Case Study: The Boeing 787 and HCL Technologies

You are driving north of Seattle and hear a giant Boeing 747 approaching. Then you do a double take. This one does not have the distinctive hump of a 747. The hump actually extends across most of the length of the plane. It is a Dreamlifter, a specially modified 747 with a massive cargo capacity of 65,000 cubic feet and takeoff weight of up to 800,000 pounds.

The Dreamlifter is the primary means of transporting major portions of the new Boeing 787 from suppliers in Italy, Japan, and many other countries to the final assembly site in Everett, Washington. This has allowed Boeing to reduce delivery times to as little as one day from as many as 30 days it would normally take via sea and ground transport. This is one of countless innovations Boeing implemented around the manufacturing of the 787—branded the Dreamliner.

The involvement of so many suppliers across the globe has been criticized, especially given the repeated delays and related increased costs on the 787 program. The reality is Boeing's main competitor Airbus had already shown that large sections of a plane could be made in four countries—Britain, France, Germany, and Spain—and then assembled in France or Germany.

Boeing CEO Jim McNerney has acknowledged, "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."[20]

When the 787 program was kicked off in early 2003, Boeing was adjusting to new market realities.

> As rising fuel costs and even terror attacks have impacted airlines, causing major swings in aircraft orders, OEMs like Boeing have realized that the up-front investments in tooling required to build a new plane represent growing financial risks. At the same time, experts say, aircraft lifecycles have begun to shorten, increasing the odds that Boeing's

integrated approach to design and integration could create bottlenecks. So, with the 787, Boeing decided to spread the risk among its suppliers and to call on them to help shorten cycle times.[21]

The 787 plane itself has many innovative features, and the savings expected from a streamlined supply chain allowed Boeing to price aggressively. That made the 787 the fastest selling airliner ever designed. By 2007 Boeing had announced firm orders for 544 airplanes from 44 airlines.[22] While the delays since have led to several canceled orders, Boeing says it is sold out through the end of the decade. In late 2011, as Boeing showcased the plane as part of a launch "Dream Tour," there were enthusiastic crowds across the globe.

The use of composite materials in the fuselage and the wings, the sweptback aerodynamic wings, and the more efficient engines are expected to combine to deliver 20 percent better fuel performance than a similar sized 767 of today. The plane promises flight ranges of up to 8,500 nautical miles, unusual for a mid-sized jet but critical as passengers increasingly demand non-stops across the globe.

And passengers enjoy improvements, such as:

- The LEDs allow the crew to adjust the lighting to match different phases of the flight. The light is fairly standard during boarding and while cruising. During meals it is adjusted to warmer tones. Once you're done eating and want to tilt the seat back and relax, the cabin can be bathed in a relaxing lavender hue. When it's time to sleep, the lights are turned way down.[23]
- The cabin will feel less dry (humidity twice as high as on current planes), because the 787 cooling system will be driven by electricity. An electrical system makes it easier to humidify the cabin air because it's not starting with the hot, dry air from the jet engines common in most planes.[24]
- The superior strength of the composite fuselage will allow the passenger cabin to withstand higher pressurization at an altitude of 6,000 feet instead of the usual 8,000 feet. Passenger comfort is shown to increase significantly at lower cabin altitude pressure.[25]
- An active gust alleviation system will improve ride quality during turbulence.

A major innovation passengers will not see but will benefit from is Boeing's use of HCL Technologies to provide software engineering services for the 787 program. Since HCL had already been involved with a number of its tier-one suppliers like Rockwell Collins, GE Aviation, and others both for hardware systems and software development, it offered a unique opportunity of synergy across the fragmented supply chain. HCL was designated the preferred software services company for the entire 787 program.

HCL has long had an R&D bent. It developed the first indigenous microcomputer in India in 1978 (the same time as Apple did) and developed the indigenous relational database at the same time as its global IT peers. HCL also says it developed its multiprocessing UNIX-based OS kernel in the late 1980s, a few years ahead of Sun and HP, which of course, commercialized it far more successfully.

Says Sandeep Kishore, Executive Vice President for the Engineering and R&D Services unit at HCL Technologies, "We have done over 750 projects in the aerospace industry covering avionics, engineering design, and extensive testing. We have been involved in all major commercial aerospace programs across the globe in the past decade. Under this umbrella agreement with the Boeing Company, HCL worked as the engineering services partner of choice with multiple sub-tier companies on the 787 program." HCL's services were utilized by these airborne systems suppliers across all the major design elements of the 787 such as common core systems, open systems architecture, and e-enabled architecture.

Some of the key systems that HCL was involved with included electric power generation and distribution systems, remote power distribution systems, air management systems, integrated surveillance systems, display and crew alerting systems, common data networks, and pilot controls.

HCL leveraged its offshore infrastructure and processes to ensure that almost 80 percent of the effort was delivered from its engineering design centers and labs in India.

To help test these systems that were being built all over the world, HCL helped build automated test equipment, load generators, test simulators, and data banks by remotely integrating with the labs of the Tier 1 suppliers during off-peak hours and ensuring optimal utilization of costly test lab infrastructure.

There were several advantages of having HCL across the board working with all its partners for the 787 development for Boeing. First off, it minimized compatibility issues that come from integration of multiple subsystems. It also made sure that HCL cross-leveraged the knowledge and learning on the 787 program across suppliers to speed up the development process.

Says Kishore, "We estimate HCL had some level of involvement and contributed to developing and validating almost 40 percent of airborne software. At peak, over 900 HCL engineers worked with Boeing and 10 of its sub tier partners from the U.S., Europe, and Australia."

Meanwhile, Boeing had a flight test system that needed to be enhanced to test the different versions of the 787. The test system had evolved over several decades and Boeing wanted to migrate the system to a modern architecture that could also potentially be airborne in future versions. HCL assisted in the rehosting of this flight test system.

Another major initiative at Boeing is the Test Operations Center (TOC). The TOC is a 32,000-sq.-ft. facility at the Flight Test Center at Boeing Field. The heart of the TOC is a 2,000-sq.-ft. control room, nicknamed the "bubble," with 6 × 16-ft. screens displaying the status of aircraft in the test fleet. The room brings together engineering, flight operations, and maintenance staff. The TOC is open three shifts a day, with flight tests during daylight hours, ground tests during second shift and maintenance taking place during the third, overnight, shift. In addition to Boeing employees, the TOC is designed to house employees from suppliers and the FAA. HCL played a key role in development of the visibility applications and the database that are part of the Test Operations Center.

In another innovation, HCL also agreed to tie a portion of its compensation for work with the tier-one suppliers to sales of the plane. So, while Boeing has suffered from the delays, HCL is also sharing in some of that pain.

CEO Jim McNerney summarizes: "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."[26]

As ANA and other charter airlines roll out the 787 on their routes, passengers are finding the cleanest air of any airplane ever built (the air has the same microbial content of outside air with its filters with an

efficiency of 99.97 percent) and when they glance out of their 18 5-inch-tall 787 windows, the largest on any commercial plane, and which have electronically adjustable electrochromic dimmers, the production delays are a memory from the past.[27]

In the meantime, Boeing has learned plenty about how to manage a globally distributed technology supply chain.