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# TECHNOLOGIST IN CHIEF

Jackson Yang  
PRESIDENT AND CEO  
Advanced Technology &  
Research Corp.

For this  
40-year-old  
engineering firm,  
innovation is the  
fountain of youth



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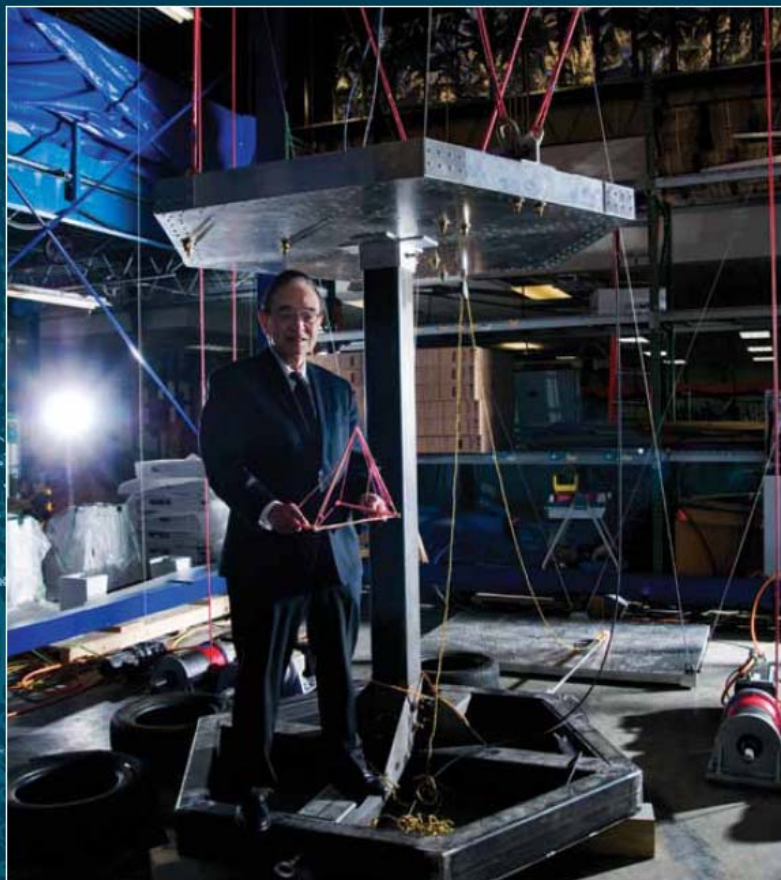
APRIL 2012 VOLUME 12 : NUMBER 4



# TECHNOLOGIST IN CHIEF

How mechanical engineering professor turned  
CEO Jackson Yang created a company that  
attracts innovators

Jackson Yang  
PRESIDENT AND CEO  
Advanced Technology & Research Corp.



By Jennifer Walker • Photography by Bryan Burris



The research and development lab at Advanced Technology & Research Corp. (ATR), an engineering firm with headquarters in Columbia, MD, feels like an organized retail storage room. There's shelving against some of the walls and plenty of room in the center for the company's technologies. CEO Jackson Yang, Ph.D., walks lightly around the space, eagerly showing off ATR's latest projects. He seems most excited about a 30-foot-long construction-cone-orange robot arm system that can catch land drones, also called unmanned air vehicles (UAVs), from moving ships. The challenge in doing so is maneuvering the robot despite outside variables, like the changing weather. "The real-time control [is] where we really excel," Yang says.

At ATR, Yang focuses on creating technology that will have a long-lasting impact in a few chosen niches. But even though he has kept his \$15 million, 90-employee company small, Yang, a self-described "technologist," is constantly developing new innovations in response to changing markets. The latest example of this is solar trackers, ATR's riff on solar panels with one very important twist: solar trackers move to capture more energy from the sun. It's a technology that has already earned Yang an award for "Clean Energy Entrepreneur of the Year" from the Maryland Clean Energy Center.

With his focus on developing new technology, Yang has created a culture that attracts innovators. It's a culture that blends research and ideas with practical applications, a result of the 40 years Yang spent as an engineering professor. And it's a culture that keeps Yang, who is now in his early 70s, coming to work each day.

