About Boeing X-32

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Abstract: The Boeing X-32 is a demonstration jet designed for the Joint Strike Fighter contest. He lost the Lockheed Martin X-35 demonstrator, which was further developed in the Lockheed Martin F-35 Lightning II. Boeing's competitive advantage has been to provide considerably lower costs of production and lifecycle by minimizing variations between different versions of the JSF. Therefore, the X-32 was designed around a delta wing of the carbon fiber composite. The wing had an opening of 9.15 meters, with a current of 55 degrees on the front edge and could have up to 20,000 kilograms of fuel. The purpose of the large inclination angle was to allow the use of a thick wings section while obtaining limited transonic aerodynamic resistances and a good angle for the corresponding antenna equipment installed in the wing. Wings would be a challenge to be done. The cost competition strategy also led Boeing to choose a direct traction vectoring system for the short-term STOVL landing requirement, as this would require the addition of a traction vectoring module around the main engine. However, this choice requires the engine to be mounted directly behind the cockpit and changing the center of gravity before being ordinarily positioned in the jets of the plane (behind the plane) to allow neutral movement of the attitude. Boeing proposed in the 1960s a supersonic fighter as a gravity motor with vector pushing nozzles, but never surpassed the images published in the aviation week. By comparison, Lockheed's entry showed, if not, a smaller version of the F-22 Raptor stealth fighter. The nickname of X-32, Boeing, was "Monica." However, another direct lifting selection effect was the chrome-air intake, similar to the Vought F-8 Crusader and LTV A-7 Corsair II. This was necessary to provide sufficient air for the main engine (to provide the force of support) during the zero speed horizon when it could not exploit the ram air pressure. A blow to the effect of this large input was the direct potential visibility of the compressor blades to the radar. Among the possibilities of attenuation were the variable moments designed to lock the received radio waves without adversely affecting the air flow.

Keywords: Boeing, Boeing X-32, Boeing Airpower Teaming System, British Airways, STOVL, Joint Strike Fighter

Introduction

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In 1996, the United States Department of Defense awarded Boeing a four-year contract for the Joint Strike Fighter (JSF) demonstration phase. The goal was to develop tactical for US Air Force, Marina and Marina, Royal Navy and Royal Air Force.

Boeing had to build conceptual demonstration aircraft to provide a community in operating, designing and manufacturing variants; with direct propulsion for the main engine (to provide the force of support) and making 66 flights over four months of testing. Boeing has assembled two conception plans, X-32A and X-32B, at the plant in Palmdale, California.

On September 18, 2000, the X-32A made the first flight from Palmdale to the airbase at Edwards, California. The X-32A demonstrated the conventional take-off and landing characteristics for the Air Force, making 66 flights over four months of testing. The flights validated the aircraft handling qualities for fuel refueling, weapons operations and supersonic flight.

The X-32B made the first flight on March 29, 2001. It carried out 78 four-month test flights, including a transcontinental flight from Edwards to Patuxent River Naval, Md. The aircraft successfully passed from and from STOVL Flight Mode using a straight line to redirect the direction from the nozzle cruise nozzle to the nozzles. The X-32B has demonstrated its ability to move and make vertical landings.

Flight trials concluded in July 2001, demonstrated that actual flight performance was accompanied by computer predictions, based on simulation years, an achievement that has not been achieved so far.

