CB DIGEST FOR TECHNOLOGY

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Netflix and Warners Shut Down Production
Several major studios, including Warner Bros., Universal and Netflix are halting nearly all production on TV shows and movies for at least two weeks to comply with government restrictions, according to the Hollywood Reporter. The move seemed inevitable as governments around the world limit the number of people that are gathered into one space to slow the spread of the coronavirus. While some aspects of the entertainment industry can be done remotely, like dealmaking, development or writing, on-location production requires a huge groups of people, often in a confined space.

This move will affect local communities, which often see an economic boon from having production in the area. But it also will slow down the flow of new content. That could be an issue for streaming services, especially WarnerMedia's HBOMax and Netflix, which are counting on a huge volume of shows to attract subscribers. Because of the long lead time from production to release, it will take some time for the effects to be felt. But a few months from now, programming slates could look a little thin.

Another Veteran Amazon Executive Departs
Another day, another departure of a senior Amazon executive. Maria Renz, who once served as Amazon CEO Jeff Bezos's shadow and pushed the company to speed up Prime deliveries to one day, is leaving the company and joining SoFi, according to The Wall Street Journal. She was one of the most high profile female executives at the e-commerce giant. For more on her career there, read the interview with her that we published last month.

Renz, who spent 20 years at Amazon, is the latest in a string of high-profile departures from Amazon. Jeff Blackburn, a longtime lieutenant of Bezos, is on a yearlong sabbatical but appears unlikely to return to the company, at least not in his previous role, in which he oversaw corporate development, a growing advertising business and video. Steve Kessel, who ran Amazon's physical stores initiative, also said last fall that he would leave the company in early 2020.

The brain drain is a big deal. Amazon was long known for its ability to hold onto a core group of senior leaders who helped Bezos shape the company over decades, particularly as it diversified beyond its first core business of online retail. Now it will have to rely on new blood.

U.K. Imposes Digital Services Tax
The British government said it will start implementing a digital services tax of 2% on April 1, affecting U.S. social media platforms, search engines and online marketplaces, as the U.S. pushes forward with negotiations on the international level to decide on a uniform global deal on digital taxes.

The U.K. standing on its own to impose a digital tax drew the ire of tech industry trade groups and U.S. lawmakers, who have called the tax discriminatory and unfair, and an attempt to make money off of successful U.S. companies. But companies won't have to start making payments until 2021, POLITICO reports, meaning there is time yet for the U.K. to join an international deal. France was also set to start its own digital tax regime until it agreed to wait for global negotiations.

Meanwhile, U.S. states are trying to pass their own digital service taxes on online advertising and other services.

HPE debuts 5G Core Stack to deliver containerized software for 5G networks
Hewlett Packard Enterprise Co. today pulled back the curtains on 5G Core Stack, a suite of containerized software modules that wireless carriers can use to power their next-generation 5G networks. The offering is one of several new networking solutions that HPE announced today. The company also unveiled a budget-friendly billing model for

its carrier products, while subsidiary Aruba debuted a pair of services designed to improve connectivity on corporate Wi-Fi networks.

HPE is looking to capture a bigger slice of the billions of dollars carriers are spending annually to roll out 5G. With the 5G Core Stack, the company is promising to ease the development of next-generation networks by providing the necessary software building blocks in a prepackaged form. The bundle includes network functions from HPE and partners that run inside software containers, tools for automating infrastructure administration and a shared data environment to help manage important information.

Omnivision Nyxel-2 Technology Extends NIR QE to 50% @ 940nm and 70% @ 850nm
PRNewswire: OmniVision announced Nyxel 2 — the second generation of its NIR technology. Despite launching the first generation more than two years ago, competing mass-produced CMOS image sensors are said to be still failing to achieve comparable NIR performance. Meanwhile, OmniVision's R&D team has continued to refine its pixel architectures and processes to achieve new records in QE, with Nyxel 2 now providing a 25% improvement in the 940nm NIR light spectrum and a 17% bump at 850nm wavelength.

Top five big tech firms lost over $320 billion of value in Monday's market crash amid coronavirus and oil slump; Apple plunged 7.9%. Amid the worst day for U.S. stocks since the 2008 financial crisis, the five most valuable tech companies lost $321.6 billion in value, with Apple accounting for almost one-third of that sum. Shares of the iPhone maker plunged 7.9%. Microsoft, Facebook and Alphabet each lost more than 6% and Amazon fell 5.3%. They had been among the biggest contributors to the market's extended rally that lifted the S&P 500 to a record just last month, and now their declines are having an outsized impact on the broader index.

Robotics Startup Vicarious Launches After 10 Years
Vicarious, a 10-year-old robotics company backed by Elon Musk, Jeff Bezos and Mark Zuckerberg, has launched its first commercial service, in which it rents robots to companies like Sephora, which uses them to sort cosmetics into boxes, Wired reported. The launch represents a departure from existing warehouse robots that use deep learning, a form of AI that has yielded breakthroughs in image recognition and self-driving cars. Vicarious has built its own AI software and claims that it lets robots perform a wider range of tasks than deep learning-based robots can handle, while also learning on the fly.

This also illustrates a coming shift toward AI software that is more aware of the context in which it operates, and is capable of handling situations for which it isn't explicitly programmed. If Vicarious follows through on its plan, the startup could raise its profile significantly.

Video Company Claims Quibi Stole Its Video Tech
A month before launch, Quibi is wrapped up in a legal dispute about its video technology. New York-based Eko has sent legal notices to Quibi that it has a patent on the Turnstyle tech—a feature that Quibi uses to let people watch videos seamlessly in vertical and horizontal mode. The Wall Street Journal first broke news of the dispute.

As Eko sees it, it first patented the technology in 2015. A few years later the company was in discussions with Snap engineers about the possibility of the company licensing the technology. While that never materialized, several Snap engineers have gone over to Quibi and lifted Eko's technology and incorporated into Quibi. For its part, Quibi is saying that it was working on Turnstyle tech before it hired the Snap employees and has received its own patent for the tech. It has filed a suit asking for a judgment saying it was clear of any patent infringement.

Most likely this will get messier before it clear up—although it's too soon to tell whether it will actually get to a point where these two sides appear in court. For Quibi's sake, it better hope this matter doesn't provide a major distraction (or financial drain) as it focuses on its coming launch.

Facebook Adds Two New Board Members

Facebook has added two more board members, ending a period of unusually high turnover for the social network's group of directors.

The new appointments are Nancy Killefer, a former partner at McKinsey and ex-CFO for the U.S. Treasury, and Tracey T. Travis, the CFO of Estée Lauder. Both are filling board positions lost through a string of departures last year that included Susan Desmond-Hellmann, Reed Hastings and Erskine Bowles. Dropbox CEO Drew Houston, a close friend of Facebook CEO Mark Zuckerberg, was recently added to the board as well. Since Zuckerberg is Facebook's controlling shareholder, he still has final say over all company decision-making and board changes. The addition of Killefer and Travis brings needed diversity to Facebook's board, which had no women or people of color when the company went public in 2012. Now four out of its 10 board members are women and two are black.

Shopify is giving employees a $1,000 stipend to buy supplies while they work from home during coronavirus pandemic. Shopify is offering workers a $1,000 stipend to purchase any necessary office supplies and ease the transition to remote work. Shopify spokeswoman Sheryl So said employees can use the money to purchase office equipment such as lamps, office chairs and a new desk, then submit the "one-time remote allowance through their expenses." The announcement came as Shopify told its employees to work from home starting March 16, in light of the coronavirus outbreak. Several tech companies including Twitter, Google and Amazon have told employees to work remotely this month.

Google Pauses In-Person Social Networking Experiment Over Health Concerns
Shoelace, Google's experimental social app meant to bring people together in-real-life, has suspended operations indefinitely due to the coronavirus outbreak, according to notice sent to users on Wednesday (March 11, 2020).

Google's in-house incubator, Area 120, launched the social networking app last July as an invite-only test in New York City. Shoelace allowed users to organize in-person events and helped them discover other local activities.

The Shoelace team said in its notice to users "in consideration of general public health and safety, we decided to pause operations" and they would "be in touch" when new events within the app resume.

A Google spokesperson did not immediately confirm whether Shoelace has expanded to cities outside of New York. Still, the user base for the app is likely very limited.

And although circumstances with the coronavirus are unique, Google's rocky history with building its own social networks is hard to ignore. Most recently, last April, the company shut down its biggest social networking effort yet, Google+, amid decreased usage and data privacy issues.

RF Semiconductor Market to Grow to $26.2 Billion by 2025 at 8.5% CAGR
According to a new market research report published by MarketsandMarkets, the global RF semiconductor market size is expected to grow from USD 17.4 billion in 2020 to USD 26.2 billion by 2025, at a CAGR of 8.5%. The growing penetration of LTE and advanced technologies has resulted in the increased demand for RF semiconductors. Other drivers for the RF semiconductor industry growth include the increasing demand for RF devices for smartphones and the growing importance of advanced RF devices in radar and electronic warfare systems.

Version One Ventures launches $18M 'Opportunity Fund' to double down on its portfolio companies. Version One Ventures just launched the "Version One Opportunity Fund," an $18 million ($25 million CAD) investment vehicle that lets the firm continue backing existing portfolio companies.

"While raising a new fund is never an achievement per se (returning the fund profitably is!), I am very excited about our new Opportunity Fund as it gives us the chance to have an even closer and longer relationship with some of our portfolio entrepreneurs and partnering with them to build category-leading companies," Boris Wertz, partner at Version One Ventures, wrote in a blog post.

Wertz told GeekWire that Version One will make 5-to-7 investments out of the new fund. Version One typically writes checks between $500,000 to $750,000 for early-stage startups. It focuses on four geographies — Vancouver, B.C., Silicon Valley, Toronto/Waterloo, and Seattle — and announced a $45 million fund, its third, in 2018. The firm has backed Seattle startups such as Outreach, Julep, Front Desk, Yapta, Dwellable, and Booster Fuels, which relocated to the Bay Area.

TFLiving raises $4.8 million in seed funding to accelerate expansion. TFLiving, South Carolina-based tech-enabled platform providing fitness and amenities services to residential and commercial communities, has closed a $4.8 million series seed funding round led by Camber Creek with participation by Courtside Ventures and other strategic investors. The funding proceeds will be used to support and scale Master Service Agreements TFLiving has inked with a number of major U.S. residential and commercial real estate owners, as well as adding to the company's executive staff. Founded in 2016, TFLiving's platform serves more than 100,000 units of apartment and condominium developments and active adult communities, as well as millions of square feet of office buildings and other venues in 28 states across the U.S.

London-based PropTech startup Goodlord raises $13M Series B funding to create world's best renting experience. Goodlord, a London, UK-based property technology startup has raised $13 million (£10 million) Series B to make renting simple and transparent for everyone involved by using its mobile-friendly technology to streamline the lettings process for agents, landlords and tenants. Backers for this round include Latitude Ventures, the Series B+ sister fund to LocalGlobe known for backing scaling European success stories such as Transferwise, Zoopla, Monzo, TravelPerk, and SecretEscapes. Founded in 2014 by Philip Mundy, Richard White, and Tom Mundy, Goodlord's cloud-based software digitizes tenancy creation and progression, allowing Goodlord to cut pointless, time-consuming administration for agents while transforming the tenant and landlord experience.

Seattle-based SaaS startup Banzai scores $7M Series A funding to simplify event marketing. Banzai, a Seattle, Washington-based cloud software-as-a-service provider of Event Marketing Automation solutions for enterprise marketers, today announced that it has raised $7 million to double its headcount and to expand its product and service offerings in the Event Marketing Automation category. The round, which was in the form of equity financing, was led by DNX Ventures, with participation from Vulcan Capital, the multi-billion-dollar investment arm of Vulcan Inc. Founded in 2015 by Alexey Melnichenko, Andy Linteau, Joe Davy, Banzai is a cloud software-as-a-service company that provides Event Marketing Automation software used by companies like Microsoft, Google, and Oracle. Banzai connects people to life-changing experiences. Its suite of Event Marketing Automation solutions maximize audience reach, simplify event invitations, increase the quality of registrations, and prove ROI for field marketers through a single platform.

Fintech startup QRails closes $8M Series A funding to enable innovative payment solutions for financial services companies. QRails, a Denver, Colorado fintech startup that is focused on solving problems for prepaid, debit and credit card issuers with integrated payment processing and program management, has closed $8 million Series A

funding round to accelerate growth. The round, which brings total funds raised to date by QRails to $18 million, was led by EFM Asset Management. The announcement comes as QRails, in partnership with payroll service providers, is about to launch a novel earned wage access solution in North America, Europe and Australia. Founded in 2016 by Gerard Griffin and Laurence Molke, QRails enables payroll service providers, fintechs, banks, insurance companies, and other financial services businesses in North America, Europe and, as of summer 2020, Australia, to deploy innovative payment solutions

DeepCrawl bags $19M Series B funding to help brands accelerate growth and mitigate losses in organic search performance. DeepCrawl, a comprehensive website crawler that helps clients with a complete overview of their websites' technical health, announced it has raised $19 million in a Series B funding round to invest in R&D, sales and drive greater market penetration in the U.S.. The round was led by Five Elms, a growth equity and venture capital firm focused on B2B software companies, with participation from Beringea. To date, DeepCrawl has raised $25.8 million through angel investments from Beaumont Capital and Series A funding led by Beringea. DeepCrawl is used by 54% of enterprise brands as well as all six major global agency networks to monitor and improve site performance across digital properties. DeepCrawl's portfolio of customers includes IKEA, Shopify, Publicis, GroupM, Nestle and Intercontinental Hotels and Resorts.

Zeto Raises $7.3 Million Series A Funding to Accelerate Commercialization Efforts of its Easy Use Electroencephalography (EEG) Headset and Software Platform. Zeto, a medical technology startup company, today (March 10, 2020) announced that it has raised $7.3 million in Series A financing led by Seraph Group and joined by Aphelion Capital, SV Tech Ventures and Shangbay Capital. Zeto raised $4 million previously in dilutive and non-dilutive funding. The new capital will be used to accelerate commercialization of its lead product, the zEEG headset and software platform, and develop new products to expand its portfolio. zEEG is the first true dry electrode EEG headset to be approved by the U.S. Food and Drug Administration (FDA) for clinical use.

Monograph, developer of project and cost management software for architects, raises $1.9 million. Monograph, a startup working on cloud-based software that makes project and cost management easier for architects, announced today that it has raised $1.9 million in seed funding. The round was led by Homebrew Ventures and Parade Ventures, with participation from Designer Fund, Hustle VC and angel investors.

The San Francisco-based startup was founded last year by Robert Yuen, Alex Dixon and Moe Amaya. Each has experience in architecture, design and software development, making them well-positioned to create a management platform tailored for architects.

London-based FinTech platform Purely Capital launches with $150M in funding to revolutionize payments for the entertainment industry. Purely Capital, a London, England-based tech startup today announced the launch of its entertainment FinTech receivables platform backed by a $150 million institutional funding line, Finch Capital. The platform meets the growing need of rights owners, producers and distributors to bridge the funding gap that is created by long-dated payments when content is licensed to global streaming platforms, broadcasters and publishers. The startup also purchases contracted license fees from major studio and streaming giants including Disney, Netflix, Amazon, Universal & HBO. Back in 2019, Purely Capital closed a seed equity round backed by Finch Capital, an early-stage FinTech venture capital firm that invests in innovative businesses that transform the financial services sector in Europe and South East Asia. Purely Capital plans to do a Series A round later in 2020.

Swiss FinTech startup Expense Robot raises $1.79M seed round to automate expense and business credit card processing using AI. Expense Robot, a Zürich, Switzerland-based fintech startup that uses artificial intelligence, announced raised $1.79 million (CHF 1.7 million) in a seed round co-led by Swisscom Ventures and SIX Group to expand its mission. Expense Robot uses artificial intelligence to automate expense and business credit card processes from the picture of a receipt all the way to the compliance checks, the Finance booking, VAT input tax reclaim, archiving and reimbursement. This allows managers and the Finance team to focus on exceptions and outliers only. Max. 5 seconds of manual work per expense is their promise.

Validere Raises $15M USD Series A Funding to Accelerate Supply Chain Efficiencies in the Energy Industry. Validere, a Calgary, Canada and Houston, Texas-based energy tech startup and provider of informatics platform that enables energy companies to realize efficiencies through real-time product quality insights, has closed $15 million ($20,551,275 CAN) Series A funding to scale in its rapidly growing U.S. market, expand its team, and grow its technological capabilities across the oil and gas ecosystem. The round was led by Wing VC, with participation from Greylock Partners and Sallyport Investments. Validere was founded by Harvard graduate and award-winning scientist Dr. Ian Burgess and entrepreneur Nouman Ahmad, who both recognized the enormous opportunity to bring data transparency to oil and gas.

Healthtech startup b.well scores $16M Series A funding to provide consumers a new front end to healthcare. b.well Connected Health, a Baltimore, Maryland-based healthtech startup and a provider of platform designed to provide consumers a new front end to healthcare, has closed $16 million Series A investment to enhance patient experience and improve population health. The round, which brings the company's total funding to over $27 million, was led by UnityPoint Health Ventures, the venture capital arm of UnityPoint Health. Other backers include ThedaCare – a leading Wisconsin-based community health system, and Well Ventures – a subsidiary of Walgreens Boots Alliance, Inc (WBA). The startup previously raised $11.5 million in seed funding.

VCs warn coronavirus will impact fundraising for the next 2 quarters

By Sarah Buhr

As of this writing, COVID-19 has killed more than 3,400 people around the globe and the coronavirus has infected tens of thousands more. But its impact has gone much further, causing major disruptions in public markets and leading corporations to pull out of conferences and delay travel. Big tech companies are asking workers to stay home and investors are now urging startups to prepare accordingly.

Sequoia Capital sent a letter to its founders on Thursday warning that the coronavirus was a "black swan" event and startups should "brace themselves for turbulence" by considering if they have enough cash and preparing to face supply chain disruptions. The letter also warned they could have a harder time fundraising, similar to the market downturns of 2001 and 2009.

The coronavirus effect is rippling throughout the tech world. Seattle, which has seen a cluster of cases, seems almost a ghost town in some parts, according to entrepreneur and former Madrona Capital partner Shauna Causey. She told TechCrunch that many of the coffee shops and co-working spaces popular among VCs have gone empty in the last week and all of her fundraising meetings are conducted via Zoom.

And already there's some chatter that funding might be drying up for early-stage startups, though Bloomberg Beta's Roy Bahat tells TechCrunch that startups should always be fundraising as soon as they can to protect themselves from this type of calamity.

"The question a few investors are talking about, effectively: is coronavirus only the black swan or do all the swans now have

coronavirus? Whether it's the new normal, that's the big question," he said.

Still others say it's just business as usual. "There have been a couple instances of cancelled travel from founders visiting the Bay Area and pushing back of board meetings where somebody would be on a plane," Signia Venture Partners' Sunny Dhillon told TechCrunch. "But I think fewer handshakes — and more hand sanitizer — and increased remote work at a couple of our portfolio companies are the only real differences we've seen."

Spark Capital's Nabeel Hyatt tweeted earlier in the week that only "shortsighted VCs will panic and stop doing deals, the good VCs will keep calm and carry on. But there are a decent number of shortsighted VCs, so plan accordingly."

In a follow-up with TechCrunch, Hyatt clarified his position: "You fall for the company and its vision, that requires a pretty positive frame of mind. That's a frame of mind that can definitely be [p]ut under stress in a situation like this."

Homebrew's Hunter Walk said all founders should already have a strategy in case their fundraising timetable is delayed for reasons beyond their control.

"Assuming the company is 'on plan' but for macro/sector reasons a fundraise is delayed, what would your plan be?" he asked. "Would you cut/manage discretionary spending, would you lay off people/cut salaries, do you know if your current investors are in a position to back you through a downturn?

Outside of that thought exercise — which I believe is always a good thing to do — if there are people who want to give you money sooner rather than later, then it's just a question of whether it would eliminate existential risk to do so. Otherwise, I'm of the belief that great companies will always be able to raise in downturns or periods of risk — perhaps with some round size and terms impacted, but the round will get done. VCs also can be proactive in approaching their companies scheduled to fundraise soon and let them know if insiders are able to carry them through an extended period if necessary."

So it seems there may be a bit of a slow down, with early-stage startups finding themselves in a rougher spot than this time last year. Good companies will probably get deals, according to several VCs — though those deals might be more likely to be made over video chat over the next couple of quarters.

The dollars and cents of raising VC during the coronavirus pandemic

By Danny Crichton

The novel coronavirus is raging across the planet. Millions are quarantined, the stock market is violently gyrating and one of the preeminent VC firms in the Valley is back to saying RIP Good Times. The daily stream of news is terrifying, and we are going to learn even more in the coming weeks.

For founders, the biggest challenge is inoculating their teams from the vagaries of the market so they can do their jobs, continue building momentum against this market adversity and, ultimately, ensure there is enough cash in the bank to avoid layoffs and sustain their company for growth.

I want to talk today about the money details, saving some of those other topics for future posts. What does VC fundraising look like today? What's going to change in the VC market? What might actually get better about fundraising today than just a few months ago? The daily headlines can be traumatizing, but with the right approach, you can navigate these waters safely.

