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How United Technologies became a top gun

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United Technologies CEO Louis Chênevert has nurtured the development of the Geared Turbofan engine for nearly two decades. Photograph by Stephen Willkes for Fortune.

The ultra-profitable industrial giant has made a bundle outfitting skyscrapers in China. Now it's shaking up the world of aviation.

Like a proud father, Louis Chênevert is waiting expectantly for my compliment, a wide grin plastered on his face. Firmly gripping my shoulder in one of his massive hands, the 6-foot-5 CEO of United Technologies has positioned me in front of his baby — a sleek-looking, 5,000-pound jet engine that is mounted and dramatically lit from below like an art installation.

We're standing in a cavernous airplane hangar not far from the United Technologies headquarters in Hartford, Conn. In a couple of hours Chênevert will be hosting the company's annual investors conference, and the building is filled with impressively huge displays of the conglomerate's well-known industrial brands. Nearby is a Sikorsky S-76D helicopter, an SUV-like 13-passenger aircraft favored by the energy industry for ferrying workers out to oil platforms. Not far away is a Carrier industrial air-conditioning system powerful enough to keep an entire office complex chilled. And then there's the drivetrain of an Otis elevator — similar to the ones that will be hoisting the 50 double-decker elevators in the 117-story Goldin Finance building under construction in Tianjin, China, and expected to open in 2016.

To Chênevert, however, the star of the show is the newest jet engine from Pratt & Whitney (yet another venerable United Technologies business unit). Called the Geared Turbofan, or GTF, the engine is a major technological leap forward for the aviation industry. Testing has shown the GTF to be 16% more fuel-efficient than existing engines and 50% quieter — huge gains in a business that in recent years has mostly advanced in increments. But the GTF is more than just an exciting example of his company's ability to innovate. When the first GTF engines take flight in Bombardier and Airbus jets in 2015, it will be a personal triumph for the CEO. Chênevert has been championing and nurturing the project for nearly two decades. No wonder he can't contain himself.

Before I can muster a comment, the boundlessly enthusiastic Chênevert begins waving his free hand, still smiling, and launches into his sales pitch. "The GTF is the future," he declares in his thick Québécois accent. "It's the biggest disruptive force in commercial jet engines in decades!"



Workers in the Otis elevator plant in Tianjin, China — Photograph by Stefen Chow for Fortune.

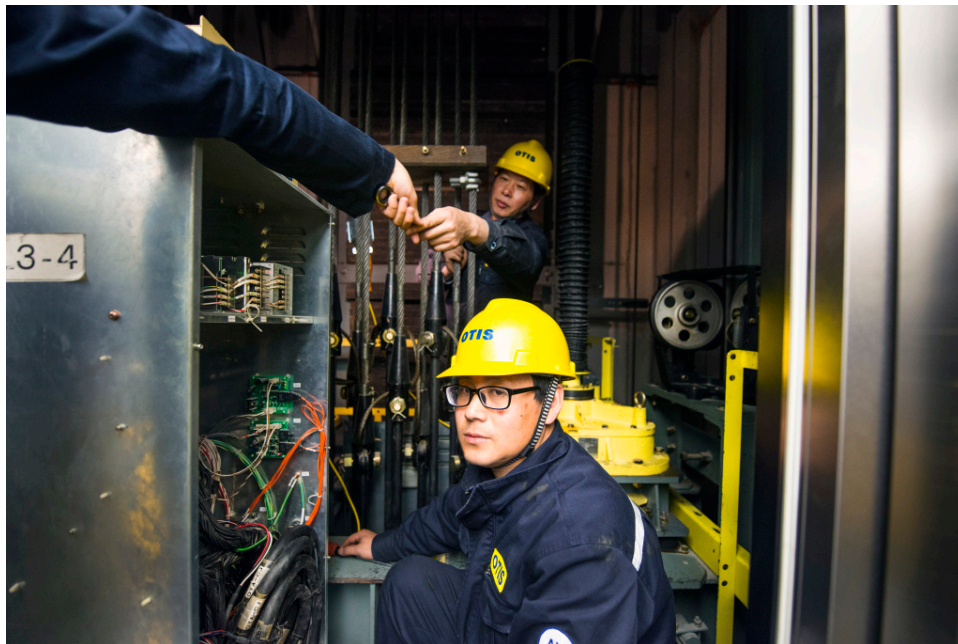
As we peer at the engine's giant fan blades, Chênevert gleefully explains how his pet project has proved to be a disruptive force in the airline business — even before helping to transport a single passenger. "The airlines wanted the GTF because it saves them so much money, so airplane manufacturers had to embrace it too," says the CEO. "It pushed them to bring out a new generation of jetliners a decade earlier than they had planned."

