

DISRUPTOR AT WORK

UTC Chief
Technology Officer
Paul Eremenko

➤ NEW FOCUS ON STRATEGIC TECHNOLOGY AREAS AND ROAD MAPS

➤ FAST-PACED ORGANIZATION TO DELIVER DISRUPTIVE PROTOTYPES



Graham Warwick New York

On display in United Technologies Corp.'s (UTC) digital accelerator in New York are two of the most important products in the company's history: the Pratt & Whitney Wasp aeroengine and the Otis Elevator safety mechanism.

To those working in the former tobacco warehouse in Brooklyn's Dumbo area advancing UTC's digital transformation, they are reminders of the industrial heritage on which the company is built—a history for which a new and challenging chapter is being written.

The 2018 acquisition of Rockwell Collins and its merger with United Technologies Aerospace Systems to create Collins Aerospace has positioned UTC to spin off its Otis and Carrier businesses and redefine itself as an integrated aerospace company—a \$50 billion Tier 1 supplier.

Against this background, and the backdrop of the digital accelerator, Chief Technology Officer (CTO) Paul Eremenko sat down with Aviation Week to discuss his priorities as UTC goes through its biggest transformation since it was formed, as United Aircraft, in 1934.

With a reputation as a disruptor, Eremenko joined UTC in 2017 from Airbus, where he was also CTO. A former DARPA program manager and office director who worked at Motorola and Google, he had joined Airbus in

2015 as the founding CEO of Silicon Valley outpost A³.

A³ was created to disrupt Airbus from within and bring Silicon Valley's tolerance of risk and speed of execution to aerospace markets. At A³, Eremenko launched the Vahana electric vertical-takeoff-and-landing (eVTOL) demonstrator and, under his tenure as CTO, Airbus' exploration of electric propulsion expanded to include the CityAirbus eVTOL and E-Fan X hybrid-electric regional aircraft demonstrators.

It is no surprise, then, that the first signs of Eremenko's trademark disruption at work within UTC are the launch of a Skunk Works-like organization, United Technologies Advanced Projects (UTAP), and its first undertaking—Project 804, to fly a 2-megawatt-class hybrid-electric propulsion demonstrator based on a modified Bombardier Dash 8 Q100 regional turboprop.

Unlike E-Fan X, which is purely a drivetrain demonstrator, Project 804 is intended to produce a system that is “productizable”—capable of being developed into a product. This will be a hallmark of UTAP projects, which will bring together two or more business units, last 2-3 years and retire the major technical, regulatory and business risks while moving at a faster pace than the rest of UTC.

“The fundamentals [at UTC] are tremendous. The company knows how to execute and has some of the best engi-

neers I've ever worked with,” Eremenko says. But there was no mechanism to do things that required imagination and the integration of multiple business lines. “So a lot of what I've been trying to do with the engineering leadership is unleash that potential and provide avenues. UTAP is one of them,” he says.

Changes are also being wrought at United Technologies Research Center (UTRC). “We've reshaped the portfolio of the research center to be more focused on fewer things that are bigger in scale, that are much more likely to really move the needle and change the course of the future,” he says.

Eremenko contrasts this with “peanut buttering” investments, saying: “Today we build Product X, there's a plan to build Product X Prime, and the research center is going to look at Product X Double Prime.” The approach now is to ask: “In the domains that we operate in, what is our ambition, what is the future, and can we drive the company and the industry toward that?” he says.

UTRC is now focused on six pillars—“Call them model, make, power, connect, automate and secure,” he says. “We have grand challenges in each of these pillars so that if you solve that challenge—and it's a multi-year investment to solve it—it's going to change the landscape of that particular domain.”

As the majority of UTC's R&D is performed not at UTRC, nor the

newly created UTAP, but within the business units, the company has begun developing strategic technology road maps—a formal, disciplined process Eremenko also initiated at Airbus. To do that UTC has brought in John Paul Clarke, a professor at Georgia Institute of Technology.

