A WING AND A PRAYER: OUTSOURCING AT BOEING

The Dreamliner is three years behind schedule and massively over budget. What went wrong? Critics point to outsourcing.

REUTERS/ANTHONY BOLANTE

BY KYLE PETERSON
EVERETT, WASHINGTON, JAN 20

ON A BLUSTERY AND DRIZZLY December afternoon in the Pacific Northwest, about 20 airplanes sat engineless and inert near the runway at a Boeing manufacturing plant. Huge, yellow blocks hung from the wings of some planes to substitute for the weight of absent engines.

Every few minutes, the heavy clouds parted to give a glimpse of blue skies over Everett, Washington, just north of Seattle. Then new clouds rolled in.

The parked planes are 787-8 Dreamliners, the world's first commercial aircraft with a body and wings made largely of lightweight carbon-composite materials instead of aluminum. Someday these sleek, fuel-efficient machines -- already painted in the liveries of their airline customers -- may change the face of air travel and plane-making.

But not today.

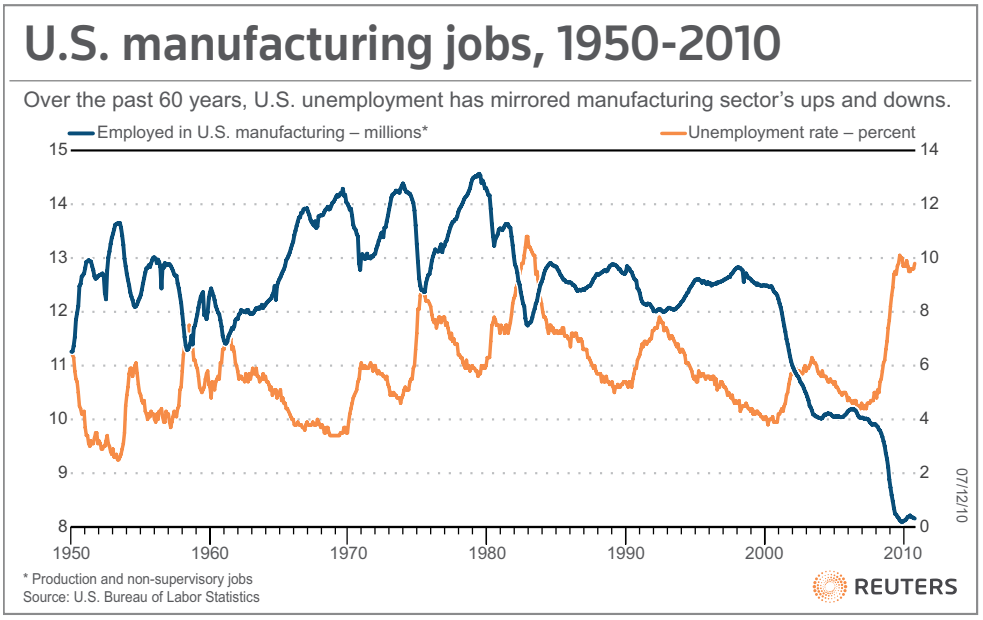
The program that produced these unfinished 787s is nearly three years behind schedule and, by some estimates, at least several billion dollars over budget. Dreamliner flight tests were halted in November after an electrical fire aboard a test plane. The tests resumed in December, and the company later announced yet another delay for the delivery schedule. The new ETA is sometime this summer.

About 45 miles (72 km) away in south Seattle, members of Boeing's work force gathered at a union hall for a monthly lodge meeting, a holiday party and a chance to lament the seismic shift in plane-making strategy they say the Dreamliner represents.

The 787 is not merely a historic feat of engineering. The program also marks Boeing's departure from its own time-honored manufacturing practices.

Instead of drawing primarily from its traditional pool of aircraft engineers, mechanics and laborers that runs

BOEING FAMILY: Aerospace Machinist Industrial District Lodge 751 union member James Williams speaks at his union's office in Seattle, Washington on December 8, 2010. **REUTERS/ANTHONY BOLANTE**



Reuters graphic/Stephen Culp

generations deep in the Puget Sound region around Seattle, Boeing leads an international team of suppliers and engineers from the United States, Japan, Italy, Australia, France and elsewhere, who make components that Boeing workers in the United States put together.

"Do you see the stupidity in that?" said James Williams, an imposing 43-year-old who has been employed by Boeing for 15 years, mostly working in factory safety.

Williams, whose father worked at Boeing for more than three decades, is just one of many in the company who blame the repeated Dreamliner delays on a splintered engineering strategy and a complex supply chain of about 50 partners.

Boeing itself has acknowledged that the system needs tweaking, and the company promises to bring more of the design work back in-house for the upcoming 787-9 model. But Boeing defends its reliance on outside partners, saying their work and investments made the Dreamliner possible.

"It is true that supplier involvement in the development and design of the 787 is significant," the company said in an emailed response to Reuters questions. "Suppliers helped us develop and understand technologies and options for the airplane as we went through the early phases of concept development. Suppliers have also provided more of their own development, design and manufacturing funding."

"A LOT OF WESTERN EUROPE WAS STILL REELING AFTER WORLD WAR TWO, AND SO WE DIDN'T HAVE THE SAME KIND OF COMPETITION WHEN IT CAME TO MANUFACTURING IN THE '50s."

