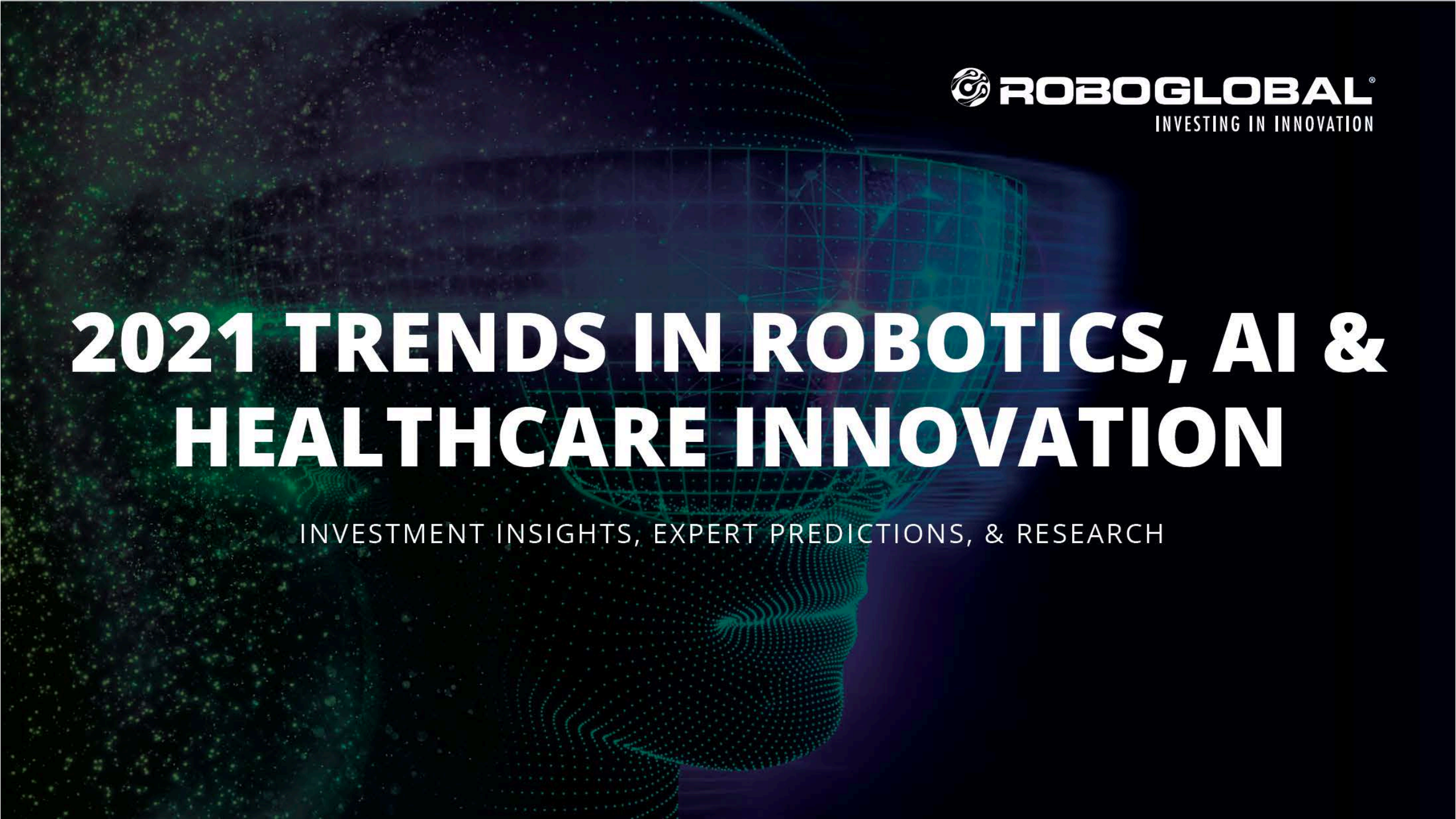
ROBOGLOBAL
INVESTING IN INNOVATION
2021 TRENDS IN ROBOTICS, AI & HEALTHCARE INNOVATION
INVESTMENT INSIGHTS, EXPERT PREDICTIONS, & RESEARCH

While some industries were devastated by the events of 2020, others thrived.

That was particularly true in many areas across the landscape of robotics, automation, AI, and healthcare innovation.

Here are some of the key trends we are watching in 2021:

SUMMARY

In this annual report, we highlight key growth trends in robotics, AI, and healthcare technologies going into 2021, and the role those trends will play within our three innovation indices: ROBO, THNQ & HTEC.

ROBOTICS & AUTOMATION

- Factory Automation Will Boom in 2021
- China Will Remain the World's Top Factory Automation Story in 2021
- Logistics and Warehouse Automation Growth Will Continue to Soar
- Look Up: Commercial Use of Indoor Drones

ARTIFICIAL INTELLIGENCE

- Big Data and AI: Digital Transformation and Cybersecurity
- Ecommerce: Immersive Experience
- Ecommerce: Integrated Mobile Payment Platforms
- Consumer Media: Video Games
- Autonomous Systems: Commercial Vehicles

HEALTHCARE TECHNOLOGY

- A Look Back at Our 2020 Expectations
- As COVID-19 Impacts Ease, Focus on Innovation Will Fuel Growth
- We've Only Just Scratched the Surface of Virtual Care
- Data Analytics and AI are Revolutionizing Primary Care
- Gearing Up for Early Cancer Detection
- Therapeutic Innovation Has Reached an Inflection Point

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ROBO

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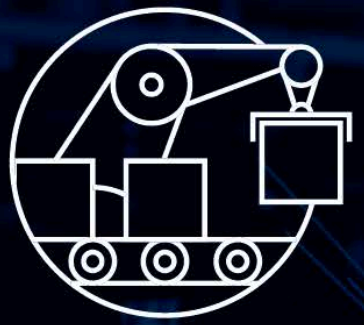
ROBOTICS & AUTOMATION



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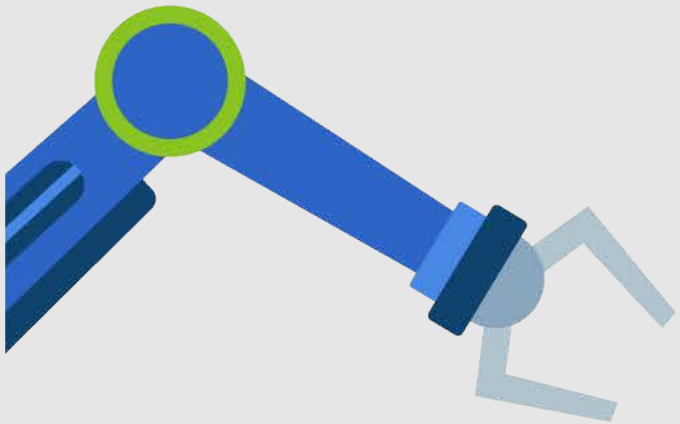
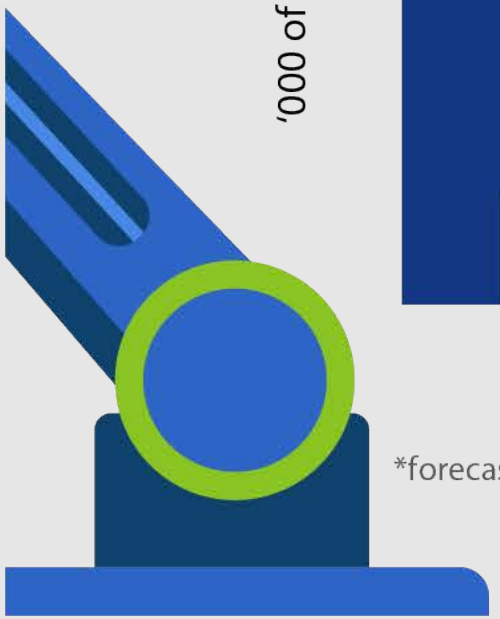
Factory Automation Will Boom in 2021

