November 23, 2020
Chicago Quantum Exchange
Chicago Quantum Summit highlights new U.S. quantum centers, economic opportunities
By: Emily Ayshford

In a year where the U.S. federal government invested $700 million in quantum information science research centers and institutes, it's clear that quantum science is on the cusp of a revolution.

The third annual Chicago Quantum Summit, hosted virtually at the University of Chicago Nov. 11-13 by the Chicago Quantum Exchange, brought together more than 20 speakers from across the nation and attracted more than 1,000 attendees from 42 countries.

While quantum technologies have the potential to create next-generation computers and sensors, "the challenge and the opportunity for us lays in advancing the necessary fundamental science and engineering to scale this technology and to really build a quantum economy," said David Awschalom, Liew Family Professor in Spintronics and Quantum Information at the University of Chicago, director of the Chicago Quantum Exchange, and director of the new U.S. Department of Energy Q-NEXT center at Argonne National Laboratory.

Investing in new quantum centers and institutes
This year's summit comes on the heels of the announcement of five new U.S. Department of Energy National Quantum Information Science Research Centers and three new National Science Foundation Quantum Leap Challenge Institutes, authorized by the National Quantum Initiative Act.

"I see this as maybe the most compelling scientific enterprise of our time," said Dan Stamper-Kurn, professor of physics at University of California, Berkeley who directs the NSF Challenge Institute for Quantum Computation. "If we can bring about a revolution in computation, we can revolutionize all science."

The new centers and institutes comprise hundreds of researchers and students across dozens of universities, national laboratories, and industry partners. At the summit, each director gave an overview of their quantum center or institute goals. These ranged from eliminating decoherence (when quantum bits, or qubits, lose the information they hold), scaling quantum systems, building qubit technologies, developing algorithms for quantum computation, and creating new quantum devices.

The centers and institutes will also work together to share insights and common problems, and facilitate collaboration, including exchanging researchers to ensure "that the whole is greater than the sum of the parts," said Steven Girvin, Eugene Higgins Professor of Physics at Yale University and director of the Co-design Center for Quantum Advantage. "We're all trying to solve fantastically difficult problems. We will be much better at it in coordination."

Each center will also help to train the quantum workforce of the future, through elementary and high school STEM programming, new university-level initiatives, and post-graduate training.

At the summit, Harriet Kung, deputy director for science programs in the Department of Energy's Office of Science, said the agency has a long history of funding quantum research and hopes "these centers will be poised to accelerate the pace of the progress and also expand the scale of impact of quantum information science."

Sethuraman Panchanathan, director of the National Science Foundation, said the foundation has funded partnerships, people, and translational work related to quantum research for 40 years and is now looking to strengthen that research with speed and scale.

"The support for basic research will continue to be the main focus of NSF," he said. "We are going to continue to drive breakthroughs and advances across the spectrum of quantum science. That foundation has led to exciting new horizons for quantum science and technology."

Building a regional quantum economy

At the summit, Illinois Governor J.B. Pritzker spoke about continuing to invest in infrastructure to ensure that Chicago and Illinois can become a commercial hub for quantum technology. "We have an opportunity to become an industry leader in this arena by getting into it early," Pritzker said.

Three of the eight new federal centers and institutes are located in Illinois, demonstrating the strength of the research conducted at Illinois labs and universities. The State of Illinois committed $200 million for quantum research infrastructure at the University of Chicago and the University of Illinois at Urbana-Champaign.

"We created the opportunity for these awards to come to us," he said. "They wouldn't have come here if not for all the groundwork that we laid."

While Illinois is a hub for quantum research, of the $1 billion in venture investment in quantum information science in North America, only $150,000 has been invested in Illinois.

That's one of the reasons Penny Pritzker, founder and chairman of PSP Partners, Pritzker Realty Group, PSP Capital and PSP Growth and former U.S. Secretary of Commerce, co-founded P33, a nonprofit that aims to transform Chicago into a tech and innovation hub. "Without investment dollars, we will just be a research hub," she said. To win the quantum race, the region needs to attract deep tech investors. "We need to do a lot more if we are going to seize one of the great economic opportunities our state has seen," she said.

Nurturing quantum startups, now and in the future

While many large companies like Intel and Google are investing in quantum information science research, the quantum economic ecosystem also depends on startups to advance these leading-edge technologies.