Although not selected for full JSF development, Boeing considered its involvement in the competition as a strategic investment. The program has produced many advances in stealth technology and in designing and manufacturing methods. These achievements have been applied to other Boeing programs, including the F/A-18E/F Super Hornet and the XCA-45A Unmanned Unmanned Vehicle or UCAV (Rulkov et al., 2016; Agarwala, 2016; Babayemi, 2016; Gusti and Semin, 2016; Mohamed et al., 2016; Wessels and Raad, 2016; Rajput et al., 2016; Rea and Ottaviano, 2016; Zurfi and Zhang, 2016a-b; Zheng and Li, 2016; Buonomano et al., 2016 a-b; Faizal et al., 2016; Ascione et al., 2016; Elmeddahi et al., 2016; Calise et al., 2016; Morse et al., 2016; Abouoaida, 2016; Rohit and Dirit, 2016; Kazakov et al., 2016; Alwetaishi, 2016; Riccio et al., 2016a-b; Iqbal, 2016; Hasan and El-Naas, 2016; Al-Hasan and Al-Ghamdi, 2016; Jiang et al., 2016; Sepúlveda, 2016; Martins et al., 2016; Pisello et al., 2016; Jarahi, 2016; Mondal et al., 2016; Mansour, 2016; Qadi et al., 2016b; Campo et al., 2016; Samantaray et al., 2016; Malomar et al., 2016; Rich and Badar, 2016; Hirun, 2016; Bucinell, 2016; Nabilou, 2016b; Barone et al., 2016; Chisari and Bedon, 2016; Bedon and Louter, 2016; Santos and Bedon, 2016; Minghini et al., 2016; Bedon, 2016; Jafari et al., 2016; Chiozzi et al., 2016; Orlando and Benvenuti, 2016; Wang and Yagi, 2016; Obaiys et al., 2016; Ahmed et al., 2016; Jauhari et al., 2016; Syahrrullah and Sinaga, 2016; Shanmugam, 2016; Jaber and Bicker, 2016; Wang et al., 2016; Moubarek and Gharsallah, 2016; Amani, 2016; Shruti, 2016; León et al., 2016; Mohseni and Tsvadardis, 2016; Abu-Lebdeh et al., 2016; Serebrennikov et al., 2016; Budak et al., 2016; Augustine et al., 2016; Jarahi and Seifilaleh, 2016; Nabilou, 2016a; You et al., 2016; Qadi et al., 2016a; Rama et al., 2016; Sallami et al., 2016; Huang et al., 2016; Ali et al., 2016; Kamble and Kumar, 2016; Saikia and Karak, 2016; Zefirino et al., 2016; Pravettoni et al., 2016; Bedon and Amadio, 2016; Chen and Xu, 2016; Mavukkandy et al., 2016; Yeargin et al., 2016; Madani and Dababneh, 2016; Alhasanat et al., 2016; Elliott et al., 2016; Suarez et al., 2016; Kuli et al., 2016; Waters et al., 2016; Montgomery et al., 2016; Lammarre et al., 2016; Petrescu, 2012b; Aversa et al., 2017 a-b, 2016 a-o; Petrescu and Petrescu, 2016, 2015 a-e, 2014 a-i, 2013 a-g, 2012, 2011, 2005 a-d, 2003, 2002 a-b, 2000 a-b, 1997 a-c, 1995 a-b; Petrescu, 2018, 2015 a-b, 2012; Petrescu et al., 2016, 2017 a-d, 2018 a-d; Petrescu and Calautit, 2016 a-b; Daud et al., 2008; Taher et al., 2008; Zulkifli et al., 2008; Pourmahmoud, 2008; Panirselvam et al., 2008; Ng et al., 2008; El-Tous, 2008; Akhesmeh et al., 2008; Nachiengtai et al., 2008; Moezi et al., 2008; Boucetta, 2008; Darabi et al., 2008; Semin and Bakar, 2008; Al-
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**Materials and Methods**

The Boeing X-32 (Fig. 1) is a demonstration jet designed for the Joint Strike Fighter contest.

He lost the Lockheed Martin X-35 demonstrator, which was further developed in the Lockheed Martin F-35 Lightning II.

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In 1993, the Advanced Defense Research Projects Agency (DARPA) launched the Light Aircraft Project (CALF). The purpose of the project was to develop a design that would allow the replacement of all US Air Force defense and attack aircraft including F-16 Falcon, McDonnell Douglas F/A-18 Hornet and Vertical / Land Flight Vertical (V/STOL) AV-8B Harrier II. At the same time, the Joint Strike Technology (JAST) project was launched. In 1994, the US Congress ordered the two to join the Joint Strike Fighter.

Many companies took part in the first phase of this project, which involved the development of aircraft concepts for deployment to the Department of Defense. On November 16, 1996, Boeing and Lockheed Martin received contracts for each to produce two "Concept Demonstration Aircraft" (CDA). Under the contract, these fighters were required to report departures and landings (CTOL), take-off and landing of the carrier (CV variant), short take-off and vertical landing (STOVL). It is also expected to include ground demonstrations of representative aircraft production systems, such as the Preferred Armament Systems Concept (PWSC).

A major deviation from previous projects has banned companies from using their own money to finance development. Each of them received $ 750 million to produce the two planes—including avionics, software and hardware. This limitation promoted the adoption of low production and assembly techniques and also prevented either Boeing or Lockheed Martin from bankruptcy in an attempt to win such an important competition.

