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For Airbus, Making Huge Jet Requires New Juggling Acts

Mr. Champion Has to Oversee
Welsh-Spanish Squabbles,
Floppy Resin Sandwiches

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TOULOUSE, France -- Charles Champion had a major weight problem. He urgently needed to lose several tons.

It was early 2001 and Mr. Champion, a top engineer at Airbus, had just become project manager for the A380 super-jumbo jetliner, the world's largest passenger plane. The \$12 billion project was only weeks into its five-year schedule and the aircraft was seriously overweight.

The extra pounds threatened to ruin the plane. Airbus was touting the efficiency of the A380 to potential customers. But heavy planes guzzle fuel, driving up operating costs. To fix the problem, engineers resorted to methods never used before on commercial jets, such as building wing parts out of synthetic materials. Workers had to learn, fitfully, to handle unusual compounds. The innovations prompted turf battles among Airbus's European operations and each potential solution created more technical difficulties.



Charles Champion


Mr. Champion's task is critical to Airbus in its dogfight with **Boeing** Co. for command of the commercial aerospace business. Airbus last year edged out Boeing as the No. 1 commercial-jet maker. Airbus's chief executive, Noel Forgeard, thinks the A380 can widen the gap and predicts the plane will boost the company's \$20 billion annual revenue by \$10 billion a year after 2006. Airbus has firm orders for 129 A380s, which have a list price of \$280 million apiece. (Airlines typically receive significant discounts).

Boeing, meanwhile, is placing its bets elsewhere. In April, the Chicago-based giant gave the go-ahead to an ultra-efficient plane, dubbed the 7E7, which is much smaller than the A380. There is a larger market for Boeing's 250-seat jet than for Airbus's mega-carrier, but it sports smaller profit margins.

"We don't think [building the A380] is a very smart thing to do," says Randy Baseler, a vice president of marketing at Boeing. Boeing engineers think Airbus has over-estimated the size of the market by a factor of four and is "being very optimistic" about its ability to trim the weight of the A380, Mr. Baseler says.

Airbus is pitching the A380 as nothing less than a flying cruise liner. It will have two decks, each split by two

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FLIGHT OF FANCY

The Airbus A380 will be the world's largest-ever passenger plane. Some

facts:

- \$12 billion investment, employing over 6,500 staff worldwide, before first passenger boards
- 129 orders so far from 11 customers; Airbus sees market for 1,200 A380s
- A380 has two full decks, with two aisles each, seating 555 people in 3 classes -- or 840 people in just economy class
- First test flight slated for early 2005
- First passenger flight slated for 2006, on Singapore Airlines

Source: Airbus

aisles, and connected by two large stairways. It will seat 555 passengers in three classes; with economy-class seats only, its capacity will reach 840. Airbus is suggesting airlines use some of the plane's extra space for shops or lounges.

Compared with Boeing's biggest jetliner, the 747-400, the A380 has about 35% more seats and Airbus has pledged its plane will cost airlines about 20% less per passenger to fly any given route.

Airlines liked the savings, but had fresh demands. Emirates Airlines of Dubai asked for more cargo space. Australia's Qantas wanted to fly farther. Singapore Airlines wanted to make the A380 quieter, with a written guarantee the plane would meet new airport noise limits at London's Heathrow. Airbus agreed, and also promised to stick to its efficiency guarantees.

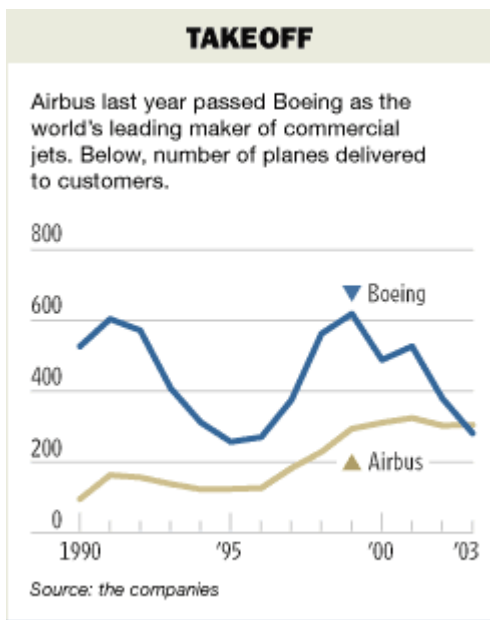
Mr. Champion's predecessor, Juergen Thomas, had already made moves to cut the plane's total empty weight of 243 tons. He trimmed one ton by using a hydraulic system borrowed from fighter jets. Hydraulic systems carry fluid around the plane to control the movement of external parts such as the rudder and wing flaps.

But in cutting noise to please Singapore Airlines, Mr. Thomas increased the diameter of each engine by five inches, a move that added back one ton. "Many things did not behave the way we predicted," recalls Mr. Thomas, who has retired from Airbus but remains an adviser to the company.

A 24-year Airbus veteran, Mr. Champion joined the A380 project in December 2000, three days after it was officially approved by Airbus's owners, Franco-German-Spanish **European Aeronautic Defense & Space Co.** and the U.K.'s **BAE Systems PLC**. Airbus was trying to build the A380 with unprecedented speed. Its contract with Singapore Airlines guaranteed that the airline would be able to inaugurate the plane in early 2006. It would need a year of testing before the launch.

A 48-year-old aerospace engineer, Mr. Champion had faced troubled programs before. In 1990, he was managing production of the smaller A320 model when engineers discovered that key parts didn't fit the fuselage. Only after assembling about 100 planes did Airbus and Mr. Champion work out how to fix the problem.

