



Technology ventures



Artificial intelligence, blockchain, and autonomy are just some of the buzzwords emerging from the explosion of new technologies and disruptive business models impacting industry today. To remain competitive in this fast-changing, increasingly digital world, large incumbents have to be more agile than ever, proactively engaging with external players to increase the pace and effectiveness of their own innovation programs. How does ABB do it? ABB Review presents an introduction to ABB Technology Ventures (ATV), ABB's venture capital group, and highlights some examples of how ATV helps bring outside innovation into ABB.



- 08 In search of strategic innovation and collaboration
- 13 Interview with the Managing Director of ABB Technology Ventures
- 18 Transforming robotics with Soft Robotics

TECHNOLOGY VENTURES

In search of strategic innovation and collaboration

Accelerating digitization is forcing enterprises to reassess how they capitalize on new technology. Previous innovation models are often inadequate and companies have to look beyond their own walls to engage with a dynamic, partnership-driven innovation ecosystem.



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As ubiquitous as it is, few people realize that the Apple iPhone is a decade old. When it came on the market in 2007, it joined stalwarts such as BlackBerry and Palm as the latest “smart” gadget promising convenience and connectivity. Fast forward to 2018 and the impact of near-universal

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connectivity and computing is just starting to be seen. The last decade has witnessed an explosion of new technologies and disruptive business models and technology is now touching almost every aspect of our lives, at work and home.

As digitization begins to impact traditional businesses like power utilities and manufacturing, entirely new - and often highly digital - markets are opening up and the rules of the game are changing. In order to tap into these opportunities and address the challenges this new world brings, existing business models, strategies and operations have to be re-evaluated. Companies must reassess the way they adopt new technologies and keep up with their peers.

01 A constantly shifting and continually accelerating technology world is forcing large companies to look outside their own boundaries.

Open Innovation - now more than ever

In the 1980s, some of the best innovations came from government research labs. In the 1990s, when businesses started deploying personal computers, local area networks and Internet connectivity, they took over the lead in technological development. Since the early 2000s, technology innovation has moved to

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the consumer space. The rapid adoption of technologies and platforms such as cellphones, social networks and streaming media has led to dramatic improvements in computation, storage and connectivity. Those technologies and their functionalities are now spilling over into other markets and are generating a massive opportunity for new value creation, especially in industrial settings. As author Gary Hamel put it in his book, “Leading the Revolution” [1], “if you want to see the future coming, 90 percent of what you need to learn you’ll learn from outside your industry.”

Traditionally, new business development processes and the marketing of new products took place within a firm’s closed environment. However, in the last decade, overcoming a not-invented-here mindset and the need for outside-in-innovators have become widely discussed topics, with the result that more companies now look outside company boundaries as part of an innovation strategy →1.

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One prominent way to do this is Open Innovation. Endorsed by Henry Chesbrough in 2003, Open Innovation is the process of also looking outside a company's walls and beyond its industry for ideas that will keep the enterprise well ahead of its competitors. Especially considering today's environment where companies are increasingly

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dependent on technologies that are coming from the consumer space and the line between the consumer and industrial sphere is blurring, Open Innovation has gained further importance. More recently, the emphasis has been placed on not only looking outside of an organization's boundaries but also proactively engaging with external players by creating partnerships and working in an innovation ecosystem. According to a recent article in Harvard Business Review "in order to seize the opportunity and belong to the winners of the game, collaboration across the economy must become universal" [2].

Engagement in an interconnected, dynamic innovation ecosystem can take many forms, ranging from co-creating groups where the ideation phase of a new product is outside the company, over lean startup approaches such as experimenting, incubating and failing fast to corporate venture capital (CVC). However, the common denominator in all of these is cooperative interaction with the relevant stakeholders.

ABB Technology Ventures

Innovation is at the core of ABB and many of the technologies that underpin modern society were pioneered by ABB since its founding over 125 years ago. The super-twisted liquid-crystal display, self-blast circuit breakers for high-voltage switchgear, the electronic gas meter, optical current and voltage sensors, high-voltage DC technology, the world's first truly collaborative industrial robot as well as many advances in power electronics are just a sampling of the fundamental breakthroughs and innovative product technologies created by ABB. With seven research centers worldwide and an annual investment of approximately \$1.5 billion, ABB's R&D engineers and scientists continue to develop breakthrough technologies that change the way the world works and industries do business.