Marc Singer, managing partner of venture capital firm Osage University Partners, said that while venture capitalists have a growing interest in funding quantum startups, it can be difficult for university startups to understand how their technology platform translates into a product. It takes many years and much funding to build the technology, and startups need to find a way to get market feedback during that timeframe.

“Ultimately, when we make an investment and its successful, it’s because they’ve built a great product, not because they have discovered great technology,” he said.

QEYnet, a startup out of Canada, is working to create a global microsatellite-enabled quantum key distribution network. Most secure information on the Internet is encrypted through public key encryption, which could someday be broken by quantum computers. In fact, bad actors are currently downloading encrypted information in order to “break” it once quantum computing becomes available.

QEYnet is now working to use satellites to transmit information with unbreakable quantum key distribution.

Other technologies, like quantum computing, have a longer time horizon. But startups like Zapata Computing, which is developing software for quantum computing, is working to secure the knowledge and IP needed to be successful in the future.

“If you don’t start now, you’re never going to be able to catch up, in the infrastructure sense and in the workforce development sense,” said Christopher Savoie, CEO and founder of the company. That said, there is a lot of hype around the field, and investors and the public need to be realistic about timelines of deliverables, he said.

“It takes time, and there are going to be visionaries and curmudgeons,” he said. “I’m on the optimist side.”

November 12, 2020
Forbes
Industry 4.0 Will Help Fuel Economy Post Election
By: Pete Wilkins

Days after the election, individuals, communities and the nation at large are still trying to predict how the results will impact the markets.

Despite the differences of the parties' platforms, however, both Democrats and Republicans ultimately support strengthening the economy and increasing jobs in the U.S. That said, how will emerging tech markets respond and expand in these uncertain times?

In the Midwest, some of the most promising tech sectors are emerging from a long history of world-class manufacturing companies headquartered in the heartland. These companies are a big part of the Fourth Industrial Revolution. However, this is not your grandfather's industrial revolution. This is the transformation of traditional manufacturing and industrial practices that is using modern smart technology, a powerful blend of hardware, software and artificial intelligence. When you peel back the layers, you'll find trillions of dollars in market opportunities in the following sectors:

- **Smart Manufacturing and Industrial Internet of Things:** As a result of the challenges from the global pandemic, this $709 billion market is growing even more, faster. Manufacturers realized they needed to be flexible and provide solutions when global supply chains were suddenly disrupted. Similarly, this year revealed an increased need for machine to machine communication, automation, robotics and other IIoT technologies.
- **Med Tech:** Typical regulatory barriers have been reduced because of the Covid-19 outbreak, which allows for innovations to break through in relation to timing, product development and design. Even once regulations return, it is expected that the competitive landscape will look different moving forward. After a year prioritizing health consciousness, healthcare and digital medical technology will continue to grow from its current market size of $312 billion.
- **Smart Homes and Buildings:** Internal collaboration tools and the necessity for adaptability within the work environment were greatly influenced by the pandemic. Now, there is an opportunity to make hard assets more adaptable and to improve remote work capabilities. It is expected that smarter equipment, buildings and collaboration tools will shape the next decade. This $22 billion market is expected 5-year market growth is 247%, which will create a lot of opportunity for startup disruption.
- **Connected Devices:** Now more than ever, it is important for companies to be able to sustain unpredictable or industry-level changes. Hardtech products, as well as digital apps and tangible collateral, create a strong business model to adapt to those unforeseen changes. This $26 billion market is ripe for strong growth for the foreseeable future.

With Industry 4.0 picking up steam, it is reasonable to predict that the Midwest will be at the center of it. From Ford to Medtronic to John Deere, the Midwest has a strong history of manufacturing success. As an industrial leader, the region continues to drive growth and increase jobs for the Midland and beyond. Better yet, there is an even brighter future ahead.

One of the organizations emerging as a leader for this revolution is mHUB. The nation's largest hardtech innovation and manufacturing center was launched to develop an entrepreneurial ecosystem around physical products and hardware innovation. mHUB focuses to accelerate industry growth by cultivating a community of collaboration and connection between innovators, entrepreneurs and manufacturers.