The two X-32 models featured a delta wing design. However, eight months after the demonstration aircraft concept, the JSF's maneuverability and payload requirements were refined at the Navy's request and the Boeing Delta design failed to reach new targets. The engineers changed the design of the double plan (a Pelikan tail), which reduced weight and agility, but it was too late to change the aircraft. The demonstration of Boeing technology was considered sufficient.

On December 14, 1999, Boeing presented both designers at the Palmdale, California plant in front of 5,500 attendees. While the X-32A was due to appear, the launch of the X-32B was a surprise, as the construction of the last aircraft began three months after the first and was completed six weeks after the X-32A. Boeing has awarded STOVL the rapid construction of digital design and assembly methods. After the installation of Pratt & Whitney F119 in April 2000, the X-32A began small and medium taxi tests completed by the end of May.

Due to the heavy design of the X-32 delta, Boeing demonstrated STOVL and supersonic flight in separate configurations, the STOVL configuration requiring removal of the parts from the fighter. The company promised that their conventional design for the production models would not require separate configurations. Instead, the Lockheed Martin X-35 demonstration aircraft was able to move between the STOVL configurations and the mid-flight supersonic configurations.

The first flight of the X-32A (designed for CTOL and transport studies) took place on September 18, 2000, from the Boeing factory in Palmdale to the Edwards Air Base. The aircraft, piloted by Boeing test pilot Fred Knox, took a 670-foot slope before reaching 150 knots (about 280 km/h) at 8:00. Shortly after takeoff, a small hydraulic leak was discovered and the flight was cut from expectations from 30 or 40 minutes to 20 min. According to Knox, the tracking plan F/A-18 has called for "a lot of post-burners" to keep up with the X-32 in the initial stages. During the flight, the aircraft reached 3000 meters, reaching a speed of 200 knots (370 km/h, 230 mph) and reached an attack angle of 13°. Despite the shortened flight, approximately 80% of the planned test points were obtained. It was fed by a conventional F-22 derivative called F119-PW-614C.

Results

On March 29, 2001, the X-32B STOVL version made its first flight. The flight lasted 50 minutes when the plane flew from Palmdale to Edwards AFB. The flight was initially scheduled for the third quarter of 2000. A modified version of the 614C, known as the F119-PW-614S, powered the STOVL. In normal flight, the 614S was configured as a conventional turbofan after firing. However, in STOVL mode, a butterfly valve removes the exhaust gases from the base stream to a pair of traction vector nozzles located near the center of gravity of the airplane. Prior to these nozzles, a jet screen nozzle provided a cold bypass air sheet to minimize hot gas recirculation. Two pairs of pipes fed the rear nozzles and the front nozzles. The post-burner was not lit, with no gas flow, during the ascension. The X-32B made the STOVL flight in the same way as the AV-8B Harrier II with vector drainage. A smooth transition (between STOVL and Normal modes) was achieved by maintaining a consistent engine match, facilitated by the
control system algorithm, maintaining an effective area of stationary fixed nozzles. Thus, the engine did not know that different nozzles are open and closed to complete the transition.

In principle, the F119-PW-614S engine was a Direct Lift engine, while the Lockheed Martin STOVL team used a more complex and risky alternative, known as the F119-PW-611, which includes a remote fan with the shaft, engine. However, it generated more lifting force than possible only with direct exhaust gas. A successful design would have a higher payload and thus a longer range than a vectorized turbofan simply.

Verification of flights of two companies continued until July 2001.

On October 26, 2001, the Department of Defense announced that Lockheed Martin X-35 won the JSF contest (Fig. 2). The X-35 will be developed in the Lockheed Martin F-35 Lightning II.

The loss of the JSF contract to Lockheed Martin in 2001 was a major blow to Boeing, representing the most important international combat aircraft project in the 1960s and 1970s, which led to Falcon Fighting F-16 and F/A-18 Viespe. At that time, JSF production was estimated at anywhere from 3,000 to 5,000. Prior to awarding the contract, many MPs pushed the idea of keeping their competitors at the loss of subcontractors; however, the “winner takes everything” principle has not changed. However, Boeing believes that its X-32 activity is a strategic investment, generating important technologies that it embraced in the Boeing F/A-18E / F Super Hornet study.

