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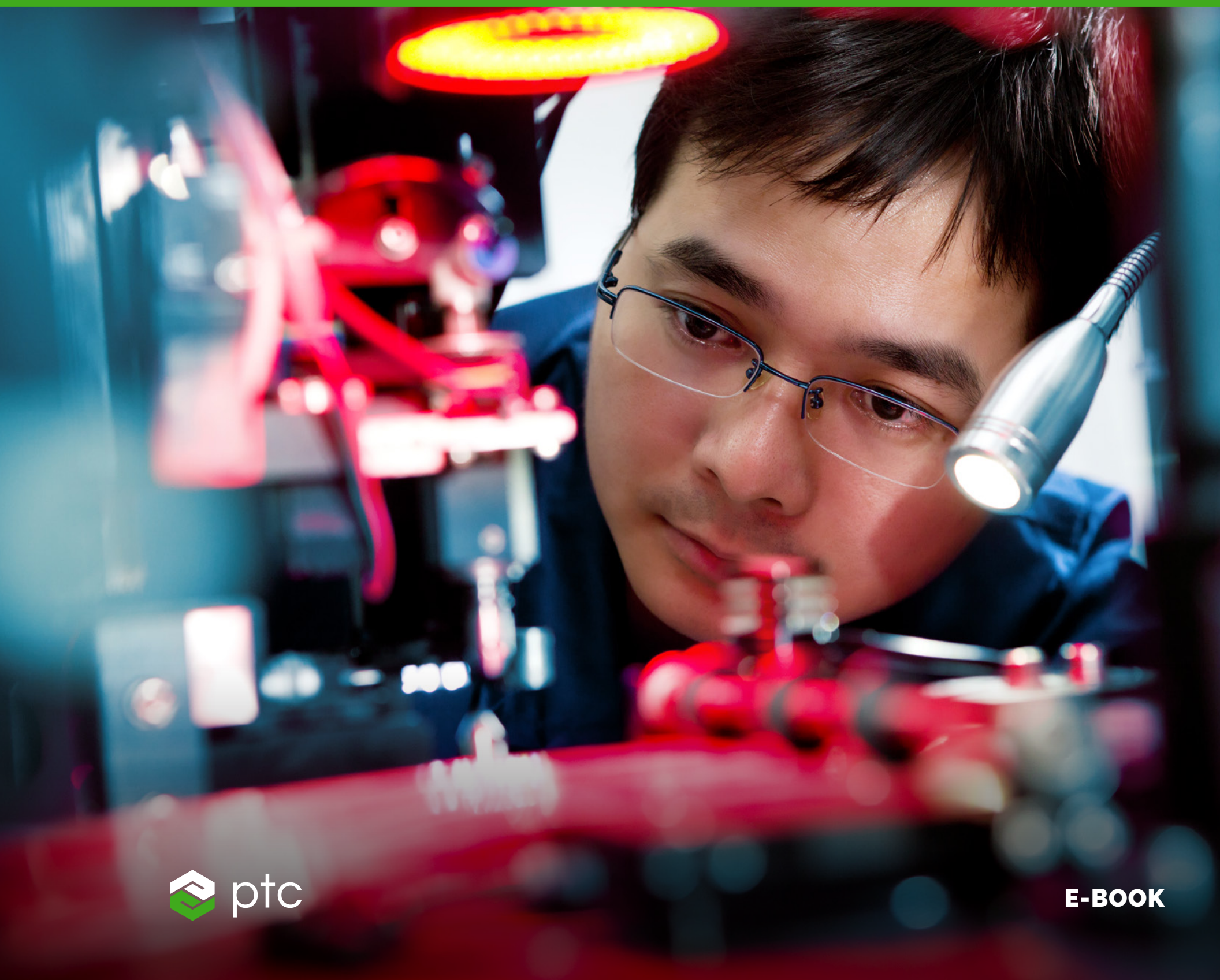
MORE THAN A PRODUCT: **INNOVATION FOR A NEW ERA**

EVOLVING PRODUCTS TO PLATFORMS IN A CHANGING WORLD



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EDITOR'S NOTE

Arena conducted interviews with the leaders of six cutting-edge high-tech and med-tech companies earlier this year to capture their insights on the changing face of product innovation. Given the unprecedented disruption currently confronting all companies, we revisited this report in whole to verify that its conclusions have kept their relevance in today's climate.

The conclusions are more relevant than ever. You'll learn how these innovators were already implementing strategies that tackle some of the most significant business challenges that product managers face today—solving complex and urgent needs, preparing for supply chain shocks, and collaborating across distributed teams and partners.

We believe you'll gain key insights from their approaches and can apply them to your organization's methods of product innovation in this new era.

EXECUTIVE SUMMARY

by Robert Tucker

If you are in charge of creating new products for your company, you already know that a confluence of forces is challenging long-held assumptions about the way that products are devised, developed, and delivered to market.

Advances in digitalization, artificial intelligence, and the Internet of Things (IoT) are connecting products to people in ways never before possible. Apps, sensors, and social platforms are integrating products and casting off terabytes of data in the process. Add the movement toward virtual and contract manufacturing and globalized, interwoven supply chains—with both the benefits and risks they involve—and you begin to realize the breadth of changes taking place. Mix in evolving customer demands, burgeoning regulatory and compliance requirements, and the unpredictable consequences of political, environmental, or health crises, and the result is a complexity accelerating at the rate of Moore's Law.