Working with a collection of early partners such as GE, UL and Molex, mHUB built a state-of-the-art facility. Thus, mHUB eliminates the high barriers of entry for hardtech innovation by providing access to capital intensive equipment, business and technical training, and a robust network of mentors, investors and partners. Since 2017, mHUB has supported over 350 startups, developed 900 products and attracted over $320 million in investments. While based in Chicago, the success of mHUB is evidenced across the country.

In an effort to accelerate Industry 4.0 growth, mHUB created the Product Impact Fund, and launched an incubation program for rapid commercialization called Accelerated Incubation. The Product Impact Fund is dedicated to investments in hardtech startups building IoT, medical devices, smart cities and other tech. The goal is to eliminate the funding gap for hardtech startups and solidify the U.S. as the global leader in the latest industrial revolution. The venture fund is complemented by Accelerated Incubation, which is a six-month, hands-on accelerator focused on the product development and commercialization of early-stage, high-potential hardtech startups. In each cohort, ten companies will have access to nearly a million dollars in investment capital and a variety of support and testing opportunities. So far, mHUB has partnered with AVNET, Panduit and Baxter to support the first two cohorts of the program.

Of course, mHUB is not alone. Another organization in Chicago working diligently to help industrial tech companies grow and scale is P33, which is a private sector funded tech catalyst working to turbocharge Chicago’s tech ecosystem and promote inclusive economic growth. They’ve developed a program called P33 Company Connect, which introduces corporations and startups in Chicago to create more commercial activity. They are focused on the growth stage tech companies. Through facilitating curated connections around specific use cases, they are helping scale growth stage startups through acquisition of enterprise customers and improve access to capital for women and minority entrepreneurs.

The impact from P33 can already be exemplified by companies such as Impossible Objects and Xaptum. Impossible Objects is providing manufacturing companies with a cost-effective 3D printing solution that produces strong, market-ready products in an accelerated time frame. Their composite-based, strong and quick additive manufacturing capabilities yield high stiffness,

strength and fidelity that is critical to manufacturers of certain products (imagine the most complex automotive parts or associated tooling).

Xaptum goes further. The company has developed an enabling technology to scale and secure enterprise edge deployments such as Industrial IoT (IIoT) and machine vision. Their overlay network secures traffic between IoT devices and any cloud through any last-mile connection, 10X faster at 20% of the cost of alternative systems. Not only does Xaptum's technology protect the data from the sensors and machine vision equipment from being modified by unwanted parties, but the overlay network also enables interoperability between different assets, giving operations leaders even more options on how to run their equipment. This technology provides significant impact for utilities, TDL and manufacturing companies with large and dispersed asset bases.

Chicago has long been home to a host of industrial behemoths, like ITW, Grainger and Navistar, to name a few more. It is no wonder that many innovative industrial tech companies have sprouted here as well. These growth stage companies offer solutions that improve the flexibility of core manufacturing processes, protect and optimize the extensive asset base and extend the capabilities of their customers' workforces.

The Midwest has positioned itself to be a leader in the Fourth Industrial Revolution. It will be exciting to watch the continued innovation, collaboration and leadership from the heartland region.

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STAT
How much is a startup worth? For biotech companies, the answer is rarely public
By: Kate Sheridan

Valuations are fundamental information about any startup. Not only can high valuations give a company bragging rights, it can also affect how much its stock could eventually be worth or how much another company will be willing to pay to acquire it.

Figuring out how much a company is worth can be easy in some industries; if more people stayed at an Airbnb last year than the year before, the company is likely worth more.

Biotech valuations are based on far less concrete information — and the industry is notoriously more private than the tech industry, for example, which has become more and more willing to talk about valuations.

Part of the fogginess in biotech valuations stems from the fact that until a drug is actually approved, investors aren't working with concrete numbers or sales trends. Instead, they're betting on probabilities that change with every clinical trial result.

"Biotechs get valued based on promise," said Bill Whela , an attorney at Mintz who works with privately held life science companies that are raising money.

Ultimately, valuation comes down to how much of a company an investor is able to buy for a certain amount of money. If one venture capital firm invests $10 million into a company — and if that's enough to buy 10% of a company's shares — then that firm and that company must have agreed that the company is worth at least $100 million.