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 02 Much technological impetus can be gained from idea injection from partner companies.

Being a pioneering technology leader, ABB has long embraced a decentralized approach to innovation. ABB's global research centers and business units cooperate with leading universities around the world and other external partners in a fully networked environment.

Part of ABB's R&D organization is ABB Technology Ventures (ATV), the company's strategic venture capital investment arm. Headquartered in Switzerland, with offices in Silicon Valley and India, ATV identifies startups that have the potential to be leaders in their sector and thus

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ABB Technology Ventures is the company's strategic venture capital investment arm.

drive strategic value for ABB. Once ATV has mapped out how the startup can be beneficial to ABB, it will invest equity in the startup, purchasing up to 20 percent of the company with investments ranging from \$250,000 to \$20 million. The average check size is \$4 million.

Founded in 2009, ATV has deployed over \$190 million into 26 startup companies and four venture capital funds. The team's portfolio currently has 18 active companies. Aligned with ABB's goal to write the future of industrial digitization, these companies span a range of sectors – including robotics, industrial IoT (Internet of Things), machine learning, distributed energy and smart buildings – and are spread across North America, Western Europe, Israel and China. While these partner companies should promise best-in-class financial returns, it is more important that investments offer strategic value to ABB. This can come through enhanced understanding of a new technology like additive manufacturing or blockchain, delivering to ABB an early glimpse of a new sector – such as drones – where ABB may want to participate, challenging internal thinking, driving product pull-through, or simply filling a portfolio gap and helping ABB get to market faster →2.

Delivering market intelligence, identifying trends and acting as something of an early warning system for ABB businesses are functions of ATV. By picking the most interesting and promising of the startups to invest in, ATV complements ABB's internal R&D activities by taking calculated risks in the development of "may breakthrough" innovations that potentially fall outside of the purview of traditional corporate technology development. ATV can act as a test lab for emergent, higher-risk technologies or business models, testing them with a fraction of the money and resources that would be needed for a comparable venture involving ABB's in-house R&D.

While ATV is a key pillar of ABB's approach to Open Innovation, according to René Cotting (Head of Operations, Innovation and R&D at ABB, and as Chairman of ATV) working with startups has to be complemented by a strong focus on ABB's R&D competencies, partnerships and M&A (mergers and acquisitions) activity. "Our goal is to create marketable products that are able to meet rapidly changing customer requirements in new ways, and can be introduced onto the market in a lasting, sustainable manner," says Cotting. "In order to do so, our world-class R&D organization, as well as other parts of the organizations such as our business units and M&A teams, have to work together to enable a holistic perspective on different growth and innovation mechanisms."

— 03 PointGrab is another company that has benefited from collaboration with ATV. PointGrab's vision sensor, equipped with an integrated deep-learning algorithm, is able to count and track people without using CCTV.

References

[1] Hamel G., "Leading the Revolution: How to Thrive in Turbulent Times by Making Innovation a Way of Life," Plume Printing, August 2002. ISBN 1-57851-189-5 (hardback), ISBN 0-452-28324-8 (paperback).

[2] Gnanasambandam C. Uhl M., "Innovation Is as Much About Finding Partners as Building Products," Harvard Business Review, July 20, 2017.

A good example of ABB's synergistic approach to R&D is ATV's investment in Bonsai AI. Bonsai is a small company based in Berkeley, California, just across the bay from San Francisco and in the same high-rise building as the University of California, Berkeley's own startup accelerator, Skydeck. The company has raised money from Microsoft, Samsung and New Enterprise Associates – the largest VC fund in the world – and is attacking

A good example of this synergistic approach to R&D is ATV's investment in Bonsai AI.

the problem that artificial intelligence, and in particular reinforcement learning (RL), is relatively difficult to understand, debug and implement.

"If you're Google, Facebook, Amazon, that's fine, you're okay," Bonsai CEO Mark Hammond explains. "But it's less than ideal if you're a company in manufacturing, retail, or anything that involves real-world logistics, where you might not have those same engineering resources and those prepackaged services don't meet your needs."

