WWJMRD 2025; 11(06): 44-47
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor SJIF 2017: 5.182 2018: 5.51, (ISI) 2020-2021: 1.361
E-ISSN: 2454-6615

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Supply Chain Challenges in Commercial Aircraft Manufacturing

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Abstract
Supply chain problems not only arose from the vast distances among suppliers located in different countries, but issues of communication developed that made it difficult to coordinate the activities of all these diverse manufacturers. Natural disasters, shipping problems and geopolitical tensions contributed to delays. Rising trade barriers disrupted the supply chains as components moved back and forth among suppliers and eventually to final assembly. Further complications arose when suppliers were not capable of meeting the specifications for the components and the timelines assigned to them.
Supply chain disruptions challenged manufacturers' ability to deliver planes on time. Aircraft manufacturers struggled to find engines and other components. Delays in aircraft deliveries left airlines without planes, so they continued to fly older less efficient planes.
In addition to the supply chain disruptions, the aircraft manufacturers contributed to their own problems. Fuel leaks, smoke in the cabin, fires and crashes plagued manufacturers and led to aircraft groundings with concerns over performance, reliability and safety. Airlines suffered groundings and delayed deliveries. Groundings continued until it was determined what caused these problems. This led to supply problems for the airlines since planes were not arriving and existing models of those planes were grounded. Airlines continued flying older jets that were not as fuel efficient and cost more to operate. Aircraft manufacturers incurred financial penalties tied to the delays. In addition, manufacturers covered the costs associated with fixing the problems once the planes were certified to return to service subject to fixing the problems.
The tariffs and other trade barriers imposed by the U.S, on imports during the 2025 trade war caused more disruptions to Boeing's supply chain than to Airbus. Tariffs, reciprocal tariffs, retaliatory tariffs, and trade barriers impacted Boeing's sales in the global market. Even though Boeing planned to navigate the trade war through a variety of measures, the future offered many challenges for Boeing.

Keywords: outsourcing, supply chain, manufacturing, duopoly

Introduction

Commercial Aircraft Market

Consolidation was necessary to improve the prospects of commercial aircraft manufacturers. While the future looked bright for commercial aircraft manufacturers, they encountered obstacles that hampered their ability to capitalize on the opportunities presented to them.
Supply chain disruptions challenged commercial aircraft manufacturers' ability to deliver planes on time. Delays in aircraft deliveries left airlines without planes, so they continued to fly older, less efficient planes, raising operating costs. Manufacturers paid financial penalties for late deliveries of aircraft.

Boeing Merger

Boeing merged with McDonnell Douglas on August 4, 1997 (Skapinker 1997). Problems for Boeing continued as they focused on maximizing short-term profits rather than investing in design and development as they shifted to outsourcing to decrease costs, took advantage of specialized skills of subcontractors, satisfied local content requirements, and shared risks associated with product development.
Eventually, consolidation in the commercial aircraft industry led to a duopoly with Airbus and Boeing as the dominant manufacturers in all areas of commercial aircraft manufacturing except for the manufacture of regional jets until Airbus acquired the regional jet

manufacturing operations of Bombardier.
eventually Extensive outsourcing contributed to supply chain problems that impacted Boeing's performance with numerous suppliers distributed all over the world. Supply chain problems not only arose from the vast distances between suppliers, but communication issues developed that made it difficult to coordinate the activities of all these diverse manufacturers. Natural disasters, shipping problems and geopolitical tensions also contributed to delays and disruptions. In addition, rising trade barriers disrupted supply chains as components moved back and forth among suppliers to final assembly. Further complications arose since many suppliers were not capable of meeting the specifications for the components and the timelines assigned to them.