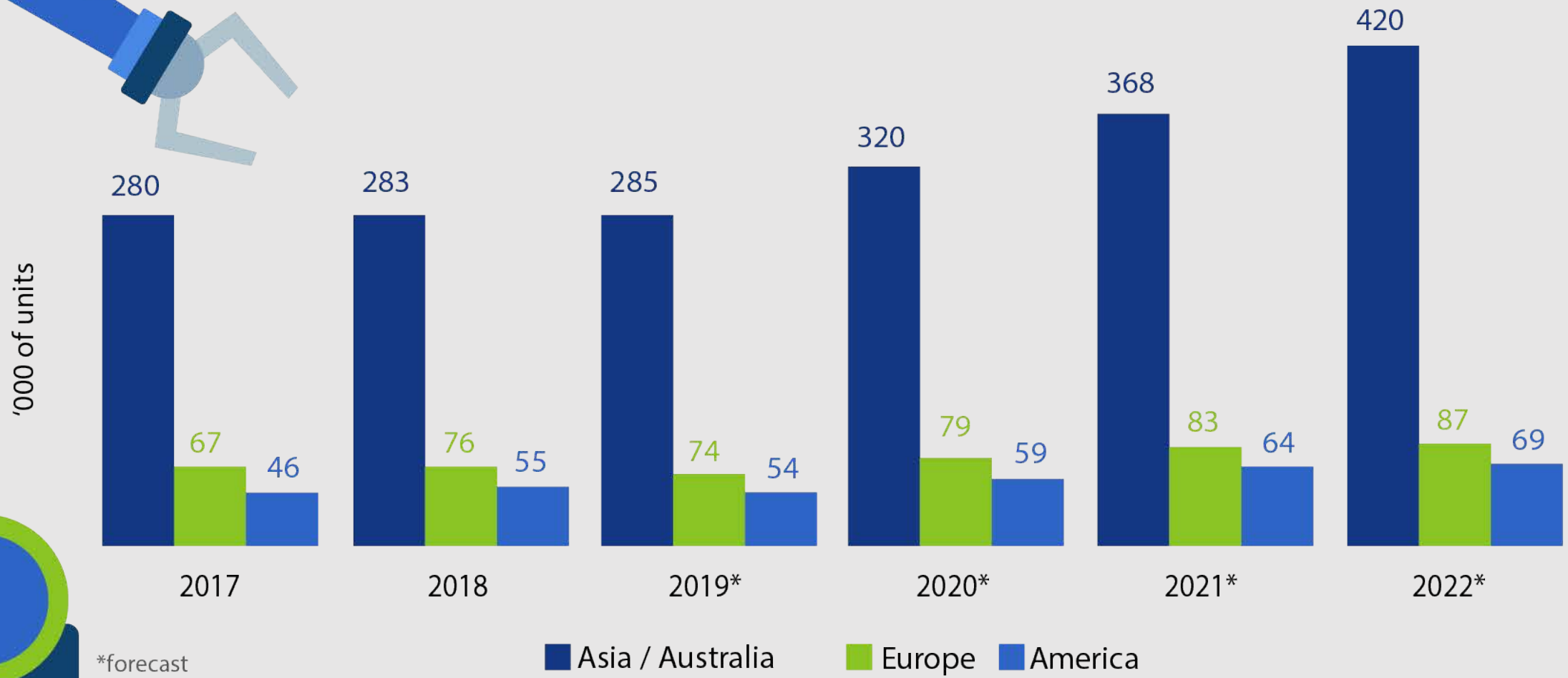
The brutal combination of a global downturn in capital spending in 2019, followed almost immediately by the shockwaves of the pandemic in 2020, hit automotive and electronics—the two largest industries that rely on robotics and automation—hard. Heading into the new year, we expect the factory robotics market to accelerate strongly in 2021. In fact, demand has already bottomed out in China and stabilized in both the US and Europe. By the end of 2021, we expect the installed base of factory robots to exceed 3.2 million units—double the level in 2015, and still a tiny fraction of the human workforce of 360 million in manufacturing. As this recovery continues, we expect to see significant upside and double-digit growth over the next five years, driven by technological advances, the digitization of production systems, an increase in worker shortages, and a significant boost from post-COVID-19 adjustments.

The world's top industrial robotics providers include Fanuc, Yaskawa, ABB, and Kuka (a unit of Midea), which together command nearly 75% of the global market. Fast-growing collaborative robot specialists are also key players, including Teradyne and its Universal Robots and MiR units. Suppliers of key factory automation components, such as Harmonic Drive, Rockwell Automation, Nabtesco, AirTAC, IPG Photonics, Keyence, and many others, also stand to benefit from the growth ahead.