To be sure, these combined forces of change continue to make the process of product development increasingly challenging. At the same time, however, they create the conditions for incredible growth and opportunity. For those who understand how to navigate this shifting terrain, the future holds a great deal of promise.

This report explores that terrain. It is based on a series of wide-ranging interviews with senior leadership at six organizations on the cutting edge in healthcare, consumer electronics, and autonomous vehicle technologies. Each organization was selected for its bellwether qualities.

Some of these firms are in the startup stage. Others are long established. What they have in common is that they are not just navigating this new terrain, they are mapping it and shaping it to their advantage. This report reveals common themes in these companies' approaches. And while further research is surely warranted, we believe that these commonalities in approach clearly indicate how new products will be developed into the next decade.

Our interviews revealed four key principles that guide companies on the cutting edge of innovation:

1. Breakthrough innovation results when the goal is solving a complex problem in urgent need of a solution.

To truly stand out, an innovative product needs to address a complex problem, particularly where existing solutions have come up short. Sometimes solving such problems saves lives. Sometimes doing so simply makes life more sustainable and enjoyable.

For one of the senior leaders of Lumicell, a medical device innovator, the goal was literally saving lives. Founding President and Chief Scientific Officer W. David Lee had lost his wife to cancer. She had an operation to treat her breast cancer, and Lee learned that they did not have imaging to guide the resection and find all of the cancer. Lee and his partners at Lumicell, based in Newton, Mass., went to work.

They created a handheld imaging system that allows surgeons to literally see any unremoved cancer cells during an operation.

In this way, thanks to Lee's innovative vision, the outcomes of breast cancer surgery are being improved, and others are being spared the loss of a loved one.

2. The most innovative products create a connected customer experience.

Today's whiz-bang new product is tomorrow's ho-hum commodity. Product lifecycles are now measured in dog years as me-too manufacturers neutralize new features as fast as they appear. One way to stay ahead is to turn the traditional "product" into a connected customer experience. Peloton redefined the experience of using an exercise bike, connecting in-home users to live classes and streaming shared fitness experiences to their growing legion of fans. In an era that's seeing social distancing become a new norm, Peleton's ability to create a virtual community is particularly relevant.

Spinn, incorporated in 2015 and headquartered in San Francisco, is creating a similar networked experience for coffee lovers. In 2014, Spinn captured media attention with an entirely new approach to making coffee based on a patented centrifugal brewing system. The company's sleek machines are voice-enabled.

Users can "speak" to the coffee maker and interact with it remotely via an app.

But as described in this report, these innovations were only the beginning. Spinn really gained traction when it began thinking beyond the product—seeking ways to connect to the experience of great coffee and becoming an ongoing part of their customers' lives. As one example of creating networked experiences, Spinn's idea factory developed a community of boutique coffee roasters in various parts of the world from which users can reorder their java at the touch of a button. Orders arrive with a QR code telling the machine specifically how those beans should be brewed.

3. Innovative products reduce complexity for the customer.

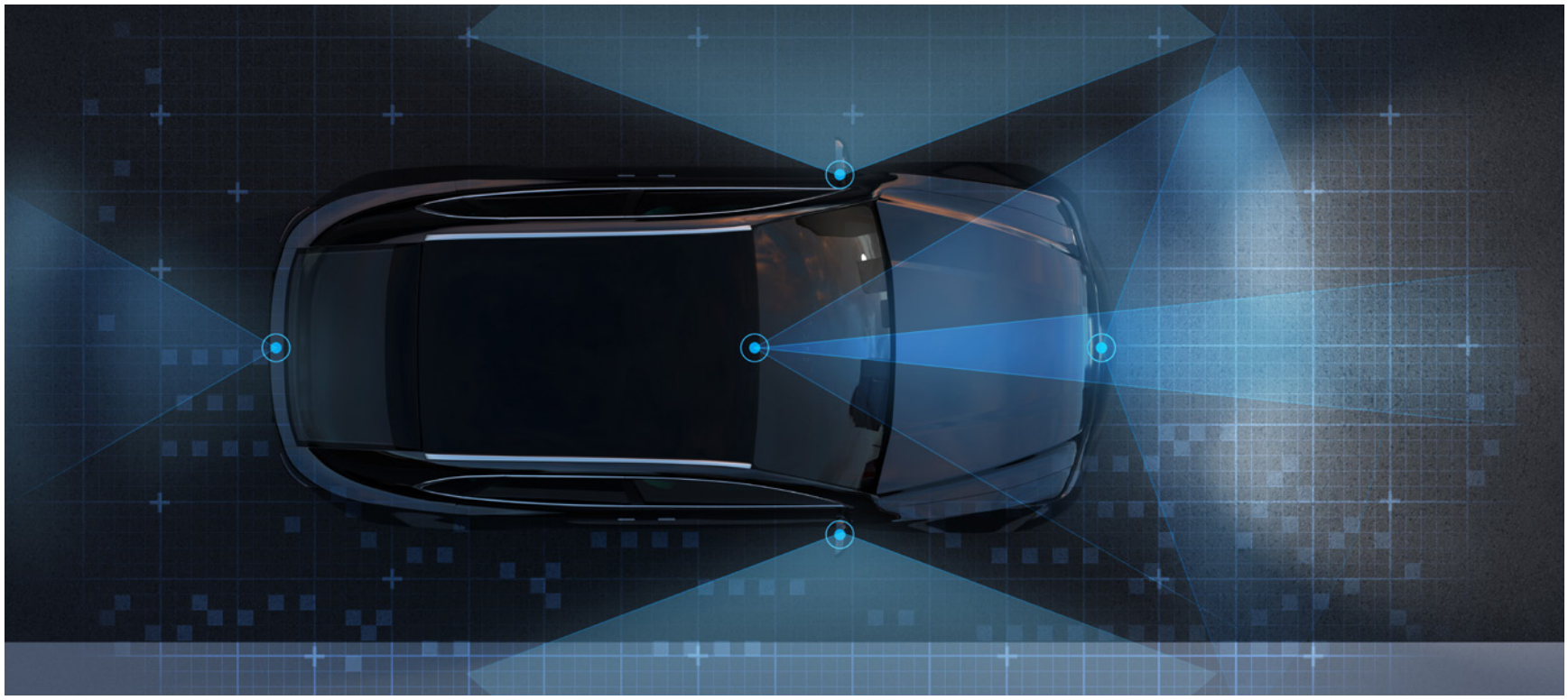
As we discovered in these interviews, creating a simple, elegant solution that allows customers to address real challenges requires overcoming increasing levels of complexity. As we also discovered, that simplicity is often the key to innovation and something customers tend to value the most.