Volatility affects different VCs differently

Perhaps nothing is more important in the fundraising landscape than volatility in the stock market. As much as venture, and particularly early-stage venture, is far, far away from the public markets, the reality is that all markets are inter-connected and what happens in one affects all the others. Let me give some examples.

VCs need to raise funds from limited partners that have less money to put into their alternatives portfolio since the market has crashed. In fact, those LPs may want to double down on the lower prices available on the stock market and actively direct money away from locked-up alternatives with long-term horizons to public equities in the hope of making a relatively quick buck now.

There are a variety of ways that companies are valued on a VC fund's investment sheet, but among the most common is "mark to market." That's where a company is compared to a basket of similar companies on the public market in order to derive a valuation for that company. So, for instance, a SaaS company might be marked against a variety of public cloud and SaaS companies like SalesForce, Zoom, Datadog and others based on its ARR and growth metrics.

As the markets have tanked, so have these mark-to-market comparisons, which means VCs are looking at negative declines in many of their portfolio valuations — even if the underlying companies are doing just as fine as always. Those devaluations are going to affect a VC's own ability to fundraise from LPs, their desire to hang tight and wait out the storm and their own psychology and optimism — which directly affects their excitement to invest in new, speculative projects.

Next, for some very early-stage investors at the angel stage who might be running a family office (or themselves are the family), declines in the markets may effectively prevent them from having the cash liquidity to invest in promising startups at all. Some of these investors may not want to sell stock at a low price just to get some cash to invest in alternative assets, and may effectively exclude themselves from the fundraising market for a while until the markets improve.

In other words, what happens on the Nasdaq does affect startup fundraising, even if the two might seem a half-dozen rounds apart from each other. That's one of the reasons why my colleague Alex Wilhelm covers the ups and downs on Wall Street so feverishly — it's a huge signal about what is happening elsewhere in the market.

And given that the news has been pretty uniformly negative, it seems obvious that many VCs are going to pare back their investing in the short to mid-term.

Yet, not all VCs will pull back
As I have said ad nauseam this year, VCs are in a hyper-competitive market like we have never seen before. There are more VCs, VC firms and VC dollars in more geos worldwide prowling for the next startup than ever.

The coronavirus outbreak has not changed this basic thesis in the market.

Some VCs will certainly pull back from the markets due to their LP fundraising challenges or portfolio management practices. But for many other VCs, there is opportunity here — and they may never get another moment like this again for some time.

I have heard from a smattering of VCs (not enough to call it a trend mind you, but still) that they actually intend to double down in the coming weeks on investing. Why? Because with other investors departing the market, deal terms are getting better, the competition is less keen, they can do more due diligence and there are a lot of companies being built that have great growth prospects and are going to survive this global pandemic.

It's the VC equivalent of buy (actually) low and sell high.

Let's get one thing straight: Fundraising isn't a binary. It's not whether you succeed at fundraising or fail. Fundraising is a spectrum: How many dollars do you raise and at what price? What are the terms attached to that term sheet and how much future flexibility do they afford you?

There is no doubt in my mind that the coronavirus will dampen enthusiasm for startup investing and thus lower valuations. That's reality, and a product of the supply and demand of investors in the market. However, that doesn't mean that all term sheets just got frozen in legal with no chance of ever seeing ink signatures on the wire sheets.

Instead, expect that the valuation you might have received even a few weeks ago has declined, maybe as much as 20-30% right now. But at that new valuation, there is almost certainly a line of VCs waiting to invest in promising startups with a discount on valuation.

As a founder, it might suck that, due to timing, you are coming up on a fundraise just as we are hitting peak coronavirus scare. If you can cash-manage your burn and potentially get out of this fear window, then by all means do so.

But remember, startups take an average of more than a decade to get to the public markets these days, and often raise more than six rounds of venture capital across their lifespans. Every single one of these rounds can't be perfectly timed. One of them is going to be the relatively hardest one of the set (just as much as one of them was the relatively easiest among them). This fundraise may well be your tougher fundraise, and it may cost you some extra dilution than you might have anticipated. Frankly, that's life, and one of your rounds was almost certainly going to be a harder one. It might as well be this one.

Is it possible to fundraise today? Absolutely. Will it be as easy as before? Almost certainly not. Will valuations sink a bit? Yes, almost certainly. But should all that worry you? No, no and no. You should be going into every fundraise with the mentality that it will be arduous, that no additional capital will ever be found again and then be pleasantly surprised at the result. This one is no different.

Fundraising in today's market
The biggest challenge today is going to be maintaining momentum during a fundraise. A lot of investors are going to wait and see, and you must identify those investors and cut down on your contacts with them. Focus on those that

proactively talk about the coronavirus, but seem sincere in wanting to commit to your startup despite the global macro environment. As always, choosing the right VCs that propel a fundraise forward is the core of fundraising, and so this isn't exactly novel advice.

One big challenge on keeping momentum will be handling all the new "no in-person meetings" policies that have sprung up at some Sand Hill offices. Raising funds, particularly post-seed, is nearly impossible virtually. I've seen it happen regularly with $50K and $100K seed checks (I've seen such checks written over a 20-minute Skype call). I have never seen it personally when millions of dollars are at stake. You need to meet your investors, just as they need to meet you. The coronavirus or not, these folks are still going to be on your board and be with you for the next decade.

It's a changing situation, so it is hard to give long-term advice here. Instead, I would emphasize that you meet in person with those you can, work with those who only want to do so virtually and do your best to identify who is just wasting your time and who might actually move forward with an investment in spite of the lack of an in-person meeting. My guess is that the number of VCs on your final fundraise list will be smaller, but there will still be competition among them, assuming the core of a business is solid.

In short then, the novel coronavirus is adding huge ambiguity to the futures of a lot of startups. But ambiguity is what founders navigate, literally every single day. This issue, like every other issue that comes up in the activities of building a company, is no different. Ask for advice from other founders and advisers. Listen to the feedback people tell you. Get creative about how to connect with new folks as quarantines and lockdowns persist. Husband your capital, but realize that now might be a moment of growth rather than merely stagnation.

Do what you can with what you have. That's all you can ever be expected to do.

How Coronavirus Epidemics Could Alter the Future of Tech

By Sam Lessin

The impact of COVID-19 on the economy and our lives has been the subject of a lot of discussions in the last several weeks. But there's been less discussion of the potential long-term implications of how the virus—or something like it—may alter the longer-term trajectory of our society and economy.

Here are some big-picture considerations of how the new coronavirus, or something like it, may fundamentally and uniquely alter our highly connected, communication-dense and unevenly flexible world of 2020.

1) Downward pressure on the on-demand economy and a reversion to asset ownership and control
The short-term pressure on the "sharing economy" and marketplace of a shock like COVID are clear. In the longer term, people may think twice about moving fully away from asset ownership and control and trusting the open marketplace for things like cars, housing, office space and food.

There is the question of trust. Do you want to get into a car or stay in a vacation home when you don't know who else has been in it recently? Do you want to order food that will be delivered through a long series of handoffs where you aren't precisely sure about the chain of custody? Do you want to work out of a shared office space when people are getting sick?

There is also a question around guaranteed access. What is the premium you are willing to pay for exclusive use and control of transportation, housing and so on?

I strongly believe that sharing assets remains the future. You could imagine, however, that for a period we will see an uptick in car sales and a shift toward branded hotels. You could also see a world where the on-demand platforms need to invest even more heavily in systems to support the safe, clean and consistent operations of their services provided through third parties. This could be an opportunity for them. But it could also require an alteration of their business models if they have to take on more of the risks and guarantees associated with providing services.

2) Increase in desirability of full-time work versus participating in on-demand jobs and marketplaces
Shocks like COVID-19, of indefinite severity and length, are hard to manage if your livelihood is earned on demand. This is especially true if it is the case that many of the people who participate in these labor markets are living nearly paycheck to paycheck.

The flexibility for workers that on-demand work platforms provide is obvious. But if labor-market disruption caused by COVID-19 goes from a theoretical possibility to a reality, you could imagine that people suddenly will start placing a higher value on consistent full-time employment.

3) Broad flight toward job security with the best, most profitable companies
The best companies with the strongest balance sheets will clearly get through what we face today, as well as the pandemics of the future. However, I am personally worried about companies in less generous situations with high fixed costs.

And if a lot of companies in less defensible positions fail, large, well-positioned companies may gain more power in the labor markets as people start evaluating companies based on their ability to withstand shocks.

4) Broad exacerbation of inequality issues and social challenges

Setting aside medical risks, and speaking strictly in terms of the economy for well-off people, COVID-19 will likely be no more than a small blip. Asset prices are (at least so far) not even down that much. Knowledge workers who can continue to do their jobs from home will experience this largely as an inconvenience.

Less well-off people, however, who are paid hourly for in-person jobs by companies that cannot afford to float them through an episode like this, are going to be severely challenged. This will be especially true if they do not have savings.

To be sure, since we are a consumption-based economy, we are all in this together. If a lot of consumers end up financially upside down, everyone is affected. I can't help but wonder if a COVID-like shock could have serious repercussions for the direction democracies take. Would a poorly timed epidemic draw us toward socialism?

There obviously have been shocks to the system before. But because knowledge workers today have real flexibility in being able to work remotely, unlike other workers, the impact of an epidemic in 2020 has the potential to be more unequal than a similar shock would have been a century ago.

5) Reorganization of government tactics for supporting people during a shock
So far, the government has cut interest rates to support the stock market. This, however, is a crude tool for keeping things working in a world where hourly workers are going to be most deeply affected.

What you want the government to be able to do is route money and support to the people and companies whom the epidemic most directly displaces.

In the world of physical disasters like hurricanes, we have agencies like FEMA to direct assistance to those impacted and in need. When you look at something like a pandemic, which is national and global but unevenly impacts different industries and people, how do we administer support more precisely? Dropping interest rates can't be the answer.

6) A move toward a strong national identity, acceptance of increased state surveillance and border hardening
In times of crisis, the balance between privacy and security shifts. We saw this with September 11 in the U.S. I have heard that the Chinese have deployed some aggressive people-tracking technologies to handle COVID-19. A national health crisis could easily tip the U.S. and other countries toward dramatically strengthening national identification strategies and assuming the right to track people in detail for the sake of security.

This isn't necessarily a bad thing in time of crisis. The question is, is it ever possible to roll back these steps? Or does the added control only grow over time?

7) Pressure toward digital voting, remote services, and drone and bot delivery
Imagine if we are in a position where we want broad swaths of people to stay home during an election cycle. This might propel a real demand for digital or remote voting and remote government service delivery. This will be especially true if we end up with a strong national identity.

A pandemic might similarly create a sense of urgency about regulation to open up drone airspace and bot delivery as we look for ways to deliver services remotely in both urban and rural environments.

8) Pressure to decentralize production facilities, knowledge work and education
Apple is obviously discussing this in practical terms right now. More broadly, you could see a world where supply chain diversification and fortification becomes a key scorecard for companies.

The same thing applies to knowledge work and education. Today some companies are clearly better set up to manage remote work than others based on both the nature of their work and their preparedness. The same goes for schools.

I would imagine that in the future organizations will start to think about their decentralization strategies or at least contingency plans, and will actively pursue more resilient approaches to work.

This is actually going to be a pretty interesting shift to pull off, and will require significant reorganization and rethinking of many core principles for all sorts of organizations. As just a single example, many customer service departments rely on having physical locations to maintain their security compliance. Moving to remote work for them doesn't just mean installing some fancy new software—it means rethinking their entire approach to security.

9) Possible decline in desirability of cities and value of commercial real estate
Will cities become less desirable if they are harder hit because of higher transmission rates than in the suburbs or country? That was certainly the case before modern drugs allowed cities to be more livable. You could imagine a world where, just as companies and organizations look toward decentralization, there is pressure to "decentralize" communities away from inner cities entirely.

Similarly, if people start to ask questions about how they choose to use shared infrastructure and services, restaurants and so on, the relative value of living in cities will rapidly decline.

This, coupled with investment in remote work capabilities and so forth, could deal a major blow to the value of city living and commercial real estate.

10) Adoption of virtual reality, Peloton and so on
This is obvious but still needs to be said. In a world where quarantines grow, you can only assume that entertainment platforms, VR and home fitness categories will all significantly grow.

11) Shifts in event and media businesses
All of the media companies that currently rely on monetizing live events will have to evolve their business models or insure against monetary shocks. This could involve making all events a hybrid of physical and virtual. It could involve a shift toward subscription. It could involve new types of paid digital experiences. Regardless, it is clear that the live events business and the media companies it supports are going to change in some deep ways as a result of the risks around pandemic.

12) Shifts in who we trust and how we evaluate truth
It is hard to know whom to trust for good solid analysis and understanding of what is going on with COVID-19.

Do trustworthy paid journals like The Information need to be covering health? Do hedge funds need to evolve to do their own science and publish results, putting dollars transparently against their research? Do we need new government regulation and rating services as was the case in the Upton Sinclair era?

There has been a broad discussion for quite some time about how, in our era of mass communication, trust in reality is slipping away. It is interesting how visceral that starts to feel when we're faced with something like a pandemic.

Conclusion
There have been scores of pandemics throughout human history, some very severe and some relatively mild.

The difference today is that we have a strange new mix of knowledge, communication and flexibility in how we work and live that we didn't have before.

Setting aside the physical impact of the disease for a second, the reality is that if COVID-19 had happened a century ago, we likely wouldn't have been talking about it at all until nearly everyone already had it (and many had already died or recovered).

Even if we had known about the disease, I question how socially disruptive it would have been, because everyone would still have had to go about their lives, go to work and so on.

There is some irony in the truth that our increased knowledge, communication bandwidth and flexibility to reorganize our lives rapidly is magnifying the social impact of COVID-19—in a way that would have been unimaginable historically.

What's the Difference Between Bluetooth LE and Bluetooth Classic Audio—and How Will It Impact Hearing Aids?

Bluetooth LE Audio improves upon Classic Audio in a number of ways, and the opportunities for developers are exciting. Check out some potential use cases for the new audio standard.

By David Hollander

The theme for World Hearing Day 2020 was simple: "Don't let hearing loss limit you."

This is sometimes easier said than done for the 455 million people worldwide that have disabling levels of hearing loss, and the number will rise to 900 million by 2050. Though hearing aids and hearing-loss prevention and treatment techniques have improved over the years, people with hearing loss may still feel restricted in certain situations, like when trying to engage in a conversation with several people talking over each other or watching a video without subtitles.

Audio is Blue: A New Way to Experience Hearing

This year's World Hearing Day focused on encouraging people with hearing loss to continue participating in public and social life. And the Bluetooth Special Interest Group (SIG) has worked closely with the hearing aid industry to define and introduce LE Audio, the next generation of Bluetooth wireless audio, to help advance this mission.

LE Audio, announced in January, is a new Bluetooth audio standard that improves Bluetooth audio for all, including the growing number of people with hearing loss. Thanks to its low energy consumption, high sound quality, and multi-stream audio functionality, LE Audio will help enable a more seamless integration of hearing aids and other audio technology.

Dr. Stefan Zimmer, Chairman of the Board of the German Hearing Aid Industry Association (BHVI), believes the new audio standard will positively impact people across the world.

"Far too often [those affected with hearing loss] withdraw from their social and professional environment. This does not have to happen," says Zimmer. "LE Audio will be one of the most significant advancements for hearing aid and hearing implant users."

How Does LE Audio Differ from Classic Audio?

With the introduction of LE Audio, Bluetooth audio will support two modes of operation, the current mode, now referred to as Classic Audio, and LE Audio. As the names suggest, Classic Audio operates on the Bluetooth Classic radio (also referred to as Bluetooth BR/EDR), while LE Audio operates on the Bluetooth Low Energy (LE) radio. LE Audio will improve the performance of the same audio products and use cases supported by Classic Audio, including wireless calling, listening, and watching.

Significantly, LE Audio will also support the development of standard Bluetooth Hearing Aids. In addition, it will introduce exciting features that will enhance their performance as well as an entirely new use case—Bluetooth Audio Sharing—which is expected to enable the next generation of Assistive Listening Systems (ALS). This will make hearing assistance not only more accessible, but the places we go and the world around us will be more friendly to hearing aid users.

The Importance of Standardization

Support for Bluetooth technology in hearing aids to date has been based on proprietary implementations. As a result, relatively few hearing aids include Bluetooth technology and compatibility is limited. By standardizing support for Bluetooth technology within hearing aids, LE Audio will lead to the availability of more Bluetooth hearing aids and enable true global interoperability.

Thanks to the standardization that LE Audio will enable, people with hearing loss will be able to realize the same benefits of Bluetooth audio enjoyed by users of standard Bluetooth headphones and earbuds.

Audio Sharing

While current Assistive Listening Systems, such as inductive loops, have provided tremendous benefit to people with hearing loss, they suffer from a number of challenges that have limited deployment, including quality, cost, spill-over, interference from other devices, and privacy issues. In addition, telecoil systems are optimized for speech, which means music can sound distorted. They're often most effective at a certain angle, too, which may require the user to hold a device (like a telephone) in a way that could be awkward or uncomfortable.

Bluetooth Audio Sharing will enable an advanced new type of ALS with higher audio quality and greater privacy that avoids spill-over challenges. It will also be significantly easier and cost less to deploy.

Here are just some of the ways you might see Bluetooth Audio Sharing in action in the future:

- At a movie theater, the audio track would send audio directly to hearing aids.
- Hearing aid users will be able to receive direct announcements at public venues like train stations or airports via their hearing aids.
- Multiple friends will enjoy music played on a smartphone through their Bluetooth headphones and hearing aids at the same time, helping hearing aid users tune in and be part of a shared music experience.
- Audio from home TVs or public TVs, such as those in waiting rooms, terminals, and sports bars, could be streamed directly to hearing aids or earbuds.

CES 2020 provided a glimpse of the future, as Nuheara unveiled its IQstream TV, a hardware accessory device that connects directly to a television. The user can then balance the volume of the TV sound with ambient sounds and conversations or simply focus on the TV itself.

These actions are all controlled independently from anyone else in the room. The user can give themselves as immersive an experience as they'd like. For example, if other people in the room were talking too loudly during an episode of *Schitt's Creek*, you could isolate the broadcast without disrupting their conversation. Indeed, when one of us shines, we all shine.

In the future, LE Audio will make this more mainstream. The technology could work with a more extensive amount of Bluetooth-enabled products and also be installed directly into a TV, rather than an external device.

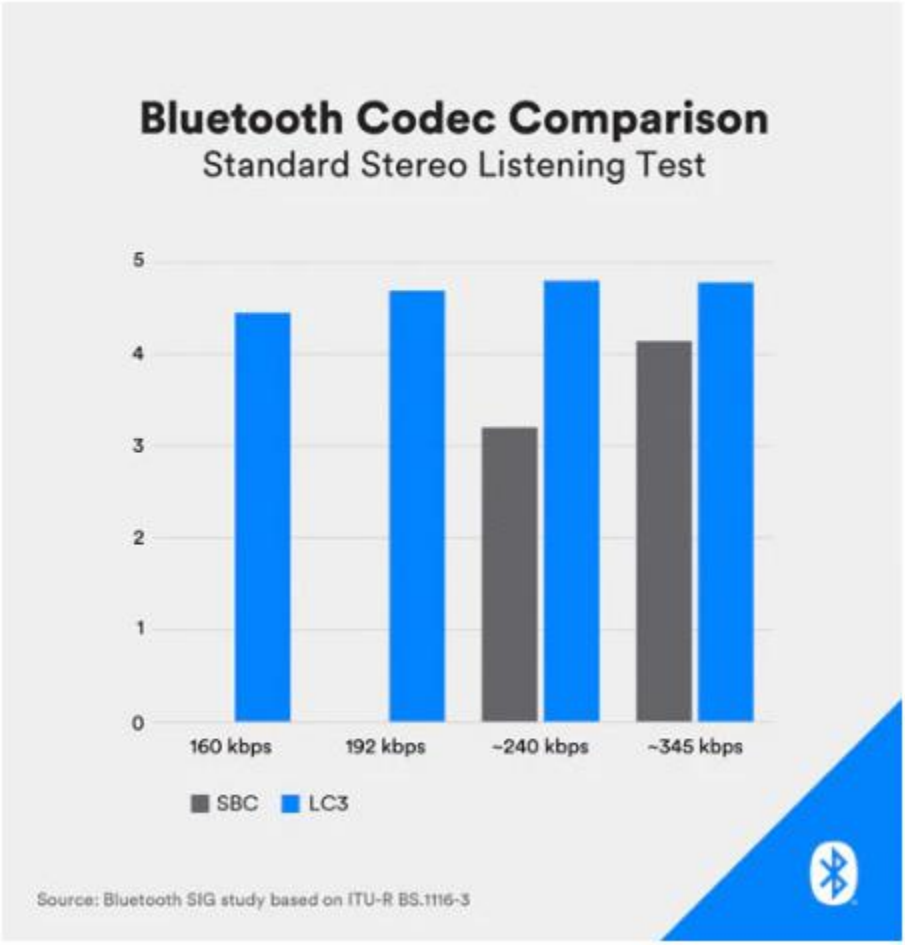
"Location-based Audio Sharing holds the potential to change the way we experience the world around us," says Peter Liu, Architect, Wearables Systems, Bose Corp. "For example, people will be able to select the audio being broadcast by silent TVs in public venues, and places like theaters and lecture halls will be able to share audio to assist visitors with hearing loss as well as provide audio in multiple languages."

