you hear the stories from real customers, people were afraid to smile and afraid to speak and that’s when I realized that this is a tool that can better people’s lives in so many ways.”

***It's important to communicate to your banker and investors that you have a handle on the issues facing your company — but that you need their support***

By Frank Williamson

I've been in my career long-enough now to experience four recessions: in 1991, 2001, 2008, and right now. Despite some individual differences (this is the first one brought on by a health crisis, for instance), by and large they follow the same blueprint: initial warning signs leading to a crisis, then the emergence of a long, difficult period.

As CFOs look at the current situation and consider its likely medium- and long-term effects, they're naturally concerned about protecting their company's liquidity, staying financially healthy for the foreseeable future, and, if possible, looking for opportunities to emerge from this crisis in a better position.

In order to do that, CFOs and other business leaders need to be able to communicate clearly and effectively with their capital partners, demonstrating that their hands are on the wheel and they have a clear plan for the period ahead. Yet, during previous recessions and even in better times, I've watched executives fail at this crucial job again and again.

Based on what I've seen work previously, here are several pieces of advice on how to have productive conversations with your banker and investors.

**Institute a company-wide decision-making process and create a roadmap.** First, you'll need to assemble a team of senior managers who can knowledgeably discuss pressing matters across the company and work together on solutions.

(In light of the current situation, this team might need to hold its meetings via Zoom.) After identifying the issues most in need of attention, establish a provisional plan that can be adjusted, if necessary, and make a list of specific drivers that will dictate the need for adjustment. Once you've done so, communicate this plan to your business partners and keep them updated on any changes as they take place.

As time goes on, maintain a close eye on those drivers and be prepared to change course if the situation calls for it. Even if the details of the plan change, by keeping a stable team of decision-makers, you'll be demonstrating consistency and a serious-minded attitude to your business partners.

**Prepare for a range of situations using scenario planning.** Right now, many companies are putting together financial projection models that include a detailed cash forecast. But in times like these, it's impossible to be overprepared. So, I encourage companies to take the time needed to do rigorous scenario thinking — in other words, imagining a range of plausible situations that could happen, assessing your company's resilience, and developing a set of plans to mitigate them. Some questions to be asking: Could my company lose money, and how much? How long would it take to run out of cash? Are we operating under inaccurate assumptions? Nobody can predict the future, so the goal of scenario thinking should be to create a living plan that is applicable for many possible situations.

**Demonstrate what you've already done.** Recently, I heard this suggestion from a banker: "If you can describe what the problem is, and ideally estimate how long it will last, that's good. Your bank can defer payments or go interest-only if they believe that you have your arms around the issues and are creditworthy." It's important to communicate to your banker and investors that you have a handle on the issues facing your company — but that you need their support.

Make any tough-but-necessary decisions without unnecessary deliberation, and make sure to explain your context and your reasoning to your business partners so that they're in the loop.

Make any tough-but-necessary decisions without unnecessary deliberation, and make sure to explain your context and your reasoning to your business partners so that they're in the loop.

**Be a credible voice to your partners.** In tough times, you need your banker and investors to back you up. To do that, you need to gain their trust, and trust comes from establishing credibility. In conversations with them, your tone must be fact-based, but also humble and balanced. It's a fine line to walk, as you don't want to appear lackadaisical or, on the other extreme, overwhelmed. The worst thing you can do is to paint a cheery picture if there are problems that need to be discussed. Instead, bring those issues up in a calm, matter-of-fact way to your partners as early as possible.

**When your capital partners offer help, accept it.** Don't presume that you know everything — humility is always an important quality, and maybe no more so than right now. So, make sure that your conversations with investors, board directors, and bankers include plenty of listening on your part. Each group will bring a different, equally valuable perspective. Since they're probably having similar conversations with executives at other companies, they might be observing wider patterns and trends throughout certain industries or over the economy as a whole. Make sure that you empathize with their perspectives: Bankers, for instance, interface with highly regulated companies, and investors will be concerned about managing reserves and risks across their entire portfolio.

**When the time is right, be ready to go on the offensive.** When you're in the middle of a crisis, it's easy to lose perspective. But it's important to be thinking not just of how you'll stabilize your business, but what you want to do after you've accomplished that objective. First, confront your issues head-on and make sure your business is back on solid footing. Then, be ready to pivot to a growth mindset — a recession creates opportunities that might only exist for a short period, so make sure you're prepared to take advantage. For some companies, it's possible that a business combination will be preferable to overhauling the financial structure or undergoing major operational changes.

Nobody enjoys going through a recession, but few financial professionals would argue that they don't serve a necessary purpose by forcing businesses to work in a smarter, more streamlined way. If you communicate honestly and knowledgeably with your business partners during rough periods like this, you'll put your company in the best position to emerge on the other side stronger than ever.

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*Frank Williamson is the founder of [Oaklyn Consulting](#), a consulting firm that helps investor groups and private businesses, from startup to middle market, with mergers, acquisitions, capital-raising, investor relations, succession and other strategic corporate finance decisions. Oaklyn Consulting does not work as a broker but as an extension of clients' boards and management teams, charging time-based fees for investment banking advice.*

Provided by Chinese Association of Automation

Heating, ventilation and air-conditioning (HVAC) systems are the biggest consumers of energy in a building. For smart buildings, technologies have evolved to improve energy efficiency of HVAC systems, but faults often occur. Due to the complex nature of large-scale HVAC systems used in buildings, diagnosing these faults can be challenging.

A team of researchers led by Professor Marios Polycarpou, Director of the KIOS Research and Innovation Center of Excellence, Cyprus, has developed a distributed sensor fault diagnosis algorithm, a sequence of well-defined computer-implementable instructions for detecting and isolating multiple sensor faults in large-scale HVAC systems in smart buildings. The team published their findings in *IEEE/CAA Journal of Automatica Sinica*.

"The operation of Heating, Ventilation and Air-Conditioning (HVAC) systems in our homes, work spaces and public indoor spaces are based on the use of feedback measurements from sensing devices to make adjustments for maintaining a desired temperature. The presence of faulty measurements disorients the system and may create uncomfortable indoor conditions and/or significantly waste energy," said Professor Polycarpou.

This study presents an algorithmic approach that can be applied either on existing Building Management Systems or on plug-in Internet-of-Things (IoT)—a system of physical computer devices that are interconnected via a network for collecting and sharing data—to notify the building's users and operators about the presence of faulty measurements, as well as the location of any faulty sensors.

In this study, the authors model a large HVAC system consisting of 83 building zones as a network of smaller interconnected sub-systems, rather than using a global model that describes the HVAC system for the entire building. This simplified method not only makes the design of model-based fault diagnosis more feasible, but it is also scalable, allowing for other parts of the building to be incorporated into the network using a plug-and-play approach.

According to Polycarpou, the utilization of thermal models of the variation of temperature in HVAC equipment and building zones, in combination with the design of diagnostic algorithms implemented in a multi-agent framework—a self-organized system consisting of several intelligent agents that interact with each other to solve complex problems that would be difficult for them to solve singularly—enables the development of advanced methods for detecting and isolating sensor faults, "In this framework, a wireless smart sensor can communicate with its neighboring sensors to enhance the fault diagnostic process in terms of reliability, robustness, sensitivity, and scalability," Polycarpou explains.

"Our ultimate goal is to develop lifelong diagnostic systems for smart buildings, which are able to continuously monitor their operation over the lifetime of the buildings, to detect, diagnose and self-heal any faulty behavior, and to be able to learn from their prior experiences, as well as from the experiences of diagnostic systems from other smart buildings," said Polycarpou.

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**More information:** Scalable Distributed Sensor Fault Diagnosis for Smart Buildings, *IEEE/CAA Journal of Automatica Sinica* (2020) [www.ieee-jas.org/article/doi/10.109/JAS.2020.1003123](http://www.ieee-jas.org/article/doi/10.109/JAS.2020.1003123)

By Jeff Kagan

Influencer marketing is more important today with COVID-19 than ever before. It's just different. It has been a rapidly growing cottage industry over the last several years. However, the coronavirus is changing things in this world. Finding the right influencers are more important than ever before to help keep your company in the conversation and continuing to grow.

All influencers are different. All companies are different. While yesterday, companies partnered with many influencers, today it's more important than ever to find the right people to partner with.

Do you know how to find the right people to partner with for your company? Let me help you understand and leverage different slices of this powerful community.

After talking with dozens of successful influencers from different industries like @EvanKirstel and @TamaraMcCleary, and many companies, I have learned several very important lessons.

Let me share some of what I learned with you. There are some surprises. While some companies and influencers are busier than ever, others have recently slowed down significantly during this current health episode.

To help you better understand the best way to choose the right partner, let's take a look at the differences between different types and the companies that use them.

### **Industry analysts, opinion leaders and tech influencers**

Smart executives know the power of leveraging relationships with certain key industry analysts, key opinion leaders and key industry influencers in order to continue to grow.

In fact, since companies can no longer meet at regular conferences for a while, many are trying other things like setting up their own online briefings. Others participate with other companies in a sort of online conference. In recent years, companies have started to hold online events. They have hired industry analysts, opinion leaders and influencers to be participants or speakers.

This unbiased angle often attracts a larger audience. It's less, like an advertisement and more like an unbiased industry discussion.

### **First: Two different types of Influencer**

Let's take a closer look at the influencer marketplace. These are typically entrepreneurs and small businesses at heart.

Today, many companies need to focus their efforts and use a rifle approach, not a shotgun in choosing the right people to work with. There are two distinct groups of influencers.

- Some are Influencers first and foremost. More often than not, these are generalists who help their clients get the word out about a product or service. They share their postings on social media.
- Others first are Industry Analysts, Consultants, Key Influencers or Opinion Leaders. They come at this from the opposite direction. Their opinions and thoughts are part of the industry-wide conversation. They raise interesting questions and challenge the status-quo.

This second group is as busy as ever. They may also write columns, speak at industry meetings and share their thoughts and opinions with the marketplace. These are important industry voices. Many companies have learned the value of this smaller group.

After doing their primary business, many of them also share their and comments and thoughts on social media as an influencer.

There seems to be a big difference in the way these two different groups operate and the value they bring for different reasons.

Today, companies who understand they will continue doing business through and after this COVID-19 crisis is over are choosing the people they work with more carefully.

### **Companies need to continue to stay relevant in a noisy environment**

Executives know they need to keep their company's competitive position in the industry. If they do not focus on keeping their company in the conversation, they will simply get lost in all the noise around coronavirus and everything else over the next year or two in the media.

That means companies need to be a thought leader if they want to continue to lead in their industry. They must stay focused, stay on target and continue to invest in advertising, marketing and public relations.

I have found many companies who are very active with the influencer community. However, I have also noticed now they choose more carefully the people they work with.

Rather than the shotgun approach, successful companies are taking a more targeted focus. They are looking for people that can help them retain their competitive position and win in the marketplace.

Today's marketplace may look different, but the goal is still the same... to win.

### **Second: Two different Influencer angles**

There are two different angles that influencers take. Some are generalists and others are targeted.

Some influencers are generalists and focus on one company in an industry and work with several different industries. These are not industry experts. They are often more generalist in nature. They may have a large follower group that companies want to reach.

Other influencers are targeted and focus on particular industry or sector. They work with many competitors in the same industry. These are more often well-known experts in that particular industry.

This targeted group are often very influential industry experts. These are very important to work with since they are key players in the industry.

Both generalist and targeted influencers can be powerful, but in very different ways.

### **5G wireless, health care, telehealth, autonomous vehicles, tech influencers**

Consider wireless. The 5G revolution impacts everything. That means wireless carriers, wireless handset makers, wireless network builders and all the other companies in the wireless industry.

That also impacts other industries as well. Industries like healthcare with TeleHealth, TeleMedicine, automotive with self-driving cars, automated driving, navigation, entertainment and so more.

In fact, this new 5G wireless technology will continue to spread to and advance industry after industry over the next decade. That is both a challenge and an opportunity.

### **5G wireless network builders like Qualcomm, Ericsson, Intel, Nokia**

As an example, the 5G Automotive Association or 5GAA shows how automakers like Audi, BMW, Mercedes and others are partnering with 5G wireless technology companies like Qualcomm, Ericsson, Intel, Nokia and Huawei. This association let's these leaders talk and share information and advance the connected car experience.

It's so important for larger wireless carriers like AT&T Mobility, Verizon Wireless and T-Mobile. Also, for smaller competitors like US Cellular, C-Spire Wireless and others. Even for MVNO players like the cable TV wireless services Xfinity Mobile, Spectrum Mobile and T-Mobile.

### **AT&T, Verizon, T-Mobile, Xfinity Mobile, Spectrum Mobile, Altice Mobile**

It is just as important for network builders like Qualcomm, Ericsson, Intel, Nokia and others. And for handset makers like Apple, Google Android, Samsung Galaxy and more.

There are also plenty of smaller, lesser known companies who are just as important to the industry. Some of these are larger players and others are smaller, but they all need to be seen and heard if they want to continue to lead and be successful.

As you can see, many companies large and small need to get their message heard in an increasingly noisy industry. That is an important reason to choose the right influencers to work with.

### **Keep your brand name in the news to remain competitive**

In the meantime, it's more important than ever for companies to keep their messages out into the noisy marketplace. It's very important for them to stake their claim and to be there as a leader when the dust settles. It is important for consumers, business customers, investors, workers and partners. Companies must maintain their leadership.

Think of leadership like a growth wave. It goes up, crests then comes down. As long as you are on the growth side of the wave, your company is healthy. Once your company crests and is on the falling side, you are in trouble. You become an afterthought. You become invisible to customers, workers and investors.

### **Companies must stay on rising side of growth wave to remain relevant**

That's why you must stay on the growing side of the growth wave. If not, you will just disappear into the background noise around us all.

Today, it's harder than ever to break through all the noise with the health issue front and center. However, that's exactly what every competitor needs to do. That's why it's important for them to continue to keep their brand name relevant in the marketplace.

That's why every company must carefully partner with the right influencers, analysts and opinion leaders to help in them growth. This is a very important tool for every company, especially during these trying times.

So, even though influencer marketing is changing, if you understand these key differences in the influencer marketplace and how to choose wisely, you and your company can remain at the top of your game, today and going forward.

Bottom line... you must stay on the rising side of the growth wave.

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## Investors bet on HR automation as potential boon amid mass layoffs

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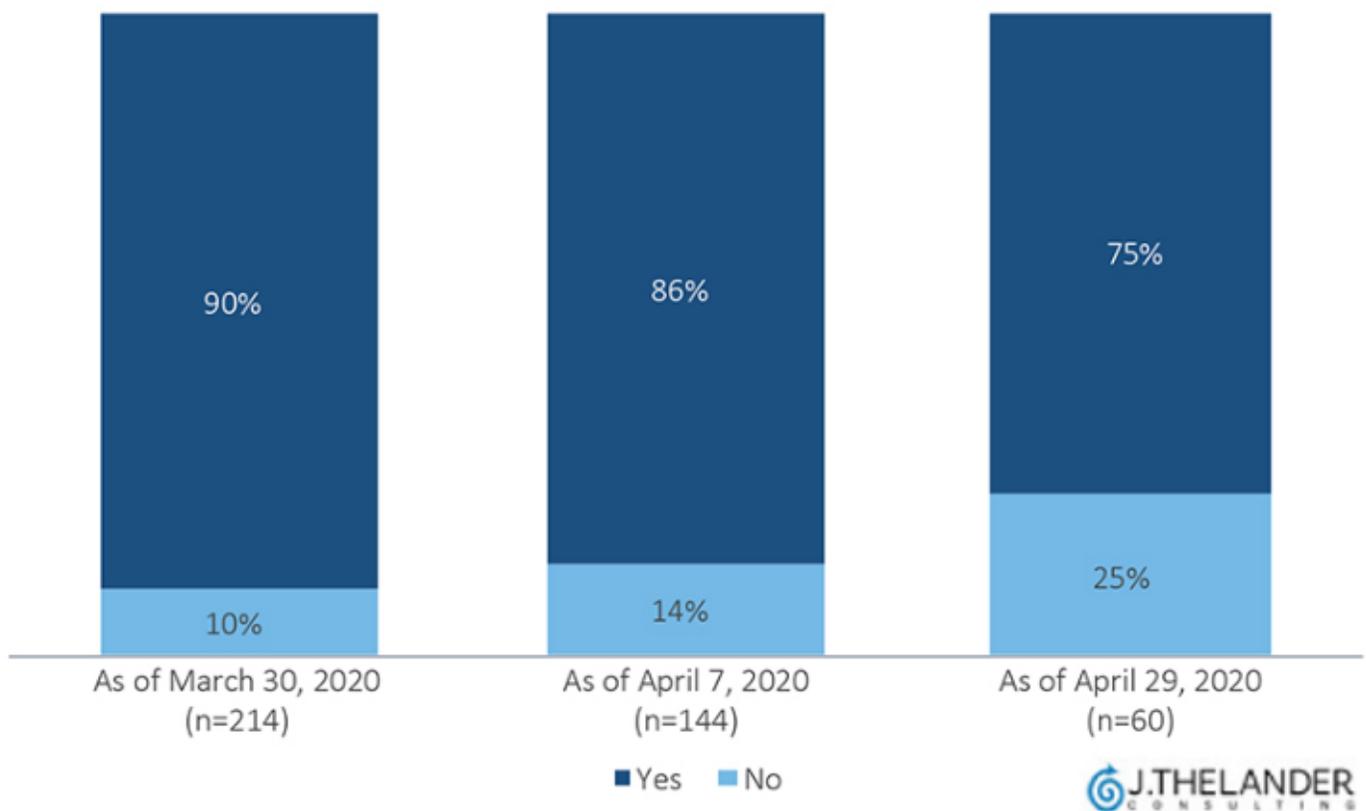
By Priyamvada Mathur

In the midst of extensive layoffs and an economic downturn, venture capitalists are keeping tabs on which industries can thrive.