## TEACHER TO CEO

On a wall next to the door of his pristine office, Yang keeps a framed Chinese newspaper article that tells the story of his life. There are pictures of the University of Maryland tennis team – which he once captained – of a younger Yang behind his desk and of Yang with his wife and four children dressed for a 50th birthday party celebration. It's a life that has been filled with engineering inventions, business and university teaching, one that began in Asia more than seven decades ago.

As the son of diplomats, Yang was born in Japan, where his father was on assignment. His family moved to China just six months later, eventually settling in Shanghai. During the Chinese Civil War in 1948, one year before the communists took over Shanghai, his family decided not to follow the many Chinese who migrated to Taiwan. Instead, Yang, age 10, his parents and his brother immigrated to Washington, DC, where his older brother, 17 years his senior, lived.

Washington proved to be a better place for Yang academically. His classes offered more room for creativity than the schools in China. "I will never make it in college in China because I do not like to memorize things," Yang says with a laugh. "Over there, you have to memorize book after book, and the history is much longer. I came here and thought, 'Oh, wonderful, only 200 [years] to remember!'"

He also succeeded as a sportsman. At age 11, just one year after arriving in the United States, Yang landed on the front page of *The Washington Post* sports section for his victory in the 12 and under marbles district championship. Years later, as a high school senior, he received two scholarships to the University of Maryland: one to play soccer, the other for tennis.

"We're very good at technology, but more and more I'm learning that technology alone isn't going to do it. One of the most important parts [is] creating a sales and marketing force."

**Jackson Yang, president and CEO, ATR**

Still, Yang faced some racism in those days. At the Kenwood Golf & Country Club near Washington, DC, he was invited to play in a tennis tournament but couldn't go inside the clubhouse to use the bathroom. In Ocean City, MD, he entered a hotel where he had reserved a room; seeing him, the proprietor said the establishment was full. And in South Carolina for another tennis tournament – where Yang good-naturedly says that residents had "never seen an Asian" – he walked on a bus and stumbled. "It says black in back, white in front," he says, laughing again. "I thought, 'Where the heck do I sit?'"

His status as an Asian immigrant also impacted his career choices. There were few colleges for Asian men at the time, Yang says, and only a handful of careers that were considered acceptable. One was teaching. So Yang got his doctorate in mechanical engineering with a focus on applied mechanics and structural dynamics, and he taught mechanical engineering in the A. James Clark School of Engineering at the University of Maryland for 38 years.

But Yang was also thirsty to focus on innovation. "While teaching, I always thought in the universities that everything is very theoretical," he says. "But I really think it could be much more useful when you can apply. All these ideas, we should be putting them to good use."

In 1973, he started engineering firm ATR while still teaching at the university. His experience as a CEO impacted the way he taught his students. By "having a company while I'm teaching, I could bring some real-life situations to the students," Yang says. "I think that's a good combination."

Robert Cutlip, an engineer with ATR since 1987 and one of Yang's former students, worked closely with him in the University of Maryland's Maryland Robotics Center, which Yang founded in the 1980s. As a teacher, Yang "was very hands-on," says Cutlip, now a project manager and senior engineer. "He would emphasize what he was doing in

## INNOVATION DNA

### Fusing innovation with administration

As CEO of engineering firm ATR, self-described "technologist" Jackson Yang had to learn how to be an administrator. Here are his seven tips for building a company that is strong in both innovation and operations.

- 1. Recruit the best.** When hiring his team, Yang made sure his chief operating officer and general manager were both strong administrators who shared his work ethic.
- 2. Remember marketing and sales.** In the past, ATR employees have been so focused on technological innovation that they've forgotten the importance of marketing and sales. Today, Yang makes plans to get a marketing team in place while his engineers are developing new technologies.
- 3. Empower your staff.** Robert Cutlip, one of ATR's engineers, says that the company culture encourages staff to get involved in new projects. This is by design. Yang wants his engineers to enjoy their work, so he gives them opportunities to grow.
- 4. Embrace the Small Business Research Development (SBRD) program.** This program helped ATR get its start. The organization encourages small businesses to respond to government agencies' requests for proposals in specific topic areas. Companies whose ideas are chosen will receive funding to move forward, sometimes as far as the procurement stage.
- 5. Build a reputation.** Yang is passionate about most of the technology that ATR works on because he's built a reputation in a few niche areas. By doing this, he ensures that the projects he is interested in are the ones in which ATR wins bids.
- 6. Value work-life balance.** ATR is a company with a friendly culture, one in which Yang doesn't require staff to work around the clock. Just as he values his own home life, he values the home lives of his employees too.
- 7. Be patient.** ATR doesn't always win bids, and getting patents for new technologies can take up to three years. But Yang doesn't get upset. Instead, he cultivates patience. It's a lesson his mechanical engineering students taught him long ago.