Boeing 787 Dreamliner

Outsourcing for the 737 and 747 was 35-50 percent respectively. Boeing increased outsourcing for the 787 to 70 percent (Hiltzik 2011).
The lack of reliability among the subcontractors disrupted the supply chains and contributed to delays in the manufacturing process. Furthermore, the inability of suppliers to develop and produce the specified components contributed to supply chain issues and reduced Boeing's competitive advantage as the aircraft's performance did not meet expectations. The 787 suffered from fuel leaks, smoke in the cabin, and fires, that led to its grounding until the sources of the problems were identified, solutions were determined, and corrections were made so the plane could be certified to re-enter service. These issues were not the outcome expected by Boeing and the airlines that were either flying the 787 or those waiting to receive the planes they ordered.
Boeing did not maintain tight control and failed to monitor the overall design and engineering of the 787. It did not thoroughly review suppliers to determine whether or not they possessed the capabilities to develop and deliver the specified components consistent with stated specifications within the required timelines, at the expected quality, and at the agreed upon cost (Hiltzik 2011).
Supply chain disruptions cost Boeing significant financial penalties and discounts on future sales. Boeing lost its competitive advantage in the commercial aircraft industry.

Fukushima Daiichi Nuclear Disaster

The Fukushima Daiichi nuclear disaster occurred when the nuclear power plant was hit by a tsunami triggered by the magnitude 9.0 Tōhoku earthquake (Einhorn, Culpan and Ohnsman 2011).
Suppliers in the region shut down until the damages from the nuclear disaster, the earthquake, and the tsunami were assessed and repaired. Japanese companies designed and supplied 35 percent of the content of Boeing's 787 Dreamliner (Einhorn, Culpan and Ohnsman 2011).
The Fukushima Daiichi nuclear disaster and related events impacted many of Boeing's suppliers. This led to delays in delivery of components for the 787 Dreamliner and caused significant problems for airlines that placed orders for the 787. These supply chain delays cost Boeing significant financial penalties and further discounts on the 787.

Dreamliners Grounded Globally

While Boeing scheduled the first 787 delivery in 2008, a string of supply chain delays and cost overruns pushed deliveries into 2011. However, problems continued to plague Boeing and the 787. An empty Japan Airlines 787 caught fire while parked at Boston's Logan Airport in January 2013. A second battery incident that occurred nine days later led to an emergency landing in Japan. The Federal Aviation Administration (FAA) grounded the entire Dreamliner fleet for three months until it accepted Boeing's proposed modifications to the lithium-ion battery system (Cooper 2013).
The grounding caused additional problems for Boeing that further hurt its competitive advantage as it was forced to pay substantial financial penalties because of late deliveries and to provide deep discounts to maintain existing 787 orders and attract new customers.
After it persuaded regulators that the redesigned batteries did not pose a hazard, Boeing focused on reassuring airlines and fliers that the plane was safe and reliable (Pasztor 2013). In addition to financial penalties, repair costs, and discount repercussions, the grounding caused damage to Boeing's reputation and its competitive advantage.

Supply Chain Problems

Executives cited supply chain delays, labor shortages, and inflation as Boeing underperformed rivals (Cameron 2016).
Boeing and Airbus suffered delays for engines as well as components used to make wings and fuselages made by Spirit AeroSystems Holdings Inc (Wall and Cameron 2018).

Boeing 737 MAX

Global regulators grounded the Boeing 737 MAX after two fatal crashes. Investigators blamed a flight-control system in the aircraft that led to the crashes in Indonesia (October 2018) and Ethiopia (March 2019) that killed all 346 people on the two flights (Cameron and Tangel 2019).

More Boeing 787 Dreamliner Delays

Boeing paused deliveries of 787 Dreamliner aircraft in May 2021, due to production quality issues (Johnston 2022). Boeing discovered small gaps where aft, or rear, sections of the plane joined together. Although the gaps did not pose immediate safety-of-flight issues, they did not meet Boeing's engineering specifications. The presence of two defects in a certain location raised concerns about the plane's structural integrity in extreme flying conditions. Boeing voluntarily grounded eight aircraft in airlines' fleets late in 2020 (Johnston 2022).
In October 2020 Boeing halted production of the 787 after it found more flaws and reported the findings to the FAA. Boeing pushed its global suppliers to examine the 787 parts they produced. Suppliers found more problems, that meant more parts and planes needed to be examined and fixed. Boeing booked $5.5 billion in costs related to these problems (Tangel 2022).

Airbus

In 1970 three European companies France's Aerospatiale, Deutsche Airbus, and CASA of Spain formed Airbus Industrie based in France. Initially, it benefitted from significant government subsidies and a lack of attention from U.S. competitors. Fortunately, its first plane, the A300, offered attractive features that made it a success (Letovsky 2016).