Some investors are bullish on the possible demand for artificial intelligence in human resource applications. Employers will need tools to help conduct thousands of virtual interviews and handle a potentially significant wave of applicants when the uncertainty of the pandemic finally settles to reveal a new work reality.

"There's always been a war for talent, but now there's a massive shift in labor," said Anton Simunovic, chief investment officer at Alumni Ventures Group. "We're seeing an uptick in investor activity toward AI solutions that help companies look for employees who can add value immediately."

As of April 29, 25% of businesses reported having laid off employees as a result of the coronavirus outbreak, according to a survey of 60 VC-backed companies conducted by compensation data provider J.Thelander Consulting. That figure has jumped since the end of March, when 10% of the 214 companies surveyed reported layoffs.



"With tens of millions unemployed in the US alone, there is going to be a great rehiring as we get through the recovery," said Matt Gatto, managing director at Insight Partners. "Recruiters will need tools to effectively find, qualify and hire the best talent before their competitors."

While it is too early to gauge how the crisis will impact the HR automation industry in the long-run, companies in the space will likely face a distinct set of challenges ahead.

HR automation companies need to be able to demonstrate that they can identify more qualified candidates compared to competitors, lower costs and help companies reach their diversity targets faster, Simunovic said.

"HR automation is a 'show me' industry, and startups in the space need to prove that they can convince clients to overcome the inertia of traditional HR processes to hire quality talent," he explained.

Paradox is one such startup that has designed a platform to help HR teams. Its AI-based assistant helps to schedule interviews, collect feedback, streamline onboarding processes and host virtual events.

The Scottsdale, Ariz.-based company recently raised \$40 million in Series B funding led by Brighton Park Capital.

"It's a weird time to celebrate [the funding] because so many companies are struggling and people are losing jobs, but at the same time, it's a validation for the opportunity in our business," said Josh Zywiec, chief marketing officer at Paradox.

In March, Paradox client CVS Health announced plans to hire 50,000 workers for full-time, part-time and temporary jobs in response to crisis-fueled demand.

The pandemic has also eased the stigma around work from home policies in recent months. And San Francisco-based HR automation startup Oyster is hoping the remote work model is here to stay.

Launched in 2019, Oyster helps companies automate recruitment processes of remote employees, manage payroll compliance and provide local benefits to cross-border employees. In April, the company collected \$4.2 million in seed financing led by Connect Ventures, with other investors including Sorenson Ventures and Kima Ventures.

Oyster co-founder Jack Mardack said that investors are considering the plethora of international job opportunities that could be available for the millions of unemployed workers in the US.

Several VC-backed companies have already looked at freezing hiring until at least the second quarter of 2021, leaving many HR automation startups with a short-term dip in vendor business—for now.

But when hiring does begin to pick up again, companies in a range of industries may seek new solutions to help with the influx of applicants.

"Regardless of whether the recovery is going to be V-shaped or U-shaped or a Nike swoosh, a lot of people are going to go back to work at some point," said Adam Godson, chief product officer of Paradox. "Whenever that happens, a platform that specializes in communication and hiring at scale can take a lot of the chaos out of that."

By Kyle Wiggers

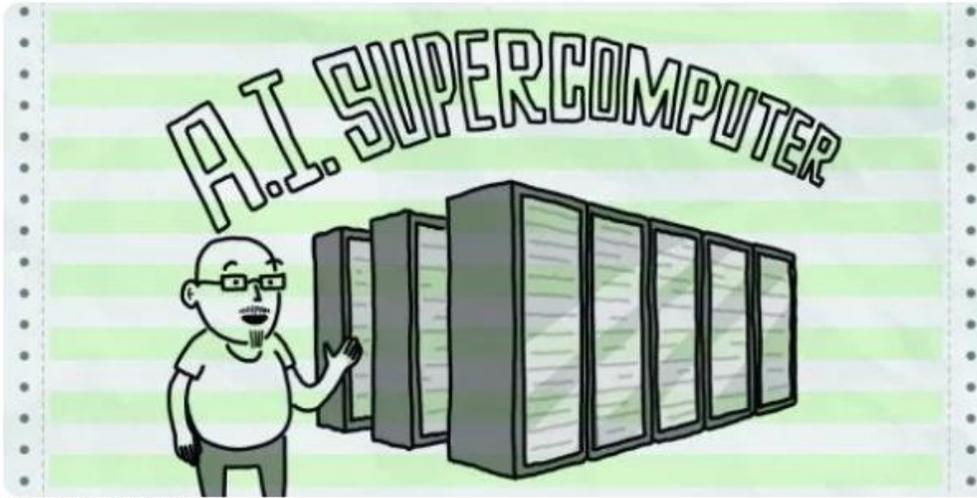


Image Credit: Microsoft

Roughly a year ago, Microsoft announced it would invest \$1 billion in OpenAI to jointly develop new technologies for Microsoft's Azure cloud platform and to "further extend" large-scale AI capabilities that "deliver on the promise" of artificial general intelligence (AGI). In exchange, OpenAI agreed to license some of its intellectual property to Microsoft, which the company would then commercialize and sell to partners, and to train

and run AI models on Azure as OpenAI worked to develop next-generation computing hardware.

Today during Microsoft's Build 2020 developer conference, the first fruit of the partnership was revealed, in the form of a new supercomputer that Microsoft says was built in collaboration with — and exclusively for — OpenAI on Azure. Microsoft claims it's the fifth most powerful machine in the world, compared with the TOP 500, a project that benchmarks and details the 500 top-performing supercomputers. According to the most recent rankings, it slots behind the China National Supercomputer Center's Tianhe-2A and ahead of the Texas Advanced Computer Center's Frontera, meaning it can perform somewhere between 38.7 and 100.7 quadrillion floating point operations per second (i.e., petaflops) at peak.

OpenAI has long asserted that immense computational horsepower is a necessary step on the road to AGI, or AI that can learn any task a human can. While luminaries like Mila founder Yoshua Bengio and Facebook VP and chief AI scientist Yann LeCun argue that AGI can't exist, OpenAI's cofounders and backers — among them Greg Brockman, chief scientist Ilya Sutskever, Elon Musk, Reid Hoffman, and former Y Combinator president Sam Altman — believe powerful computers in conjunction with reinforcement learning and other techniques can achieve paradigm-shifting AI advances. The unveiling of the supercomputer represents OpenAI's biggest bet yet on that vision.

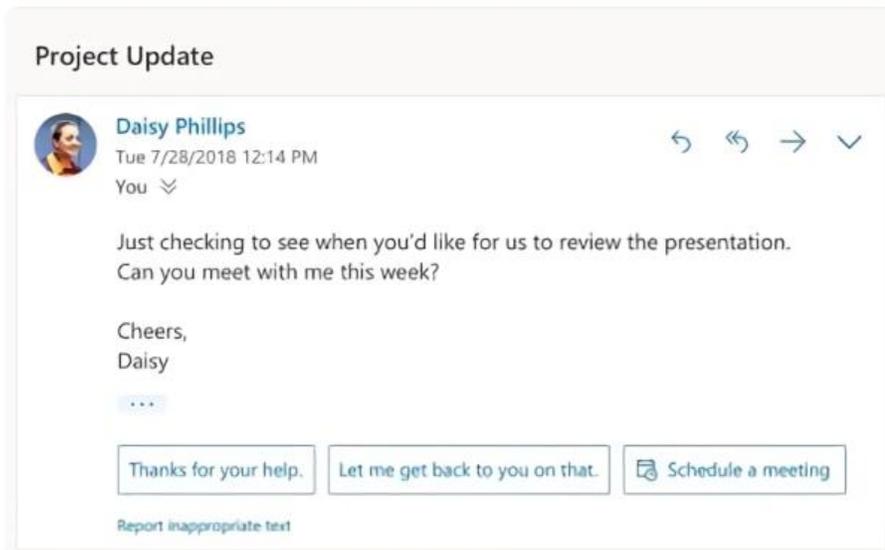
### **The benefits of large models**

The new Azure-hosted, OpenAI-co-designed machine contains over 285,000 processor cores, 10,000 graphics cards, and 400 gigabits per second of connectivity for each graphics card server. It was designed to train single massive AI models, which are models that learn from ingesting billions of pages of text from self-published books, instruction manuals, history lessons, human resources guidelines, and other publicly available sources. Examples include a natural language processing (NLP) model from Nvidia that contains 8.3 billion parameters, or configurable variables internal to the model whose values are used in making predictions; Microsoft's Turing NLG (17 billion parameters), which achieves state-of-the-art results on a number of language benchmarks; Facebook's recently open-sourced Blender chatbot framework (9.4 billion parameters); and OpenAI's own GPT-2 model (1.5 billion parameters), which generates impressively humanlike text given short prompts.

"As we've learned more and more about what we need and the different limits of all the components that make up a supercomputer, we were really able to say, 'If we could design our dream system, what would it look like?'"

OpenAI CEO Sam Altman said in a statement. “And then Microsoft was able to build it. We are seeing that larger-scale systems are an important component in training more powerful models.”

Studies show that these large models perform well because they can deeply absorb the nuances of language, grammar, knowledge, concepts, and context, enabling them to summarize speeches, moderate content in live gaming chats, parse complex legal documents, and even generate code from scouring GitHub. Microsoft has used its Turing models — which will soon be available in open source — to bolster language understanding across Bing, Office, Dynamics, and its other productivity products. In Bing, the models improved caption generation and question answering by up to 125% in some markets, claims Microsoft. In Office, they ostensibly fueled advances in Word’s Smart Lookup and Key Insights tools. Outlook uses them for Suggested Replies, which automatically generates possible responses to emails. And in Dynamics 365 Sales Insights, they suggest actions to sellers based on interactions with customers.



Above: Outlook’s Smart Reply uses deep learning models trained in Azure Machine Learning.

From a technical standpoint, the large models are superior to their forebears in that they’re self-supervised, meaning they can generate labels from data by exposing relationships between the data’s parts — a step believed to be critical to achieving human-level intelligence. That’s as opposed to supervised learning algorithms, which train on human-labeled data sets, and which can be difficult to fine-tune on tasks particular to industries, companies, or topics of interest.

“The exciting thing about these models is the breadth of the things [they’ve] enable[d],” Microsoft chief

technical officer Kevin Scott said in a statement. “This is about being able to do a hundred exciting things in natural language processing at once and a hundred exciting things in computer vision, and when you start to see combinations of these perceptual domains, you’re going to have new applications that are hard to even imagine right now.”

### AI at scale

Models like those within the Turing family are a far cry from AGI, but Microsoft says it’s using the supercomputer to explore large models that can learn in a generalized way across text, images, and video data. So, too, is OpenAI. As MIT Technology Review reported earlier this year, a team within OpenAI called Foresight runs experiments to test how far they can push AI capabilities by training algorithms with increasingly large amounts of data and compute. Separately, according to that same bombshell report, OpenAI is developing a system trained on images, text, and other data using massive computational resources the company’s leadership believes is the most promising path toward AGI.

Indeed, Brockman and Altman in particular believe AGI will be able to master more fields than any one person, chiefly by identifying complex cross-disciplinary connections that elude human experts. Furthermore, they predict that responsibly deployed AGI — in other words, AGI deployed in “close collaboration” with researchers in relevant fields, like social science — might help solve longstanding challenges in climate change, health care, and education.

It's unclear whether the new supercomputer is powerful enough to achieve anything close to AGI, whatever form it might take; last year, Brockman told the Financial Times that OpenAI expects to spend the whole of Microsoft's \$1 billion investment by 2025 building a system that can run "a human brain-sized AI model." In 2018, OpenAI's own researchers released an analysis showing that from 2012 to 2018, the amount of compute used in the largest AI training runs grew more than 300,000 times with a 3.5-month doubling time, far exceeding the pace of Moore's law. Last week and on pace with this, IBM detailed the Neural Computer, which uses hundreds of custom-designed chips to train Atari-playing AI in record time, and Nvidia announced a 5-petaflop server based on its A100 Tensor Core graphics card dubbed the A100.

There's evidence that efficiency improvements might offset the mounting compute requirements. A separate, more recent OpenAI survey found that since 2012, the amount of compute needed to train an AI model to the same performance on classifying images in a popular benchmark (ImageNet) has been decreasing by a factor of two every 16 months. But it remains an open question the extent to which compute contributes to performance compared with novel algorithmic approaches.

It should be noted, of course, that OpenAI has achieved remarkable AI gains in gaming and media synthesis with fewer resources at its disposal. On Google Cloud Platform, the company's OpenAI Five system played 180 years' worth of games every day on 256 Nvidia Tesla P100 graphics cards and 128,000 processor cores to beat professional players (and 99.4% of players in public matches) at Valve's Dota 2. More recently, the company trained a system on at least 64 Nvidia V100 graphics cards and 920 worker machines with 32 processor cores each to manipulate a Rubik's Cube with a robot hand, albeit with a relatively low success rate. And OpenAI's Jukebox model ran simulations on 896 V100 graphics cards to learn to generate music in any style from scratch, complete with lyrics.

### **New market opportunities**

Whether the supercomputer turns out to be a small stepping stone or a large leap to AGI, the software tools used to design it potentially open new market opportunities for Microsoft. Through its AI at Scale initiative, the tech giant is making resources available to train large models on Azure AI accelerators and networks in an optimized way. It splits training data into batches that are used to train multiple instances of models across clusters and periodically averaged to produce a single model.

These resources include a new version of DeepSpeed, an AI library for Facebook's PyTorch machine learning framework that can train models over 15 times larger and 10 times faster on the same infrastructure, and support for distributed training on the ONNX Runtime. When used with DeepSpeed, distributed training on ONNX enables models across hardware and operating systems to deliver performance improvements of up to 17 times, Microsoft claims.

"By developing this leading-edge infrastructure for training large AI models, we're making all of Azure better," Microsoft chief technical officer Kevin Scott said in a statement. "We're building better computers, better distributed systems, better networks, better datacenters. All of this makes the performance and cost and flexibility of the entire Azure cloud better."

Sourced by *Financier Worldwide Magazine*

Intellectual property (IP) is often the most valuable of a company's assets – making it a natural target for threat actors bent on appropriating the fruits of others' labours.

By way of definition, an IP crime is committed when someone manufactures, sells or distributes counterfeit or pirated goods, such as such as patents, trademarks, industrial designs or literary and artistic works, for commercial gain.

According to 2019 figures compiled by the Organisation for Economic Co-operation and Development (OECD) and the European Union Intellectual Property Office (EUIPO), fake goods are now worth \$509bn, equating to 3 percent of world trade. Furthermore, around 7 percent of European-imported products are now counterfeit (corresponding to €121m per year), with 37 percent of these products posing a danger to consumers. Helping to identify these products are EU-wide RAPEX alerts from member states, which show that 97 percent of recorded counterfeit goods pose a clear health risk.

In the UK, a 2019 joint report by the UK Intellectual Property Office and the OECD revealed that the overall UK market in fake goods is now worth £13.6bn. "Counterfeit goods are 3 percent of all UK imports and the total value of lost sales from products smuggled into the UK is £9.2bn," says Phil Lewis, director general of the Anti-Counterfeiting Group (ACG). "This equates to £11bn in lost sales, 60,000 job losses and £3.1bn in lost taxes. The overall result is a reduction in UK public revenue of £4bn."

In the view of IP experts, large-scale counterfeit networks will underpin IP crime in 2020 and beyond, due largely to advances in technology. "Given reverse engineering techniques, faster, quicker and more precise 3D printing and software-driven manufacture, copying has never been easier," observes Liz Ward, founder and principal at Virtuoso Legal. "The problem lies in detecting counterfeit products and closing down both providers and sellers of such goods. Counterfeit goods are often made by the same manufacturer who makes the genuine ones. Therein lies the dilemma. These goods are often the same as the branded ones but are made available at a lower cost by the manufacturer."

Unfortunately, in many cases detecting such practices still relies heavily on traditional investigative techniques, such as private investigators and test purchasing. These offline strategies, although important, ideally need to be augmented with sophisticated online tools.

### **Protecting IP**

With IP the lifeblood of many companies, identifying, selecting and implementing an effective means of protecting innovation is essential.

"To help combat this growing form of criminality, companies need to invest in a wide range of technology, such as systems to identify counterfeiting supply chains," suggests Mr Lewis. "Pedigree systems are used in some industries to record the movement of authentic products from manufacture to sales."

***"With the nature of IP theft becoming ever more sophisticated, developing effective detection and protection strategies remains a priority for companies under threat."***

Technologies, such as data analytics and artificial intelligence (AI), play an increasing role in detecting counterfeiting. “These tools help track down copyright images and text used to sell goods online,” explains Ms Ward. “This means that with the right monitoring, detection is swift and takedown notices can be applied straight away on third-party platforms.

“However, it has also never been easier for counterfeiters to cover their tracks by using domains or platforms that are difficult to trace and outside the usual prosecution jurisdictions,” she continues. “It is also much easier to keep the door closed to infringement, rather than pursue a galloping horse once counterfeit products hit the market.”