Until recently, United Technologies' archrival, General Electric, easily dominated what is the largest, most profitable market for engines: those fitted on narrow-body and regional jetliners. But with the Geared Turbofan — marketed as the PurePower family of engines — United Technologies is

mounting the first real challenge to GE in decades. **“It’s amazing that UTC, which was far behind in these engines, is now the pioneer,” says Stephen Vella of Kestrel Aviation, a firm that advises airlines on their aircraft purchases. “They’re forcing GE to follow.”** Today UTC is collecting around 30% of new-generation single-aisle-jet engine orders — business that is expected to add around \$5 billion a year in new revenues by 2020.

United Technologies is an industrial conglomerate on a tear. In fact, it is arguably America’s most successful diversified manufacturer. With \$62.9 billion in 2013 revenues, the 85-year-old company ranks third in sales to GE (\$146 billion) and Boeing (\$87 billion), but leads most, if not all, of the field in profitability and performance for investors. In fact, United Technologies, No. 45 on this year’s 500 list, has been on an underappreciated roll for the past 20 years. In that period, it has produced shareholder returns of 16.3% a year, growing its market cap from \$8 billion to \$107 billion, and easily besting GE (8.8% annual returns) and Boeing (11.0%).

Since Chênevert, 56, became CEO in early 2008, UTC has delivered nearly 12% average annual returns, vs. 8.4% for the S&P 500 over the same span. As for profitability, a study performed for Fortune by Jack Ciesielski, author of the Analyst’s Accounting Observer, a leading newsletter for money managers, shows that United Technologies generated an outstanding 11.4% cash return on total assets in 2013, well above the industry average of 10.2% and way ahead of the 8.9% figure for GE’s industrial businesses.



Otis workers conducting a maintenance-training session on the 35th floor of the Shanghai World Financial Center — Photograph by Stefen Chow for Fortune.

Chênevert has achieved those results in part by simplifying and reorganizing his sprawling conglomerate into two high-growth business units: aerospace products and building systems. UTC used to be far more diversified. But over the past several years Chênevert has exited a variety of businesses, from windmills to industrial turbines to window air conditioners. At the same time he greatly expanded his scope in aerospace by acquiring components maker Goodrich in 2012 for \$16.5 billion — the biggest acquisition in aerospace history.

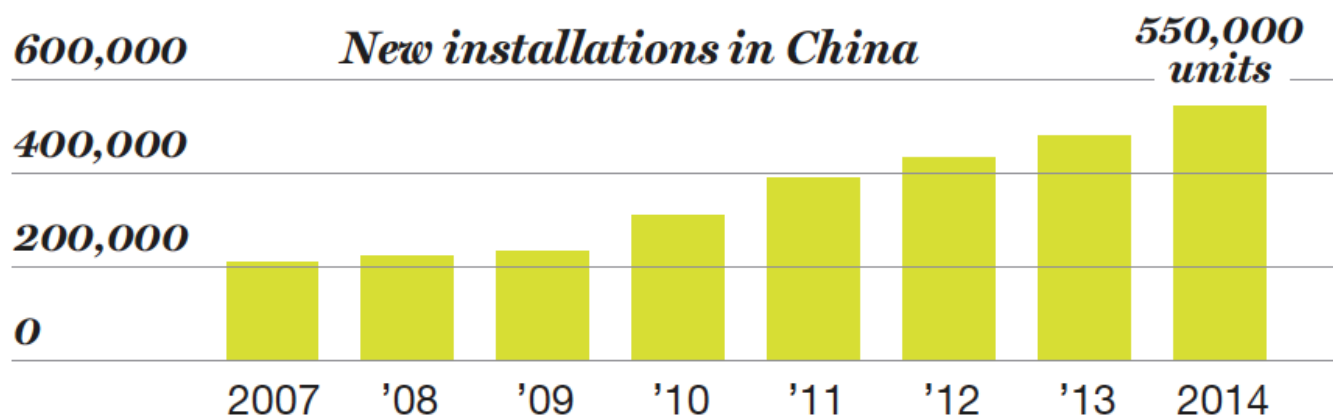
The Goodrich deal made aerospace the bigger of UTC’s two segments. It now contributes 54% of revenues. The business includes both engine builder Pratt & Whitney and Sikorsky, a world leader for both military and corporate helicopters. Goodrich was added to the aerospace systems group,