Kymeta, based in Redmond, Wash., provides an example. The firm makes flat-panel satellite-tracking antennas. First responders and the military use these antennas to create broadband connectivity in remote locations. One of their many differentiating features is that they can be attached to vehicles of all sorts—cars, planes, ships—and used while the vehicle is in motion. (The typical satellite antenna must remain stationary to receive signals.)

Before Kymeta's breakthrough design, installing satellite antennas with similar functionality was expensive, cumbersome, and time-consuming.

An engineer had to be on site to properly align the equipment with the satellite's sending signals. Kymeta decided to simplify the process.

"We wanted an easier way for buyers to use the service," said Neville Meijers, Kymeta's Chief Product and Marketing Officer. "So we developed an end-to-end service that allows customers who aren't familiar with satellites to become connected."



4. Innovation depends on collaboration and cooperation between the organization, the supply chain, and the customer base.

As we were winding up our interview with Nate Ramanathan, Vice President of Operations for autonomous vehicle pioneer AEye, Nate made clear why we had trouble scheduling an interview with him. Last year alone, he flew over 289,000 miles!

Ramanathan, we discovered, is much more than the traditional operations executive. He's chief orchestrator and evangelist of a vast network of engineers, suppliers, partners, and customers all collaborating to bring highly complex products to market. Except the market doesn't yet exist and the future is still being defined.

AEye is one of 80 companies in the Light Detection and Ranging (LiDAR) market, the du jour autonomous guidance system that detects objects and maps their distances. AEye's breakthrough product is called iDAR.

Unlike the competition, it allows self-driving vehicles to see "only what matters."

Impressive as the technology is, AEye's other breakthrough is one its customers rarely get to see: the company's innovative system of global orchestration that spreads AEye's cultural values and sense of mission across platforms, across P&Ls, and across continents. As the leader of this complex set of actions, Ramanathan says it's essential to build and reinforce trust. Trust is established with good communication, supported by a connective software platform. With that in place, AEye can integrate and anticipate ever-changing customer requirements.

As the autonomous vehicle industry evolves, some players are already dropping out. Others like AEye are moving forward and inventing the future—not just in terms of deliverable products, but in how they collaborate with multiple partners and interact with customer ecosystems. "We take customer feedback seriously," Ramanathan told us. "We are learning every day."

Summing Up

We wish to thank the many executives who took time out of their busy schedules to allow us to ask them questions and probe the secrets of their success. We encourage you to read their stories, find out what they do differently or better than other companies, and apply these lessons to your own organization. As we learned from speaking with these industry leaders, innovation isn't simply the result of one moment of brilliant insight. It results from building a culture, an infrastructure, and a connected experience to bring that insight to life and continuously improve on it.

COMPLEXITY, HYPERCONNECTIVITY, AND VIRTUAL MANUFACTURING

Today, when even a simple door lock can consist of mechanical parts, software, electronics, and supplementary websites and apps, we have entered an era of unprecedented product complexity. This has wide-ranging implications for product design and development. It even begins to challenge our notion of what a product is—or can be.

Consider the mundane electric coffee maker. Coffee had been brewed on a stove top until the advent of electricity made possible the first percolator, patented in 1865, that used an onboard heating element. This design remained largely unchanged until the 1970s when electric drip coffee makers were first introduced. Drip makers soon became more popular than percolators, but they weren't appreciably more complex. Additional features such as timers were added, but the basic elements—a case with a water reservoir, a heating element, and tubing—remained the same.

Fast forward to the present day and the Spinn coffee maker. First, this coffee maker features a patented centrifugal brewing system, an entirely new approach to brewing. But the innovation doesn't stop there.

Spinn is voice-enabled, so its owner can tell the coffee maker what to do.

It even comes with an app allowing the user to interact with the machine remotely. What's more, Spinn has built a community of boutique coffee roasters so that users can order premium coffee via a subscription service. And when they receive their coffee beans, the package comes with a QR code that the machine can read to understand specifically how this particular roast should be brewed.

In other words, the "product" that Spinn has brought to market has far more capabilities—and complexity—than the traditional coffee maker. It combines a sophisticated machine featuring software-based intelligence, a controller app, and a broad community of roasters organized into a kind of personal supply chain for the coffee aficionado. The result is a high degree of simplicity for the user and an improved customer experience. Customers can control the Spinn appliance remotely, receive fresh coffee beans regularly without having to go to the store, and brew the beans to perfection without having to touch the coffee maker itself.