### **Evolving IP threats**

With the nature of IP theft becoming ever more sophisticated, developing effective detection and protection strategies remains a priority for companies under threat.

“The key takeaway should be to look at the source of the problem, operate with the right manufacturers and third parties and ensure the security of goods via the supply chain,” suggests Ms Ward. “It is always better to prevent than to find yourself after individual counterfeiters – many of whom can easily slip through the net.”

In Mr Lewis’s view, IP crime is a global issue best tackled through multi-agency and interdisciplinary partnerships. “A true response cannot be accomplished unless we are truly inclusive,” he says. “In short, alongside operational partnerships, businesses enforcement and government agencies need to build and use even wider ranges of information and intelligence to help develop more joint public-private sector planning. It is vitally important that we produce better evidenced and compelling narratives to build more understanding about existing and growing IP threats.”

### **The impact of COVID-19**

In recent times, another threat dynamic has emerged to challenge IP practitioners in the form of coronavirus (COVID-19). “There will be lots of counterfeit and fake goods that spring out of the COVID-19 crisis, concurs Ms Ward. “Where there is demand, there is a crook willing to exploit people with either useless testing kits, which have flooded the market, or poor quality hospital kit.”

In the view of Mr Lewis, at a time when counterfeiters are making COVID-19- related remedies and equipment, protecting IP has never been more important. “Counterfeiters know that people are becoming more interconnected with e-shopping and are stockpiling, while enforcement is being forced to shelve their brand protection services,” he concludes. “It is a sad time when predators have the advantage.”

Movandi looks to bring 5G mmWave signals to locations where base stations can't reach. 5G Technology World spoke with CEO/co-founder Maryam Rofougaran and Craig Ochikubo, SVP business development/marketing to find out how the company brings 5G indoors work and how its coping with COVID-19.

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Having just completed a third round of funding, Irvine, Calif.-based Movandi is on the cusp of bringing 5G mmWave products to market. Starting by developing mmWave front-end ICs and incorporating them into modules, the company has brought those modules into systems for carriers to bring 5G indoors, something that mmWave signals can't do on their own. That company now has products deployed with carriers that are in final test. Work continues despite having to cope with COVID-19.

### **5GTW: What is Movandi's focus?**

Rofougaran: Movandi is focused on the mmWave aspect of 5G, which is needed to deliver 5G's promise of high throughput and low latency. We're focused on making sure that mmWave 5G will happen. 5G mmWave has problems penetrating buildings and we're addressing that problem, which has become apparent as deployments have started. The traction we have gained has let us attract interest from venture capitalists, partners, and customers.

We have developed products that let 5G mmWave signals work inside buildings. They are currently going through trials and that let us raise the capital needed to grow the company.

### **5GTW: Where are the trials taking place?**

Rofougaran: Testing takes place at the Movandi office, customers, and test labs. Customers and Movandi are doing the last stages of testing. Before shipping a product, we must make sure it's been tested in the field running actual use cases.



Our first product is a complete system called BeamXR (**Figure 1**). It uses custom RFICs and antenna arrays that are integrated into a module to produce and process the analog and digital signals. It makes sure that the mmWave signal can get inside a building. mmWave signals can't penetrate buildings. Regular glass can attenuate signals by 6 dB and low-e glass can have almost 40 dB of loss. Signals are already weak when they reach a building and can't get inside.

*Figure 1. Movandi's BeamXR brings 5G signals into buildings. The two 3x3 antenna arrays focus signals at nearby outdoor small cells. It uses the company's ICs and RF-front-end modules. Image: Movandi.*

The BeamXR resides just inside the building, taking a weak beamed signal and lighting up the entire room inside the building with a range over 200 ft. It does the beamforming to connect to

the base station. Every piece of customer-premise equipment (CPE) and mobile handsets can now have access to the base station (**Figure 2**).

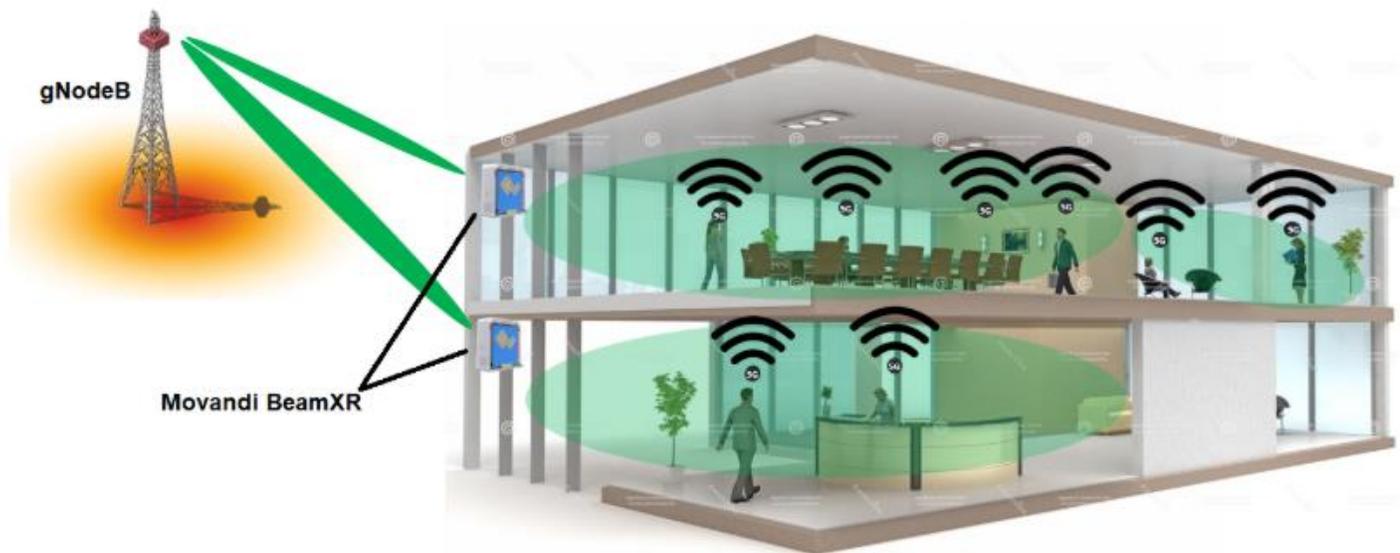


Figure 2. Movandi's BeamXR connects to a base station over mmWave and illuminates the inside of a building with 5G. Image: Movandi.

**5GTW: If the mmWave signal can't penetrate certain kinds of glass, then how can the BeamXR communicate with the base station?**

Rofougaran: We have special builds of the repeater that use the same IP but built in different configurations to handle high window losses. Signal attenuation from multipane low-e glass can reach 30 dB or more. The same IP in different configurations can address many different consumer and enterprise indoor applications and outdoor network repeater applications.

**5GTW: What else is Movandi working on?**

Rofougaran: In addition to the BeamXR, we are working with partners to develop Open Radio Access Network (O-RAN), CPE, hot spot, and small-cell products. Our modules connect to a customer's product such as a modem. The modules are scalable; a 2x2 antenna array could go into a cellphone but could be scaled to over 500 elements using more chips and antennas to make a bigger module for a macro base station. We can adapt to any application if the customer has the modem and baseband processing capability. The BeamXR contains our modules. We've implemented our signal-processing algorithms in a FPGA and will continue to optimize them in the future. We provide the entire reference design and work with manufacturers to ship it to the customer.

**5GTW: Do you plan to produce other products with your RF front-end modules?**

Rofougaran: With our RF front-end modules, we plan to produce in 2020 a fixed wireless CPE where our module connects to a partner's baseband modem.

Later in 2020, we plan to produce a multi-band, multi-beam outdoor router that can perform the same functions as today's small cells but at a much lower cost. The router won't require a fiber connection and is thus easier to install. In 2021, we plan to produce a mesh network so that users can get maximum 5G coverage inside a building. In 2021, we expect our modules to become part of a portable hotspot/router.

**5GTW: How far do you expect the additional funding to move Movandi?**

Rofougaran: We will be able to expand 5G deployment including the router and O-RAN products. But, to ship product, we must build product. The additional funding will give us the money to manufacture products while continuing to innovate.

**5GTW: Have you seen any slowing in the pace of 5G during this time of the COVID-19?**

Rofougaran: We haven't seen any slowing at all. Our primary customers and partners are the service providers.

We're seeing considerable activity in the U.S., Korea, and now Japan. There's no slowdown. Indeed, we're seeing an increase in activity. China and Europe are looking into mmWave as well. With so many people working from home, there's greater interest deploying 5G.

COVID-19 has shown that people need internet access to work at home. Throughput and latency have grown in importance, but we're also seeing emerging applications. 5G can help with these applications. A recent FCC [auction](#) added 37 GHz, 39 GHz, and 47 GHz to wireless applications. We were surprised to see Verizon spend another \$1.8 billion on these frequencies after having invested heavily in 28 GHz. AT&T and T-Mobile have also added mmWave spectrum. Carriers are also increasing spending to accelerate 5G deployment. There's eagerness to deploy mmWave in 2020.

**5GTW: How have you managed to conduct your testing with everyone working at home?**

Rofougaran: In the early stages of the company two years ago, we did most of the testing in our lab. Today, we have equipment under test at customer locations. Our lab is set up to the point where we can remotely perform even lower-level testing. Once in awhile, one or two people will go to the lab to configure a setup. Equipment at our customer sites are constantly under test and we can also gain access to them from home. We can monitor their conditions and see how they are working with a gNodeB and even perform software upgrades from home. Sure, we'd like to have people in the lab, but working from home has not slowed us down. If something needs to be changed at the customer site, they have people who do that.

**5GTW: You mentioned that Movandi is developing O-RAN products. Why has O-RAN gain so much traction?**

Rofougaran: Recently, we've discovered that the radio-access network needs to be open, virtual, and interoperable. Opening the RAN enables virtualization and AI because it's not tied to one manufacturer's hardware or software. The open concept allows for more innovation and easier upgrades and lower costs.

Published by TechCrunch

This week Alexia Bonatsos of Dream Machine and Niko Bonatsos of General Catalyst swung by Extra Crunch Live to discuss where they are investing today and what the future might look like.

As expected, these seed and early-stage venture capitalists had a lot to say about their current investing cadence and what interests them in the world of edtech, Clubhouse and more. A big thanks to everyone who came out and submitted some great questions.

Going back through the chat today, a few sections jumped out. For this recap, I've gathered answers from the transcript regarding today's fundraising climate, the future of AI and the possible impact of the downturn on VC-backed founder diversity.

And for everyone who couldn't join us live, I've included the full video replay below. (You can get access here, if you need it.)

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### **Today's fundraising climate**

Alexia

It's kind of a Rashomon; depending on whose perspective you're getting the story, is just completely different.

Let's see, are [VCs] being as active as they were in 2018? I'm gonna say no. I mean, look at your data, your data says no. But does that mean people [have] shut down the shop and are all in Montana? Also no, right?

We know that these kinds of "crisistunities" — and I'm not diminishing the crisis at all, it is very sad and very scary, and it's something that I'm very privileged to be able to be experiencing from inside my apartment and not from outside within an emergency room or a food bank or any other place that it's actually at the front lines, right?

So we know in the last recession, Airbnb, WhatsApp, Uber, Instagram [were founded], how much value was created from the last contraction? Multiple billions of dollars, \$100 billion-plus. So the reason VCs aren't saying, "oh, we're just gonna wait until valuations drop," is because then they're not going to get the email from the next [Airbnb CEO] Brian Chesky. If someone's saying, "I'm putting up a closed sign on my business," then they're not going to be the person that the next category-defining founder automatically reaches out to.

But are many of us pausing, or trying to see if we can get more ownership when valuations correct to the amount of demand in the market? A lot of people are. That being said, I did two deals in March [and] April. And I'm chasing after a deal right now. And I'm still taking meetings and I'm still doing my job. I have to, that's what I owe to my LPs.

So were we in an overheated market before? Yes. Are people waiting for the market to cool down? Yes. Are they still taking meetings? Yes.

Niko

I think that's a pretty good read. Maybe a couple more points to add. The first one is [that] it's been a journey the last 10, 11 weeks. At the beginning, you start with more introspection, checking out what the portfolio looks like to figure out how you want to spend your time and how much damage has occurred over there.

Then what happens is, you start seeing some new areas exploding, where the — in a good way — where the future is getting accelerated. And you guys have done a good job sharing some of these trends around like e-commerce, telehealth, enterprise security, education, remote-work acceleration. [Those] sectors are looking freaking awesome right now... the metrics are looking really good. The product-market fit is very strong. So any companies you can find in these sectors, for example, I will say it's business as usual.

Then the other point that I would like to add to what Alexia was saying before... it takes some time and a different mindset to adjust to, "let's make deals over videoconferencing." And [it's] probably easier if it's a smaller amount of capital, or, most importantly, you've kind of relationship with that team from before. But it's not for everybody to make that jump and be like, "you know what, for people we've never met before, we're gonna write them a \$15 million check because they're going to get us to the promised land."

So it takes some adjustment from the venture capital community to do that. And you're seeing it also from our portfolio companies or companies that were not remote-first or had a distributed team. Recruiting is trickier for them, for executives.

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## How AI is used today

Alexia

I don't necessarily know if this is a better future, [but] when I think of [AI] in terms of the consumer context, it's something like TikTok, where you don't even have to log into TikTok and it automatically serves you a personalized feed [of] short videos that are tailored to your unique tics. Whether that's somebody surfing a pool or doing a dance with their dad. TikTok gives you exactly what you want in your feed.

I have a portfolio company named Trash that looks through your camera roll [and] allows you to scoop up videos that are trash and uses AI and ML editing to turn those trash videos into treasure. So it's more of a personalization aspect, than a, you know, crazy science-fiction Elon Musk neuro-link vision. It's more subtle than what science fiction would have had you believe in consumer.

Niko

Something to add to that is it could be also something running in the background around content moderation, for example. It's like one of the companies that Alexa mentioned, like how do you make sure that it's [a] more trusted environment, where safer, more positive conversations are happening? So there's certain companies, like our portfolio company Hive, that's working with a lot of consumer-facing companies to help them eradicate all the NSFW content.

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## VCs, diversity and founder capital

Alexia

I'm also concerned that they'll backslide on multiple levels.

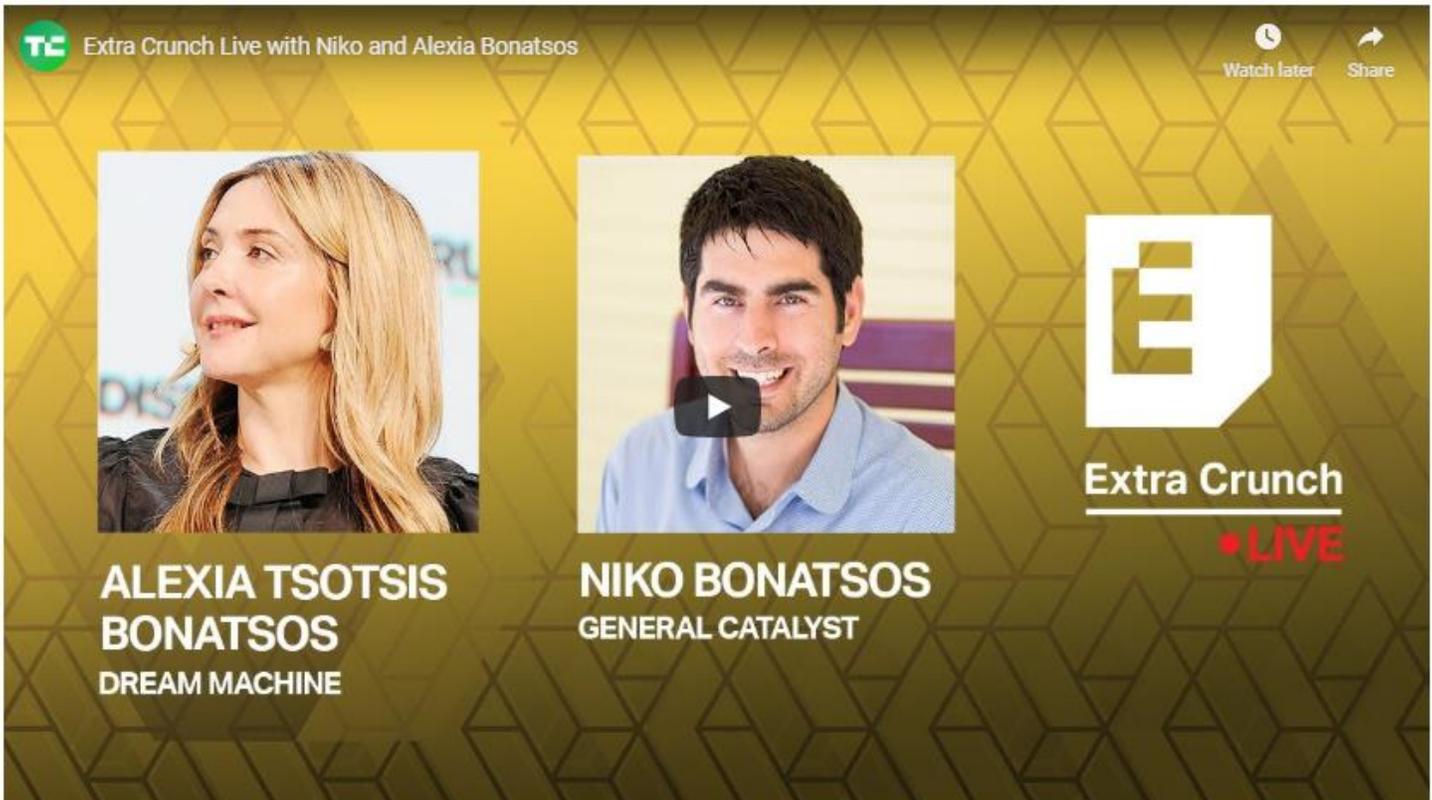
So when there is a shock to the system, when there's an earthquake, when a meteor strikes, when there's a black swan event, we default back to more conservative modes, we default back to the patterns that we're used to — the way of normality is a stronger force than gravity. And that normality is women doing a lot of the unpaid labor — which is childcare, cleaning, cooking — and that unpaid labor takes away from paid economic productivity. That's one angle of it.