The Joint Strike Fighter (JSF) is a development and acquisition program designed to replace a wide range of existing aircraft for wrestling, strikes and fights for the United States, Britain, Turkey, Italy, Canada, Australia, the Netherlands and the Allies. After a competition between the Boeing X-32 and the Lockheed Martin X-35, a final design was chosen based on the X-35. This is the F-35 Lightning II, which will replace the different tactical aircraft, including F-16, A-10, F/A-18A-D, AV-8B and British Harrier GR7, GR9 and Tornado GR4. The estimated average annual cost of this program is $ 12.5 billion, estimated at $ 1.1 trillion of the program’s life cycle.

The JSF program was the result of the merger between Common Journey Lighter Fighter (CALF) and Joint Alert Strike (JAST) projects. The merged project continued under the name "JAST" for Engineering, Production and Development (EMD), where the project became Joint Strike Fighter.

CALF was a DARPA program for developing a STOVL Strike Fighter (SSF) for the US Maritime Corps and F-16 Fighter Replacement. The US Air Force jumped over the Agil Falcon F-16 in the late 1980s, essentially an F-16 increase and continued to interfere with other models. In 1992, the Navy and Air Force agreed to jointly develop an accessible fighter, known as Advanced Short Takeoff and Vertical Landing (ASTOVL). The CALF project was chosen after Paul Bevilaqua convinced the Air Force that the concept of his team (if stripped of his lift system) had potential as a complement to the F-22 Raptor. In a way, the F-35B gave birth to the F-35A, not the other way around.

Fig. 2: Boeing JSF production mockup (Note the separate wing and tail planes)
The Joint Strike Technology Program (JAST) was created in 1993, implementing one of the recommendations of a state-of-the-art US Department of Defense (DoD) review to include the United States Navy in the Common Strike Fighter program. The review also led the Pentagon to continue the F-22 Raptor and F/A-18E/F Super Hornet programs, cancel the A/FX programs and reduce F-16 and F/A-18C/D 1994 for aviation; sensors to replace several US and UK planes with interrupted aircraft; most products would replace the F-16. Merrill McPeak, the former head of the United States Air ForceStaff, complained that Les Aspin's decision to force all three services to use a single aircraft significantly increased the costs and difficulties of the project.

In November 1995, the UK signed a Memorandum of Understanding to become a formal partner and agreed to pay $ 200 million or 10% of the demonstration phase of the concept.

In 1997, the Canadian National Defense Department signed the Concept demonstration phase with a $ 10 million investment. This investment has allowed Canada to participate in a rigorous and rigorous competitive process in which Boeing and Lockheed Martin have developed and competed for their prototypes.

Studies supporting JAST/JSF began in 1993 and led to STOVL presentations at DOD by McDonnell Douglas, Northrop Grumman, Lockheed Martin and Boeing.

McDonnell Douglas proposed a plan powered by a reheat ed turbine with a remote gas fan to lift the elevator in STOVL mode. Later, General Electric made a ground demonstration of this engine configuration.

The Northrop Grumman engine featured an amplified auxiliary lifting power of a dry turbofan engine equipped with a pair of vector pushing nozzles.

We did not have this engine configuration to drive the F135-PW-600, which operates the JSF F-35B production aircraft.

Boeing opposed growth in force. They proposed an aircraft powered by a re-heated turbocharger that could be reconfigured (in STOVL mode) in a direct lifting engine with a pair of traction vector nozzles located near the center of gravity of the aircraft. This led to the F119-PW-614S that powered the X-32B JSF demonstrator.

Two prototype development contracts were awarded on November 16, 1996, one at Lockheed Martin and Boeing. Each company produces two take-offs and landing (CTOL) take-off and landing (CV version) take-off and landing (STOVL). McDonnell Douglas's request was partially rejected due to the complexity of its design. Lockheed Martin and Boeing received $ 750 million to develop the concept of demonstration concept and to define a preferred weapon system (PWSC). It's not me, I am, also in 1996, the British Defense Ministry launched the Future Carrier Borne Aircraft project. This program sought a replacement for the Sea Harrier (and later Harrier GR7); Joint Strike Fighter was selected in January 2001.

During the definition, two Lockheed Martin X-35A plans (which were later converted to X-35B) and X-35C with larger wings were moved. Probably the most persuasive demonstration of the X-35's capacity as the Joint Strike Fighter students' flight studies where the STOVL X-35Bs took off in less than 150 meters, were supersonic and landed vertically - that Boeing's entrance failed.

