Supply chain management: boeing and airbus

Environment, Air

I would like to mention a subject relating to aviation industry, especially in leasing aircraft sector. The most important task in this sector is how to order, purchase and lease back aircraft to airlines. But to implement this task, we should know in detail how the aircraft assembly process under the control of aircraft manufacture is.

In Vietnam, the aviation market has a great development with the air traffic increasing year by year. In order to meet the high demand, Vietnamese airliners have to add more aircraft to their fleet. They not only purchase aircraft by itself, but also need to lease from aircraft lessors. So that, aircraft lessors have to support airlines to develop their fleet. Beside, leasing aircraft sector is the new one in Vietnam aviation industry. With this purpose, this final paper will provide an overview of the supply chain management practices by Airbus and Boeing in their new products as Airbus A350 XWB (Extra Wide Body) and Boeing B787 Dreamliners and how the both aircraft manufactures apply lean process management. Understanding this process, aircraft lessors will make a suitable decision to purchase aircrafts.

On this occasion, I would like to thanks my partners in Boeing Commercial Airplane and Airbus SAS for providing necessary internal documents for reference. I also thanks my colleague in aircraft technical section in my company, Vietnam Aircraft Leasing Company, and technical staff from Vietnam Airlines Corporation for supporting during the data collection.

2. Research Goals and Approach:

2. 1 Goals:

– In this final paper, I would like to provide the some overview for understanding the emerging of supply chain management strategies in the commercial aviation industry.

– It also shows the longer-term implications of the supply chain management in the aviation industry in the future.

2. 2 Approach:

– To implement a comparative analysis of supply chain management applied by Boeing and Airbus and their lean process management.

– To focus on two new large development programs in commercial aviation (Boeing 787 Dreamliners and Airbus A350 XWB).

– To concentrate on the common set of suppliers supporting both programs to develop a sharp “ compare and contrast” perspective, looking at Boeing & Airbus from the vantage point of these common suppliers.

3. Literature review:

The extensive literature showing that lean supply chain management practices represent a critical source of sustained competitive advantage and containing some factors as following:

- Supplier network architecture linked to company’s vision & strategy.

- Early supplier integration into design and development.

- Visibility and transparency through open communications.

- Long-term, trust-based, mutually-beneficial relationships.

- Continuous supplier development & process improvement.

- New supplier network architectures represent a defining feature of emerging new business models for managing complexity, uncertainty and competition in a globalized market environment.

- Access to investment capital, new markets and new sources of innovation.

- Greater outsourcing, strategic alliances & partnerships, delegation of greater responsibilities to suppliers to minimize risk and transaction costs.

- Internet-enabled information technologies and systems radically redefining supplier integration via improved information visibility and information-sharing efficiency gains.

- Machine-to-machine data communication & system integration globally.

- Unprecedented visibility, transparency and accuracy.

- Greater flexibility in interconnecting different systems, facilitating both bilateral and multilateral collaboration.

4. Research Design:

- To develop baseline data about the individual supplier companies.

- To gauge whether and the extent to which they are employing lean practices.

- To assess the extent to which the two large customer companies are practicing lean principles in their engagement with the suppliers.

- To document the extent to which the two large customer companies have proactively required the suppliers to adopt lean practices.

- To develop more deeply into specific topical areas (e. g., role in design & development, information/communication links, contract design).

- To probe how exactly the two customer companies manage their relationships with these specific suppliers.

- Open source information to ensure external validity & generalizability.

- About the two companies & their supply chain management practices.

- About the two specific programs.

- About the common suppliers.

5. Boeing 787 Program:

5. 1 Overview:

- Launch Year in 2002 in order to responding to the overwhelming preference of airlines around the world, Boeing Commercial Airplanes' new airplane is the Boeing 787 Dreamliner, a super-efficient airplane. An international team of top aerospace companies is developing the airplane, led by Boeing at its Everett, Washington facility near Seattle.

- Represents Boeing's response to expected demand for an aircraft that would cost less to own, operate and maintain.

