From the largest companies to the smallest, a successful product begins with a spark of innovation — that one idea so big, so exciting that it seizes customers’ imaginations.

Dyson. Apple. Tesla. These market leaders all began as small startup companies with a unique product vision that defied the conventional wisdom. This vision began with a spark of creativity, with engineers asking the question, “How can we do it better?”

At one point, their product ideas were most likely considered crazy, unrealistic or a bad financial risk for investors. Their success hinged on both technology and engineering breakthroughs. Yet the entrepreneurs who founded these companies stuck by their vision and ultimately achieved incredible success. Today, customers line up for their products because they represent a design revolution — offering features and performance benefits unmatched by competitors, effectively disrupting the pre-existing market and redefining product performance.

These and other successful startups have proven that a single spark of creativity has the potential to rewrite historic design rules and even change lives. But first, entrepreneurs must confidently and thoroughly answer the question, “How can we do it better?” — usually without significant human or financial resources. While they might believe passionately in their product ideas, entrepreneurs need to prove their concepts from an engineering standpoint to attract investors, navigate regulatory approvals and ultimately win customers’ confidence.
In the past, inventors like James Dyson had to rely on building and testing thousands of physical prototypes, which often required years of effort. Today, entrepreneurs have access to an array of advanced tools and processes, including engineering simulation, that can help them take design risks and test their innovative ideas at a minimal investment of time and money.

Profiled on the following pages are seven companies at various stages of maturity, and representing a wide range of industries, that are somewhere on the road to startup success. Some of these businesses have not yet launched a product, while others have shipped to thousands of customers. What their founders have in common is an unwavering belief in their product ideas, as well as a commitment to applying the best available technology to verify and commercialize those ideas.

From new energy solutions and medical products to sports equipment, these companies are taking that spark of innovation and turning it into viable commercial products. They are creating new product categories, taking on established market leaders and otherwise turning their industry on its head. Their stories are inspiring and informative, because they are conquering engineering and product development challenges that are common to many companies, large and small.

Starting a company has never been simple or straightforward, but today’s fast-changing, crowded marketplace makes it even more challenging. Product life cycles are growing shorter and shorter, groundbreaking ideas are quickly copied, customers are constantly demanding new features and functionality, and engineering teams are leaner than ever. In this complex environment, dramatic and ongoing innovation is not just an option, but an imperative. Read on to learn how innovation has become a way of life at seven unique businesses.
A born problem solver, Kyle Doerksen enjoyed his work as a consumer and technical products developer at IDEO, a leading Silicon Valley design firm. But he was always looking for a product idea that would be his alone, a product that would embody his passion and energy. As he walked a mile to work each day, Doerksen began to imagine ways to make his daily commute both faster and more fun.

While growing up in the Canadian Rockies, Doerksen had been an avid snowboarder and, after years of living in California, he still missed the experience of gliding effortlessly over the ground. A question began to form in his engineer’s mind: Could there be a way to combine the practical necessity of moving around an urban environment with the thrill of board sports?

That question was the genesis of Onewheel, a motorized skateboard equipped with a single 11.5-inch tire and a battery-powered 2-horsepower motor. Doerksen’s concept was to bridge the worlds of sports and transportation by making it fun to move from one place to another. From the beginning, he designed Onewheel so it would be equally at home on pavement, grass, dirt or sand — built for both fun and practicality.

The engineering challenges were not insignificant. For example, to enable riders to control the movement of the board by shifting their weight, Doerksen had to incorporate pressure-sensitive, self-balancing sensors in the footpad. With two engineering degrees from Stanford University and years of hands-on design experience, Doerksen was up to these challenges. In 2013, he left his job and devoted all his energy to his new startup company, Future Motion, headquartered in the California beach town of Santa Cruz.
“Leaving the security of my job was a risk, because there was no existing product that was anything like Onewheel,” says Doerksen. “I was not only launching a product, but also creating an entirely new category. But the early reaction to Onewheel was so strong that I knew it was a chance worth taking.”

A Kickstarter fundraising campaign in January 2014 confirmed that Doerksen was on to something. Investments poured in from around the world, allowing Future Motion to reach its goal of $100,000 in just four days. By the end of the three-week Kickstarter campaign, the company had raised more than $630,000 from more than 1,000 backers.

