Conversion of the dual training aircraft (DC) into single control advanced training aircraft (SC). Part I

Ioan ŞTEFĂNESCU[1]*

*Corresponding author
Aerospace Consulting, Bdul. Iuliu Maniu 220, Bucharest 061126, Romania

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***Abstract**: Converting the DC school jet aircraft into SC advanced training aircraft - and use them for the combat training of military pilots from the operational units, has become a necessity due to the budget cuts for Air Force, with direct implications on reducing the number of hours of flight assigned to operating personnel for preparing and training.*
The purpose of adopting such a program is to reduce the number of flight hours allocated annually for preparing and training in advanced stages of instruction, for every pilot, by more intensive use of this type of aircraft, which has the advantage of lower flight hour costs as compared to a supersonic combat plane.

Key Words: reorganization of flight programs

REORGANIZATION OF FLIGHT PROGRAMS AND NAVIGATOR PERSONAL FROM THE OPERATIONAL UNITS AS A RESULT OF THE REDUCTION OF ANNUAL HOURS OF FLIGHT

Starting in the 70s, when the oil crisis deepened leading to the increase of the fuel prices at a global scale, the economic crises occurred periodically, usually accompanied by financial crises that have disrupted the economy of the most countries on all continents.

To get a picture of the evolution of oil prices over the last 24 years, the increase of the oil barrel price is given in Fig. 1.

During different periods this bulge reached peaks caused by political and military crises such as, for example, the Middle East crisis, with the Arab countries embargo on the supply of the commodity markets, first and second oil Persian Gulf crisis, each time accompanied by a military intervention, the political crisis and the military intervention in Afghanistan and also the last and most severe financial crisis triggered in the U.S. in years (2007 - 2008) continued with an economic crisis, which included most countries on all continents and has influenced the oil price, bringing it to unprecedented value over the past 50 years as can be seen in the graph in Fig. 2 where the value of a barrel of oil reached U.S. $ 140.

As a result, in 24 years, the price of a barrel of oil rose from 20 U.S $, in 1987 to 140 U.S. $ in 2008, representing an increase of about 7 times.

The occurrence of the crisis on the financial markets, repeated every few years, has led inevitably to fuel prices rising, especially of the aircraft fuel, which was also the most expensive on the market.

Consequently there was a corresponding increase in flight hours expenses, both in civil aviation, but especially in the military one, which is financed from the state budget that drastically reduced the allocated amounts because of the above mentioned crisis.

[1] Scientific Researcher I, IAR 99 - SOIM Aircraft Program Director and Project Leader, Dipl. Av. Eng.

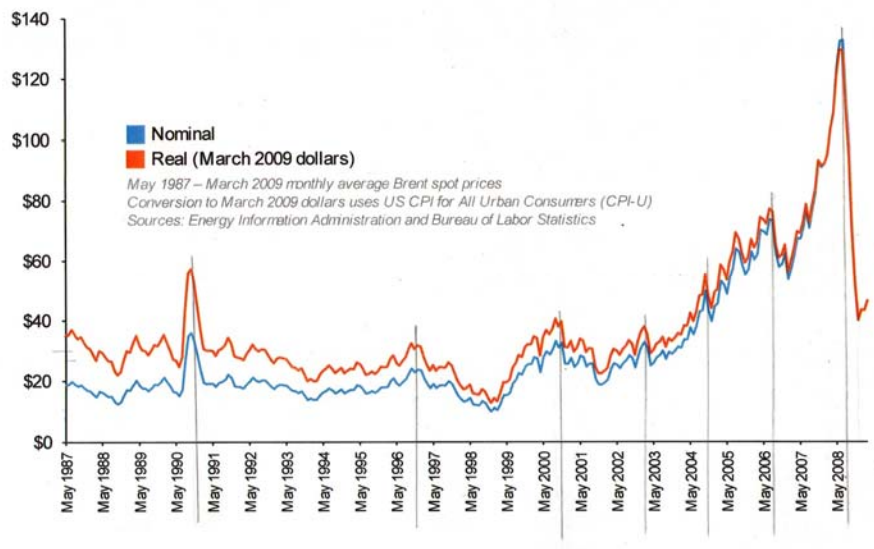

Fig. 1. The evolution of oil prices in May 1987 - March 2009

NOTE:

- Curves in the higher plane show the real price of a barrel of oil in U.S. dollars, in May 2008, reported to the dollar value of that year, shown horizontally.
- Curves in the lower plane, show the nominal price of a barrel of oil in U.S. dollars of that year
- Differences between the two curves represent the evolution of the U.S. dollar, in certain stages, relative to the value of the dollar in May 2008.

This could not be neglected, more so as, most countries that have air forces, have faced and are facing financial difficulties, increasingly larger, which led to the reduction of funds in most areas of activity, including the army, air force respectively.

Reducing the funds allocated to the Armed Forces in general and especially to the Military Air Forces leads, in turn, to a reduction in the number of flight hours of each pilot, in particular of those who carry out their combat training and instruction in operational units, usually, flying supersonic aircraft, which are characterized by high consumption of fuel and high cost of flight time and logistics. Until the years 1970-1980, military pilots from the operational units, belonging to the Air Force, in most NATO countries and others, conducted their daily instruction and combat training, flying planes from the units where they were employed, usually supersonic single or dual command combat aircraft. Along with the flight hours reduction after the 80s, the strategy of combat training for the military pilots from the operative units, has changed fundamentally in terms of methodology, number of hours scheduled and organization. Their instruction and training programs, different from country to country were to be held as follows:

– In the countries that relied on separate instruction and training programs, these activities were held in two stages. The first stage refers to training in specialized units, equipped with double - control subsonic or supersonic jet while the second stage was held in basic operational units, which were equipped with supersonic combat aircraft.
– In the countries that had unitary programs, the instruction and training activities were held concurrently with both subsonic and supersonic training aircraft, and supersonic combat aircraft; both types of aircraft (supersonic and combat aircraft) were part of the operational units equipment; this methodology is also the most frequently used.

In both cases, after the 80s instruction and training programs of the pilots provided a smaller number of hours of flight with supersonic combat aircraft; the combat training was mostly based on the flight with subsonic aircraft, which had allocated a greater number of flight hours as a result of technical and economic advantages offered by this type of aircraft.

The aim was to cover as much as possible, the reduction of the total number of flight hours for combat training and instruction of military pilots for a certain period of time, usually for one year. A study conducted in the U.S. during 1979 - 1980, mentioned that U.S. units from the AIR FORCE have revised the military pilot training programs in order to reduce the total volume of allocated flight hours per pilot in various stages of instruction, as a result of flight simulation technology improvement.

Due to this fact, it was possible to reduce the percentage of the number of flight hours necessary for the transition from one type of aircraft, to another type more efficient, both in each phase separately as well as in transition programs from one phase to another, see Fig. 2.

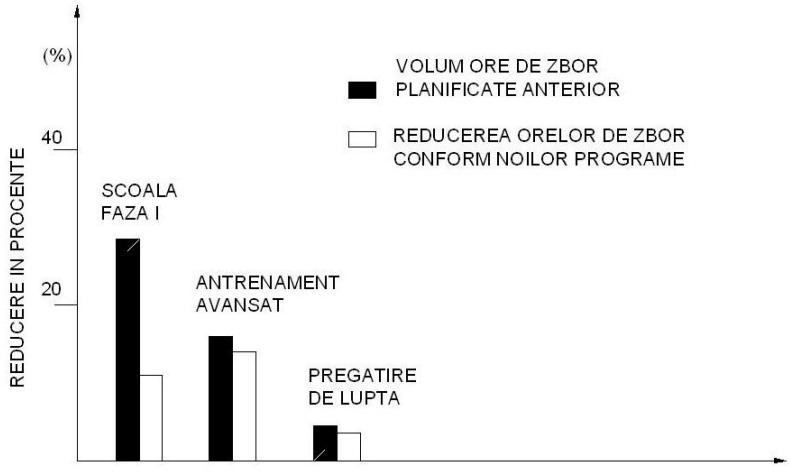

Fig. 2. Reduction in percentage of the number of flight hours required to the transition from one aircraft type to another type more efficient. (Source 'INTERAVIA'- 1980)