And then if the venture community — which is predominantly male, predominantly white — is going to default back to old pattern-matching that is also predominantly male, predominantly white. So what we have to do as a

community is start building out platforms for greater access. It's not a pipeline problem, it is an access problem. And the way that you build out a platform for greater access is something along the lines of what Ryan Hoover did with Fundraise From Home, where you could submit videos from anywhere in the world.

Ryan, Niv Dror, Harry Stebbings [and] Vedika Jain [and] myself are sitting there sifting through the videos, picking three that we're interested in and then listening to these amazing ambitious founders every Thursday from home. And that's not like an old boys' club, that's not a velvet rope, that doesn't necessitate that you live next to the Blue Bottle on South Park. That's that is opening up the access to everyone.

Now, hopefully the progress that we have made, the women and the people of color that are already in the industry, will hold fast. And make sure that they continue to discard the cognitive bias. But that's hard, that's a conscious action in a time where we're operating from ... so you have to be very, very self-aware as a VC, which is hard.



The image shows a YouTube video player interface. At the top left, there is a 'TC' logo and the text 'Extra Crunch Live with Niko and Alexia Bonatsos'. At the top right, there are 'Watch later' and 'Share' icons. The main content area features two portrait photos: on the left, Alexia Tsotsis Bonatsos, a woman with long blonde hair, and on the right, Niko Bonatsos, a man with dark hair, smiling. Below the photos are their names and titles: 'ALEXIA TSOTSIS BONATSOS DREAM MACHINE' and 'NIKO BONATSOS GENERAL CATALYST'. To the right of the photos is the 'Extra Crunch' logo, a stylized white 'E' inside a square, with the text 'Extra Crunch' and '•LIVE' below it. A play button icon is overlaid on the Niko Bonatsos photo.

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## *Why micromobility may emerge from the pandemic stronger than before*

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By Megan Rose Dickey

Since its inception, shared micromobility services have been in a precarious position — one supported by millions of dollars in venture capital. But the COVID-19 pandemic has brought even more turmoil upon an industry that has long struggled with unit economics. It has led to mass layoffs, operation shutdowns across several markets and more consolidation.

Despite the struggles of individual operators, micromobility as technology will come out of this stronger than before, industry analyst Horace Dediu tells TechCrunch.

Dediu, an analyst who coined the term “micromobility” and founded Micromobility Industries, sees the silver lining in the pandemic for micromobility as it relates to the adoption of public transit alternatives. With ongoing concerns about the disease and social distancing, consumers may look to alternative modes of transportation — ones that require fewer interactions with strangers. But simply because a certain technology takes off doesn’t mean the current slate of operators will benefit.

“The companies involved may not survive a crisis,” Dediu says. “We don’t remember the fact there were 3,000 automobile companies in the United States prior to Henry Ford’s Model T. We don’t remember all the electrical suppliers out there and the consolidation that took place in the electrical field with Westinghouse. There’s a lot of historic references we can cite. But the fact of the matter is that up until the crisis there was an over-investment where probably too much capital was allocated to the industry chasing business models which are not sustainable... I think there will be a washout with a kind of consolidation and we’re seeing that already.”

Earlier this month, for example, Uber sold off JUMP to Lime, while simultaneously leading a \$170 million investment in the micromobility startup. That funding round brought Lime’s valuation down 79%, to \$510 million, according to The Information. Last April, Lime was valued at \$2.4 billion.

Shortly before Lime announced the funding, the company laid off 13% of its workforce amid the pandemic. Those layoffs came just a few months after the startup laid off about 14% of its workforce and ceased operations in 12 markets.

Before the pandemic hit, Bird had already acquired Scoot in July 2019 and Circ in January 2020. Amid the pandemic in April, however, Bird laid off about 30% of its workforce.

As Trucks VC Partner Kate Schox previously told TechCrunch, the companies most at risk during these times are “any mobility hardware startups with fleets of vehicles that are grounded and their business model depends on high utilization (micromobility, motor coaches, airplanes, etc.).”

But struggling companies don’t necessarily equate with a struggling industry as a whole. Even if some companies ultimately shut down, there is still room for personal ownership of micromobility, as well as room for other, more stable companies to pick up where others left off.

“There may be a shift to personally owned micromobility,” Autotech Ventures Partner Jeff Peters recently told TechCrunch. “Perhaps people will realize it is more cost-effective to just buy a scooter or bike, and they don’t need to worry about sanitation.”

In New York, we've already seen more people biking amid the pandemic. In March, Citi Bike reported demand had increased 67% between March 1 and March 11 compared to the same period in 2019.

Moving forward, venture capitalists Stonly Baptiste and Shaun Abrahamson of Urban.us said they envision even more bike adoption.

"We will likely see more bike adoption, and the demand will hopefully drive new innovation in bike forms for more security, safety and portability," they told TechCrunch. "And naturally, we are excited about Onewheel and other 'owned' light EVs' growing presence in urban mobility."

### **Micromobility versus public transit**

The big question right now for Dediu is whether public transit ridership will return to normal, and, if not, whether it's an opportunity for micromobility to fill that gap.

Worldwide, the coronavirus has disrupted demand and ridership for public transit. Ridership in major cities in the U.S., Europe and China are down by 50-90%, according to City Lab. New York's regional Metro North commuter rail, for example, dropped 95% and Bay Area Rapid Transit in Northern California operated with 93% fewer riders than usual earlier this month. A decrease in ridership has led many public transit operators to drastically reduce service, which means many are facing major declines in revenue. And given potential difficulties with social distancing on public transit, some are predicting more people will be getting into personal cars in a post-pandemic world. Dediu is not one of those people.

"Transit moves a lot of people," Dediu says. "To substitute that many people with automobiles — it's incredible how much more street space parking and time is necessary. Switching to a car means you need to spend more money. Secondly, it's going to take more time because a car needs to be parked wherever its destination may be."

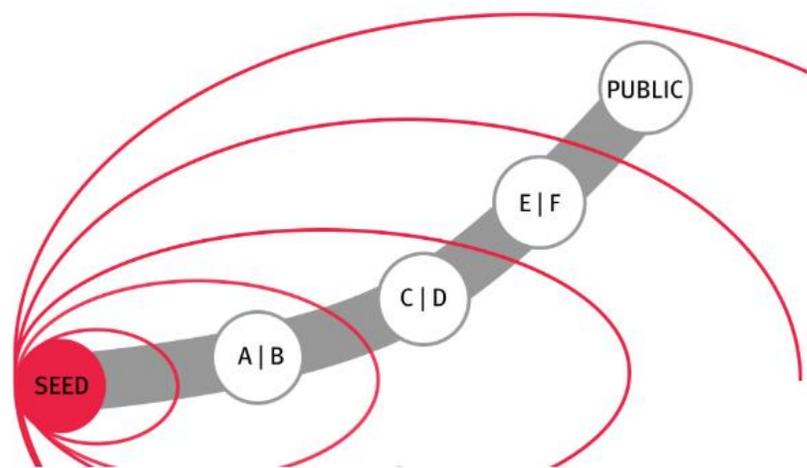
Parking in the pre-pandemic world was already difficult in many major cities, so imagine accommodating even 10% more cars, Dediu says.

"If you don't have parking, you don't have cars," he says. "Period. So the problem with people suggesting that we're going to drive instead of take the bus or the subway — they have to answer these three questions: Where's the money coming from? Where's the time coming from? And where's the space coming from?"

With micromobility, assuming the journeys are short enough, you don't have to worry about traffic, parking and high costs of gas, insurance and car payments, Dediu says. It's not that micromobility will replace all of the public transit trips, but even 1-2% of transit trips going to micromobility would make it 10 times bigger, Dediu estimates.

"I'm still trying to work out the exact numbers," he says. "These are still rough numbers, but that's the opportunity right now. We don't need to see everybody jump on a scooter or a bike, but we need to convince just a few people. That's all we need to see and as that snowball grows, you know, it just grows and grows."

By Sam Lessin



Two months into sheltering in place, it is becoming clearer how Covid-19 is going to affect the early-stage venture community. Raising venture funds will become harder, but some companies will get a boost from lockdowns and remote work.

Here are several of the most important ways in which early-stage company formation and seed financing is changing in the Covid-19 era.

Early-stage valuations are dropping quickly.

Early-stage venture-backed startups that are just getting off the ground are in some ways the most disconnected from the broader state of the economy right now. They are many years (and perhaps even an entire economic cycle) away from broad engagement with the public markets. That said, valuations are still dropping rapidly at the very early stages for two reasons.

First, early-stage investors don't know what the market for later-stage financings is going to be in 12 to 18 months, so they don't know how to price deals. Over the last several years, early investors got comfortable with having a clear financing pipeline where they knew that if they hit certain metrics, later-stage financiers would line up to fund rounds at increasing prices.

Now, early investors worry that even if companies hit their milestones, there might not be capital available at attractive prices for ventures in Series A, B and so on. So most early investors are looking for much lower valuations to make sure there is room for markups at the next round and beyond, even if things get much tougher.

Second, and just as important, most venture funds recognize that with the public markets under pressure, it is going to be much harder to raise new venture funds from institutional sources of capital. Institutional capital sources were already generally topping out their venture allocations going into 2020. But now, with public equities having fallen, their overall portfolios are far too heavily invested in venture. Since dollars are going to be scarcer in the coming years, investors are looking to conserve capital.

**Early deals are including a lot of protective provisions.**

For the last several years, term sheets at the early stage have been extremely “clean.” Investors were signing documents like Y Combinator's simple agreements for future equity (SAFEs), which provided almost zero investor protection. This is changing. I am seeing more term sheets with all sorts of added controls and defensive provisions for venture capital. Things that were rare—like forcing teams to revest equity, mandating certain levels of burn, and all sorts of rights to participate in future financings or put more money in on certain terms—are becoming common.

Generally speaking, while some of these terms seem out of bounds to me, most of them make good sense given investor worries about getting wiped out in the next 12 to 18 months if later-stage financing markets turn.

**Early investors are reserving more capital to be prepared to stick with companies for multiple financing rounds. Angel investors who can't follow suit face a squeeze.**

For the last several years it has been a great time to be an angel investor who writes one small check to a company early but doesn't participate in later rounds. So long as everything is "up and to the right" this strategy can work out very well.

Now bigger funds are starting to reserve more capital per deal on the theory that even if a company is doing well, there isn't clearly a next financing to be had at good prices in the future. This allows them to easily invest more in the companies that are working.

Angels that generally can't (or don't) do this now face the prospect of being seriously diluted by low valuation and "pay to play" rounds even on companies that are doing well.

There will continue to be angel investors and breakout successes. But in some ways the cost of entry to the venture game just got a lot higher. People who aren't reserving capital early on are at much greater risk of being washed out of companies.

Rapid swings in the fortunes of big technology companies (and startups) are starting to force questions about risk tolerance and risk sharing for employees.

There has been a shocking reversal of fortunes for so many Silicon Valley startups, and the ecosystem is starting to discuss what that means in terms of risk sharing.

Compare, for instance, how fortunes have changed for a company like Airbnb versus many of the delivery startups. Airbnb was perhaps the most high-flying company in Silicon Valley pre-Covid, while many delivery companies were struggling. Now, Airbnb has hit a rough patch, and many of the delivery companies are doing fabulously well.

I believe this will affect the mentality of many Silicon Valley workers on how they value illiquid equity compared with cash. It may encourage employees to be more open to the idea of buying into a pool of companies so they can diversify their risk.

#### **Access to talent feels less pressured than it has been.**

One of the challenges most early-stage startups have faced in recent years is that it has been very hard to get employees to join a team. The financing market was so open that every engineer, designer and product manager who would be ideal to join early-stage companies could instead start their own company. There is a theory starting to be discussed that perhaps as financing tightens and people get a bit more risk averse, it might become easier in the coming years to put together high-quality teams. This is only feeling more true as top-tier later-stage companies shed talent.

#### **The declining cost of advertising and reaching new customers is creating new opportunities.**

In the last several years, many startups have been priced out of "paid acquisition" because Facebook and Google ads got too expensive for them to afford, at least in the U.S.

With the contraction of advertising spending by big companies, the cost of ads has come down. All of a sudden, many companies that recently couldn't afford to buy distribution and new customers now can do so economically and rationally. This is a big win for any company with products to sell and enough of an understanding of their economics to pay efficiently for growth.

There is renewed focus on quick profitability and separating truly venture-dependent companies from businesses that can grow without venture.

Founders and investors are more focused on quick paths to revenue and profit because everyone is worried that capital won't be there when companies need it in the future.

There are some ways in which this discipline is clearly helpful. I like to remind entrepreneurs that venture capital is the most expensive capital in the entire world, and that they should seriously consider growing without it if they can execute their business plan without venture funds.

More founders seem to be moving in this direction—considering bootstrapping for longer periods of time, possibly all the way to profitability—and treating venture capital as more of an optional accelerator if the stars align.

**Geography is becoming less of a factor in team building and fundraising.**

It is pretty clear that now that most companies have been forced to try remote work, many will stick with it in a meaningful way even after the Covid-19 era.

This is going to open up the talent pool and allow Silicon Valley technology companies to draw from the whole globe. That was already starting to happen. But this episode is going to greatly accelerate this trend, likely leading to lower-cost access to talent for companies and new opportunities for people who to date have been geographically excluded.

On the financing side, I have heard at least some non-Valley-based entrepreneurs say that this episode is leveling the playing field because all meetings are on Zoom regardless of physical location. This diminishes the advantage enjoyed by founders and teams living in the Bay Area.

Startups thematically focused on remote work have a huge momentary tailwind.

The story of companies targeting remote work has clearly accelerated by years in the past month. People and companies that might have experimented with working remotely and the tool ecosystem around remote work—Zoom, Slack, Asana—were suddenly forced into that model.

This is drawing forward a ton of growth for remote work-oriented software, as is evidenced in the public market by companies like Zoom and Slack. This growth has spilled over into big rounds and rich valuations for productivity and remote work software and services.

There is nothing wrong in theory with this acceleration. The question is only whether in the long term, people will stick with the software they are using to work from home today.

**Consumers are open to new social experiences for the first time in a long time, opening space for new social products and creating a financing tailwind.**

Slow Ventures, the early-stage fund where I am a partner, hosted a conference on the future of social right before Covid-19's outbreak. At that event, there was a sense that, for the first time in a long time, many builders were starting to experiment with next-generation social networks and products. Attendees had a vigorous debate about whether the future of social would be a “return to the real world” or a move deeper into virtual worlds.

What we have seen in the few weeks that have passed since that conference is that because people are at home, there is a huge amount of openness to try new virtual social experiences—and of course people are blocked out of the real world.

I have felt this change, whether playing multiplayer virtual reality games with friends or playing the game Codenames over Zoom. There are many social experiences and products I wouldn't have had the time or space to try before that I am now engaged with.

Much like the long-term impact on the productivity ecosystem, there is no question that new digital social platforms have an enormous opportunity. People are willing to try new things, and the capital is following the potential.

**Within social, there is a renewed focus on ‘real’ versus ‘professional’ friends and content.**

In the last several years “professional” friends on Instagram have been huge wells of engaging content. In many ways the story has been about “professional” social media crowding out the amateurs and real friends on networks. Covid-19 has, at least temporarily, reversed that. Facebook is alive with real friends looking to connect. People care about interacting with and supporting those with whom they have real relationships.

On the flip side, professional celebrities and social media charters are stuck in reruns because they can't go out in the real world and produce new content. Much of the overproduced, manicured and appealing realities they build seem tone-deaf given the world situation we face.

Even my beloved TikTok is starting to feel stale after some great initial creativity in the earliest days of lockdown. This reversal is creating opportunities for countless startups focused on real relationships and friends.

**Transportation and real estate startups are challenged both by questions about how Covid-19 will affect long-term societal trends and by high capital requirements.**

On the transportation side, there is the argument that people will avoid mass transit for a very long time after this incident—so that while the lockdown is damaging, there is an enormous global opportunity for private transit. Perhaps.

On the real estate side, the very large question is whether commercial real estate will ever recover—or whether the whole model (and not just WeWork) will have to change. If many people come out of this crisis believing that remote work is effective and commuting is wasteful, will companies slim down their commercial real estate? Will all startups that touch office workers suffer as a result? These are such large unknowns that, for the time being, it seems hard for early-stage companies in this space to do financing deals. It isn't impossible, but the macro uncertainty, coupled with the usually high capital requirements for operating in the real world, make this space difficult.

**There is an interest in new ways to earn from home, but not many new companies are coming online yet.**

We all know the dire unemployment statistics, and the challenge to service workers and entertainers who work in the real world and are sidelined at home.

One of the areas where I think technology can have an enormous impact is helping people make money with their skills and talents from home. People are talking about this a lot, but I haven't seen much momentum building in the space yet.