Annual installations of industrial robots 2017-2018 and 2019*-2022*







*forecast

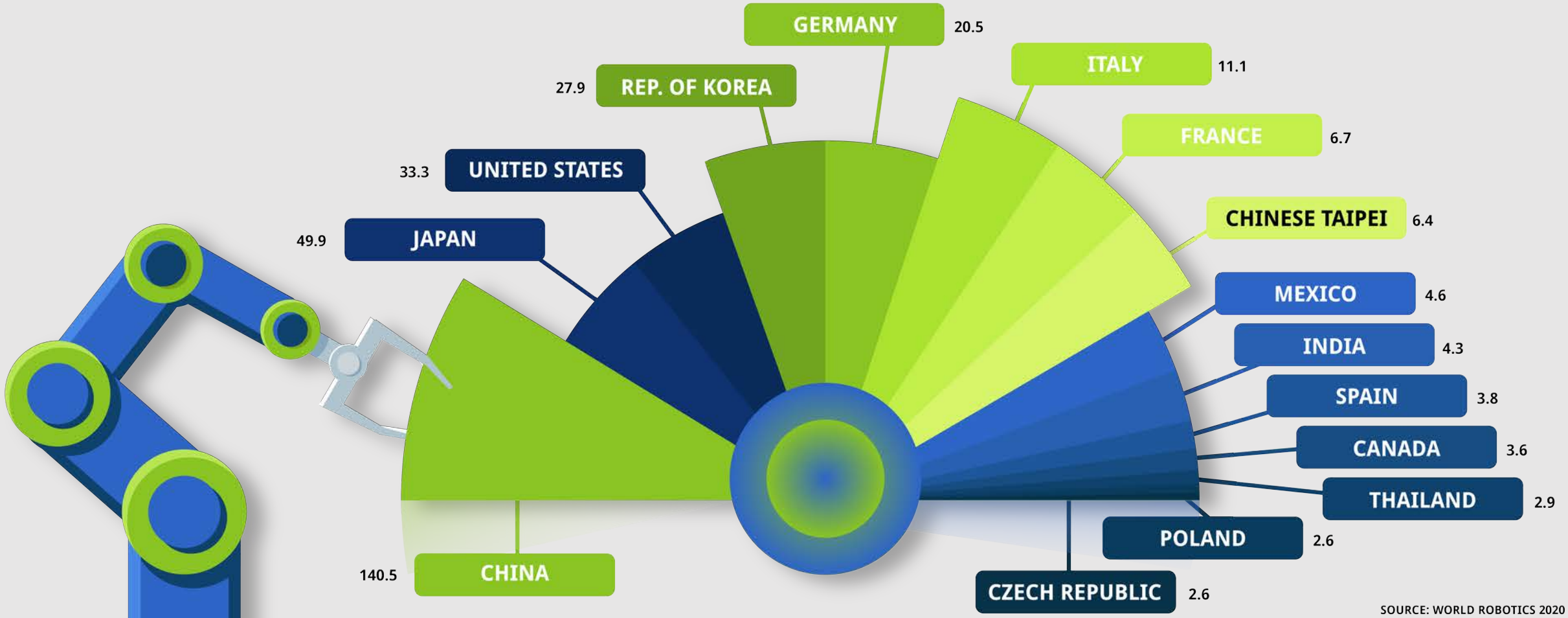
Source World Robotics 2019*

China Will Remain the World's Top Factory Automation Story in 2021

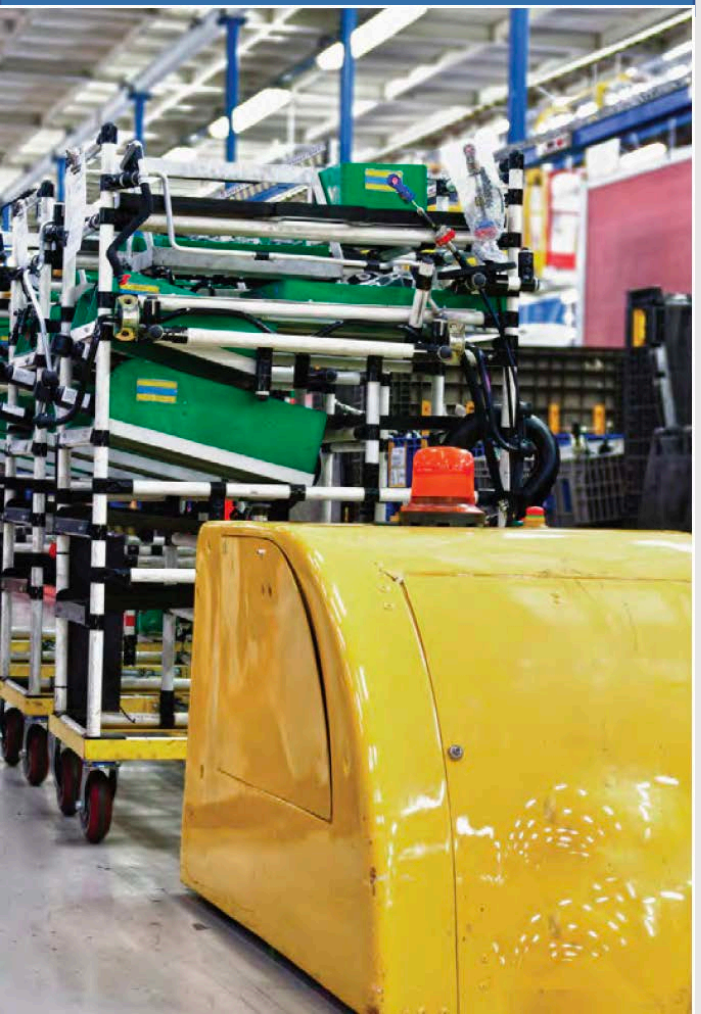
China is the largest buyer of industrial robotics by a large margin, with more than 140,000 annual installs in each of the past three years. This is more than all installs in Europe and the Americas combined. But though China's numbers are impressive, the country has deployed just ~1.9 robots per 100 manufacturing workers, less than half the density already deployed by Japan (3.6), and less than a fourth of the deployments in Singapore (9.2) and South Korea (8.6). That leaves enormous room for growth. We expect China to continue to drive global market growth as manufacturers strive to upgrade manufacturing quality and productivity. The ROBO index includes several key players in Chinese factory automation, including the Shenzhen-listed equities of Shenzhen Inovance, Han's Laser, and Siasun Robotics.

ROBO GLOBAL

ANNUAL INSTALLATIONS OF INDUSTRIAL ROBOTS
15 LARGEST MARKETS 2019



SOURCE: WORLD ROBOTICS 2020



Logistics and Warehouse Automation Will Continue to Soar

The pandemic has transformed the global supply chain, as well as the expectations and demands of buyers of logistics services. In 2021 and beyond, these companies are going to require their providers to offer much greater agility, financial stability, transparency, and speed. Many are seriously considering insourcing at least a portion of their logistics operations.

The disruption of consumer supply chains is also driving change. We expect to see a new surge in warehousing demand, especially for temperature-controlled warehouse space as more consumers order food online. But that won't be the only driver. Pre-pandemic, lean-inventory strategies like Just-in-Time (JIT) and Quick Response (QR) were rampant. Post-pandemic, consumer goods suppliers are looking to bump up safety-stock inventory by an estimated 5%, a shift that will require about 750 million square feet of additional industrial space. Assuming that the warehouse construction pipeline remains full and warehouse availability remains tight, this should also spur industrial activity.

These changes will require a greater focus on efficient management by private warehouses, and by third-party logistics (3PL) warehouse service companies that help suppliers keep their supply chains in motion by providing trucking, freight brokerage, freight forwarding, packaging, materials handling, and other specialized services.

Technology is also being deployed to boost efficiencies in warehouses and distribution center operations. Pandemic-driven ecommerce is expected to increase the adoption of warehouse automation solutions to help keep costs and operational complexity in check. Sales of autonomous mobile robots are estimated to double to $27B by 2025. This and other tech solutions position the industry well for a vigorous recovery.

“COVID-19 is causing ecommerce to skyrocket. The increased demand in home shopping by consumers (which will continue after COVID-19 subsides), combined with the close quarters in warehouses that limits safety for human workers, has created a huge surge in interest in robots and automation to handle products and packages for warehouses, transport centers, and logistics.

Solving this is non-trivial for many reasons, but a number of companies and research teams are working aggressively to address it using recent advances in AI. The challenge is similar to self-driving cars—but far more fault tolerant. My hunch is that there will be many developments and major adoption of robots in warehouses, transport centers, and logistics in 2021.”

— Ken Goldberg, PhD

Professor & Chair of the Industrial Engineering and Operations Research Department at UC Berkeley,
Co-founder & Chief Scientist at Ambidextrous Robotics

Look Up: Commercial Use of Indoor Drones

In recent years we've seen good penetration by drones in niche markets that support inspections of a variety of outdoor structures, including wind turbines, building exteriors, and high-voltage electric power lines, and that expand surveying capabilities in the mining industry. In 2021, drones are coming indoors. Small, autonomous drone systems are now being adopted by manufacturers and warehousers to autonomously scan bar codes for inventory management.

Verity, the autonomous indoor drone company founded by ROBO Global strategic advisor Raffaello D'Andrea, has partnered with logistics company **DSV**, where Verity's indoor drones will be used to manage DSV's inventory. In 2021, we expect to see the commercial applications for these indoor drone systems continue to grow—and the market for industrial drones of all kinds to expand exponentially.

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“The potential for commercial drones is incredible. Drones are already being used for photography, precision agriculture, pipeline inspection, and firefighting. Next up: package delivery, including ‘last mile’ package delivery for Amazon and other retailers, as well as delivering blood samples from one hospital site to another. This is already a multi-billion-dollar market, and the sky is literally the limit.”