A company's valuation is generally reassessed only when new money comes in; on paper, a biotech company could appear to be worth the same amount while still making progress. Arriving at a new valuation typically requires a negotiation between early-stage investors and the company's founders. Investors want to buy part of a company at the lowest price they can get — hoping that the price of those shares will eventually go up — while executives want to make sure their companies have enough money to function.

"It's a negotiation with the management team and the founders and the other [venture capital] funds about how much money we really need around the table, and how much ownership everyone needs to make their returns make sense," said one biotech venture capitalist, who asked not to be named.

For tech companies, outsiders can often take a good guess at what a company's valuation might be.

“You can look at revenue growth rates, you can look at these metrics of a business that brings in cash on a daily, monthly, or weekly basis,” the biotech venture capitalist said. “In biotech, we don’t have that.”

Instead, biotech investors have to rely on a set of factors that are more complicated to appraise. If another biotech company has proven that targeting a specific protein can successfully treat a condition, for example, then private companies aiming for the same protein might be able to negotiate a higher valuation.

“Data, at the end of the day, is the primary currency of value in biotech — and that’s very hard to benchmark back to specific valuation metrics,” said Bruce Booth, a partner at Atlas Venture.

Some factors are even less quantifiable. Some investors might value an experienced chief scientific officer. Others will weigh in on how much a patent is worth. If a company’s product fails in clinical trials — a routine experience in early-stage drug development — is there an obvious pivot or backup plan? That, too, could affect how much a company is worth.

In any negotiation, information is power — so in theory, the biotech industry’s tight-lipped approach to valuations could give venture capitalists an opportunity to take advantage of upstart entrepreneurs who don’t know the market well. (One venture capitalist compared it to how salary negotiations can be influenced by whether a person knows how much their co-workers or colleagues in similar positions at other firms make.)

On the other hand, many of today’s biotech startups are hand-crafted by venture capital firms — which means people negotiating on either side of the table often have more insight into the other side’s position than usual.

It’s also getting increasingly hard for biotechs to keep their valuation information private, said Jon Norris, a managing director at Silicon Valley Bank. Data sources like PitchBook will comb through filings to find the information and sell it to potential investors. “I’ve actually had situations where a biotech did not want to tell me their valuation — but PitchBook had it,” he said.

Cultural differences could also explain why tech and biotech companies seem to take such divergent approaches to discussing their valuations in public.

“I think that there’s this cultural disconnect — in tech, they really care about the unicorn status,” the venture capitalist said. “I don’t think that the biotech community thinks in unicorns.”

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Reuters
For workers, 'digital upskilling' puts tech trends on fast-forward
By: Chris Taylor

NEW YORK - This year has taught us a lot of things, but here is one major 2020 lesson: Tech skills are a virtual necessity.

With much of the workforce cooped up at home for eight months or so, many of us have had to get increasingly tech-savvy in a hurry.

There is even a term for it: "Digital upskilling".

Patricia Miller is already a pro. Miller works for management consultants PwC in Tampa, Florida. She signed up for the firm's "Digital Accelerators" program that aims to boost the high-tech skills of its workforce.

As a result, she went from previous roles in human resource and project management to become an IT operations team lead.

"I didn't even code prior to this program, and now every time I get to use my coding skills like Python, I do a little happy dance," Miller said.

TECH TRENDS ON FAST-FORWARD
Digital upskilling is not new: Amazon announced a $700 million initiative to boost the digital skills of its workforce last year. PwC rolled out its own $3 billion program, and a flurry of other corporate giants from Nationwide to Home Depot to IBM are all doing the same.

The COVID-19 pandemic pressed the fast-forward button, however, accelerating a tech shift already taking place.

"Since the pandemic started, companies are fast-tracking their embrace of digital technologies," said Gianni Giacomelli, chief innovation officer at business transformation firm Genpact, and head of innovation design at MIT's Collective Intelligence Design Lab. "They are enabling people to learn wherever they are, whenever they want, on any device."

It stands to reason that equipping employees for the digital world would have positive bottom-line results. According to PwC's Global Digital IQ survey, 86% of top-performing companies reported that digital training programs boosted employee engagement and performance.

So what tech skills are we talking about, exactly? When careers site LinkedIn analyzed job openings for sought-after skills this summer, its tech-heavy top 10 list included data science, data storage technologies, tech support and digital literacy.