- Targeted at the “ middle of the market” segment — the rapid, direct, point-to-point connections aviation market segment, with capacity of 250 passengers.

Unparalleled Performance

At the first stage of the program, Boeing tent to launch 03 type of aircraft: 787-3, 787-8, 787-9 but up to now, there are 02 main versions. The 787-8 Dreamliner will carry 210 – 250 passengers on routes of 7, 650 to 8, 200 nautical miles (14, 200 to 15, 200 kilometers), while the 787-9 Dreamliner will carry 250 – 290 passengers on routes of 8, 000 to 8, 500 nautical miles (14, 800 to 15, 750 kilometers).

In addition to bringing big-jet ranges to mid-size airplanes, the 787 will provide airlines with unmatched fuel efficiency, resulting in exceptional environmental performance. The airplane will use 20 percent less fuel for comparable missions than today’s similarly sized airplane. It will also travel at speeds similar to today’s fastest wide bodies, Mach 0. 85. Airlines will enjoy more cargo revenue capacity.

Passengers will also see improvements with the new airplane, from an interior environment with higher humidity to increased comfort and convenience.

Advanced Technology

The key to this exceptional performance is a suite of new technologies being developed by Boeing and its international technology development team.

50 percent of the primary structure – including the fuselage and wing – on the 787 will be made of composite materials.

An open architecture will be at the heart of the 787’s systems, which will be more simplified than today’s airplanes and offer increased functionality. For example, the team is looking at incorporating health-monitoring systems that will allow the airplane to self-monitor and report maintenance requirements to ground-based computer systems.

General Electric and Rolls-Royce are the two engine manufacture to develop engines for the new airplane. It is expected that advances in engine technology will contribute as much as 8 percent of the increased efficiency of the new airplane, representing a nearly two-generation jump in technology for the middle of the market.

Another improvement in efficiency will come in the way the airplane is designed and built. New technologies and processes are in development to help Boeing and its supplier partners achieve unprecedented levels of performance at every phase of the program. For example, by manufacturing a one-piece fuselage section, we are eliminating 1, 500 aluminum sheets and 40, 000 – 50, 000 fasteners.

Continuing Progress

The Boeing board of directors granted authority to offer the airplane for sale in late 2003. Program launch occurred in April 2004 with a record order from All-Nippon Airways. Since that time, 56 customers from six continents of the world have placed orders for 847 airplanes valued at $147 billion, making

this the most successful launch of a new commercial airplane in Boeing’s history. The 787 program opened its final assembly plant in Everett in May 2007. First flight of the 787 Dreamliner occurred in Dec. 2009.

The program has signed on more than 40 of the world’s most capable top-tier supplier partners and together finalized the airplane’s configuration in September 2005. Boeing has been working with its top tier suppliers since the early detailed design phase of the program and all are connected virtually at 135 sites around the world. Eleven partners from around the world completed facility construction for a total of three million additional square feet to create their major structures and bring the next new airplane to market.

5. 2. Specification

Model

B787-8

B787-9

Engine

GEnext or Rolls Royce Trent 1000

GEnext or Rolls Royce Trent 1000

Range

7, 650 to 8, 200 nautical miles (14, 200 to 15, 200 kilometers)

8, 000 to 8, 500 nautical miles (14, 800 to 15, 750 kilometers)

Seat

210 to 250 passengers

250 to 290 passengers

Configuration

Twin aisle

Twin aisle

Cross Section

226 inches (574 centimeters)

226 inches (574 centimeters)

Wing Span

197 feet (60 meters)

197 feet (60 meters)

Length

186 feet (57 meters)

206 feet (63 meters)

Height

56 feet (17 meters)

56 feet (17 meters)

Cruise Speed

Mach 0. 85

Mach 0. 85

Total Cargo Volume

4, 400 cubic feet

5, 400 cubic feet

Max Takeoff Weight

502, 500 lbs (227, 930 kilograms)

545, 000 lbs (247, 208 kg)

Program milestones:

Authority to offer: late 2003

Program launch: April 2004

Assembly start: 2006

First roll-out ceremony: July 2007

First flight: December 2009

First delivery: Mid Q1/2011 (estimated)

5. 3. Program Fact Sheet:

The 787 Program covers many areas of interest, from the market, customers, and airplane technology to manufacturing enhancements and an extensive partner team, among others. Here are some interesting facts and figures on a number of these topic areas:

Market size:

3, 310 units over 20 years (Boeing Market Forecast 2009-2028)

Firm orders by customer (up to October 2010 at www. boeing. com)

Model Series

Orders

Deliveries

Total

B787-8

629

—

629

B787-9

218

—

218

B787 Total

847

847

B787 vs. B777 on composites and aluminum (by weight):

B787

B777

50 % composites

12 % composites

20 % aluminum

50 % aluminum

Material breakout on B787:

Composites: 50%

Aluminum: 20%

Titanium: 15%

Steel: 10%

Other: 5%

Better designe:

– More fuel efficient: 20 % more fuel efficient than similarly sized airplanes

– Produces fewer emissions: 20 % fewer than similarly sized airplanes

– Better cash seat mile costs than peer airplanes: 10 %

– Better maintenance costs: 30%

Generators:

Four at 250 kVA (two per engine)

Two at 225 kVA (on auxiliary power unit)

Hydraulic power:

Distributed at:

– 5, 000 pounds per square inch on the 787

– 3, 000 pounds per square inch standard

Advantage of the new electric architecture: Extracts as much as 35 percent less power from the engines than traditional pneumatic systems on today’s airplanes.

US and non-US content on the 787: Roughly 70 percent US Roughly 30 percent non-US.

The number of new city pairs the 787 will connect: At least 450

Other special features:

- Represents large step towards “ all-electric-airplane”, one in which all systems are run by electricity.

- Driven by the belief that power electronics, key to the all-electric airplane, are on a steep curve of performance & cost improvement, while pneumatic systems growth has “ tapped out” around 1995.

- The traditional bleed air and hydraulic power are replaced with electrically powered compressors and pumps.

- Cabin pressurized by electric motors, not by bleed air used by almost every pressurized aircraft. An open architecture centralized computer hosts the avionics and utility functions, rather than dozens of individual buses.

- Anti-icing of the wing to be done with electric heat instead of bleed air.

- Composites: resist long-term wear and tear, because cracks do not propagate from holes as in aluminum; inspections are made easier; maintenance intervals stretched to 1000 hrs (compared with 500 hrs for 767 or 700 hrs for A330 — the two most prominent aircraft 787 aims to replace).

- Much more savvy focus on flexible financing arrangements, plus closer attention to passenger comfort, fuel burn and life cycle costs.

6. Airbus A350 XWB Program:

6. 1. Overview:

Aimed at compete with B787 from Boeing, Airbus has decided to build A350 XWB based on the technologies developed for A380. The Airbus A350 XWB is a long-range, mid-size, wide-body family of airliners currently under development by European aircraft manufacturer Airbus. The A350 will be the first Airbus with both fuselage and wing structures made primarily of carbon

fibre-reinforced polymer. The A350 is designed to compete with the Boeing 777 and the Boeing 787. Airbus claims that it will be more fuel-efficient, with up to 8% lower operating cost than the Boeing 787. It is scheduled to enter into airline service during the second half of 2013. The launch customer for the Airbus A350 is Qatar Airways. Development costs are projected to be US$15 billion.

Airbus utilises next-generation manufacturing and assembly techniques to make the A350 XWB a more efficient and reliable aircraft. The A350 XWB is equipped with an advanced cockpit and onboard systems optimised for robustness and simplicity, while its advanced wing design makes this aircraft faster and quieter.

The A350 XWB’s onboard systems are designed for maximum reliability, operability and simplicity.

The advanced wing design of the A350 XWB will make it a faster, quieter and more efficient aircraft.

Airbus utilises new techniques to optimise the A350 XWB’s weight, maintenance and operating costs.

