

A Work Project, presented as part of the requirements for the Master Degree in Management  
from the NOVA - School of Business and Economics.

BEST OPTION FOR ALPHA-JET FLEET REPLACEMENT

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This dissertation was elaborated merely for academic purposes, as a part of the Master's program in Management of NOVA School of Business and Economics. The author's opinions, expressed with total academic freedom, are referred to the actual period of time, and do not represent the doctrine approved by the Portuguese Air Force.

Esta dissertação foi elaborada com finalidade meramente académica, durante a frequência do Mestrado em Gestão da NOVA School of Business and Economics. As opiniões do autor, expressas com total liberdade académica, reportam-se ao período em que foram escritas, não representando a doutrina sustentada pela Força Aérea Portuguesa.

### **Abstract**

This work is titled "Best option for Alpha-Jet fleet replacement" and it is part of requirements for the award of a Master in Management from NOVA SBE. The objective of this work is to do a complete and detailed analysis through a capital budgeting decision for the replacement of the Portuguese Air Force Alpha-Jet fleet. It starts with an introduction to the current fleet and its history and then the possible scenarios are given. Afterwards, the scenarios conditions and incremental values are calculated and a project decision will take place. In the end, conclusions and a decision are presented.

Keywords: Alpha-Jet; Capital Budget; Flight hour; Portuguese Air Force.

## **Acronyms**

APT - Advanced Pilot Training

CICPAC - Complementary Instruction Course in Combat Airplanes

CIO - Operation Introduction Course

DIVOPS - *Divisão de Operações*

EBT - Earnings Before Taxes

EICPAC - *Esquadra de Instrução Complementar de Pilotagem em Aviões de Combate*

ENJJPT – Euro-NATO Joint Jet Pilot Training

IRR – Internal Rate of Return

LOBOFA - *Lei Orgânica de Bases da Organização das Forças Armadas*

LOFA - *Lei da Orgânica da Força Aérea*

NATO – North Atlantic Treaty Organization

NOPLAT – Net operating Profit After Taxes

NPV – Net Present Value

PDINST – *Publicação da Direcção de Instrução*

PoAF – Portuguese Air Force

RFI – Request for Information

SUPT - Specialized Undergraduate Pilot Training

USA – United States of America

USAF - United States Air Force

## **Table of Contents**

Acronyms	3
History and mission of Advanced phase of Air Force Pilot Training	5
Introduction	6
Scenarios	8
Project A and B	10
Foreigner Course	12
Capital Budgeting Decision	14
Projects Evaluation	17
Sensitivity Analysis	19
Decision	19
Conclusion and advises	21
Bibliography	22
Appendix	24

## **History and Mission of Advanced Phase of Air Force Pilot Training**

The jet era in Portugal started in 1953 with the arrival of the T-33A “Shooting Star” at the Portuguese Air Force (PoAF). In the same year, the PoAF acquired the F-84G “Thunder Jet” which led to the creation of a new squadron – Squadron 20 – located at Air Base N° 2 at Ota. The F-33As goals were to train instrument flights and give a jet familiarization and adaptation course for the F-84Gs. In the next year, it was created another squadron (Squadron 21) for the F-84Gs, and both Squadrons received instruments flight training from the T-33A squadron.

In this context, the Squadron 22 was formed with all the T-33As in 1995. Its designation was later changed to *Esquadra de Instrução Complementar de Pilotagem em Aviões de Combate* (EICPAC), which is still used today.

In 1960, EICPAC received all F-84Gs and this squadron was then divided into two squadrons, one that operates the T-33As and other that operates the F-84Gs. Its mission was then to give complementary instruction in T-33As and operational conversion in the F-84Gs for the pilots destined to the F-86 “Sabre”.

Em 1977, the PoAF was restructured, and EICPAC is now designated as Squadron 103. In 1987, Squadron 103 is transferred to Air Base N° 11, at Beja, where is currently operating.

In the next year, the T-33 fleet was progressively deactivated and the Complementary Instruction Course in Combat Airplanes (CICPAC) and the Operation Introduction Course (CIO) for Portuguese pilots that come from USA were now assured by the T-38A fleet until 1993.<sup>1</sup> In this year, the Squadron 103 receives by the German detachment in Beja the Dassault-Bréguet/Dornier Alpha-Jet A, which are currently the aircrafts used to give advanced instruction.

From then on, the squadron started to include Air-Ground shoot, air defense course, Air-Ground strike with guidance and simulator instruction in his operational adaptation plus the complementary pilot course in 1998. The Portuguese Air Force received 50 Alpha-Jet from the

*Luftwaffe* in order to financially compensate the use of the Portuguese Air Base for their operation.