Bonsai's technology - aimed at helping companies in these more traditional spaces, including companies like ABB who are looking to make their robots and other hardware

easier to program and safer to interface with - abstracts away the complexity of programming and managing AI models. At its core, Bonsai's technology is based on TensorFlow – a popular tool created by Google that helps the user build so-called machine learning systems. TensorFlow is an alternative to Microsoft's Cognitive Toolkit but with a highly visual and intuitive implementation. ABB's robotics researchers immediately saw the value of providing a higher-level AI language and compiler.

In conjunction with its investment, ATV has facilitated collaboration with Bonsai to adapt their graphical interface from the robot simulation tool Gazebo to ABB's RobotStudio and is now working with the company to make the jump to simulations using live robots such as ABB's two-armed YuMi robot and then go after real-world use cases.

The Bonsai relationship is a good example of how ATV can identify the most suitable partners for collaboration and how such collaborations can provide a mutually advantageous outcome for both parties →3. The interview with Grant Allen, Managing Director of ATV and the description of the partnership with Soft Robotics in the following pages reinforce the lesson that it is essential for a company to look outside its boundaries and proactively engage with suitable external players to increase the effectiveness of its innovation processes. ●

INTERVIEW

Interview with the Managing Director of ABB Technology Ventures



Grant Allen

Corporate venturing has become a key component of ABB's quest for growth. To understand better how ABB works with startups and how investment decisions are made, ABB Review met with Grant Allen, Managing Director and Head of Ventures at ABB Technology Ventures (ATV). Grant is based in ABB's new Silicon Valley headquarters in San Jose, CA.

ABB Review (AR): Can you please describe the innovation ecosystem at ABB and how it has changed in the last few years?

Grant Allen (GA): A robust and forward-leaning R&D function is the foundation for ABB's pioneering technology leadership. It's what I point to most frequently as our sustaining competitive advantage and the number of true breakthroughs we've had as a company over the years is remarkable. Every time I meet with ABB's researchers, I'm impressed by the capacity we have internally to develop new products and progress the state of the art in our industry. However, as in any large company, there can be a bias towards improving the known, rather than exploring – even clumsily – the unknown. This can lead to patterns of incrementalism and optimizing towards the evolutionary rather than the revolutionary. In practice, this means that a large percentage of development resources are spent on improving and optimizing the current portfolio, often at the expense of risk-taking and investigation of new breakthroughs. We view this as a search for local rather than global maxima that will, over time, build shareholder value. I clearly see the need for any large company to have a search party function to identify and capitalize on breakthrough technologies and business models that go beyond the core and help the parent company find entirely new offerings for their customers. This is the search for the new white space and ultimately the global maxima. And this is where I believe corporate venturing functions like ATV can be a good tool.

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AR Where do you see corporate venture capital (CVC) five years from now? What are the biggest trends in terms of corporate startup engagement?

GA Corporate venturing is more prevalent today than it has ever been. It is a clear trend that large companies are looking outside their walls for disruptive innovations. Now, whether they are simply looking to track those innovations or take them seriously, engage with them, perhaps even challenge their own existing models, that's the real trick. I don't think many of these corporate venture capitalists are doing this well – they're window shoppers in the sense that they're looking at and talking with a lot of startups and bringing their executives through Silicon Valley for what we call the technology petting zoo but they are not investing big checks or meaningful business unit calories. That's when CVC activities become hard because while we all like to make money on our investments, the real measure of our success is how much it moves the strategic needle for our parent company.

In five years, I see CVC still going strong but with about half – if not more – of the groups investing today having pulled back from the market. These are the groups who have dabbled but have either failed to produce strategic value for their parents or have lost too much money, or both. History dictates that CVC groups have a short shelf life; often the simple turnover of an executive sponsor can trigger a strategic review and bring about the end of the venture capital arm. Thus, we have to be especially vigilant that at every stage of our platform life cycle we are delivering strategic value and doing so in the context of a durable financial returns mechanism.

AR Tell us a bit more what role ABB Technology Ventures plays in this market environment?