Whatever the advantages, Boeing's outsourcing is emblematic of corporate practices that have sent large chunks of U.S. industry overseas and to other states, battered communities and vaulted the U.S. jobless rate to nearly 10 percent, economists say.

Yet the biggest victim may be the culture that underpins the aerospace behemoth. Here in Boeing country, where children follow parents into the aviation business, outsourcing is plain heresy.

"It was like the family," said Williams, whose wife, Sarah, and three children joined him for the holiday party. "Can you outsource Mom? Can you outsource Dad?"

SHRINKING WORKFORCES

BOEING IS THE WORLD'S second-largest commercial plane-maker after its European rival Airbus. Founded in 1916 in Seattle by William Boeing, the company earned $68.3 billion in revenue in 2009, split between its defense and commercial airplanes divisions.

The U.S. Chamber of Commerce says the aerospace industry achieved $215 billion in sales in 2009 and provided more than 644,000 jobs. According to data compiled by consulting firm Challenger, Gray & Christmas, Boeing is the 24th largest U.S. employer, including private companies and government. It is the fourth-largest employer in the U.S. manufacturing sector, excluding wholesalers, distributors and construction companies.

All told, Boeing and its subsidiaries employ 160,000 people in the United States and abroad, including 73,000 people in Washington. But while the company remains a pillar of the local economy and is hiring right now in Washington, Boeing is not the engine of job growth it once was.

At the time of the Sept. 11, 2001 attacks on New York and Washington D.C., Boeing's total workforce was about 199,000. Its defense and commercial units shed 20,000 jobs between January 2002 and January 2003 after the 9/11 attacks sparked a steep decline in air travel and aircraft orders.

Myriad other U.S. manufacturers also cut jobs during that economic downturn, and many of those never regained their former staffing levels.

BLOG

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http://link.reuters.com/heq72q

"What you've seen is a continual decline in manufacturing employment that didn't just start 20 years ago," said Stephen Bronars, senior economist at Welch Consulting. "And it's accentuated during downturns, where you see the steepest decline in manufacturing employment when there's a recession."

At its numerical peak, in 1978, the U.S. manufacturing sector accounted for more than one out of every four U.S. jobs, according to government data. Back in the 1950s, manufacturing made up an even higher share -- more than a third -- of total employment.

"A lot of Western Europe was still reeling after World War Two, and so we didn't have the same kind of competition when it came to manufacturing in the '50s," Bronars said.

Since the 1970s, employment in manufacturing has fallen more than 30 percent in the United States, compared with about 60 percent in Britain, and about 20 percent in Japan.

Then came the 2008/2009 global economic downturn, which wiped out nearly 8 million U.S. jobs. About 2 million of those were in manufacturing. Economists believe that many of these positions are gone for good, forcing blue-collar workers to search for employment elsewhere -- often at lower wages.

In several ways, Boeing's replacement of in-house labor with outside partners is typical of this trend. Although some of its outsourcing is to other U.S. companies and some of its job reductions came from spinning off businesses, the net effect has been punishing for Boeing's Washington workforce.

From Boeing's perspective, change was inevitable. Its role as a truly international company -- with 80 percent of its commercial airplane backlog for international customers -- demands a diverse and global operation to blunt the shocks to the U.S. job market from the highly cyclical aerospace business.

"Clearly, Boeing is a global company with a global customer base, and our U.S. employees benefit from that," the company said in an email response to questions by a Reuters reporter. "U.S. jobs are created by selling airplanes around the world."

ALL ENGINES GO: A Rolls-Royce engine built for the Boeing 787 Dreamliner jets sit on display at the Future of Flight Aviation Center at Paine Field in Everett, Washington on December 8, 2010. **REUTERS/ANTHONY BOLANTE**

NOT SO SIMPLE

THAT IS TRUE AS FAR as it goes, but building airplanes is far more complicated than other frequently outsourced jobs like, say, textile manufacturing.

Plane-making is best done by a group of engineers and builders working in close proximity without the distractions of language barriers, cultural differences and bureaucracy, said Tom McCarty, president of the Society of Professional Engineering Employees in Aerospace (SPEEA) local representing Boeing engineers in the Puget Sound region.