With the Squadron 301 *Jaguares* going to Monte Real in 2005 to operate the F-16 AM/BM, the syllabus of Squadron 103 is changed. The final syllabus changes, that were maintained until today, occurred at the end of 2010, having as an objective to give formation to pilots from 201 and 301 Squadrons that operate de F-16 Fighting Falcon for Airspace defense and Air Strikes respectively. The offered courses are as follows:

- Advanced phase and Complementary flight in jet aircrafts (FAAR) [Fase III]<sup>1</sup>
- Conversion phase in combat airplanes (FCAC) [Fase IV]<sup>2</sup>
- Instructor course of advance phase in jet aircrafts (CIFAAR)<sup>3</sup>
- Aircraft qualification program (PQA)<sup>4</sup>

The Alpha-Jet is currently used for advanced pilot training (APT) and for fighter conversion, with a variety of armament deployed. From the 50 airplanes given by *Luftwaffe*, only 8 aircrafts are still operational.

With the expected Alpha-Jet phase-out in 2018, and due to the technological gap between this aircraft and F-16, the PoAF has to decide what needs to be done in order to assure the fighter pilots regeneration.

## **Introduction**

The 273<sup>rd</sup> Article from Constitution declares that the State is responsible to assure the national defense, which means that respect for the constitutional order, democratic institutional international conventions, national independence, territory integrity, freedom and safety of population against any aggression or threat from the exterior, must be assured. One of the

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<sup>1</sup> Original title: Fase Avançada e Pilotagem Complementar em Aviões a Reacção

<sup>2</sup> Original title: Fase de Conversão em Aviões de Combate

<sup>3</sup> Original title: Curso de Instrutor da Fase Avançada em Aviões a Reacção

<sup>4</sup> Original title: Programa de Qualificação no Avião

organizations that assures the compliance with this Article is the PoAF which has as main mission to participate in the republic defense system and in missions in accordance with the terms laid out in the Constitution and law.

In the previous section it was stated how important the Alpha-Jet mission is for the PoAF operation and how the instruction model have evolved over time. With the end of life of a series of airplane fleets, including the Alpha-Jet fleet, the PoAF resources will decrease and therefore the Armed Forces mission might be at risk.

The main financial goal of Air Force, as a public entity, is to make decisions that lead to a minimum increase in costs to the organization and its main stakeholder, the State, and that take into consideration the country defense, independency and best interests. In fact, as stated in the terms laid out in Article 6 of the LOBOFA (*Lei Orgânica de Bases da Organização das Forças Armadas*) and the Article 4 of the LOFA (*Lei da Orgânica da Força Aérea*), two important military law documents, the decisions to be taken should ensure the optimization, efficiency and rationalization of resources (human and material) without affecting mission objectives.

Before looking for other expensive solutions and in order to avoid putting the jet instruction at risk, the *Divisão de Operações* (DIVOPS) came up with four possible short-term solutions in 2015 for the Alpha-Jet fleet operation until 2018:

- Solution 0: No investment, no management improvements and no extra fuel costs;
- Solution 1: Investment in the Canopy system (acquisition should initiate in 2015 and has a cost of €560 000), in materials (€690 000), management improvements (€178 000) and fuel costs (€600 000) but not in the engine maintenance. Total Cost of €2,028M;
- Solution 2: Solution 1 plus a small engine overhaul (€51 000). Total cost of €2,079M;
- Solution 3: Solution 1 plus a better engine overhaul (€2 100 000). Total cost of €4,128M.

According with DIVOPS wants to avoid solutions 0, 1 and 2 as there is no guarantee that the courses initiated in 2017 will finish on time or before the end of the fleet life. It is assumed that solution 0 is the one that will probably happen due to the financial and economic situation that Portugal still faces. Moreover, a year has passed and no acquisition of Canopy material was made, which indicates that today PoAF is facing Solution 0 and the certainty that the fleet will end by January 2018. This also indicates the financial constrains for new investments in public administration and how important is it to find the best economic solution for the fleet replacement.

In order to make the best decision, the analysis was based in quantitative methods (through an objective financial perspective and data collection) but also in qualitative methods (such as subjective and environmental factors) to come up with a decision. Even though the author has experience in the aeronautical field, this work had an impartial perspective and his past experience was only used to assure values and model veracity.