The percentage reduction in the number of flight hours required to the transition from one type of aircraft, to another more efficient, in each of the three phases of a military pilot training influenced both the reduction of the total hours of flight, previously planned, and the expenses associated with each phase separately (see the graph in Fig. 2).

50% (i.e. 175 hours) from the total of 350 flying hours previously planned during 1979-1980 were allocated for transition programs from a type of aircraft to another type more efficient (which usually represent the passage from one stage of preparation to another).

The graph in Fig. (2) shows that, total flight hours for transition programs was reduced from 50% to 30%, namely from 175 hours to 105 flight hours, respectively. It follows that the total flight hours was reduced by 30%, so instead of 350 hours of flight only a total of 245 flight hours are kept. According to the training phases, the 105 flight hours for transition programs have been divided as follows, the remaining 140 hours of flight being dedicated to instruction programs, advanced training and combat training:

– 11% Phase I = 38,50 hours
– 14% Phase II = 49,00 hours
– 5% Phase III = 17,50 hours

Total = 30% Phases I– III = 105 hours

In principle, keeping the aforementioned proportions, the number of hours, is divided into phases of training, the purpose being that most hours to be distributed mostly to the phases (I) and (II) and less to phase (III), so that the 245 hours of training, divided between phases, will be:

- in Phase I 38,50 + 42 = 80,50 hours
- in Phase II 49,00 + 71 = 120,00 hours
- in Phase III 17,50 + 27 = 44,50 hours
- Total – Phases (I – III) = 105 + 140 = 245 hours,

instead of 350 hours

It is apparent that pilot training was mostly centered around phase I, forming, and phase II, advanced training, where the aviation school graduates (with a service record on double command jets) flew supersonic or subsonic jets in double command and less around phase III combat training and training specialization, that took place at operational units equipped with supersonic fighters and had the smallest flight hour count (Fig. 2).

Due to the economic and financial status, and especially due to rising oil costs, even USA had to cut back on flight hours, as shown in fig. 3, especially phase III of combat training and preparation where the flight hours number is very low compared with the other phases, representing 26 to 38% of the total flight hours. In some states, faced with financial difficulties, this tendency to reduce the flight hour number is maintained for the time being, meaning that the number of allocated flight hours, is increasingly smaller compared to the figures in the '80s. In the same period, around 79-80, AERONAUTICA_MACCHI published a study carried out in few NATO member countries plus Australia, showing that the ratio between flight hours allocated to subsonic jet pilot training and supersonic jet pilot training is clearly in favour of subsonic jet training.

This particular result, also illustrated in figure 3, is due to the logistics and overall operation costs of the supersonic jets that are bigger than those of subsonic trainers.