— Raffaello D’Andrea

Founder and CEO of Verity, the world’s leading autonomous indoor drone company, and a Professor at ETH Zürich

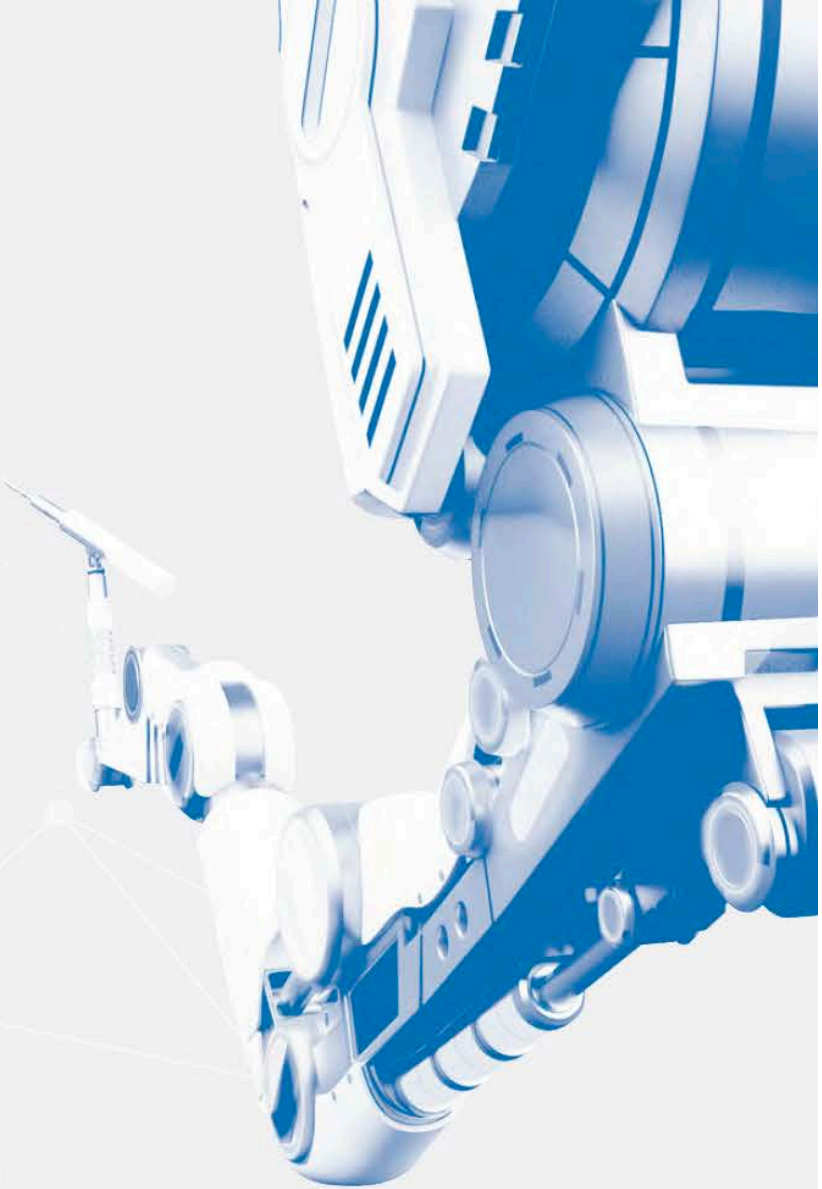
ROBOTICS & AUTOMATION (ROBO)

The ROBO Global® Robotics & Automation Index (ticker: ROBO) provides investors with unique and diversified exposure to best-in-class robotics, automation and enabling technology companies from around the world.

THE ROBO INDEX OUTPERFORMED THE GLOBAL EQUITIES INDEX IN 2020 AND OVER THE PAST 3 AND 5 YEARS.

	YTD	1 Year	3 Year	5 Year
ROBO GLOBAL® ROBOTICS AND AUTOMATION INDEX	40.21%	40.00%	14.20%	20.84%
GLOBAL EQUITY INDEX	13.96%	15.93%	9.77%	12.05%

Rebased 100 on December 15, 2015; Total Return through December 15, 2020; Periods greater than 1 year have been annualized



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THNQ

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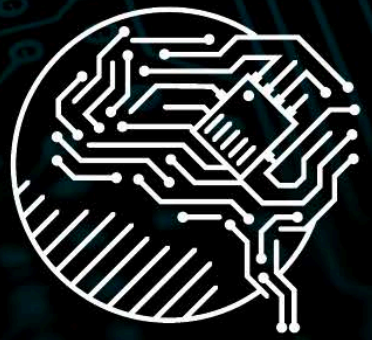
ARTIFICIAL INTELLIGENCE



- Big Data and AI: Digital Transformation and Cybersecurity
- Ecommerce: Immersive Experience
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Big Data and AI: Digital Transformation and Cybersecurity

The COVID-19 era is driving a massive transition where the boundaries between home and office are blurred, and disruptive innovation in cloud, data storage, and AI analytics is accelerated.

In the coming months, enterprises will continue to accelerate their digital transformation initiatives to improve business continuity and agility. 84% of enterprises plan to expand work-from-home policies following the pandemic and to increase technology spending to support the workforce. Because many businesses were not prepared for remote working, new security challenges were inevitable. The result: network security companies like Cloudflare experienced a 30% increase in network traffic during the pandemic, a trend that is expected to accelerate into 2021.

In the new year, next-generation cyber and data security platforms embedded with machine learning will assist in stopping threats, securing IoT devices, and enabling recommended security policies. Arista's AI-driven network software stack is a foundational architecture for supporting the next-generation data center deployments that will power much of the enterprise-driven digital transformation. Varonis, a THNQ index member, offers integrated enterprise security platforms that provide critical tools such as user behavior analytics, advanced threat detection and response, and alerts for ransomware and other suspicious activity.

Ecommerce: Immersive Experience

Ecommerce, which was a mere novelty less than a decade ago, has become a mandate for retailers in the era of COVID-19. But while this trend is expected to continue long after the end of the pandemic, so far, digital commerce has not been able to replicate the key aspects of the in-store experience that attract and retain customers over the long term.
In stores, consumers can touch and try products before buying them. These interactions help people determine the quality, dimensions, and fit to know if a product meets their needs and expectations. Physical contact provides control, transparency, and tangibility—all of the things necessary to build trust and drive purchasing confidence. Winning in ecommerce requires the ability to deliver a new kind of immersive experience that gives consumers purchasing confidence.

The solution is to apply technologies like augmented reality (AR), 360° video, 3D content, and virtual reality (VR). The good news for ecommerce providers: these technologies are more sophisticated, affordable, and accessible than ever. And the ROI is impressive. AR alone has been proven to reduce product returns and increase the reach of marketing across social media platforms. The potential impact is immense.

And it is vital. In 2020, Growth in ecommerce surged in the US to 30% of total retail sales, up from 14% in 2019, and we expect this upward trend to continue in 2021. Global online penetration of ecommerce is projected to increase +20% in 2020 to ~$4T, up from a growth rate of 11% in 2019. In China, where ecommerce sales are the highest in the world, the penetration rate of retail sales was already over 30% in 2019. As ecommerce soars, the ability to deliver immersive shopping experiences will be vital for retailers seeking leadership in the space.

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“We are seeing profound transformations in how people shop. Machine learning, robotics, and AI algorithms are powering the future of retail. Some companies are turning physical stores into warehouses due to today’s demand. Others, like UK-based Ocado, are leading this transformation using robotics. Ocado recently acquired Kindred AI to enable even finer control of how they might use robots to complete food packaging for deliveries. I’m very excited about the possibilities there.”