The technique used for this analysis was the capital budgeting to rank projects and to help deciding which projects should be undertaken. A sensitivity analysis was also done to test the relevance of several assumptions on the net present value (NPV). In the end, a subjective view will complement the financial models, followed by conclusions and advises.

## **Scenarios**

According with DIVOPS, Alpha-Jet fleet operation is only guaranteed until 30<sup>th</sup> of January, 2018. Thus, to assure the APT that is essential to provide fully qualified pilots to the Fighter Squadrons (Squadrons 201 and 301), the PoAF came up with 4 possible solutions:

- Scenario 1: Pay per hour regime through leasing;
- Scenario 2: Euro-NATO Joint Jet Pilot Training (ENJJPT) for Pilot Advanced instruction course (plus 2/3 instructors);

- Scenario 3: Instruction in a Foreign Air Force;
- Scenario 4: New Fleet acquisition to replace Alpha-Jet.

The analysis carried out in this project will focus only on scenarios 3 and 4, through a critic and detailed analysis, in order to find the best solution based in a financial management perspective. Scenario 1 will not be investigated as there is no information provided and for Scenario 2 some considerations will be given on an extra appendix.

The fleet replacement process initiated with the identification of the capabilities required for a new aircraft in order to provide Advanced Pilot Training (APT). After that, a Request for Information (RFI) was made in order to “identify prospect service providers”.<sup>5</sup> Suppliers had until March 16th 2016 (the initial deadline was February 16<sup>th</sup>, 2016) to send proposals. As such, suppliers replied to the PoAF RFI with some proposals. All the information sent by the aeronautical suppliers are considered commercially confidential. In order to protect the confidentiality, during this analysis the values used suffered changes, the contract conditions have been modified and do not represent specific proposals from suppliers, and the nomenclature used for two possible aircraft acquisitions has been changed to “Project A” and “Project B”.

Since it was not requested information regarding instruction courses to other countries, a past course taken in United States Air Force (USAF) was used as a benchmark of an instruction course abroad. Flight Hour Cost was calculated based on that past information and additional cost or savings were taken into consideration.

All the data regarding suppliers information, average fuel consumptions, allowances, Alpha-Jet operation costs, and other relevant aeronautical information were provided by the Portuguese Air Force. Economic data was obtained through Bank of Saint Louis, European Central Bank and Federal Reserve System websites.

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<sup>5</sup> PoAF (2015)

## **Project A and Project B**

As it was explained before, two aircrafts with different contract characteristics will be investigated: “Project A” and “Project B”.

It was requested for all the suppliers two different quotations: one with a minimum of 1000 flight hours; and another one with a maximum of 2000 flight hours. Suppliers had also the possibility to send other relevant proposals if it entails an increase in financial efficiency. Here, both projects will be considered for the 2000 hours’ case in order to provide a better comparison between contracts and also to protect confidentiality.

For both fleet acquisition cases, Air Force will continue to operate in only one Air Base (in this case Air Base N°11 headquartered at Beja) and infrastructures will not need an upgrade or the costs for an upgrade will not be significant.

Maintenance for major components, flight manual and publications, instructor and maintenance personnel training, simulator and its maintenance, and maintenance material, will be offered in the first 10 years of operation for aircraft “A”, whereas for aircraft “B” they will only be offered in the first 3 years of operation, and the PoAF is responsible for maintaining the “Flight Line”. After these years, all maintenance costs will be assumed by the PoAF. Military aircraft maintenance will be considered for this study as an authorized repair center for major repairs and overhauls, meaning that their maintenance will be independent from suppliers. In the first year, the maintenance cost of these aircrafts will be the same as 50 percent of the value of Alpha-Jet maintenance costs, that comprises the *Material de Consumo de Unidades* (MCU)<sup>6</sup>, *Reparações no âmbito da DMA* (RMA)<sup>7</sup> and *Reparações no âmbito da Repartição de*

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<sup>6</sup> MCU maintenance are all the maintenances regarding parts substitutions, minor and programmed maintenances

<sup>7</sup> RRA maintenances are the ones when outsourced companies are required to deal with armament issues, programmed maintenances, and other issues

*Armamento* (RRA)<sup>8</sup>. These maintenance costs will increase progressively until they reach 100 percent of the Alpha-Jet maintenance cost in the 30<sup>th</sup> year.

Simulator maintenance costs is constant over the years for aircrafts “A” and “B” acquisitions and it was considered to be the same as the Alpha-Jet simulator costs.