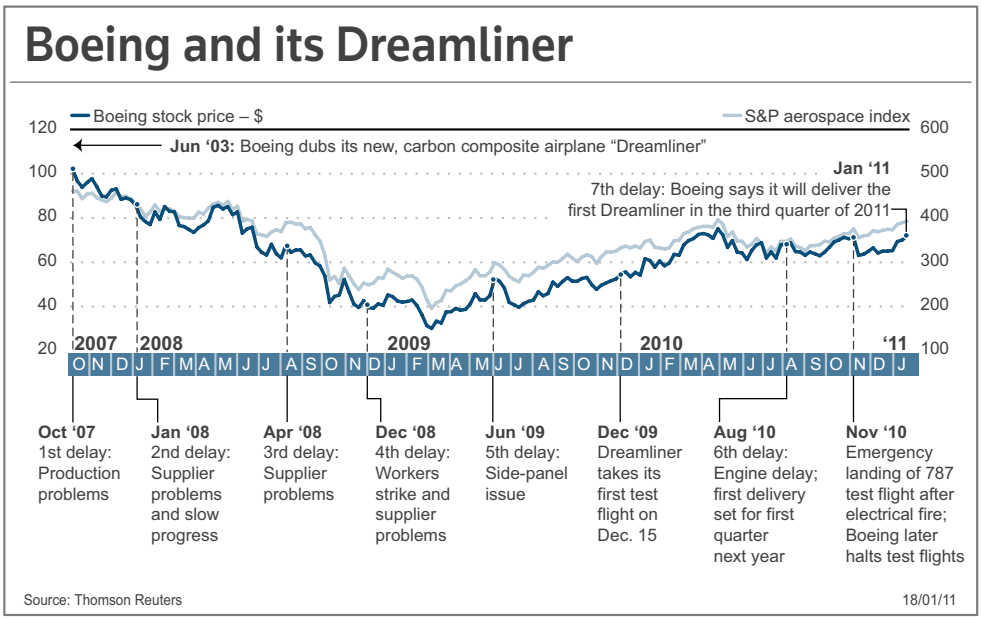
"Now with the 787, management felt they knew how to outsource the design jobs. Turns out they didn't," he said. "We're talking about how do you design and manufacture a plane like the 787?" McCarty said. "It's a very unique skill set. And schools don't turn out people who know how to do that. And there is a culture that has developed the composite knowledge of all those skills. We know how to build all these planes."

To be sure, language barriers and borders have not prevented Airbus from overtaking Boeing as the world's largest aircraft manufacturer in the past decade.

Driven by history and political necessity,

"AS WE REDUCE THESE OPPORTUNITIES TO LEARN HOW TO DO THESE JOBS, THE BOEING COMPANY BECOMES LESS CAPABLE TO DO THE JOB."

TRIBAL KNOWLEDGE: Society of Professional Engineering Employees in Aerospace (SPEEA), International Federation of Professional and Technical Engineers (IFPTE) Local 2001 union Executive Board Director Tom McCarty speaks at the union's office in Seattle, Washington on December 8, 2010. **REUTERS/ANTHONY BOLANTE**



Reuters graphic/Stephen Culp

REUTERS

the 40-year-old plane-maker was forced from the outset to create a system in which planes are built from large sections made in four countries -- Britain, France, Germany and Spain -- and then assembled in France or Germany. Airbus has also begun assembling smaller A320 150-seat planes in China for the local market.

The difference with the 787 and its future Airbus rival, the A350, is that both manufacturers are being forced to ship an increasing quantity of work for these planes beyond their traditional borders to share the risk and costs of giant technological changes aimed at making planes lighter to save fuel.

Still, Airbus has been more conservative on outsourcing. It contracts 52 percent of the airframe to outside suppliers. Boeing says it purchased 65 percent of the 787 airframe, which is comparable to the 777.

Because the A350 will not be available before 2013 -- a result of previous dithering over product strategy, according to its critics -- the EADS subsidiary can also afford to sit back and learn from Boeing's perceived mistakes on the 787.

McCarty said that by relying so heavily on foreign partners for their engineering, Boeing devalues the so-called tribal knowledge that facilitates practical application of complicated, academic engineering concepts that eventually produce a new plane.

Acquired on the job and over time, tribal knowledge is a key ingredient in the development of a new plane, some experts say. It is the shared method of performing countless daily tasks efficiently and in coordination with colleagues. In short, tribal knowledge is the grease that cuts friction throughout the design and assembly process.

"One of the things you don't want to outsource is your core competencies," said Karen Kurek, national leader of the manufacturing practice at RSM McGladrey, a tax and consulting firm. "It's the thing that gives your organization your value added."

McCarty says the loss of tribal knowledge could have far-reaching consequences for American engineering.

"As we outsource part of this work, we're removing opportunities for learning this trade, for learning these skills," he said. "As we reduce these opportunities to learn how to do these jobs, the Boeing Company becomes less capable to do the job."

THE PIVOTAL MOMENT

MANY AVIATION EXPERTS say Boeing began to put a lower premium on in-house labor after its 1997 merger with rival McDonnell Douglas. That was the same year Boeing posted its first full-year loss as Airbus stole market share.

Boeing's $16.3 billion purchase of McDonnell Douglas triggered the integration of management at the two companies with Boeing Chief Executive Phil Condit, a former aerodynamics engineer, retaining the top job.

McDonnell Douglas CEO Harry Stonecipher, formerly of General Motors, GE and Sundstrand, became president of the merged aerospace giant. After a brief retirement, Stonecipher later returned to Boeing as CEO.

In September 1998, Alan Mulally, who started his career as a Boeing engineer, was made head of the Boeing Commercial Airplanes (BCA) division.

Some critics view the merger as the point at which BCA began to favor a corporate culture that prized near-term profits over long-term engineering dominance. "Back in the early 2000s there was effectively a battle for Boeing's soul," said Richard Aboulafia, vice president at aviation consultancy Teal Group.

He and others also single out Stonecipher as the face of Boeing's shifting priorities. "He was symptomatic of the McDonnell Douglas philosophy," Aboulafia said.