> Paradoxically, the simplicity of the customer experience stems from a complex, multifaceted product vision.

The complexity of the manufacturing process, which can often involve a host of geographically distributed partners, mirrors the complexity of the product itself. Indeed, many of the companies we discuss consider themselves "virtual" manufacturers because they don't directly manufacture the products they create and sell. Instead, a myriad of suppliers manufacture individual components, while the company assembles and tests the final product, even, in some cases, outsourcing these functions as well.

INNOVATION ON THREE LEVELS

In the world of complex, multidimensional products, innovation takes place at several levels.

First, innovation takes place in the act of conceiving an idea for solving a pressing, complex problem. The recurrence of breast cancer after a lumpectomy. Chronic pain. Gaps in connectivity for first responders and remote communities. Better management of energy consumption in the home. And so on. The solutions usually involve combining emerging and existing technologies in novel ways, such as using a viewer powered by artificial intelligence to detect previously invisible cancer cells.

Second, innovation occurs in the creation of adjacent or connected services that make the product more valuable and usable.

Turning a coffee maker into the nexus of a global community of coffee roasters is one example. Peloton's revolutionary vision of connecting exercise bike riders to a community, along with instructors and premium content, is another.

Finally, innovation can be found in the orchestration of production across multiple suppliers and contract manufacturers. The creation of agile and collaborative global supply chains, a challenge under the best of circumstances, is a "hidden" innovation—invisible to the consumers that are its direct beneficiaries, but critical to the development and delivery of products.

In this report, we will look at product innovation through the lens of companies bringing complex, multifaceted products to the world. Some of these products save lives; others make life more sustainable and enjoyable. What all these companies have in common is a commitment to serving their customers and succeeding as businesses. Innovation, after all, is not an end in itself.

> To have an impact, innovation needs both to solve complex problems and deliver business results, which in turn funds ongoing innovation.

SUPPORTING AND SUSTAINING INNOVATION IN PRODUCT DEVELOPMENT

All innovation starts with an idea, and that idea must be truly novel. But a novel idea isn't enough. One also needs to build an organization that can bring that idea to life. There are three things that separate consistently innovative companies from everyone else: the right mindset, the right culture, and the right systems (tools, technology, enablers).

The right mindset

> When we talk about the customer experience, it isn't whether or not they're able to download a Netflix movie for the evening. It's about whether or not they're able to save lives, save their own lives, and keep the ecosystem alive. So what we do is important. How we do it is important and our DNA is such that we can never put pencils down in terms of thinking about how to make our product better.
>
> —Sam Christensen, Chief of Staff, Kymeta

Kymeta manufactures flat-panel satellite antennas (like dishes, but not rounded) guided by software to sync with satellites. Based on their advanced design, these antennas can be easily deployed, installed on moving vehicles (including ships), and provide broadband connectivity from anywhere. While these antennas have multiple applications (they may eventually be used on autonomous vehicles, for example), today they are used primarily by the military and first responders.

Kymeta's technology is used by people in harm's way. The performance of Kymeta's satellite terminals can mean the difference between life and death. This reality drives Kymeta's mindset, a mindset focused on continuous improvement and innovation and a never-ending quest for a better product. Behind all this stands the core belief that "What we do is important," as Kymeta's Sam Christensen put it.

> To drive rapid innovation, leaders need the right people (culture) and a shared set of processes (systems), supported by relevant technology.

Above all, though, leaders and their employees need to have a mutual sense of purpose and commitment to innovation. The idea that "what we do is important" fuels this commitment. And it expresses itself in an emphasis on serving the customer through product and service improvement.

By itself, a mindset focused on continuous improvement is not enough. A product can't have an impact if no one buys it or uses it. For this reason, the innovation mindset also has to be pragmatic. As Sam said when we interviewed him, "Yes, our technology by itself is profound, but it's only going to be relevant if we're able to produce it at a cost point that is available more broadly than just one or two verticals."

What makes innovation particularly challenging is this need to be creative, and even visionary, within constraints. This also serves as a reminder that companies don't innovate for innovation's sake. Instead, innovation realizes its value and importance when it solves real problems for real people. Doing that calls for the perfect mix of purposefulness, perseverance, and practicality.

The right culture

An organization's mindset is expressed in its culture—the explicit and implicit norms, attitudes, and behaviors that govern how people interact and how work gets done. Rather than being imposed from the top down, an organization's culture is created from the ground up by the people who work there.

This means that hiring the right people is key to creating and maintaining a culture of innovation.

While traditional views surrounding innovation often dwell on a few visionary leaders, the burden of innovation needs to be distributed. That means hiring people who are empowered and motivated to innovate or solve problems in new ways. It also means creating and maintaining a work environment that fosters open dialogue, fails fast, and embraces the introduction of new ideas and perspectives.

Putting together a team of innovators does not mean hiring people all cut from the same cloth. Instead, it calls for hiring with an eye to diversity: of background, culture, age, and skill sets. Arena provides product lifecycle management (PLM) software to many companies pushing the envelope of innovation. As Arena's Principal Customer Success Manager Kraig Clark put it,

"Innovation thrives with the right mix of employees. You need both mature, seasoned leaders and youthful, creative employees that are not bound by traditional business constraints. And you need a flat organization that disrupts hierarchy and fosters collaboration".

With this type of culture—openness, collaboration, and diversity—employees will think outside the box to solve problems and create new solutions or unique approaches that spur creativity and innovation.