Removing the Stigma of Hearing Loss

On average, people with some degree of hearing loss wait seven years before seeking help. Spending nearly a decade without the full ability to hear is partly a result of the stigma around hearing loss.

The introduction of LE Audio also brings a new, high-quality, low-power audio codec called LC3 (Low Complexity Communications Codec). LC3 offers lots of possibilities for hearing aid manufacturers and users. Listening tests have shown that LC3 provides superior audio quality over the subband codec (SBC) included with Classic Audio, even at a

50% lower bit rate *(see figure)*. Developers and hearing aid manufacturers can leverage the power savings provided by LE Audio to design products that provide longer battery life or, in cases where current battery life is enough, reduce the form factor by using a smaller battery.



A performance comparison between Bluetooth LC3 and SBC codecs shows the power of LC3.

In this way, LE Audio will assist hearing aid manufacturers in designing devices that are more discreet or that more closely resemble earbuds that have become increasingly mainstream. Both trends have the potential to help remove some of the stigma around wearing a device in our ears and reduce the time it takes for people experiencing hearing loss to take action.

Audio for All, with No Limitations

A big theme of World Hearing Day 2020—and, by extension, for World Health Organization and Bluetooth effort—is inclusivity, reminding all of us that being hard of hearing shouldn't limit anyone. Hearing aids can significantly improve how people with hearing loss engage with the world. LE Audio's standardization of Bluetooth Hearing Aids and its introduction of Bluetooth Audio Sharing have the potential to further improve the quality of life for hearing aid users, remove limits, and empower people with hearing loss to feel more confident and connected in their daily lives.

With companies taking various steps to protect employees' health in the face of COVID-19, it's important to be ready for working remotely.

By Kaumil Dalal

Faced with the potential threat of Coronavirus, household names like Amazon, Goldman Sachs, IBM, and Microsoft are among a majority of North American companies that have instituted travel restrictions or work-from-home policies. But while the concept of working from home may sound simple, the preparation that goes into a 100% digital workplace is no small feat.

At West Monroe, we help organizations become digital workplaces — typically to improve productivity, increase employee satisfaction, and save costs. With COVID-19, a company's ability to operate as a digital workplace is top-of-mind, even if only for a defined period.

CFOs have little time to make investments and decisions. So we pulled together five questions they can ask their technology team in order to hit the ground running.

Do employees have the hardware they need to be successful?
Simply, employees and contractors needs the right equipment to do their jobs. Do they have a laptop, either instead of or in addition to a desktop? Do they have headsets to make calls and spare laptop chargers at home? If not, we recommend taking the proactive step to have enough laptops, headsets, and other hardware for everyone, as soon as possible.

Once the workforce is equipped with the right hardware, broadband connections become important. Do employees have the right internet speed while working from home for the type of work that's expected? Conduct an inventory of employees' broadband connections and pay attention to their downloading and uploading capacities to ensure there is have adequate capacity for telephony, video, or screen sharing.

Not everyone will need the same level of bandwidth, so some role-specific guidelines may be necessary to keep requirements realistic. If the workforce is lacking bandwidth overall, the company's collaboration strategy may need to take that into account.

It may also be necessary to revisit reimbursement policies regarding personal broadband connections. For some employees it may be necessary to invest in mobile hotspots and related data plans to establish adequate internet access at home. Work with employees to get at least a minimum-viable capacity in place.

And if the company relies on VPN and all employees are working on it simultaneously, current hardware may not be able to handle that load. Starting today, test the limits to understand whether the existing mobile workforce solution needs to change.

Virtual collaboration 1: Are the right tools and technology in place?
We often take for granted how many colleagues, partners, and vendors we collaborate with daily to get our jobs done via phone, email, and other communication devices. To be successful while remote, maintaining that collaboration is critical.

Does the company have tools such as Microsoft Teams, Slack, WebEx Teams, or Zoom that allow the ability to chat, co-author documents, access important files, and host meetings with video? Are there intelligent workplace tools

such as Beezy to help people stay connected and productive? These types of solutions help connect employees at all levels and deliver targeted, personalized information to the right employees at the right time.

Having the right collaboration tools is crucial, but do the company's employees and partners have the proper training and skills needed to use them effectively?

There is a good chance this may be the first time they are using such tools as intended. Are there documentation and best practices that can easily be shared as employees navigate these platforms? When users are given proper instruction and support, their usage of the tools increases and their productivity improves. Investing in this type of support now will cut down on the time learning them later.

Virtual collaboration 2: Do you have the culture to support it?
If working from home is not a solution for the company just yet, there is at least a likelihood that travel will slow down due to coronavirus. (For example, Salesforce recently announced it is suspending non-essential travel for its 50,000 employees.)

More meetings will have to be virtual, making a platform that allows effective communication essential. Does the company culture promote videoconferencing today? If not, can efforts be made to become more virtual before these work-from-home policies are required?

Using video helps employees stay connected, regardless of distance. If the company doesn't have a remote working culture today, it will be even harder to change and teach employees how to use digital workplace collaboration tools while remote.

Traditional ways of working will also change. Teams will need to be flexible with a potential shift in working hours. Consider the school closings in Japan: If daycare or schools begin to close, traditional work hours might shift to accommodate changing schedules. Team meetings may have to shift to earlier or later in the day to best fit schedules.

Managers will also have added pressure to ensure their teams can perform well while remote. They will need to make sure their team has an adequate understanding of tools and that they encourage collaboration, foster open communication, and can measure productivity.

Microsoft's usage analytics is a good built-in tool to see how people are working. Third-party tools, like Brainstorm's QuickHelp, can also help with monitoring and shaping effective usage through learning, support material, communication campaigns, and analytics.

While this data is helpful information, managers still have the task of clearly crafting and communicating expectations for how their teams should interact and collaborate — for instance, being available and online during normal work hours.

From there, it's a matter of managing to those expectations. How the management team goes about managing this change can make a significant difference in results.

What is the best path forward for security and mobility?
If the company's remote working strategy involves employees using personal devices, employees will shift from working on secure networks and machines to relying on their own devices and home and public Wi-Fi.

To address the security concerns these changes represent, here are a couple ideas.

First, fast-track multifactor authentication (MFA) to allow the workforce access to the sites and files they need while ensuring the right person is logging in. This can take several months to implement at a sizable organization (both technically and culturally), so start working toward this today.

Meanwhile, in the Azure and Office 365 ecosystem, Intune and Conditional Access can be combined to validate that the devices accessing the company's data are sufficiently trusted before providing access to corporate systems.

Second, get people remote access without sacrificing security. Are all apps and programs that employees use accessible from home? If not, are you relying on VPN technologies that put untrusted personal devices onto the corporate network?

If you are stuck with applications hosted in the data center, consider using a reverse proxy such as Azure Application Proxy to make web applications available to users outside the corporate network, quickly and securely, using TLS and multifactor authentication.

This can effectively reduce the burden on VPN infrastructure while maintaining security. If there are desktops in the office to which remote workers must have access, solutions like ConnectWise Control can be integrated with Azure Active Directory, protected with TLS and MFA, and deployed very quickly.

While not a cloud-first mobile-working experience, solutions such as ConnectWise Control can allow employees to access their everyday desktop from anywhere and work without significant disruption to their everyday processes.

Can the company's support desk handle a higher volume of requests?
When the workforce is remote and trying to figure out new processes and tools on their own, support desk requests will surge. Are there self-service resources and knowledge bases to provide support before requests occur? Are there enough IT resources to cover increased demand?

Evaluate — today — the company's ability to troubleshoot remotely. From taking pictures with mobile devices to using remote-assistance software, this will be necessary as in-person options subside.

You may have to get creative if you're not able to meet and diagnose in-person and still help remote workforce resolve issues. Consider increasing self-service capabilities by using a tool like ScreenSteps to easily create and publish guides that help avoid many of the issues that go to support.

It's even possible to create workflow articles that mimic the troubleshooting process that people would get from a first-tier agent. If done right, through the process, the workforce can even become more adept with technology and troubleshooting.

It takes a great deal to keep a workforce efficient while remote. While not exhaustive, this initial set of questions will help mobilize your digital workplace and make the company more nimble — for tomorrow and beyond.

PedestriANS: A bipedal robot that adapts its walking style in response to environmental changes

By Ingrid Fadelli

Humans are generally able to adapt their walking style based on the environment they are moving in, for instance, speeding up if the consistency of the ground below their feet allows it, slowing down when the floor is slippery, changing direction to avoid puddles or holes in the ground, and so on. To navigate a variety of environments, robots should be able to adapt their walking behavior in a similar way, adjusting their structure in response to environmental changes.

With this in mind, Researchers at Osaka University in Japan have recently created PedestriANS, a bipedal robot that can change some of the physical characteristics and movements of its legs in response to changes in its surrounding environment. This new robot, presented in a paper published in SAGE's journal Adaptive Behavior, can change its walking style using a simple system that connects the movements and configuration of its two legs.

"The main objective of our work is to develop robust robots that can handle disturbances; robots that can accompany humans and walk effectively over even terrains as well as uneven ones such as grass and gravel," Huthaifa Ahmad, one of the researchers who carried out the study, told TechXplore. "To reach this goal, we need to develop robotic systems with an adaptive morphology; because even with most advanced bipedal robots that are available these days, having a precise model of both the robot body and the environment is crucial for them to operate properly."

PedestriANS, the robot developed by Ahmad and his colleagues, relies on an actuator network system (ANS), a design concept introduced in their previous work. In their past studies, the researchers incorporated the same concept in several other applications, including robotic spines, arms and multi-legged robots.

"As its feasibility was demonstrated in several studies, I am currently using the ANS principle in my research to achieve adaptable robots, by utilizing the different interactions among the mounted actuators on their bodies," Ahmad said.

The movements of the robot developed by Ahmad and his colleagues are produced by a single motor, and its legs are linked together through an ANS. Contrarily to other bipedal robots based on complex systems, PedestriANS has a fairly simple structure. The robot adapts to changes in its surrounding environment by exploiting physical characteristics of its legs and interactions between its different components, resulting in a range of different walking behaviors.

"The robot's walking behavior changes by changing the interaction between the actuators of the ANS," Ahmad said. "To produce better behavior, the robot's demands for a certain connection pattern differ based on the given situation. Our work suggests that the best way to realize self-adaptable robots is by enabling them to adjust their morphologies and exploit their whole-body dynamics in response to environmental changes"

The researchers evaluated their robot's performance in a series of experiments. Firstly, they tested how shifts in the robot's morphology impacted its walking behavior by observing its ability to adapt to different ground materials, focusing on changes in its walking style, stability, speed, and the direction in which it moved.

After analyzing the results gathered in this first experiment, Ahmad and his colleagues upgraded the robot's design in a way that allowed it to switch automatically across different connection patterns between its legs. They then conducted a second evaluation and found significant improvements in how the robot adjusted its morphology

during locomotion. In this second experiment, PedestriANS effectively produced adaptable walking styles in response to the environment in which it was operating.

In the future, the robot developed by this team of researchers could be used to complete tasks that involve moving around in uncontrolled and continuously changing environments. While PedestriANS can change the type of interaction between its legs to produce different locomotion behaviors that best match its environment, it still can't autonomously identify the morphological adjustments best suited to specific situations. The researchers plan to continue working on the robot to enable this important capability, which is necessary for the robot to operate without continuous human input and guidance.

"The next step in our research will be to realize a control system that can allow the robot to keep providing the best performance during all locomotion phases, autonomously selecting an adequate connection pattern," Ahmad said. "Moreover, by extending the ANS to include more parts of the robot (e.g., upper body), this will increase the possible morphological changes, which in turn reflects on the robot's adaptability."

More information: Huthaifa Ahmad et al. PedestriANS: a bipedal robot with adaptive morphology, *Adaptive Behavior* (2020). DOI: 10.1177/1059712320905177

Skin-like, Flexible Sensor Lets Robots Detect Us

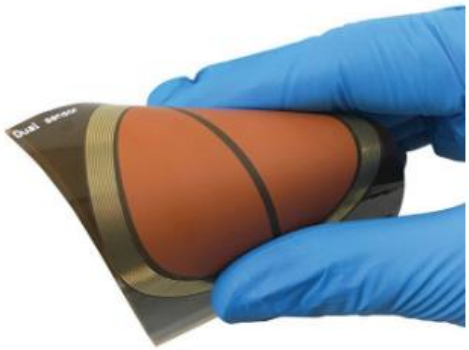
A new sensor allows robots to accurately detect the speed and angle of someone's approach

By Michelle Hampson

A new sensor for robots is designed to make our physical interactions with these machines a little smoother—and safer. The sensor, which is now being commercialized, allows robots to measure the distance and angle of approach of a human or object in close proximity.

Industrial robots often work autonomously to complete tasks. But increasingly, collaborative robots are working alongside humans. To avoid collisions in these circumstances, collaborative robots need highly accurate sensors to detect when someone (or something) is getting a little too close.

Many sensors have been developed for this purpose, each with its own advantages and disadvantages. Those that rely on sound and light (for example, infrared or ultrasonic time-of-flight sensors) measure the reflections of those signals and must therefore be closely aligned with the approaching object, which limits their field of detection.



Photos: Aidin Robotics

To circumvent this problem, a group of researchers in South Korea created a new proximity sensor that measures impedance. It works by inducing electric and magnetic fields with a wide angle. When a human approaches the sensor, their body causes changes in resistance within those fields. The sensor measures the changes and uses that data to inform the robot of the person's distance and angle of approach. The researchers describe their design in a study published 26 February in IEEE Transactions on Industrial Electronics. It has since been commercialized by Aidin Robotics.

The sensor is made of electrodes with a flexible, coil-like design. "Since the sensor is highly flexible, it can be manufactured in various shapes tailored to the geometries of the robot," explains Yoon Haeng Lee, CEO of Aidin Robotics. "Moreover, it is able to classify the materials of the approaching objects such as human, metals, and plastics."

Tests show that the sensor can detect humans from up to 30 centimeters away. It has an accuracy of 90 percent when on a flat surface. However, the electric and magnetic fields become weaker and more dispersed when the sensor is laid over a curved surface. Therefore, the sensor's accuracy decreases as the underlying surface becomes increasingly curved.

Every robot is different, and the sensor's performance may change based on a specific robot's characteristics. The latest version of the integrated sensor module, when installed on a curved surface, can detect objects from up to 20 centimeters away with an accuracy of 94 percent.

Lee says the device is already being used in some collaborative robot models, including the UR10 (by Universal Robots) and Indy7 (by Neuromeka Inc.). "In the future, the sensor module will be mass-produced and applied to the

other service robots, as well as collaborative and industrial robots, to contribute to the truly safe work and coexistence of robots and humans," he says.

Market Crash Pressures SoftBank's High-Risk Investment Strategy

By Amir Efrati, Cory Weinberg, Juro Osawa and Martin Peers

If here's one company that is vulnerable to the fallout from a virus-inspired economic slump and the stock market crash, it is SoftBank, along with its $100 billion Vision Fund.

The 27% drop in the stock market in the past three weeks, along with the sharp downturn in major industries like travel, will slash the value of Vision Fund's investments in the March quarter. That could wipe out much of the $9.5 billion investment gains it was showing as of Dec. 31.

Just one of Vision Fund's biggest holdings, in Uber, had lost nearly half its value between mid-February and Thursday—reversing a recovery in the stock over the winter, which SoftBank CEO Masayoshi Son had trumpeted to analysts just a month ago.

And even Vision Fund's privately held startups will be affected by the economic downturn underway: it has $2 billion invested in hotel and travel startups such as Oyo, Klook and GetYourGuide, for instance, which are sure to lose some of their value from travel drying up.

Adding to Softbank's risk is its high debt load of about $160 billion, including debt of subsidiaries like Sprint. In particular, SoftBank or the Vision Fund has borrowed as much as $16 billion against some of its equity stakes, most notably in Alibaba, its Japanese telecom unit and Uber. If the market continues spiraling down, SoftBank may need to come up with extra cash or stock to make up the losses in collateral value.

A steep decline in Vision Fund's performance would make it harder for SoftBank to raise more money for new investment funds in the future, said Tokai Tokyo Securities analyst Masahiko Ishino.

SoftBank declined to comment. Meanwhile, on Friday, SoftBank announced a stock buyback as its own shares fell. Confidence in SoftBank had already taken a battering in the wake of WeWork's failed initial public offering. That cost Softbank about $5 billion and intensified questions about SoftBank's lavish spending spree through the vehicle of Vision Fund in recent years.

To be sure, some of SoftBank's Vision Fund investments—such as ByteDance and DoorDash—are benefiting from the social upheaval caused by the virus, according to a person close to the company. More people are ordering food for delivery, which gives DoorDash a boost, while ByteDance's video apps like TikTok offer a diversion for people stuck at home. Meanwhile, the stock market may recover from the lows reached on Thursday, opening up more than 3% on Friday. But those gains may not be enough to offset the losses.

Here are the key risks to SoftBank's balance sheet:

- **Uber's stock price.** The $7.6 billion Vision Fund has invested in Uber is one of its single biggest stakes. But Uber shares have fallen 45% just in the past three weeks, as the coronavirus has sent shockwaves throughout the ride-hailing industry. Vision Fund's stake is now worth about $5 billion, which translates to an unrealized loss of $2.6 billion. That's a major reversal of the $1.5 billion gain on the Uber position that SoftBank highlighted a month ago.

  And there's another issue: Last July Vision Fund borrowed $3.65 billion using stock it holds in both Uber and cancer testing firm Guardant Health as collateral, according to people who have worked at the fund. Both stocks have fallen sharply since then: Uber's close on Thursday of $22.61 is 50% below its level in July, while Guardant shares have dropped about 30%. If the stocks keep falling, the fund could face demands from its

lenders to pony up cash to cover the drop in the collateral's value. A person close to the company said there have been no such demands from lenders so far. (In after-hours trading on Thursday, Uber shares were even lower, at $21.11.)

- **The direction of Alibaba shares.** SoftBank's $153 billion stake in the Chinese e-commerce giant is its biggest position. It provides SoftBank with an enormous cushion, as the company bought the stake for a negligible amount between 2000 and 2004. SoftBank was widely reported to have borrowed $8 billion in 2018 using that stake as collateral. As of Thursday Alibaba stock has fallen 20% to $185 since mid-January, when spread of the virus in China started to hurt it. One banker with knowledge of SoftBank's loans said that if Alibaba's share price were to fall to $141, SoftBank would have to provide more Alibaba shares to the collateral. And if Alibaba's stock were to fall to $128, SoftBank would be forced to provide cash to make up for the decline in the collateral's value.

  Moody's Investors Service noted three weeks ago that SoftBank's "increasing use of margin loans creates risk and potential new vulnerabilities to any temporary or sustained fall in the Alibaba share price."

- **SoftBank's Japanese telecom firm share price.** SoftBank just last month said it would borrow $4 billion using its stake in its Japanese telecom subsidiary as collateral. Moody's estimated at the time that the collateral amounted to 30% of the shares SoftBank owned in the telecom firm. It also estimated that the loan amounted to a relatively high 35% of the equity's stake value. Moody's said the loan was a "credit negative" for SoftBank bonds. The telecom unit's stock has fallen about 28% in the past week, worse than the 20% decline in the Nikkei 225 Index.

- **How long international travel is disrupted**. One of Vision Fund's largest private investments is Oyo, an India-based hotel company that has expanded rapidly in China and around the world. Vision Fund has pumped about $1.5 billion into Oyo for a 46% stake. Oyo, valued at about $8.5 billion, laid off thousands of employees around the world at the start of the year, and it has let go of thousands more in China over the last few weeks, according to the Chinese media.

  Vision Fund has two other prominent travel firms in its portfolio: Hong Kong–based Klook and Berlin-based GetYourGuide. Both firms offer tickets to museums, bus tours and other travel experiences. Klook's bookings for February fell about 50%, and the company is bracing for a bigger drop in March, according to people familiar with the matter. A GetYourGuide spokesperson said earlier this week that the number of people booking new experiences over the last two weeks was 50% lower than forecasted demand. Chief Marketing Officer Emil Martinsek said the company was still "well capitalized" as it raised $484 million from SoftBank and other investors last May. "We're not a boom and bust company," he said.

- **Sprint–T-Mobile's merger close.** The completion of the telecom deal will be a huge relief for SoftBank, which consolidates Sprint's nearly $40 billion in debt. That will change once the deal closes, because SoftBank is giving up control of Sprint in the merger. The deal will cut SoftBank's consolidated debt by 29%. Regulatory challenges have delayed completion of the deal, but a recent court victory over a group of states opposing the merger has opened the way for it to close in early April.

- **WeWork's business**. The co-working provider is trying to get its business on a firmer financial footing, but the virus, which makes communal workspaces less appealing, may set those efforts back. SoftBank is due to complete the final tranche of its bailout of WeWork, a $3 billion tender offer, by next month.

By E. Anthony Incorvati

The idea that sensors can try to solve traffic issues is hardly a new one. These sensors are everywhere, and have been around for years. There are sensors that can detect when a car runs a red light, and even take a picture of the license plate. There are sensors designed to detect when a car is sitting at an intersection or waiting to enter a garage. There are even sensors that make sure the streetlights turn on when the appropriate level of darkness has been reached. None of these things scream "smart city," but they have become a ubiquitous part of everyday life in most cities and towns nonetheless.