Around this time, Boeing moved its corporate headquarters to Chicago after 85 years in Seattle. Labor unions complain the departure drove a wedge between executives and Seattle-area rank-and-file. But the global corporation cited a need to be

"BACK IN THE EARLY 2000S THERE WAS EFFECTIVELY A BATTLE FOR BOEING'S SOUL."

near Wall Street, Washington D.C. and big customers.

BCA headquarters remained in Seattle, its attention fixed on the next big project. "There were the legacy commercial guys who once a decade invested very heavily in the company's future by creating a new jet. And then there were the newcomers," Aboulafia said.

"Effectively, it was dominated by a lot of the McDonnell Douglas people who were a little more concerned with shareholder relations and perhaps even their own wealth," he added. "And they absolutely did not want to make a big investment."

Boeing's previous initiative, the 777, had recently entered service, and it was time for Boeing to get to work on its next new model. Responding to airline demands for greater fuel efficiency, Boeing began developing the design that in 2003 would be dubbed Dreamliner.

The carbon-composite structure would be lighter than aluminum planes of comparable size and would consume 20 percent less fuel. The concept was incredibly popular among cash-strapped airlines that were still reeling from a drop in travel demand after 9/11.

But when it came time to build the 787, Boeing turned away from its stable of engineers and mechanics to embrace a complex web of suppliers. For the first time in its history, Boeing would outsource the wing design and manufacturing.

"That, I think the smart people there knew, was an incredibly risky way of doing it, but it was the only way they could move forward," Aboulafia said. "It was kind of a Faustian bargain, I think, that Alan Mulally made. He did what he had to do to launch the program given the tremendous adversity he was facing."

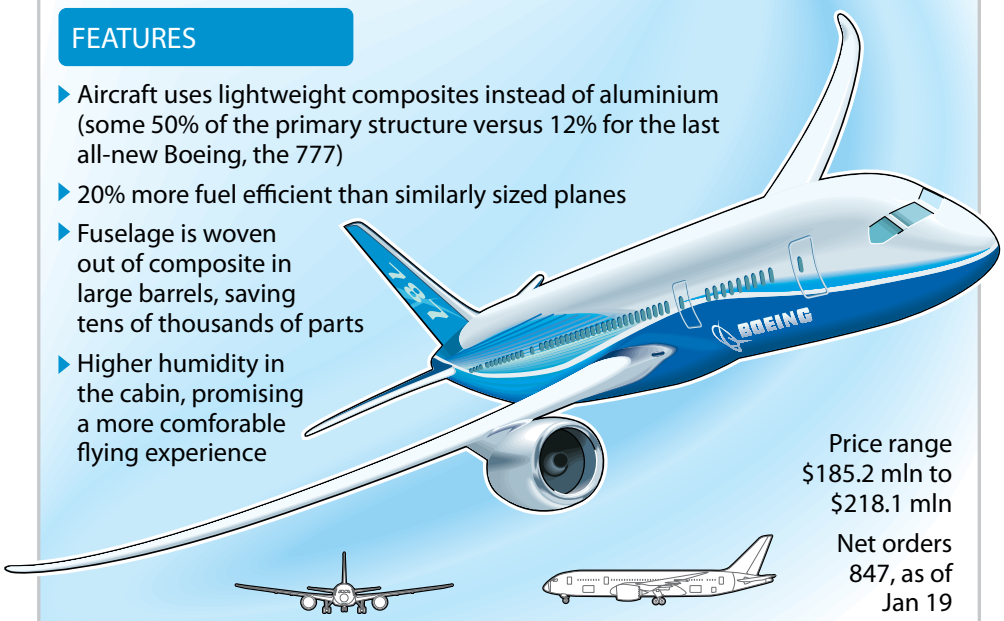
For its part, Boeing maintains that it never abandoned its standards for design and engineering.

"Boeing leads the design effort, oversees the processes and tools, and holds both ourselves and our partners to the highest standards of performance on safety and quality," the company said. "It is important for Boeing to retain critical skills for engineering and building structures such as wings and composite structures," Boeing said.

BOEING 787 DREAMLINER

FEATURES

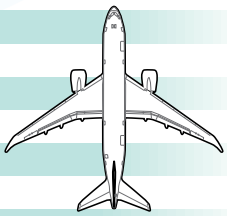
- Aircraft uses lightweight composites instead of aluminium (some 50% of the primary structure versus 12% for the last all-new Boeing, the 777)
- 20% more fuel efficient than similarly sized planes
- Fuselage is woven out of composite in large barrels, saving tens of thousands of parts
- Higher humidity in the cabin, promising a more comforable flying experience



Price range $185.2 mln to $218.1 mln

Net orders 847, as of Jan 19

	787-8	787-9
SEATING	210 - 250	250 - 290
RANGE	14,200 - 15,200 km	14,800 - 15,750 km
CONFIGURATION	Twin aisle	Twin aisle
CROSS SECTION	574 cm	574 cm
WING SPAN	60 m	60 m
LENGTH	57 m	63 m
HEIGHT	17 m	17 m
CRUISE SPEED	Mach 0.85 (920kmh)	Mach 0.85 (920kmh)
MAX. TAKEOFF	227,930 kg	247,208 kg
CARGO VOLUME	4,400 cubic feet	5,400 cubic feet



Source: Boeing

REUTERS

The company had planned to make a first test flight of the Dreamliner around late August 2007 and first delivery in May 2008. But that target began to slip in 2007 when Boeing postponed the first test flight due to a shortage of bolts and flight control software.