“The success of the Kickstarter campaign marked a significant milestone because it demonstrated there was incredible interest in our product concept,” recalls Doerksen. “But at the same time, it created enormous pressure on our engineering team. We had to go from prototype to mass production very quickly.” Since then, Future Motion has shipped more than 10,000 products and earned rave reviews in media outlets including, the Wall Street Journal, Sports Illustrated, Popular Mechanics and NBC.

Kyle Doerksen
Founder and CEO, Future Motion
While the initial development of Onewheel was a slow and manually intensive process, focused on building and testing physical prototypes, today the Future Motion engineering team is leveraging the power of simulation to refine and improve Onewheel. For example, Onewheel has a battery range of six or seven miles, but the Future Motion engineering team is working to extend the battery life. One key strategy is reducing the overall product weight of 25 pounds via lighter materials and a new chassis geometry.

“ANSYS software is helping us quickly make design changes, predict how they will impact real-world performance and achieve meaningful improvements.”

According to Doerksen, simulation via ANSYS engineering simulation software is making an enormous impact on both the time and the cost involved in design iterations. “We estimate that it costs about $10,000 to design, build and test a physical prototype,” explains Doerksen. “Now that we have access to ANSYS software, we can better predict performance in the real world — which means we are building far fewer prototype boards. In addition, we can work a lot faster. Now that we’ve established the category, we expect lots of ‘me too’ competitors to show up — and we need to accelerate our launch of future designs to stay ahead.”
A self-described “serial entrepreneur” whose first company was a pioneer in business process outsourcing, in 2009 Lumley was living on Kauai, Hawaii, U.S.A. Always on the lookout for a new idea, one day Lumley was riding a kiteboard when the wind came up suddenly, filling his sail. Noting the sudden power that resulted — and how fast and efficiently his kite moved him across the water — he wondered if somehow a system of graceful kites could be used to generate energy on a broad scale, replacing large wind turbines. Inspired, Lumley began to study the global wind-based power generation industry so that he could understand the existing technologies and carve a new niche for himself.
While attending an international wind energy conference in Berlin, Germany, in 2013, Lumley sketched on a cocktail napkin an innovative wind power–generation system — one that would merge established technology from horizontal-axis wind turbines (HAWTs) with emerging kite concepts. With that sketch, AirLoom Energy was officially born. Today, the company is based at the Wyoming Technology Business Center in Laramie, Wyoming, U.S.A. and capitalizes on research and development activities at the Wind Energy Research Center at the University of Wyoming.

“Although the physics of the AirLoom are identical to HAWT technology, our design turns the geometry of the whole thing on its ear,” explains Lumley. In his innovative design, small gliders acting as a hybrid of kites and HAWTs travel along an oval track, where they continuously capture the wind’s energy. Mounted on each traveling glider are magnets that induce an electric current in the winding next to the rail. The thin rail acts as the structure of the wind turbine, the winding of the generator and the power transmission infrastructure.

“The AirLoom is 23 times lighter and 15 times cheaper than the dominant wind technology today,” notes Lumley. “The flexible, scalable design of the AirLoom also makes height and length a design choice rather than a predetermined necessity, making the AirLoom perfect for both utility-scale installations and mobile applications such as emergency response.”
In July 2016, Lumley won a Small Business Innovation Research (SBIR) grant from the National Science Foundation (NSF) that will allow him to build a working prototype of his patented AirLoom system. His NSF proposal included multiple simulation graphics generated by ANSYS software. “It’s incredibly powerful to visually demonstrate to someone that your technology works in the real world, whether that audience is a funding organization, a private investor or a potential customer,” states Lumley. “Simulation software has enabled me to do just that. I don’t think I would have made such rapid progress through the research and development phase without having access to such a powerful and sophisticated tool.”

As any startup company can attest, preserving working capital — especially in the early stages — is of paramount importance. For this reason, Lumley calls the ANSYS startup program “a lifeline.”

“At this point in our development, the ANSYS simulation suite has basically replaced the need for us to coordinate the work of numerous remote contractors and experts in a wide variety of disciplines,” says Lumley. “We are constantly refining the overall design in response to data. Trying to coordinate that among an entire remote team at this stage would be expensive and time-consuming, especially as each expert would potentially focus on just one part of the elephant.”
Lumley and his engineering staff are using a full suite of simulation software from ANSYS to not only specify the measurements and other physical characteristics of their components, but also to ensure that the system works optimally as a whole. “The AirLoom system is subject to just about every physical force, and therefore the structures and controls must be optimized,” he points out. “From the electromagnetic fields in the generator and the structural integrity of the towers to the aerodynamics of the airfoils, simulation is helping me design the highest-performing system across all metrics. I can ask the right questions and make the right design trade-offs.”

