



The 11th International Scientific Conference
“DEFENSE RESOURCES MANAGEMENT
IN THE 21st CENTURY”
Braşov, November 10th -11th 2016



**AN EVALUATION ON F-35 JOINT STRIKE FIGHTER:
TURKISH PERSPECTIVE**

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Abstract:

Turkey as well as Italy, the UK, Canada, the Netherlands, Norway, Australia, and Denmark is a member of consortium to produce next generation fighter. Since JSF as the future king of aerospace fighters enhances Turkey's aerospace competition, Turkey attaches great importance to the program. Because the program is also promising to promote domestic base as well as to create employment, improve trade balance, promote innovation, and provide off-set. To this end, the study aims at revealing issues regarding political, economic and social grounds.

Key words: JSF Program, Aerospace, Turkish Aerospace Industries, Turkish Air Force, F-35.

1. Introduction

Turkey was awarded partnership in the JSF program on 12th July 2002, joining the existing members Italy, the UK, Canada, the Netherlands, Norway and Denmark. Five years later, Turkey signed a MoU concerning its participation in the production of the JSF program. Contrary to the F-22, JSF was designed for export market from the outset. Joint involvement in the F-35 program development as well as sales was dynamically sought after alleviating some of the expenses incurred in aircraft design and production. A total of 8 countries (Turkey, Italy, the UK, Canada, the Netherlands, Norway, Australia and Denmark) pledged an average of \$4.5 billion to join the program during the primary System Development and Demonstration (SDD) stage [1]. Furthermore, all partners consented to sign successive “Production, Sustainment, and Follow-on Development” (PSFD) MoUs, delineating their willingness to procure the aircraft [2]. The Turkish Air Force initially planned to purchase a total of 116 F-35As at an estimated value of \$11 billion [3].

The significance of remaining in the program for the subscribed nations is motivated to have adequate state security in order to defend homeland and allies from external threats. Lack of considerable national security would mean inadequate guidance on handling the concerns relating to national security and foreign policy. Besides the significance to national security, air dominance is also another key aspect that requires continuous improvement. This study, therefore, aims to reveal that aerospace dominance is an essential approach to tactical national security, where highly competent weapons are required. There is also a scarce literature investigating the significance of sophisticated

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weapons for Turkey as an approach of maintaining its escalating dominance in security. Modernization, therefore, remains the pathway to achieving universal peace, strength and security.

Back in 2009, Turkey considered procurement of 120 F-35 aircrafts rather than procuring Euro-fighter Typhoons. The plan initially was to have the F-35 produced under Turkish license by Turkish Aerospace Industries (TAI), one of the two global vendors to Northrop Grumman (whilst Terma being the other supplier) [2]. Both Northrop Grumman and TAI signed a LOI back in 2007, assigning TAI the other producer of the F-35 center fuselage. TAI's production of the center fuselages was highly dependent on the quantity of F-35s procured by Turkey as well as the quantity of F-35s produced globally. By 10th of Dec 2007, Northrop Grumman approved TAI to commence manufacture of main doors as well as the multiple parts of the initial two F-35 production aircraft. These parts are engaged in the F-35 center fuselage, a key area of the aircraft under Northrop Grumman's production, a prime member of the "Lockheed Martin-led F-35" universal sector team [4]. F-35 center fuselages are presently being produced by Northrop Grumman at its F-35 assembly point located in California. As of 2013, F-35s were being assembled by TAI under Lockheed Martin Corporation's license, just as stipulated in the case for the F-16 program [5].

As of January 2011, Turkey had already indicated its profound interest being involved in the F-35 program, as well as procuring the aircraft. However, the political conflict between the United States and Turkey led the former to refuse to have the components shipped, resulting in a delay of the shipment, quoting Turkey's relations with Israel as making the procurement plans non-feasible. Therefore, in addition, the escalating costs associated with the F-35 program compelled Turkey to consider creating its own fighter, rather than being a part of joint program [6]. Nonetheless, Vecdi Gonul, National Defense Minister, argued Turkey's intention to procure up to 116 of the JSF. Turkey, however, showed its loyalty to the Lockheed Martin partnership more than two and half decades, starting with "F-16 Fighting Falcon aircraft." Currently, this partnership is still strong upon joining the F-35 program at the SDD stage.