Fuel price values were provided by the PoAF DAT (*Departamento de Abastecimento e Transportes*). For the following calculations, only JP-8 Fuel was considered, since this fuel is the only one used in PoAF operations in this fleet. The average price from 2011 to 2015 is 0,74 €/liter.

Capital Expenditure for project A is a “pay by the hour” system for 10 years with a minimum of 2000 Flight Hours per year, with a price of €6500 (aircraft payment is incorporated in the final price). After the 10<sup>th</sup> year, the PoAF assumes all costs and the complete ownership of the fleet. For project B, the capital expenditure is divided by the first 4 years (25 percent for each year) and during that period the PoAF have the same conditions (number of flight hours, maintenance, worthiness, personnel training, and aircraft manual and publications are offered) as project A. Regarding the payment, fleet “B” purchase requires an immediate (year 0) cash out-flow of 25 percent of 100 million euros, whereas fleet “A” allows a cash outflow divided by the first ten years of operation. Once the fleets payment has been concluded, its ownership passes to the PoAF, as well as all the maintenance costs.

After the payments have been completed, the number of flight hours will be reduced to 1000 flight hours per year. This reduction is justified by the military publications PDINST<sup>9</sup> 144-27 and PDINST 144-29, which regulate the APT course. These publications state that a pilot only requires an average of 148 flight hours jet training to be an “Advanced Pilot”. As such, to train new 4 advance pilots, the PoAF only needs 592 flight hours per year, if the instructor training

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<sup>8</sup> RMA maintenances are all the other outsourced services contracted excluding big maintenances and major repair

<sup>9</sup> Publicação da Direcção de Instrução

is not taken into consideration. The squadron flight hour quantity in 2013 and 2014 was respectively 630 and 650 to instruct an average of 4 new pilots per year, which confirms that 1000 flight hours are in this perspective a reasonable number to take into consideration during the calculations. However, it should be noted that 1000 flight hours may not be the perfect amount to the Squadron operation, since that in 2013 and in 2014 reduced budget was imposed to the PoAF due to the economic crisis.

### **Foreign Course**

Since Alpha-Jet fleet operation is coming to an end, the PoAF tried to come up with some short term solutions in May of 2013. The *Memorando n°6077/DIVOPS/2013 de 24mai13* “*Proposta de planeamento de cursos de pilotagem nos EUA para o periodo 2015/2019*” recommended three annual positions (without commitment) for the USAF Introduction to Fighter Fundamentals between 2016 and 2019. However, the *Directiva do CEMFA 02/2014* states the necessity to graduate 4 pilots per year and to ensure the instructor auto-regeneration. The *Decreto-Lei n.º 232/2009 de 15 de Setembro* and the 2<sup>nd</sup> Article, line c) of the LOFA supports this decision to send pilots to a foreign country, where the Portuguese Air Force is also responsible for insuring military and technical cooperation with other Forces. In the past, the PoAF had pilots having military instruction in foreign countries like Brazil and United States of America (USA). These kind of services was used when there was a great demand for PoAF pilots to join ranks and there were no sufficient conditions in Portugal to qualify pilots. Thus, this service allowed pilots from the Portuguese Academy to attend the tirocinium (last academic year) in USA, where they flown T-6 or T-37 plus T-38 (Jet aircraft and fighter training aircraft). Although PoAF pilots had instruction in a jet aircraft (T-38) in USA, there was no training to be a fighter pilot, which means that none of them received an equivalent training to the one offered by the PoAF Alpha-Jet Phase IV.

In order to comply with North Atlantic Treaty Organization (NATO) procedures, only military instruction courses in NATO Air Forces will be considered in this study. Financial Data from the Specialized Undergraduate Pilot Training (SUPT) at United States Air Force (USAF) will be used since there is no more data regarding others courses in NATO countries and because PoAF already has considered the course in USA as an alternative to Alpha-Jet.

Information provided comes from 2004, 2005 and 2006 PoAF Academy Finalists that went to the USAF to finish their training and become a pilots. In order to find the flight hour cost estimation, a sample of 49 student pilots was considered, where the average amount of flight hours, including simulator flight hours, was found to be approximately 296 flight hours per student. Afterwards, the average final cost per student at the SUPT program was divided by the average amount of flight hours per student, which was then multiplied by the average US inflation between 2007 and 2015, resulting in a flight hour cost of \$2295,26 USD.