In today's world, though, it's rare to see a sensor designed with just one thing in mind. Technology has become increasingly an open platform, enabling devices to be loaded with multiple capabilities, increasing their ability to serve multiple functions while also extending their potential lifespans. This has made another IoT device, the IP camera, perhaps the most valuable asset in the ITS/Traffic environment. In many ways, the camera is the ultimate sensor, and as video analytics continues to grow more advanced—particularly as the avalanche of machine learning and deep learning capabilities make their way into the mainstream—these multipurpose sensors are increasingly being deployed to help road systems increase efficiency by addressing everyday problems like traffic congestion.

Applications That Go Far Beyond the Obvious

When you think of cameras on the road, red light cameras likely come to mind first, and that association can make motorists wary of the idea of deploying cameras more widely. But today's cameras are being used in more complex ways, beyond simply enforcing traffic regulations. Today, cameras are deployed to help city planners improve things like safety, emergency response, and even parking efficiency in a predictive way.

Think about it this way: accident statistics reveal which intersections have the highest collision rates, but that doesn't necessarily tell the whole story. What about the near misses, for instance? Cameras equipped with computer vision and deep learning are being applied to the traffic environment, where they can not only detect these near misses, but help city officials determine the cause. If there are a ton of near-accidents involving motorists turning right on red at a certain intersection, that can help city officials determine that a "no right on red" ordinance is needed.

These cameras can generate significant reporting over time, providing city officials with a considerable amount of integration to draw from—and this information can be used in ways that might not always be obvious. For instance, traffic accidents don't just impact the vehicles involved—they impact first responders, tow truck companies, even the families of those involved. Giving decision makers the information they need to better organize their emergency response teams doesn't just help improve traffic—it can actually save lives. Understanding where and when additional ambulances, personnel, and other resources are most likely to be needed can prove invaluable.

Even the mundane can be impacted by today's camera and sensor technology, and things like more efficient parking can have a greater impact than you might think. Imagine an app connected to cameras capable of detecting where the nearest available parking space is. Even something as simple as knowing where to park can take countless cars off the road as motorists who would otherwise have been forced to circle the block can instead proceed directly to their destination. Removing those distracted drivers from the road can have an outsized impact on traffic efficiency and driver happiness.

Looking to the Future

Thanks to the advent of machine learning and computer vision, today's IP cameras are no longer simply augmenting other sensors—in many cases, they are taking on the functionality of other IoT sensors themselves. Modern

cameras are able to capture more than just visual data, while neural networks armed with deep learning capabilities can analyze what is actually happening. In addition, the processing power of IP cameras will continue to evolve, and we will continue to see more GPU power in these cameras.

This is the direction in which the world is moving in an accelerated way. As recently as a couple of years ago, much of this technology simply wasn't commercially available, and was being driven by researchers at our top computer and behavioral science universities. But things are changing quickly, and as the camera continues to become the ultimate sensor, the potential applications for forward-thinking cities are only growing in value and importance.

BlackBerry's Pitch for Driverless Dominance

By Eric Volkman

The technological world is littered with companies that once sold 'The Hot New Thing'.

When technology and trends moved on, though, these businesses were left behind. One such company that had been left nearly for dead by many pundits and consumers is BlackBerry, which at one point made the mobile communications device, the eponymous BlackBerry email pager. That product went the way of the Dodo bird a decade or so ago with the invasion of the iPhone and peer smartphones into our lives. BlackBerry faded away into irrelevancy.

At least to the general public. The connected car world is a different story. "To insiders and industry experts, the BlackBerry brand has meant, and still means, secure," said Matt Arcaro, research manager, next generation automotive at IDC. "In an automotive world where software and more importantly data is the new currency, being secure is a differentiator."

The company motored into the vehicle space with its acquisition of automobile tech specialist QNX in 2010. Building on QNX's stock in trade, in-car infotainment systems, BlackBerry positioned the business unit as a major provider of foundational in-car operating systems.

One part of QNX's appeal is flexibility. It's a relatively light system upon which an automaker or a solutions provider can develop various types of connected vehicle functionalities. More importantly for many of these clients, though, is that emphasis on security. This feature made the old BlackBerry email devices popular with government entities and big companies with sensitive information to protect. In this respect, BlackBerry and QNX were well matched.

"QNX's focus on providing a safe, secure, reliable and trusted software platform for the automotive and general embedded markets has remained constant both pre and post the BlackBerry acquisition," said Grant Courville, vice-president, products and strategy at BlackBerry QNX.

With an advanced-level or, ultimately, autonomous car, these elements are a must. Real-time data has to flow uninterrupted through "pipes" that are as protected against hacking as possible.

Flexibility and security are powerful selling points and they're obviously striking a chord with the market. Last year, BlackBerry announced that QNX software was in use in more than 150M cars around the world, a roughly 25% increase from the year before. Some of the planet's most significant carmakers are clients; BlackBerry listed General Motors, Ford, Honda, BMW and Volkswagen, among others.

However, what's hot in any area of tech today can be shoved aside with a solution that is better, cheaper, faster, or a combination of any of the above. BlackBerry and its auto tech unit are clearly aware of this, which is probably a key reason behind the company's recent unveiling of a set of functionalities to compliment the base QNX OS.

It has integrated the capabilities of Cylance, a recent $1.4Bn acquisition, into QNX. This results in a next-generation "concept solution" that in its own words is "a new AI-based transportation solution that provides holistic visibility and control of the security and health of a vehicle to OEMs and commercial and public fleets looking to 'future-proof' their vehicles".

BlackBerry also announced a partnership with Amazon Web Services, the retailer's cash-cow cloud computing

platform. It marries QNX's OS with Amazon Web Services' IoT functionalities and gives scope for clients to create tailored apps and machine-learning models for their systems.

These tie-ups and new offerings are impressive but, in a way, BlackBerry and QNX have little choice but to broaden their range. The prize is awfully big and other companies have their eyes on the OS segment, particularly in a world where systems can be constructed with free building blocks. Arcaro points out that "the biggest challenge that QNX faces is the maturation of alternative open source-based solutions that are becoming readily available.

"This is most evident in the area of infotainment (ex., AGL and Android) but as OEMs and suppliers become more and more comfortable with open source (and as the breadth of the open source code base grows) this will proliferate across automotive domains."

Courville doesn't see much of a threat from open source. As an example, he said that: "Linux, which many of our competitors use, comes from the complex microprocessor

world but does not have the necessary safety certification or real-time pedigree to be appropriate for safety-critical systems in the car (i.e. steering, brakes, engine systems, etc.)"

It also doesn't have BlackBerry behind it. According to Arcaro, the company "has a strong reputation and brand loyalty among automotive manufacturers and suppliers". He cites QNX's more than 20-year "pedigree" as one element of this and the fact that it "has never missed a committed production vehicle program delivery date".

"As time is money to OEMs, having dependability they can count is key," he said. If BlackBerry and QNX can maintain these habits while broadening and innovating, its systems should continue to be popular and straddle the cutting edge – unlike those funny old email devices it used to sell.

Lots of excitement surrounds the potential for utility-scale energy storage, but anyone working in the industry knows battery innovation is needed for mass commercialization.

Lindsay Gorrill

A revolutionary shift is underway in the electricity we use, and few people are even aware it's happening. For years, much of the conversation has been about trying to get people to think green and make small changes in their lives to make a difference for the planet.

Meanwhile an idea has been taking root quietly, one with massive scale ramifications. That idea is large-scale energy storage, which has less to do with the average consumer and more to do with the decision-makers on where our energy comes from.

To understand the concept of energy storage, one must first understand the fundamental shortcomings of our electrical grid. The way the grid works sounds straightforward enough: When electricity is generated through wind, solar, or even traditional power-generation sources like coal-fired power plants, that electricity has to be pushed to the grid to be used immediately. If it goes unused, it's essentially lost forever.

If you've ever driven by a wind farm and noticed that some or most of the wind turbines (Fig. 1) aren't spinning, it's not always because the wind isn't blowing. Often, they aren't spinning because the grid doesn't need the electricity at that moment, so the wind turbines are shut down, otherwise known as curtailment.

1. This group of wind turbines in the same location, known as a wind farm, is used to produce electricity.

However, energy-storage systems represent the future of utility-scale energy management, theoretically allowing every type of electricity-generation system to harvest the electricity at any time of the day and hold it in reserve for use whenever the grid actually needs it. This stands in sharp contrast to the status quo of "use it or lose it."

But alas, nothing is that simple. While energy-storage systems have demonstrated their ability to be effective in practice, the cost far outweighs the benefit. That's why changes in battery manufacturing, small and nuanced as they may seem, are so critical to the energy-storage sector, utilities, and most broadly, human life.

The Li-Ions

More recently, lithium-ion battery storage systems have been developed. These are capable of packing in enough energy, hopefully produced by renewables such as wind and solar at a low-enough price, to make utility-scale energy storage a practical addition for optimizing electricity-producing systems.

For industry context, the first lithium-ion batteries were commercialized for consumer use in 1991. In 2012, if you wanted a battery storage system, it would cost around $800 per kilowatt hour.

Since then, the cost of electricity from batteries has decreased 76%, and the price for standalone systems now averages about $209 per kilowatt hour. In addition to cost, today's lithium-ion energy storage solutions (Fig. 2) also allow utilities to continuously collect and store excess energy, be it from wind and solar or traditional methods like hydro power, gas, and coal. This energy can then be used during the intermittent peak times, or when it's needed most and the traditional grid can't be relied upon, such as during a natural disaster or blackouts.

2. A standard 19-in. racked energy-storage system, including battery cells with integrated safety features, comes fully equipped with a battery-management system.

As amazing as these increases in energy density and decreases in production costs are, there's still a price to pay. Nonetheless, the ability for large-scale battery storage systems to optimize electricity-generating systems is a real concept garnering mass adoption around the world, especially in parts of Australia, Europe, and Canada. The desire for more efficient and longer-lasting systems is growing, and people continue to dream of better solutions.

Developing Reliable Data and R&D

Despite the relative newness of lithium-ion batteries, they own the category, and while other battery formats offer promise, it's lithium-ion that remains the de facto battery solution. However, in an industry this young, there's not a lot of data about energy storage that's easily accessible or current. So, if you happen to find data on lithium-ion battery storage, but it's even a year or two old, the numbers for energy density and cost per kilowatt hour will be vastly different than what they are today.

Another reason why lithium-ion based energy storage is only just now beginning to hit its stride is due to the focus of previous research and development related to the technology. Electric vehicles have been the epicenter of funding and strategy for lithium-ion batteries, which is why most lithium-ion energy-storage solutions have had to make use of adapting electric-vehicle technology for energy storage. This lack of customization now opens up an

opportunity for battery developers, as there's significant room for improvement in the growing field of energy storage.

New systems now under development are specifically optimized for stationary energy storage. They're using lithium-ion batteries and related technical components that have been designed from the ground up to be as effective as possible.

In the energy-storage sector, industry materials make up 80% of the total cost of lithium-ion battery cells. Research and development in material science for lithium-ion batteries often revolve around three key aims—lower cost, higher energy density, and longer life. For example, in terms of cost, when transitioning from NMC 5-3-2 to NMC 6-3-1, you're looking to increase energy density with a further reduction of cobalt. With the high cost of cobalt today you could achieve as high as 5% savings in cost. This 5% savings becomes significant on a mass production scale.

On the Rise

This evolution in lithium-ion energy storage development is leading more investors, utilities, and wind and solar farm project developers to pursue these new energy-storage offerings. As new investments come in, the industry starts to develop more advanced technologies, leading to more robust supply chains (Fig. 3). In turn, the positive impacts on lithium-ion energy storage becomes more significant.

3. Here's a rendering of a 10-GWh manufacturing facility that's built to produce energy-storage systems.

Most people are only aware of news stories related to a few kilowatts of batteries in electric cars and residential energy-storage packs. Meanwhile, there are gigawatts of lithium-ion batteries being installed to optimize our electrical grid and build an enhanced, greener, more cost-effective future. If you talk to people in areas where the grid is unreliable, or places that get hit by natural disasters and the power is sometimes out for days or weeks, they understand the importance of what we're trying to do.

The meteoric rise of these battery systems isn't a short-term trend. Bloomberg reports projections on adoption and growth of lithium-ion battery-storage systems are regularly being updated, and the numbers continue to grow at higher rates than previously projected.

The more we can educate people about the importance of integrating energy storage into the grid, what that means, and the impact it can have, the better off the future will be for all of us. It was only a couple of years ago that people would talk about the environmental impact of clean energy as an aspiration for the future. But we're here to say it's no longer a dream.

Announcing TensorFlow Quantum: An Open Source Library for Quantum Machine Learning

Posted by Alan Ho

"Nature isn't classical, damnit, so if you want to make a simulation of nature, you'd better make it quantum mechanical." — Physicist Richard Feynman

Machine learning (ML), while it doesn't exactly simulate systems in nature, has the ability to learn a model of a system and predict the system's behavior. Over the past few years, classical ML models have shown promise in tackling challenging scientific issues, leading to advancements in image processing for cancer detection, forecasting earthquake aftershocks, predicting extreme weather patterns, and detecting new exoplanets. With the recent progress in the development of quantum computing, the development of new quantum ML models could have a profound impact on the world's biggest problems, leading to breakthroughs in the areas of medicine, materials, sensing, and communications. However, to date there has been a lack of research tools to discover useful quantum ML models that can process quantum data and execute on quantum computers available today.

Today (March 9, 2020), in collaboration with the University of Waterloo, X, and Volkswagen, we announce the release of TensorFlow Quantum (TFQ), an open-source library for the rapid prototyping of quantum ML models. TFQ provides the tools necessary for bringing the quantum computing and machine learning research communities together to control and model natural or artificial quantum systems; e.g. Noisy Intermediate Scale Quantum (NISQ) processors with ~50 - 100 qubits.

Under the hood, TFQ integrates Cirq with TensorFlow, and offers high-level abstractions for the design and implementation of both discriminative and generative quantum-classical models by providing quantum computing primitives compatible with existing TensorFlow APIs, along with high-performance quantum circuit simulators.

What is a Quantum ML Model?
A quantum model has the ability to represent and generalize data with a quantum mechanical origin. However, to understand quantum models, two concepts must be introduced - quantum data and hybrid quantum-classical models.

Quantum data exhibits superposition and entanglement, leading to joint probability distributions that could require an exponential amount of classical computational resources to represent or store. Quantum data, which can be generated / simulated on quantum processors / sensors / networks include the simulation of chemicals and quantum matter, quantum control, quantum communication networks, quantum metrology, and much more.

A technical, but key, insight is that quantum data generated by NISQ processors are noisy and are typically entangled just before the measurement occurs. However, applying quantum machine learning to noisy entangled quantum data can maximize extraction of useful classical information. Inspired by these techniques, the TFQ library provides primitives for the development of models that disentangle and generalize correlations in quantum data, opening up opportunities to improve existing quantum algorithms or discover new quantum algorithms.

The second concept to introduce is hybrid quantum-classical models. Because near-term quantum processors are still fairly small and noisy, quantum models cannot use quantum processors alone — NISQ processors will need to work in concert with classical processors to become effective. As TensorFlow already supports heterogeneous computing across CPUs, GPUs, and TPUs, it is a natural platform for experimenting with hybrid quantum-classical algorithms.

TFQ contains the basic structures, such as qubits, gates, circuits, and measurement operators that are required for specifying quantum computations. User-specified quantum computations can then be executed in simulation or on real hardware. Cirq also contains substantial machinery that helps users design efficient algorithms for NISQ machines, such as compilers and schedulers, and enables the implementation of hybrid quantum-classical algorithms to run on quantum circuit simulators, and eventually on quantum processors.

We've used TensorFlow Quantum for hybrid quantum-classical convolutional neural networks, machine learning for quantum control, layer-wise learning for quantum neural networks, quantum dynamics learning, generative modeling of mixed quantum states, and learning to learn with quantum neural networks via classical recurrent neural networks. We provide a review of these quantum applications in the TFQ white paper; each example can be run in-browser via Colab from our research repository.

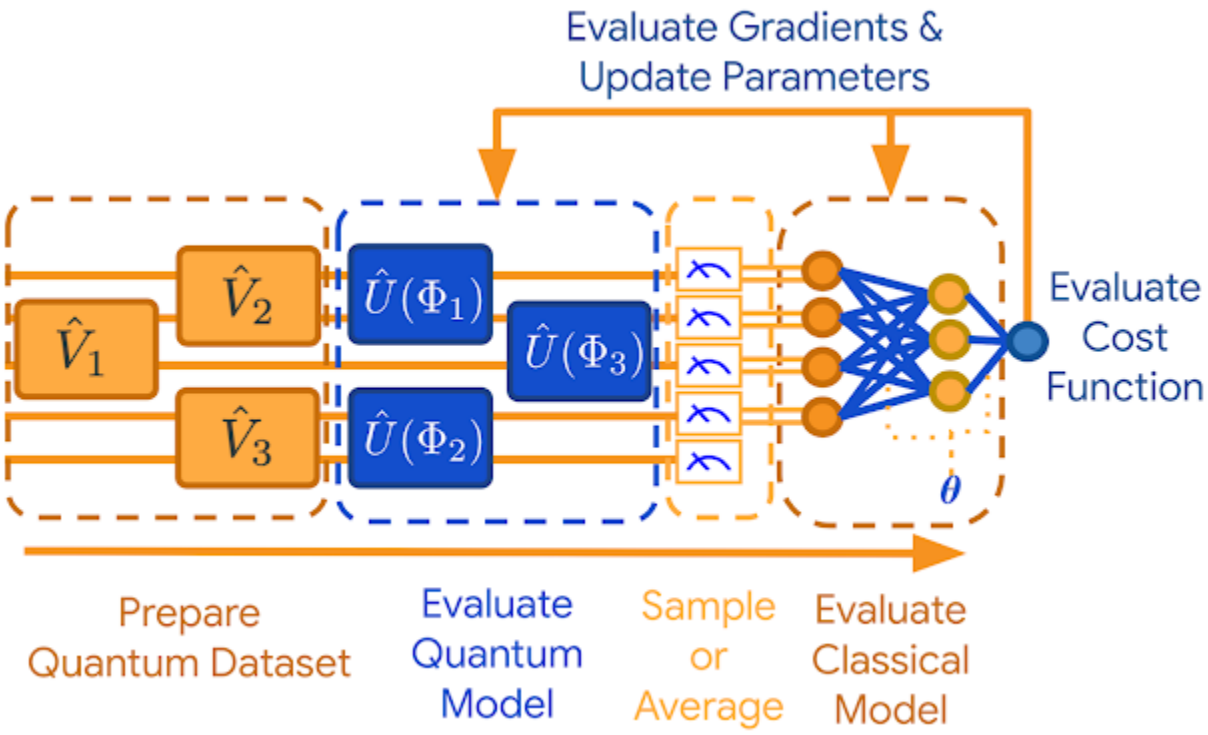
How TFQ works

TFQ allows researchers to construct quantum datasets, quantum models, and classical control parameters as tensors in a single computational graph. The outcome of quantum measurements, leading to classical probabilistic events, is obtained by TensorFlow Ops. Training can be done using standard Keras functions.

To provide some intuition on how to use quantum data, one may consider a supervised classification of quantum states using a quantum neural network. Just like classical ML, a key challenge of quantum ML is to classify "noisy data". To build and train such a model, the researcher can do the following:

1. Prepare a quantum dataset - Quantum data is loaded as tensors (a multi-dimensional array of numbers). Each quantum data tensor is specified as a quantum circuit written in Cirq that generates quantum data on the fly. The tensor is executed by TensorFlow on the quantum computer to generate a quantum dataset.
2. Evaluate a quantum neural network model - The researcher can prototype a quantum neural network using Cirq that they will later embed inside of a TensorFlow compute graph. Parameterized quantum models can be selected from several broad categories based on knowledge of the quantum data's structure. The goal of the model is to perform quantum processing in order to extract information hidden in a typically entangled state. In other words, the quantum model essentially disentangles the input quantum data, leaving the hidden information encoded in classical correlations, thus making it accessible to local measurements and classical post-processing.
3. Sample or Average - Measurement of quantum states extracts classical information in the form of samples from a classical random variable. The distribution of values from this random variable generally depends on the quantum state itself and on the measured observable. As many variational algorithms depend on mean values of measurements, also known as expectation values, TFQ provides methods for averaging over several runs involving steps (1) and (2).
4. Evaluate a classical neural networks model - Once classical information has been extracted, it is in a format amenable to further classical post-processing. As the extracted information may still be encoded in classical correlations between measured expectations, classical deep neural networks can be applied to distill such correlations.
5. Evaluate Cost Function - Given the results of classical post-processing, a cost function is evaluated. This could be based on how accurately the model performs the classification task if the quantum data was labeled, or other criteria if the task is unsupervised.

6. Evaluate Gradients & Update Parameters - After evaluating the cost function, the free parameters in the pipeline should be updated in a direction expected to decrease the cost. This is most commonly performed via gradient descent.