In fact, LinkedIn has even set up a training hub, in partnership with Microsoft (opportunity.linkedin.com). It offers free training resources for the top 10 jobs with the greatest number of openings, steady growth during the past four years, a livable wage and skills that can be learned online.

Those in-demand gigs include software developer, digital marketing, IT admin, and data analyst.

“Before there used to be tech jobs, and non-tech jobs,” said Joe Atkinson, PwC’s chief products and technology officer. “Now there are just ‘jobs’, and everyone needs to have comfort with technology.”

The real challenge in digital upskilling lies in execution, especially if you are talking about large companies with thousands of employees. Making an entire workforce digitally savvy, especially when the latest technologies are changing all the time, is a bit like herding cats.

A few guidelines:

GO BITE-SIZE
A lot of employee learning just does not get done because the task can seem so massive and daunting. So make learning easy, accessible and universal – such as PwC’s “Digital Fitness” app, which is not only internal but available in public app stores.

“If you ask an employee to find six hours for a learning effort, that’s really hard,” said Atkinson. “But if you ask them to find 15 minutes, that’s a lot easier. That bite-size approach can make a big difference.”

THINK COLLECTIVELY
Having an employee learn a tech skill alone on a computer is nice, but that’s not going to drive big transformation across a firm. Instead, you have to think about collective intelligence and how staffers interact, said Genpact’s Giacomelli.

“Create opportunities for employees to source knowledge and learn from each other,” he said. Use the human brain as a model for information transmission, Giacomelli suggested. The central nodes are experts (the masters), and the branches around them are the learners (the apprentices).

“Then activate it, like a brain’s neural network connects across parts of the brain,” Giacomelli added.

ESTABLISH A CONTINUAL LEARNING HABIT
This might sound counterintuitive, but the particular tech skill you want to learn – a coding language or a software program, for instance – is not as important as the habit of learning itself.

“Don’t worry too much about whether or not you are studying the right tech,” said Atkinson. “Just keep learning about subjects you are passionate about, whether it’s data visualization or coding or blockchain or virtual reality. Because the tech landscape will look completely different in three to five years.”

October 27, 2020
Illinois Science and Technology Coalition
Catalyst Conversations: Launching a Pioneering Quantum Startup
By: No Author Listed

In October, we partnered with the Chicago Quantum Exchange (CQE) to explore the evolving landscape of Quantum Information Science (QIS) in Illinois—including how researchers in the state are learning to harness the technology and building relationships with industry along the way. *In this Catalyst Conversations, we hear from* ***Pranav Gokhale, Founder of Super.tech*** *about launching a pioneering quantum startup, Chicago's entrepreneurial ecosystem, the role quantum will play moving forward, and much more.*

1. Tell us about your background. What in your career led you to become a startup founder?
I grew up in suburban Maryland, near the National Institute of Science and Technology (NIST) laboratory. Through NIST's science outreach programs, I became interested in quantum technology and I had the opportunity to intern in their quantum cryptography and ion trap labs. Based on those positive experiences, I studied computer science and physics in college, which have a natural intersection in quantum computing. In parallel, I caught the entrepreneurship bug. I think there's something really special about what a small but dedicated team can do when they have an exciting vision. I wound up working at two Silicon Valley technology startups after college graduation. I loved both jobs, but in 2017 I became keenly aware that recent experimental strides meant that quantum computing was now closer to reality. I felt this was not an opportunity to miss, and I was also fortunate to meet Professor Fred Chong from UChicago.

One thing led to another and I joined Fred's lab in fall 2017, with a research focus on closing the gap from near-term quantum computers to practical applications. As our research progressed to more and more commercially relevant outcomes, spinning off a company felt like the natural next step after my PhD defense. While academia is important for proof-of-concept oriented research, industry has the right incentives for transferring research into a usable product. Super.tech is aiming to do exactly that.

2. Your startup, Super.tech, has really gained steam in recent months. Tell us about how Super.tech came together and the technologies you're pursuing.
Super.tech is a spin-out of research in Professor Fred Chong's quantum computing group at UChicago. The core philosophy behind Super.tech is that quantum programmers should be aware of the underlying hardware. This is akin to traditional computing in the 1940s, when programmers like Grace Hopper might find that a pesky moth (a "bug") had broken the computer. While we certainly don't expect to see moths inside quantum computers, we do deal with high component failure incidence, just as in traditional computers from the 1940s. And yet, the existing quantum software frameworks typically assume the underlying hardware has perfect and abundant qubits (quantum bits). Our technology breaks this assumption and allows the quantum software to better match the restricted and imperfect hardware underneath. We

think that our technology and strategy will enable us to accelerate the timeline for practical quantum computation.

