F-22 fighter aircraft essay

Business, Accounting

F-22 Fighter AircraftIntroductionThe Air Force’s latest combat aircraft, the F-22 is an air superiority aircraft with a capability to deliver air to ground weapons. It is a highly advanced low observable tactical fighter aircraft that will be the USIF frontline defence aircraft in the next century. Advanced technologies being developed for the F-22 makes it a very ambitious, challenging program. The most significant features include super cruise, the ability to fly efficiently at supersonic speeds without using fuel consuming after burners, low observability to adversary systems that have the objective of locating and shooting the F-22 and integrated avionics to significantly improve the pilot’s battlefield awareness.

1 The F-22 is designed principally for offensive counter air missions. Advanced technologies, including stealth, are intended to enable it to penetrate deeply into hostile airspace and shoot down threatening aircraft before they can detect the F-22. If detected, the F-22 has the countermeasures, speed and manoeuvrability that should minimize the likelihood of its being hit. Only a very small proportion of encounters are expected to result in closure to ranges at which enemy missiles or guns could be fired at the F-22. 2 Sensor fusion in F-22 also provides the pilot a high speed data correlation, excellent situational awareness, and1. Tactical aircraft restructuring of the Air Force F-22 fighter program, United States General Accounting Office, Diane Publishing, 19972. Live fire testing of the F-22, National Research Council (U.

S.) committee on the study of live fire survivability testing of the F-22 aircraft, The National Academies Press, 1995timely precise tactical action. Information from its integrated sensors includes thelocation of friendly, unknown, and hostile aircraft, threat identification, radar classification, missile launch detection, electronic countermeasures, and external data links.

Internal weapons and fuel of the F-22 provide less aerodynamic drag, more manoeuvrability, better fuel efficiency, and lower radar return. Its highly manoeuvrable with thrust vectoring and super cruise function. Short field operations and slow speed manoeuvrability are significantly enhanced by thrust vectoring (Crawford & Moon, 2000, p. 273). The F-22 avionics architectures is characterised as a common, modular, highly integrated system.

These characteristics result in increased performance, reliability, availability, and affordability. It is the first fully integrated avionics system in U. S. military aircraft. The F-22 does not employ traditional single function " black boxes" to perform basic avionic functions such as navigations, communications, threat warning, and fire control.

Instead these functions are implemented with common programmable modules which are software configured to process many different functions. These architecture not only allows increased mission effectiveness, but also allows significant flexibility in basic avionic designs through robust, fault tolerant reconfiguration capabilities, higher reliability, easier supportability, higher availability, lower weight, extended growth capability, and lower acquisition and life cycle cost (Spitzer, 2001, p. 32-3). History of F-22 Fighter AircraftThe F-22 is slated to replace the aging U.

S. fleet of F-15 Eagle fighters and was originally conceived as a counter to the agile Soviet aircraft in the 1980s. In 1985, the Air Force requested proposals for what was then named the Advanced Tactical Fighter (ATF) program.

The prototype F-22, the YF-22 flew for the first time on September 29, 1990. At the end of the 54 months demonstration, and validation, which involved design, construction, and flight-testing, the Air Force announced the winning team of Boeing, Lockheed Martin, and General Dynamics. The first flight of the F-22 aircraft occurred on 7th Sepember, 1997. The Air Force plans to procure 399 F-22s and production is scheduled to run through 2013 (Evans, 2003, p. 160). The P & W F119 –PW 100-production prototype first flew in 1997. The engine appeared to be experiencing relatively few technical difficulties during the F-22 EMD flight test program, especially in comparison with the F-100 and TF-30 programs. With Pratt & Whitney supplying the engines for both F-22 and all the JSF prime contractor contenders, concerns grew about the need to provide greater competition and continue support for GE, the country’s sole second source for high performance fighter engines.

In summer 1995, Congress directed the JSF joint program office to pursue a second engine source to maintain engine competition during production in the JSF program. In late November 1995, initial development contracts was awarded to P & W for an F-119 derivative and to a GE/Allison team for design studies for the YF 120 and F110 variants for the JSF (Younossi, 2002, p. 118). Contractual agreements with other companiesA team of companies headed by Lockheed Aeronautical systems and including Lockheed Sanders Inc, OIS, Kaiser Electronics and others are developing the F-22 aircraft. This contract was for engineering and manufacturing development of the F-22, and the awarded contract amounted to $ 9.

55 billion. Since the awarding of the contract, the value has changed and elevated to approximately $11 billion. During the contract period, the F-22 team is expected to complete the design of the aircraft, develop production tools, and build and test nine aircraft ready for flight and two more for ground testing. A contract worth more than $US 10 million, for the development and delivery of active matrix liquid crystal displays (AMLCDs) for the US Air Force F-22 Advanced Tactical Fighter Programme has been awarded to OIS Optical Imaging Systems Inc. OIS will develop and deliver the color AMLCDs over a three-year development and prototype programme.

