



Comparative Analysis of Supply Chain Management Practices by Boeing and Airbus: Long-Term Strategic Implications

by

Tzu-Ching Horng and Kirk Bozdogan, MIT

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Research Goals and Approach

Goals

- Develop an improved understanding of emerging supply chain management strategies and practices in the commercial aerospace industry
- Explore the longer-term implications of the findings for supply chain management practices in the aerospace industry in the future

Approach

- Conduct a comparative analysis of supply chain management practices by Boeing and Airbus by
- Focus on two large development programs -- the Boeing 787 Dreamliner and the Airbus A380 Navigator
- 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
- Capture bottom-up “supplier’s voice” to complement “top-down” perspective, while controlling for any “embellished” top-down view from the two companies



Key Questions

- **What are the defining characteristics of supply chain management practices adopted by Boeing and Airbus in connection with the Boeing 787 Dreamliner and the Airbus A380 Navigator programs?**
 - Design of the supplier network architecture
 - Supplier selection and certification
 - Supplier engagement in design and development
 - Management of supplier interfaces & relationships
 - Technical engineer data exchange -- technologies, systems, and practices
- **What are the significant similarities and differences between the two?**
 - Cost and risk sharing
 - Workshare allocation, supplier role and responsibilities
 - Contractual arrangements
 - Global outsourcing, alliances and partnerships
 - Use of information technology and infrastructure
- **What are the longer-term future implications of the findings?**
 - Emerging business models and networked enterprise architectures?
 - Technology development, product and process innovation, and knowledge-sharing
 - Global product development & production
 - Structure of the supplier base & customer-supplier relationships



Guiding Insights from the Literature

- **Extensive literature showing that lean supply chain management practices represent a critical source of sustained competitive advantage.** Examples:
 - Supplier network architecture linked to company's vision & strategy
 - Early supplier integration into design and development
 - Synchronized flow throughout the supplier network
 - Visibility and transparency through open communications
 - Long-term, trust-based, mutually-beneficial relationships
 - Knowledge-sharing and fostering supplier-based innovation
 - 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

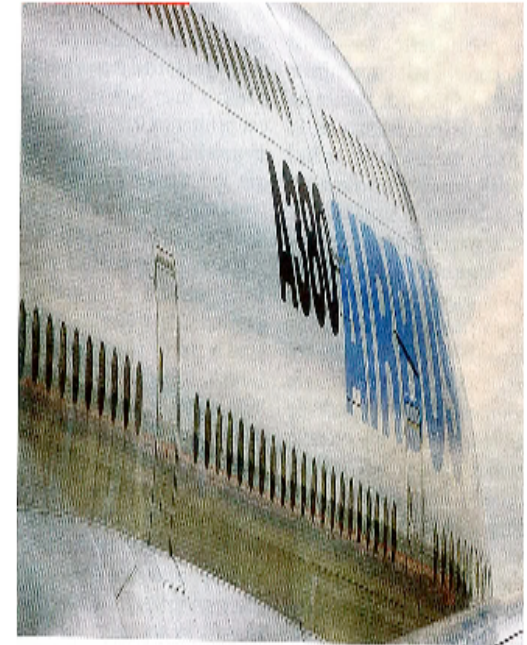


Research Design

- **Questionnaire survey of a sample of common suppliers supporting both programs**
 - 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
- **Telephone interviews with key representatives of a selected set of suppliers**
 - To delve 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

Airbus A380 Program -- Quick Profile

- **Basic information**
 - Double-decker super jumbo aircraft available in two models
 - 555-seat A380-800 in a three-class configuration, with a range of 8000 nautical miles (15,000 kilometers) and cruise speed (typical) of Mach 0.85 (max Mach 0.89)
 - 853-seat in a single-class economy configuration
 - Economic and environmentally-friendly
 - A380 can fly 10-15% more range but burn 13% less fuel than the 747; consumes less than 3 liters of fuel per passenger-seat over 100km
 - List price: \$292 million (in 2006 dollars)
- **Launched in mid-1990s to end Boeing's dominance in long-distance commercial aviation market since 1970s**
- **Initial launch cost: \$10.7 billion (now higher)**
- **Final assembly in Toulouse, with interior furnishings and customization to be performed in Hamburg**
- **Wiring problems discovered early in 2006 have led to a (more than) two-year delay in the program and over \$2 billion in expected losses in net revenue**





Airbus A380 Program -- Further Details

- **Aimed at ending Boeing's worldwide dominance in long-distance hub-dominated commercial passenger aviation market since 1970s**
 - With 35% more capacity than Boeing 747, A380 positioned to help airlines cope with rising worldwide passenger traffic -- hub-to-hub traffic growing at staggering rate, as evidenced by the fast-growing aviation routes connecting Asia with North America and Europe
 - Provide better utilization and efficiency of fleets without increasing number of flights
- **Targeted as a calculated bold response to projected market demand**
 - Next 20-year outlook: 22,663 new aircraft (2006-2025); growth over 5%/yr
 - Main difference between Boeing & Airbus projections: for the A380/Boeing 747-class aircraft, Boeing sees a market for 990 aircraft (for both passengers & freighters), while Airbus sees a total of 1,665 (latest 20-yr outlook Global Market Forecast issued in Nov 2006)
 - Boeing A380 launch decision based on expected rise in market fragmentation (new markets, higher-frequency thinner routes & hub-bypassing) along with consolidation of hub-to-hub traffic and hub-dominated traffic, typical of alliance networks