The A350 XWB’s cockpit features the latest in display technology and integrated modular avionics.

6. 2. Specification:

Aircraft Dimensions

Overall length

198 ft. 7. 5 in.

219 ft. 5. 5 in.

242 ft. 4. 7 in.

Height

55 ft. 11. 3 in.

55 ft. 11. 3 in.

55 ft. 11. 3 in.

Fuselage diameter

19 ft. 58 in. (horiz)

19 ft. 58 in. (horiz)

19 ft. 6 in. (horiz)

Wingspan (geometric)

212 ft. 5 in.

212 ft. 5 in.

212 ft. 5 in.

Wing area (reference)

4, 740 ft2

4, 767 ft2

4, 767 ft2

Wing sweep (25% chord)

31. 9 degrees

31. 9 degrees

31. 9 degrees

Wheelbase

81 ft. 7 in.

94 ft. 1 in.

108 ft. 7 in.

Wheel track

34 ft. 9 in.

34 ft. 9 in.

35 ft. 2 in.

Basic Operation Data

Engines

2 Rolls-Royce Trent XWB

2 Rolls-Royce Trent XWB

2 Rolls-Royce Trent XWB

Engine thrust range

75, 000 lb. slst.

84, 000 lb. slst.

93, 000 lb. slst.

Typical passenger seating

270 (3-class)

314 (3-class)

350 (3-class)

Range (w/max. passengers)

8, 300 nm.

8, 100 nm.

8, 000 nm.

Max. operating Mach number (Mmo)

0. 89 Mo.

0. 89 Mo.

0. 89 Mo.

Design Weights

Maximum ramp weight

548. 7 lbs. x 1000

592. 8 lbs. x 1000

659. 0 lbs. x 1000

Maximum takeoff weight

546. 7 lbs. x 1000

590. 8 lbs. x 1000

657. 0 lbs. x 1000

Maximum landing weight

407. 9 lbs. x 1000

451. 9 lbs. x 1000

503. 8 lbs. x 1000

Maximum zero fuel weight

382. 5 lbs. x 1000

423. 3 lbs. x 1000

470. 6 lbs. x 1000

Maximum fuel capacity

34, 082 US gal.

36, 460 US gal.

41, 215 US gal.

Some Design & Technical Features:

- Cockpit design follows same cockpit layout, characteristics and operating procedures as in the A320 and A330/A340 platforms, providing a number of advantages (e. g., in terms of crew training, crew transition, cross-crew qualification).

- Also incorporates new features that benefit from innovation in technologies for displays, flight management & navigation systems.

- First commercial airplane to adopt EHAs (electrohydrostatic actuators) flight control technologies, a step forward to the “ all-electric airplane”. EHAs are electrically powered but use hydraulic pumps and reservoirs that transform electrical power into hydraulic power.

- Advantages: large savings in terms of weight and space (e. g., reduction in the size of pipelines, actuators and other components, power generation equipment, tubing, amount of fluid required), as well as ease of installation.

- First commercial aircraft capable of flying with total hydraulic failure, using electricity to operate the flight control surfaces.

- Extensive use of composite materials – 25% (by weight), compared with 10% in A320 and 30% in A340-500/600.

- Use of carbon composites and advanced metallic hybrid materials, along with laser beam welding to eliminate fasteners, reduce weight and provide enhanced fatigue tolerance.

- Glare: highly resistant to fatigue, used in construction of panels for upper fuselage.

- Aluminum and fiberglass layers of Glare do not allow propagation of cracks.

- Glare lighter than conventional materials & represents a weight saving of about 500kg.