While Boeing's problems persisted, Airbus thrived as it invested in its future. Airbus stood at the forefront of technological advancements in aviation. It pioneered fly-by-wire technology, which replaced mechanical flight controls with electronic systems, and enhanced flight safety. Airbus invested heavily in research that led to incorporation of state-of-the-art materials like carbon fiber reinforced polymer in aircraft structures, reduced weight, and increased fuel efficiency. Airbus focused on enhancing cabin features, offering improved entertainment systems, spaciousness, and comfort for passengers.

Airbus extended its lead over Boeing with a new, longer-range plane: the A321XLR, or "Extra Long Range." The XLR debuted in 2017, with a flying range longer than any single-aisle plane on the market. It burned 30% less fuel per seat than previous-generation aircraft (CNN 2025).

Airlines lined up for the XLR. It offered the opportunity to fly routes to cities unable to support wide-body twin aisle aircraft that were common on transatlantic flights. Airlines needed more efficient planes to reduce costs and increase flying range. Airbus built an XLR supply chain that reduced manufacturing and assembly costs, offloaded financial risks to suppliers and satisfied local content requirements to sell planes in foreign countries (CNN 2025).

The 2025 trade war accelerated risk for the XLR since it impacted its supply chain and sales in foreign countries. Airbus avoided tariff impacts on its supply chains as it moved final assembly of some XLRs w to China and the United States where it operated production facilities. Supply chain disruptions challenged Airbus' ability to deliver planes on time. The biggest obstacle was jet engines. Disruptions must be avoided for the XLR to be a success despite all of its positive features.

Aviation Battle with China

China's state-owned aerospace manufacturer, COMAC, was central to the "Made in China 2025" strategy. COMAC developed a narrow-body jet, the C919, to compete with the Airbus A320 and Boeing 737 families. China partnered with Russia to build a wide-body aircraft, C929, for long-haul routes. The C919 was significantly inferior to the A320neo and 737 MAX in every respect even though the 737 Max was plagued by numerous problems (Sindreu 2021).

Since C919 relied on the same suppliers as Airbus and Boeing for its components, COMAC was subject to the same supply chain disruptions as Airbus and Boeing. Furthermore, expanded COMAC production led to more stress on the supply chain and created more challenges in commercial aircraft manufacturing.

2025 Global Trade War

Boeing and Airbus along with their suppliers worried that new trade barriers increased plane manufacturing costs since parts were sourced from numerous suppliers across the globe. Since manufacturers sold more planes outside of their domestic markets, any trade barriers caused potential supply chain disruptions and impacted profits (Tangel and Wall 2018).

The trade war added costs and disrupted the supply chain. These disruptions added to the costs of airplanes and led to reduced sales which damaged profits and impacted development of the next generation aircraft. Given that the supply chain for components and jet engines was at the breaking point, it was not easy for aircraft manufacturers to switch suppliers to reduce the impact of the trade war.

COMAC's leading commercial aircraft model, the C919, depended on critical technology from U.S. firms. If China stopped buying components from the U.S. in retaliation for U.S. tariffs on Chinese imports, the C919 program was likely to collapse. Likewise, it was possible for the U.S. to block sales of U.S. made components and jet engines to COMAC (Areddy 2025).

Objective

The resurgent air travel caught aircraft manufacturers and their supply chains off guard. This left suppliers of components and jet engines unable to increase production quickly enough to manufacture components not only for new aircraft but replacement parts for planes in service.

The 2025 Trade War that pitted the U.S. against virtually all nations was more harmful to Boeing than Airbus if the recipient nations retaliated against U.S. goods including commercial aircraft. Such retaliation raised the prices of Boeing aircraft relative to Airbus planes in international markets. All these measures added to Boeing's woes on top of its existing problems.

Supply chain problems continued to be among the top problems faced by commercial aircraft manufacturers. Some of the issues related to extensive outsourcing caused the firms to lose some of their dynamic capabilities. In addition, they failed to invest in their future rather than focusing on short-term profits. Some of the operating problems were caused by failure to monitor their suppliers and more thorough scrutiny in the selection process of suppliers. These problems must be addressed. Despite the short-term pain caused by the 2025 Trade War, it may offer an opportunity to resolve these problems over the long term.

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