GA When I first moved to Silicon Valley three years ago, I met with many of the big-name financial venture capitalists: Andreessen Horowitz, Greylock, Kleiner Perkins, Lightspeed. There was generally muted interest in the ABB-relevant topics such as renewable energy, factory automation – even robotics. The hardware investment trend had not taken off yet and there was still a hangover from the cleantech boom of the early 2000s in which most funds investing in energy tech lost their shirts. Fast forward to today, and AI and robotics are two of the hottest topics in tech investing, deep tech is highly en vogue, and in spite of the longer ramps, many funds have turned to hardware investing. Other funds like Eclipse Ventures and

Andy Rubin's Playground Global have been created solely to invest in hardware! Now, some of these same top venture capitalists seek ABB out because we are experts in these fields, particularly robotics and industrial IoT. We are happy to play the role of technical advisor and as we leverage that to add value to the other investors in the ecosystem, we can then get into the very best deals and bring to the table the other things that make ABB such a great investing partner: ABB's brand, a deep R&D bench, a global supply chain and channel access, market knowledge and decades of experience producing some of the most precise, rugged and functional hardware on the planet.

AR What is your investment footprint and style?

GA Since we were founded, ATV has invested directly into 26 startups. One of our most recent investments was a Chinese company, but the rest are spread between North American, Western Europe and Israel. The pace has been about four new investments per year and today we have 16 active portfolio companies in which nearly \$88 million is invested.

To maximize our value-add to the companies in which we invest and to give us downside protection, we like to take an active role in each investment. In practice, this means ATV takes either a voting seat on the board of directors or one or more non-voting observer seats. We often get asked if we need right of first refusal or other special considerations and the answer is "no."

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01 TaKaDu's AI solutions complement ABB's products.



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02 Pointgrab's vision sensor counts and tracks people without using CCTV but with similar accuracy.

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AR How do you find the appropriate startup to invest in?

GA We talk to over 2,000 startups per year that we identify through many different channels. We are continually running market and technology sector studies and mapping companies in segments of interest – understanding the key startups in the food and beverage automation space was one of our recent projects – and we have a full-time team member helping with market analytics and driving competitor insights. We also are developing a tool to help us track all of these companies and allow a common, Web-based means for R&D and the ABB businesses to uncover relevant startups on their own.

AR What does a typical startup collaboration look like?

GA Once the ATV investment committee, which includes ABB's CTO, to whom I report, approves an investment and that company becomes part of the active portfolio, ATV, together with our counterparts in the sponsoring business unit, supports and mentors them. We assist, as most good VCs do, with technology roadmapping, refinement of business model, finding product/market fit, recruiting and follow-on financing. We go beyond the "typical" VC value add, though, and assist directly with deeper technology development, giving the startup access to ABB's R&D bench, and making introductions to ABB customers and partners. We drive them quicker to commercial viability and the interaction the startup has with the ABB business units is critical to begin this catalysis. From the outset of working with potential investments, ATV acts as a bridge between the startup and the key ABB players: global business and technology managers, any of ABB's seven corporate research centers, as well as local and global business units, sales groups and product groups. This ensures that there is a full alignment of expectations and goals and maximizes the ease with which a smaller company can tap into ABB's global network of ABB expertise and resources. With 136,000 employees and

being the largest supplier of industrial motors and drives, the largest provider of generators to the wind industry and the largest supplier of power grids in the world, the ABB network is a formidable asset for a startup at any stage. ABB helps companies in rapidly accelerating their paths to the commercialization of products and services through access to ABB's R&D manpower and labs, global sales channels and wide-ranging partnerships.

AR Is there a concrete example where working with a startup has created direct value for ABB's customers?

GA In each of our investments, we look for the win-win synergy where there is value for the startup and for ABB. When we unlock this combination, by definition we are providing more ultimate value for ABB's customers. One example is TaKaDu, an Israel-based startup providing a Software-as-a-Service (SaaS) solution for water utilities. Their software enables the utilities to detect, analyze and manage network events and incidents via an automated cloud-based service. Whereas ABB is a supplier of instrumentation and control systems, and hardware components such as sensors and measurement products, TaKaDu delivers an AI-based solution to provide early warning of the most likely leakage scenarios in the system and

to tell the customer the optimal placement of the minimal number of pressure sensors. This approach saves costs and maximizes reliability. ABB together with the TaKaDu expertise is a clear symbiotic relationship →1. Again, a win-win in our eyes.

AR Tell us a bit about one of your latest investments.