As one example, Lumley and his staff designed a one-of-a-kind transverse flux permanent magnet linear generator as part of the AirLoom system. They used ANSYS software to run approximately 6,000 parametric studies of the generator’s geometry. Lumley estimates that engineering simulation shaved three months off the time that would otherwise be required to complete this analysis.

“Even though I’m an experienced entrepreneur, I’m not an engineer by trade — but the ANSYS simulation suite has allowed me to apply my knowledge of physics and mechanics to create unconventional designs and validate that they will work in the real world,” Lumley concludes. “Simulation has helped my simple sketch from the cocktail napkin take flight.”

Robert Lumley
Founder, AirLoom Energy
Each year, more than 2 million patients worldwide undergo a procedure called coronary artery bypass grafting (CABG). Used to treat blocked arteries and restore normal blood flow to the heart, CABG involves grafting a blood vessel — typically taken from the leg — around the diseased area, re-establishing blood flow to the heart tissue.

Veins used as CABGs offer an inadequately durable solution to coronary artery disease, with a long-term outlook that is not promising. Within 18 months, 25 percent of the implanted veins fail — and, after five years, that failure rate increases to 40 percent.

“The blood vessels in the leg are relatively large and easy to harvest and implant, but unfortunately they are not built for the high flow rates and pressures near the heart,” explains Mohammed El-Kurdi, co-founder and director of research at Neograft, a startup headquartered in Taunton, U.S.A. “Over time, these grafted veins begin to dilate and eventually become blocked, necessitating another surgery.”

A mechanical engineer by training, El-Kurdi focused his doctoral work at the University of Pittsburgh on designing a structural support system that would improve the durability of arterial vein grafts. In 2009, he co-founded Neograft, and Jon McGrath, a seasoned health care entrepreneur, became the company’s chief executive officer. Neograft markets a patented product called Angioshield that is designed to increase success rates for CABG procedures.

“Through a novel process called electrospinning, our Angioshield technology creates a ‘scaffold’ of polymer material around the vein prior to implant. This scaffold improves both the vein’s strength and its geometric uniformity,” says El-Kurdi.

According to El-Kurdi, Neograft’s proprietary advanced material is key to the success of Angioshield. “Our polymer sheath shapes itself to the vein without deforming it,” he notes. “And, because the material is porous, it allows nutrients and new cells to migrate to the tissue. Over time, this results in the growth of stronger and healthier graft tissue.”
Because of the difficulty associated with visualizing and manipulating structures inside the human body, El-Kurdi began relying on the power of engineering simulation while still in the Ph.D. program at Pitt. Today, Neograft engineers use simulation to model different blood flows inside implanted veins, as well as to understand diverse mechanical forces that act on vein grafts, such as the motion associated with a beating heart. Product developers can then change the physical properties of the polymer scaffold as they increase their understanding of vein graft mechanics.

An external stent for the grafted vein, Angioshield is deposited directly onto the outer surface of the vein via a novel electrospinning process. Neograft’s product development team has used ANSYS finite element analysis (FEA) software to ensure the structural strength of the stent, and has leveraged ANSYS computational fluid dynamics (CFD) software to study and optimize blood flows inside the grafted vein. Fluid–structure interaction analysis is planned for the future, as Neograft expands its use of ANSYS solutions.

“Perfecting the Angioshield material is an iterative process, during which we apply different material configurations, then test the treated vein’s resulting strength and durability,” states El-Kurdi. “It would be impossible to move so quickly, and conduct so many studies, without working in a risk-free virtual design environment. By the time we moved to animal and clinical trials, we had a deep foundation of knowledge that allowed us to predict outcomes very accurately. And we continue to add to that knowledge base every day.”

Today, as Angioshield is tested in patients, computerized tomography angiography (CTA) generates images of the implanted vein. These images are fed back into ANSYS software to generate 3-D models of Angioshield inside an actual human body. “We’re currently using simulation as an investigative tool to understand patient-specific behaviors of treated veins,” says El-Kurdi. “Our studies will enable the Neograft engineering team to build better predictive models and continually improve the product.”