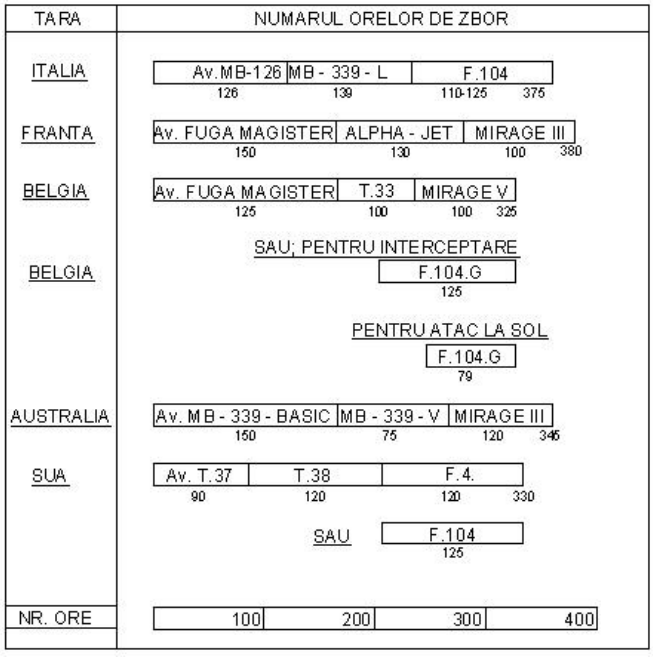

Fig. 3. Comparation between different programs of several countries regarding the number of flight hours for pilots training (Source AERONAUTICA MACCHI)

Training periods for a US AIR FORCE pilot (as stated by Aeronautica Macchi) was reduced from a total 350 flight hours, as before 1980, to 330 hours, and supersonic jet training represents 36% of this total; taking into consideration that accommodation time to supersonic jets has been reduced by approximately 20 hours it results that the Phase III flight hours have been reduced from 140 hours to 120 hours, considering the NATO normatives that require a larger yearly flight hour number for each pilot. As stated before, the cause for this cut back was an increase of the operating costs of supersonic fighter and associated logistics, compared to subsonic trainers.

The solution to compensate the cut back of the flight hours, accepted in many states was to combine training, preparation and advanced training flights both with subsonic advanced trainers as with supersonic jets, the greater percent of flight hours being made on advanced specially-equipped subsonic trainers.

Based on the study published by AERONAUTICA – MACCHI we analyze how the solution to combine the combat training and basic training flights with the supersonic and subsonic trainers was applied. Conclusions are drawn, that are valid to the present day:

- reducing the supersonic flight hours and compensating with a greater number of flight hours on subsonic advanced trainers.
- most states accepted that for the training of a single pilot, starting from phase I until he is declared fit for combat missions, a mean of 300 to 350 flight hours is necessary, instead of the previous 400,effectuated in 2,5 to 3 years, instead of 4.

The aforementioned study shows the repartition of supersonic and subsonic flight training hours:

- ITALY: a total of 375 flight hours were allocated, for combat preparation and pilot training over 3 years, thus:
  110-115 hours for supersonic flight on F104
  139 hours on MB-339L or V, subsonic double command trainer
- FRANCE: a total of 380 hours spanning 3 years, out of which:
  150 hours on the subsonic trainer Fouga Magister (phase I)
  130 hours with the subsonic trainer ALPHA-JET (phase II)
  100 hours on supersonic fighters type MIRAGE III (phase III)
- BELGIUM: a total of 325 flight hours, over 2,5 years, divided into:
  125 hours on Fouga Magister (phase I)
  100 hours on T33 –phase II
  100 hours on supersonic fighters type MIRAGE III (phase III) or,
  125 hours for supersonic flight on F104
- AUSTRALIA: a total of 345 hours, over 2 years and 7 months, divided into:
  225 hours on MB339- phase I and II
  120 hours on MIRAGE III (phase III)
- USA: a total of 330 flight hours, over 2 and a half years, distributed as follows:
  90 hours on T37 (phase I)
  120 hours on T38 (phase II)
  120 hours on supersonic fighter F4 or
  125 hours on F104.

The data shows that the total flight hours on supersonic jets, with their expensive logistics and operating costs compared to the total training costs per pilot, are distributed as follows: 37% in Italy, 26% in France, 38% in Belgium, 25% in Australia and 36% in SUA, the remaining flight hours being made with subsonic double command trainers (lower operating costs and logistics).

From the graph presented above two conclusions can be drawn:

- the yearly flight hour number for a pilot was around 125-130.
- the mean flight, training and preparation hour number on supersonic aircraft is around 26% to 38% of the total of allocated flight hours, the remaining training and advanced training hours being made on subsonic advanced trainers.