Like other partners, Turkey has raised concerns over the refusal by the U.S. to share the F-35's software source code [7]. Back in March 2011, Turkey announced that it was putting its order for 100 jets on hold, quoting the existing concern over the United States' denial of access to the source code [8]. According to the Minister of National Defense, negotiations focusing on access to the F-35's source codes, including codes used in the aircraft's remote control, had not produced "acceptable results." It was later suggested by Turkey that the costs associated with the program could be reduced by outsourcing additional production to local aerospace firms and Turkish defense contractors, operating at minimal labor costs as compared to the States and the other partners [9].

Notwithstanding the software disagreement, Turkey consented to technically order two F-35 aircrafts in early 2012 [10][11]. Unfortunately, this articulation was called off at the Defense Industry Executive Committee (DIEC) conference in early 2013, citing technical issues with the aircraft as well as concerns over the escalating expenses [12]. The first F-35 aircraft delivery was scheduled in 2017, with Turkey approving its first order of 2 F-35 aircrafts in May 2014, subsequent to a 15-month holdup [13]. Upon their employment in 2018, Turkey is scheduled to receive a delivery of 10 aircrafts on an annual basis, having ordered a total of 100 F-35s. As of 1999, Turkey has roughly invested \$195 million in the F-35 program with the entire program cost being projected at \$16 billion [14].

2. Partners in the Program

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The United States has, since the program started, remained as the key dominator of the program and the U.S. is being termed hegemonic. This has led other partners to fight this state, with Turkey and the United Kingdom aspiring to re-possess the technologies required for control of the F-35 fighters, but the States has remained firm on retaining the sensitive source codes, in addition to other technologies.

The United Kingdom is committed to procuring about 48 F-35Bs. As of now, the country has acquired an initial 3 aircrafts with a probability of acquiring 14 more, with the Royal Air Force pilots undergoing further training at the Eglin Base facilities. The average expenditure for the training process is expected to range within \$5 billion dollars.

The Netherlands Parliament had given a green light in the procurement of 37 F-35As for a cost of 4.5 billion Euros in November 2013. With respect to the harmony between Rome and Amsterdam, Cameri would be the venue for assembling the Dutch aircraft.

Denmark intended to procure a total of 25 to 30 aircrafts. Despite participating as a founding partner, the Government of Denmark often expressed its execution of an aggressive tendering process in having their F-16 aircrafts replaced accordingly. The key prerequisite of the order is the growth in jobs for the nation. Besides the F-35, further competition has been evident in the Saab JAS-39 Gripen NG, Eurofighter Typhoon, as well as the Boeing F/A-18E/F Super Hornet.

The Government of Norway is among the curtailing supporters of the F-35 program. The state initially intended to procure 52 aircrafts, with the delivery of the first 16 being projected by 2017.

Since the start of the F-35 project, Canada has remained a key member and considered an initial purchase order of 65 F-35As. Back in 2012, the local “Corte dei Conti” offered a report that strongly criticized the procurement procedure considered by the state, since it had engaged a selection procedure with one vendor. Due to this, Canada has since then instigated a novel approach of competitive assessment that considers the competence of F-35 as higher than that of the Dassault Rafale, the Eurofighter Typhoon as well as the Boeing F/A-18 E/F Super Hornet.

Australia considers the procurement of a total 100 F-35As. The initial 2 aircraft were scheduled for delivery and delivered back in 2014. Later on, an order of 12 more aircraft was due to be delivered. Recently, the F-35 project has attracted more nations in addition to the inventive project associates. These countries are considered as “foreign clients” and they are required to order the aircraft specifically via American Government transaction channel concerning weapon systems for FMS (foreign military sales).