In spite of the possibility to do the Advance Pilot training in another country, the Air Force is obligated to maintain the infrastructure operational in case there is a military need to use it. As experience showed before, international military exercises like Hot Blade, Real Thaw, among others, typically require these buildings to provide shelter and basic conditions to foreign military personnel. Canteen, command administration and handling personnel are services allocated for the entire Air Base and not specifically for the Squadron 103. In this case, no changes in costs or savings will occur. Pilot equipment and accessories are also provided by the PoAF.

Although military personnel are considered civil servants and, as such, they are under the law of public administration, which means that militaries cannot be fired unless there is a strong cause that compels the State to do it. However, the PoAF has mechanisms that allow to control the amount of militaries.

## **Capital Budgeting Decision**

The decision to undertake a project and its forecasting will be carried out through a Capital Budgeting process. A comparison was done between the three projects to identify and prioritize from a financial point of view the projects considered. In this way, it will be possible to make a decision based on NPV calculations.

The following premises/assumptions are going to be taken into account in the analysis:

- All projects have the same maturity (30 years);
- It will not be possible to take a different course of action during the execution of a project;
- Year zero (contract signature) is considered to be the end of year 2017;
- It is assumed that an investment in Alpha-Jet fleet is not an option and that Solution 0 is the current scenario at PoAF;
- Zero income tax rate because PoAF it is not a private company and so it is not taxed by the State;
- Exchange Rate is the monthly EUR/USD average rate since January of 1999 to May 2016;
- USA inflation is the average since 1960 to 2015, and for Portugal is the average from 1999 to 2015 (Euro Period);
- Prices of the economy are growing according with inflation. USA inflation is used for fuel, materials, foreign course costs and aircraft payments, and the Portuguese inflation is used for allowances and wages;
- Discount Rate is the Long-Term Government Bond Yields for 10 years: 1,723 percent (01/03/2015);

- It is assumed that there is no need for a private insurance. In case of incident or accident, the PoAF assumes the total cost of repair. Here it is assumed that no accident will happen;
- According with BCE expected inflation rate for Portugal is 1,8 percent;
- According with FED expected inflation rate for USA is 2 percent.

With the data provided by suppliers and Air Force, it was possible to identify the incremental cash inflows and outflows which are the ones that will occur if the project is accepted. Note that sunk costs should not be confused with incremental costs. Sunk costs are related to previous costs regarding the Alpha-Jet fleet and are not recoverable. Therefore, all the costs involved in past decisions, such as the resulting savings from choosing Solution 0, will not be taken into account. Concerning the identification of incremental costs and savings for the different projects are:

- Up-front Investment in all of the cases;
- Outsourced services are offered to PoAF at the contract signature for the acquisition of aircrafts and are contemplated in the capital expenditure;
- Airfield and logistic services, pilot equipment, fuel and aeronautical services are still going to be provided by the PoAF independently on the chosen project and therefore they are not considered incremental costs;
- Fuel cost per year was calculated through the multiplication of the average fuel price by the number of flight hours, times the fuel consumption per hour of the aircraft. Fuel it is not included in the suppliers project and is taken into consideration for the aircraft acquisitions;
- The State has the option to not renovate with militaries under contract and there will not be promotions for the ones that are permanent staff, which forces them to go out of duty (private companies or reserve). As a consequence, the decrease in

maintenance and instructor wages will be progressive. In other words, it is assumed that 10 percent of maintenance personnel will leave each year, beginning at year one, and reaching full maturity at the 10<sup>th</sup> year. It is assumed that at the 5<sup>th</sup> year, the instructor pilots will not have the possibility to progress their career in the PoAF and will leave the Air Force and go work in a private company;

- At the end of equipment life (30 years for both aircrafts) there will be no positive market price or disposal cost;
- MCU, RRA and RMA are the maintenance costs (with *DIRECTIVA N.º02/04* and with 2014 Alpha Jet costs as references) that the organization will have to pay once the maintenance offered by the suppliers is over. The first year is 50% of the reference and reaches full maturity at year 30;
- Flight Simulator costs are assumed to be equal to the Alpha-Jet operation;
- Regarding Foreign Services, it is assumed that a fee will be required. This fee is usually used and seen as a contribution for foreign fleet upgrades, bureaucracy and other management processes. Since there is no information about entering fees in this program, it is assumed a €10M in order to be conservative. A sensitivity analysis will then tell how significant is the impact of this fee;
- Usually, Advance Pilot students are 1<sup>st</sup> Lieutenants and/or 2<sup>nd</sup> Lieutenants and, according to *Circular 28/201*, allowances are €111,81 per day. It is assumed that the course will take place during a year and that the students will receive 100 percent of allowances (that will be used to cover accommodation and food costs), resulting in €40 251,60 (360\*111,81) per year for one student pilot and €161 006,40 for four student pilots. In case of project B, it is considered that four instructors (usually are 2<sup>nd</sup> Lieutenants or Captains) must go abroad to learn how to fly the aircraft for only one year and allowances are also €111,81 per day;