6. 3. Fact Sheet:

Firm orders by customer: (up to October 2010 at www. airbus. com)

Model Series

Orders

Deliveries

Total

A350-800

158

—

158

A350-900

340

—

340

A350-1000

75

—

75

A350 Total

573

—

573

A350 vs. B787 on material breakout (by weight)

A350

B787

Composites: 53%

Composites: 50%

Aluminum: 19%

Aluminum: 20%

Titanium: 14%

Titanium: 15%

Steel: 6%

Steel: 10%

Other: 8%

Other: 5%

Airbus internal goal to freeze the design and expects:

10% lower airframe maintenance cost

14% lower empty seat weight than competing aircraft

More fuel efficient: Up to 25 % more fuel efficient than similarly sized airplanes

Produces fewer emissions: Up to 25% fewer than similarly sized airplanes

Better cash seat mile costs than peer airplanes: 15%

7. Supply Chain Management Practices by Airbus and Boeing:

- Supplier selection on both programs following a typical competitive bid process during initial “ plateau phase”; selection on best-value basis.

- Boeing retains unified list of pre-qualified suppliers/vendors (qualified parts list – QPL; qualified vendor list – QVL).

- Airbus does not yet maintain such a unified list, but moving in same direction.

- Both have major suppliers participate early in design and development process.

- Both committed to long-term, mutually-beneficial, reliable and stable relationships with key suppliers.

- Supplier partnerships typically limited to suppliers that continuously show excellence in performance, demonstrate credible long-term business interest, and back it up with their own development and investment.

- Life-of-program fixed-cost contracts, but with some differences.

- Electronic links with suppliers via supplier portals (request for quote/proposal; order placement; technical data interchange, such as technical specifications, key characteristics, engineering drawings; exchanging documents; facilitating virtual collaboration with global partnering suppliers in a 3D design software environment).

- RFID (Radio Frequency Identification) initiatives: Both Boeing and Airbus have expanded the application of RFID tags for both the B787 and A350 programs; they have worked together to reach for consensus regarding standards for using global RFID technology on commercial airplanes).

8. Major suppliers' responsibility is greater:

- Important strategic shifts in supply chain management, driven by pressing need to reduce cost and spread development costs.

- Both have asked major suppliers in B787 and A350 to absorb non-recurring costs, thus greatly shifting costs and risks to suppliers, but using somewhat different approaches.

- Suppliers delegated much more responsibility for design, development and manufacturing through closer collaboration, partnerships and integration across supplier networks.

Boeing 787:

- Boeing has gone the extra distance with the 787 program — retains only about 33%-35% of the total 787 work share

- Deliberate effort to reduce parts count to enable “ snap” three-day assembly of the 787

- Suppliers moving up the value chain & assuming more of a system integrator role, providing more integrated components and managing their own sub-tier suppliers

- This is the first time Boeing has outsourced the entire wing design and manufacturing to external suppliers (risk-sharing partners Fuji Heavy Industries, Ltd.: center wing box; Kawasaki Heavy Industries, Ltd.: main wing fixed trailing edge; Mitsubishi Heavy Industries, Ltd.: wing box)

- This is the first time Boeing applied lean manufacturing process in B787 program to improve absence management while merging its short and long-term disability program administration with leave-of-absence offering.

Airbus A350:

- Airbus, as a multinational consortium prior to July 2001, had already adopted a strategic partnership model with well-defined work-share arrangements.

- Airbus has increased its outsourcing in the A350 program, but has still kept in-house core technologies, such as composite technology and wing design.

- Airbus also applied lean process technique by getting advice from Porsche (a German car manufacture) in order to reduce production time and avoid delay as happened in A380 program.

9. Worldwide Outsourcing:

Both Airbus and Boeing have increased their global outsourcing in Japan, China, India, Middle East, Eastern Europe and Russia (estimated in the future). Why the two aircraft manufacture select these region because of the strong economic growth as well as fast-growing air travel particularly in Asia/Pacific region. Large Asian and Middle Eastern carriers as Singapore Airlines, Emirates, Vietnam Airlines now are the major customers. The variety of offset arrangements have opened up new market opportunities, tied to increased sourcing (e. g., from China).

Boeing strategy: long unparalleled dominance in Japanese market & strong presence in China.

- In Japan: 80% of orders from Japanese airlines from Boeing during last decade; Japanese suppliers (“ heavies”) account for 35% of 787 work-shares.