The right systems (technologies, platforms, solutions, enablers)

To produce complex products that increasingly resemble or rely on connected networks and platforms, an organization needs systems that harness complexity. Global product companies require a system of design partners, suppliers, and manufacturers to help realize their vision. They also need a single platform to allow both formal and informal processes to facilitate real-time, transparent collaboration between internal teams and extended supply chain partners. Finally, innovative product companies need to bring together complementary technologies and multidisciplinary solutions into a single platform or single source of truth for everyone involved.

As mentioned earlier, Lumicell's handheld imaging system allows surgeons to literally see in real time if they have left any cancerous cells behind when removing a tumor. The system relies both on a sophisticated, AI-powered viewer and an injectable contrast dye that fluoresces when it reacts with the tumor cell microenvironment.

Producing this complex medical device requires a complex team effort.

As Lumicell's Senior Vice President of Quality Ben Locwin explained, "In many ways, we are a virtual company since we do some assembly on site and lots of testing, but we don't manufacture our devices or drug products (e.g., the contrast dye). We rely on suppliers for fabrication of the device and for the starting materials to use in the drug product. And so it becomes incumbent upon us to stringently monitor our supply chain."

Ben described Lumicell's relationship with its suppliers as symbiotic. To support this symbiosis, product companies need a unifying, connected system of record, one that provides visibility into the entire process. "We have several dozen vendors providing different pieces of work for us," Ben said. "Keeping that straight is difficult."

The single source of truth provided by product lifecycle management (PLM) and quality management system (QMS) platforms connects the organization's product and quality processes to internal teams and the broader, symbiotic network of suppliers. These platforms serve as technical enablers to support the organization's development and quality assurance processes. They also facilitate communication and visibility across the supply chain, providing the consistency and stability that allows innovation to flourish.

> We help suppliers by providing them with business, and our suppliers help us by producing a high-quality output. By nurturing each other and challenging existing processes for the better, we end up with a stronger supply chain, better devices, and better drugs. As part of this synergistic interaction, suppliers can thrive and Lumicell can thrive as well.

"Having a quality management system (QMS) in place—so that we don't lose sight of actual, objective reality and replace it with things that we hope to be true—is critical.

—Ben Locwin, Senior Vice President of Quality, Lumicell

SEVEN PRACTICAL LESSONS FOR PRODUCT INNOVATION

Arena has worked with thousands of companies that are devoted to creating high-impact products that change people's lives. We could fill volumes with the stories of these organizations, what they've done, how they do it, and what they plan on doing next. Until the time that all those tales can be told, we would like to share the following practical lessons from a select group of our clients.

1. Don't Think "Product." Think "Platform."

"Investors don't want to hear that you just make a product, like a coffee maker," said Roderick de Rode, Founder and Chief Executive Officer of Spinn, which does, as a matter of fact, make a coffee maker. And yet, what Spinn offers is a long way from the classic Mr. Coffee. For starters, Spinn's coffee maker features a patented, centrifugal brewing system (which would even work in space!).

Spinn also features something no other coffee maker offers: a built-in connection to a large network of coffee roasters from around the world.

The creation and marketing of this community was not an afterthought; it was an integral part of Spinn's vision. About the time Roderick acquired the patent for his new coffee maker, he started to notice something. "I saw these independent coffee roasters popping up in Amsterdam," he said. "These were all three-man bands making great products with a passion for great-tasting coffee. But no one could find them because they were hidden in these little alleys and streets around Amsterdam. They had very cool packaging and made great coffee, but they didn't have any online presence."

Thus the vision for Spinn came together. The coffee maker itself would play a role, but, as unique as it was, it would not be the focus. Instead, Roderick chose to focus on connecting first to coffee enthusiasts and then the wider public with amazing coffee, using a variety of technologies to do so.

Thinking of a product as a platform involves connecting the dots. If people want to have a great cup of coffee, giving them a machine that can make it is a start. But where do they get the beans? From a network of roasters. How do they get the beans? Through a subscription service.

How do they make the best cup of coffee? By allowing the machine to learn new recipes based on the properties of the bean. And how do you make interaction with the machine as convenient as possible? Allow customers to control it with an app or voice commands.

Product innovation calls for thinking beyond the product. It involves seeing the product as a potential platform—or as part of a larger platform—allowing you to envision all the complementary products and services that can plug into this platform. In this way, you provide customers an ever-expanding network of value and constantly evolving experience.

> What we're doing is making a platform for artisanal coffee roasters to sell their products and market their products in a way that hasn't been done before. Essentially, we've created a marketplace for independent coffee roasters. And the machine is a carrier to the kitchen of our consumers that makes them a better cup of coffee. What we've done is created an end-to-end coffee experience.
>
> —Roderick de Rode, Founder and Chief Executive Officer, Spinn

2. Make the Innovation Useful Out of the Gate.

Kymeta makes an innovative flat-panel satellite antenna. These antennas consist of layer upon layer of innovation, from the metamaterials they are made of to the software and electronics that provide their tracking and communications capabilities. Yet as powerful and innovative as the antenna may be, it could have been challenging for an inexperienced person to properly deploy.

Kymeta sought to simplify that process. "We wanted a very easy way for buyers to consume the service, so we developed an end-to-end service, which allows customers who aren't familiar with satellites to get connectivity. We're actually allowing our customers to purchase our product and, out of the gate, get a solution that they can then offer their customer base with always-on connectivity. This means they don't have to worry about going and sourcing satellite capacity, figuring out how they're going to build a backend to manage that capacity, and so on."