“It would be impossible to move so quickly, and conduct so many studies, without working in a risk-free virtual design environment.”
Not only has simulation helped accelerate the product development process at Neograft, but it’s also supporting this startup in communicating the unique advantages of Angioshield to investors and regulators. “Simulation provides a very visual way to tell our product’s story,” El-Kurdi points out. “There’s no way to see what’s actually happening inside a patient’s body. But, with simulation, we can replicate that environment and show Angioshield at work.”

As a Class III medical device, Angioshield faces a rigorous approval process before it is commercially available to patients. But El-Kurdi is committed to bringing the benefits of Angioshield to people around the world who undergo CABG procedures every year. He says, “By increasing the odds for a successful vein graft, we hope to significantly improve the quality of life for millions of heart patients — and simulation is critical in accomplishing that mission as quickly as possible.”

Mohammed El-Kurdi
Co-Founder and Chief Scientific Officer,
Neograft Technologies, Inc.

“Simulation provides a very visual way to tell our product’s story.”
Nikolaj Hviid has always been a busy man. A mechanical engineer by training, he has spent his entire career developing and growing startup companies — six to date. So he’s no stranger to rushing around, trying to keep up with phone calls and ultimately feeling frustrated by the burden of multitasking.

“In 2012, I was an equity partner in an industrial design firm when I realized that personal technology had not kept pace with what was happening in my own life and in the lives of my colleagues,” Hviid recalls. “I would try to answer phone calls while doing something else, and it was impossible because the smartphone was not built for multitasking. It demands too much focused attention.”

“The things I was doing with my phone — like listening to music or making calls — were serial immersive experiences,” he continues. “I realized that parallel immersive experiences would be much more efficient — say, if I could answer a call without actually holding a phone or looking at a phone.
I could have my hands free to accomplish something else. I could be anywhere. All that was missing was a new technology solution that would enable parallel immersive experiences.”

In March 2013, Hviid started up a new company, Bragi, to fill this market void. The company launched a Kickstarter campaign that attracted nearly 16,000 backers and raised $3.39 million — setting a record for European Kickstarter fundraising efforts. Today, Bragi has 176 employees and delivers personal computing innovations to a global market from its headquarters in Munich, Germany. Bragi’s flagship product, called The Dash, is marketed as “the world’s first wireless smart hearable.”

“I envisioned The Dash as a kind of personal assistant that fits into the ear,” Hviid explains. “You can listen to music, dictate a message, measure your steps, monitor your heart rate while exercising or answer a call with a simple head gesture — freeing up the rest of your body. For the first time, you can immerse yourself in numerous tasks in parallel, without the need to hold on to a phone or keep looking at a device on your wrist.”

While wristwatch-type computers are making headlines today, in Hviid’s opinion “hearables” make much more sense than wearables, which tend to have limited functionality and are somewhat clunky physically. In contrast, Hviid points out, The Dash is elegant, practically invisible and deceptively compact — while delivering a huge amount of functionality.
“The Dash is much more than just a wireless earbud,” notes Hviid. “It’s a microcomputer that functions as a headphone, headset, tracker and human input device.” Crammed into a device the size of a fingertip are 150 microcomponents, 27 sensors, 4 GB of storage and a 32-bit processor. And underlying its robust functionality are proprietary algorithms developed by Bragi’s engineers, as well as a custom operating system that understands multiple languages.

As a hands-free wireless solution, The Dash must perform reliably under a broad range of conditions to fulfill its customer promise. “Signal integrity and electronic noise reduction are engineering concerns that are especially critical to our product development team,” says Hviid. “As we introduce future generations of The Dash, consumers will be looking for a smaller and smaller footprint — with more and more functionality. We need to make sure our antennas remain optimized under these new and increasingly challenging conditions.”
Today, the Bragi engineering team relies on the power of ANSYS HFSS to ensure that antenna performance is maximized in future product releases. “Engineering simulation is an absolutely essential component of our efforts to create next-generation hearables,” Hviid states. “We can only prototype and test a finite number of configurations, and we need to account for a wide range of human bodies. Simulation is really the only way to move forward quickly and optimize our products across all conditions. In addition, simulation will help us ship better-performing products and reduce our potential warranty obligations.”