which supplies virtually everything else that goes on an airliner from the nose to the tail, except avionics.

In building systems, UTC furnishes the “heavy iron” that heats and cools office and apartment buildings, and moves people from floor to floor, as well as supplying the infrastructure girding the world’s airports, railways, and metro stations. The branch comprises two main segments: the \$12.5 billion Otis business of elevators and escalators, and climate, controls, and security, which encompasses Carrier’s commercial heating and AC systems plus fire and safety equipment.

As much as it may sound like your grandfather’s industrial company, UTC under Chênevert contradicts the conventional view of manufacturers as unwieldy behemoths destined to simply plod along with GDP growth. The CEO favors bold, zoom-to-the-future ideas — such as his beloved GTF. (Other big projects include a hyper-energy-efficient Carrier AC system and a new Sikorsky military model that can fly 50% faster than its bestselling Black Hawk helicopter.) And at the investors’ meeting, Chênevert unveiled growth goals so ambitious that he left many analysts astounded. He pledged to raise sales to well over \$100 billion by 2020. That will require annual gains of 8%, far exceeding the projected growth in world GDP. “Getting to their goals is a really hefty job for a company the size of UTC,” says Daniel Holland, an analyst with Morningstar. “Pulling off that kind of growth is difficult even in really good economic times, and we don’t know what lies ahead.”

GETTING A LIFT / *The elevator and escalator market in China is the world’s largest and has grown 20% annually, boosting Otis sales.*



Chênevert has set those lofty targets for his company at a time when it’s facing potentially powerful headwinds in two areas. First, there’s the ongoing shrinkage in U.S. military spending, driven by the pullout of forces in Afghanistan and pressure in Washington to curb looming deficits. Pratt & Whitney is the sole engine supplier for the Lockheed Martin-built Joint Strike Fighter. The JSF, though plagued by gigantic cost overruns, remains the Pentagon’s biggest single program and appears to be a stable source of engine sales for years to come. But other parts of the defense business are feeling the pinch. Last year Sikorsky’s sales actually fell 7.9%, to \$6.3 billion, on lower orders and servicing revenues for its Black Hawks. Overall, UTC’s military revenues should manage no better than mid-single digits through 2020, about half the pace of the past decade.

The second reason for concern is decelerating growth in China. Fitch Ratings is projecting Chinese GDP growth of 7.3% for 2014. While that is still well above growth rates in the developed world, it would fall short of the government’s official 7.5% target and would be the slowest annual rate in the People’s Republic since 1990. If the slowdown ends up putting the brakes on China’s urban building

boom, that could be a problem for Chênevert. United Technologies had \$4.8 billion in sales in China last year, providing elevators and HVAC systems for the gleaming new skyscrapers popping up in each Chinese megacity.

If Chênevert is worried, he doesn't show it. The CEO talks constantly about the two global megatrends that inspired him to concentrate on construction and aerospace: Urbanization and the rapid growth in air travel. "Only 16% of the world's population has ever flown on an airplane!" he exclaims. "In 20 years it will be one-quarter. And the world's cities will add well over a billion middle-class people by 2030." The big-picture, world-is-moving-our-way concept sounds good. But to fully exploit those trends, UTC must, if anything, increase the pace of innovation.

As a leader, Chênevert blends an ebullient, hyper-optimistic personality with a wealth of knowledge drawn from years of running labs and factories. Little known outside the industry, he has a reputation inside UTC for setting impossible-sounding goals and then achieving them through a mixture of arm-twisting and inspiration. His occasionally adventurous use of English adds to his charm. For example, when asked about the advantages of speaking his native French while wooing Airbus in Toulouse, he replies, "It makes charming and enhances the relationship."