More delays followed as production problems mounted. In 2008, the company blamed another delay on a 58-day strike by Boeing assembly workers over contract terms.

The next year, Boeing bought portions of business units of two of its suppliers to help regain control of its Dreamliner production. It paid $580 million for the South Carolina operations of Vought Aircraft Industries, the company that worked on the 787 aft fuselage section.

Boeing later purchased Alenia North America's half of Global Aeronautica LLC, the South Carolina fuselage subassembly facility for the 787. Boeing did not disclose financial terms of that deal. "By taking Alenia out of the ownership equation, this tidies up the situation in Charleston," Boeing said in a statement at the time.

The Dreamliner finally made its first flight on Dec. 15, 2009. But less than a year later the company postponed delivery again -- this time to early 2011 -- because of a delay in the availability of a Rolls-Royce engine needed for the final phases of flight testing.

In October 2010, Boeing said it would tell suppliers to halt deliveries of sections for its 787 Dreamliner for two weeks because of delays at Alenia, a unit of Italian defense and aerospace company Finmeccanica SpA. Alenia makes the horizontal stabilizer for the tail of the 787.

On Nov. 9, the Dreamliner schedule

PILOT'S VIEW: Aircraft flight information is shown on a heads-up display in the Boeing 787 Dreamliner Engineering flight deck simulator during a media tour of Boeing Co. engineering labs in Seattle, Washington, May 22, 2007. **REUTERS/ROBERT SORBO**

endured a new hiccup when a fire on a 787 test flight forced an emergency landing in Laredo, Texas.

Boeing halted the test flight program to determine the cause of the fire, which it later attributed to foreign debris in an electrical equipment cabinet. The company resumed 787 flight tests in late December, saying it had installed an interim version of updated power distribution system software and conducted a rigorous set of reviews.

The electrical system and a power panel for the 787 are built by the Hamilton Sundstrand unit of United Technologies Corp, a major Boeing supplier responsible for several key components of the 787's electrical systems.

On Nov. 30, Jim Albaugh, who took over as BCA chief in 2009, confirmed to Reuters that Boeing would delay delivery to its 787 launch customer All Nippon Airways. Then, earlier this week, Boeing announced that it had moved first delivery to the third quarter of 2011 from the first quarter. That at least had the effect of assuaging Wall Street concerns about an even longer delay.

"IN RETROSPECT, OUR 787 GAME PLAN MAY HAVE BEEN OVERLY AMBITIOUS, INCORPORATING TOO MANY FIRSTS ALL AT ONCE."

CONTRITION AND DAMAGE CONTROL

NOWADAYS, BOEING IS quick to acknowledge the rocky road the Dreamliner has traveled so far. In a speech to the Wings Club of New York on Nov. 11 -- just two days after the electrical fire that grounded the 787 test fleet -- Boeing CEO Jim McNerney appeared chastened.

"In retrospect, our 787 game plan may have been overly ambitious, incorporating too many firsts all at once -- in the application of new technologies, in revolutionary design-and-build processes, and in increased global sourcing of engineering and manufacturing content," he said.

But he also reiterated the company's faith in the Dreamliner. "While we clearly stumbled on the execution, we remain steadfastly confident in the innovative achievements of the airplane and the benefits it will bring to our customers," he said

Boeing executives declined to be interviewed for this story, but the company replied to written questions submitted by Reuters. "The sourcing decisions made on the 787 are a natural evolution of the work done at Boeing Commercial over the years," the company said. "We've said in the past that for the most part, we are satisfied with the general direction. However, there are a few things we would change, and you've seen us make changes on the 787 over the years."

HARD WORK AND HEARTBREAK

BACK IN SEATTLE, workers take little comfort in the words of their leader McNerney, the onetime head of GE Aircraft Engines. McNerney came to Boeing in 2005 after a tenure as CEO at 3M Co, a conglomerate that produces tens of thousands of diverse products like Scotch tape, medical masks and optical film used to brighten flat screen TVs and computers.

A group of Boeing employees, mostly stewards in the International Association of Machinists (IAM) union, sat down with

STILL CONFIDENT: Boeing Chief Executive Officer Jim McNerney gestures to the media as he stands in front of the Boeing 787 Dreamliner aircraft at Farnborough airport in Farnborough, southern England July 18, 2010. **REUTERS/KIERAN DOHERTY**

Reuters in December to describe their own experiences on BCA projects, including the 787.

Daniel Swank, 47, an aircraft maintenance technician on the 787 program, who had previously worked on the 777, said "I can say it's night and day as far as processes and flow."

Swank and his colleagues refer to pre-Dreamliner Boeing as "legacy." In those days, he had easier access to the program engineers who worked in the same building and could quickly address problems as they arose.

"They started vendoring out years ago, but pretty much legacy is different from 787, because on 787 everything has been vendored out," Swank said.