A high-level abstract overview of the computational steps involved in the end-to-end pipeline for inference and training of a hybrid quantum-classical discriminative model for quantum data in TFQ. To see the code for an end-to-end example, please check the "Hello Many-Worlds" example, the quantum convolutional neural networks tutorial, and our guide.

A key feature of TensorFlow Quantum is the ability to simultaneously train and execute many quantum circuits. This is achieved by TensorFlow's ability to parallelize computation across a cluster of computers, and the ability to simulate relatively large quantum circuits on multi-core computers. To achieve the latter, we are also announcing the release of qsim (github link), a new high performance open source quantum circuit simulator, which has demonstrated the ability to simulate a 32 qubit quantum circuit with a gate depth of 14 in 111 seconds on a single Google Cloud node (n1-ultramem-160) (see this paper for details). The simulator is particularly optimized for multi-core Intel processors. Combined with TFQ, we have demonstrated 1 million circuit simulations for 20 qubit quantum circuit at a gate depth of 20 in 60 minutes on a Google Cloud node (n2-highcpu-80). See the TFQ white paper, Section II E on the Quantum Circuit Simulation with qsim for more information.

Looking Forward

Today, TensorFlow Quantum is primarily geared towards executing quantum circuits on classical quantum circuit simulators. In the future, TFQ will be able to execute quantum circuits on actual quantum processors that are supported by Cirq, including Google's own processor Sycamore.

To learn more about TFQ, please read our white paper and visit the TensorFlow Quantum website. We believe that bridging the ML and Quantum communities will lead to exciting new discoveries across the board and accelerate the discovery of new quantum algorithms to solve the world's most challenging problems.

Acknowledgements

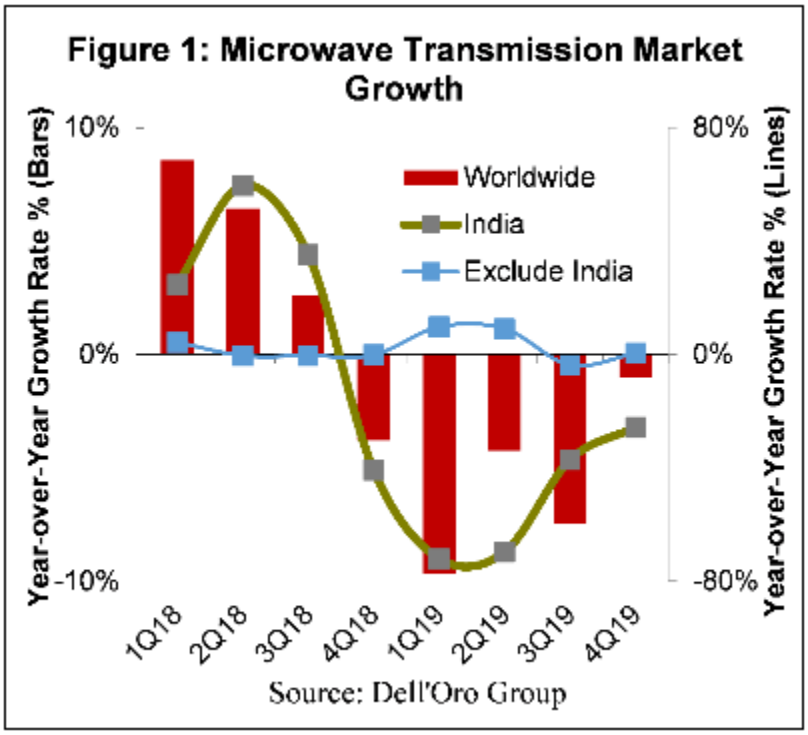
This open source project is led by the Google AI Quantum team, and was co-developed by the University of

Waterloo, Alphabet's X, and Volkswagen. A special thanks to the University of Waterloo, whose students made major contributions to this open source software through multiple internship projects at the Google AI Quantum lab.

Microwave mobile backhaul in a 5G world (Analyst Angle)

By Jimmy Yu @ VP of Dell'Oro Group

The Microwave Transmission market, comprised of point-to-point systems, declined 5 percent in 2019, bringing the market revenue down to $3.2 billion—far smaller than the good days of rampant 4G build outs and upgrades that drove this market's revenue up over $5.0 billion. Additionally, a decline of 5 percent just as 5G rolls out seems to imply a negative sentiment towards wireless backhaul in the new 5G world or does it?



When you dissect the drivers for the 2019 market decline, one thing becomes exceedingly evident (Figure 1). As you can see from this chart, the second largest influence on the Microwave Transmission market has been the events in India (the largest one will always be the timing of new cell site deployments and capacity addition). However, when we remove the impacts of the decline in India, the growth rates show a different story—market demand has been fairly stable and improving since 1Q18. Of course, this isn't a blanket statement across all countries. There are some countries in the world, such as those in Africa, that haven't improved and may not this year. However, those countries are also the ones that will likely enter the 5G world later rather than sooner.

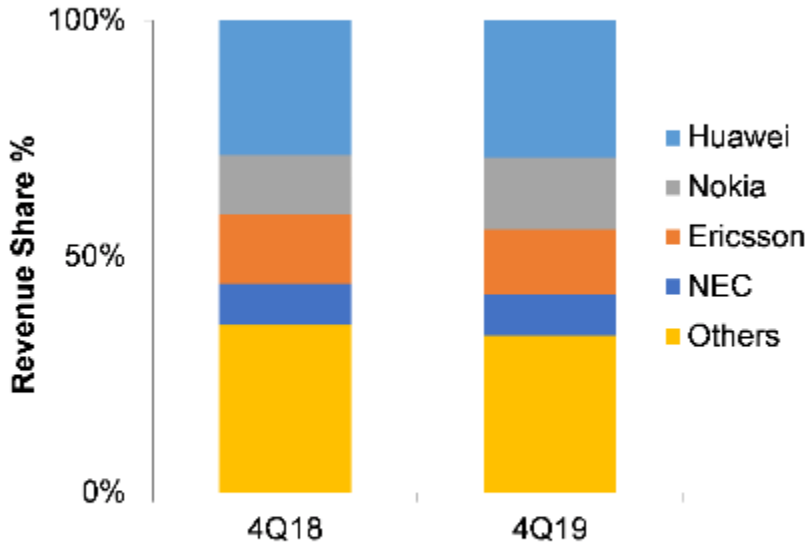
Most of the 5 percent market decline resulted from lower sales in India; India declined 60 percent in 2019 due to a slowdown in 4G deployments, accelerated by India's verdict that a number of operators owe AGR dues to the department of telecommunications. The largest dues have been imposed on two of the largest operators—Vodafone Idea owes Rs 53,000 crore ($7.4 billion) and Bharti Airtel owes Rs 35,586 crore ($5.0 billion). When we exclude India, the market for microwave gear grew 4 percent in 2019—a better indicator for market demand in a 5G world.

What does this mean for 2020? We think India will be less of a negative factor or influencer in 2020 since its revenue in 2019 dropped to such a low level—under $200 million (lowest revenue in past six years)—from an average annual revenue level of $420 million. 5G deployments are ramping up, and while many of the initial sites are leveraging the fixed line infrastructure (fiber-based backhaul systems), we anticipate a growing need for wireless backhaul using microwave equipment. Assuming the coronavirus (COVID-19) doesn't debilitate network infrastructure roll out, we anticipate the worldwide microwave market will stabilize in 2020 and begin a period of growth aligned with 5G.

Among the microwave technology segments, E/V Band systems (millimeter wave) have the greatest growth potential in a 5G world due to its ultra-high capacity (10 Gbps), small footprint, and low spectrum license fees in certain countries. In addition to these advantages, demand for E-band systems in particular is projected to grow due to the availability of multiband solutions that combine the benefits of standard microwave frequencies with that of E-band. There are of course a number of technical factors that will limit the demand for E/V Band equipment, but we

believe the benefits outweigh the costs in many instances. Hence, we forecast E/V Band revenue to grow about 20 percent in 2020.

Figure 2: Microwave Transmission Vendors



Others include companies such as Aviat, Ceragon, Intracom Telecom, SIAE, Siklu, Radwin, and ZTE

Source: Dell'Oro Group

Which system manufacturers benefit? By our calculations, four manufacturers or vendors captured the largest share of the Microwave Transmission market (Figure 2). However, with changing tides, we have witnessed a more fluid market as of late. Huawei continued to hold the largest share of the Microwave Transmission market, garnering nearly 30 percent share in 4Q19. And while this company's market share held fast, vendors beneath it such as Ericsson and NEC lost some footing due to lower sales into India. So, while typically the top three vendors in this market consisted of Ericsson, Huawei, and NEC, in 4Q19 Nokia overtook Ericsson for the first time and captured the second highest share. The vendor landscape includes other vendors that we think are well positioned, and while that group of vendors, combined, lost some share to these larger vendors, we anticipate at least one or two of them will break away from the pact of Others in the new 5G world.

The Direct Listing Craze

Post by Cooley

2019 marked the rise of the Direct Listing. Though they are not exactly new structures, following the heavily-publicized Direct Listings of tech giants Spotify and Slack, they have captured the imagination of the capital markets world. Venture capitalists love them. CFOs are intrigued by them. Bankers want to hang out with them. Securities lawyers are fearless of them. And, accountants, well, they mostly roll their eyes at them. They are everywhere. Howling in the hills, whispering in the wind, psst!'ing from hastily revised pitch books. If you want to get into a Direct Listing seminar, you have to call on Tuesday morning between 9 and 9:15 am, at least a month out. The point is that Direct Listings are kind of a big deal.

And they should be. The growing sophistication and breadth of private financing alternatives, combined with the mounting frustration at inefficient IPO pricing and market volatility at the very outset of trading, have made traditional IPOs a love-hate affair for investors and companies. Liquidity is fun and zesty, but its charms are often overset by the arbitrary whims of an unequal supply and demand curve. Plus, for the tech Supercorns, doing an IPO just isn't what it used to be. To a tech Founder, the hallowed sanctum of old Wall Street (and its once-apotheotic IPOs) isn't exclusive entry into some gilded mansion party. It's closer to a full day at the DMV, exacerbated by the frustrating knowledge that she could probably create and launch an app in about two weeks to handle the entire process in a few mindless swipes.

More than that, with increasingly notable stock "pops" in technology IPOs, companies are wary of leaving money on the table at IPO pricing by setting the price too low. Direct Listings avoid the shame of hindsight scrutiny. Better to let complete market dynamics (whose capriciousness is too providential to demand apology) decide the day, rather than arbitrary convention and countervailing and conflicting self-interests. Particularly for companies that have plenty of money on the balance sheet, Direct Listings provide a very appealing alternative and avoid dilution and the other potential downsides of an IPO.

With all the innovative energy associated with Direct Listings, they may appear at first to be more different than they really are. Legally, they are pretty similar to a traditional IPO, including:

Similar legal and financial disclosure requirements;

- 2-3 month SEC review process;
- Adopting governance policies and programs to meet SEC and listing requirements;
- Some marketing efforts to build support in Wall Street for post-listing trading;
- Similar publicity and Section 5 concerns when "in registration";
- Engaging sophisticated financial advisors to inform trading and pricing;
- Significant diligence processes to assess the material risks of the business and inform comprehensive disclosure to investors; and
- Securities Act liability for accuracy of disclosure in the registration statement.

Despite these similarities, there are definitely some fundamentally different aspects that companies will want to carefully consider before deciding to pursue a Direct Listing. Accordingly, we (and posterity) strongly advise that companies carefully read the following (and then call your attorney with any questions): 10 Key Considerations for Direct Listings

The two technology Direct Listings that have kicked off this trend (Slack and Spotify) were very similar in terms of process and structure. As Direct Listings become more prevalent, we will certainly see more bespoke versions. For

example, companies are now considering private placements of stock shortly before listing, in which they have more control over the potential dilution and it can be used to help determine the reference price for listing. An initial proposal by the NYSE to allow companies conducting Direct Listing to also sell primary shares to the market – which would have greatly increased the accessibility and appeal of Direct Listings for companies that are seeking capital in the public markets – was recently (and rather swiftly) rejected by the SEC, but the NYSE has since submitted a revised proposal to the SEC last week. Though this primary sale limitation remains a potential shortcoming for Direct Listings, we believe these efforts will continue and will ultimately result in structures that combine some of the best qualities of both IPOs and Direct Listings.

To that point, we suspect the primary catalysts behind Direct Listings will begin to trigger changes in some IPOs. For example, to get the benefits of immediate liquidity that we see in some Direct Listings, we may start to see shorter, staggered or more limited lock-up agreements. A company, for example, could allow all holders to sell a portion of their shares immediately (e.g., 25-50%) to satisfy early trading demand and increase initial trading volume, while keeping some shares back to potentially aid in stabilization. Similarly, IPOs could include only secondary shares to avoid concerns over too much dilution and pricing inefficiencies. Companies could look to a private placement just before or concurrently with a listing with investors with increased control over pricing and investor selection. Finally, for companies that do not want to spend weeks with potential investors pitching their stock, we may see shorter roadshows and/or Investor Days like that seen with Direct Listings.

All in all, Direct Listings are a great development. They have illuminated real concerns about IPOs and give companies another alternative in the seminal process of becoming a public company. Plus, in case you haven't read any actually interesting blogs on the topic, I will clue you in that many pre-IPO/listing investors really like them. Like all great new technologies, they strive to solve deficiencies in a system that continues to evolve. We think they are here to stay and that many investors and companies will grow to love them.

Direct Listing

A direct listing is the process by which a company lists shares held by its existing stockholders for sale on a public exchange. Unlike an IPO, where the company will typically raise capital by selling securities, in a direct listing no capital is raised by the company. Instead, the company registers the stock held by its existing stockholders, and those stockholders may sell their shares when the price is right for them. Just like with an IPO, companies undergoing a direct listing will need to comply with the registration requirements of the 1933 Act (pdf) as well as the public reporting requirements of the 1934 Act (pdf). In a direct listing, the company will file an S-1 Registration Statement, which includes a prospectus on the company and other detailed disclosures.

Once the S-1 is filed, the SEC makes comments that require revisions to the form, and the back and forth typically takes ten to twelve weeks before the securities can be publicly listed.

Unlike an IPO, in a direct listing, a company does not engage banks as underwriters to price securities and ultimately distribute them. Banks are involved as "financial advisors" to assist with messaging in the S-1 and other activities. In addition, the company can only engage in very limited marketing efforts for the securities to potential investors.

Dell spent $67B buying EMC -more than 3 years later, was it worth the debt?

By Alex Wihelm, Ron Miller

Dell's 2015 decision to buy EMC for $67 billion remains the largest pure tech deal in history, but a transaction of such magnitude created a mountain of debt for the Texas-based company and its primary backer, Silver Lake.

Dell would eventually take on close to $50 billion in debt. Years later, where are they in terms of paying that back, and has the deal paid for itself?

When EMC put itself up for sale, it was under pressure from activist investors Elliott Management to break up the company. In particular, Elliott reportedly wanted the company to sell one of its most valuable parts, VMware, which it believed would help boost EMC's share price. (Elliott is currently turning the screws on Twitter and SoftBank.)

Whatever the reason, once the company went up for sale, Dell and private equity firm Silver Lake came 'a callin with an offer EMC CEO Joe Tucci couldn't refuse. The arrangement represented great returns for his shareholders, and Tucci got to exit on his terms, telling Elliott to take a hike (even if it was Elliott that got the ball rolling in the first place).

Dell eventually took itself public again in late 2018, probably to help raise some of the money it needed to pay off its debts. We are more than three years past the point where the Dell-EMC deal closed, so we decided to take a look back and see if Dell was wise to take on such debt or not.

What it got with EMC

EMC is a consortium of companies; some, like VMware, operate separately with their own board and stock price. They can acquire and sell companies and are essentially separate entities, yet they operate within a shared corporate framework.

The EMC collective included Pivotal, considered a key piece at the time of the sale. It also went public eventually and was acquired by VMware after a disastrous quarter last June. RSA Security, another piece of the EMC puzzle, was considered another key component at the time. It was sold recently for $2 billion to a private equity consortium led by Symphony Technology Group.

Later divestments aside, EMC was a huge entity with lots of pieces, including, of course, its core storage business, which Dell was happy to get. VMware shareholders weren't thrilled by the deal, but they eventually came around and the agreement closed in 2016.

As we wrote at the time though, it was touch-and-go for awhile:

> Dell agreed to pay EMC shareholders $24.05 per share. In addition, it agreed to pay what's called a tracking stock, an amount that tracks against the share price of VMware. As the stock price dropped, it made the provision less valuable and shareholders increasingly nervous. With the stock price back close to its pre-acquisition announcement level, this should no longer be an issue.

Not everyone was critical, however. Oracle founder and chairman Larry Ellison said he wished he could have bought EMC, but his company was investing in building data centers to move to a cloud model at the time and didn't have the cash to spare.

All of this came with a price. Most organizations don't have $67 billion lying around (unless maybe you're Apple). Dell certainly didn't, which required it to borrow $48.6 billion, according to the company.

Let's have a look at the financials and then see how far they've come taking down that debt and if the results have justified taking on so much.

The financial impacts

We'll spare you a deluge of nuance on the history of Dell, Dell Technologies, the VMware tracking stock and why Dell wound up reporting earnings results even before it re-listed as a public company. All that matters for us today is that Dell did share financial results before the EMC deal was completed. So despite Dell not becoming a public company again until 2018, we have all the data we could hope for looking at the company before the deal and after.

This means that we can track how much debt it took on to pay for the transaction and how much its revenue and profit grew afterwards.

Dell reported quarterly earnings on September 6, 2017. That date, the company noted, was the day before the EMC deal was set to close. So we have results from the company on the cusp of the deal. During the three-month period, Dell reported $13.1 billion in revenue (+1%) and non-GAAP operating income of $752 million (+32%).

In the next quarter, the first partial period with EMC aboard, Dell's number grew: $16.2 billion in revenue and non-GAAP operating income of $1.975 billion. The next quarter saw even more growth, with Dell reporting (in the fourth quarter of its fiscal year, a three-month period ending February 3, 2017) revenue of $20.1 billion and non-GAAP operating income of $1.843 billion.

In very simple terms, the Dell deal looks smart. Adding EMC not only rapidly expanded its revenue, but Dell posted huge gains to its adjusted operating profit. All good, right? Mostly.

What about debt?

Recall that Dell took on lots of debt to finance the deal — debt that cost a lot of money to service and pay down over time. It was so much debt that the firm made lots of noise about how it was responsible, good for it and intended to pay it down quickly.

For example, Dell stressed during the deal's announcement that itself and EMC had "strong track records of cash flow generation and debt reduction." Moreso, Dell decided to make promises to its investors, saying that the "combined company will focus on rapidly de-levering in the first 18 to 24 months following the closing of the transaction." That's no small promise.

The firm certainly got off to a good start, noting in its first, post-deal earnings report that it had already achieved "$5.8 billion of debt paid down to date following the EMC merger close."

So how fast did debt come down? Let's run through the numbers. We'll look at the combined short-term and long-term debt figure for Dell over the quarters before and after the EMC deal:

- Quarter ending April 29, 2016: $13.1 billion in total debt
- Quarter ending July 29, 2016: $36.3 billion in total debt (final quarter pre-deal)
- Quarter ending October 28, 2016: $55.6 billion in total debt (first post-deal quarter, $5.8 billion paid down against deal)
- Quarter ending February 3, 2017: $49.4 billion in total debt ($7 billion paid down against deal)

Why did Dell's debt spike ahead of the deal's completion? It was issuing tens of billions of dollars in bonds to pay for the transaction. What matters, skipping the more granular accounting notes that we could include, is that after the deal it appeared that Dell was paying down debt quickly. Just like it had promised.

Now, three years down the line, what is Dell's total debt situation? For the fiscal quarter ending February 27, 2020, Dell reported $24.0 billion in revenue and adjusted operating income (sticking to that metric as it was what Dell reported while private and we want an apples::apples comparison) of $2.8 billion.

It also disclosed debt, once again combining short and long-term liabilities, of $52.0 billion.

Surprised by that number? So were we. Dell even noted in that same earnings report that it had "paid down $19.5 billion in gross debt since closing the EMC transaction in September 2016." We reached out to the company, which pointed us to a recent earnings slide deck that showed how far it had reduced EMC-driven debt, even as some of its other debts had increased.

Summarizing our hunt, then, Dell took on a bunch of debt to buy EMC, juicing its revenue and adjusted operating income. Initially debt fell as Dell made good on its promises to pay down its loans quickly. Dell kept paying off its debts related to the transaction over time, as its revenue and adjusted incomes grew. However, its overall level of debt has creeped back up over time for what appear to be unrelated reasons.

Ahead

Dell has work ahead of it, including lowering its overall debt load and perhaps simplifying its corporate structure. But returning to our opening question, how would we grade Dell's buy? Our general bias is toward viewing the transaction positively. The quick gains to the company's scale and (admittedly adjusted profit), not to mention later gains to both, cast a good light on the transaction. We would be more bullish on the combination if Dell owed less today, but its debt load appears manageable. That means Dell got EMC aboard without capsizing, something that at closing was not guaranteed, given the scale of the transaction.

Matternet's new drone landing station looks like a sci-fi movie prop

By Devin Coldewey

Drones making deliveries is of course the hot new hyperlocal tech play, but where are these futuristic aircraft supposed to land? On the lawn? Matternet *(*Chambiz's DF 17 Feb 2017)* has built a landing station for its cargo drones that looks less like a piece of infrastructure and more like a death ray from a '60s sci-fi movie.