“He’s standing up a methodology to do technology road-mapping in a rigorous and world-class way, as opposed to just putting down a chronological sequence of activities and calling it a road map. It’s a framework for thinking about what we should do, what we should not do, what we partner on, and how we make those decisions,” Eremenko says.

“We have outlined four strategic technology focus areas for the company. Electrification is one of them. Autonomy is another. The connected aircraft, and connected ecosystem around the aircraft, is the third. And the fourth is advanced design and manufacturing,” Eremenko says. “I would anticipate UTAP will have a keystone demonstrator in each of those areas.”

UTC is looking at the next steps in cockpit crew reduction, for cargo at

The use of certified Collins Pro Line Fusion avionics for manned aircraft is key to General Atomics’ development of the certifiable Sky Guardian unmanned aircraft.

first to reduce the need for multiple crews on long-range flights. Eremenko sees that as a logical first step that is fairly low-risk and where UTC has technologies it can bring to bear. “In every step in the crew-reduction journey, from five crew in the early days of aviation to two crew today, some part of UTC played a pivotal role,” he says.

“The question now is one of pilot numbers—the dire predictions on growing pilot demand and ensuing shortage. I think we can play an important part in helping solve that,” Eremenko says. “I don’t think we know yet exactly what that architecture looks like, but it’s probably some combination of improved onboard autonomy and ultrasecure, ultrareliable communication with the ground. Both areas are core strengths for us.”

Artificial intelligence (AI) may play a role in crew reduction, but not yet. “In the near term, I don’t think you need AI to solve the operational challenges [for single-pilot operation],” he

says. “For the longer term, the grand challenge project that we’ve tasked our research center to look at is explainable artificial intelligence.”

Most approaches to AI today are “black box,” he says, with the operation of the algorithms opaque to the user. “You can train a multilayer convolutional neural network, but then you have no idea what that neural network will or will not do in the future. You can get statistics on its performance, but for today’s certification basis it’s not explainable—you cannot tell why it’s doing what it’s doing.” So UTRC is focusing on alternative approaches to AI that are explainable, and therefore certifiable, and also provide much better human-machine collaboration.

The connected ecosystem pillar is an extension of UTC’s work on the connected aircraft—sensors on Pratt’s

something different that brings value to the passenger.”

The fourth strategic technology area, advanced design and manufacturing, is a favorite topic for Eremenko, a thread running through his career from DARPA to Airbus and now UTC. “I am personally proud of my contribution to it from many different angles throughout my career. But I think that for UTC, which is really the quintessential industrial company, it’s what we do,” he says.

For inspiration, Eremenko turns to the design automation and reuse that has revolutionized the semiconductor industry. “If you look at other places where this kind of transformation has happened, the most notable is chip design and the shift to a foundry-style design and manufacturing model,” he says. “Design automation and reuse—those are the big gains.”



COLLINS AEROSPACE

engines and Collins’ flight components and services such as predictive health monitoring and improved fleet management. “The next step for us is to think more broadly about the connected ecosystem, and how we can leverage our competency in the connected aircraft, together with the fact that we supply a lot of other pieces of the air travel experience,” he says.

Collins’ product portfolio includes everything from check-in kiosks to baggage handling systems to flight information displays for airport terminals, he says. “ARINC is both a flight communication and a business backend network. We have lots of piece parts and are looking at how we can put all of them together to really do

Digital continuity, and the ability to codesign and co-optimize the product and the industrial system in a model-based environment, will be essential, he says. “The productivity improvements in [the chip] industry, both in engineering and manufacturing, have been astounding. We haven’t yet seen anything close to it in more traditional industrial domains, but if we can crack that nut, it would be incredible for the industry, as well as a competitive differentiator for us.”

The companies that comprise UTC today helped create the modern industrial system, Eremenko notes. “So I think we would not be true to ourselves if we didn’t position UTC as a leader in the next industrial revolution,” he says. 🌐