“If we’d had access to ANSYS software when we were engineering our initial product, we would have been able to cut significant time and costs out of the development cycle by reducing the need for lab testing and physical prototypes,” notes Hviid. “I’m delighted that this state-of-the-art design tool is accelerating our future product releases and improving product quality — not just for new iterations of The Dash, but for a number of other consumer solutions currently in development at Bragi.”
Sometimes great ideas are born out of tragedy. That was certainly the case in August 2013 when Jeffrey Schab — an equestrian, engineer and entrepreneur — lost one of his horses to colic in the middle of the night.

“Although colic is the leading natural cause of death in horses, it’s usually easy to treat and benign if you intervene early, which means you need to be aware that the animal is in danger or distress,” says Jeffrey. “Immediately I thought, ‘Surely there must be some way to remotely monitor the general health status of a horse when no one is around and, more important, alert someone when there’s an issue.’

“There must be some way to remotely monitor the general health status of a horse when no one is around and alert someone when there’s an issue.”
As a world-class equestrian, biomedical engineer and co-founder of a successful network of healthcare marketing companies, Jeffrey knew he had both the passion and the expertise to invent and commercialize a remote monitoring solution for horses. So he formed a new company, Protequus LLC — which combines the word “protection” with *equus*, the Latin word for horse — to answer this market need.

However, Jeffrey faced one major challenge. He needed someone to design and fabricate the necessary software and hardware to make his vision a reality. Fortunately, he didn’t have to look far. His brother, Michael Schab, is also an established engineer and entrepreneur — as well as owner and co-founder of a technology consulting firm, NRGXP LLC, which specializes in Internet of Things (IoT) solutions.

Although Protequus is headquartered in Austin, Texas, and NRGXP is based in Rochester, New York, the brothers’ close relationship has bridged the physical distance and resulted in a successful business partnership. “My initial vision and product idea came solely from an emotional place, and the fact that I had witnessed a market need firsthand,” notes Jeffrey. “Michael brought the expertise, bench strength and conviction needed to engineer the best possible solution.”

The resulting IoT-enabled product, NIGHTWATCH®, is the world’s first smart halter — or optional safety collar — that can save a horse’s life through early intervention in the event of danger or distress. By continuously monitoring real-time data on a horse’s heart rate and respiratory rate, as well as its behaviors, motions and posture, NIGHTWATCH identifies abnormal patterns. The device then automatically alerts a caretaker via text, phone or email.

“NIGHTWATCH is like a home security system for your horse’s health. The system is designed to automatically alert you to a problem, any time of the day or night, so you don’t have to worry or stay up monitoring an app or video camera yourself,” says Jeffrey. “Since horses spend about half their time unsupervised, whether in a pasture or a barn, NIGHTWATCH is there when you can’t be.”

Having earned a degree in electrical and computer engineering, Michael understands the power and value of engineering simulation, especially when combined with design of experiments (DOE) methodologies. Throughout the NIGHTWATCH development program, ANSYS HFSS was utilized exclusively to understand and identify the driving factors affecting the reliable performance of the halter’s onboard ultra-wideband impulse radar (UWB-IR) antenna.
Simulation enabled the Protequus team to study a wide range of factors that could impact antenna performance, while high-performance computing allowed numerically large computations to be run in parallel extremely quickly.

“The halter has a novel antenna system that uses UWB-IR to measure biometrics, which are often the first sign of pain and distress in these animals,” Michael explains. “ANSYS HFSS has served as a kind of ‘tuning fork’ to help perfect the signaling capabilities of NIGHTWATCH and ensure that it will operate reliably in real-world conditions.”

“Without simulation, I would have had to rely on guesswork and physical prototypes, which would be hugely time-consuming — if not impossible,” Michael continues. “With a unique product like NIGHTWATCH, we needed to have complete confidence in signal integrity, while moving quickly to make this lifesaving device available to as many horses as possible.”

“Each day, more than 100 horses in the United States alone will die of colic, and that’s what keeps us up at night,” states Jeffrey. “We’re literally on the cusp of not only saving horses’ lives, but also revolutionizing how insurance companies assess risk, how veterinarians practice telemedicine, and how researchers use real-world data to study and prevent colic and other forms of equine distress.”

“Without simulation, I would have had to rely on guesswork and physical prototypes, which would be hugely time-consuming — if not impossible.”
Lightweighting is one of the most important trends in the aerospace industry today, as jet manufacturers and their suppliers work to reduce the overall weight of planes and improve their fuel efficiency. But little attention has been paid to reducing the weight of the cargo carried by planes every day.