- Course total cost per student is the flight hour cost abroad times the 148 hours (Phase III and Phase IV Portuguese Course). The foreign course price is based in past information that has not been updated and thus it has been assumed that this price includes the payment of the American fleet and simulator maintenance, fuel, instructor salaries, installation usage and other management and instruction costs. A factor of more 50 percent was used in order to be conservative (\$3442,892 per hour) and the respective change in the NPV will be evaluated;
- There is a surplus of flight hours during the payments periods (2000 flight hours when 1000 is enough of the four pilots' instruction). However, this surplus can't be recovered, for instance, by give instruction to other pilots Air Forces, (this issue will be later discussed).

Once all the incremental values were encountered, the Earning Before Taxes (revenues less the expenses) was calculated. Since PoAF is not taxed by the State, EBT are equal to Net Operating Profit After Taxes (NOPLAT).

Next, the capital expenditures or entering fee were added to the NOPLAT, which led to the Free Cash Flows for each year and then the discount rate was used to obtain the Discounted Free Cash Flows. The 10 year bond yield was used as a discount rate because the interest rates of this yield curve is set by the market and represent the willingness to lend or borrow for a long period in time to the State.<sup>10</sup>

### **Projects Evaluation**

Various methods of analyzing the capital budget were used to decide which project should be chosen.

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<sup>10</sup> Jaffe, Ross Westerfield. 2005.

The NPV is the present value of all incremental cash flows including the present value of the investment. The objective is to know how much the project is worth today. NPV results were obtained through the sum of all discounted free cash-flows at a discount rate of 1,72 percent. The following table (Figure I) ranks the projects from the best NPV to the worst NPV. Calculations to obtain it are represented in Appendix I.

<b>Rank</b>	<b>Project</b>	<b>NPV</b>
#1	US Course	€ -19 493 556,27
#2	Project “B”	€ -120 781 169,71
#3	Project “A”	€ -135 981 940,21

Figure I – NPV Rank

In a typical situation, the project to be chosen should be the one with the highest NPV. Usually, it is assumed that an investment with a negative NPV should not be undertaken. However, in this analysis, the benefits of the investment are not taken into account, only the costs, rendering any NPV necessarily negative. In fact, the benefits of having military pilots are not accountable and it is the necessity to have advanced pilots that imposes the State to undertake one of the projects. Implicitly, the analysis assumes that the benefits are the same in all three projects. From a financial point a view, the project to be chosen is the one with the lower negative NPV. The Internal Rate of Return (IRR) is the discount rate that sets the NPV equal to zero, providing information about the projects profitability<sup>11</sup>. It is not possible to compute the IRR because there are no positive cash flows.

The payback period expresses the length of time that it will take the cash flows to pay the initial investment. In this case, all cash flows are negative, and it is not possible to compute the payback period. Nevertheless, this method is not as reliable as the NPV rule because, amongst other reasons, it does not have into account the time value of money and is normally used to evaluate simple projects with a small time length.

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<sup>11</sup> Jaffe, Ross Westerfield. 2005.

## Sensitivity Analysis

By carrying out a sensitivity analysis, it is possible to study the impact of different assumptions for the variables in the case study. Here, the objective is to look for NPV variations by changing variables and finding which ones have the larger impact in NPV.<sup>12</sup>

Depending on the chosen project, the change in variables and respective results can be found in Appendix II.

A sensitivity analysis has been conducted and it can be concluded that in no situation the projects will have a positive NPV (See Appendix II). Although Project A and B have negative cash flows and thus the NPV cannot be positive, the US Course can have a positive NPV because there is a reduction of costs. The variables that cause more impact to the aircraft acquisitions' NPVs are the change in initial investment and the discount rate. Regarding the US Course, the initial fee has the most significant impact on the NPV (no initial fee equals half of the NPV and double if the fee is 100 percent more).