3Another company who won a contract to produce composite parts of F-22 was Marion Composites. The contract is for different airframe parts, made from carbon fibre composite, including vertical stabilizer skins, chine assemblies and door assemblies. Delivery of these parts was scheduled to begin from December 2001 to 2005. The initial $22 million contracts from Lockheed Martin Aeronautics Co was for around 50 aircraft, with follow on potential of $ 135 million over the next years for an additional 289. 43. U. S.

Air Force F-22 displays contract awarded, Displays, Vol. 13, issue 1, 1992, pp. 634. Marion F-22 contract, Reinforced plastics, 2001, Vol. 45, issue 9, p. 16Life cycle of F-22The formal origins of F-22 can be traced back to its predecessor, the Advanced Tactical Fighter Program (ATF).

The U. S. Air Force Aeronautical Systems Divisions (ASD) released a request for information for concepts for an advanced tactical fighter in 1981.

However, the term " advanced tactical fighter" already appeared in a general operational requirements document issued to contractors in 1972, which pertained to a new air to ground fighter to complement the then new F-15 fighter. The time span from the original concept (1972) to operational status (2005) is thirty-three years, which is quite unbelievable. Even using the formal origin date of the F-22 of 1981, the time span is twenty-four years. What is amazing is the number of companies that competed for the contracts to design, build and manufacture the F-22 during these years. These companies who were competitors at the beginning later became alliance partners (Kuglin and Hook, 2002, p.

101). The F-22 program have not been achieved without cost and effort, with significant demands being placed on equipment suppliers to provide faster digital computers with more memory, higher bandwidth actuators and improved sensors (for both aircraft motion and air data). There has been continual pressure to improve the reliability of equipment, to allow reduced redundancy levels to cut weight and cost, while still achieving the required system availability and safety targets. At the system level, the redundancy management has had to become more sophisticated to provide an optimum fault tolerance by reliable fault detection, fault isolation and reconfiguration strategies. Monitoring functions have had to cope with increasing demand from flight crews, who need to be informed about the system status and who have to be supported by electronic checklist during flight. Various F-22 technical staff were in constant demand such as the maintenance staff for built-in-test functions, data loggers for failure reporting and diagnostics to reduce maintenance efforts and cost (Pratt, 2000, p. 11).

The DOD was particularly concerned about the F-22 and Joint Strike Fighter (JSF) programs, which together were to replace aircraft that accounted for 33 percent of all the Air Force's aircraft operating and support costs in 1999. The F-22 low rate initial production decision was scheduled for December 2000. The aircraft was designed without a specific top level operating and support cost requirement.

As its low rate initial production decision approached, the program office, the principle contractor and the Air Force cost analysis agency were trying to determine how much more or less the F-22 would cost to operate and support than the F-15 it would replace. Because the F-22 design was mature, there was not much opportunities to reduce its operating and support costs, yet these costs will continue for at least next 30 years. 5At the initial phase, the production version F-22 cockpit required seven AMLCDs. At the end of 1994, some 422 F-22's were built, which required some 3, 000AMLCDs, including spares. However, like all major weapon systems, the F-22 faced an uncertain procurement cycle and final numbers remained uncertain.

6 The F-22 uses large two5. Defense acquisitions: Air Force operating and support cost reductions needs higher priority, United Nations General Accounting Office, Diane Publishing, 20006. Assessing the potential for civil-military integration: selected case studies, Congress of the United States, Diane Publishing, 1995dimensional rectangular cross section nozzles to

vector thrust upward and downward. However, these large thrust vectoring nozzles with their thousands of moving parts areexpensive and challenging to design due to the extraordinary forces, temperatures, acoustic vibrations and the limited signatures that they are allowed to produce. Although several design approaches were explored in the laboratory, and on experimental flight test aircraft, the F-22's F-119-100 engine is the first production thrust vectoring nozzle. The Air Force and Pratt and Whitney have worked hard to control the cost and complexity of these nozzles. Opportunity is still there to enhance affordability, maintainability and simplicity in future generation mechanical thrust vectoring nozzles (Younossi, 2002, p.

32). The Air Force's F-22 program is fraught with continuing problems with assembly and delivery of development test aircraft and the flight test program. The Air Force extended the development test program, delayed the beginning of operational testing, and reduced the content of the test program. As a result, some additional development flight-testing is planned to take place concurrently with operational testing.

7 The F-22 program concurrency is high because the F-22 program is scheduled to proceed into low rate initial production well before any operational testing begins. Furthermore, the F-22 program contemplates a higher commitment as a percentage of total production prior to completion of initial operational testing than most modern fighter programs. 87. Major management challenges and program risks, Department of Defense, GAO, Diane Publishing, 20038. Addressing the deficit budgetary implications of selected GAO work for fiscal year 1998, Diane PublishingEven though F-22

development began in 1991 and flight-testing began in 1997, a significant amount of testing remains prior to the completion of flight-testing in 2002 and the planned completion of development in 2003. The Air Force through 2002 said that they have satisfied 9 of 11 criteria for awarding a contract for low rate production. However, several of the criteria required the initiation of certain test, not successful completion of a significant amount of testing.