To counteract the cut backs on yearly flight hours for a pilot in an operating unit issued mainly with supersonic fighters, several solutions were proposed.

In the early 80's the solution was to use subsonic double command trainers separately or in conjunction with the supersonic fighters for combat training and pilot training for the pilots that flew supersonic jets or, after the 90's, single command advanced trainers that have lower operating costs per flight hour and afferent logistics, and lower costs per unit compared to supersonic jets.

To make an idea of the flight hour costs in the mid 70's and 80's, we quote from the study published by AERONAUTICA MACCHI fig. 4, that shows the total pilot training costs to the phase of advanced training on subsonic aircraft per flight hours total on this airplane type.

From the ratio of total costs and total flight hours a mean cost for a flight hour, by aircraft type, is derived and presented in fig. 5.

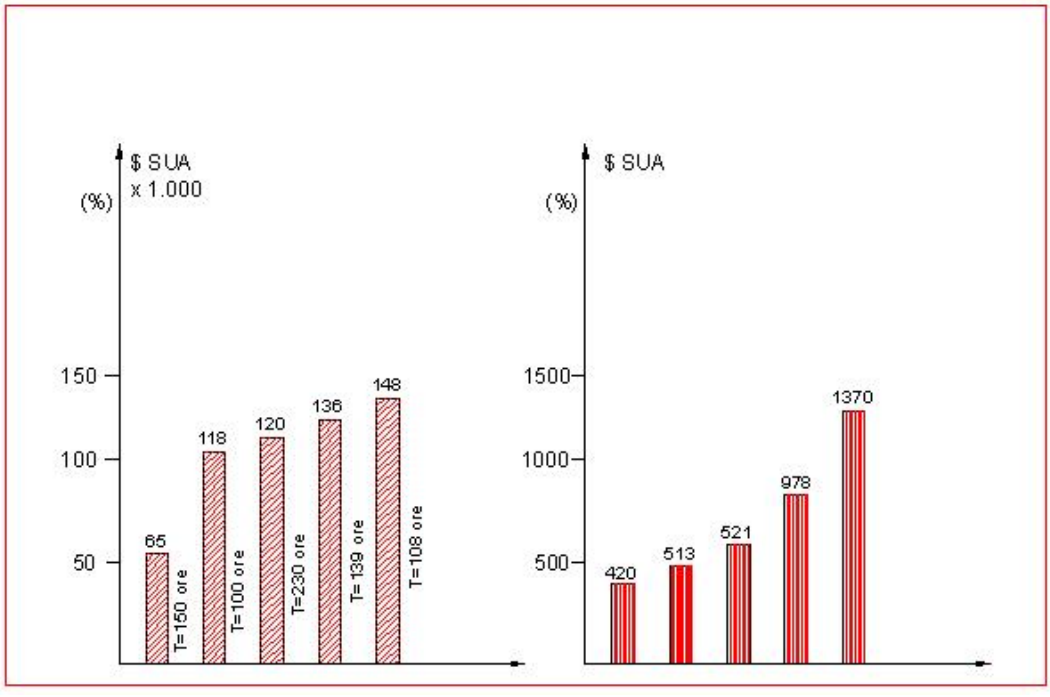

Fig. (4) – Total cost for a pilot training reported to number of hours per type of aircraft

Fig.(5) – Cost of flight hour (in US dollars) per type of aircraft

Type of aircraft

1. FOUGA MAGISTER
2. T.33.A
3. A. MACCHI MB. 339 V.
4. A. MACCHI MB. 339 L.
5. G.91.T.

Analyzing the graphs above gives the cost of a flight hour without logistics:

- FOUGA MAGISTER
  - Total flight hour costs for a pilot was estimated to 6500 USD for 150 hours, so that each hour costs approx. 433 USD at the time's value.
- AERMACCHI – MB – 339 (V) si (L)
  - Total costs for flight hours allocated to a pilot was approx. 120000-136000 USD for 139 hours, resulting in 863 to 978 USD per hour
- T.33
  - Total flight hour costs for a pilot was 118000 USD for 100 hours, that leading to the sum of 1180 USD per flight hour
- G.91.T. subsonic fighter jet
  - Total costs for a pilot's flight hours were 148000 USD for 108 flight hours, leading to a cost of 1370 USD per flight hour.