## Decision

Before a decision is made, one has to take into consideration the LPM (*Lei de Programação Militar*), which establishes the amount of money for modernization and operation of Armed Forces armament and equipment according to what was military planned and considering the current financial status of Portugal. This money is applied to all PoAF Instruction fleets and not only applied in one single project. The dashboard below (Figure. II) shows the amount of money available for the PoAF Instruction investment. In parentheses is the amount planned to the Alpha-Jet modernization:

1 <sup>st</sup> Quadrennium		2 <sup>nd</sup> Quadrennium		3 <sup>rd</sup> Quadrennium	
<b>2015</b>	0	<b>2019</b>	5250 (2500)	<b>2023</b>	7250 (3500)
<b>2016</b>	0	<b>2020</b>	5250 (2500)	<b>2024</b>	7250 (3500)
<b>2017</b>	250	<b>2021</b>	7250 (3500)	<b>2025</b>	6250 (3000)

<sup>12</sup> BERK, Jonathan, DeMARZO, Peter. 2014.

<b>2018</b>	250	<b>2022</b>	7250 (3500)	<b>2026</b>	6250 (3000)
Total	500	Total	25000	Total	27000
Grand Total: 52500					

Figure II – Budget for Air Force Instruction in thousands of euros

As it can be seen, none of the projects are suitable to the planning made in terms of investment. LPM values after 2018 for Alpha-Jet fleet modernization may be used to invest in a new fleet or used in one of the solutions but it is still below what the PoAF needs.

Although the current strategic investment plan for the Armed Forces for the next 11 years does not imply a big investment in the area of military instruction, there is a lack for assets or a program in order to comply with the continuity of military instruction and crew's renovation for the next generation. A revision of this law might be needed in order to comply with PoAF demands, or Portugal safety standards might be at risk.

A useful diagnostic instrument that gathers all the information of a particular strategy to be taken and that tells the internal and external constraints and opportunities of such position is a SWOT analysis. The assumption for this SWOT analysis is:

- Portugal buys a new airplane to substitute Alpha-Jet and maintains the current model instruction.

What is intended here is to check the positive or negative aspects to maintain the current instruction philosophy (Instruction in Portugal) versus a new instruction philosophy (Course in a NATO Foreign Course). To do that, the internal part of the strategy (consider the Strengths and Weaknesses of the organization when compared with other competitors (in our case other Air Forces)) needs to be compared with the external factors (Opportunities and Threats):

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>- Capacity to instruct pilots according to Portuguese requirements;</li> <li>- Capacity to assure the fighter pilots demand in case of war;</li> <li>- Less resistance to changes in the PoAF organization and structure.</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>- Great amount of Resources (Human and material) invested to the squadron;</li> <li>- Outsourced services might be required for maintenances or upgrades in the future.</li> </ul>
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<p><b>Opportunities:</b></p> <ul style="list-style-type: none"> <li>- All fleet is tasked only to comply with Portuguese objectives;</li> <li>- Acquire know-how when working with new manufacturers and their operations management;</li> <li>- There is no resistance to change in cultural behavior.</li> </ul>	<p><b>Threats:</b></p> <ul style="list-style-type: none"> <li>- Lack of experience flying in/to foreign countries;</li> <li>- Lack of international cooperation with other countries (knowledge, culture);</li> <li>- Lack of capacity when dealing with foreign models of instruction and operations.</li> </ul>
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It can be concluded that the decision that will bring less financial costs to the PoAF is the course in the foreign country. Although this is true, it will be a risky decision since the PoAF will lose the ability and capability to instruct their own pilots (the squadron will be “dismantled” and with time the PoAF will be without APT instructors) and to assure it can train more fighter pilots in case of war. Since the difference from Aircraft A and B is approximately €15M the decision between them should also consider the aircrafts performance and capabilities on top of the costs that are associated with their acquisition. For example, Turboprop or Jet aircrafts have different capabilities and give different training conditions:

- Jet training aircrafts will be much faster than a turboprop which will prepare better the pilots to the F-16 operation speeds;
- If the decision is between two aircrafts with similar performance and engine type, then it is the avionics quality that should differentiate;
- Turboprop aircrafts (like T-6 or T-27) can substitute the PoAF Epsilon TB-30 (Single Engine Piston) fleet and give basic flight training (tirucinium) plus the Phase IV (APT course). In this case, Phase III course would not be necessary.

### **Conclusion and Advices**

Although the US Course is cheaper than acquiring a new aircraft, this cost does not have into account the lost in air power and instruction capabilities of the PoAF. Change in instruction

philosophy and adaptation to this new way of thinking might lead to risks that need to be overcome in the future.