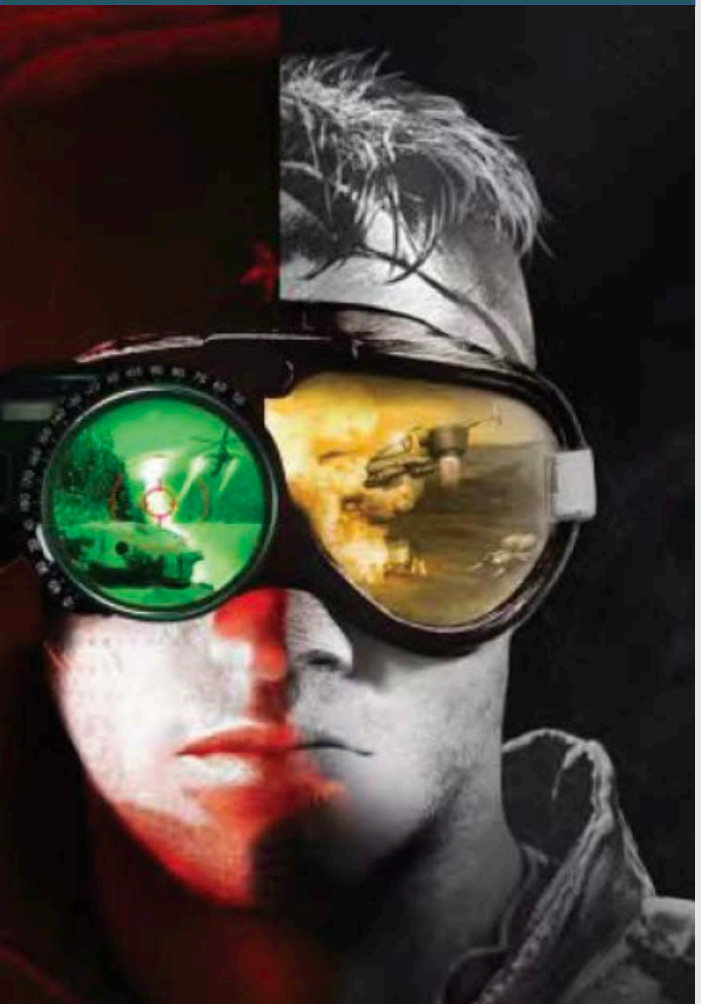
— Daniela Rus, PhD

Professor & Director of MIT’s Computer Science & AI Lab

Ecommerce: Integrated Mobile Payment Platforms

Mobile services that are integrated with social media, online marketplaces, and back-end payment platforms are helping to reduce friction throughout the purchasing process.

Customer experience is becoming a key competitive differentiator, and payment platform companies continue to play a major role in enhancing customer experience by simplifying the buying process and making it easier to complete a purchase. A unified mobile payment experience that accepts digital currencies and contactless payments is pushing the envelope to meet consumer expectations. Using APIs to enable digital invoicing and embedding payment options directly onto social platforms, THNQ index members Alibaba, Square, Etsy, and Shopify are at the forefront of this innovation.



Consumer Media: Video Games

The pandemic brought a significant uptick in the use of streaming services for movies, video games, and eSports, and these will continue to gain in popularity in the year ahead. Specifically, video games will play a massive role in 2021 due to a growing number of cloud-based platforms such as Google Stadia, Microsoft Game Pass, and PlayStation Now. Thanks to advancements in AI, the gaming industry is poised to transform how we consume our digital experiences in ways we could not have imagined before. Immersive, multiplayer games that allow people to stream content without a computer or console will be the fastest growing segment of the gaming industry.

In-game purchases and downloadable content are also creating new revenue models that companies are now beginning to monetize. THNQ index members CD Projekt and Electronic Arts are betting on increasing monetization of revenues as the number of users engaging with each other online grows. The video game industry is expected to be worth $305B USD by 2025 with a CAGR of 13%, while the video game streaming market is expected to grow at a CAGR of 27% by 2026.

Autonomous Systems: Commercial Vehicles

COVID-19 has accelerated deployments of autonomous ride-hailing vehicles, last-mile delivery robots, and robots that disinfect facilities. Short distance, low speed autonomous delivery vehicles from Yandex, a THNQ index member, and Nuro will see wider deployments thanks to their ability to limit human interaction. Autonomous long-haul freight trucks should see deployment in 2021 as demand for deliveries of goods between select cities will continue to rise with stronger adoption of ecommerce.

THNQ index members that are powering up the AI engines that enable autonomous vehicle technologies, such as Nvidia and Infineon, and solution providers such as Appen, Baidu and Nuance will benefit from these trends.

ARTIFICIAL INTELLIGENCE (THNQ)

Launched in 2019, the ROBO Global Artificial Intelligence Index (ticker: THNQ) offers exposure to the global AI ecosystem. The index includes companies that are demonstrating early growth and earnings potential across the AI landscape.

THE THNQ INDEX OUTPERFORMED THE GLOBAL EQUITIES INDEX IN 2020 AND OVER THE PAST 3 AND 5 YEARS.

	YTD	1 Year	3 Year	5 Year
ROBO GLOBAL® ARTIFICIAL INTELLIGENCE INDEX[1]	63.19%	66.70%	36.32%	36.02%
GLOBAL EQUITY INDEX	13.96%	15.93%	9.77%	12.05%

Rebased 100 on December 15, 2015; Total Return through December 15, 2020; Periods greater than 1 year have been annualized
1: Includes back-tested data prior to August 21, 2018

HTEC

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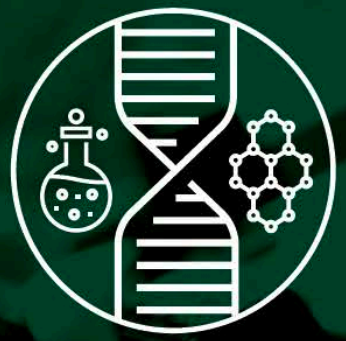
HEALTHCARE TECHNOLOGY & INNOVATION



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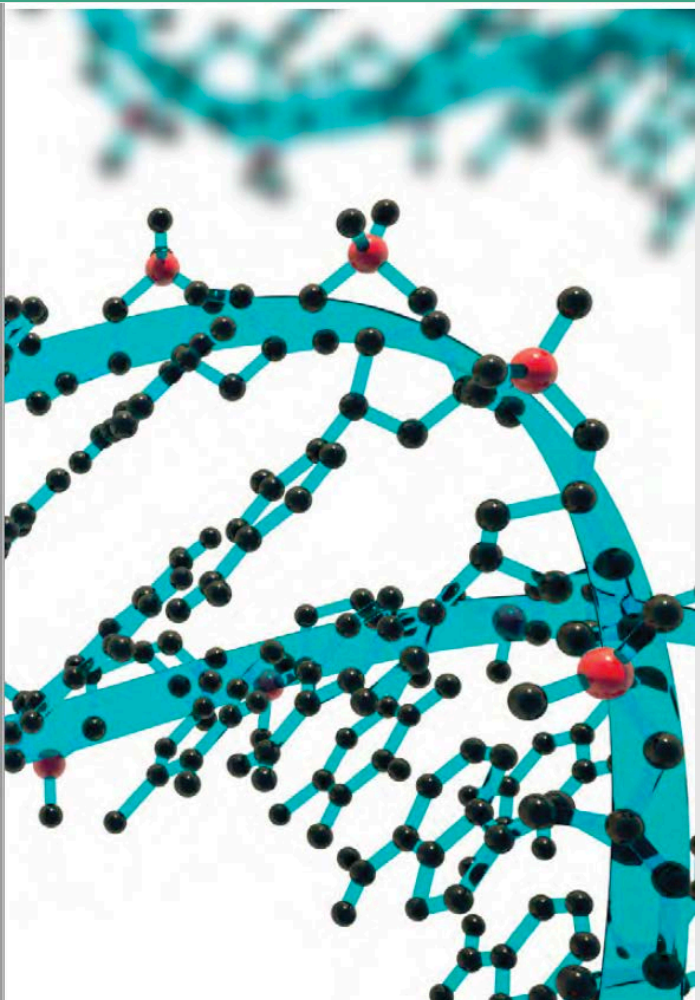
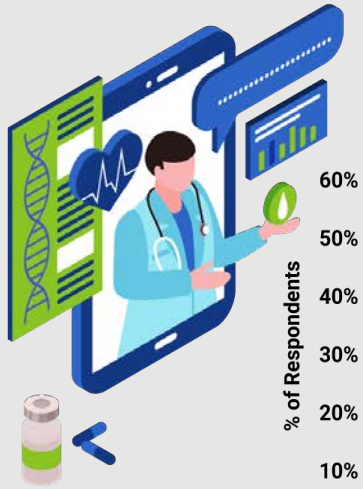
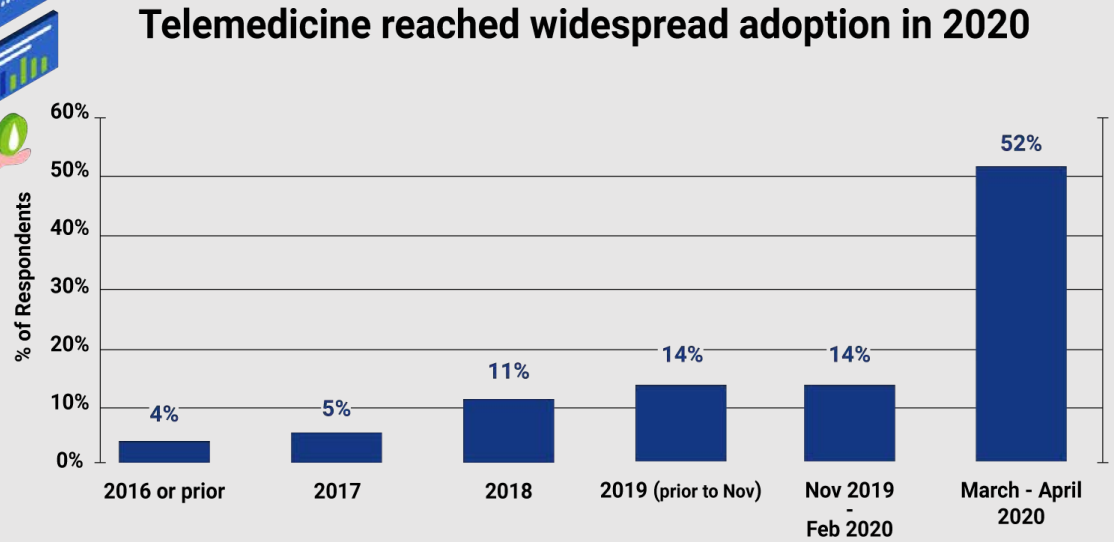