When products are innovative, they bring something new to the world, pushing and expanding what people think of as possible. In many cases, this can result in new technologies, such as the Internet of Things (IoT), that offer new capabilities before companies and consumers know how to fully unleash their potential. Creating a complementary product or service can help streamline adoption and even create a market for the product the innovative organization has introduced.

> If you look at traditional satellite service, you basically have to have an engineer on site to install the satellite equipment and then you have to call the service center to get the equipment attached to the satellite itself.
>
> —Neville Meijers, Chief Product and Marketing Officer, Kymeta

3. Make It Simple.

Dataspeed produces a drive-by-wire kit for companies doing research and development in the autonomous vehicle space. Dataspeed's kit allows auto manufacturers, sensor makers, software developers, and others focused on autonomy to control the steering, braking, shifting, and acceleration in vehicles electronically. A true first mover with hundreds of customers, Dataspeed's technology has found wide acceptance.

Building a system that is an important part of what Greg calls "the autonomy stack" is not simple. Aside from the amount of code required to effectively tell a vehicle how fast to go and when to turn (not to mention the machine learning required to support "perception"), Dataspeed also has had to solve for interactions with a wide array of vehicle platforms and sensor types. That they are the go-to solution in their industry speaks to how well they have succeeded in mastering this complexity.

In Greg's view, what has driven the broad adoption of Dataspeed's technology is the high level of vehicle control it

> The drive-by-wire kit was the start of our work but that's not all we provide because we've moved up the food chain. We integrate sensors and do actual autonomous development ourselves, converting vehicles not to full-blown autonomy, it's not there yet, but to limited autonomy. In other words, we're developing the software stack and using our own drive-by-wire kit to build autonomous vehicles.
>
> —Greg Fleck, Chief Operating Officer, Dataspeed

provides. “I think the reason the product reached a level of market acceptance is this: It controls the vehicle very well. When a developer sends a message to turn the wheel or whatever, it does it smoothly and consistently every time. And that’s ultimately what an engineer or developer wants—to not have any issues.”

“Ultimately, it’s the simplicity of it, though it’s not so simple because there are tens of thousands of lines of code in there.”

For an innovation to be adopted, a company has to design and manufacture a product in a way that is commercially viable. It also needs to be able to scale up to meet demand. But there is something else that makes an innovation “sticky”: a strong user experience.

Greg touched on several key components of such a user experience. The product needs to perform as advertised. And it needs to do so reliably. But above all, it needs to be simple to use. All the product innovations we have discussed solve complicated problems and are themselves complicated to manufacture. But beyond this, they all have something else in common: a user-centric design that aims to drive adoption through simplicity.

4. Accept Ever-Moving Timelines.

While many seem to take it for granted that autonomous vehicles are the future of transportation, projections for when that future will arrive keep getting pushed out. Just within the past year, Ford CEO Jim Hackett said the industry “overestimated the arrival of autonomous vehicles.” And Raquel Urtasun, the chief scientist in charge of Uber’s self-driving efforts, told Reuters,

“The first thing I learned is no timelines, right?”

Such skepticism is no surprise to Nate Ramanathan, Vice President of Operations at AEye. AEye is a pioneer in the artificial perception space for self-driving cars, particularly in the area around iDAR (intelligent Detection and Ranging).

When starting out, the company was focused on two different markets: the robot taxi market and the advanced driver-assistance systems (ADAS) market. As it turns out, the latter is taking the front seat today. “It turns out that the next step for autonomous vehicles is not Level 5 (full) autonomy,” Nate said, “but Level 2.5, Level 3 autonomy. And we’re going to have to ease people into it, because all of a sudden letting the car drive itself, for most people, is kind of a freaky moment.”

> When Luis Dussan started our company many of us were optimistic about focusing on full autonomy right off the bat. But he looked at it differently. ‘This is going to come in stages,’ he told us. So our architecture needs to support that.
>
> —Nate Ramanathan, Vice President of Operations, AEye

So what does this mean for companies on the cutting edge? First, the company has to go where the market is. Especially in the world of autonomous vehicles, those wishing to compete must be aware of the problems and use cases that have already been solved and begin working on the use cases that will only be solved in the future.

“We have to deal with corner cases, like the kid running out in the middle of the block or the person coming out from behind a car carrying a trash bag,” Nate said.

Secondly, the company has to build an architecture that anticipates the changes to come. AEye is doing this, in part, by building an architecture that leverages edge computing to save both power and time. It is also anticipating the evolution of sensor systems that will provide iDAR with critical data.

Accepting that you can’t put a timeline on the ultimate goal, in this case, full autonomy, forces you to think both in the near term or what is needed today, while building for the future and what will be needed next.

> Some people think that the camera can solve the problem. Not really. Radar can’t solve the problem, either. What it’s going to take is a combination of sensors, and your sensor suite has to be smart enough and use advanced artificial intelligence to take any information from any sensor and use it. That’s when it’s going to be a fully autonomous solution.

5. Collaborate With Supply Partners to Manage Supply Shocks.

"Ten to fifteen years ago, the relationship that product companies had with their contract manufacturers was very different," says Arena's VP of Strategy, George Lewis. "Frankly, the model was: The OEM told their manufacturers and design partners what to do, and they did it."

That paradigm has evolved. The model adopted by innovative companies today is based on cooperation, not command and control. This cooperation is evident both as new products are being introduced—where suppliers can serve as key collaborators when it comes to designing for manufacturability (DFM)—as well as when companies seek to sustain manufacturing, particularly in the face of supply chain disruptions.