To these costs, as noted above, one must add the logistics cost that represents between 40 and 60% of a flight hour cost and that is very different from country to country, based on the technical level of the hardware and personnel, and aircraft requirements for the type.

To calculate present values for flight hours, based on figures of the 70's and 80's one must account for the depreciation of the US dollar compared to the 2009 value.

Because subsonic flight hour cost data are not published or if published not updated, to compare the costs I took into account the difference in value between nominal and real value of the USD for the 80's and compared it to the situation in 2009 (fig. 1) and reached a value that approximates the flight hour costs for this plane type, at around 1350 and 1800 $.

The flight hour costs for advanced or basic training on a subsonic plane, compared to a supersonic fighter, places it in a ratio of 1 to 2,5 to 3, even bigger in some cases.

For a comparison it is necessary to know the flight hour cost for supersonic aircraft at the 2008 level.

In a study published and recently available on the internet, estimations on flight hour costs for supersonic aircraft belonging to NATO countries, both Eastern and Western, including the associated services, are made.

List of combat aircraft flight cost per hour,

From various sources and their claims:

- Gripen $3,000 – $4,500 USD
- F – 16 approximately $3,500 – 5,000 USD
- Rafale $16,000 USD
- F – 22 $19,000 – $40,000 USD
- F – 15 $17,000 – $30,000 USD
- Eurofighter Typhoon – $14,000 USD
- F – 22 was $19 k, F – 15 $17 k (200 $ figures): http://hatch.senate.gov/public/_file...nsAndFacts.pdf
- EA – 18G expected to cost – $7400 vs. EA – 6B – $17000 + (probably also 200 $ figures)

To these costs one must add 40 to 50% for logistics and personnel. Because these costs are not clearly explained regarding to what they cover, we must regard them with a certain skepticism.

A potentially subjective source confirms them – Flygvapnet - the Swedish Air Force - fig 10; these costs covering a service pack the producers of the aircraft offer, such as training for pilots and technical personnel (familiarization with the type), spare parts (within warranty), fuel, logistic support (during transition to the type), etc.

Comparing the costs between the two types of aircraft, subsonic and supersonic, and accepting a mean cost per flight hour of 1350 to 1800 USD for a subsonic jet and 4500 to 5000 USD for a supersonic jet, the ratio becomes.

In the case of Gripen and F16:

$$\Delta C_{(MED)} = \frac{C_{(\cos t)} / ora_{Av.(SS)}}{C_{(\cos t)} / ora_{Av.(Ss.)}} = \frac{(4.500 - 5.000)}{(1.350 - 1.800)} \cong (2{,}8 - 3{,}4) ori$$

For the Eurofighter:

$$\Delta C_{(MED)} = \frac{C_{(\cos t)} / ora_{Av.(SS)}}{C_{(\cos t)} / ora_{Av.(Ss.)}} = \frac{14.000}{(1.350 - 1.800)} \cong (7{,}8 - 10{,}5) ori$$

In other words for one flight hour with a supersonic aircraft, 2,8 to 3,4 times the money for a subsonic flight hour are spent (in USD); this is only a mean estimation, in some cases it can be significantly greater, as shown above.

This conclusion was the basis on which the flight programs were restructured to obtain some cost cuts and to better distribute the allocated funds so that a greater flight hour number could be achieved on subsonic advanced trainers, so that the total flight hour number per pilots would increase or at least not decrease.

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