A Look Back at Our 2020 Expectations

Reflecting back on our 2020 Trends Report, we highlighted telemedicine, diabetes, and CRISPR as investment themes to watch out for in the coming year. Obviously, we didn't anticipate the pandemic or the degree to which it would interfere with the normal course of progression across these themes. In the case of telemedicine, the pandemic accelerated adoption by at least 4-5 years. Our proprietary survey shows that by April 2020 over half of consumers had tried telemedicine once, vs. less than 10% only three years prior. Shares of telemedicine companies like Ping An and Teladoc returned over 70% and 100%, respectively (as of December 2020).





Source: ROBO Global

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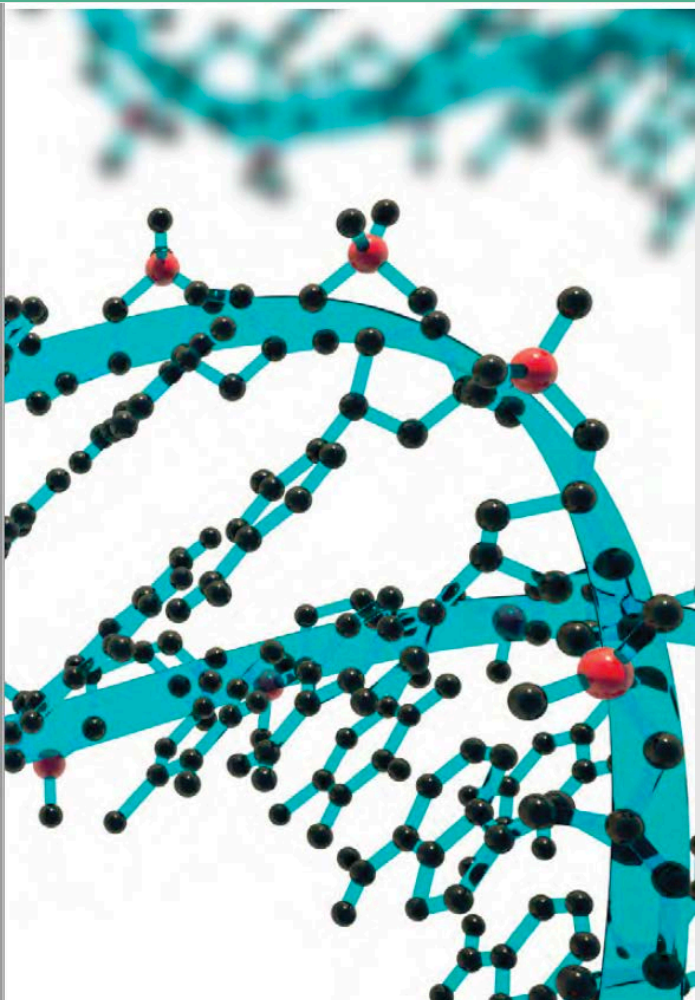
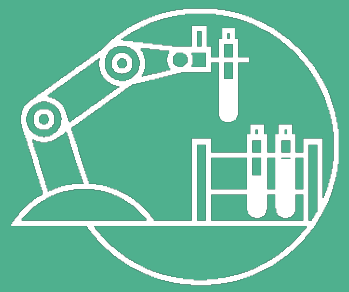
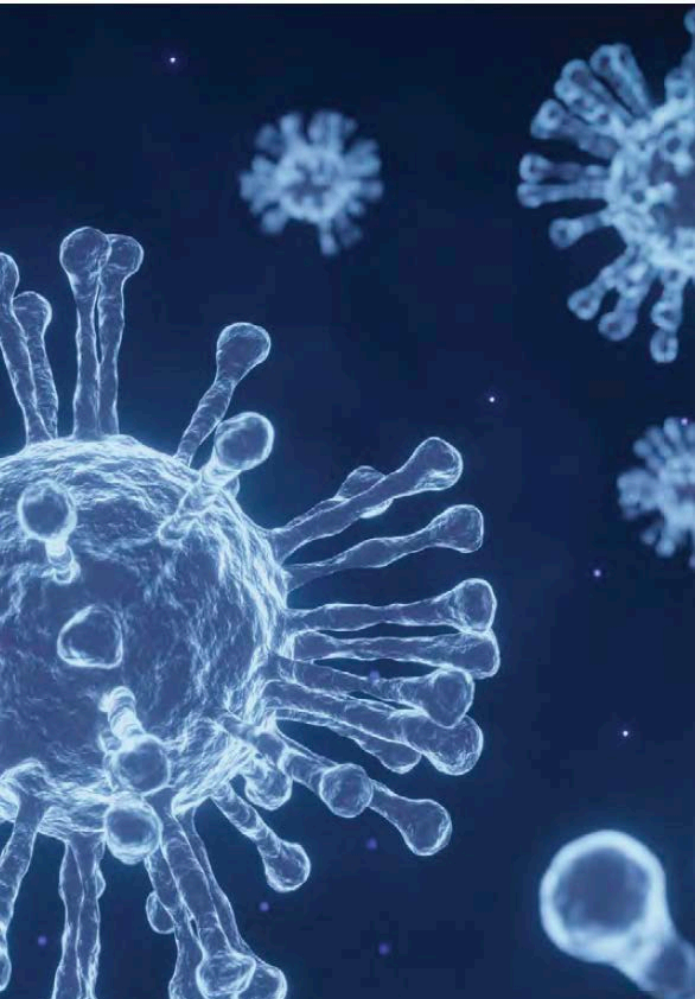


A Look Back at Our 2020 Expectations

Because of the increased risk of COVID-19 severity among people with diabetes, utilization also accelerated for diabetes monitoring devices and services, driving strong performance for HTEC members Dexcom, Abbott, and Livongo.