GA For the past few years, we've been trying to figure out how ABB can participate in the aerial inspection and drone services space. We initiated an external study on drones and have been tracking a number of UAV companies and how they are deploying value-add services for field operations, logistics and security. One company, Kespry, emerged as a clear leader in the space, with a unique focus on the data ingest and workflow capabilities as well as the ease-of-use so that field workers can very quickly deploy their drone solution on the job site. Kespry is using a high-resolution aerial camera to do volumetric estimations of mining aggregates and device estimations are ±1 percent accurate. This is a huge leap forward from the current practice and we see significant applications for this technology within ABB. For instance, with our marine and port operations, we could use the drones from this particular company to do high accuracy counts of shipping containers and to automate many other aspects of port operations. And that's just the beginning.

AR Can you give us some concrete examples of technologies that are bound to cause disruption?

GA Let's take the example of PointGrab, an Israel-based company. PointGrab developed a vision sensor with an integrated deep-learning algorithm for home and building automation. The sensor is not a video sensor – no video signal is produced, though the sensor is able to count and track people with an accuracy you would usually get only with a CCTV camera →2. This solution is cyber-safe and no-one can look into the room. It represents a completely new generation of sensors that overcome physical barriers by using artificial intelligence.

AR Thank you for the interview. ●

TECHNOLOGY VENTURES

Transforming robotics with Soft Robotics

ABB Technology Ventures (ATV) is ABB's strategic venture capital investment arm. ATV finds the startup partners from which ABB can best benefit, both strategically and financially. ABB's partnership with Soft Robotics provides a perfect example of how proactive engagement with a startup can make all the difference when it comes to improving innovation processes.



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Who says a robot has to be made of metal? For the past decade, Harvard's George Whitesides and his army of post-doctorate fellows have been rewriting the rules on what constitutes a robot. Through a collaboration between Harvard and DARPA, the innovation arm of the Department of Defense, the Whitesides Group at Harvard University has been focused on a new breed of biologically inspired "soft robots." The challenge was initially to create a robot that could make its way underneath a pane of glass just 20 mm above a surface [1]. While most robotic engineers attempted to solve this problem with traditional, rigid robots, Dr. Whitesides drew inspiration from nature to create a new class of soft robots made entirely of elastomeric polymers. It was that challenger mindset that made way for a breakthrough in the field of robotics.



Soft Robotics is born

The earliest applications of the technology to come out of the DARPA collaboration were in surgery and other biomedical applications. But a major unmet need and opportunity in industrial automation were recognized: The majority of robotic solutions today are based on hard linkages, making it difficult for them to pick up soft and variable objects, like fresh produce, or interact safely with humans. If the new robot technology could safely manipulate and transport organs and soft tissue without damage, it could easily grasp

The underlying design for Soft Robotics' technology was inspired by the octopus's tentacle.

delicate and variable products that had previously been off-limits to automation, like fresh produce or consumer goods. This premise resulted in the foundation, in 2013, of Soft Robotics as a spin-off from the Whitesides Group →1.

Getting the upper hand

The underlying design for Soft Robotics' technology was inspired by the octopus's tentacle – a dramatic shift away from the traditional robotics approaches involving hard linkages, sensors and servo motors. This inspiration led to the invention of soft robotic actuators made entirely of polymers that do not require sensors or other electromechanical devices for operation. Soft Robotics' novel approach solves the problem through material science, not through higher levels of cost and complexity. The computational power of the system is built into the gripper itself – a proprietary blend of materials with microfluidic channels that, when actuated, mimic the soft tissue of the human hand.

Prof. Whitesides' work at MIT spawned an entirely new area of research, with soft robotics becoming a focus at Harvard University and the associated Wyss Institute, Cornell, Stanford, MIT and numerous other institutions. While there is now significant academic work in this area, Soft Robotics Inc. has been the pioneering force in developing the first and only commercial applications. The commercial need is driven by the fact that only 12 percent of non-automotive industries are automated by robots today because solutions for tasks that are either unstructured or that call for dexterous manipulation of variable product have not been available →2.

By leveraging the properties of soft and compliant materials, Soft Robotics has been able to build a fundamentally new set of adaptive and dexterous robotic hands and automation systems that open up completely new applications. Labor-starved industries such as food and beverage, advanced manufacturing and e-commerce can now realize

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ABB is a pioneering force in industrial automation and the company's decades of experience have proved invaluable to the Soft Robotics team.

the power of robotic automation. Soft Robotics' technology can now manipulate objects that vary in shape, size and weight, and that are easily damaged →3. The most immediate need for this type of technology was seen to be in food and agriculture, advanced manufacturing and e-commerce, where automation is needed not only to meet increasing market demand and labor scarcity but to manipulate the variable and fragile nature of the product.