The cabin of an Otis elevator in the 101-story Shanghai World Financial Center — Photograph by Stefen Chow for Fortune.

Chênevert grew up in Montreal, where his grandfather had co-founded what is now SNC-Lavalin — the "C" was for Chênevert — the Canadian civil-engineering colossus. "I always wanted to build things — cars, boats, or planes," he says. After graduating from the University of Montreal's business school with a degree in production management, Chênevert took a job in 1980 at the General Motors plant near Montreal that made the Chevy Camaro. He rose to head the 45-person team that installed the axles and frames on the 5 p.m. to 2 a.m. shift.

Even among the brawny autoworkers, Chênevert stood out because of his big personality and imposing physique. "He'd wear two radios on his belt and walk around with a six-foot antenna, even if he left the plant to go to the hardware store," says Guy Hachey, who was Chênevert's boss at the plant and is now president of Bombardier Aerospace. "He looked like a cross between G.I. Joe and an extraterrestrial."

In 1993, Chênevert joined the Pratt & Whitney plant in Quebec Province, where the company manufactured engines for propeller planes. A critical component in those planes were gearboxes that were then little used in jets but would become the keystone of the GTF technology. Chênevert's skills in manufacturing attracted the attention of United Technologies CEO George David, a brilliant financial and efficiency specialist who was transforming UTC from a high-cost laggard into a leader in global supply-chain management.

David promoted Chênevert to chief of Pratt & Whitney in 1998. At the time Pratt was running a distant third in engines for commercial aircraft to its two big competitors, GE and Rolls-Royce. "We'd been the overwhelming leader from the 1960s to the early 1980s," says Chênevert. "We'd lost our position." In the early 1980s, Pratt had ceded its dominant presence in narrow-body jetliners — single-aisle planes that typically hold 120 to 190 seats — to concentrate on the more glamorous wide-bodies that, management felt, would capture more and more domestic traffic. By contrast, GE saw narrow-bodies as the future. It formed CFM International, a fifty-fifty joint venture with Snecma of France that in 1981 won an exclusive contract with Boeing on its new 737 family. CFM remains sole supplier on the bestselling 737 to this day.



United Technologies CEO Louis Chenevert, here in Pratt & Whitney's customer-training facility in East Hartford, Conn., has guided his conglomerate back to prominence in jet engines — Photograph by Stephen Wilkes for Fortune.