3. Turkish Perspective

3.1. Turkish Contribution

The main reason for Turkey to seek partnership in the F-35 consortium was its aspiration to gather the expertise and higher technologies to come up with a valid Turkish combat aircraft [15]. By 2023, the state aims to replace the aged F-16s with this high-level fighter aircraft, designed and produced either jointly or indigenously. This objective was announced by Turkish government back in December 2010 while launching the country’s TF-X initiative to devise, create and manufacture an indigenous fighter aircraft [16]. Turkish objectives explain its readiness to engage in cost overruns in the JSF program, provided these overruns are paid off by local work-share, totaling 50% of the worth of Turkey's F-35 orders [17]. Here, it is possible to speak of a trade-off between jobs and the transfer of know-how, which can and does open up another level for politics. The other key reason compelling Turkey’s partnership in the F-35 program is the fact that the program is capable of offering international prestige.

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Just as important to the Turkish government, Turkey's position in the program, with the key global superpowers, is an affirmation of the state as a regional superpower as well as its capacity to integrate with the international powers – an ambition that the government of Turkey has often communicated [13]. Furthermore, the condition that the defense sector in Turkey will obtain state work-share amounting to roughly \$7 billion is a clear indication that Turkey's Defense Ministry holds a significantly high level of capacity and knowledge. Last but not least, Turkey did acquire sufficient knowledge from its participation in the F-16 program that engaging in defense programs early comes with significant benefits [2]. Turkey's hesitations throughout the negotiation period of the JSF program should be associated with Turkey's opposition to U.S.-Turkey relations, rather than opposition to the JSF program. The main concern and most compelling factor was the pursuit of enhanced local work-share (i.e. off-set) as far as the Turkish defense sector was concerned. Turkish relations with the United States during Iraq's invasion by the U.S. deteriorated hugely, while relations with the UE partners were getting better. It was during the aftermath of the announcement that Turkey considered the Euro-fighter Typhoon as a key substitute for the F-35, hence aiding Turkey to obtain 3.5 billion value of local work-share – a quantity considered inadequate by the Turkish government, whose officials later worked tirelessly to augment this figure to \$5 billion, later \$7 billion. This means that Turkey's involvement in the F-35 program has been very vulnerable.

3.2. Turkish Gains

3.2.1. Industrial Gains

The pros and cons of F-35 technology seem to be identical across associate countries. What comprehensively sticks all the 8 partners to this project is the aspiration for progressive military innovation, profitability, defense jobs, as well as the country's status. On the other hand, frequent media reports concerning the project uncertainties, affordability and schedule failures tend to diminish the enthusiasm of the partnership. As anticipated in democracies, debates concerning F-35 have been extensively politicized globally; however no tangible benefits or profitability levels have been associated with this politicization. Even the most penetrating reports that have circulated with procedural and technical concerns – for instance disagreement by Canada concerning costs of opportunity – have placed great emphasis on non-defense prerequisites.

With the design of this program being defined by uneven inter-reliance, so that non-United States associates possess little negotiating power, these other nations hold extremely low or no power on the product's specification. Both Turkey and the United Kingdom have endeavored to re-possess dominion over the technologies required to control F-35 fighters, but the United States has remained firm on retaining the sensitive source codes, in addition to other technologies. Such a result cannot be unforeseen, either from a historical or theoretical perspective. Schedule and price overruns had previously affected the production of the stealth jet, although not being critical. The dynamic relations among reductions, delays and costs, more so opposing the backdrop of recurrent face-offs, will define the next occurrence, although all political pointers indicate that the present phase of the project cannot fail. After investing heavily in the program's development phase, all partners have a reason to facilitate the procurement, regardless of the prices going beyond the expectations.