Accordingly, substantial amount of testing must yet be accomplished before the capabilities of the F-22 will have been fully demonstrated. 9 The table below show the additional testing required to demonstrate F-22 capabilities: Table 1 Additional testing required to fully demonstrate F-22 capabilitiesCriteria for awarding a contract for low rate initial productionEstimated completion date at start of 2000Actual completionAdditional testing required to fully demonstrate capabilityInitial high angle of attack testing with weapon bay doors openJuly 2000August 2000Over 90 percent or about 40 flights to be completed by mid 2002Initiate fatigue life testing with goal of completing 40 percent of first fatigue lifeAugust 2000December 2000Four lifetimes to be completed in approximately 3 yearsInitiate separation testing of AIM-9 and AIM-120 missilesNovember 2000October 200032 AIM-9 and 30 AIM 120 separation tests extending into 2002Initiate radar cross section flight testingAugust 2000January 2001143 hours of flight testing remain with schedule completion in at the end of development testingComplete avionics block 3. 0 first flight, initiating testing of unique functionalityNovember 2000January 2001Block 3 scheduled to be tested through spring 2001, plus a total of 1970 avionics flight hours remainingSource: GAO analysis of Air Force DataStudies conducted by F-22 System Program Office (SPO) and other organization show that OPP problem is serious for new systems now under development, even if they designed from the beginning to incorporate commercial grade parts.

This problem has been evident for sometime on F-22 fighter program. Hundreds of parts have been identified that are already unavailable or will terminate production in the coming years. Scores of parts had become unavailable before the first flight of the first EMD prototype in September 1997. Most of these commercial off the shelf parts become completely unavailable. The OPP problem means that avionics modules and components of the F-22 may have to be redesigned several times during and after production to incorporate new types of parts to keep avionics system operable (Lorell, 2000, p. 87). Another problem encountered is that the F-22 raptor seemed far too expensive for foreign export and its technologies much too advanced to share elsewhere.

However, there is possibility of reduction of price, given an adequate production run. At the same time the plane’s qualities gave Air Force squadrons capabilities of a much larger force of aircraft. The raptor promised not only clear air-to-air superiority, but also superb air-to-ground capabilities with advanced precision-guided munitions. But the Air Force’s preferred fighters for the new millennium, the F-22 is continued to be plagued by the major issue of cost (Bilstein, 2001, p. 338). 9. Tactical Aircraft DOD needs to better inform Congress about implications of continuing F/A22 cost growth, GAO, Diane Publishing, 2003ConclusionAlthough government have good intention, it may not have adequate incentives to implement a policy of continuous technology insertion during the support phase of the lifecycle of F-22. A policy of continuous insertion implies the necessity of new R & D, which means new development costs and new technological risks.

A private contractor has the financial incentive to take on such costs and risks because they can result in more reliable lower cost modules. The Government has no such incentives to motivate taking the risk of technological failure and increased R & D expenditure. However, the DOD and its contractors need to adopt a more commercial like approach to weapon system acquisition, like F-22. It may be necessary for DOD to grant configuration control and change authority to contractors, at least at the sub-system and parts level, throughout the life of the system. The DOD may also benefit from adopting the best commercial firms to minimize the risk of inadequate product performance and excessively high costs. Currently pilot programs are constantly being tested and implemented to avoid high performance failure and to meet the cost objectives (Lorell, 2000, p.

90). The Air Force restructuring program for F-22 indicates that the projected cost are optimistic. The planned reductions in F-22 production unit costs are greater than achieved on prior fighter programs and the initiatives to reduce the production cost are not fully developed yet.

According to DOD officials, the F-22 unit cost reductions are the result of production cost reduction business plans for the tier I and tier II initiatives. However, no configuration changes, except for safety of flight changes were made during LRIP of the first 70 aircraft. However, by not making configuration changes in the first 70 aircraft, thelikelihood of cost growth in the first full rate production lot has increased. 10Hedging against future threat requires the U. S. to maintain selected, critical elements of combat power. In reduced numbers, the F-22 may qualify in this category if the USAF is to maintain its current edge into the first part of the next century. Though fewer usually means more expensive, a life cycle cost analysis of the F-22 may reveal that fewer, more capable F-22's which require less support by escorts and tankers and fewer people to operate them are not prohibitively expensive (MacGregor, 1997, p.

203). To conclude, we need new and technologically superior fighter plans to replace the ones that are wearing out. The F-22 raptor, though expensive is a magnificent airplane with next generation stealth technology and there is necessity indeed to incorporate it to the Defense arsenal and make U. S. air power a mightier force to deal with. 10.

Tactical aircraft restructuring of the Air Force F-22 fighter program, U. S. General Accounting Office, Diane Publishing, 1997ReferencesBilstein, R. E.

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