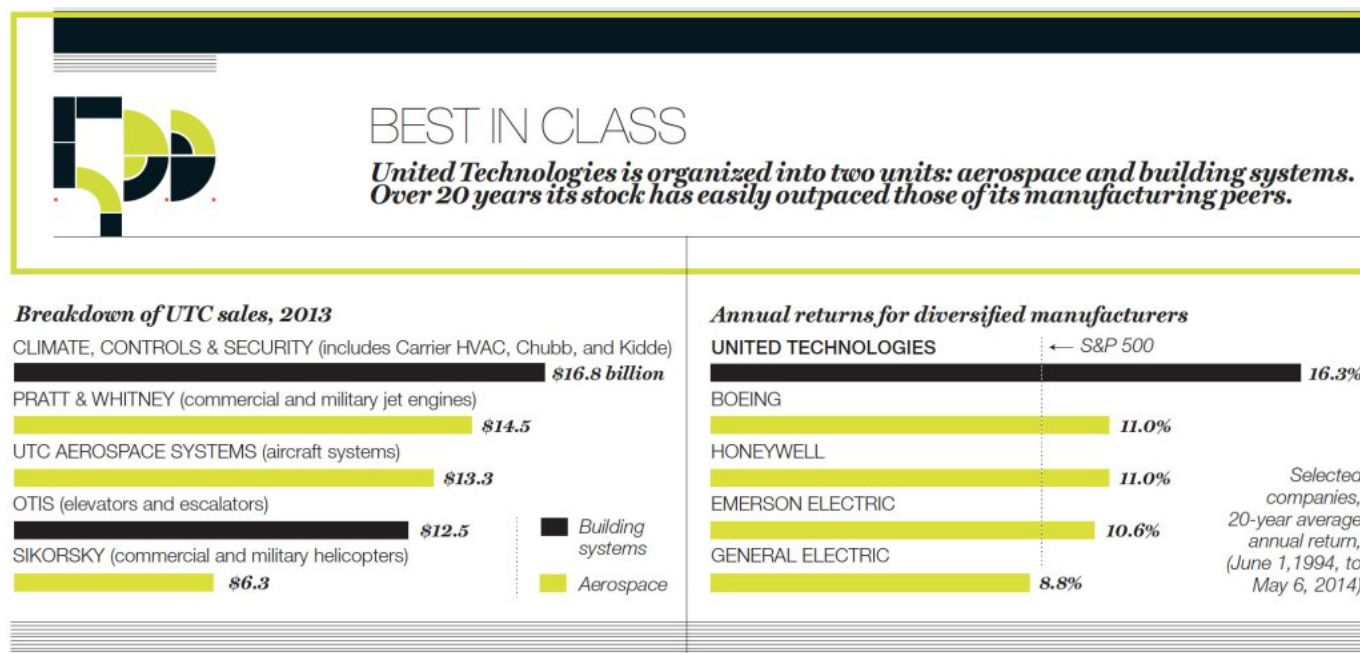
Narrow-bodies proved a much better business than wide-bodies, driving GE's rise and Pratt's decline. "The pricing in wide-bodies was and is crazy," says former CEO David. "We'd be bidding on programs at half the production costs, meaning we'd lose millions of dollars an engine at the start." Nor are wide-bodies the best place for aftermarket sales. Engines are a bit like razor blades:

Manufacturers sell the engines initially at breakeven or at a loss in the early years, but make loads of money on replacement parts, overhauls, and maintenance. Service revenues are biggest on planes that do a lot of flying. A 747 or 767 will make, on average, just two roundtrips a day. Narrow-bodies are workhorses, more like taxis than luxury cars. They're in constant use, typically making seven roundtrips daily. Hence, the aftermarket sales come a lot sooner and are much bigger. A single-aisle engine that costs \$5 million typically generates \$20 million to \$30 million in spare parts and maintenance over its 20- to 30-year life.

There are also just many more narrow-bodies in the air. The two airplane families that dominate the single-aisle market, the Boeing 737 and Airbus A320, are the bestselling series in the industry's history. Single-aisle planes are the exclusive choice of low-cost carriers such as Southwest and JetBlue, and allow airlines everywhere to schedule more frequent flights on domestic routes and still fill all the seats.

As Pratt & Whitney's new chief, Chênevert wanted to restore Pratt to a major role in narrow-bodies. So he championed a revolutionary technology stuck in the lab: the GTF. But first Chênevert had to sell the plan to George David. "In the beginning he was not enthusiastic," says Chênevert. Pratt was developing a new engine to compete as one of the offerings on the trophy of all trophies in wide-bodies, the Boeing 787 Dreamliner. But Chênevert and David ultimately decided to withdraw from the 787 competition and focus their R&D dollars on the GTF. As much as anything, that was the decision that propelled Pratt & Whitney's comeback.

If you're not an aerospace engineer, the details of how the Geared Turbofan engine works will make your head spin. But here's the short version: The GTF is the first engine specifically designed to use gears to drive the fan powering a jetliner. And it's the innovative use of gears that makes it such a breakthrough. In conventional jet engines a single "direct drive" shaft runs from the fan you see in the front to the turbine that turns the fan. The turbine gets its power from fuel that is mixed with compressed air, then ignited in the combustion chamber to create a controlled explosion of expanding gas. The fan and turbine are directly connected. Hence, they both rotate at exactly the same speed.



But there's a problem with that arrangement. The fan is more efficient turning at a far slower pace, especially when it's larger. And the turbine operates best at higher speeds. The reason is that a bigger fan, at slower rotation, raises the engine's crucial "bypass ratio" by greatly increasing the volume of air that swooshes around the outside of the engine. That bypass air is what gives the plane 90% of its "thrust," or propulsive power. Pratt's innovation is to place a gearbox between the fan and turbine. The gearbox allows the fan to turn at one-third the speed of the turbine. The result is a much quieter, more fuel-efficient engine, which jetmakers are clamoring to buy.