One of the only things I have seen is something I helped get off the ground—LiveStack video. This startup makes it dead simple for creators, from yoga instructors to comedians, to charge a fee for “pay per view” access to livestreams they host. I am expecting to see more things like this.

**There is a lot of energy in telemedicine, which affects seed companies.**

Many states are relaxing regulations around telemedicine, and even things like HIPAA compliance requirements, during the emergency. Different people have different predictions on what will happen long term and which regulations will be reinstated or dropped forever.

This, coupled with the fact that people still need medical support but do not want to go to doctors in person, is dramatically accelerating what was already good growth in the telemedicine space.

**There is early demand for companies and projects focusing on advocacy services for small business owners and individuals.**

The small businesses and individuals that are most under pressure from Covid-19 are clearly going to need support and guidance as they navigate their future. Getting trusted viewpoints and help in both renegotiating loans and leases, and dealing with displacement, is a new and very large business space.

Take, for instance, what is going to happen with restaurant rent in the coming months. Many restaurants are going to be stuck in a position of technically owing rent they can't afford to pay if and when they are able to reopen. This would generally put a lot of power in the hands of whoever owns the real estate and holds the lease. But the problem for those owners is that if they kick out their current tenants, they will be unlikely to find a new one anytime soon at good prices to fill the space. That gives the restaurateur who wants to reopen a ton of leverage. That creates an opportunity for helping small businesses and people renegotiate their obligations and commitments.

This is obviously just the start of a longer list of implications for early-stage venture capital in the coming years. The best companies will always get financed. But everything else about the early-stage pipeline presents many challenges and unknowns.

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### **The Takeaway**

*Covid-19 and the accompanying economic downturn will affect startups in numerous ways. Early-stage valuations are falling, investors are demanding stronger protections, and angel investors might find it harder to compete. But there are more opportunities for startups in areas like social media and working from home.*

They say clothes makes the man, a proverb that means you should dress to impress. In the Age of COVID-19, many of us have stopped wearing pants, but that doesn't mean we're not interested in some of the cool technology coalescing around clothing. You've probably read or seen some of the smart fabrics that can track your heart rate, respiration, and even your muscle development. Functional fabrics are particularly finding inspiration in the natural world, a science known as biomimicry. From sharkskin-inspired swimsuits to Velcro modeled on hooklike burs, companies are recreating and repurposing Mother Nature's design for commercial products. And thanks to innovations in synthetic biology, startups like Bolt Threads are giving us spider web clothing without the spiders.

### So What's So Great About Spider Silk?

Spider silk has some amazing properties, such as being incredibly strong and lightweight. Take the Darwin's Bark spider, for example, which was not discovered until 2009. It can create silk strands that extend up to 82 feet that are built out of the toughest biological material ever studied – about 10 times stronger than Kevlar. Then there's the golden orb spider which weaves a silk web of such strength that it can even catch birds. Over the years, researchers have been untangling the protein-based fiber's structure down to the molecular level, leading to new insights and the potential for eventual commercial uses.

Some of the far-out applications include harnessing spider webs for robotic muscles and even a real-world web-slinging contraption that the U.S. Navy is developing to ensnare enemy vessels. Near-term uses could include spider-sticky bandages in the biomedical industry and more durable alternatives to safety equipment like seatbelts and parachutes. The often-used comparison of a spider's web being stronger than steel refers to tensile strength that's as strong as steel at a fraction of the weight.

The problem is that it's pretty hard to use actual spiders. You can't exactly milk them like cows. There's also the fact that they're naturally territorial and cannibalistic, so any attempt to farm them would likely lead to an amount of arachnid carnage not seen since Bilbo Baggins visited Mirkwood Forest. So if you want to swing like Spiderman, you need to figure out a way to replicate the material in a lab.

### Spinning Spider Webs with Yeast

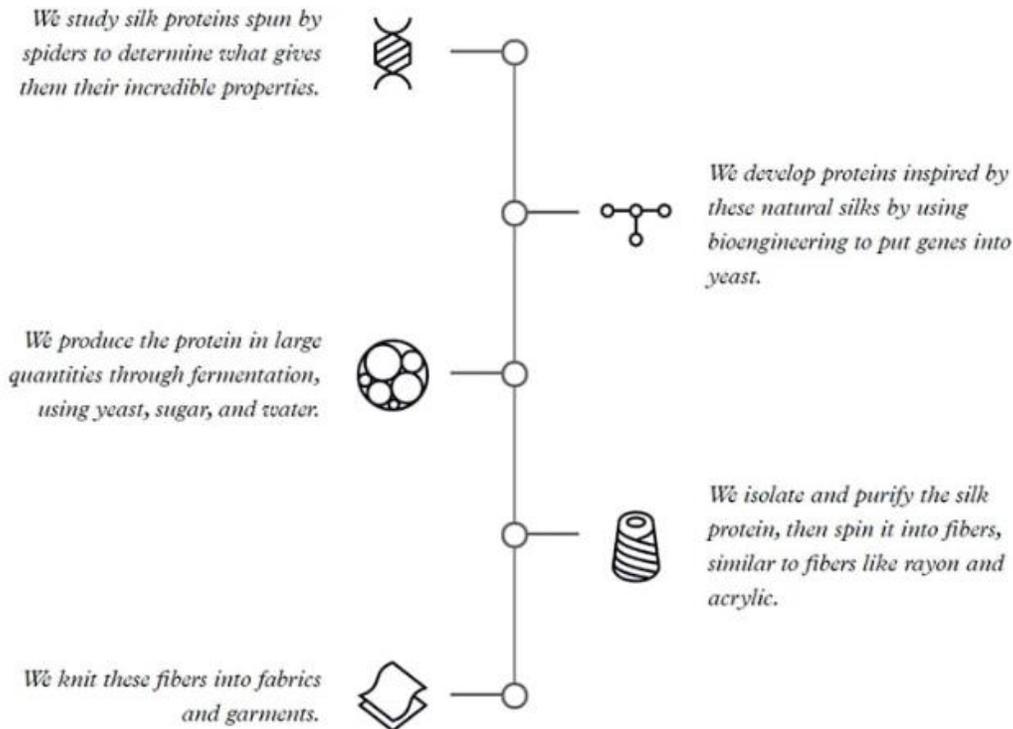


That brings us to Bolt Threads. Founded in 2009, the Emeryville, California startup has taken in a whopping **\$213 million** in funding so far to create synthetic spider silk using genetically modified yeast cultures, which sounds nearly amazing as getting bitten by a radioactive spider. Investors include Fidelity, Baillie Gifford, Temasek Holdings, and Peter

Thiel's Founders Fund, among others.

Bolt Threads is using a form of synthetic biology, also called synbio, which applies engineering, design, and computer science principles to biology, usually at the cellular level. Often there is a high level of automation – and sometimes artificial intelligence – to replace the manual labor of yesterday's laboratories. In one sense, synbio is about turning microorganisms like bacteria or yeast into biological machines, which is why we usually cover this topic under nanotechnology. In fact, we profiled Bolt Threads previously in our list of startups developing nano clothing technologies.

Like food companies producing certain kinds of alternative dairy and fake meat products using fermentation technology, Bolt Threads inserts certain genes into yeast that feed on corn-based sugar to produce large quantities of silk proteins. But not to worry: The company's overpriced Microsilk fibers are not genetically modified themselves. After fermentation is complete, the silk protein is purified from the yeast, and the remaining yeast cells are destroyed by the same methods used to pasteurize milk.

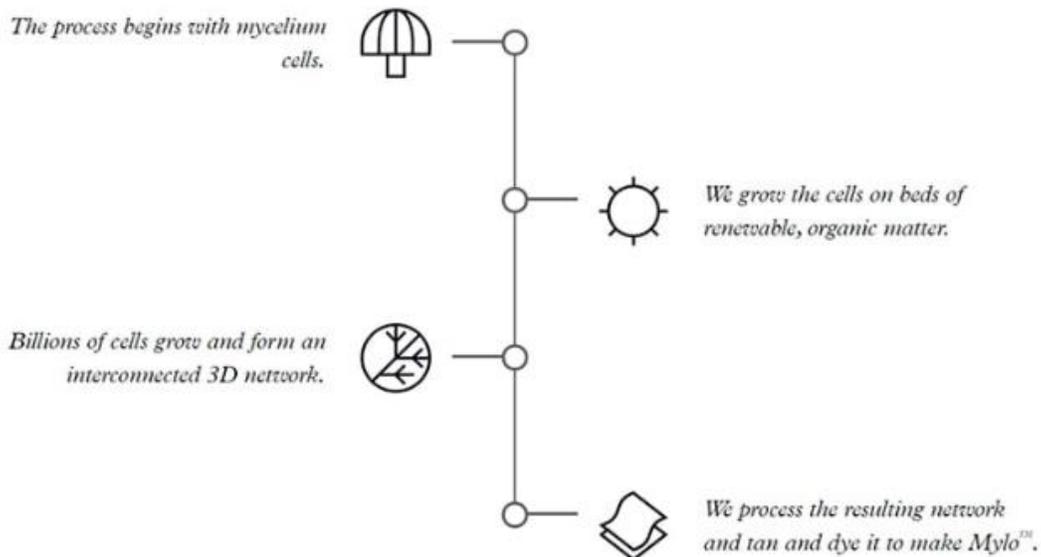


Credit: Bolt Threads

The company says its Microsilks offers not only better performance in terms of durability but it's also eco-friendly. Depending on which pro-environment website you check, it can take hundreds, if not thousands, of gallons of water to produce one cotton T-shirt.

### A Mushrooming Business

Bolt Threads appears to be positioning itself as some sort of eco-chic apparel maker. A few years ago, it debuted its first piece of spider web clothing – a synthetic silk tie that retailed in the neighborhood of \$300. More recently, the company has unleashed its war chest of money to develop a non-animal leather product line that's made from mycelium called Mylo, which can be produced in days versus years. The startup is able to control the mycelium's growth conditions to produce a substrate that can be cured and tanned into a soft, supple material that looks and feels like leather.



Despite its millions in funding, Bolt Threads took to Kickstarter to help fund the project, offering a handbag to those who donated \$400 or more.

Super cool and all that, but those price points need to come way down if this will ever achieve more than just overpriced designer handbags for ESG types. We get it: The company is trying to showcase what you can do with these alternative materials in order to save the planet, in the same way other startups are going after the alternative protein market with microbes, fungi, and seaweed.

But then Bolt Threads went all Gwyneth Paltrow Goop on us last year when it introduced a new material called B-silk protein that it produces in the same way as Microsilk. As the company explained in a blog post: “Knowing the rich history of silk in biomedical engineering and tissue regeneration, we naturally wanted to explore whether our silk proteins might be beneficial in skincare.” Yes, saving the world one moisturizer at a time. Bolt Threads launched a whole new company, Eighteen B, named after the protein’s repeating molecular structure of 18 amino acid segments. The core ingredient in its lotions and potions is B-silk protein. Fast Company wrote a [whole article on it](#), explaining how silk proteins act as a barrier to protect hair follicles and skin. If you’ve ever walked through a spider web in the woods, it doesn’t really feel that soothing to us.

### An Expanding Spider-Verse



In the same article on nano clothing technology, we also highlighted the work by Japanese startup Spiber. Founded way back in 2007, the company has amassed an equally impressive **\$246 million** in funding and is a direct competitor to Bolt Threads.

Spiber also uses fermentation technology to produce its Brewed Protein, a material that can be processed into a variety of forms, ranging from “delicate filament fibers with a silky sheen to spun yarns that boast features such as cashmere-like softness or the renowned thermal and moisture-wicking properties of wool.” It can also be processed into resins closely resembling tortoiseshell or animal horn for the Big Game Hunter in your household. In other words, the company has also gone down the runway of haute couture, enlisting famed Japanese fashion designers like Yuima Nakazato to feature Brewed Protein in their apparel lines. Spiber announced it will open a mass production facility in Thailand by next year with an annual capacity of several hundred tons.



Yet a third company in the ever-expanding Spider-Verse of spider web clothing and cosmetics is AMSilk out of Germany. Founded in 2008, the company has raised more than **\$30 million**, according to [an article](#) in Forbes. The startup also uses fermentation tech for its Biosteel fiber, but opts for using genetically modified *E. coli* bacteria for production. AMSilk actually sold off its cosmetics business last year to Givaudan, a Swiss manufacturer of flavors, fragrances, and cosmetic ingredients. That may signal that the company is focusing on developing different types of commercial and industrial materials based on its Biosteel fiber platform.

For instance, its synthetic silk polymers could be used as a coating for silicone breast implants to reduce inflammation after surgery. A couple of years ago, AMSilk [inked a deal with Airbus](#) to develop a new high-performance material that would use Biosteel fiber.

### Conclusion

We always knew that nanotechnology would lead to innovations in material science. We just never thought it would involve milking genetically tweaked yeast, bacteria, and silkworms to produce overpriced beanies and parkas. Still, we have hope that some of these companies will use their spidey powers for both profit and progress in areas like medical biotechnology and aerospace. Something has got to stick.

**A research team used machine learning in an optimal experimental design to quickly find the best method for Li-ion battery charging in under 10 minutes, while also maximizing overall battery lifetime.**

By Bill Schweber

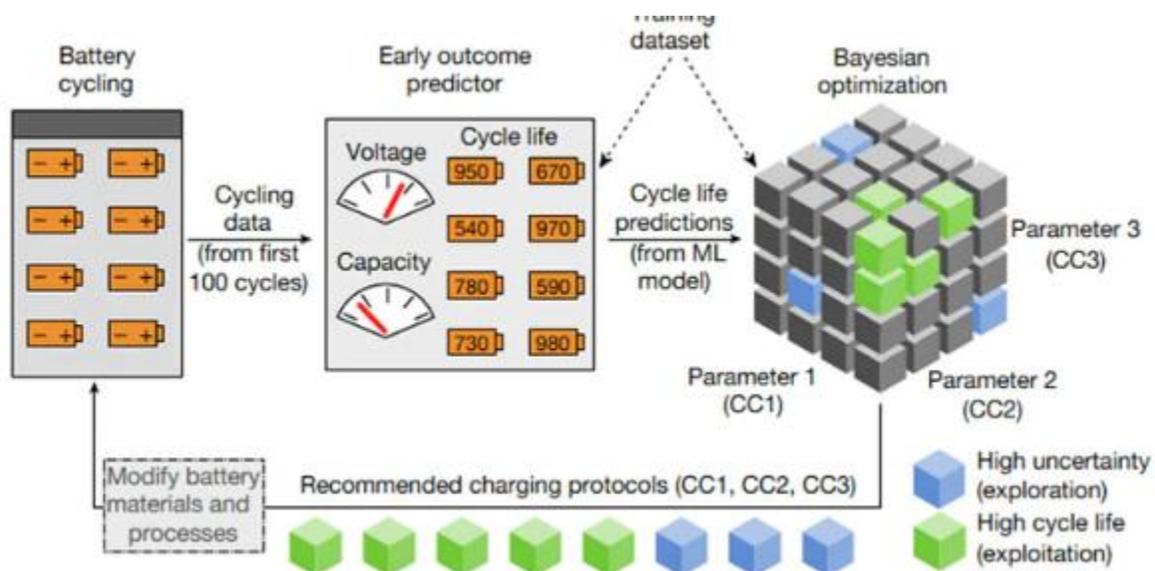
A major issue associated with investigating battery improvements for high-capacity applications such as automobiles is the harsh reality that simultaneously optimizing the many design parameters, including driving range, charging time, and lifetime, requires many time-consuming experiments. For example, testing lithium-ion batteries across factors such as materials selection, cell manufacturing, and operation to maximize battery lifetime can take months to years.

Designing batteries that can accept ultra-fast charging is difficult because, among other factors, it tends to significantly shorten the battery's overall lifetime due to additional strain placed on the battery. To minimize this problem, battery engineers typically perform exhaustive tests of charging methods to find the ones that work best.

Now, a team based at Stanford University, collaborating with researchers at MIT and the Toyota Research Institute, has developed an approach based on artificial intelligence (AI) and machine learning (ML) that cuts testing times by up to 98%. Their optimal experimental design (OED) ML goal: Find the best method for charging a lithium-ion battery, such as in an electric vehicle (EV), in under 10 minutes while also maximizing overall battery lifetime.

Instead of testing every possible charging method equally, or relying on intuition, the computer learned from its experiences to quickly find the best protocols to test. The researchers wrote a program that predicted how batteries would respond to different charging approaches, and did so based on only a few charging cycles. The software also decided in real time which charging approaches to focus on or ignore.

By reducing both the length and number of trials, the researchers cut the testing process from almost two years to 16 days. Although the group limited their method on battery-charge speed, they said it can be applied to numerous other parts of battery development, and even to non-energy technologies.