Carbon Freight — a startup based in Pittsburgh, U.S.A. — is attacking this issue with flexible, lightweight cargo pallets that are 18 percent lighter than traditional pallets. "There hasn’t been much innovation in the air cargo industry, certainly not compared to the aerospace leaders’ focus on new materials and production processes that reduce weight,” notes CEO Glenn Philen. “Since cargo can represent a significant percentage of a fully loaded jet’s weight, it only makes sense to look at historic cargo storage and transportation product designs — which have been in use for decades — and ask how we can adapt them for the challenges of today.”

Philen founded Carbon Freight after graduating from Carnegie Mellon University as a mechanical engineer and completing internships with Boeing. “I worked with plastic composite materials at Boeing and began to ask myself, ‘Could these materials be used to transform cargo carrying operations?’ It seemed a logical extension of the industrywide lightweighting initiative,” says Philen.

Measuring 8 feet by 10½ feet, freight cargo pallets have typically been constructed of aluminum. By integrating composites into the materials mix, Carbon Freight has been able to achieve a significant reduction in overall weight. This weight reduction allows a typical cargo plane to carry up to 1,365 pounds in additional freight, and it enables passenger flights to carry more people by reducing cargo load.
While Carbon Freight’s innovative design decreases weight, at the same time it actually increases a pallet’s strength and durability significantly, compared with existing lightweight options. “Durability is a key characteristic for cargo pallets, because they need to fit together as closely as possible in the hold of an aircraft, in order to optimize all available space,” explains Philen. “But they also take a lot of abuse and they need to have some give. We’ve found that composite pallets initially present some durability challenges, but there are actually opportunities for increased durability over other options. They actually deliver a lot of positive performance characteristics that go beyond lower weight.”

The close proximity of pallets to one another, coupled with constant movement and handling, has created some engineering challenges for the Carbon Freight team. Says Philen, “We not only have to consider the loading stresses on our products created by the cargo, but also a wide range of contact stresses that occur as pallets are lifted, transported and packed together. There is a diverse set of complex forces that our design team needs to consider, in order to deliver the best product durability over time.”
Simulation via ANSYS has saved 50 percent in development time and hundreds of thousands of dollars in physical testing.

Carbon Freight’s product development team has relied heavily on engineering simulation to understand and manage these diverse physical stresses. “Simulation has helped us model and understand our pallet structures to improve their overall strength and flexibility, while minimizing their potential for damage,” notes Philen. “We’ve been able to test different material thicknesses and fiber orientations without the time and expense of creating physical prototypes. When we do get to the physical testing stage, we’re really happy with the accuracy of our simulations. Our engineers have been able to predict actual real-world performance with a very high degree of fidelity.”

Simulation has also been able to help Carbon Freight manage one of its biggest business challenges: securing regulatory approvals from the Federal Aviation Administration and other organizations. “One of the reasons that traditional aluminum pallets are so entrenched is that it’s difficult to secure approvals for a new product design,” Philen points out. “Everything that goes into an aircraft must be stringently tested and proven to be safe. As passengers, we want and need that high degree of confidence. But the numerous approvals present challenges that a startup like Carbon Freight has to overcome to compete in the global aerospace industry. Established companies have an advantage in navigating the approval process.”

By visually demonstrating how its pallets will perform under everyday stresses — and verifying their safe performance over time — engineering simulation has helped Carbon Freight progress through the regulatory approvals process. According to Philen, “Simulation via ANSYS has saved 50 percent in development time and hundreds of thousands of dollars in physical testing.” The company launched its pallets to the global marketplace in early 2017.

Despite the fact that simulation has helped reduce product weight by 18 percent, Carbon Freight executives recognize that there will be challenges involved in breaking into the global market. “Composite materials are more expensive than aluminum, which means a higher price point for our pallets. However, the new lightweight design of our products has the potential to save significant fuel costs and add revenues over their lifetime. We’re offering passenger airlines and freight carriers a very attractive value proposition, and we believe Carbon Freight has a bright future ahead,” concludes Philen.
With fourth-generation (4G) mobile internet technology reaching its maturity, the world is bracing for the launch of a new fifth-generation solution starting in 2017, spurred by the U.S. Federal Communications Commission’s (FCC) announcement in July 2016 that spectrum will be allocated to support a new standard for 5G.