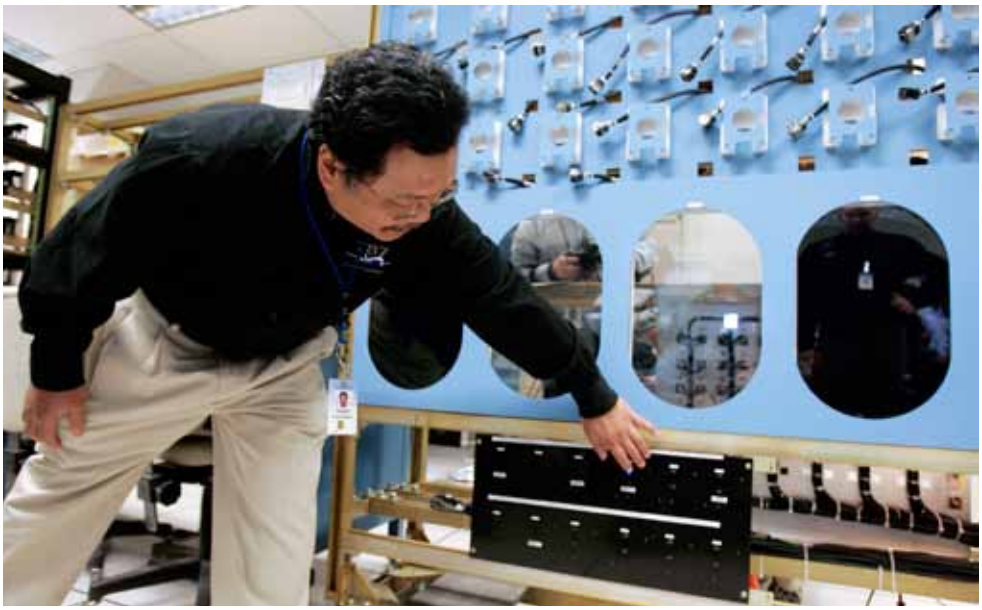
He recalled a time on the 787 program when he ran out of a particular washer to fit with a screw on the plane. He said he had to fill out paper work to order a single washer and waited one day to receive it from the outside supplier.

"That shows you how ridiculous it's gotten," he said. "Everyone knows that vendoring has killed this program. You have contractor agreements that have slowed the whole process down."

Reuters graphic/Stephen Culp

That assessment is shared by Jason Redrup, 48, who has been with Boeing for 15 years and currently works for the IAM. Prior to that post, he was a structures mechanic on the 767 where he put the airplane body sections together. He said Boeing's plan to fly the Dreamliner parts to Seattle for easy assembly has not worked out.

"On the 87, the idea was Boeing was not going to own any of that. That all this stuff was going to come in kits -- all the parts, all



SHADES OF THE FUTURE: Boeing engineer Gerald Lui-Kwan demonstrates high-tech electronically shaded windows that will be used in the 787 Dreamliner airplane during a media tour of Boeing Co. engineering labs in Seattle, Washington, May 22, 2007. **REUTERS/ROBERT SORBO**

the fasteners, everything you needed to do this one particular job," Redrup said.

"It's a very elaborate supply chain, so even their suppliers don't necessarily control where parts are being made," he said. "So it's a very complicated web of work now that's not so easy to fix when there's a problem."

Then there is Clark Fromong, 49, who has been at Boeing for 23 years. He makes duct work and tubing. His parents worked at Boeing as do both of his brothers.

He said outsourcing since the 1997 merger -- and especially since the Dreamliner -- has made life at Boeing and in the Puget Sound region stressful and gloomy. Workers who earned a living in plane-making now must look elsewhere and often leave the state.

"We keep offloading our work overseas, and it's cutting our work in half," Fromong said. "So we all think our jobs are going away. The attitude is everyone is always nervous. Always on needles. Stressed out."

Aircraft workers near Seattle suffered another blow in 2009 when, after a long battle to keep 787 assembly in Everett, Boeing selected South Carolina as the site of its second 787 final assembly plant. The company aims to ramp up 787 production to 10 planes per month in 2013.

The plant in South Carolina is expected to create thousands of new jobs in that state and is likely to be less disruptive to Boeing than its Everett counterpart, where four major IAM strikes in the last two decades have cost Boeing about 200 days in lost production. The machinists in South Carolina, a right-to-work state, voted against IAM representation.

"WE KEEP OFFLOADING OUR WORK OVERSEAS, AND IT'S CUTTING OUR WORK IN HALF."

Tom Wroblewski, district president of the IAM unit representing Boeing workers in the Puget Sound region, said downsizing and outsourcing have taken a toll on IAM membership, which is down to about 25,000 today from 42,000 in 1990.

He illustrates his point with a graphic depicting work performed by IAM members on six models of Boeing commercial planes. Parts of the plane that are made by IAM workers are colored red. The graphic for the single-aisle 737 is mostly red, compared with the 787, which features only a little red, mainly on the vertical fin.

IAM members and local government leaders mounted a campaign before work began on the 787 to entice Boeing to make the plane in Washington. The union was later surprised to find out how little work the locals would actually get.

"No sooner did the helium go out of the winning balloons than we find out that their commitment was to assembling the airplane and that was it," he said.

But three years of delays speaks for itself, he said. The vast global partnership was meant to share risk and cut costs. The opposite is happening, he said.