The development and demonstration agreement of the system was granted on October 26, 2001, to Lockheed Martin, whose model X-35 beat the Boeing X-32. One of the main reasons for this choice seems to be how to get the STOVL flight and the Department of Defense said that high-performance ventilation systems deserve additional risk. When it was close to the ground, the Boeing X-32 suffered from the hot air problem in the exhaust gases that returned to the main engine, causing axle weakening and overheating of the engine.

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The United States Department of Defense and William Bach, the British Defense Minister, said the X-35 has consistently outperformed the X-32, although both have met or exceeded the requirements.

The development of the JSF will be jointly funded by the United States, Britain, Italy, the Netherlands, Canada, Turkey, Australia, Norway and Denmark.

Lockheed Martin X-35 will become the basis of the F-35 Lightning II, currently in production. On April 6, 2009, US Secretary of Defense Robert Gates announced that the US would buy a total of 2,443 JSFs.

On February 1, 2010, Secretary of Defense Robert M. Gates announced that due to delays and other issues related to the JSF development program, he removed Major General David R. Heinz from commissioning the program and has retained $ 614 million in bonuses from Lockheed Martin. On February 16, 2010, Deputy Secretary of Defense Bill Lynn announced that the program would be postponed by one year. Estimates suggest that overrun could increase program costs up to $ 388 billion, up 50% from baseline. Many of the
program's financial and technical complications result from the JSF Marine version, capable of taking off and landing vertically.

On March 11, 2010, the US Senate Commission for Armed Services investigated the progress of the JSF program during a meeting with Pentagon officials, highlighting the costs of a Nunn-McCurdy trial. According to the Government Accountability Office, the F-35A cost increased from USD 50 million in 2002, from 69 million USD in 2007 to 74 million in 2010, all measured in 2002.

Canada has revised its commitment to the project in December 2012 due to cost overruns. The decision was taken following a report by the KPMG audit firm that showed that the purchase by Canada would cost 45 billion dollars for 42 years. Defense Minister Peter MacKay announced Canada's plan to buy the F-35 in 2010, saying that "we have not been able to make a full assessment of all available aircraft," said Rona Ambrose, the purchase price was 9 billion but did not provide estimates of operating costs. During a 2011 election campaign, the Conservatives said the total cost of more than 20 years would be 16 billion dollars.

Concerns about F-35 performance were partly due to RAND Corporation’s simulation reports, in which three Sukhoi fighters in Russia defeated six F-22 refusals. As a result of these press reports, Australian Defense Minister Joel Fitzgibbon requested official information from the Australian Defense Department on simulation. This information indicated that the simulation reports were inaccurate and did not compare the performance of the F-35 with those of other plans.

Andrew Hoehn, director of the RAND project, made the following statement: "Recently, Australian media accusations from RAND Corporation’s game analysts have made no analysis of the war game with the F-35 Joint Strike Fighter and the game will not try to provide details explaining the air-to-air battle. " The RAND game and the RAND game do not compare the combat qualities of certain combat planes.

Moreover, it is said that Maj. Richard Koch, head of the US Department of Aeronautics Control, said: "I found myself in a cool sweat that the F-35 only goes with two-speed guns," says an extremely skeptical source. The F-35 would be 400% more efficient than the designers.

The experience of the JSF program has led to a more conservative and open schedule for upcoming vertical lifts.

Conclusion

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Acknowledgement

The work was appreciated by teams of professors from the departments of automobiles from several universities in Romania and Italy. This text was acknowledged and appreciated by Associate Professor Aniello Riccio SECONDA UNIVERSITA’ DEGLI STUDI DI NAPOLI Italy, whom we thanks and in this way.

Funding Information


Ethics

Author declares that are not ethical issues that may arise after the publication of this manuscript. This article is original and contains unpublished material.

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DOI: 10.3844/ajeassp.2016.1019.1026


DOI: 10.3844/ajeassp.2009.407.415


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DOI: 10.3844/ajeassp.2016.770.788


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Source of Figures:

Fig. 1: https://upload.wikimedia.org/wikipedia/commons/thumb/3/39/USAF_X32B_250.jpg/1024px-USAF_X32B_250.jpg

Fig. 2: https://upload.wikimedia.org/wikipedia/en/9/95/Boeing_JSF_X-32_on_tarmac.jpg