**Postal Service Automation:** Yang and his team worked with the U.S. Postal Service to automate many of the Post Office's functions, including sorting the mail and reading barcodes.

the industry to make sure you understood what was currently going on in the field.”

This is similar to the way Yang leads ATR today. “He’s always actively looking at new technology and trying to solve problems,” Cutlip explains.

## INVENTION AND REINVENTION

In ATR’s youth, Yang focused on building the business by responding to requests for proposals in specific research and development topic areas. These requests were put out by federal agencies – including the Department of Homeland Security, the Department of Commerce’s National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration – through the Small Business Innovation Research (SBIR) program. Established by Congress in 1982, SBIR’s mission is to encourage innovation among small businesses by awarding funding for technologies that could someday be commercialized. Projects are funded in three phases, with the final phase focusing on procurement of the developed product.

For Phase I projects, “we got about 60 of these when the company started,” Yang says. “That’s because we have good people with innovative ideas.” Ten to 15 of these ideas went on to Phase II, but Yang says the Phase III level is difficult to attain. At this stage, regardless of the quality of the ideas, a company must have buy-in from potential consumers – and this is hard to get. Still, several of ATR’s projects have gone on to Phase III, including the company’s work with robots and unmanned air vehicles (UAVs).

Today, the employees at ATR’s headquarters and in its small satellite office in Fredericksburg, VA, focus on technological innovations in three prime areas: model-

## THE COOL STUFF

### Inside ATR’s research and development lab

From specialized blast loading helmets to robot arms capable of catching unmanned air vehicles, ATR has developed a range of exciting technologies for clients like the United States Postal Service and the Office of Naval Research.

**Robotics:** Currently in the testing phase, ATR engineers developed a 30-foot robot arm system that can catch land drones, also called unmanned air vehicles (UAVs), from moving ships.

**Specialized helmets:** Because the impact of a blast or explosion causes a specific reaction in the brain, ATR engineers are working on a specialized helmet that can prevent soldiers and civilians from suffering traumatic brain injuries.

**Automation technology:** From prototypes to large production runs, ATR’s systems group designs machines to help companies automate their services.

**Green technology:** As ATR’s newest innovation, solar trackers move to follow the sun and capture up to 50 percent more energy than solar panels. Because they are available in various sizes, the trackers are suitable for commercial and consumer clients and can even be used to power electric cars.





"I always thought in the universities that everything is very theoretical. But I really think it could be much more useful when you can apply. All these ideas, we should be putting them to good use."  
**Jackson Yang, president and CEO, ATR**

ing and simulation to evaluate the effects of blasts on land, sea and people; robotics, which includes the shipboard launch and recovery of the UAVs and the transfer of personnel and cargo between ships; and automation technology.

It's this technology that clearly excites Yang. He lights up when talking about, say, the new connection his team found between blast loading and traumatic brain injury. A blast from an explosive causes a much different reaction in the brain than a hit to the head during a football game, which is known as impact loading, Yang explains. With impact loading, the force lasts longer, while blast loading produces more intense, short-duration pressure waves that can create a cavitation, or bubbles, in fluid in the brain. Those bubbles quickly collapse, creating more, even sharper pressure spikes.

"It triples the pressure of the spike, and that's what causes traumatic brain injury," Yang says. "We need to design a specialized helmet, not based on impact loading like the football players, but designed specifically for blast loading with a short duration." ATR is currently working on this technology.