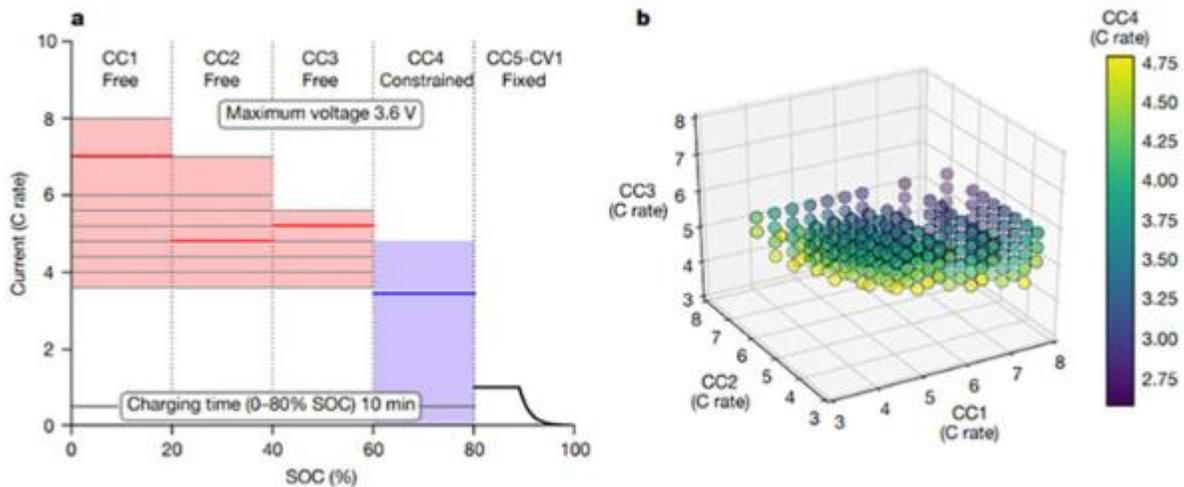
1. Schematic of the closed-loop optimization system: First, batteries are tested. The cycling data from the first 100 cycles (specifically, electrochemical measurements like voltage and capacity) are used as input for an early outcome prediction of cycle life.

These cycle-life predictions from a machine-learning (ML) model are subsequently sent to a Bayesian-optimization (BO) algorithm, which recommends the next protocols to test by balancing the competing demands of exploration (testing protocols with high uncertainty in estimated cycle life) and exploitation (testing protocols with high estimated cycle life). This process iterates until the testing budget is exhausted. In this approach, early prediction reduces the number of cycles required per tested battery, while optimal experimental design reduces the number of experiments required. A small training dataset of batteries cycled to failure is used both to train the early outcome predictor and set BO hyperparameters. (Source: Stanford University)

The team implemented an ML methodology to efficiently optimize the parameter space by specifying the current and voltage profiles of six-step, ten-minute fast-charging protocols for maximizing battery cycle life and overall lifetime. They combined two key elements to reduce what is called “optimization cost” (Fig. 1):

- An early-prediction model that reduced the time per experiment by predicting the final cycle life using data from the first few cycles
- A Bayesian-optimization algorithm that reduced the number of experiments by balancing two elements—exploration and exploitation—to efficiently probe the parameter space of charging protocols.

The team reported that, using their approach, they were able to rapidly identify high-cycle-life charging protocols among 224 candidates in 16 days (Fig. 2). In contrast, an exhaustive search without early prediction would have taken over 500 days.



2. Structure of the six-step, ten-minute fast-charging protocols: Currents are defined as dimensionless C rates; here, 1C is 1.1 A, or the current required to fully (dis)charge the nominal capacity (1.1 Ahr) in 1 hour. (a) Current versus SOC for an example charging protocol, 7.0C–4.8C–5.2C–3.45C (bold lines). Each charging protocol is defined by five constant-current (CC) steps, followed by one constant-voltage (CV) step. The last two steps (CC5 and CV1) are identical for all charging protocols, optimized over the first four constant-current steps, denoted CC1, CC2, CC3, and CC4. Each of these steps comprises a 20% SOC window, such that CC1 ranges from 0% to 20% SOC, CC2 ranges from 20% to 40% SOC, and so on. CC4 is constrained by specifying that all protocols charge in the same total time (10 min) from 0% to 80% SOC. Thus, the parameter space consists of unique combinations of the three free parameters CC1, CC2, and CC3. For each step, the range of acceptable values is specified; the upper limit is monotonically decreasing with increasing SOC to avoid the upper-cutoff potential (3.6 V for all steps). (b) CC4 (color scale) as a function of CC1, CC2, and CC3 (on the x, y, and z axes, respectively), where each point represents a unique charging protocol. (Source: Stanford University)

Their closed-loop methodology automatically incorporates feedback from past experiments to improve future decisions. Equally important, they were able to validate the accuracy and efficiency of their approach. They further assert that their approach can be generalized to other applications in battery design, and even applied to other scientific domains that involve time-intensive experiments and multi-dimensional design spaces.

In addition to dramatically speeding up the testing process, the computer’s solution was also better and much more unusual than what a battery scientist would likely have devised, said Stanford Professor Stefano Ermon, a team co-leader. “It gave us this surprisingly simple charging protocol – something we didn’t expect.” Instead of charging at

the highest current at the beginning of the charge, the algorithm's solution uses the highest current in the middle of the charge. Ermon added, "That's the difference between a human and a machine. The machine is not biased by human intuition, which is powerful but sometimes misleading."

The full results of this research can't be summarized by a few numbers, words, or metrics, but they are available in their detailed paper "[Closed-loop optimization of fast-charging protocols for batteries with machine learning](#)," published in *Nature* (an unlocked version is posted [here](#); be sure to scroll down). Beyond that basic paper, their [Supplementary Information](#) provides additional detailed graphs and charts, discussion of the machine-learning algorithm, perspectives on the results, and more specifics of the investigative arrangement. This work was supported by Stanford University, the Toyota Research Institute, the National Science Foundation, the U.S. Department of Energy, and Microsoft Corp.

Northvolt and Vattenfall have launched a new battery energy storage solution, Voltpack Mobile System—a rugged, highly modular lithium-ion battery system envisioned as a zero-emission alternative to replace diesel generators.

Voltpack Mobile System delivers up to 250 kW with a scalable capacity from 245 to 1225 kWh of available energy. The system scales through a central interface hub, which can connect in parallel up to five self-contained Voltpacks, each containing three liquid-cooled, industrial-grade battery Voltpack Cores.



The hub also serves as an interface for applications, and houses inverter and auxiliary systems. If further power or storage capacity is needed, this can be fulfilled simply by connecting multiple Voltpack Mobile Systems in parallel.

Voltpacks feature high safety standards, and are designed and built by Northvolt. Leveraging field-proven technologies, Voltpack Mobile System is well-suited to operate under even the harshest conditions with a rugged profile and unique design features

engineered for transportation and repeated redeployment.

Voltpack Mobile System will serve as a modular power supply solution which can be configured to meet energy and power requirements of a wide variety of market scenarios.

Prime applications include powering remote electricity grids, reinforcing weak grids, supporting electric vehicle charging and delivering grid services such as balancing power, flexibility, or other ancillary services.

Designed for redeployment, the system can be deployed for operations lasting days, weeks or even longer periods of time. This characteristic opens Voltpack Mobile System up to opportunities of leasing and is expected to significantly expand the system's utility.

*The need for flexible energy solutions such as energy storage is vital for the transition to the new energy system. Energy storage provides fast access to power when customers need to peak-shave or the capacity of the grid connection is insufficient. The battery storage solution will be offered as part of our concept "Power-as-a-service", which means that we deliver a complete package with ownership of the energy storage and manage it to the specification of the customer. Vattenfall add a long experience of owning and operating different kind of network solutions including energy storage. —Torbjörn Johansson, head of Vattenfall Network Solutions Sweden*

Within the project, Northvolt has led development and production of core technologies, including battery and complementary inverter systems, and the battery management system.

Drawing on the company's experience of delivering commercial grid solutions to market, Vattenfall has supported Voltpack Mobile System project development to tailor the product to match the needs of the market, through both advising on design and functionality.

Final validation of the system will be undertaken at Vattenfall's test and certification center in Älvkarleby, Sweden. Vattenfall will be the first to offer the battery unit to the market, and have identified the need for sustainable solutions at industries, for microgrids, construction sites as well as for event organizers.

By Cory Weinberg and Alex Heath

In 2015, Facebook employees were offered an unusual perk: a cash bonus of at least \$10,000 if they moved within 10 miles of the company's suburban Menlo Park, Calif., headquarters. The lure was typical at the time for the social media giant, which had just completed a new office building that placed thousands of employees in one giant room.

Five years—and a pandemic—later, Facebook is retreating from the idea that employees need to work close together to thrive. Facebook CEO Mark Zuckerberg said Thursday that it would begin allowing some employees to work from home permanently, with the expectation that around half of Facebook's 48,000 employees will be working remotely in five to 10 years.

The move is likely to reverberate across the tech industry, whose identity for more than half a century has been tied to the notion that its success comes from having employees work in close proximity.

Facebook's decision, which Zuckerberg said was influenced both by the coronavirus pandemic and the desire to accommodate current and future employees' wishes, represents a stunning departure from the company's yearslong physical expansion in some of the world's priciest real estate markets. While the company hasn't indicated it would offload any existing spaces, the move will likely slow or shift its physical expansion. The company has said it would begin reopening its offices in July, initially limiting them to 25% occupancy.

Other high-profile tech firms such as Twitter, Square, Shopify and Coinbase in recent days also have announced plans to make working from home a permanent option for employees. But Facebook, which currently has around 48,000 employees, is by far the largest company to do so, and the decision will force Silicon Valley's other tech giants, all of whom compete fiercely to hire top talent, to examine their workplace policies.

The move also has implications for the economies of regions where big tech companies are clustered, especially the San Francisco Bay Area, which has seen rapid growth and increases in wealth in the last decade as big tech companies have hired tens of thousands of workers and gobbled up real estate. Google, whose own corporate headquarters is in nearby Mountain View, Calif., already has put real estate deals on hold during the coronavirus. Uber, based in San Francisco, is closing more than 40 of its satellite offices as it laid off nearly 7,000 people this month.

"It's a shock to the system," Robert Sammons, senior director of Bay Area research for Cushman & Wakefield, a real estate brokerage, said of the Facebook announcement.

He played down the immediate impact of the move on real estate, pointing to companies' long-term office leases and in some cases ownership stakes in their office complexes. "It is a very abrupt change. Does it last? That's what none of us know."

### **Recruiting Advantage**

Facebook's decision to morph into a company less shackled to physical offices may reflect its historical tendency to grab any tactical advantage it can over its competitors in the war for talent. In this case, offering more remote work options could appeal to prospective employees seeking lower costs of living outside cities who can now use sophisticated digital tools to keep up with colleagues.

Relative to other smaller companies that have announced permanent remote-work policies, Facebook is tiptoeing into the trend. Only senior employees in the U.S. and Canada who meet specific performance benchmarks will

initially qualify to work remotely. And if they relocate to a city with lower costs of living, they could have their salary reduced starting at the beginning of next year, Facebook said.

But Facebook leaders are projecting big changes. In five to 10 years, Zuckerberg predicted that roughly half the company will be working remotely.

In an internal survey, more than half the employees who responded said they have been just as productive while working from home as before, while 40% said they were interested in continuing to work remotely even after the pandemic ends. Of that 40%, three-quarters said they might move if they could continue to work from home. The people who said they were interested in working from home permanently often were more experienced employees.

The move to let people work remotely will have recruiting benefits, Miranda Kalinowski, Facebook's vice president and global head of recruiting, said in an interview.

"The fact that people won't have to choose between where they want to live and where they work is incredible to me," she said. "I think it just opens the door to many, many folks who wouldn't have otherwise considered us because they weren't prepared to relocate for a job."

Zuckerberg said in a publicly streamed all-hands meeting Thursday that the move also could help Facebook retain more employees.

"One of the top reasons that some good people give us when they leave the company is that they're moving to a place where we don't currently have an office and don't support work," he said. "And being able to keep people at the company is going to be very valuable. In a lot of ways, improved retention is as valuable if not more [valuable] than being able to recruit new people."

### **Tight Spaces**

Facebook has used its offices as a showcase for potential recruits and as a means of sparking spontaneous interactions among employees.

Now, with 95% of its workforce stuck at home due to the coronavirus, the company has added a meet-and-greet section in virtual interviews to "mimic the time when a recruiter is walking the candidate down the hall and they're making idle chatter," said Kalinowski.

When Facebook took over the old Sun Microsystems campus in Menlo Park in 2011, the then-upstart social media company famously kept visible the corporate logo marking the fallen tech giant. But Facebook made a more consequential change: Bent on increasing collaboration, it installed nearly twice the number of employees on the campus as its predecessor.

It built its own elaborate offices on some of the most expensive land in the world, betting that potential hires would want to live in San Francisco, Seattle or New York. Or, if they didn't, they would relocate anyway for the professional opportunity.

The real estate strategies forged by Facebook, Google and other tech firms have helped set trends around the world. Companies all over accelerated their adoption of open-office plans and offered unlimited free food.

There were, however, negative consequences. Researchers have found that large open offices diminish worker productivity. Bay Area cities struggled to accommodate companies' growth, exacerbating inequality in the region. Intense competition among tech firms for talent meant employees hopped jobs faster than ever.

Facebook's strategy has started to show strain over the years. Some employees bristled at the open office layouts. While the company put parks and cafes on top of its buildings, it also squeezed each employee into 150 square feet, on average, in its headquarters, the company has told real estate professionals—far less than traditional corporate standards.

To accommodate Bay Area employees who didn't want to drive or move to the suburbs, it opened large outposts in San Francisco two years ago, as well as bigger satellite offices in urban strongholds such as Seattle and New York.

Over the past year, Facebook's real estate executives have confided to developers and attorneys about the political battle scars they have incurred building acres of office space in the Bay Area.

The social network's latest Menlo Park headquarters, designed by famous architect Frank Gehry, is its most expensive campus in the world on a per-employee basis, according to a person who discussed the matter with Facebook. A second campus planned for across the street from the current site would include offices, houses and a grocery store. It has faced pushback from local residents, forcing Facebook to scale back the amount of office space by 29%, the company said earlier this week.

For years, people watching Facebook's office expansion around the Bay Area anticipated they might have to think about life after Facebook. Its growth felt fleeting to Alex McIntyre, former city manager of Facebook's Menlo Park hometown, who told *The Information* in 2016 that he wondered what would happen if Facebook one day abandoned what it had built.

"Nothing lasts forever. If we're a company town, and the company for which the town is known leaves, what are you left with?" he asked.

By Sophia Kunthara

Reporting on startups opening offices in Phoenix without crunching data on homegrown companies raising capital doesn't do Arizona justice.

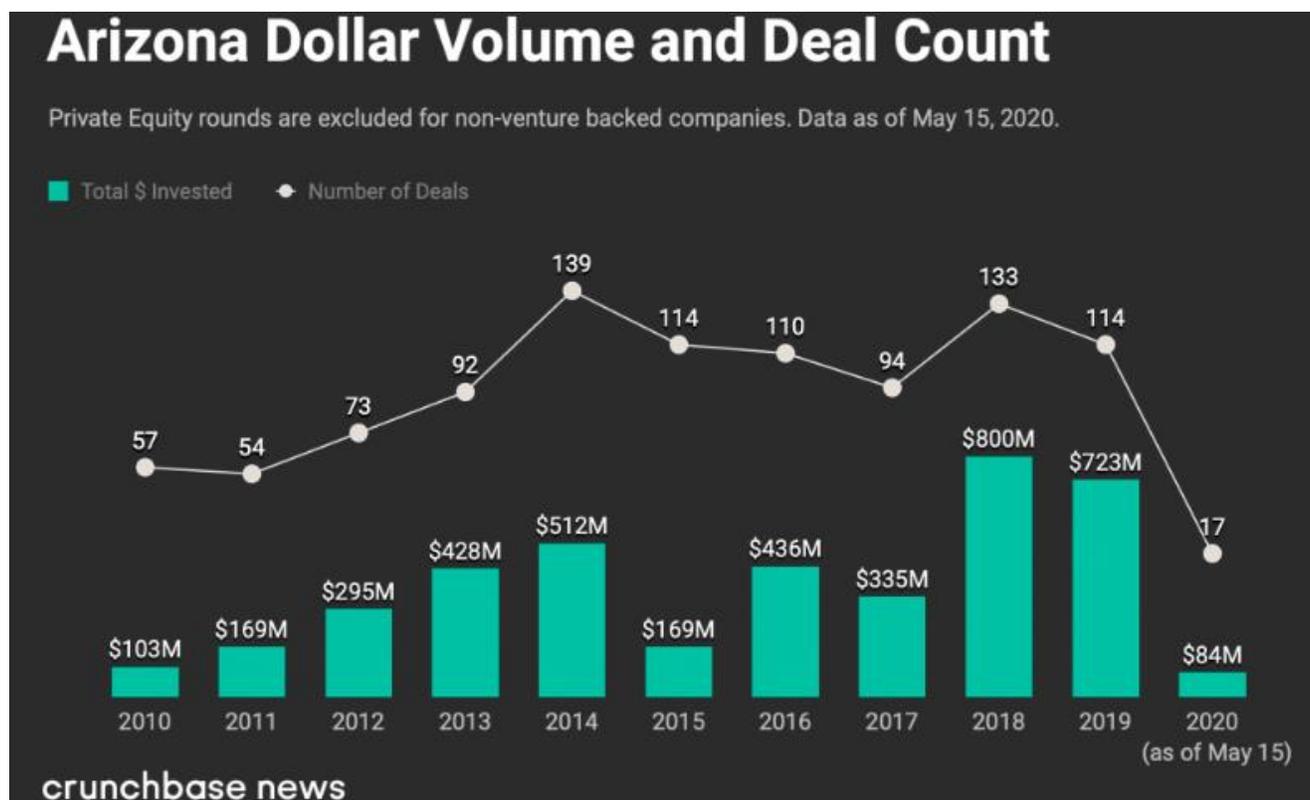
While this is often the talking point—how Arizona's tech and startup scene serves as a less expensive option for companies based elsewhere to open offices—the state's local startups are attracting more venture dollars than in years past.