Contract manufacturers are in a unique position to identify potential manufacturing design issues or emerging shortages of component parts and materials. At the same time, they can also play a pivotal role in identifying alternate sources for materials and replacement parts. Having a more cooperative and collaborative relationship with supply chain partners helps companies gather supply chain intelligence to improve design and manufacturing processes to accelerate chain innovation.

Real-time communication is the key to cooperation.

In today's global economy, this requires web-enabled control and access to information to maintain the flow of design information up and down the supply chain. A cloud-based platform serving as a single source of truth provides such a mechanism. It is via this channel that product companies proactively engage with their distributed teams and supply chain partners.

Frequent bidirectional communication throughout the new product introduction process eliminates manufacturing issues and launch delays, and ultimately speeds time to market. This ensures the proactive resolution of supply chain shocks and continuous product delivery.

> "When you provide real-time access to product information with your contract manufacturers you foster faster collaboration to help pivot quickly when manufacturing issues arise or parts shortages occur."
>
> —George Lewis, VP of Strategy, Arena.

6. Plan for Scale.

Solar trackers are mounted solar panels that can adjust themselves to track the sun's movement according to an algorithm and intelligent controls to optimize energy capture. NEXTracker is the leading smart solar tracker manufacturer worldwide, with over 30 gigawatts either installed or under fulfillment. To put that in perspective, one gigawatt is enough to power 725,000 U.S. homes.

Looking at it another way, a traditional power plant has an output of half a gigawatt, and the largest nuclear power plant in the U.S. produces four gigawatts.

Alex Au, NEXTracker's Chief Technology Officer, explained, "Every week, we're shipping more than 500 megawatts worth of product. We're essentially shipping full-scale power plants every one or two weeks. But the first project that we did was a one-megawatt project, which might sound small, but it's not. To produce one megawatt, you need to install solar trackers across six square acres of land."

By their fourth project, things were already changing; the client wanted 69 megawatts, which meant shipping and installing trackers across 414 square acres.

"Every single part and component that we shipped was installed and used," Alex said, "and you can only scale to that magnitude if the infrastructure is in place."

Like many companies today, NEXTracker is a virtual manufacturer. They work with a network of partners who help source and build their systems.

In fact, when those systems are shipped, they don't go to a NEXTracker warehouse but instead go directly to the site where they are to be installed. So when Alex talks about building out infrastructure that allows the company to scale, he is referring specifically to the technical infrastructure—the systems that orchestrate this complex system.

"When I became CTO, I was asked, 'What resources do you need first? Engineering and all that stuff?' I said, 'No, but I do need resources for data management and creating processes from procurement through to delivery.' "

Alex based this decision on experience. As he told us, "When I was 28, I actually ran procurement, among other things, at the company where I worked. So I know: You can get an order, but if you can't ship it, you can't install it, and you can't get paid."

Alex and his team implemented a comprehensive stack including everything from engineering and design tools to Arena's PLM system and a CRM featuring configure price quote (CPQ) capabilities. In addition, they built extensive data management and analytics capabilities, capabilities NEXTracker leverages for everything from quality management to predictive maintenance and monitoring the most remote power plants in the world.

A particularly powerful benefit of this system is that it provides every part of the organization with the data it needs.

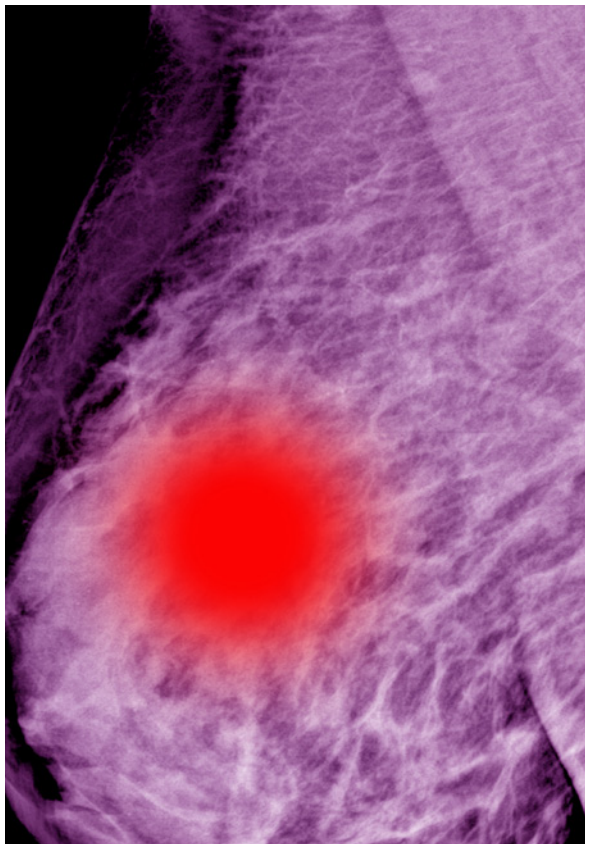
> One of my biggest pet peeves is when you call a large organization, for example, to resolve a billing issue. Then you say, 'Hey, I have a question, a technical question about XYZ,' and they say, 'Sorry, that's not my department.' The problem is, since every department is using totally different software, you get booted around.
>
> —Alex Au, Chief Technology Officer, NEXTracker

At NEXTracker, customers have a different experience, because all stakeholders have access to relevant customer information via a unique customer identifier. What's more, the data the company collects gets remarkably granular.

When a company brings a product to market that's so innovative it quickly takes market share from its main competitors, it's easy to believe the innovation is the reason for success. As Alex Au and NEXTracker know, that's not the whole story.