“Carriers such as Verizon and AT&T have already publicly stated that they will be offering 5G service in 2017,” says Paul Gilliland, head of business development for PHAZR, a startup company based in Allen, Texas, U.S.A. “Now the race is on to see which technology provider can step up to fill this need.”

PHAZR was formed in 2016 by a group of executives and senior engineers from leading technology companies — including Samsung, Ericsson and Texas Instruments — who believed they could quickly arrive at a commercial 5G solution better than the competition. They founded PHAZR with the goal of developing a unique 5G millimeter wave system that provides a 128 times faster experience and 1,024 times more capacity compared to 4G LTE, to address mobile and fixed-access applications.

Since consistent, uninterrupted user access has not been achieved using 4G technology, the engineering challenge for PHAZR is to significantly increase capacity, allowing many more mobile broadband users to receive service with much higher speeds in the same service area. Fifth-generation technology should also support the consumption of significantly higher data quantities per user, creating a true streaming experience.
Engineers at PHAZR are addressing this challenge by creating millimeter wave systems that can adjust beam width and power levels to accommodate a variety of user needs. PHAZR’s 5G millimeter wave systems operate in the 24 GHz to 40 GHz frequency range, which means that antenna elements can be much smaller than those supporting 4G systems, which operate below 6 GHz.

By packing as many of these high-frequency antennas as possible into very small arrays, PHAZR engineers are enabling radio energy to be “steered” to the specific users being serviced. Not only will the user experience be improved, but transmission sites can be much smaller, making them easier and less expensive to install.

“What we’re doing at PHAZR is really revolutionary, because it represents a new way of looking at how beams are propagated and the frequency at which they operate,” explains Gilliland. “This creates a number of engineering challenges, which we are addressing every day via simulation.”

PHAZR’s product development team is leveraging the power of ANSYS software for electromagnetic simulations to study the radio frequency propagation of various antenna and array designs at different frequencies across a variety of materials. As they analyze the results, engineers can make changes to the designs and move forward quickly until they arrive at an optimal solution. The simulations are extremely accurate, and they allow PHAZR to avoid building expensive and time-consuming evaluation parts — saving at least two weeks per design.

According to Gilliland, not only is ANSYS software helping the PHAZR team speed up its analysis, but it is providing all-important design agility and flexibility. “There are still some uncertainties in exactly what 5G service is going to look like, so we’re making assumptions in our product design efforts today,” Gilliland says. “As the standard and requirements become clearer, ANSYS software will allow us to make rapid changes to meet those requirements, without investing in physical testing or prototypes.”

Gilliland notes that the ANSYS startup program has been critical in enabling PHAZR to compete with much larger companies. “We’re a small business with fewer than 50 employees and limited revenues to date,” Gilliland points out. “It means so much to our team to have access to a world-class product development tool like ANSYS software without making a huge financial investment.”

“Without the power and agility provided by engineering simulation, we would be challenged to be in the race to compete with feasible 5G solutions,” he adds. “Backed by a wealth of industry knowledge — along with the powerful capabilities of ANSYS software — we’re hoping to win that race and establish PHAZR as a 5G market leader.”

Paul Gilliland
Vice President, PHAZR

“It means so much to our team to have access to a world-class product development tool like ANSYS software.”

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Every startup company begins with a great idea — an innovative new product that represents a dramatic improvement over existing offerings. The new product might be more user-friendly, smarter, more energy-efficient or less expensive. It might answer customer requirements, or anticipate needs that customers did not know they had.

While every startup company and its product focus are different, all share a common characteristic: their product’s performance must be robustly designed, tested and verified in order to attract investors, pass any regulatory hurdles and ultimately win in the marketplace.

Of course, product design and testing require significant financial and human resources, which is a challenge for most startups. Already strapped for cash — and typically lacking any revenues — entrepreneurs cannot afford to build multiple prototypes or use advanced testing facilities, such as wind tunnels or test rigs, to verify performance. In addition, physical prototyping and testing are notoriously time-consuming. And time is of the essence when entrepreneurs are driving a product to market that could be anticipated or copied by competitors.

The ANSYS Startup Program gives entrepreneurs access to a world-class product development tool — positioning them to compete with much larger companies.
Helping Startups Deliver on Their Product Promise

Recognizing the challenges faced by entrepreneurs in designing and testing new products, ANSYS has created the ANSYS Startup Program to get engineering simulation tools into the hands of the smallest companies. Tens of thousands of startups around the world now have affordable access to the cutting-edge software solutions leveraged by industry leaders.