On the robotics end, with funding from the Office of Naval Research and the Defense Advanced Research Projects Agency (DARPA), Yang and his team developed the robot arm system that works with UAVs. When Yang first explains how this technology works, it sounds simple: the robot merely extends its main arm off the side of a ship to catch a UAV or firmly holds onto the plane to provide a stable ground from which it can launch. But, as with other innovations, many other factors come into play.

First, there's the natural movement of the ship at sea. Ships roll along the surface of the water, sometimes gently, other times, when the tide drops 10 or 20 feet for example, with wide, sweeping motions. So ATR designed a robot arm that compensates for the movement of the ship so that it appears stationary at its hand, or tip, so the

**Large Vessel Interface Lift-on/Lift-off (LVI Lo/Lo) crane:** The crane, funded by the Office of Naval Research, demonstrates container transfers aboard a Military Sealift Command auxiliary crane ship. The LVI Lo/Lo crane enables the rapid and safe transfer of standard ISO containers and other heavy loads at sea. (U.S. Navy photo by John F. Williams/Released).

UAV has a stable point to aim for when coming back to the ship. "Otherwise, you wouldn't have a chance of catching the plane," Yang says.

Then the engineers had to account for the movement of the UAV, which circles and slides around in response to the air's turbulence. The massive robot, however, does not move that fast. A smaller arm at the tip of the main arm tracks the UAV and moves to ensure it can catch the UAV as it flies by. "It's just like catching a baseball," Yang says. "You go to absorb it. But if it doesn't come straight at you, you have to move your arm to catch it."

It's much more advanced technology than the devices that ATR developed for one of its first clients: the United States Postal Service. Fifteen years ago, Yang received the company's first contract to optimize the United States Postal Service's mail package handling equipment through computer modeling and simulation. Yang and his staff discovered that many of the Post Office's functions – sorting the mail and reading barcodes, for example – could be automated.

ATR eventually signed an agreement to be the post office's right hand in research and development. Yang and his team developed new Post Office equipment for five years before realizing that, once the equipment got to the procurement stage, they could not bid to produce it. "So we make peanuts," Yang says with a laugh. "Not only can we not bid on it, but we can't be on anybody's team." Once the procurements rose to nine figures, Yang decided that ATR would work directly with the Post Office up to a certain point, as long as it didn't prevent the company from bidding.

This is when Yang first realized he had to be innovative within ATR's means. For each piece of equipment, the company who won the procurement bid needed to place 500-plus machines in Post Office mail processing centers across the United States. "They don't look upon us as being able to do that because we're a small company," he says. "So we got smart." Yang decided not to place bids alone. Instead, ATR teamed up with another company, who had prime status on the project. This way, if they won the bid, ATR collected license revenues for the products sold.

This arrangement worked well for the next 20 to 30 projects, until the United States Postal Service decided to potentially close 3,600 offices that were deemed to have too little workload or to be too close to one another. Yang was forced to think of a way to fill in the gap in ATR's business.

The Post Office "hasn't put out large capital equipment for many years," Yang says. "I don't like to just lay the people off. That's how we got into solar."

## MORE THAN TECHNOLOGY

Three years ago, Yang realized the potential of the green energy market, but he also knew that solar panels, which were selling well, were not the right product for ATR. He foresees that the popular panels will eventually be produced in Asia, driving down the price and ATR's ability to compete with large corporations for sales. Yang and his engineers, instead, focused on improving the solar panel model.

First, they realized, solar panels are stationary, meaning they only absorb energy when the sun is at an optimal angle. The energy savings would be even greater if a device could harness more of the sun's natural power. So ATR's engineers designed and developed an automated sun-tracking system with solar panel mounts that use an internal GPS chip and software, which follows the sun, absorbing energy from it at all angles. The technology can lead to a 30 to 50 percent improvement in energy production per panel.

With a \$1.1 million Clean Energy Economic Development Initiative grant from the Maryland Energy Administration, Yang started producing solar trackers marketed as "ATR Solartech." In most cases, the solar trackers attach to already-existing structures that are connected to the power grid, such as wind turbines and lampposts in commercial districts. Because the product is available in several sizes, it is suitable for commercial clients, the military and even individuals.