For a sense of the overall funding health of companies based in the state, we looked at what these startups are raising on their own.

Let me get my bias out of the way right now and start by saying I do love Arizona. I'm a proud alumna of Arizona State University (Go Devils!) and the Phoenix metro area is where I consider to be home.

So after seeing the news of Zoom, arguably the most talked-about enterprise company right now, opening up a research and development hub in the Phoenix area, I wanted to look at the state of funding for Arizona-based startups.

In short, the past two years have set records for venture dollars going to Arizona-based startups in the past decade. According to Crunchbase data, \$800 million in venture capital across 133 deals went to startups based in Arizona in 2018, the highest dollar amount of any year for the past decade. Last year also reached a high, with \$723 million in funding across 114 deals.



So far this year, startups in the state have raised \$84 million, with the most recent round being Scottsdale-based Paradox's \$40 million Series B.

### **But why?**

Arizona's startup scene is maturing, according to C'pher Gresham, CEO of social impact startup incubator Seed Spot.

"Arizona's startup ecosystem has gotten more sophisticated in the past 10 years and there's been a dramatic increase in programs to help entrepreneurs, with Seed Spot being one of them," Gresham said.

Living and doing business in Arizona is also more practical, local advocates say. The cost of living is much lower than places like the Bay Area, New York, or Boston, it's home to the country's largest university (ASU), and Phoenix is the fifth-largest city in the United States.

Policies like the angel investment tax credit provide incentives for investors to bet on companies based in Arizona. The program, which was established by the Arizona State Legislature in 2005 and runs through fiscal year 2021, provides up to \$2.5 million in tax credits every year (plus credits that were unused in previous years, according to the Arizona Commerce Authority).

The main goal is to attract early-stage investments in Arizona companies.

And early-stage investments have been coming to the state. The majority of the deals last year were pre-seed through Series B, though there were some large late-stage rounds as well—perhaps most notably Nikola Motor Co.'s \$250 million Series D in September 2019. Nikola announced that it would be moving from Utah, where it was founded, to the Phoenix area in 2018.

### **Knowing your competition**

Venture capital investments tend to be concentrated on the coasts, mostly in the Bay Area and New York, but the greater Phoenix area isn't focusing on competing with those hubs, according to Greater Phoenix Economic Council (GPEC) CEO Chris Camacho

It wants to go head-to-head with technology markets like Denver and Austin.

Arizona (as a whole) hasn't caught up to markets like Denver and Austin when it comes to VC investments. Last year, there was more than \$1.8 billion invested in Austin-based startups, according to Crunchbase data. The city broke into the top 10 U.S. markets for VC funding last year. Denver, on the other hand, had \$877.8 million invested in 2019.

But Phoenix has a shot. Its startup scene has grown rapidly, and it has plenty of access to talent, given that ASU's Ira A. Fulton Schools of Engineering is the largest in the country, with more than 23,900 students.

In fact, U.S. News and World Report ranked the university "No. 1 in innovation" for the past five years—something ASU will never let you forget.

Part of Arizona's attraction is its "generous ecosystem" where there's plenty of access to mentorship and support, Gresham said. That combined with the quality of life, affordability and access to a large market makes the state an attractive place to put down roots.

### **From the incubator POV**

Incubator Seed Spot receives a few inquiries from investors based in places like Texas, California and New York "at least every other week," Gresham said. Investors want to know what deal flow is looking like, and Seed Spot has mostly gotten interest from seed-stage investors or firms that invest in Series A-stage companies.

As an economic developer, GPEC wants to work with the state legislature on an economic acceleration plan, with one of the main pillars being to rapidly grow ASU's engineering program and "triple down" on engineering capacity, Camacho said. The organization also wants to see more Arizona-based companies evolve through the funding stages and is creating more infrastructure to support that.

GPEC brought in around a dozen VC firms from the Bay Area to Phoenix around the time of the Waste Management Phoenix Open golf tournament. VCs met with about 30 of Arizona's leading tech companies to meet leadership teams in Arizona. Norwest Venture Partners, Altos Ventures, Founders Circle Capital and Village Global were among the firms that attended the Waste Management event.

"They were surprised [by] how much technology and capability was here," Camacho said. "And so we're going to continue to cultivate those relationships with the leading VCs so we create better engagement with our tech companies and those capital sources."

**The tech giants need to use their marketing budgets and reach to convince people to download exposure notification apps—not just enable the back-end technology.**

By Mark Sullivan

Apple and Google announced a significant new step in their collaboration to help public health authorities track and trace COVID-19 exposures using smartphones. The companies say they're ready to send out an application programming interface (API) that could let health agencies enlist the help of millions of smartphones in tracking the spread of COVID-19 from person to person.

The API will let health agency apps use the Bluetooth in iOS and Android phones to detect and remember other smartphones that they've come near, in case the owner of one of the devices later proves to have COVID-19. Then the health agency would be able to notify the device's owner that they've potentially been exposed. Apple and Google said that "a number of" U.S. states have asked for access to their API, but declined to give an exact number. The two companies held a press call Wednesday to announce the API release, and to address some of the privacy concerns about their contact tracing framework. With any tech platform that sets out to track users, privacy and security will be major concerns. While Apple and Google appear to have built in a fairly elaborate system of safeguards into the design, how long the tracking data is kept and how it's used later on is worth watching. But there's a larger, more immediate issue.

What's more pressing is whether a critical mass of people will actually use the health authority apps to make a difference in the fight against the virus. An Oxford University [study](#) found that for contact tracing programs to significantly slow the spread of disease, 60% of the population must participate (although, it said, even a 20% participation rate might yield useful insights). A *Washington Post*/University of Maryland [survey](#) found that three in five Americans probably wouldn't participate in a digital contract tracing program developed by large tech companies.

That's probably why representatives from Apple and Google spent a good amount of time on the press call emphasizing that the tech companies are merely providing an "enabling" technology, and that it's the health agencies that will be building the apps and making the decisions on when and how to contact the exposed. On one level, that's smart. The two tech companies are involved in healthcare tech, but they should default to the experts at the health agencies in epidemiological matters. They may also be aware that people are more likely to trust a public health agency to track and trace than a big tech company, especially one like Google that's in the business of harvesting personal data.

But though providing an enabling API is a significant contribution, it probably won't be enough to make contact tracing apps a helpful tool in reducing virus spread. Look at Utah: The state paid \$2.75 million for its own app, turned it on in mid-April, and so far only 45,000 of the state's 3.2 million people have downloaded it, *Buzzfeed News* [reports](#). It might help that sometime this summer, Apple and Google plan to build the contact tracing technology into their respective mobile operating systems, which is something like the Amber Alerts you can opt into or out of in iOS. This will "allow more individuals to participate . . . as well as enable interaction with a broader ecosystem of apps and government health authorities," Apple said in a [press release](#) last Month.

However, if the companies want the contact tracing apps to be successful, they will likely have to do more than enable the apps on a technical level behind the scenes.

Apple and Google have another tool at their disposal: they can leverage the vast reach and marketing power of their mobile platforms to educate people on how digital contact tracing works without location tracking or other threats to privacy, and how health officials use the contact tracing data. Education, it turns out, is a big component of this—and it may be just as important as the technology.

“Potentially problematic but probably surmountable is the amount of misunderstanding about the technology,” says Cornell University government professor Sarah Kreps, who just managed a large national [survey](#) on people’s perceptions of digital contact tracing. “Large proportions of the population are convinced that either ‘Big Tech’ or ‘Big Government’ is out to steal their data or spy on them.”

“It will be important to combine the eventual roll-out of the app with a public health campaign that educates the public about the tech features that guard against potential misuse of data,” Kreps says.

Apple and Google could play a crucial part in that campaign. Along with sending users notifications and putting ads in their respective app stores encouraging people to download their health authority’s app, the companies should use their big marketing budgets to tell the story of digital contact tracing. They should produce ads and social media content showing how public officials use the smartphone tracing data to notify people who’ve been exposed to COVID-19 cases.

Apple already likes to [tell the stories](#) of people whose lives were saved by the health features in their Apple Watch; it needs to tell similar stories about contact tracing. Both companies should provide examples of real people who were thankful to be traced before they inadvertently spread the infection to their families. And if the apps they support prove to be successful in some areas, Google and Apple should tell the stories of cities that hit their contact tracing thresholds using apps enabled by their technology and were therefore able to reopen.

Above all, the tech companies—especially Apple, which holds a certain public trust—should double down on promoting contact tracing this summer. They should not just enable it, but own it. Only then will the companies’ work get the reach and scale needed to make a real difference.

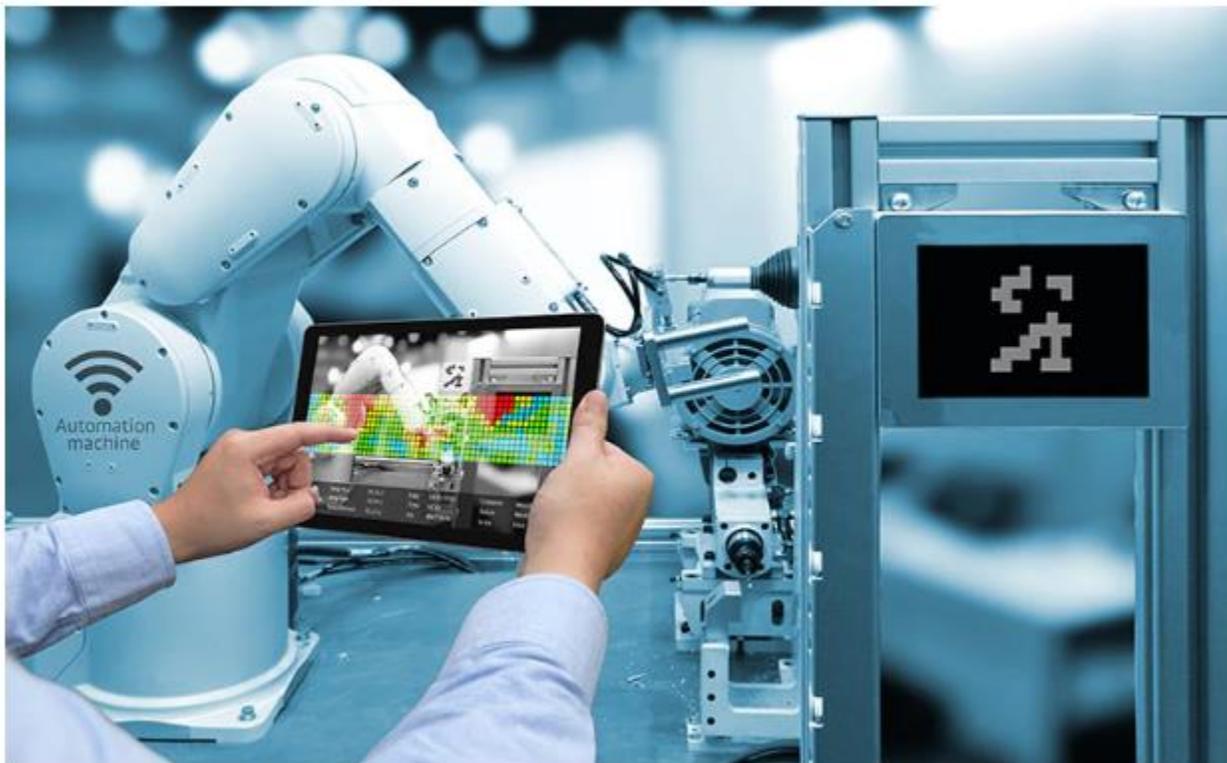
**To gain a competitive edge in today's Industry 4.0 landscape means having multiple advanced technologies work harmoniously together. A hybrid scenario involving the cloud and edge hardware might be the best solution.**

By Thomas Leyrer

The digital transformation of manufacturing, dubbed "Industry 4.0," brings together a myriad of technologies, but the competitive advantage comes from making them work in harmony.

On the factory floor, transformative technologies include new sensing, control, and communication systems. They also involve functional safety and power-management capabilities that enable people to work smarter, take on new roles, and in some cases, work in closer proximity to robots in a much more integrated manner.

We've hit the tipping point at which we're past the early adoption phase. Organizations are deploying at least some of these technologies in discrete parts of their business. The next step for those looking to further adopt Industry 4.0 technologies is to get them to work together (see figure). Accomplishing that requires an underlying foundation to unify their various intelligent capabilities.



This is an example of a factory implementing Industry 4.0 technology.

Standards and specifications are critical to this unification. Not only do they create a long-term, competitive advantage for manufacturers by making systems interoperable and more efficient, but they also enable iterative learning. Connected, distributed devices can feed artificial intelligence (AI) and machine learning to evolve and optimize manufacturing operations.

### **Communication Enables Control**

Technologies that keep the manufacturing floor humming fall into five broad categories: communication, sensing, control, safety, and power. These categories aren't necessarily new, but Industry 4.0 proposes a scenario of seamless communication that harnesses innovations in each discrete area.

It should come as no surprise that functional safety and power management are critical considerations in a manufacturing environment. Keeping workers safe and conserving power are two of the most pressing priorities—when implemented successfully, they offer a competitive advantage. Power management is also tied to environmental control, making sure that temperatures and climates are conducive to specific types of manufacturing. Meanwhile, industrial communication, sensing, and control all enable people to work safely and more effectively while being mindful of power consumption.

Even with technological advances, industrial communication remains the most fundamental technology, because it enables a single control unit to manage multiple inputs and outputs (I/Os) through a network. The networked control architecture in a factory includes applications such as motor control, motion control, robotics, and classical programmable logic control (PLC).

A PLC provides a whole range of status information, including measurements, temperature, and position. A modern-day example of a PLC in action is a robot gripper picking up or modifying something on a conveyor. Robotic control is a special version of motor control that governs a multi-axis robot arm with its own ecosystem of sensing. Machine vision is used to position the robot arm, and combined with functional safety, enables operators to monitor the environment and ensure safe operation for people working near robots.

Such a level of safety and precision requires both communications and processing power. For example, [Texas Instruments' \(TI\) SitaraAM6x processor family](#), with Arm Cortex-A53 and Cortex-R5F cores, enables gigabit industrial Ethernet networks and includes safety diagnostic libraries. Sitara processors help enable functional safety systems and support the intelligence that helps dynamically control and optimize production in a smart factory, while also being energy-efficient.

Sitara processors are part of a system with a broader set of interactions that aren't possible unless various control systems can talk to each other. Before specifications like time-sensitive networking (TSN) and IO-Link, I/Os traversed separate analog paths. Different control systems acted as their own isolated islands of activity.

TSN is a set of standards that fall under three main component categories necessary for complete real-time communication:

- Time synchronization
- Scheduling and traffic shaping
- Selection of communication paths, path reservations, and fault tolerance

Traffic shaping is related to Ethernet packets in a network with different priority. Some packets get higher priority (real-time) compared to other packets (non-real time). Depending on the application, priority can be determined by type of packet, arrival time of packet, or bandwidth of a packet. Traffic shaping is sometimes compared with road traffic HOV lanes—a fast path crossing an intersection.

TSN is aptly named in that it understands all devices on the network must be in sync, whether it's a PLC or a robot. Furthermore, every device follows the same rules for processing and forwarding communication packets, with redundancy to guarantee fault tolerance.

[International Electrotechnical Commission 61131-9T](#) establishes the bidirectional, digital, point-to-point IO-Link industrial communications networking standard. IO-Link connects digital sensors and actuators to either a type of

industrial fieldbus or a type of industrial Ethernet, wired or wirelessly, over short distances and sometimes in less-than-ideal conditions.

For example, TI's [DP83867 physical-layer transceiver](#) meets the time-synchronization needs of Industry 4.0. However, it's also designed to facilitate implementation of 10-/100-/1,000-Mb/s Ethernet local-area networks in harsh environments by interfacing directly to twisted-pair media through an external transformer.

Together with TSN, IO-Link supports the use of sensors and actuators that can produce and consume enriched data sets in real time—necessary for the intelligence to optimize manufacturing and support digital transformation.

### **Unified Comms is the Backbone of Industry 4.0**

Unified systems communication through TSN and IO-Link has digitized production systems in the field in real time, realizing many different Industry 4.0 capabilities.

It goes beyond just being able to do more, and do it faster, at one assembly station, or even linking the control systems of those stations together. Unified communication also improves machine availability because it supports predictive maintenance. Not only can you run multiple control systems, including PLC, motion control, and machine vision, over a single TSN backbone, but you can service those systems and diagnose any issues from a central point.

The various parts now speak the same language, rather than having separate systems with separate communications protocols.

Plus, real-time data exchange enables comparability or compatibility between various areas of production. Data moves fluidly from a robot control to a PLC controller to a machine tool, thus increasing the overall efficiency of the production system.

Furthermore, Industry 4.0 offers full transparency because it feeds production data into enterprise-resource-planning (ERP) systems. And although an ERP system doesn't directly control how quickly a product is made on the floor, the existence of more business intelligence enables manufacturers to make smarter decisions, with data to inform manufacturing performance and how it may impact costs and profitability.

### **Deciding Where the Data Goes**

Data science also plays a big role in Industry 4.0. By getting control systems to talk to each other, organizations have more information to work with to make smarter decisions—optimizing manufacturing in alignment with business objectives. Because every device and every I/O produces data, it's now possible to know almost immediately if a system requires maintenance to prevent disruptions.