With frequent technological faults, delays, and escalating budget costs, the F-35 program has achieved some notable milestones since its start. Lockheed Martin was given the mandate to establish and create the F-35 fighter, expected to be the largest possession program globally (Gertler, 2014). Creation of the F-35 fighter engine system was to be handled by "Pratt and Whitney and General Electric" (Gertler, 2014). Currently, the

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program has not only facilitated innovation but also established more than 125,000 jobs in the U.S. alone, and other partners, as well providing jobs in the following areas: general engineers, program management, program analysts, contracts specialists, finance analysts, business analyst, and cost value analyst among others.

The aircraft is designed to exhibit a minimal radar cross-section as a result of the aircraft's shape as well as the utilization of stealthy, radar-absorbent construction parts like fiber-mat. Contrary to earlier generations of fighters, the F-35 was intended for extremely-low-observable qualities. Reduction measures of visual signature and infrared are among the integrated security measures [18].

In an acoustic study engaged by Lockheed Martin, to compare the noise levels among F-35 and previous versions of fighters, it was realized that replacing the F-16 replaced with the F-35 subjected residents to above 21 times the level of noise. The JSF program office realized back in 2014 that take-off noise by F-35B was merely two decibels higher than a super Hornet, typically not distinguisher by human ear [19].

The F-35 fighter has been devised in a manner that maintenance will be conducted at ease, having close to 95% of replaceable parts in the field [20]. A number of Turkish aerospace firms have been offering Turkey support in developing F-35 as the future king of aerospace fighters, hence enhancing Turkey's aerospace competition. **Alp Aviation** has shown great support to F-35 program since 2004 and presently manufactures F-35 landing gear structures, airframe parts, as well as titanium incorporated engine rotors. **Aselsan** is manufacturing methods for advanced optical parts, which are integral to the F-35 "Electro Optical Targeting System". The company is equally collaborating with Northrup Grumman towards commencing complete production operations in the near future. **Ayesas** is presently the only source vendor for two key F-35 parts – the panoramic cockpit display and the missile remote interface unit. **Fokker Elmo** creates about 40% of the F-35's EWIS (Electrical Wiring & Interconnection System) as well as being expected to assist TAI with the entire central section wiring scheme. **Havelsan** has also offered great support, particularly in F-35 training since 2005. Furthermore, this company is active in constructing the future Turkish F-35 aircraft ITC (Integrated Pilot and Maintenance Training Center) and affiliated systems in Turkey. **Kale Aerospace** has shown deep support for the F-35 program since 2005. In collaboration with TAI, they assemble and produce F-35 airframe structures and components. The company also sustains Heroux Devtek as the key source vendor for all the 3 variants of landing gear lock assemblies. Furthermore, Kale Aerospace has instituted a partnership in Izmir with Pratt & Whitney in order to come up with engine's production hardware. MiKES too has shown its support for the F-35 project since 2004 as well as delivering components and assemblies for F-35 aircraft to Northrup Grumman and BAE systems. **TAI** has shown a strategic support for F-35 project since 2008. Presently, TAI supplies production hardware towards assembling and producing aircraft. In partnership with Northrup Grumman, TAI is up to task in manufacturing and assembling the central fuselages, creation of weapon bay doors and composite skins, as well as creation of fiber placement multiple air inlet ducts. TAI equally embodies the organic depots of TAF within Autonomic Logistic Global Sustainment system.

3.2.2. Military Gains

The present study engages previous qualitative studies in assessing the best solution to offer for the problem of Turkish Air Force capacity. Based on a number of qualitative studies reviewed, the following outcomes have been reached.

3.2.2.1. Time is money

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The Turkish Government, just like other members, has committed huge amounts of money in implementing this program. The rate of delivery and cost overruns has controlled the program debate, where a significant number of researchers have considered this project as time wasting and highly expensive [6]. It is evident that no government can afford the comfort of arguing that the project is cheap to maintain. The F-35 program has been hobbled by several twists hence hampering its production, hence in one way slowing the economic growth, regardless of the huge benefits associated with the program's success.