Far from the free-form delivery network envisioned by Prime Air or the like, Matternet's drone deployments have been fixed point-to-point affairs focused on quickly connecting a handful of locations that frequently trade time-sensitive deliveries: hospitals.

The company has performed pilot tests in Switzerland and North Carolina, and just started a new one in San Diego, in which medical facilities are able to send blood samples, medications and (soon, one hopes) vaccines and other supplies back and forth without worrying about traffic or other complications on the ground.

But there's the problem of where exactly the drones land, and what happens afterwards. Does someone have to swap out the battery? Who says when it's safe to approach the drone, and how to detach its payload? Whatever the process is, it could probably be easier and more automated, and that's what the station aims to accomplish.

With its techno-organic curves and flower-like hatch on top, the 10-foot-tall station seems to channel the likes of "Star Trek: The Original Series" and "Lost in Space," and no doubt it's intended to be eye-catching as well as functional.

When the drone arrives, the top opens and the drone lands right in the center, where it is enclosed and grasped by the station's machinery, unburdened of its payload, and given a fresh battery. The payload is contained in the tower until it is called for by an authorized person, who scans a dongle to receive their package.

If there's just the one drone, it can live in the top part, the bulb or whatever you'd call it, until it's needed again. If there are multiple deliveries or drones, however, the one inside will leave and enter a holding pattern about 60 feet above, in an "imaginary donut."

The station will get its first installation in the second quarter of this year, at one of Matternet's existing customer hospitals. Presumably it will roll out more widely once this shakeout period ends.

You can see the full operation in the dramatization below:

As Prices Fall, Private Equity's Deal Appetite Could Grow

By Kevin Dugan

Monday's market decline - he biggest one-day drop since 2008—is rattling markets and is likely to throw tech companies' initial public offering plans into jeopardy. It may be just the moment that private equity giants have been waiting for.

For years, as valuations of private and public tech companies have climbed, some firms have sat tight on big deals. The aggregate value of technology deals done by private equity has fallen from a peak of $174 billion in 2015 to $108 billion last year, even though the number of deals has remained at historically high levels, according to data from Preqin.

That may change as prices come down and companies who had been planning on going public decide to hit the pause button. While the markets finished up 5% on Tuesday, trading was extremely volatile, with stocks falling below Monday's level at one point. That volatility is likely to freeze the IPO market for the time being.

Private equity firms could be an alternative route for private tech companies to raise cash. "Private equity investors who have the money surely will be knocking on doors saying, 'Hey, can we help you out?'" Lise Buyer, founder and principal at Class V Group, told The Information.

Some late-stage investors, such as Silver Lake, appear to be cashed up. Silver Lake has made two big investments in the past couple of weeks, including its $1 billion move on Twitter, unveiled on Monday, and its leadership in a $2.25 billion round for Alphabet's Waymo.

The market crash is bringing down valuations from high levels. Software companies in particular have become expensive, with multiples frequently reaching 8.5 times revenue, when historically they have been valued at less than half that, one banker said. Some are even pricier. Enterprise software firm Workday, for instance, was trading at 10 times 2021's expected revenue last month. Its stock has fallen 25% since then, cutting its multiple to 7.7.

If the haircut to valuations makes companies more appealing to late-stage investors, that could be helpful for companies that were relying on going public to raise cash. With an IPO likely off the table for the moment—and uncertainty about when the market will improve—one option would be to either sell or raise money from a late-stage investor such as a private equity fund. Even if the companies have enough cash to last them three to six months, they may need more cash if the market volatility continues all year.

"Given the moves in stock prices and valuations more broadly, every investor we talk to, both public and private, is advancing their work on [the question] 'Does [private financing] look more interesting at this time?'" William Connolly, head of technology equity capital markets at Goldman Sachs, told The Information. He estimated that tech companies have lowered their valuations by 5% to 20% percent amid the recent sell-off.

Of the companies expected to go public this year, one that could decide to delay its IPO and raise money is DoorDash, most recently valued at $12 billion. It announced a couple of weeks ago that it had filed confidentially with the Securities and Exchange Commission for an IPO, beginning the formal process. DoorDash could wait several months, although it may need to raise cash at some point this year. The Information estimated in December that DoorDash likely had between $500 million and $1 billion on hand. A person close to the company said DoorDash has plenty of cash.

There's ample precedent for companies delaying IPOs and raising money elsewhere. In 2014, Box put off its IPO during a bumpy market turn and raised $150 million from Coatue and TPG. It ended up going public in early 2015.

Of course, the market bumps of 2014 were mild compared with the current turmoil. It's unclear when the market will recover, given that the underlying cause of the downturn—the COVID-19 coronavirus—is still spreading around the world. The Nasdaq is now down 15% since mid-February. Bankers say companies contemplating IPOs will likely postpone for the next six weeks or so as they wait and see how long and how severe the global slowdown is.

"It's hard to assess not just how fast [the virus] is going to spread or the severity of it, but what it's going to do to the manufacturing cycle and the entire industrial complex," said Joe Voboril, managing partner at Farvahar Partners.

The last major freeze in the IPO markets came in 2008, following the September bankruptcy of Lehman Brothers. Investors didn't warm up to IPOs again until Mead Johnson, a baby-formula maker, raised $720 million in its February 2009 IPO after no company had gone public for nearly three months. Such large companies are often called "icebreakers" for their ability to bring the IPO market back to life, said Kathleen Smith, co-founder and chairman of Renaissance Capital, an IPO advisory and investment firm.

One company that as of last week was still committed to its IPO plans is Airbnb. Its CEO Brian Chesky told employees last week that the company still planned to go public this year, despite the hit that travel companies have taken in recent weeks. At the annual companywide meeting, Chesky urged employees to stay optimistic, saying that the company would need to get through the turbulence and eventually people would travel again, people familiar with the matter said.

Airbnb has plenty of cash—estimated at more than $2 billion. Its deadline to go public is related to employee stock grants, some of which will begin to expire early next year if it doesn't go public.

Startup advice for coronavirus turmoil: curb expenses; assess hiring; don't panic; be human

By Taylor Soper

When the global financial crisis hit more than a decade ago, Zillow was a burgeoning startup with 150 employees and no revenue.

"It was a tough time," recalled Rich Barton, co-founder of the online real estate giant. "But we made it through strong."

Barton, who returned as CEO of the $9 billion company last year, knows what it's like to lead a startup through economic turmoil.

It's a situation company leaders must face again as the COVID-19 outbreak that has infected more than 113,000 globally creates uncertainty about the business climate. Fears over the outbreak and an oil price war led to the worst day for U.S. stocks since 2008 on Monday. President Trump has already discussed a payroll tax cut.

"The biggest challenge is that the current situation is extremely fluid and very different scenarios are almost equally possible," said Boris Wertz, general partner at Version One Ventures. "So everyone should just prepare for the worst and diligently watch the situation."

Silicon Valley venture capital firm Sequoia Capital last week published the letter it sent to portfolio founders and CEOs titled "Coronavirus: The Black Swan of 2020." The investment group told its entrepreneurs to "question every assumption about your business" related to cash, fundraising, sales forecasts, marketing, headcount, and capital spending.

Barton, who previously co-founded Expedia and Glassdoor and is a board director at Netflix, echoed the advice.

"Raise cash when you don't need it," he said. "If it's too late to be prepared, raise cash anyway. If you don't like the price, learn to like it."

Tim Porter, managing director at Madrona Venture Group. (GeekWire Photo / Kevin Lisota)

He said CEOs should slash expenses where necessary. Beyond the balance sheet, company leaders must also think hard about their behavior and messaging to employees.

"The character of the founders and their companies is on full display when hard decisions are being made," Barton said. "Be human and respectful."

Seattle-based Madrona Venture Group is in close contact with its portfolio management teams, sharing best practices and providing advice.

Tim Porter, managing director, said the overall guidance is to not panic, but to be ready if this downturn lasts for an extended period of time. He said companies should re-examine hiring plans, think about how sales and marketing changes in a work-from-home environment, and consider cash reserves.

"While some businesses will be impacted more or less than others, we expect Q2 to be soft and likely also Q3," Porter said.

Some investors will be more skittish about plowing millions of dollars into companies, at least for the time being.

Valuations may take a hit as a result, and the record amounts of capital invested — funding to Seattle-area startups reached $3.5 billion last year — could take a cut.

Diane Fraiman, managing director at Voyager Capital. (Voyager Photo)

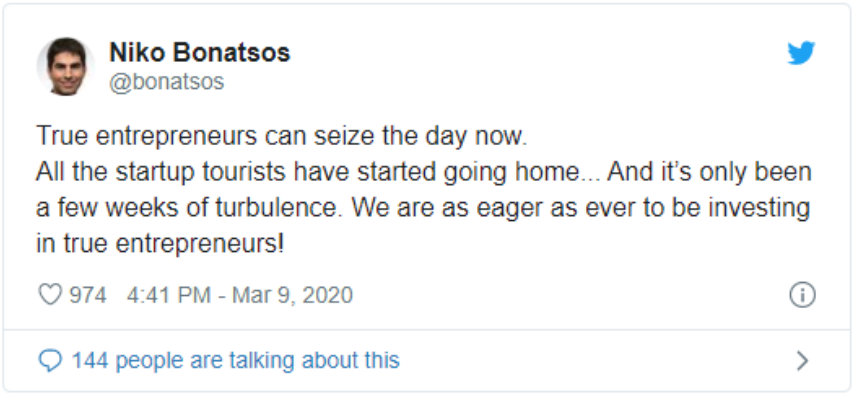
Chris Devore, general partner at Founders' Co-op in Seattle, said there was already considerable uncertainty due to the presidential election. "This only compounds what was already expected to be an anxious year," he said.

But a potential recession also provides opportunity. Companies such as Airbnb, Square, and Stripe all launched during the global financial crisis.

"While there is no question that fundraising for an early stage startup might be harder in these market conditions, we also believe that great companies are built during difficult market environments," said Diane Fraiman, managing director at Voyager Capital. "The teams that know how to stay focused on executing on the product and customer priorities win in the long run when the markets turn around."

And some investors aren't spooked — in fact, just the opposite.

Greg Gottesman, managing director at Pioneer Square Labs, helped startups work through two global economic crises during his tenure at Madrona Venture Group. He said this situation is different.



“There aren’t fundamental structural issues in regard to the economy that’s driving this period of uncertainty,” he said.

Even though Seattle has become the first epicenter for the U.S. coronavirus outbreak, Gottesman said he still considers the region the most exciting tech market in the country.

“This will be tough for us,” he said. “But we’re going to get through this situation ahead of other folks. All the underlying fundamentals for what makes Seattle so incredibly compelling as a tech center will remain.”

Key Takeaways

- Amid the coronavirus outbreak, investors are telling startup founders to look closely at sales forecasts, hiring plans, expenses and every other assumption about their business.
- Turmoil can also present opportunity, as changing markets and circumstances create new challenges to solve and opportunities for startups to grow their businesses.
- Difficult times bring out the true character of company leaders. Be human, but do your best to keep a level head under pressure.

Spanish-Israeli Venture Fund Cardumen Capital Raises $60 Million in Commitments

Cardumen focuses on early stage deep tech startups. The fund is led by former Samsung Ventures investors Gonzalo Martinez de Azagra and Roy Gottlieb

By Amarelle Wenkert

On Thursday (March 12, 2020), Tel Aviv-based venture capital firm Cardumen Capital announced it had secured $60 million in commitments for its first fund. Led by former corporate investors Gonzalo Martinez de Azagra and Roy Gottlieb, Cardumen has set its sights on deep tech B2B startups in early development stages. In a January interview with Calcalist, Gottlieb said that the two are looking to invest in what he called "the usual suspects:" artificial intelligence, cybersecurity, big data, IoT, and industry 4.0 startups.

Cardumen, which already has six portfolio companies under its belt, is looking to make at least 10 more investments within the next two years, aiming at initial investments of $1 million to $3 million per company, they said. Among the firm's portfolio companies are Israeli wireless charging company Humavox Ltd., 3D imaging startup MultiVu Technologies Ltd., and wireless communication technology company ***CoreTigo Ltd*** *(* Chabmiz's DF & 1st memo 5 Aug 18 / Chambiz's Executive summary 8 Aug 19)*.

Martinez de Azagra, who served as the former head of Samsung Ventures Israel, first announced the fund in 2017. During his tenure at Samsung Ventures, Martinez de Azagra backed companies such as Tel Aviv-based 3D sensing startup PrimeSense, later acquired by Apple; Replay Technologies, a developer of 3D video technologies later acquired by Intel; and ***Corephotonic***s, a developer of cameras for mobile devices acquired last year by Samsung.

The move from corporate investment to an independent venture capital firm means a shorter decision process and a greater focus on financial returns, according to Martinez de Azagra and Gottlieb. "Corporate VCs look for a double bottom line. They want financial returns, but more importantly, they are looking for strategic value," Martinez de Azagra said. "I think good corporate VCs aspire to be like financial VCs and use them as role models. They try to make deals that make financial sense with structures that are adequate and appropriate to their markets. But it is not entirely up to them; there are internal politics of the corporate world that sometimes make decisions on the corporate venture side somewhat dysfunctional."

At Samsung Ventures, Gottlieb said, the path to a deal was more complicated. "We had to think about what's in it for Samsung, and then find the internal sponsor that could push the deal forward, and these are processes that require time, months even," he said. "In a market as competitive as we now see in Israel, days and weeks matter. We are a lean team; the fastest we have been able to approve a deal is 48 hours, so far."

Cardumen is backed by Spanish bank Banco Sabadell and Spanish oil and gas company Repsol S.A. Other backers include other corporations, financial institutions, and individual investors, primarily from Europe and Latin America.

"We have been working for many years with large corporates," Martinez de Azagra said. "In the past, we brought corporate investors like Samsung and Accenture to Israel, and now we are looking to do the same for new corporates." As far as investments in Israel, European and Latin American companies have begun catching up to the trend, he said. "Europe was late to understand the importance of the startup nation."

Cardumen's backers, Martinez de Azagra said, are now looking for more than just financial returns. "These are large companies interested in entering Israel and investing in Israel," he said. "They want to work with Israeli startups and they are also looking for proof of concepts, pilots, and technology integrations."

Some, Gottlieb reminds, already have. In September 2019, Cardumen backer Sabadell invested directly in Israeli cybersecurity Kovrr Inc., as part of a $5.5 million seed round.
Speaking about Cardumen's investment strategy, Martinez de Azagra said they strive to co-invest with leading venture capital firms and corporates. "Our investments are designed to promote M&As," he said. "Our fundamental assumption is that most of our companies are going to get acquired."

"Personally, I look for a team that brings the right background, the right storyline to what they do. A good team-product-market fit," Gottlieb said. "I'm looking for strong synergy and long-term relationships between members of the team. We are not huge fans of teams that have met three to six months ago and just started working together."

Coronavirus alters the merger playbook for dealmakers

By Priyamvada Mathur

The coronavirus epidemic has begun forcing dealmakers to rethink how to manage risk in mergers and acquisitions.

When Morgan Stanley agreed to acquire E-Trade in February, the deal included terms that precluded both parties from invoking the novel coronavirus or its fallout as cause for renegotiating the $13 billion pact.

Deal terms for mergers and acquisitions typically provide buyers and sellers the right to change their agreements in the case of an unforeseeable event that causes a material adverse effect. That is a legal term for factors that could have a long-term impact on the potential of a company.

The fact that the E-Trade acquisition didn't treat the coronavirus in this way reflects how some dealmakers are viewing the crisis, which the World Health Organization declared on Wednesday to be a pandemic. But the purchase of the online brokerage appears to be one of the first major deals to explicitly make a reference to the outbreak.

The epidemic doesn't necessarily qualify as a material adverse effect because it isn't currently considered a long-term change, and its existence and potential business impact on various industries is highly visible, said Michael Szlamkowicz, a New York-based partner at the law firm Hogan Lovells.

Most buyers don't have an option to cite the coronavirus as a reason to walk away from a deal. But Szlamkowicz said corporate lawyers are advising their clients to do more aggressive due diligence—including closer scrutiny of supply chain and insurance policies.

Szlamkowicz, who represents buyout firms and pension fund sponsors, said that the way people evaluate companies has not changed, but the focus has become sharper.

"From a due diligence perspective, people are thinking about what the impact of this virus could be on a business, and that is causing target companies to perhaps look at things in slightly different ways than they did before," he said.

Some indicators are more straightforward than others: If the revenue of the target company is derived from situations where large groups of people are in close proximity, due diligence would be expected to dig deeper into how the virus might affect the health of the business. If staff is unable to gather, for example, even routine processes such as conducting a physical inventory during the outbreak could be challenging.

In addition, many companies have been advised by investors to gauge whether they are overly dependent on suppliers in specific geographies and devise ways to diversify their supply chain to be better prepared for the pandemic.

"We all know that several companies are suffering because they're trying to get a product out of China, and that's proving to be very difficult," Szlamkowicz said. "Alternate resources for raw materials and finished goods is definitely something that people are thinking about."

Some executives on both sides of a deal are checking for sound business continuity and contingency plans, which could mitigate negative effects of the virus.

“The idea is to make sure that buyers are able to factor in potential effects of the outbreak in the agreement—either as a material adverse clause or the valuation,” said Brandee Diamond, a Silicon Valley-based partner at law firm DLA Piper.

According to Szlamkowicz, one of the biggest threats to M&A deals is uncertainty over the duration of the pandemic.

"There is a lot of discussion about how the coronavirus will affect companies, but ultimately not a lot is changing in agreements," Szlamkowicz said. "That's because people don't yet know whether coronavirus is a short-term issue or a long-term issue."

Beyond the current pandemic, uncertainty in general can create a blind spot: Buyers wonder whether they are paying too much, and sellers wonder whether they are getting the right price for whatever it is that they're selling.

These days, buyers would certainly want the definition of a material adverse effect to include something explicit about the coronavirus. But sellers are likely to push back. What will the common ground be?

One area for negotiation could be to explore if there is a disproportionate effect the epidemic would have on a given target business as compared to the general impact on an industry or a particular geography.

But it is going to be challenging to negotiate, as buyers and sellers are likely to have a fundamentally different view on whether that effect is material enough to allow a buyer to abandon a deal.

The market is expected to eventually adjust to the new normal once it's known whether the coronavirus outbreak is going to be a more straightforward or complicated disease to manage from this point on.

Said Szlamkowicz: "But until we know what that normal is, there's room for a lot of concern."

The 7 deadly sins of startups

By Caryn Marooney

Pride. Greed. Lust. Gluttony. Wrath. Sloth.

You've probably heard of the Seven Deadly Sins, but I bet you've never wondered how they apply to starting a company. The answer: surprisingly well!

Over the years, I've talked about the seven habits every company should try to avoid and the seven (non-biblical) virtues each company should strive for. Done right, they will help founders focus, save time and avoid some common — and painful — mistakes.

For the purpose of this post, I've paired each sin with its closest corresponding virtue.

Sin No. 1: Lust (don't focus on what other companies have)
As a founder, you have to pay attention to your competitors. Just don't let that attention turn into lust for what they have — whether it's a flashy marketing campaign, a fancy office or a killer staff.

Executive lust: Lusting after leadership can be especially tempting. So your competitor hired a rockstar executive who seems to be doing all the right things. It's easy to think you need your own COO, or CRO, or CCO right now — and they need to be just like the person filling that role at the other successful company that looks nothing like yours.

Think carefully about what you need, why and what role that person will play day in and day out. What strengths and weaknesses do they have? What gaps do you need to fill? And what matters most to your customers and your business? It's also important to think about your stage and your go-to-market model. When it comes to personnel, one size never fits all.

Virtue No. 1: Patience (know who you are and improve over time)
Think long-term. Have you ever heard the saying, "everyone overestimates what they can do in one year and underestimates what they can do in 10 years"? It's true. There really is no such thing as an overnight success, and building something great takes time and a lot of patience.

Seek first to understand, then to be understood. The best CEOs I have ever worked for are tremendous listeners. They take everything as a learning opportunity. And they listen to understand and learn, not just to reply. Think about every interaction, especially with customers, as a learning opportunity.

Don't get ahead of yourself. I recently talked to a founder who had taken a lot of VC funding and thought she had to hire a super-senior field sales team, because that's what companies do when they have a lot of funding. There was just one problem: She didn't know if her company was going to have a direct sales model, a self-service model or a hybrid. Could she really sell to enterprises? Was her target SMBs? She hadn't answered those questions yet. First things first. Think carefully about what you need to do and then figure out how to do it.

Wash, rinse, repeat. Repetition isn't exciting, but it is important. Are you bored of saying the same thing again and again and again? Are you tired of having to repeat some version of the same thing time and time again to employees, customers, users, investors, social media and the press? Good. Very good. Smart people hate repeating themselves, but people (including me) have the attention span of a gnat. We all need to hear the same message over and over before we have any clue you are even talking. Think about how many times you've seen the same commercial and

still have no idea what it was for — or how many times you've heard someone's name and still can't remember it. This doesn't mean you have to say the exact same thing in the exact same way. As a founder, you can and should keep things interesting and fresh. But you have to be consistent with your core messages and what you stand for. Repetition (made interesting and relevant) is critical.