3. Why quantum? What excites you about the technologies made possible by quantum information science (QIS)?
QIS is exciting because it can fundamentally change what is scientifically possible. In the particular domain of quantum computing, what's incredible is that qubits (quantum bits) can be exponentially more powerful than traditional bits. As a result, there's an entire class of problems that are virtually impossible to solve even on a supercomputer, but would be easily solvable by a quantum computer. For example, with a few hundred perfect qubits, we could figure out how to biomimic the process of nitrogen fixation. This process is needed for the production of fertilizer, which accounts for 2% of the world's entire energy expenditure. Quantum computing will enable us to dramatically reduce that energy burden. While many of these applications will materialize in the longer term, we think that quantum computing will also enable nearer-term speedups for use cases in energy, finance, and logistics. And that's just quantum computing—other areas of QIS like quantum sensing and networking enable another suite of applications as well.

4. Being a relatively new field, there aren't many quantum startups. What challenges does that present? What opportunities does it provide?
One challenge is that there are a lot of unknowns. What is the right business model for a quantum company? Is our market timing too early, too late, or just right? How do we price our product in the absence of a competitive market? On the other hand, I think it's exciting that we get to be among the first to answer these questions—the lack of precedent is an opportunity. We are fortunate to be in a generally pre-competitive era, where we are collaborating with other companies under win-win terms. Finally, I think we're well positioned to recruit top quantum talent, much of which is being incubated by Chicago and Midwest universities.

5. In June, Super.tech received an $150k investment from UChicago' George Shultz Innovation Fund. How was that investment boosted your growth? What other resources have you leveraged to get the startup off the ground?
The GSIF investment has enabled us to boost our product development pace and establish ourselves as a key player in the quantum space. It also kickstarted a number of useful introductions, which actually led to follow-on investments—stay tuned! I also had the chance to virtually meet with George Shultz, who offered his kind words and wisdom, which was cool. More broadly, we've also leveraged resources from Chicago organizations such as Argonne Chain Reaction Innovations, Chicago Quantum Exchange, P33, and the Polsky Center. One of the highlights has been joint CQE-P33 organized workshops facilitating interaction between large Chicago businesses, quantum academics, and quantum startups. We also benefited from participating in the I-Corps customer discovery program led by the Polsky Center earlier this year.

6. You recently joined Chain Reaction Innovations (CRI) at Argonne National Laboratory. Congrats! What interested you about CRI, and what are you looking to accomplish while in the program?

Thanks! CRI has been fantastic. For context, CRI is an incubator at Argonne, primarily focused on deep tech startups relevant to the Department of Energy. This is important because unlike building a traditional web or software startup, a successful quantum startup will require careful coordination with government and private industry before there is a payoff. CRI provides that opportunity, along with education and guidance around navigating the world of federal funding and government contracts, which can be quite a maze for a newcomer. At a high level, we expect that our CRI tenure will lead to (a) close government relations including funding through programs like SBIR and (b) development of a business model and strategy for engaging with industry. I've also learned a lot from my CRI peers—especially from past CRI cohorts—who have valuable wisdom to dispense.

7. What is your perspective of the quantum community in the greater Chicago area? How do you see quantum startups fitting into the region's entrepreneurial ecosystem in years to come?

Chicago has a tremendous opportunity to become the nation's leader in quantum technology. And it's getting there. I think it's fair to say that Chicago has been the quantum winner of 2020. Look no further than the fact that two of the five National Quantum Initiative Centers were recently awarded to Chicagoland via Argonne and Fermilab. The credit for Chicago's recent successes in quantum can be attributed to organizations like the Chicago Quantum Exchange and P33. I think the next step involves technology transfer from academia and government research to private industry. Given the concentration of quantum activity, talent pool via our universities, and abundant manufacturing space, many of the seeds are in place for the industry to grow. That's why Super.tech is based here, and we'd like to see other quantum companies emerge here too.