A company needs systems that allow it to scale by coordinating information across the organization and throughout the supply chain, while also providing ongoing insight into everything from manufacturing performance to customer experience. The innovation may drive the need to scale, but the systems need to support it.

> When our guys are in the field installing a system, they're scanning QR codes to be able to say, 'The power electronics on this tracker is located at this geospatial coordinate,' etc. It's getting mapped out into our database that also tags it back to the manufacturer. We can identify which manufacturer the unit came from, what country it came from, what production lot, what production week.
>
> —Alex Au, Chief Technology Officer, NEXTracker



7. Commit to Continuous Innovation.

Innovation isn't something that happens once. The very concept implies making things new, a process that by definition knows no end. Innovative companies take this to heart and devote themselves to the continuous refinement of their products, introducing new designs, new features, and new functions.

Of course, the initial idea behind any innovation may itself be fairly revolutionary. It may involve bringing something into being that has never existed before, leading to monumental changes that ripple across industries and trickle down into everyone's daily life. Even in the case of such an invention, however, the question remains: How can we make this better?

So, what fuels this commitment to continuous innovation? Mindset and culture have something to do with it because, frankly, the whole organization needs to reflect this commitment. But, as important as this organizational component is, the real fuel for continuous innovation is customer data, specifically, the feedback provided by those using the product.

Lumicell created a handheld imaging system that enables surgeons, when removing tumors, to identify any cancer cells left behind on the tumor cavity walls.

Surgeons can then remove those cells as well, improving patient outcomes. Given the high stakes of these procedures, Lumicell is extraordinarily attentive to what the surgeon's experience with the device is like.

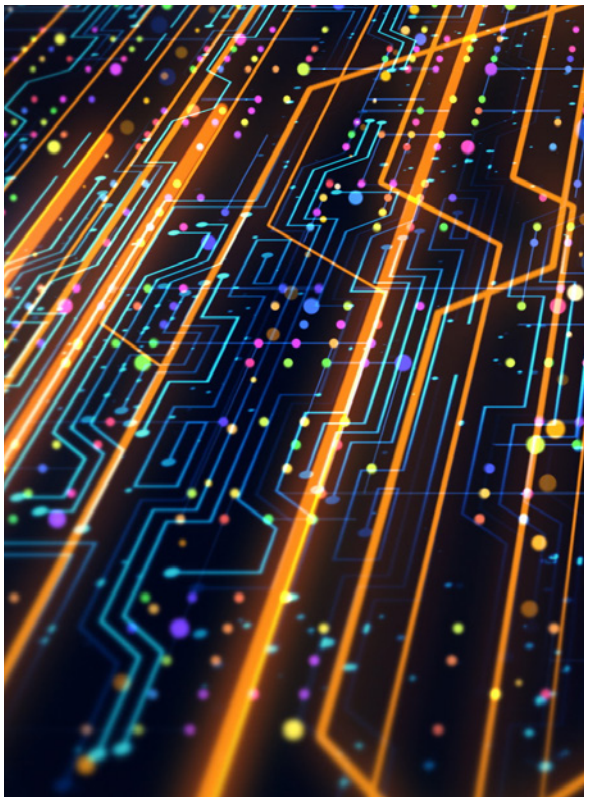
"You know," said Lumicell's Senior Vice President Ben Locwin, "we are always soliciting information from surgeons and everyone involved in these procedures regarding the feel, the form, and the function of the device, as well as the usability of the drug product [the dye causing leftover cancer cells to fluoresce]. All of this continuous learning gets incorporated into our research and development process in iterative loops. What's important to me is to be able to really differentiate between 'Evolutionary' and 'Revolutionary.'"

"People who use things on a daily basis," he added, "have high expectations for form and function. Their feedback provides us with an absolutely invaluable stream of information leading to refinements in the device and new avenues of innovation."

This iterative improvement loop, a loop that must include learning from the real-world experience of actual users, reflects Lumicell's approach to innovation. In Ben's eyes, this approach goes beyond simply inventing something new.

"A singular, one-off invention won't pass muster," he said.

> "What matters is embracing the notion of innovation and moving it forward. And we believe this continuous approach to innovation will lead to our ongoing success in the future."
>
> —Ben Locwin, Senior Vice President, Lumicell



CONCLUSION: INNOVATION NEVER ENDS

Innovation spawns more innovation. Every innovation, whether it comes in the form of a new product or the total reimagining of what a product can be, points to previously unimagined possibilities for connecting, improving, and transforming the world. And every innovative approach to product design and development informs previously unforeseen solutions to seemingly intractable problems.

The conditions that drive product innovation are dynamic, and market conditions can change in surprising and unpredictable ways.

For this reason, approaches to innovation must be dynamic as well. This calls for adopting a mindset committed to ongoing experimentation and discovery, building a culture that is open and adaptable, and adopting systems that provide stability (as in a single source of truth) while enabling flexibility.

The companies highlighted in this report embody this dynamic flexibility. They serve as models for any organization looking to solve complex problems in unprecedented ways. And while there is no shortage today of complex problems, there is also no limit to what innovative organizations can do to address and overcome them.

ABOUT ARENA

Arena, a PTC Business, helps companies create innovative products that change the world. Arena unifies product lifecycle management (PLM) and quality management system (QMS) processes, allowing every participant throughout product development and commercialization to work together fast and effectively. With Arena, dispersed teams accelerate the design and delivery of quality products. For more information, visit Arena, A PTC Business.

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