Sin No. 2: Gluttony (you can't do everything)
Don't try to be all things to all people. It's ugly and impossible. If you're a company that makes Cheetos, you really shouldn't try to make lip balm. Recognize when it's a good idea to leave something to the experts.

Think carefully about your target audience. What are you truly great at? What can you truly be the BEST at? Even the broadest technologies began by targeting a smaller audience. Facebook started with college kids. Apple focused on designers. Salesforce was all about salespeople. VMware was made for developers. All of them moved to a broader audience, but only after their initial success with a narrower one.

Virtue No. 2: Focus (stick to the plan)
Begin with the end in mind. What outcome are you shooting for? You may not get exactly what you want, but without a clear goal, you don't stand a chance. If you're starting a conversation with a customer, partner, investor or reporter, know what you'd like to get out of it. You might even want to write down the three things you will get across no matter what you're asked. Don't settle for avoiding a disaster. What would make an interaction great — for you and, more importantly, for the people you're talking to? If you know, you're halfway toward making it happen.

Don't make stuff up. No one knows everything about everything. But as a founder, you probably know more about your topic than anyone in the world. Show them. If a customer, VC, investor or reporter asks you a question, make sure your answer includes what's important. If you don't like a question or don't know the answer, don't ramble. Pause, answer the question itself (quickly, without fluff) and then tell your audience what you want to tell them. Maybe it's, "We do XYZ, but we find most customers care about ABC. We were surprised initially too, but here is a story/example of a real customer and why it matters." Or, "We thought that metric was the key as well, but it turns out what's really important is ABC and here's why. We were in an internal meeting when we discovered something surprising…" Or, "I really don't know much about that. I have read as much as you all have. But what I do know is how our customers are reacting today…"

Sin No. 3: Greed (bigger is not always better)
A lot of money and attention can make you very stupid, especially early on. Don't lose sight of why you started your company — whether it's to serve someone else, or to make something better. Running a company is hard and it's easy to let it become your whole world. Stay focused on the problem. No one is as smart (or dumb) as their stock price or valuation.

Think carefully about scale. If one is good, isn't one hundred better? Not necessarily. More employees are not always better; bigger teams are not always better; more offices are not always better; more features are not always better. Instead of scaling because you can, scale because it makes sense. Understand who a team will serve, what job someone will do, why you need that new office.

Virtue No. 3: Temperance (there's power in moderation)
Take a breath. You know the feeling when everyone on your team is super-excited and caught up in doing something BOLD or CRAZY? Sometimes it is a great idea, but sometimes it's just a bad idea caught up in group think. Step back, hold off on sending that email, tweeting that tweet or saying that thing. See if it still seems like a good idea when things are calmer.

Sin No. 4: Sloth (don't be lazy)

Skip the buzzwords. Words like "scalability," "optimization" and "disruption" end up sounding like white noise without specifics and substance. Try to scrub buzzwords from your talks and materials and see what you have left. It's a great way to force substance, details and specifics. You can always add one or two buzzwords back in later, but no more!

Longer isn't better. Mark Twain said, "I didn't have time to write you a short letter so I wrote a long one instead." It's easy to ramble and trust that others will figure out what's important. Editing is just as, if not more, important than creating.

Don't lean on other people. A good conference is an important stamp of approval, but you shouldn't rely on them to come up with your messaging and be your translator. Work to understand who the audience is and what they care about. If they're asked about your speech/presentation/Q&A later, what are they going to remember? What story or example will they be able to repeat?

Virtue No. 4: Diligence (put in the work)
Know your shit. A tremendous amount of power and satisfaction comes from knowing what you're talking about. Put in the time, go deep into something, and you'll be able to share it with confidence.

Ask for help. That said, you don't need to know everything. It's impossible. Asking for help — from experts, your team, your friends — is great. They can be older, younger, more senior, or more junior. Great experts can come from anywhere.

Sin No. 5: Wrath (keep your temper in check)
Don't get into silly fights. Unless fighting is a calculated part of your strategy — and you plan to continue fighting as part of your brand — don't do it. This includes fighting with reporters who may get tiny details wrong about your product, or competitors who say something disparaging offhand. It also includes sinking low on Twitter because you are tired or want to show your team you are standing up for them.

Let it go. Elsa was right. Letting something go does not mean rolling over when people attack the most fundamental parts of who you are or what you do. But getting up in arms over silly, small things is a waste of energy. Be thoughtful about what is and isn't worth it.

Virtue No. 5: Empathy (it's not about you)
Think win-win. Customers, investors, press and partners don't work for you, so you have to think about what they're trying to do. What problem are they trying to solve? Instead of focusing on what YOU want, focus on what THEY care about and how you can help them reach their goals.

Stay connected. Being busy and successful can distance you from your customers and the problems they are trying to solve. Work to stay connected to your teams, to your customers and to your partners. There are a million reasons not to, but it's crucial to long-term success.

Sin No. 6: Envy (don't try to be like someone else)
Don't try to be like other people. Some of the worst presentations or launches I have ever seen involved people trying to be like someone else. A bunch of them were wannabe Steve Jobs moments. It was not pretty. Be the best, most interesting version of yourself, understand what your customer cares about, be in tune to what is relevant and learn from others. But do not try to be like Steve Jobs.

Don't try to be like other companies. You've been working really, really hard, but so have your competitors — and now they're the ones getting the accolades and traction. It's not fair. But "fair" is the only four-letter word a startup founder shouldn't use (go nuts with the other ones, as long as there are no children nearby).

Comparing yourself to others can easily turn to envy — and envying someone else's anything is a giant waste of time. Having a sense of urgency and focus is useful and necessary, but envy is destructive. It can lead to rash decisions (usually in reaction to what someone else has done) and cutting corners. Chances are you will rise or fall because of what you do, or because of something like the global economy — which is out of your control — not because of another company. No one has to lose for you to win.

And envy is not inspiring. Your job as a leader is to convince other people to follow your vision and passion — not someone else's.

Virtue No. 6: Fortitude (be strong)
Everyone struggles. From the outside, every successful company looks like they're headed "up and to the right." But it's almost never that way on the inside, where setbacks and mistakes happen all the time. It can be tempting to take the easiest route, especially when you're under pressure. But sometimes you have to move back to go forward. Rewrite, redo, reorg. Doing it can be time-consuming and difficult, but if the change is important, it can make all the difference.

Leading when things are tough. Leadership matters more when times are hard. Competition, layoffs, bugs, execs leaving, controversies — these are the times when your teams need to hear more from you, not less.

Sin No. 7: Pride (…goeth before a fall)
Success has many fathers, but failure is an orphan. It's tempting to take credit for the "wins" and blame the "failures" on the market or the competition. The truth is usually somewhere in between. Learn from what you do and what happens to you.

Keep things in perspective. You are never as good or as bad as the press (or VCs or Twitter) says you are. Good press can easily go to your head, and bad press can take it all away in one fell swoop. Focus on what's important and don't get distracted by who's up and who's down, because tomorrow will be different.

Virtue No. 7: Humility (know what you don't know)
Try to understand the critics. You can't argue with trolls, but not everyone who disagrees with you falls into that category. No matter how annoying someone is, ask yourself if they have a point. Can you learn from them?

Seek feedback from others. I'm talking about real feedback, not just the good kind. Feedback can be an amazing gift that pushes you to get out of your own way. Take time to look back at what you did, why you did it and how it worked out.

Admit when you get it wrong. Everyone gets something wrong sometimes. A simple, honest apology can be incredibly powerful, and admitting when you made the wrong call or say the wrong thing can give you a lot of credibility.

Like the actual seven deadly sins, it may be impossible for founders to avoid ALL of these pitfalls — or consistently model the seven virtues. But hopefully, this list will help you and your company stay out of startup purgatory.

Have some sins or virtues of your own? I'd love to hear them.

US is preparing to ban foreign-made drones from government use

By Zack Whittaker

The Trump administration is preparing an executive order to ban federal departments and agencies from buying or using foreign-made drones, citing a risk to national security, TechCrunch has learned.

The draft order, which was drafted in the past few weeks and seen by TechCrunch, would effectively ban both foreign-made drones or drones made with foreign components out of fear that sensitive data collected during their use could be transferred to adversarial nation-states. The order specifically calls out threats posed by China, a major hub for drone manufacturers that supply both government and consumers, with the prospect that other countries could be added later.

The order says it's government policy to "encourage" the use of domestically built drones instead.

If passed, federal agencies would have a month to comply with the order, it said. But the military and the intelligence community would be granted broad exemptions under the draft order seen.

When reached, a spokesperson for the White House did not comment.

It's the latest move to crack down on Chinese-built technology, amid fears that Beijing is using its authority and influence to compel companies to spy at its behest. Huawei and ZTE among others have faced bans from operating inside the U.S. government, despite protests from the companies, which have long rebutted claims that they pose a risk due to their Chinese connections. Beijing responded in kind by banning from its state offices U.S. and other foreign-made technology.

The U.S. government's prevalent use of predominantly Chinese-made drones has come under more intense scrutiny in recent months. In January, the Dept. of the Interior issued an order grounding its fleet of close to 800 foreign-made drones, except for in emergencies, amid concerns that any data collected would be "valuable" to U.S. adversaries.

But an email seen by TechCrunch dated July 2019 appears to show internal disagreements about the risks of using foreign-made drones, just months before the grounding order would come into force. Interior's chief information officer William Vajda said in an email to two senior staffers that the department's drone program "understands the risks" of foreign-made drones and has "taken appropriate steps to mitigate them."

“The only more effective mitigation would be to use exclusively U.S. manufactured, non-foreign technologies,” he wrote.

Most of the department’s fleet is built by China-based manufacturers — including DJI — which stands to lose the most if the order is signed. DJI supplies some 70% of the world’s drones in a market said to be worth about $15 billion by the end of the decade.

A spokesperson for the Dept. of the Interior said the department was working to “further assess the risks” of foreign-made drones.

DJI spokesperson Michael Oldenburg said in a statement: “While we haven’t seen the document, this proposal is another attack on drone technology based on its country of origin, which recent reporting has shown has been criticized within federal agencies including the U.S. Department of Agriculture, Department of the Interior, Fish and Wildlife Service and even the White House Office of Management and Budget.”

“When communicating among themselves, these agencies’ officials have explained how such an approach damages American interests and does not solve any cybersecurity issues, and have acknowledged that DJI’s products have been validated as secure for use in government operations,” the spokesperson said.

Maintain data security when staff is working from home

Source by CrunchBase

The coronavirus pandemic has left governments floundering, businesses unprepared and citizens scrambling for hand sanitizer like it's worth its weight in gold.

The sense of general unpreparedness has a lot of people on edge. Not surprising, since we're on the edge of a global health emergency and it's impossible to predict exactly how government, travel or day-to-day business will operate during this outbreak.

Many tech companies already allow their staffs to work from home. Remote work policies are increasingly popular across the tech industry as companies push flexible working arrangements. In doing so, these companies have to prepare their IT infrastructure to accommodate remote working.

Granted, setting up a company to allow remote work is not an overnight job. It requires time and effort — but more importantly, investment and budget. It's an even bigger task to do it securely and without opening a door for hackers to walk in. But with the coronavirus spreading, now's a better time than ever to roll out a plan.

Secure your remote setup: The basics
Remote work has one fundamental security principle: Let in the right people to do the right things. In other words, your employees need to be able to do their jobs as if they were at the office.

It's not just letting users access their emails and files in the cloud — it requires identity and access controls, strong password policies and setting up two-factor authentication. Some companies are doing this already. Google takes a "no extra trust" approach to its workforce. By that, it means that just because you're in the office or on the corporate network, you don't get any special treatment. You still have to two-factor your way into the systems. On the plus side, Google has a completely mobile workforce that can be run out of a Starbucks if its employees need to.

TechCrunch's Romain Dillet has a good guide on how to secure your startup and Greg Kumparak has a list of things companies should think twice about.

Set up an enterprise VPN
You've probably heard a lot about virtual private networks — or VPNs — in the past year. They claim to give you security and anonymity (they don't). In fact, their original purpose — letting remote employees access resources on the company network as if they were there themselves — remains the most valuable reason for having a VPN. We're not talking about the consumer VPNs that secretly track your every move. Enterprise VPNs are exclusive to your company and your staff.

Not every company will need a VPN. But if you have services or systems behind the corporate firewall, you'll need one. If you don't know where to start, Cloudflare launched the Open for Business Hub that offers a number of services to help small and medium-sized businesses get started.

Remember, VPNs — like any other software — can contain bugs and security flaws, so make sure you keep your systems up to date. Don't forget to enforce strong access policies, like logging and enabling two-factor authentication.

Unchain your staff from their desks

Now that you have your systems set up to allow remote work, make sure you're offering your staff the equipment they need to do their jobs. That'll include laptops and perhaps dedicated work cellphones with an accompanying plan. Swallow the cost — it'll be expensive — but you might at least reduce the loss by switching the office lights off while nobody is there. You also may be able to write off the purchases as an operational expense.

It's unfair to assume that all of your staff are already equipped with their own laptops or work phones. And no full-time employee for a respectable company should have to pay out of their own pocket for a laptop or their phone bill for business purposes. Not only that, staff using for work purposes personal phones that contain data-vacuuming and privacy-invading apps can put your corporate data at risk.

Devices will break; what's your replacement strategy?
Those dedicated work laptops and cell phones remain the company's property. It's within a company's right to lock them down according to their own security policies.

Many use a central hub called a mobile device management server — or MDM — which acts as a gatekeeper and controller of your entire fleet of remote devices. You can set strong password policies, block access to malicious websites and ensure that only your work laptops can be used to access your VPN server. Not only that, it means you can set up all of your laptops in one go with one policy, saving your IT staff time in setting up each individual device.

With that in mind, you also should consider how your IT staff can work remotely for other remote workers, as well as developing a device replacement strategy. That means not if, but when accidents happen, you can send out a new laptop and have it configured as soon as it's booted up.

And don't forget to consider your employees' internet connections
Whether your office is in a busy metropolitan hub like New York or San Francisco, your staff are often not. Many commute from far and wide from the suburbs or the sticks where internet service is often less reliable — or fast — as in the inner-city.

Cell service may be better than home internet connections. You may want to buy hotspots and data plans for the workforce that requests it. As more staff are asked or forced to work from home, there's no telling what stress that might have on the internet infrastructure, such as network congestion and slower speeds. And for those working from home, allow them to expense their internet connections. It's crucial for staff who might go over any data caps as a result of their remote work. Remember, it also may be an operational expense you can write-off at the end of the year.

Watchdog sues for data on airport facial recognition

A lawsuit by a civil liberties group seeks to force the US government to disclose its policies and contracts for facial recognition technology being deployed at airports around the United States

A civil liberties watchdog sued the US government Thursday seeking the disclosure of records on the use of facial recognition technology being deployed at American airports.

The American Civil Liberties Union said it was seeking to force the Department of Homeland Security to release records on its contracts and policies for the technology which has been expanded in recent months.

ACLU staff attorney Ashley Gorski said the lawsuit aims to require disclosure of what the government is doing with the data it collects with face-scanning machines.

The expanded airport deployment is "putting us on an extraordinarily dangerous path toward the normalization of face surveillance," Gorski said in a statement.

"But because key facts about this surveillance are still secret, the public lacks the information it needs to hold these agencies to account. We're suing to bring some much-needed transparency."

The ACLU said DHS and other federal agencies have declined to respond to freedom of information requests on contracts with airlines, airports and other entities, and on retention policies regarding biometric information collected.

"The little we do know about the government's plans for face surveillance at airports is deeply disturbing," Gorski said.

ACLU said US officials have left open the possibility of mandating face surveillance on all US citizens traveling internationally and that non-citizens are currently unable to opt out of being subjected to the scans.

The lawsuit comes amid increased deployment—and complaints—about the use of facial recognition for law enforcement and private applications.

Backers of facial recognition at airports say it can ease long lines and make it easier to catch suspected criminals. But civil liberties activists argue it may be used for intrusive surveillance of innocent people.

The ACLU last year sued the FBI to seek disclosure of its database believed to hold at least 640 million images and other biometric data.

Coronavirus cancellations continue to stack up

By Kelly Hill

The list of telecom and tech events which are being cancelled due to the ongoing global outbreaks of novel coronavirus continues to get longer. As of yesterday, the International Wireless Communications Expo (IWCE) conference, which was set to begin on March 30 in Las Vegas, has postponed the event, with a new date not yet announced.

Mobile World Congress Barcelona was the first major tech event to be cancelled over coronavirus concerns. That was a preview of the weeks to come, as events large and small reconsider and often cancel amid rising spread of the virus. While confirmed cases in the U.S. remain low, they are rising. Meanwhile, Italy took the major step this week of essentially locking down the entire country in an attempt to rein in the spread of COVID-19 cases.

Austin, Texas' South by Southwest showcase of entertainment, music and tech was cancelled last week, as the city declared a local emergency. Industrial trade fair Hannover Messe, an increasingly important event for the telecoms sector as it seeks to spring the Industry 4.0 movement with wireless technologies, has been rescheduled for July. The event typically hosts over 250,000 people.

MIPIM, a major real estate and technology conference scheduled to be held in Cannes, France, this week with keynote speakers including French President Nicholas Sarkozy and Apple co-founder Steve Wozniak, has rescheduled for June.

Adobe was set to hold its annual summit in Las Vegas during the same timeframe as IWCE, and it has now cancelled the in-person conference in favor of moving some content online. Dell has decided to make its upcoming Dell Technologies World conference a virtual event, rather than an in-person show in Las Vegas. Chip maker NVIDIA's GPU Technology Conference in Silicon Valley has also moved online.

In San Francisco, Google I/O has been cancelled. IBM's Think event will be held as a virtual event. Facebook's F8 developer conference will be held online instead of in-person as well. The Federal Communications Commission has halted all domestic and international travel and event participation, and is restricting visitors to its offices, including its headquarters in Washington, D.C. It is using live-streaming and conference calls to hold some meetings virtually.

Companies' day-to-day operations are being impacted as well, with the Centers for Disease Control recommending that businesses put plans in place to allow or expand teleworking and consider cancelling non-essential business travel.

According to numbers reported by recode, data intelligence company PredictHQ said there was a 500% increase in major event cancellations and postponements in February. Meanwhile, the International Air Transport Association has said that airlines could lose 19% of their business if the outbreak is not contained soon. The organization has raised its estimates of airline travel losses to up to $113 billion, from a previous estimate of $30 billion.

However, some events are still moving forward. The Wireless Internet Service Providers Association put out an announcement affirming that it still plans to go ahead with WISPAmerica 2020, to be held in Dallas, Texas next week.

"The novel coronavirus is not to be sniffed at, but its risks are manageable – WISPs will not let these events paralyze their service to customers and the community at large," said Trina Coffey, VP of events and operations, in a statement. "WISPAmerica 2020 is still on."

Is 5G a gamechanger for end-user experience? RootMetrics tests 5G in 5 cities

Sourced by RCRWireless

What's 5G like? It depends a lot on a carrier's spectrum strategy.
As U.S. carriers expand their 5G networks' reach, is 5G living up to the promise that it will be a game-changer for end users' mobile experience?

Well … kind of. In some cases, in some places, and on some networks more than others, according to new testing by RootMetrics. 5G still has a long way to go to live up to its much-hyped potential, but there are intriguing glimpses of just how much the technology can improve the network experience for end-users who have 5G devices and coverage.

"While 5G has the potential to fundamentally alter the connected experience for both enterprises and consumers alike, the transformative effects of 5G won't happen overnight," the benchmarking company says in a new report which analyzes 5G performance across the four national carriers' 5G networks in five U.S. cities: Chicago, Dallas, Indianapolis, Los Angeles, and Washington, D.C.

"In a word, 5G can be complicated," the report concludes. "There is no one-size-fits-all 5G solution and the end-user 5G experience can vary a great deal depending on what type of spectrum the carriers use for deployments." Which spectrum a carrier uses for its 5G deployment affects both geographical coverage as well as speed performance.

RootMetrics noted that the four carriers have are pursuing different strategies in their 5G deployments. As far as spectrum used, the breakdown is:

Carrier	Low-band	Mid-Band	High-band/mmWave
AT&T	5G 850 MHz 4G 700 MHz	4G 1.9 GHz, 2.1 GHz, 2.3 GHz	5G 39 GHz
Sprint	4G 800 MHz	5G 2.5 GHz 4.G 1.9 GHz, 2.5 GHz	
T-Mobile	5G 600 MHz 4G 700 MHz	4.G 1.9 GHz, 2.1 GHz	5G 28 GHz
Verizon	4G 700 MHz, 850 MHz	4.G 1.9 GHz, 2.1 GHz	5G 28 GHz, 39 GHz

Image: RootMetrics

Among the conclusions that RootMetrics drew:

5G strategies are already shifting. "5G deployment strategies in the US have already shown signs of change," RootMetrics said. AT&T, for example, initially launched very limited 5G millimeter-wave deployments for enterprise last summer, but is now bolstering its low-band, consumer-oriented coverage — although even that has changed recently, with AT&T also beginning to offer consumers mmWave access (which it is calling 5G+ and which was not included in RootMetrics' current report, which covers testing that took place in late 2019).