3.2.2.2. Training and Flight Simulator

This program has seen training of pilots in an enhanced technique with a possible range of 1500 to 3000 hours of flight training as F-35 fighter aircraft pilots. Due to less experience with these types of aircraft, safety is considered a key concern.

It is necessary to ensure the best software manning the aircraft is achieved, by frequently upgrading the software. The simulator is characterized by a 360-degree field-of-view, replicating the exterior of the cockpit, as viewed by the pilot.

3.2.2.3. Integrated Logistic Support (ILS) and inevitable expenses and sustainability

ILS entails a cohesive and iterative technique, engaged in the establishment of materiel as well as a technical strategy utilized to optimize logistical and functional support [6]. This process is equally able to ease the F-35 system support by lowering the cost during its lifecycle as well as minimizing the need for logistics. This subsection therefore reviews the ILS as well as the inevitable expenses and sustainability affecting the establishment, lifecycle and efficiency of the F-35 aerospace fighter.

The ALIS (Autonomic Logistics Information System) offers F-35 operators the capacity to predict, preserve, plan and maintain the systems of the aircraft. ALIS offers the strength of information technology and competence to sustain present and prospective fighters globally. The F-35 program remains the very first strategic aviation scheme to entail sustainment components, constructed in unison with the aircraft to attain effectiveness and competence. ALIS coverts data from diverse sources into usable information, helping pilots, technicians and military personnel to come up with practical decisions to maintain the jets' flights.

3.2.2.4. Software development

Among the excellent abilities of the F-35 are its manifold lines of software code (8 million), considered four times safer than the level of the F-22 Raptor. Software is therefore highly important in the following ways:

- flight controls
- radar functionality
- communications, navigation and identification
- electronic attack
- sensor fusion
- weapons deployment

By May 2015, up to 97% of the needed F-35 software was in flight, with coding of 99.9% of the needed software being achieved. This means that close to about 10,000 lines of code are yet to be written.

3.2.3. Political Gains

Besides Israel, Turkey remains the only Asian nation to fly the F-35 aircraft, with its involvement being extremely high. TAF has considered the JSF program as an "important project" that is a "solid step to space." By fully integrating into the production

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process of the project, the Turkish economy is expected to significantly gain from the aircraft sales as well as establishing numerous job opportunities. The defense industry is equally expected to benefit significantly due to the competence of the fighter aircraft. From a comprehensive perception, Turkey will benefit in the following ways:

- Creation of F-35 brotherhood hence transforming the military capacity in Turkey
- Turkey will remain ahead in terms of Asian aerial supremacy

The United States will be forced to quit hegemony since the Middle East and Asia are gaining a number of partners in the F-35 program. The existing security setting in Middle East will be altered due to Turkey's dominance of F-35 aircraft in the region. Turkey will make large gains in terms of economic prosperity and defense sector. The project will also alter the fighting method by establishing a novel military hi-tech discourse in the present regional conflicts.

4. Conclusion

The significance of retaining the F-35 program lies within the ability for the subscribed nations to have adequate state security potential, in order to sustain and defend themselves and their allies from external threats. Lack of considerable national security would mean inadequate guidance in handling the concerns of national security and foreign policy. Besides the significance national security, air dominance is another key aspect that needs enhanced innovation. This study has confirmed aerospace dominance is an essential approach in tactical national security, where highly competent weapons are required. It has equally been confirmed that development of sophisticated weapons is crucial in order for Turkey to maintain its escalating dominance in security as well as its approach towards being a superpower. Modernization therefore remains the pathway to achieving universal peace, strength and security. As with other acquisition projects, the F-35 program has encountered a numbers of setbacks, such as hegemony by some states, budget costs, scheduling mishaps, as well as technological faults. This study realizes that these setbacks are not impractical. Several solutions to alleviate such challenges exist and include holding annual conferences among partners, enhancing communication within the program, embracing novel methods to counter the faulty ones. The key issues endangering the program include: software concerns, concurrency, high budgets, as well as scheduling errors. This research recommends for further research to examine production delays as well as the members' preparedness to handle the future threats.

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