Airbus A380 -- Further Details on 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

Boeing 787 Program -- Quick Profile



- **Launch Year: 2002, when Boeing abandoned its Sonic Cruise project and re-directed the 7E7 project, later named the 787 Dreamliner**
- **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**
 - This market segment covers an intercontinental range of about 2000-6500 nautical miles, with capacity around 180-250 passengers
 - Currently being served by such aircraft as the Boeing 767, A300/A310, and A330
 - Aircraft in this market segment allow airlines to offer greater flight frequency and more direct connections between city-pairs
 - Boeing 787 is designed to operate in this market segment but at a higher speed and with better fuel efficiency
- **List price: 152.8 million (in 2006 dollars)**
- **Expected rollout of the first aircraft in July 2007**
- **With the 787 Dreamliner, Boeing is expecting to win back the dominance of the \$60 billion/yr jetliner market from Airbus**



LEAN AEROSPACE INITIATIVE

Boeing 787 Program -- Further Details

- **The 787 Dreamliner twin-aisle platform comes in four variants**
 - 787-8 : carry 210-250 (223) passengers in a three-class configuration, with a range of 8,000-8,500 nautical miles (14,800-15,700 kilometers) and cruise speed of Mach 0.85
 - 787-9 : carry 250-290 (259) passengers in a three-class configuration, with a range of 8,600-8,800 nautical miles and cruise speed of Mach 0.85
 - 787-3: carry 290-330 (296) passengers in a two-class configuration, with a range of 3,000-3,500 nautical miles
 - 787-10: carry 300 passengers, stretch version, similar capacity as -9 & better range than -8
- **Designed as a lighter airplane with greater fuel-efficiency, lower emissions, lower cost per seat-mile, and lower maintenance costs**
 - 30,000-40,000 lbs. lighter than A330-200; uses 20% less fuel & lower emissions compared with similarly-sized airplane
 - Travels at speeds similar to today's fastest wide-body aircraft, allowing more cargo revenue capacity
 - 10% lower seat-mile cost than current generation aircraft
 - 30% lower maintenance costs
- **Selected two engine types: General Electric (GE) Genx & Rolls-Royce Trent 1000 to power the 787**
- **Aircraft will be built in Everett, WA; goal for final assembly 3 days**
- **Program milestones**
 - First flight August 2007
 - Certification/entry into service May 2008
 - 787-3 mid 2010
 - 787-9 late-1010
 - 787-10 late 2012



Boeing 787 -- Some Design & Technical 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
- **Unprecedented use of composite materials**
 - Composites (50%, by weight); by comparison, 777 has 12% composites
 - Aluminum (20%); by comparison, 777 has 50% aluminum
 - Titanium (15%); steel (10%); other (5%)
 - 61% of 787's airframe structure is made from fatigue-and-corrosion-resistant materials
 - 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**
 - Before: customer = airlines, not much attention paid to financing flexibility issues
 - Now: customer = airlines + banks -- that is, eliminate huge differences in systems packages common on other aircraft to enhance the aircraft's appeal to lenders (i.e., makes it easier to transfer aircraft from one operator to another when it comes off a lease)



Largely Similar 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 -- (e.g., 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 initiatives: Both Boeing and Airbus have expanded the application of RFID tags for both the 787 and A380 programs; they have worked together to reach for consensus regarding standards for using global RFID technology on commercial airplanes)



Major Suppliers Given Much Greater Responsibility than in the Past

- **Important strategic shifts in supply chain management, driven by pressing need to reduce cost and spread development costs**
 - Both have asked major suppliers in 787 and A380 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
- **Airbus A380**
 - Airbus, as a multinational consortium prior to July 2001, had already adopted a strategic partnership model with well-defined workshare arrangements (“groupement d’intérêt économique”)
 - Airbus has increased its outsourcing in the A380 program, but has still kept in-house core technologies, such as composite technology and wing design
- **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 subtier suppliers
 - This is the first time Boeing has outsourced the entire wing design and manufacturing to external suppliers (e.g., to 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)



Increased Global Outsourcing-1

- **Both Airbus and Boeing have increased their global outsourcing**
 - Japan
 - China
 - India
 - Middle East
 - Eastern Europe
- **Strong economic growth as well as fast-growing air travel particularly in Asia/Pacific region**
- **Large Asian and Middle Eastern carriers now major customers (Singapore Airlines, Emirates)**
- **Variety of offset arrangements have opened up new market opportunities, tied to increased sourcing (e.g., from China)**



Increased Global Outsourcing-2

- **Boeing -- 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 workshare (with subsidy from Japanese gov’t -- \$3 billion)
 - 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 program
- **Airbus -- relative newcomer to Japan & China**
 - In Japan -- facing difficulties in winning orders from Japanese airlines, but has contracted work with Japanese suppliers
 - In China -- sales 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/yr by 2010; announced Tianjin will be site for Airbus’ first final assembly plant outside Europe



The Emerging “Unique” 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**



Key Features of the Emerging “Unique” Boeing Model

- **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 (revenues above amortized costs of non-recurring investments based on initially-agreed-up expected unit sales volume)**
- **Major partnering suppliers (e.g., Hamilton-Sundstrand), with big “chunks” of the aircraft, 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) are 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 -- Some Concluding Observations

- **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 (component level) 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 Power8 “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



Long-Term Strategic Implications

- **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 -- aerospace supply chains are 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**