The integration of control systems through a common communications protocol is also changing how people and machines work on the factory floor. Although advanced robotics are taking over some tasks once performed by people, data scientists are becoming more involved with the manufacturing process, and other workers can collaborate in closer proximity to robots.

The enormous amount of data available can sometimes exceed the bandwidth available to ship to a central point for processing. Having a holistic view through cloud-based business applications is one of the hallmarks of Industry 4.0, but that doesn't mean that every piece of information sails into the cloud—real-time communication primarily exists only on the production floor. Even over the long term, it doesn't make sense to ship all data to a central point.

Rather, the goal is to add more intelligence to devices inside the production environment. The data generated inside motor applications is at an even higher data rate and requires local pre-processing and sometimes even local analytics inside the motor controller. Not all data goes to the cloud.

## **Conclusion**

Ultimately, Industry 4.0 has three potential scenarios. One is that everything is sent to the cloud because the bandwidth is available. Another is the extreme opposite, wherein everything is processed and decisions are made at the edge, because the deluge of data is so great that it can't be sent to the cloud.

The third—and most likely the best option—is a hybrid solution: a combination of pre-processing capabilities embedded in the edge hardware that send compressed data to the cloud for decision-making through standardized communications. This scenario best supports distributed machine learning and practical use of AI on the manufacturing floor, while also benefitting the supply chain.

By Nathan Eddy

**The COVID-19 pandemic has had many disastrous effects on the automotive industry with forced carmakers closing plants, public transport laying idle and ride-sharing services like Uber and Lyft seeing trade halved.**

The silver lining in all of this could be a renewed focus on the benefits of mobility as a service (MaaS) and open up new markets for providers of the service, as well as lead to new partnerships between automakers, governments and mobility start-ups. Beyond the overarching transportation vertical, Matt Arcaro, a research manager on IDC's IoT and mobility team, sees three other areas where MaaS in a post-corona world shows promise.

Those include the restaurant/food/beverage industry, retail and grocery applications, and lastly the government sector. "In the future, the old model of filling your restaurant space with as many seats as possible may not fly and so MaaS could provide a way to reach additional customers," Arcaro said. "Older demographics are delving into other delivery services – people are now by necessity trying it and it is pretty seamless, so I think that's an easy win."

For government services, particularly in regards to the movement of under served or vulnerable populations, Arcaro said he sees a sort of "Renaissance" in regards to government thinking about what MaaS could add as part of their toolkit. "There are some unique opportunities to work together with providers of e-scooters or e-bikes, instead of just starting another bus route, and be able to scale those services and readjust the mix as necessary," he said. "That also raises issues of revenue and profit, as well as the need for financial backing from city governments."

He said in the future, MaaS providers will have to look at new types of revenue models that have a multi-pronged model, which can support the ebbs and flows of society. "It may be not looking at rides and trips but focusing more on utilization and finding ways to keep your assets occupied and engaged during whatever the situation is," he said. "Food delivery and other models, which were maybe seen as a side hustle for some of these bigger companies, are now becoming a primary model for building a new business approach."

### **Personalized services**

Piia Karjalainen, secretary general of the MaaS Alliance in Brussels, explained MaaS is a useful tool to provide more personalized services, which the crisis has shown is important for people who have to avoid public transportation because of a risk of infection. "In this case MaaS, including various options, may be of use," she said. "In the future there might be different travel habits depending for example on external crises, and that already creates a greater opportunity for MaaS, where you are not bound to use one service every day but you have multiple choice in what you can use based on the different circumstances."

Karjalainen also pointed out approaches to MaaS may vary from region to region and, while she expects to see an evolution of mobility services in Japan, North America, and Australia, she believes Europe will be the MaaS leader for the next few years. While the focus is likely to be on urban areas, it depends less on the overall size of the population and more on the capabilities of local governments to pull together the required actors needed to formulate strategies that tie together disparate modes of transportation. Karjalainen noted Helsinki and Antwerp as two examples.

"There needs to be a high-quality mass transit system and good pool of shared mobility options, and the openness of data and service integration is an essential component," she said. "There are lots of opportunities in a range of geographies, but I see the focus on urban areas for the next couple of years."

### **New business models**

When it comes to the use of autonomous vehicle technology and ADAS, Karjalainen said the lack of concrete development timetables makes the implementation of such technologies in MaaS difficult to assess. However, she sees promise in automation providing the opportunity to develop new business models and new entities like professional fleet managers that may be linked to carmakers or other players in the automotive value chain of the auto industry.

“That could be the new way to distribute access to MaaS vehicles in the future,” she said. “The services must be designed in a way to be in a place where people are. We need to make sure automated fleets are serving public transportation hubs and that they can be easily integrated to other services.”

Sam Ryan, co-founder and CEO of UK MaaS provider Zeelo, who works primarily with providing transport for schools, large companies and to and from events, said the pandemic has turned his business upside down but that new opportunities have also arisen. “What we saw very quickly was a need in the market for managed, safe transportation. There’s the current lockdown period where you still have a need for critical workers, who still need to get to work,” he explained. “We quickly pivoted to providing safe bus transport for distribution centers and healthcare workers, using our technology to enforce no-contact policies, enhanced sanitization and driver PPE.”

He also noted MaaS software can help provide vital data regarding occupancy management and the monitoring and governance to ensure vehicles are sanitized correctly. “We also shouldn’t underestimate the power of MaaS apps and platforms,” Ryan said. “They can provide the data of how people are moving, which can help identify what potential pinch points are, and help us compliment and augment our public transport systems so that they don’t become overcrowded.”

By Nitin Dahad

Verizon has announced two partnerships for 5G, one involving Movandi for amplifying millimeter wave coverage in public spaces and buildings, and another involving Movandi, NXP Semiconductors and Qualcomm Technologies to develop 5G chipsets for customer equipment.

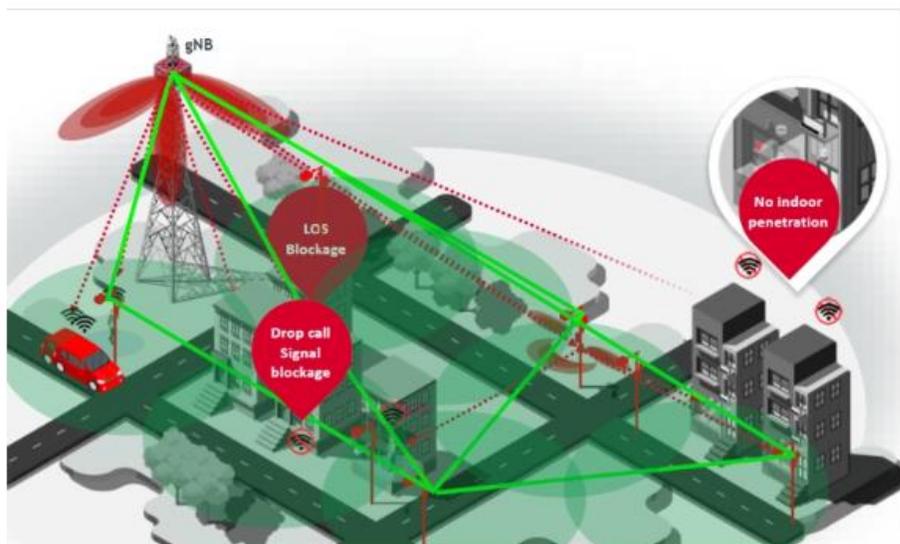
The news was part of multiple 5G announcements from Verizon. On the consumer front, Verizon said it will be launching 5G service in parts of San Diego on 28 May; the company said 5G consumers will get upload speeds 30% faster than 4G. On the development side, it said it has adapted its seven 5G labs in the US and UK, designed as incubators for the 5G technologies, to make them operate virtually.

On the chip partnerships, the first involves Movandi Corp., Pivotal Commware, and Wistron NeWeb Corp. (WNC) to provide extender technology to amplify millimeter wave coverage in public spaces and buildings. Movandi is an Irvine, CA, startup co-founded in 2016 by brother and sister team Maryam and Reza Rofougaran, who were involved in building the wireless business at Broadcom and claim to have pioneered the development of RF CMOS across cellular, microwave backhaul, Wi-Fi, Bluetooth, GPS/GNSS, NFC, femto cell, and other standards including the integration of multiple standards into a single chip.

We asked co-CEO and cofounder Maryam Rofougaran about this announcement. She told us, “While modules will actually be shipped by WNC using our technology, we have been working closely with Verizon for a couple of years on developing the solution. Our chip sets are qualified and use our own technology.”

The company calls its technology BeamXR. BeamXR addresses the issue of 5G coverage limitations caused by the propagation characteristics of radio signals at millimeter wave frequency bands. Millimeter waves are unable to penetrate physical barriers, including buildings and trees. That makes it hard to provide effective indoor coverage as well. The inability to go through objects means 5G requires line-of-sight, or strong indirect beam. With the BeamXR active router, millimeter wave signals can be boosted to penetrate buildings or bend the signal around a building. It essentially distributes a 5G signal more effectively, enabling greater coverage while supporting low latency in hard-to-reach places.

Rofougaran told us, “We are addressing the propagation challenge which helps accelerate large-scale 5G commercialization by reducing infrastructure costs, simplifying deployment and increasing network capacity without impacting latency.” She also said that sub-6GHz capacity will fail to



*5G requires line of sight or strong indirect beam, which means it is unable to penetrate buildings or provide effective indoor coverage. Movandi's BeamXR active router boosts millimeter wave signals by penetrating buildings or bending the signal around a building. (Image: Movandi)*

meet customer demand by 2023, and with operators needing to go to millimeter wave to meet the capacity requirements, Movandi's 5G enhancer will enable cost-effective capacity and coverage.

Movandi's other products include its BeamX RF front-end for fixed wireless CPE, mobile devices, small cells, and open radio access networks (ORAN) radio units. These products target deployments across the complete 5G ecosystem from consumer and enterprise markets, to IoT, mobile, artificial intelligence (AI), software defined networks and automotive.

Separately, Movandi raised \$27 million in funding last month, in a round led by WRVI Capital, along with Cota Capital and DNX Ventures. That latest investment brings its funding total to \$67 million.

#### **Chipset partnership for home equipment**

In its other partnership announcement, Verizon said it also partnering with Movandi, NXP and Qualcomm Technologies to develop the latest chipset technology to enhance experiences and expand coverage for its 5G home customers. We contacted NXP for comment but were unable to obtain a response at the time of writing.

Provided by Michal Maly and Andrea Pufflerova @ Photoneo (\* Chambiz DF 10 Aug 2019)



Thanks to advances in technologies such as 3D machine vision, robotics is entering all spheres of industrial processes. The COVID-19 outbreak has boosted awareness of the pressing need to apply automation for fast and accurate order fulfillment and efficient supply chains. One specific aspect of logistics processes can achieve higher levels of productivity with the implementation of smart automation — depalletization.

### **What is depalletization?**

Depalletization is the process of unloading pallets laden with boxes one by one. In contrast to the classic delayerization, in which the robot gripper picks the whole pallet, “hoping” it grabbed all the boxes it contains, robotic depalletization uses artificial intelligence. The system recognizes individual boxes and the robot places them one by one on a conveyor belt or other predefined place.

Depalletization presents a higher level of unloading pallets and offers several advantages over delayerization. It requires a smaller placement area — the size of the largest box in contrast to the whole pallet. And thanks to a lighter payload, a smaller robot arm and gripper can be used, which leads to considerable cost savings.

### **3D vision and AI the secrets to success**

The best depalletization systems can make the process of unloading pallets full of various boxes safe, fast, effective, reliable, and in the end also cost-efficient. This can only be achieved by combining 3D machine vision with smart robots enabled by advanced machine learning algorithms.

The scanning volume of the deployed 3D scanner needs to be large enough to scan the whole pallet from sufficient distance. Taking into consideration the minimum space required for robotic manipulation, the scanner generally

needs to be mounted approximately 3 meters above the pallet. Choosing the right 3D scanner is, therefore, the first prerequisite for successful depalletization.

The second step is training AI with this image data. Machine learning algorithms can constantly learn and recognize new types of boxes, including those of different sizes or irregular shapes caused by damage, for instance. This makes the solutions so universal that unloading of mixed pallets poses little challenge. The boxes do not need to be stacked in patterns but can be placed randomly, even tilted at an angle, and the robot is still able to pick them.

Smart systems are also able to recognize boxes that are often so tightly packed that it is difficult to recognize the gap between them, which can be as thin as 0,5 millimeters. Weaker solutions might not be able to differentiate the line separating two boxes from a line contouring the opening of one particular box.

In other cases, it may be challenging to recognize boxes with problematic surfaces, including varying textures, shiny or reflecting material, protruding tapes, patterns, or pictures that “mislead” the 3D vision. Cartons with black covering can also cause problems..

The most advanced way to segment the individual boxes on the basis of texture and 3D data is to use a convolutional neural network (CNN). The system can then decide which box to pick — boxes placed on the very top of the pallet come first — and how to grab it to maximize the suction power of the deployed gripper.

To manipulate safely in the space between the top boxes and the scanner, the depalletization system needs to take into account the possible size of the box. This is also important for safe placement of the box on a conveyor belt. That can either be ensured by calculating the height of the box from the scan data or by using an optical gate set to a few centimeters above the conveyor belt.

When the box touches the optical beam, the gripper drops it. This way, all boxes get dropped off in the same height above the conveyor belt. This is a big advantage of depalletization over delayerization, in which boxes of different heights in one layer pose a significant problem.

### **The robot can do the whole job**

Photoneo’s systems, which include 3D vision developed in house, provide an example of such robotic depalletization. The company’s system scans an entire pallet loaded with boxes and transfers the scan to a 3D-texture data set.

This scan is then processed by Photoneo’s machine learning algorithm trained on more than 5,000 types of boxes. AI immediately recognizes each box and sends a command to the robot. Using a specially developed universal gripper, the robot performs the picking action with an accuracy of +3 mm. This way, it is able to unload 1,000 boxes in our hour, with 99.7% pick-rate accuracy.

If, despite all calculations, the gripper fails to pick a box due to a crinkled surface or some other obstacle, the gripper sends feedback and informs the user about the problem so that corrective action can be performed. The cycle time is typically less than 10 seconds, depending on the robot type, the surface of the boxes, and their contents, as some need to be manipulated with greater sensitivity than others.

The environment, robot, and mechanical properties define and limit the cycle time. For example, it would be impossible to accelerate and decelerate a heavy box above a certain physical limit. In case customers need to speed up the cycle time and boost the robot performance, they can opt for a multi-zone gripper that is able to pick several boxes of the same height at a time. The gripper then drops the boxes one after another.

The secret behind perfect singulation is to know the size limits of the placement area so as not to take more boxes than can safely be dropped off, and also to precisely recognize the box type to avoid grabbing boxes with different

heights. Photoneo's product is compatible with major robot brands and works "out of the box" without any training. If it comes across new types of boxes, the system is able to retrain itself, which shortens the time needed for deployment and integration.

### **Adapting depalletization to a human-centric environment**

A successful depalletization solution must take into account all the factors discussed above. Even though the robots may seem rather simple, the machine learning algorithms need to be robust enough to handle all the possible challenges of depalletizing different objects. Developers and integrators have to think about every detail of the application and test their solutions before users can measure return on investment (ROI).

In addition, it is often necessary to adapt the robot to a human-centric environment. Although automation is evolving quickly, many customers are only gradually adapting their distribution centers and warehouses to take full advantage of robotics and AI.

One of the major challenges related to manual unloading of pallets resides in the size and weight of the boxes as well as the height from which they need to be taken. Manual operations often lead to serious injuries, so the best depalletization systems help associates avoid risky or repetitive motions.

For instance, the Photoneo Depalletizer can pick boxes of up to 50 kg without human intervention. One of the greatest advantages is that the robot can work non-stop, without ever getting tired.



*Depalletizer using 3D vision, AI, and a robotic arm. Source: Photoneo*

### **AI = unlimited potential?**

AI-driven solutions are undoubtedly the way to the future because users do not need to design, debug, or test anything. Smart systems can relieve integrators of the burdens of difficult 3D-related calculations and tasks.

What they should have, however, is some basic mechanical knowledge, including how the different types of grippers work, which ones are suitable for picking a particular part, and how to distribute all mechanical components deployed in an application to prevent failures of the robotic manipulation or scanning.

Integrators should also know the potential capacities of a particular system to be able to match it with the specific needs of a customer. It is important to bear in mind that AI is still only a part of the solution and should not be overestimated. Integrators will always need certain specific knowledge to successfully deploy a smart automation solution.

If all these conditions are met, the deployment of depalletization robots can help logistics companies obtain a fast ROI, improve their supply chain processes, and increase their productivity. They can also save time, reduce costs, and protect worker health, freeing employees for tasks that require creativity and critical thinking.

The most pressing challenge facing both employees and employers today is how to keep working. Because no one can predict with any confidence when the global economy will recover from COVID-19 shutdowns, now is the right time to automate and streamline production processes.

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*Michal Maly is director of AI at [Photoneo s.r.o.](#), and Andrea Pufflerova is public relations specialist at the company. Bratislava, Slovakia-based Photoneo was founded in 2013 and provides AI-powered robotic intelligence and industrial 3D vision. Based on patented technology, the company has developed high-resolution and high-accuracy 3D cameras. In combination with the robust machine learning software, Photoneo said it helps companies in the automotive, logistics, e-commerce, food, and medical industries improve the performance and efficiency of their manufacturing, fulfillment, and assembly processes.*