A big ATR customer is Southwest Windpower, a U.S. producer of wind turbines that markets its products around the world. When Southwest sells turbine systems, the solar tracker becomes one of the add-on options, just like you would see with cars, Yang says.

ATR also uses the solar tracker technology to power electric cars. Last August, the company installed a solar power pole in Bethesda, MD, to create the state's first solar-



assisted electric car charging station. It was a successful event with Governor Martin O'Malley, U.S. Department of Transportation Deputy Assistant Secretary Joel Szabat and several other representatives in attendance.

Despite ATR Solartech's success, Yang says it's still too early to tell if the solar trackers will make a difference in ATR's bottom line. Still, he knows ATR Solartech's challenges and is focused on addressing them.

For example, Yang admits that ATR Solartech has struggled with breaking into the consumer market. In the back of the company's research and development lab in Columbia, there are stacks of brown boxes, some assembled, all ready to be filled with residential-model solar trackers and shipped to dealers, consumers and stores like Home Depot. Some customers would simply need to buy a 10-foot wooden post and hire an electrician to hook up the system to their electrical panels. But ATR does not yet have a sales team to market the product.

Yang had a similar experience 18 years ago, when ATR engineers developed a video game that required gamers to use the force of their bodies to play. It sounds a lot like the modern day Wii. Yang took the product to physical fitness shows. "Everybody lined up at our booth to test the machines because it's fun. And they don't want to get off," he says. But ATR did not have the sales force to service the customers. Yang received several orders, some from Montreal, others from Florida, but couldn't

"If you have an idea and you can support that idea and you can get [Yang] to believe in it, then he'll let you go for it. There's always a lot of new projects that you can get your hands into."

**Robert Cutlip, project manager and senior engineer, ATR**

recruit partners to help with marketing, distribution and servicing quickly enough. So the company stopped producing the product.

"We're very good at technology, but more and more I'm learning that technology alone isn't going to do it," Yang says. "One of the most important parts [is] creating a sales and marketing force." Going forward, Yang will look at the company's marketing and sales needs while the engineers are developing new technologies.

## INNOVATION INCUBATOR

Despite the value Yang places on sales, marketing and other administrative needs, it's ATR's innovative projects that motivate him. "I enjoy coming to work because of the technology," he says. "Very frankly, I enjoy it much more than being an administrator. Those are the types of problems that I don't like. I still get involved if [the engineers] have something new. I contribute new ideas."

Because he is passionate about technology, he strives to create an environment where ATR's employees are also motivated by the possibility of creating new advancements in the company's niche areas. Instead of focusing primarily on designing new technologies on paper, Yang says it's important to create opportunities for the engineers to build prototypes. This is especially true for Yang's younger employees. "That kind of combination, the people get excited and enjoy their work," he says.

Robert Cutlip, Yang's former student turned engineer who is currently working on ATR Solartech's solar trackers, sees ATR as a company where employees can make their mark with new technologies. "It's a small company, so if you have an idea and you can support that idea and you can get [Yang] to believe in it, then he'll let you go for it. There's always a lot of new projects you can get your hands into."

Yang has also built an atmosphere where education is encouraged – ATR offers partial tuition reimbursement for up to two courses a year for each employee – and where a work-life balance is valued. "There's no curthout here," he says. "Everyone is friendly and just wants to do the best on projects."

His love of this supportive, idea-driven culture is the main reason Yang has not tried to drastically change ATR's structure in terms of size. He enjoys the environment of a smaller company. Because ATR has developed a reputation in a few niche areas, he primarily oversees projects he is passionate about. And he gets to know all

of his employees. "We're not making as much money as we could," Yang says. "But I sleep well."

After saying this, Yang leans back in the conference table chair in his office and smiles. One year away from his company's 40th anniversary, he radiates pride for his staff, his company and all of their collective accomplishments. "That's why I don't retire," he says simply. "I enjoy the work."  
**CEO**

**Solar Tracker:** ATR's engineers designed and developed an automated sun-tracking system with solar panel mounts that use an internal GPS chip and software, which follows the sun, absorbing energy from it at all angles. The technology can lead to a 30 to 50 percent improvement in energy production per panel.