The pandemic also drove headwinds to the healthcare industry as focus shifted almost exclusively toward COVID-19, like the slow-down of capital spending, elective procedure volume, and clinical trials. Despite this, several HTEC precision medicine members managed to progress their trials, and achieve significant milestones in the world of gene editing. In June, Editas Medicine (with partner Allergan) became the first company to administer an in vivo CRISPR treatment during a Phase 1/2 clinical trial for LCA-10, an eye disease that causes blindness. In December, Vertex Pharmaceuticals and partner CRISPR Therapeutics published new data on their beta thalassemia and sickle cell disease treatment that demonstrates potential to be a functional cure, and replace a lifetime of treatments for certain patients who suffer from these illnesses.

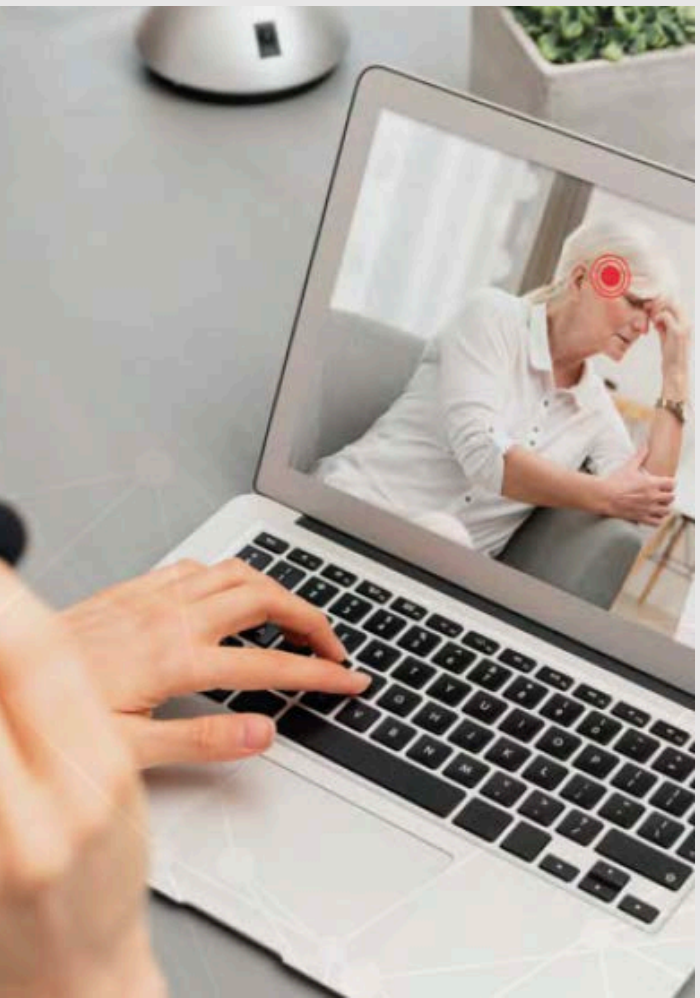




As COVID-19 Impacts Ease, Focus on Innovation Will Fuel Growth in 2021

In the coming year, we continue to expect to see pandemic-related headwinds and tailwinds, but to a varied degree from 2020. People who delayed surgery and medical exams will eventually schedule them. To the degree the COVID-19 vaccine begins to increase activity, such as driving and sports, we also expect to see an increase in trauma-related needs. Also, by next year we expect hospital capital budgets and resources to be able to shift from COVID-19 ‘reactive’ projects to other agenda items that were put on hold this year, like purchasing new radiology, laboratory, and surgical instrumentation.

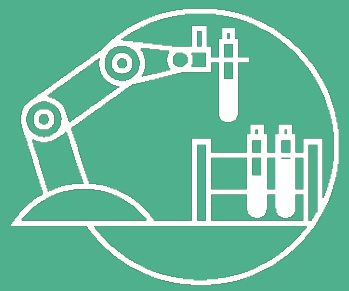
The pandemic also placed a spotlight on new needs, and we expect further investment will be allocated toward new goals like virtual care adoption, or genetic research. All this investment will fuel growth in healthcare’s most innovative areas for years to come, and HTEC’s aim is to provide investors with exposure to this growth with its 80+ companies and diversification across these areas.



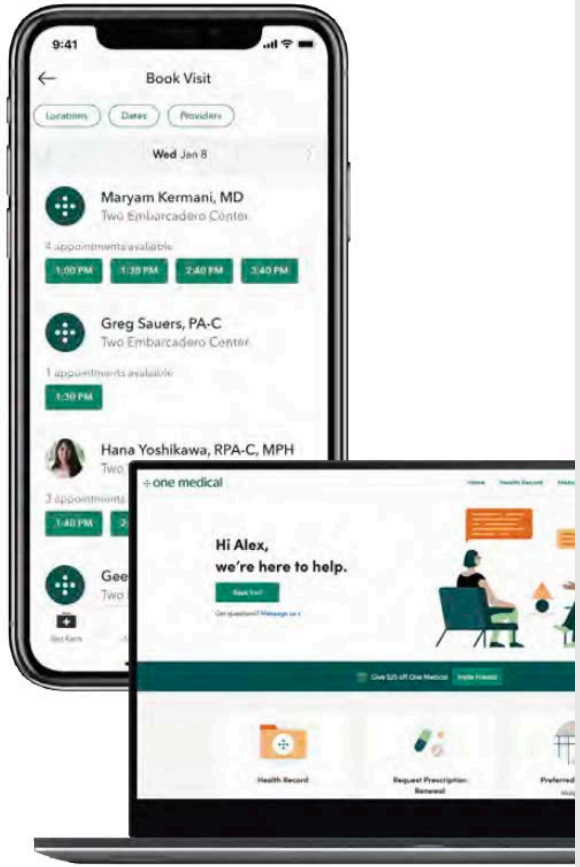
We've Only Just Scratched the Surface of Virtual Care

While telemedicine made a household name for itself in 2020, many investors remain unaware that telemedicine is only one small part of a much greater investment opportunity: virtual care. Virtual care includes not just the service that connects patients to a random doctor for a quick urgent care need, but broader platforms that connect patients to their own doctors, devices to doctors, devices to patients, and even devices to devices, from anywhere.

HTEC index member Teladoc is not only enabling but pioneering virtual care adoption. By expanding its service offering, and acquiring companies like InTouch and Livongo, Teladoc has increased its total addressable market from $35B to $121B over the last five years. As industry-wide innovation and adoption continues, we expect virtual care to underlie every facet of healthcare in the next 5-10 years.