The first, breakthrough order of GTFs came from Bombardier of Canada in 2007. The manufacturer of small regional jets was seeking to challenge Airbus and Boeing at the low end of their product line, and embracing the GTF was just the lift Bombardier needed for its new C Series of jets. "It makes our aircraft very competitive," says Bombardier president Hachey, Chênevert's old friend from Quebec. (Hachey says the plane is so quiet that on a test flight last September, most of the spectators missed the takeoff.)

The Bombardier coup helped Chênevert land the giant buyer he needed: Airbus. Given Boeing's exclusive relationship with CFM, the chances that it would switch to the GTF were minimal. But its main narrow-body competitor, Airbus, was already a Pratt & Whitney customer. For Airbus to employ the GTF, it would have to launch a new, re-engineered line of A320s, a huge decision for any manufacturer.

There was still plenty of skepticism in the industry about Pratt's new technology. "Many people in aerospace were questioning its reliability and its capacity to be competitive," says Fabrice Brégier, the Airbus CEO. But Brégier knew Chênevert well and believed him. "I knew that if Louis was putting his weight behind the R&D and claiming it would work, that it would work." Because it promised such huge fuel savings, the GTF spurred Airbus to introduce the next-generation A320neo (for "new engine option").

CFM, the GE consortium, is not sitting idly by. It has developed its own advanced engine, the CFM LEAP, that delivers fuel savings and noise reduction on the scale of the GTF and competes for orders on the A320neo. The LEAP technology is different: It doesn't use gears but compresses oxygen at far higher pressure so that less fuel is needed to generate the same thrust, running the engine at much higher temperatures.

But thanks to the GTF, United Technologies is now a major player in narrow-body engines again, challenging CFM's decades of major dominance. Pratt & Whitney is projecting total engine sales of around 1,000 units a year by 2020. "That's the biggest number we've seen since our heyday in the 1980s," says Chênevert.

When it comes to elevators and escalators, China boasts what may be the most extraordinary market for any single product line on the planet. Chinese developers and government agencies are buying 550,000 elevators and escalators of the 850,000 sold around the globe, or two units out of every three. That compares with a total of around 20,000 in the U.S. Now at \$15 billion, the market for elevators in China has been expanding at 20% a year for a decade. The driver is China's rapid urbanization. Between 15 million and 20 million people are moving from rural areas to cities each year.

The mass migration is spreading a vast web of high-rise apartment complexes and even new cities across central and western China — regions the new premier, Li Keqiang, is targeting for rapid development. Last year China built 15 million residential units, 15 times the number in the U.S. And most of those buildings need elevators. Otis's orders in China grew by 23% in 2013.

But all is not as promising as the staggering history of new sales would suggest. The western and central cities experiencing the biggest boom in building now face an oversupply of housing. “The sales and prices are already falling, and construction will follow,” says Credit Suisse analyst Jinsong Du. “All the building is exceeding the migration to the cities. That will slow construction in the future.”

Even if the building boom skids to a halt, Chênevert can still generate strong growth in China. But he needs to shift from reliance on new sales to a far stronger position in servicing. As in engines, that’s where the big money is. Today the manufacturers service only 25% of the lifts they sell in China, compared with 75% in Europe and the U.S. The Chinese government is passing new laws requiring more frequent inspections — and that developers hire manufacturers to service the elevators after they’re sold. That trend should greatly swell Otis’s servicing revenues in the years to come. Expect to see UTC buying up dozens of Chinese mom-and-pop elevator-service companies. “Clearly the big opportunity will be building the service business,” says Chênevert. Seizing that opportunity is one of his biggest challenges going forward.

Back in the hangar, as we turn away from the GTF, Chênevert begins talking enthusiastically about a coming landmark: his 50th career trip to China. He says that he relishes riding (in an Otis elevator, of course) to the top of the Shanghai World Financial Center, which features the world’s highest observatory. From that height, he surveys the buildings, new and old, that Otis will service in the decades to come. “I go to China and I smile,” says Chênevert. And why not? He has every reason to like what he sees ahead.