"I'm done saying 'I told you so' on the 87," Wroblewski said. "When they announced they were going global, we told them at that point: 'You go global, you put all of your eggs in the suppliers out there. You're going to lose control of your airplane. And when you lose control of your airplane, there's nothing you can do. So what's happened? They've lost control of it."

A400M SPECIAL REPORT

To see a special report from June 2010 on another major aerospace project, the Airbus A400M military transporter, click here: http://link.reuters.com/myc28m

WHAT WENT RIGHT

ONE KEY BOEING supplier and a long-time partner to the company, U.S.-based aircraft components supplier Rockwell Collins, disagrees with the negative assessments by labor leaders.

"There's obviously a lot that gets press these days," said Jeffrey Standerski, vice president and general manager of Rockwell Collins' air transport systems. "But I'll tell you what: It's really phenomenal when you think about the success that the Boeing systems are having in the flight test program."

Rockwell Collins makes cockpit electronics for the Dreamliner. The company has a contract with Boeing valued at $3.5 billion over the life of the Dreamliner program.

Standerski describes a cohesive design and manufacturing process that involves constant communication between Boeing, Rockwell Collins, Honeywell International, GE and Hamilton Sundstrand, who also work on airplane systems.

He said Boeing contacted suppliers in the earliest stages of the 787 program and set up identical labs for engineers at the various companies. "Things have gotten more obviously complex on airplanes because of the increased functionality that is on airplanes," Standerski said.

Integrated architecture eventually will become the norm in plane-making, Standerski said, noting comparable construction practices on the Airbus A350. "It's going to continue to force companies to

HEAVY LIFTING: One of the Boeing company's Dreamlifter cargo aircraft sits on the tarmac at a factory in Everett, Washington, April 30, 2009. **REUTERS/ROBERT SORBO**

innovate," he said. "It's going to continue to force companies to make the investments in research and development to make sure that we're working on the technology for those next-generation airplanes."

HOW WILL THIS PLANE BE JUDGED?

BY NOW, BOEING HAS about 850 orders for the Dreamliner on its books from airlines and aircraft leasing companies all over the world. It's a record number of orders for a plane still in development.

Aviation experts remain thrilled by the plane's reported fuel-efficiency as well the promise of a smooth, quiet, comfortable ride for passengers. Their delight was on full display in July when hordes of plane spotters gathered on the perimeter of the Farnborough Airshow in England to watch the Dreamliner land after its first overseas flight. Aviation buffs inside and outside of Boeing frequently call the 787 a "game-changer."

"It's still a plane with a very broad and eager market," said Teal Group's Aboulafia. "It's going to take them a long time to make money with this. But eventually -- assuming it works out -- they're going to sell thousands."

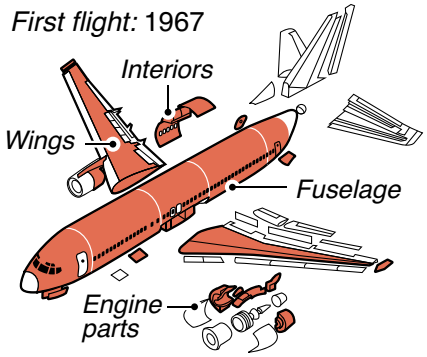
MODEL AIRPLANE: A Boeing employee sits next to a tinted window on the Boeing 787 Dreamliner at Farnborough airport in Farnborough, southern England July 18, 2010. **REUTERS/KIERAN DOHERTY**

Meanwhile, the more than 50 customers for the plane have mostly withheld public criticism of Boeing, despite the havoc that delivery delays play with their long-term fleet planning. Analysts believe Boeing