- In China: activities range from subcontracting, joint ventures, technical training and assistance for cooperative programs; visible support from Chinese suppliers (valued at $1. 6 billion), supplying essential composite parts and structures for 787 programs.

Airbus strategy: relative newcomer to Japan & China.

- In Japan: facing difficulties in winning orders from Japanese airlines, but has contracted work with Japanese suppliers.

- In China: sale activities in China jumped to 219 aircraft in 2005 from 56, overtaking Boeing by delivering 6 more aircraft; committed to doubling procurement from Chinese suppliers to $120 million/year by 2010; announced Tianjin will be site for Airbus' first final assembly plant outside Europe.

10. The Emerging " Unique" Model:

Boeing Model:

The Boeing 787 experience represents a unique model for the future in supply chain management.

- In essence, the Boeing model is about optimizing the total business, not just the supply chain in the traditional sense. Supply chain architecture as an integral part of the entire program extended enterprise architecture.

- Main emphasis is on optimizing portfolio of core competencies in entire value stream for mutual benefit.

- Lifecycle value creation perspective, not short-term waste elimination or cost minimization for Boeing itself.

- Boeing has adopted a bold new innovative “ system integrator” role. This represents a revolutionary departure from the past.

- Boeing has asked all suppliers to carry all of the non-recurring costs; in return, gives back to risk-sharing partnering suppliers the intellectual property rights on the components or systems they provide.

- Contracts are so designed that if the aircraft does well in the marketplace, the risk-sharing partners derive direct benefits and major partnering suppliers can make design trades within each work package and across company units to find optimal system solutions.

- Lower-tier suppliers are not provided IP ownership but are given long-term relationships, where they can benefit from scale economies.

- Boeing only provides high-level interface definition; the first-tier (major partnering suppliers) is responsible for the detailed interface definitions & designs.

- Suppliers work together and Boeing acts as referee in case of conflicts.

- Web-enabled information technologies & systems a critical enabler.

Airbus model:

- Airbus is reported to have established “ risk-sharing partnerships” with more than 30 of its major suppliers covering $3. 1 billion or 25% of total program non-recurring costs.

- These suppliers include Alenia, Eurocopter, Fokker, Gamesa, Labinal, Saab).

- However, this needs closer scrutiny, to see what it actually means. Airbus also continues to exercise control over all system and detail engineering interface definitions.

- Airbus suppliers work “ in parallel” (bilaterally with Airbus), with limited lateral communications among them.

- Unlike Boeing, Airbus “ has no strong partners” for major risk-sharing activities or as contributors to development spending. However, Airbus is currently pursuing new partnering arrangements under its Airbus Power “ competitiveness” Industrial Plan.

- Plan proposes “ radical” cost-cutting rationalization measures (cutting 10, 000 jobs, closing down or selling specific sites, rearranging workshare allocation).

- Investment partners being sought for the “ Extended Enterprise” sites (Nordenham, Germany; Meaulte, France; Filton, UK).

- As part of the plan, supplier relationships would also change (Airbus wants partners to commit to long-term cost reductions). Airbus also reducing its supplier base from 3, 000 down to 5, 000.

11. Conclusion:

Aerospace supply chain management will continue to evolve from a transactional or relational business model to one involving risk-sharing and cost-sharing prime-supplier partnerships, alliances & closely-knit collaborative relationships.

- Where primes (system-integrators) will likely to move closer to a “ total” system integrator & lifecycle value provider role.

- Major suppliers to assume greater system-integrator role, with greater responsibility for design, development, manufacturing, and after-market lifecycle support. Suppliers, in general, moving from short-term service providers to long-term partners.

- Global outsourcing considered as aerospace supply chains and is likely to be a lot more quite internationalized in the future.

- Adoption of information technologies enabling network-wide connectivity right down to lower tiers an imperative in the future for coordinating complex set of interdependencies.

- Continued consolidation likely in aerospace supplier base to build greater specialization & broader system integration skills, and stronger financial backbone to make the necessary investments to enhance core capabilities.