Mr. Champion also spent a year in the late 1990s selling planes while running a sales territory that stretched from Tunisia to Siberia. He says he learned "to be humble" listening to buyers. The stint gave him credibility with the company's salesmen who typically grumble that designers don't appreciate client needs. "In a roomful of engineers, he can say, 'I know the customer wouldn't accept this,'" says John Leahy, the top salesman at Airbus.



To tackle the weight crisis, Mr. Champion gathered Airbus engineers from across Europe in Filton, England, in the summer of 2001. Breaking into groups dubbed "Tiger Teams," they scoured the plane for places to use new technologies.

The teams decided to make the entire rear fuselage section from lightweight carbon-fiber composite instead of aluminum. That meant the structure had to be redesigned and retested because composites stretch and bend differently than metal. Airbus also replaced copper electrical wire with aluminum, a potentially risky move because aluminum, while lighter than copper, is also more brittle.

Mr. Champion focused on the A380's wings, which account for almost one-third of the plane's empty weight. The wings are dramatically larger than those of a regular plane: The surface area of one wing could accommodate one of Airbus's single-aisle jets and a crowd of people could stand comfortably inside.

Each wing is held together by 61 ribs running parallel to the fuselage that come in various shapes and sizes. The longest resembles a 54-foot-long kayak. Several engineers suggested building the ribs from lighter composite

materials instead of the traditional aluminum. Composites have been used in less-critical parts of passenger jets for decades, but never in main wing structures. The ribs come under enormous stress during flight.

Engineers worried that composites would behave differently than aluminum as the plane moved from the heat of the runway to the icy air at cruising altitude. If the material expanded or contracted more than anticipated, the stresses could cause materials fatigue or other structural damage. Manufacturing the ribs could also be expensive because of their unusual design. "It looked like a crazy idea," Mr. Champion recalls.

Manuel Huertas, the head of composite technologies on the A380 and a proponent of composite ribs, spent part of his summer vacation working on designs with outside suppliers. Their cost was "horrendous," Mr. Champion says, and did little to solve the weight problem.

With barely a year until the first wing was scheduled for production, Mr. Champion put Airbus engineers in Spain and Germany into competition with one another to stimulate some fresh thinking. Mr. Champion, who was born in Paris to a French father and English mother, thought he was accustomed to dealing with different national temperaments.

Mr. Huertas's Madrid team soon hit on a simple idea: Wrap each composite rib in a metal frame, to absorb some of the changes in temperature. Airbus decided that 24 of the 61 ribs would use this composite-metal combination. The other, smaller ribs would be made from aluminum.

But hitches in the production process threatened the plan. Because metal ribs are carved from blocks of aluminum, it's relatively easy to produce irregular shapes. Composite parts, by contrast, are created with floppy multilayer sandwiches of carbon-fiber strips and epoxy resin that harden when baked. The plane's ribs require ridges on both sides for extra strength but workers found it impossible to build up ridges with the floppy mixture on one side without ruining the not-yet-baked mixture on the reverse.

Mr. Huertas's team found an unconventional solution. They created ridges on one side only before baking the compound. After the rib had hardened, engineers simply glued pre-made ridges to the other side. "It's not the type of design an engineer would dream of" Mr. Champion says. "But at least it works."

In February, 2003 the first set of ribs was sent to Airbus's wing plant in Wales. Workers there found that several didn't fit properly. They scrambled to modify some and sent others back for reworking. Workers in Wales were also unfamiliar with handling composite materials and had been used to stepping on the metal ribs as they assembled the wings. They quickly found out that composites are more delicate and some ribs had to be sent back to Madrid after workers damaged them. "We struggled on the first aircraft," Mr. Champion says.

The A380's massive size -- its landing gear requires 24 wheels, more than twice as many as are used on most other planes -- further complicated the work. Airbus needs cranes to move parts that workers on other planes could carry by hand. It has to conduct tests in special facilities. Some components had to be completely redesigned because big parts vibrate at lower frequencies than small ones. Engineers need to take account of the differing frequencies to make sure the plane's parts interact properly.

"Because of the size, you cannot find one piece of the structure that has been done before," says Robert Lafontan, a senior engineer on the program.

As pressure mounted last spring, the Spanish engineers and British production teams began to quarrel. British managers complained about Spanish production quality and Spaniards criticized British handiwork. A few fights got nasty enough to require Mr. Champion's intervention. At the Paris Air Show last June, he managed to get Spanish and British managers to pose together for a photograph, but their smiles masked "a lot of tension," he recalls.

Mr. Champion calls their spats "typical," given the program's short timetable. "I'm sure I don't know 5%" of the arguments among staff, he says.

Gradually, Spanish production managers tightened up the precision of their production while British workers grew familiar with handling composites. British engineers say they met their weight targets and Mr. Huertas says rib delivery is now on schedule.

On Nov. 4, 2003, a giant crane lifted the first A380 wing from its cradle. Mr. Champion was pleasantly surprised his team worked through their problems. "Nobody would have believed it," he says. "Not even me." Mr. Champion expects to power up the first A380 in July and, in less than a year from now, flight-testing will begin.

Some of the early design changes wound up making the A380 more expensive to fly and Airbus has been scrambling to meet its promises to airlines. "It's not exactly the same numbers, but it's in the range," says Mr. Lafontan, the Airbus engineer. Mr. Champion says the plane's design isn't optimal from an engineering standpoint, but says it will give Airbus's customers what they want.

To hit the revenue mark predicted by Airbus's CEO, the company needs to more than double orders. Airbus says it expects to get at least one new customer a year through 2006. Virgin Atlantic recently postponed by 18 months the delivery of the six A380s it had ordered. A Virgin executive familiar with the matter cited problems breaking in a new airplane as one reason.

Airbus spokesman David Voskuhl declines to comment on specifics of Virgin's decision. In general, Mr. Voskuhl says, the A380 team is working "to avoid teething problems you might expect from a complex industrial product."

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