Latency hasn't been significantly impacted as of yet. RootMetrics pointed out that faster speeds aren't exactly the same as lower latency. Latency testing results, the company added, "did not show a meaningful pattern of improvement on 5G compared to 4G LTE. That said, we expect to see latency improvements over time as the carriers continue to enhance their networks by utilizing more edge computing."

Download speeds are being prioritized. This is the case in other countries as well, RootMetrics said: carriers are using 5G to boost download speeds, rather than upload speeds.

Coverage is inconsistent, especially for mmWave networks. RootMetrics found that across the five cities tested, the percentage of time in which 5G service was available ranged from more than 57% of the time on T-Mobile US' network in D.C., to around 3% of the time if you were a Verizon customer in Chicago. T-Mobile US was found to offer more 5G coverage than the other carriers, RootMetrics said, but at a performance level that was actually slower than its 4G LTE network speeds, with a 5G median download speed that never exceeded 34 Mbps. "In short, our results suggest that, currently, T-Mobile's low-band 5G isn't performing much differently from its 4G LTE network," RootMetrics said, while adding that it expects speeds to improve as the technology continues to mature.

mmWave and mid-band spectrum strategies distinguish themselves by speed. Meanwhile, Verizon's mmWave turned in blazing speed, with RootMetrics clocking its fastest 5G maximum download speed at 845.7 Mbps in Washington, D.C. and recording one of the top-three fastest 5G speeds that RootMetrics has so far recorded in the U.S.: 780.1 Mbps in Chicago.

Sprint's mid-band 5G offers a marked improvement over its LTE performance, with a max download speed on 5G of nearly 250 Mbps in Chicago. Sprint's 5G performance in each of the cities tested was generally better than T-Mo's, RootMetrics found, and it was on-par with AT&T's low-band 5G network.

Verizon's mmWave network, however, shows just how much 5G "could profoundly change the end-user experience in some cities," RootMetrics said. It said that 5G median download speeds were "incredibly fast" across the carrier's network in the five cities, with "remarkable" download speeds in Chicago, Los Angeles, and Washington, D.C. And its 4G network still delivers as well, with LTE speeds that were faster than T-Mobile US' 5G in each of the cities, and a median download LTE speed in Los Angeles that was "nearly identical" to what RootMetrics saw on AT&T's 5G network in LA.

Consistency of experience is important to overall end-user experience. RootMetrics said that the "consistency of each carrier's speeds has the most impact on the end-user experience and reflects the true consumer experience regardless of network technology." In Chicago, Sprint and Verizon showed impressive speed consistency results; AT&T did particularly well with this in Dallas; and those three carriers were generally assessed by RootMetrics as providing a more consistent experience across network technologies than T-Mobile US.

"It's important to remember that new technologies always take time to expand and mature, and we should see both faster 5G speeds and greater 5G availability over time for all four carriers," the report said.

**** Read the full RootMetrics report here.***

Why PepsiCo Is Buying Rockstar Energy Beverages For $3.85 Billion

By Amit Chowdhry

Today (March 12, 2020) PepsiCo announced that it has entered into an agreement to buy popular energy drink maker Rockstar Energy Beverages for $3.85 billion. Launched in 2001, Rockstar creates products available in more than 30 flavors at convenience and grocery outlets in over 30 countries. And PepsiCo has had a distribution agreement with Rockstar in North America since 2009. Along with Rockstar, PepsiCo's energy portfolio includes Mountain Dew's Kickstart, GameFuel, and AMP. PepsiCo also entered into an agreement, which will provide approximately $0.7 billion of payments related to future tax benefits associated with the transaction, payable over up to 15 years. And PepsiCo does not expect the transaction to be material to its revenue or earnings per share in 2020. The transaction is subject to customary closing conditions, including regulatory approval and is expected to close in the first half of 2020.

PepsiCo's products are consumed over one billion times a day in more than 200 countries and territories around the world. Last year, PepsiCo generated over $67 billion in net revenue in 2019, which was driven by a complementary food and beverage portfolio that includes Frito-Lay, Gatorade, Pepsi-Cola, Quaker, and Tropicana. PepsiCo's product portfolio includes 23 brands that generate more than $1 billion each in estimated annual retail sales.

The leader in the energy drink category is Austria-based Red Bull GmbH. Red Bull sells 7.5 billion cans annually. And 700 million of those cans are sold in the U.S. Rockstar sells about 70 million cans in the U.S. per year. Rockstar was launched by Russell Weiner in 2001. According to Orbis via Bloomberg, Russell owns 85% of Rockstar and his mother Janet owns the rest. Weiner's father is conservative radio host Michael Savage.

Before launching Rockstar, Weiner worked for Skyy Vodka founder Maurice Kanbar in product development. After a year of working at Skyy, he launched Rockstar using $50,000 he got from a mortgage on his condo in California. Weiner's goal was to sell a beverage that was twice the volume of an 8-ounce Red Bull can at the same price. After trying hundreds of flavors, he decided to go with a combination of natural ingredients like milk thistle and guarana.

The second-largest player in the energy drink space is Monster. Monster is a publicly-traded company with a valuation of more than $35 billion.

Centerview Partners LLC acted as financial advisor to PepsiCo. And Gibson, Dunn & Crutcher LLP acted as lead counsel to PepsiCo and Davis Polk & Wardwell LLP as U.S. tax and antitrust counsel. And Goldman Sachs & Co. LLC acted as financial advisor to Rockstar with King & Spalding acting as Rockstar's legal counsel.

Key Quotes:
"As we work to be more consumer-centric and capitalize on rising demand in the functional beverage space, this highly strategic acquisition will enable us to leverage PepsiCo's capabilities to both accelerate Rockstar's performance and unlock our ability to expand in the category with existing brands such as Mountain Dew. Over time, we expect to capture our fair share of this fast-growing, highly profitable category and create meaningful new partnerships in the energy space." -PepsiCo Chairman and CEO, Ramon Laguarta

"We have had a strong partnership with PepsiCo for the last decade, and I'm happy to take that to the next level and join forces as one company. PepsiCo shares our competitive spirit and will invest in growing our brand even further. I'm proud of what we built and how we've changed the game in the energy space." -Rockstar founder and creator of the world's first 16oz energy drink Russell Weiner

Posted by Jaime Lien, Research Engineer and Nicholas Gillian, Software Engineer, Google Advanced Technology and Projects

The Pixel 4 and Pixel 4 XL are optimized for ease of use, and a key feature helping to realize this goal is Motion Sense, which enables users to interact with their Pixel in numerous ways without touching the device. For example, with Motion Sense you can use specific gestures to change music tracks or instantly silence an incoming call. Motion Sense additionally detects when you're near your phone and when you reach for it, allowing your Pixel to be more helpful by anticipating your actions, such as by priming the camera to provide a seamless face unlock experience, politely lowering the volume of a ringing alarm as you reach to dismiss it, or turning off the display to save power when you're no longer near the device.

The technology behind Motion Sense is Soli, the first integrated short-range radar sensor in a consumer smartphone, which facilitates close-proximity interaction with the phone without contact. Below, we discuss Soli's core radar sensing principles, design of the signal processing and machine learning (ML) algorithms used to recognize human activity from radar data, and how we resolved some of the integration challenges to prepare Soli for use in consumer devices.

Designing the Soli Radar System for Motion Sense

The basic function of radar is to detect and measure properties of remote objects based on their interactions with radio waves. A classic radar system includes a transmitter that emits radio waves, which are then scattered, or redirected, by objects within their paths, with some portion of energy reflected back and intercepted by the radar receiver. Based on the received waveforms, the radar system can detect the presence of objects as well as estimate certain properties of these objects, such as distance and size.

Radar has been under active development as a detection and ranging technology for almost a century. Traditional radar approaches are designed for detecting large, rigid, distant objects, such as planes and cars; therefore, they lack the sensitivity and resolution for sensing complex motions within the requirements of a consumer handheld device. Thus, to enable Motion Sense, the Soli team developed a new, small-scale radar system, novel sensing paradigms, and algorithms from the ground up specifically for fine-grained perception of human interactions.

Classic radar designs rely on fine spatial resolution relative to target size in order to resolve different objects and distinguish their spatial structures. Such spatial resolution typically requires broad transmission bandwidth, narrow antenna beamwidth, and large antenna arrays. Soli, on the other hand, employs a fundamentally different sensing paradigm based on motion, rather than spatial structure. Because of this novel paradigm, we were able to fit Soli's entire antenna array for Pixel 4 on a 5 mm x 6.5 mm x 0.873 mm chip package, allowing the radar to be integrated in the top of the phone. Remarkably, we developed algorithms that specifically do not require forming a well-defined image of a target's spatial structure, in contrast to an optical imaging sensor, for example. Therefore, no distinguishable images of a person's body or face are generated or used for Motion Sense presence or gesture detection.

Soli relies on processing temporal changes in the received signal in order to detect and resolve subtle motions. The Soli radar transmits a 60 GHz frequency-modulated signal and receives a superposition of reflections off of nearby objects or people. A sub-millimeter-scale displacement in a target's position from one transmission to the next induces a distinguishable timing shift in the received signal. Over a window of multiple transmissions, these shifts manifest as a Doppler frequency that is proportional to the object's velocity. By resolving different Doppler frequencies, the Soli signal processing pipeline can distinguish objects moving with different motion patterns.

Soli's location in Pixel 4.

The animations below demonstrate how different actions exhibit distinctive motion features in the processed Soli signal. The vertical axis of each image represents range, or radial distance, from the sensor, increasing from top to bottom. The horizontal axis represents velocity toward or away from the sensor, with zero at the center, negative velocities corresponding to approaching targets on the left, and positive velocities corresponding to receding targets on the right. Energy received by the radar is mapped into these range-velocity dimensions and represented by the intensity of each pixel. Thus, strongly reflective targets tend to be brighter relative to the surrounding noise floor compared to weakly reflective targets. The distribution and trajectory of energy within these range-velocity mappings show clear differences for a person walking, reaching, and swiping over the device.

In the left image, we see reflections from multiple body parts appearing on the negative side of the velocity axis as the person approaches the device, then converging at zero velocity at the top of the image as the person stops close to the device. In the middle image depicting a reach, a hand starts from a stationary position 20 cm from the sensor, then accelerates with negative velocity toward the device, and finally decelerates to a stop as it reaches the device. The reflection corresponding to the hand moves from the middle to the top of the image, corresponding to the hand's decreasing range from the sensor over the course of the gesture. Finally, the third image shows a hand swiping over the device, moving with negative velocity toward the sensor on the left half of the velocity axis, passing directly over the sensor where its radial velocity is zero, and then away from the sensor on the right half of the velocity axis, before reaching a stop on the opposite side of the device.

The 3D position of each resolvable reflection can also be estimated by processing the signal received at each of Soli's three receivers; this positional information can be used in addition to range and velocity for target differentiation.

The signal processing pipeline we designed for Soli includes a combination of custom filters and coherent integration steps that boost signal-to-noise ratio, attenuate unwanted interference, and differentiate reflections off a person from noise and clutter. These signal processing features enable Soli to operate at low-power within the constraints of a consumer smartphone.

Designing Machine Learning Algorithms for Radar
After using Soli's signal processing pipeline to filter and boost the original radar signal, the resulting signal transformations are fed to Soli's ML models for gesture classification. These models have been trained to accurately detect and recognize the Motion Sense gestures with low latency.

There are two major research challenges to robustly classifying in-air gestures that are common to any motion sensing technology. The first is that every user is unique and performs even simple motions, such as a swipe, in a myriad of ways. The second is that throughout the day, there may be numerous extraneous motions within the range of the sensor that may appear similar to target gestures. Furthermore, when the phone moves, the whole world looks like it's moving from the point of view of the motion sensor in the phone.

Solving these challenges required designing custom ML algorithms optimized for low-latency detection of in-air gestures from radar signals. Soli's ML models consist of neural networks trained using millions of gestures recorded from thousands of Google volunteers. These radar recordings were mixed with hundreds of hours of background radar recordings from other Google volunteers containing generic motions made near the device. Soli's ML models were trained using TensorFlow and optimized to run directly on Pixel's low-power digital signal processor (DSP). This allows us to run the models at low power, even when the main application processor is powered down.

Taking Soli from Concept to Product
Soli's integration into the Pixel smartphone was possible because the end-to-end radar system — including hardware, software, and algorithms — was carefully designed to enable touchless interaction within the size and power constraints of consumer devices. Soli's miniature hardware allowed the full radar system to fit into the limited space in Pixel's upper bezel, which was a significant team accomplishment. Indeed, the first Soli prototype in 2014 was the size of a desktop computer. We combined hardware innovations with our novel temporal sensing paradigm described earlier in order to shrink the entire radar system down to a single 5.0 mm x 6.5 mm RFIC, including antennas on package. The Soli team also introduced several innovative hardware power management schemes and optimized Soli's compute cycles, enabling Motion Sense to fit within the power budget of the smartphone.

Hardware innovations included iteratively shrinking the radar system from a desktop-sized prototype to a single 5.0 mm x 6.5 mm RFIC, including antennas on package.

For integration into Pixel, the radar system team collaborated closely with product design engineers to preserve Soli signal quality. The chip placement within the phone and the z-stack of materials above the chip were optimized to maximize signal transmission through the glass and minimize reflections and occlusions from surrounding components. The team also invented custom signal processing techniques to

enable coexistence with surrounding phone components. For example, a novel filter was developed to reduce the impact of audio vibration on the radar signal, enabling gesture detection while music is playing. Such algorithmic innovations enabled Motion Sense features across a variety of common user scenarios.

Future Directions

The successful integration of Soli into Pixel 4 and Pixel 4 XL devices demonstrates for the first time the feasibility of radar-based machine perception in an everyday mobile consumer device. Motion Sense in Pixel devices shows Soli's potential to bring seamless context awareness and gesture recognition for explicit and implicit interaction. We are excited to continue researching and developing Soli to enable new radar-based sensing and perception capabilities.

Acknowledgments

The work described above was a collaborative effort between Google Advanced Technology and Projects (ATAP) and the Pixel and Android product teams. We particularly thank Patrick Amihood for major contributions to this blog post.

Robots that can efficiently disinfect hospitals using UV light could slow coronavirus infections

Sourced by IEEE

The absolute best way of dealing with the coronavirus pandemic is to just not get coronavirus in the first place. By now, you've (hopefully) had all of the strategies for doing this drilled into your skull—wash your hands, keep away from large groups of people, wash your hands, stay home when sick, wash your hands, avoid travel when possible, and please, please wash your hands.

At the top of the list of the places to avoid right now are hospitals, because that's where all the really sick people go. But for healthcare workers, and the sick people themselves, there's really no other option. To prevent the spread of coronavirus (and everything else) through hospitals, keeping surfaces disinfected is incredibly important, but it's also dirty, dull, and (considering what you can get infected with) dangerous. And that's why it's an ideal task for autonomous robots.

UVD Robots is a Danish company making robots that are able to disinfect patient rooms and operating theaters in hospitals. They're able to disinfect pretty much anything you point them at—each robot is a mobile array of powerful short wavelength ultraviolet-C (UVC) lights that emit enough energy to literally shred the DNA or RNA of any microorganisms that have the misfortune of being exposed to them.

The company's robots have been operating in China for the past two or three weeks, and UVD Robots CEO Per Juul Nielsen says they are sending more to China as fast as they can. "The initial volume is in the hundreds of robots; the first ones went to Wuhan where the situation is the most severe," Nielsen told IEEE Spectrum. "We're shipping every week—they're going air freight into China because they're so desperately needed." The goal is to supply the robots to over 2,000 hospitals and medical facilities in China.

UV disinfecting technology has been around for something like a century, and it's commonly used to disinfect drinking water. You don't see it much outside of fixed infrastructure because you have to point a UV lamp directly at

a surface for a couple of minutes in order to be effective, and since it can cause damage to skin and eyes, humans have to be careful around it. Mobile UVC disinfection systems are a bit more common—UV lamps on a cart that a human can move from place to place to disinfect specific areas, like airplanes. For large environments like a hospital with dozens of rooms, operating UV systems manually can be costly and have mixed results—humans can inadvertently miss certain areas, or not expose them long enough.

> **"And then came the coronavirus, accelerating the situation—spreading more than anything we've seen before on a global basis"**
>
> *—Per Juul Nielsen, UVD Robots*

UVD Robots spent four years developing a robotic UV disinfection system, which it started selling in 2018. The robot consists of a mobile base equipped with multiple lidar sensors and an array of UV lamps mounted on top. To deploy a robot, you drive it around once using a computer. The robot scans the environment using its lidars and creates a digital map. You then annotate the map indicating all the rooms and points the robot should stop to perform disinfecting tasks.

After that, the robot relies on simultaneous localization and mapping (SLAM) to navigate, and it operates completely on its own. It'll travel from its charging station, through hallways, up and down elevators if necessary, and perform the disinfection without human intervention before returning to recharge. For safety, the robot operates when people are not around, using its sensors to detect motion and shutting the UV lights off if a person enters the area.

It takes between 10 and 15 minutes to disinfect a typical room, with the robot spending 1 or 2 minutes in five or six different positions around the room to maximize the number of surfaces that it disinfects. The robot's UV array emits 20 joules per square meter per second (at 1 meter distance) of 254-nanometer light, which will utterly wreck 99.99 percent of germs in just a few minutes without the robot having to do anything more complicated than just sit there. The process is more consistent than a human cleaning since the robot follows the same path each time, and its autonomy means that human staff can be freed up to do more interesting tasks, like interacting with patients.

Photo: UVD Robots

A shipment of robots from UVD Robots arrives at a hospital in Wuhan, where the first coronavirus cases were reported in December.

Originally, the robots were developed to address hospital acquired infections, which are a significant problem globally. According to Nielsen, between 5 and 10 percent of hospital patients worldwide will acquire a new infection while in the hospital, and tens of thousands of people die from these infections every year. The goal of the UVD robots was to help hospitals prevent these infections in the first place.

"And then came the coronavirus, accelerating the situation—spreading more than anything we've seen before on a global basis," Nielsen says. "That's why there's a big need for our robots all over the world now, because they can be used in fighting coronavirus, and for fighting all of the other infections that are still there."

The robots, which cost between US $80,000 and $90,000, are relatively affordable for medical equipment, and as you might expect, recent interest in them has been substantial. “Once [hospitals] see it, it’s a no-brainer,” Nielsen says. “If they want this type of disinfection solution, then the robot is much smarter and more cost-effective than what’s available in the market today.” Hundreds of these robots are at work in more than 40 countries, and they’ve recently completed hospital trials in Florida. Over the next few weeks, they’ll be tested at other medical facilities around the United States, and Nielsen points out that they could be useful in schools, cruise ships, or any other relatively structured spaces. I’ll take one for my apartment, please.

Aerial Imaging Market Growth Predicted at 12% Till 2024, Revenue to Cross USD 4 Billion-Mark: Global Market Insights, Inc.

Sourced by Global Market Insights

According to the latest report "Aerial Imaging Market by Platform (Fixed-wing Aircraft, Helicopter, UAV/drone), Imaging Type (Vertical, Oblique), Application (Geospatial Mapping, Disaster Management, Energy & Resource Management, Surveillance & Monitoring, Urban Planning, Conservation & Research), End-Use (Government, Energy, Military & Defense, Agriculture & Forestry, Archaeology & Civil Engineering, Oil & Gas), Regional Outlook, Competitive Market Share & Forecast 2024", by Global Market Insights, Inc., the market valuation of aerial imaging will cross $4 billion by 2024.

With an anticipated share of 42% by 2024, North America is at the forefront of the aerial imaging market. The region outlays significant amounts on its defense sector, along with various other verticals. UAVs are gaining prominence in the agriculture sector in the US, which is likely to fuel market trends. Moreover, the market is receiving investments from technology giants such as Google, which along with the support of federal agencies such as the Federal Aviation Administration (FAA) is likely to catapult the market on an upward trajectory.

The oblique imaging segment is anticipated to experience over 15% growth till 2024 driven by demand from various end-use sectors on account of growing visibility of oblique imaging as an aerial imaging modality. Oblique imaging can efficiently determine feature elevations and cover a larger ground area from the same altitude and focal length, as compared to vertical imaging.

By the year 2024, the UAV segment is estimated to account for a majority aerial imaging market share of approximately 78% owing to its rising use for aerial photography applications in government, education, agriculture, construction, and defense sectors. As drones are a better option for capturing events in urban areas, the government agencies are implementing this resource for crime investigation and regulation enforcement purposes.

The military & defense segment is projected to dominate the aerial imaging market with a CAGR of more than 15% during the forecast period due to an increase in the use of aerial photography for applications such as simulation & planning of different mission strategies and air defense mapping & planning. The agriculture sector is expected to grow faster due to developments in technology for precision agriculture practices through mapping of various factors such as crop & soil health, quality, and moisture content. Some of its major applications include irrigation & pesticide application scheduling, seasonal analysis, and evaluation of fertilizer.

Some of the aerial imaging market vendors are Eagle View Technologies, Google, Digital Aerial Solutions, DJI, Kucera International, PrecisionHawk, Nearmap, Cooper Aerial Surveys, Getmapping, 3D Robotics, DroneDeploy, Airobotics, and GeoVantage. The market players focus on developing advanced features using modern tools of analytics and image processing. The market leaders are observed to follow a partnership strategy for improving product features.