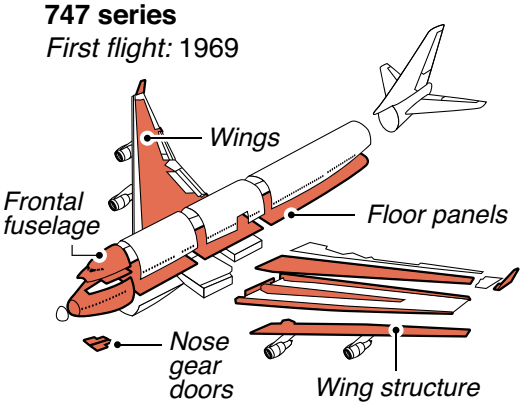
BOEING STRUCTURE SUPPLIERS

■ Parts built by the IAM union of Boeing workers

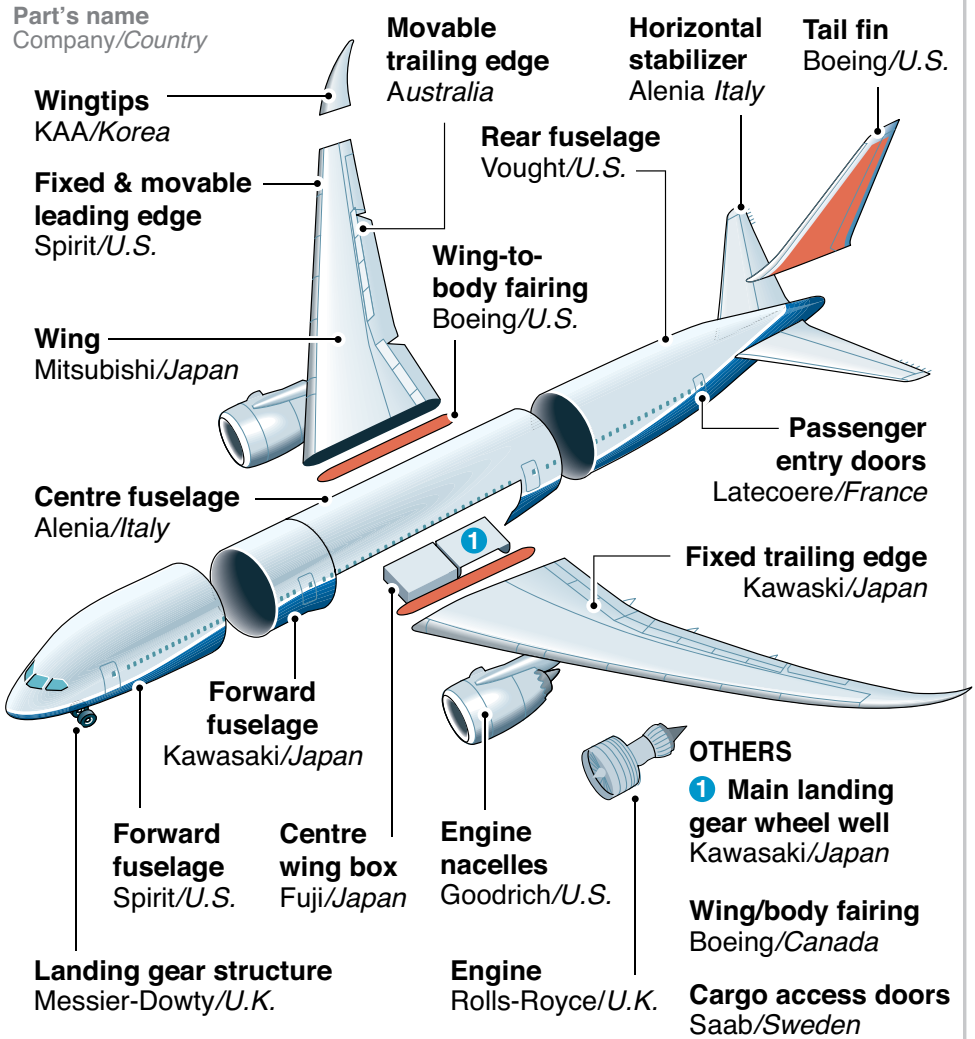
737 Classic
First flight: 1967



747 series
First flight: 1969



787 DREAMLINER *First flight:* 2009



Note: diagrams not to scale
Sources: International Association of Machinists, Boeing

REUTERS

For a full list of 787 Dreamliner parts suppliers, click here:
http://www.boeing.com/commercial/787family/dev_team.html

WORRIED WORKERS: Society of Professional Engineering Employees in Aerospace (SPEEA), International Federation of Professional and Technical Engineers (IFPTE) Local 2001 union Executive Director Ray Goforth speaks at the union's office in Seattle, Washington on December 8, 2010. **REUTERS/ANTHONY BOLANTE**

has probably already paid out hundreds of millions of dollars in penalty payments for late delivery.

Boeing has not said what it has spent on the Dreamliner program so far. But experts believe the plane is at least several billion dollars over budget.

In the end, the Dreamliner will be judged on its safety, reliability and ability to deliver on its many promises, said Ray Goforth, executive director of the SPEEA union in Seattle. "The real test on the 787 is going to come in its first year in service," he said.

The reliability rate of the Dreamliner will have to be near 100 percent to appease cost-conscious airlines that cannot afford to have a plane frequently out of service for repairs. "If it turns out that this thing is a dog because more and more of these problems are still cropping up, you are going to have to fix them quick and keep that level of confidence in the plane, or those orders will just evaporate," Goforth said.

At the same time, the Dreamliner and Boeing will also be judged on their impact on U.S. labor and American engineering.

The Dreamliner will be delivered sooner or later. And someday the same planes now parked in Everett may be the first of thousands of 787s to take their place in the skies among other Boeing icons like the jumbo 747 and the shorter-range workhorse 737.

But Boeing employees in the Puget Sound region are increasingly bitter about a corporate culture they say erodes the skills of American workers and makes their company less attractive to young people entering the job market. They hope Boeing leaders will soon see things their way.

Judging by its statements -- including the emailed comments to Reuters -- the company and its critics may not be so far apart on the issue of outsourcing.

"We made too many changes at the same time -- new technology, new design tools and a change in the supply chain -- and thus outran our ability to manage it effectively for a period of time," the company said. "In short, we have learned, and we are applying our learning."

(Reporting by Kyle Peterson and Tim Hepher; Editing by Jim Impoco and Claudia Parsons)

LIVING THE DREAM: Boeing employees work on the interior assembly of a 787 Dreamliner at the company's plant in Everett, Washington, May 19, 2008.**REUTERS/ ROBERT SORBO**

COVER PHOTO: Two Japan Airlines (JAL) Boeing 787 Dreamliner jets sit idle at Paine Field in Everett, Washington on December 8, 2010 as seen from the roof of Boeing's Future of Flight Aviation Center. **REUTERS/ANTHONY BOLANTE**

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