Productization challenges

While Harvard and DARPA had grown a robust foundational IP platform over nine years of development, Soft Robotics was faced with the challenge of moving an academic technology from the bench into the market - and designing it to meet the highest automation standards of Fortune 100 customers. DARPA and Harvard had built the grippers, but Soft Robotics needed to solve the challenge of how to control them and evolve the technology into a solution that could operate reliably, repeatedly and at high speeds for customers in food and beverage, advanced manufacturing and e-commerce. The company advanced the grippers and incorporated FDA-compliant materials to meet the food handling sanitation guidelines as outlined in the Food Modernization and Safety Act. An electro-pneumatic control system enabled by proprietary firmware was designed and developed to give customers full command over grip parameters including speed, force, gripper spacing and opening width.

The power of pairing the system with AI and machine learning was recognized: Once one solves for the human hand in robotics, machine learning can be used to train robots on how to grasp and manipulate a wide range of other things. Human-supervised automation of highly unstructured tasks like bin picking, sorting and even harvesting are now a reality. This vision for a "robotic-human alliance" has manifested itself into version 2.0 of the technology: SuperPick - designed specifically for the unstructured environments in e-commerce and logistics.

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 01 Soft Robotics was spun out of the Whitesides Group in 2013.

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 02 Soft Robotics has the first commercial solution to robotic gripping of delicate items.

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 03 Soft Robotics' technology mimics the human hand, thus allowing easy gripping of objects that are delicate and that vary in size, shape and weight.

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Reference
 [1] "Whitesides' soft robot." Available: <https://www.youtube.com/watch?v=ZrrM-QZ-xDI>

Robotic synergies

ABB is a pioneering force in industrial automation and the company's decades of experience have proved invaluable to the Soft Robotics team as they scale their technology to meet the demands of automation customers. ABB is both a partner and investor in Soft Robotics and ABB's robotic systems bring the highest level of speed and accuracy to the Soft Robotics solutions. When the Soft Robotics gripping systems are combined with ABB technologies like the IRB360 FlexPicker, entirely new pick and place applications are opened up. In partnership, the two companies have built solutions for the food and beverage industry, helping to solve top industry challenges such as food safety, productivity and regulatory compliance.

For example, one of the largest global pizza retailers and e-commerce companies ships its dough fresh to its retail locations around the world. Due to the variable and delicate nature of the dough balls, the company had been trying for two years to automate the manipulation and packaging of the end-product. Soft Robotics was able to develop a customized solution to automate this customer's challenge in under a week. The automation solution combines Soft Robotics' gripping system with ABB IRB360 FlexPicker robots to dexterously grasp and maneuver the dough at high speeds. Today, this system is being deployed at this customer's manufacturing facilities around the world.

A partnership for the future

A core premise of Soft Robotics is that the company is not looking to re-invent anything ABB is already doing; the startup is simply adding on functionality to ABB's existing robots and enhancing the value ABB can deliver to its

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In partnership, the two companies have built solutions for the food and beverage industry.

customers. At the vanguard in the fast-moving field of agile, automated manipulation, Soft Robotics presented a compelling opportunity for ATV to take an equity position in the startup and accelerate the business partnership with ABB. As Grant Allen, Managing Director and Head of Ventures at ABB Technology Ventures has said: "ABB is one of the leading corporate investors in the robotics space and we saw a critical need in markets such as food processing, agile manufacturing and logistics for an adaptable soft gripping mechanism. Soft Robotics has delivered a compelling solution – and, frankly, gone well past that."

Buoyed by this endorsement from ABB, Soft Robotics' engineers continue to break new ground in the area of intelligent grasping. They are now looking to broader automation challenges and are currently rolling out a solution for e-commerce fulfillment centers where robots can identify objects in a bin and not only identify the correct object for packing, but reach in, grab the correct object and complete the packing task. This "bin picking" task has been a classic problem in robotics. Soft Robotics' solution will help write the future of increased autonomy and customer efficiency in warehouse operations, all thanks to a dynamic young startup out of Cambridge, Massachusetts. ●

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