It can also be concluded that there are no significant differences in terms of a financial perspective between the two aircraft acquisition. If the decision is to acquire a new aircraft, the decision might be decided by the aircraft that has more capabilities and that satisfies the PoAF needs. Also, a better negotiation with the suppliers might decrease the costs. Other option is to end another fleet and substitute two fleets for just one (probably will reduce maintenance wages, instructor wages, management costs, etc). The other way to increase the value of the aircraft purchase is to sell the flight hours surplus to other countries or organizations. The sensitivity test permitted also to find the variables that have a bigger impact on the NPV.

It can be affirmed that the purpose of this thesis was achieved by giving an idea of which decision will cause more impact to the organization and what should be considered in order to embrace a project.

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# Appendix

## Appendix I – Project A, Project B and US Course

Assumptions - Project A		Assumptions - Project B		Assumptions - US Course	
Data	Value	Unit	Data	Value	Unit
Flight Hour Cost	€ 5 500	€/h	Fuel consumption	450	l/h
Fuel Price	€ 300	€/l	Number of Flight Hours	2000	Hours
Fuel Consumption	1000	l/h	Number of Flight Hours	1000	Hours
Minimum of Flight hours (until year 10)	2000	Hour	Fuel Price	0,73998601	€
MCU Material			Allowances (one year for 4 instructors)	€ 161.006	%
Reparação e Revisões RRA-RMA			50% of Alpha Jet at year 11 and 100% at Year 30		
Taxes	0,00%	%	Reparação e Revisões RRA-RMA		
Discount Rate	1,72%	%	Simulador Maintenance	Same as Alpha Jet	
Expected Inflation in Portugal	1,80%	%	Total Capital Expenditure	100 000 000,00 €	
Expected Inflation in USA	2,00%	%	Expected Inflation in Portugal		
			Expected Inflation in USA		

Assumptions - Project A		Assumptions - Project B		Assumptions - US Course	
Data	Value	Unit	Data	Value	Unit
Initial fee for Foreign Course Cost (Assumption)	10 000 000,00 €	€	MCU Material		
Phase III and IV (including Simulator)	148	Hours	Reparação e Revisões RRA-RMA		
USA Real hour cost (ROOM Price)	2829,171913	€/h	Simulador Maintenance	Same as Alpha Jet	
Number of Students	4		Discount Rate	1,72%	%
Discount Rate	1,72%	%	Expected Inflation in Portugal	1,80%	%
Taxes	0,00%	%	Expected Inflation in USA	2,00%	%
Maintenance Wages (for Year 10 everyone is out of duty)	1.463 870,98 €				
Allowances (one year per student)	€ 40 252				
Average Inflation in Portugal	2,00%	%			
Average Inflation in USA	2,00%	%			

Assumptions - Project A		Assumptions - Project B		Assumptions - US Course	
Data	Value	Unit	Data	Value	Unit
MCU Material			Fuel consumption	450	l/h
Reparação e Revisões RRA-RMA			Number of Flight Hours	2000	Hours
Taxes	0,00%	%	Number of Flight Hours	1000	Hours
Discount Rate	1,72%	%	Fuel Price	0,73998601	€
Expected Inflation in Portugal	1,80%	%	Allowances (one year for 4 instructors)	€ 161.006	%
Expected Inflation in USA	2,00%	%	50% of Alpha Jet at year 11 and 100% at Year 30		
			Reparação e Revisões RRA-RMA		
			Simulador Maintenance	Same as Alpha Jet	
			Total Capital Expenditure	100 000 000,00 €	
			Expected Inflation in Portugal		
			Expected Inflation in USA		

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MCU Material															
Reparação e Revisões RRA-RMA															
Fuel And Lubricants															
Simulador Maintenance															
<b>Incremental Operating Income</b>															
Taxes (0%)															
<b>NPVAT</b>															
Capital Expenditure (Loss)															
<b>Free Cash Flow</b>															
PV of Discounted Free Cash Flow															
<b>Discounted Free Cash Flow</b>															

349 561,15 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54 191,01 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
290 114,09 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56 049,76 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
749 916,01 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
749 916,01 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
749 916,01 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
580 357,15 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Allowances															
MCU Material															
Reparação e Revisões RRA-RMA															
Fuel And Lubricants															
Simulador Maintenance															
<b>Incremental Operating Income</b>															
Taxes (0%)															
<b>NPVAT</b>															
Capital Expenditure (Loss)															
<b>Free Cash Flow</b>															
PV of Discounted Free Cash Flow															
<b>Discounted Free Cash Flow</b>															

409 485,92 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62 020,72 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
435 171,14 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56 049,76 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
963 327,53 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
963 327,53 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
963 327,53 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
745 515,52 €	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