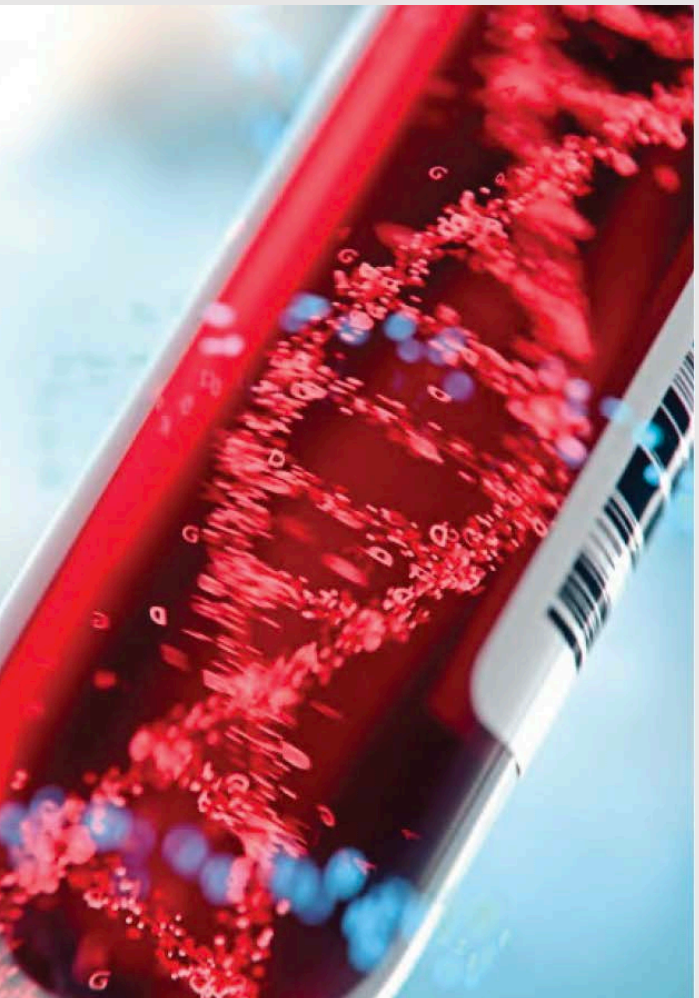


Data Analytics and AI are Revolutionizing Primary Care



It takes an average of 29 days for a person to get an appointment with a primary care physician. Unfortunately, this lack of immediate access can lead to higher-cost problems, like unnecessary urgent care or ER visits. Worse yet, if the patients don't seek care at all, it could lead to more severe illness, and greater healthcare costs over time. The NIH estimates an annual savings of $67B per year could be achieved if patients sought more care from their primary care physicians. The need to lower costs and improve access has spawned a trend of disruptive new primary care models.

HTEC provides exposure to this trend with 1Life Healthcare (aka One Medical), a company that's using technology to reimagine the consumer primary care experience. In addition to a pleasant staff, Zen waiting rooms, and virtual care access, One Medical members can typically get a doctor appointment within a day or two. Behind the scenes, the company utilizes AI to improve the overall patient experience, from scheduling to predicting medical risks like depression, diabetes, or congestive heart failure. Based on this information, they can nudge the patient to take the appropriate action before more serious conditions arise. This proactive approach to wellness (vs. sickness) is proving to reduce healthcare costs. In a recent JAMA study, One Medical was able to reduce an employer client's medical spend by 45% while improving the productivity of its workforce.



Early Cancer Detection: the Next Frontier in Genomics

Over $10B in M&A transactions took place in 2020 among HTEC companies eager to dip their toes into the growing market opportunity for early cancer detection. Diagnosing cancer in earlier stages can save an estimated 100,000 lives in the US alone, and significantly reduce costs. Yet less than a third of cancers are diagnosed in Stage 1 or 2. HTEC companies Illumina, Roche, Exact Sciences, and Natera are developing and launching liquid biopsy testing for early cancer detection, a market that is expected to reach $75B over the next 15 years. Illumina, with its acquisition of Grail, expects to launch its multi-cancer liquid biopsy test in 2021 in the hopes of increasing early-stage cancer diagnoses to 85% from the 31% of diagnoses today.

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“The COVID crisis has made it abundantly clear that we need faster diagnostic methods coupled with a continued focus on methods for individualized medicine. Companies such as Insitro are using AI to speed up development of new drugs, which will be much faster, much cheaper, and generate a new momentum for drug delivery in an individualized form.”

— Henrik Christensen, PhD

Professor of Computer Science at Dept. of Computer Science and Engineering UC San Diego
and Director of the Institute for Contextual Robotics

Therapeutic Innovation Has Reached an Inflection Point

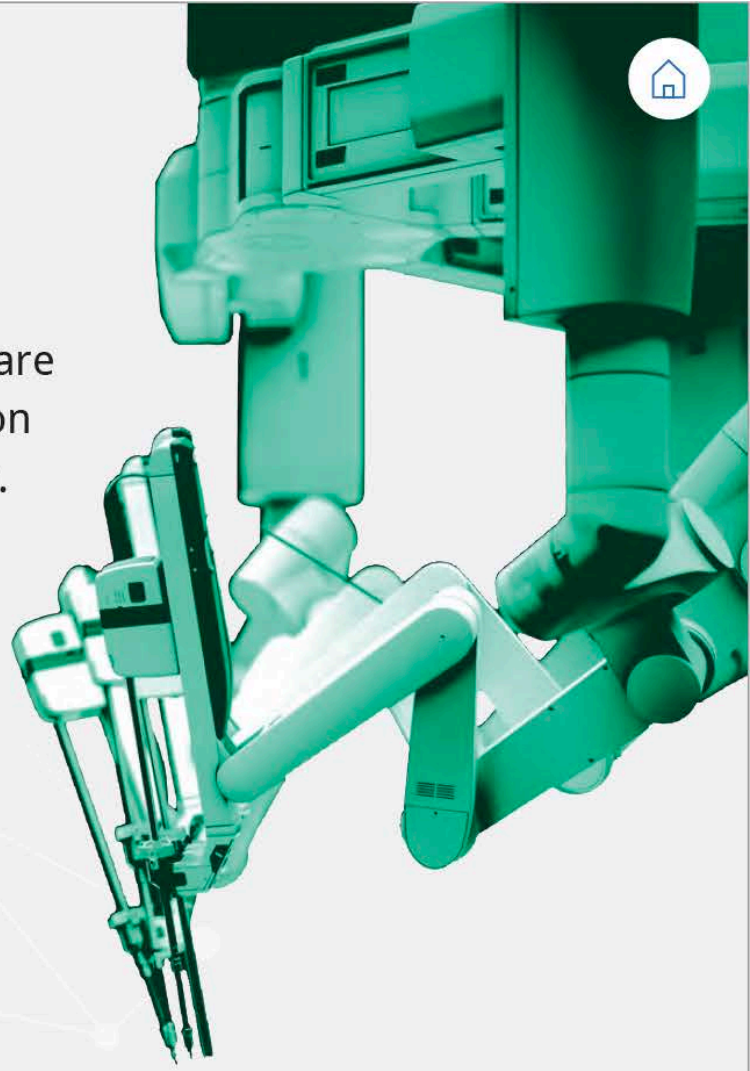
The race to treat COVID-19 drove therapeutic innovation at an unprecedented speed in 2020. HTEC index member Moderna launched its coronavirus vaccine, which utilizes new mRNA technology. Regeneron also made significant advancements with its monoclonal antibody treatment for coronavirus symptoms.

"At the moment, we're each asking, "How can I make a difference?" The answer is clear: invest the time, talent, and resources to continue to advance robotics and AI technologies, and to define new methods to deploy advanced technologies to contain viral spread and to consistently get the right resources to the right place at the right time. We have the tools at hand. What we must do now is use them to benefit future generations."

— Illah Nourbakhsh, PhD

Professor of Robotics & Director of the CREATE Lab at Carnegie Mellon University

HEALTHCARE TECHNOLOGY & INNOVATION



Launched in 2019, the ROBO Global Healthcare Technology & Innovation Index (ticker: HTEC) provides unique, global exposure to best-in-class companies leading the healthcare technology revolution. Notable sectors include diagnostics, robotics, genomics, precision and regenerative medicine, lab automation, instruments, data analytics, and telehealth.

THE HTEC INDEX OUTPERFORMED THE GLOBAL EQUITIES INDEX OVER THE PAST 3 AND 5 YEARS.

	YTD	1 Year	3 Year	5 Year
ROBO GLOBAL® HEALTHCARE TECHNOLOGY AND INNOVATION INDEX[1]	60.66%	62.77%	39.33%	33.81%
GLOBAL EQUITY INDEX	13.96%	15.93%	9.77%	12.05%
GLOBAL HEALTHCARE INDEX	10.84%	13.31%	12.36%	10.55%

Rebased 100 on December 15, 2015; Total Return through December 15, 2020; Periods greater than 1 year have been annualized
1: Includes back-tested data prior to April 30, 2019

ABOUT THE AUTHORS

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Jeremie Capron joined ROBO Global in 2017 with more than ten years of experience as an equity research analyst in Asia, Europe, and the United States, with a focus on industrial technology.

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