Engineering simulation software from ANSYS helps startup companies turn their ideas into viable products by quickly iterating through a number of design options using digital prototypes without investing in physical prototypes or testing facilities. Entrepreneurs can build geometric models of their products in a risk-free virtual environment and digitally explore behavior under real-world physical forces. Not only will these products be verified for robustness and reliability, they will offer proven performance benefits that are important to consumers.

“By identifying design challenges at the earliest possible stage via ANSYS simulation, we can fine-tune our design before prototyping and eliminate most of our structural uncertainty going into the testing stage,” says Glenn Philen, CEO of Carbon Freight, which designs and manufactures lightweight cargo pallets and specialized cargo handling equipment. “That’s saving us prototyping costs while delivering greater design insight and accelerating our market launch. We estimate that our use of simulation software has cut our development cycle in more than half compared to a traditional product development approach.”

“With ANSYS, there are no surprises when we get to the physical testing stage,” says Kyle Doerksen, CEO of Future Motion, which markets Onewheel, a motorized skateboard. “Because prototypes are expensive, we need to be pretty confident that our predictions about performance are correct before we start building a model. ANSYS software has proven very accurate in anticipating the performance of our products when they’re subjected to real-world forces. That enables us to minimize the time and costs we invest in prototypes and physical tests.”
Taking Performance to the Next Level

Most startups are based on product innovation, as entrepreneurs take a current product design and make it significantly better — or come up with a brand-new offering that has never been seen before.

Dramatic innovation means taking design risks. And, because entrepreneurs are breaking new ground, they have no idea what to expect. Simulation offers a tightly controlled yet risk-free development environment in which engineers can push physical boundaries and ask bold “what if” questions. They can reimagine traditional products and create radical innovations quickly and cost-effectively.

While ANSYS software supports innovation, startup companies can also leverage simulation to design for practical considerations such as manufacturability and product cost. They can test different product profiles, configurations and materials to ensure that their products can be manufactured at a price that is appealing to consumers.

A Democratic, Easy-to-Use Solution

At their earliest stages, startup companies are typically lean in terms of engineering staffing. Entrepreneurs must often learn to “do it all” or hire a few versatile, multiskilled employees. Because ANSYS simulation software is easy to learn, it is a democratic engineering tool that can quickly be applied by many employees.

“It was very easy to become comfortable with ANSYS solutions and integrate them into our product development process,” says Robert Lumley, CEO of AirLoom Energy, which develops low-cost, high-efficiency wind-energy technology. “We’re currently applying mechanical, fluids and electromagnetic simulation software, and it’s been straightforward and simple to test the effects of multiple physical forces on our designs. ANSYS is an advanced tool, but it has the features and feel of consumer software, which makes it accessible and easy to master.”

In addition, ANSYS software is built on a flexible technology platform that seamlessly integrates with other engineering solutions and systems. Because early-stage startups lack the resources to manage technology platform extension customization, entrepreneurs need practical solutions that are built for the way engineers actually work — and designed to integrate with the multiple tools their employees are using. ANSYS software solutions answer this need.

By helping startups succeed, simulation software from ANSYS can help change the world.
Supporting Tomorrow’s Success Stories

Engineering simulation software is used by virtually every leading company to design and verify its products. Today, thanks to the ANSYS Startup Program, the smallest and newest companies can also capitalize on this advanced capability. Not only can they apply the technology features of ANSYS software, but they can also benefit from engineering processes and workflows that are based on over 40 years of partnership with the world’s leading engineering teams.

“Our access to ANSYS software is helping us take product ideas and assess feasibility in a realistic virtual environment,” says Mohammed El-Kurdi, co-founder and CSO at Neograft, a medical device manufacturer. “Although we’re a small company, I feel like we are on a level playing field with much bigger competitors. There’s no doubt that our use of engineering simulation is positioning us for success. We’re grateful that the ANSYS Startup Program has provided us with access to this powerful product development capability.”

Startup companies are creating cutting-edge products that can change the way we think and the way we accomplish tasks. They have the power to impact millions of people’s lives every day. Entrepreneurs invest their time, energy and passion into their products because they believe they can change the world. ANSYS is excited to play a part by supporting the engineering excellence of startup companies. By helping startups succeed, simulation software from ANSYS can help change the world.