SOME THOUGHTS ABOUT CHANGE OF FIGHTERS AT AIR FORCE OF THE EAST-EUROPEAN COUNTRIES

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Abstract

The most of the Middle- and East-European countries are in the transition. After change of their political situation, they had a big economical crisis. In this situation they have a great problem of modernisation of their Air Forces. Principally they can modernise their old fighters or they can change them.

The lecture describes the basic elements of the aircraft modernisation. It summarises the possibility of modernisation of fighters, type MíG. It defines the future mission and role of fighters.

The most interesting question is which type of fighter is the best for given countries. There is no exact answer for this question. The authors have developed special method and characteristics for taking into account the real tasks of given Air Forces. These characteristics are based on the relationship between the probability of solving the cost to total life cycle cost.

Introduction

Most of the Middle and East European countries are in the transition. After change the political situations they have to improve their economy and they try to connect to European Union. These processes are connected with change in their defence policy, too. They would like to joint to NATO. Three from them, Chech Republic, Hungary and Poland are the member of NATO already.

The new role of Middle and East European countries initiates the requirements in modernisation of their army. Unfortunately their economy too poor for make a considerable change in the technical support of army. Even a great number of politicians think that the NATO will going to safe of their countries and not required to spend money for army modernisation. Some times we can meet their another arguments: the military technology will have a revolution in the defence system organisation and technical support. Therefore the countries of poor economy have to wait for this change and they have to develop their army only after technology revolution. They think not only about the changes of the military techniques, but they have opinion about the relative decreasing in the preliminary cost (price) of new developed military systems and techniques.

Air forces of the Middle and East European countries meet the transition in their political and economical situations in relatively bad condition. They had Russian made fighters and helicopters designed with application of another defence and technology support philosophy. The labour cost was very low. The maintenance was based on the cheep man work. The aircraft were designed for tactical fighting. Etc.

The goal of this lecture to do more clearly some specific features of the air force

modernisation. It tries to give answer on the questions why, what and when we have to do.

The lecture is focused on modernisation of the Hungarian Air Force, having may be a most critical situation. The Hungarian Air Force met the transition period with the small number and mostly old fighters. The SU-22 operation was stop on the political decision. However they were the multifunction fighters. The fighters, type MíG-21are designed 30 years earlier. Finally the MíG-29 were bought several years ago on the basis of Russian liability. All the fighters operated by Hungarian Air Force have the problems with low service life, low reliability, high maintenance cost. Their electronic equipment has to be modernised. They have no interoperability, they can not integrated into the NATO wings. However the MíG-29 may be the best fighters in world according to the aerodynamic and flight mechanical characteristics. From the another hand, such small country like Hungary needs small number of multifunction fighters.

1. The modernisation

The aircraft development is a complex long period process. The first 15 - 25 years are used for initial investigation of the new ideas. This part of development includes the theoretical study, laboratory, physical and flight experiences. These investigations are finished by concurrent projects. After choosing the final version and specification of the aircraft can start the real design of the new airplane? It is based on the airplane and technology process design, prototype production, laboratory and flight investigation, corrections, airworthiness examination, production and commercialisation. The second part of development longs 4 - 6 years. The airplane has to be design for 20 - 25 years of operational life. The good fighter will be in production for 10 years. So, the second part of aircraft development, the production period and the technical life together define 35 - 40 years, for which the aircraft has to be developed.

It is too long time period. In practice after 5 - 8 years, a lot of new ideas, technical decisions are appeared. After 12 - 15 years some principal, considerable changes can be found in the aircraft development processes. Finally, each 20 years a new generation of aircraft is designed.

In practice the technical and economical goodness of the aircraft, e.g. the tactical characteristics and the applicability of fighters change on the different ways (Fig. 1.) This backwardness in the economical goodness called as moral growing old.

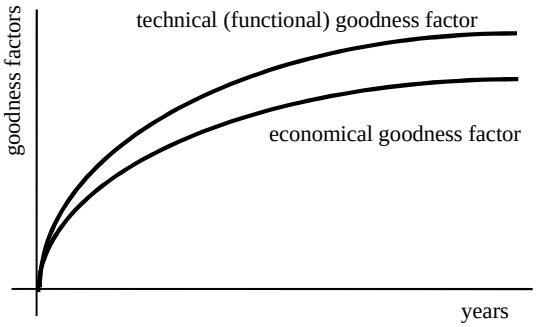

Fig. 1. Changes in technical and economical goodness factors

Let supposed, we bought the best fighters, e.g. fighters with the best characteristics, technical condition allowed by given level of sciences and technology. Of course the level of sciences and technology are increasing exponentially. However the technical condition of our fighters as usually are decreasing stochastically during their operation. When the degradation in the technical condition is accelerated, we have to use some different technical methods for returning to the initial degradation process. This works are called as maintenance (Fig. 2.). If the technical condition is too poor, we have to apply the methods of repair for return the technical condition to the initial one. (In this case, all the characteristics can not be equal to the production characteristics, but the functional characteristics will be very closed to the initial ones.)

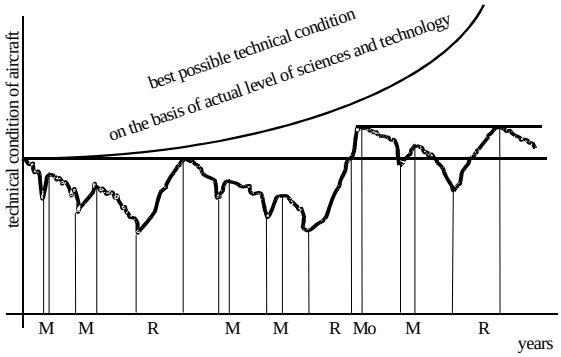

Fig. 2. Change in technical condition of aircraft during its operation (M - maintenance, R - repair, overhaul, Mo - modernisation)

When the gap between the possible technical condition defined by level of sciences and technology and the initial condition of our aircraft quit big, then we can apply the methods of modernisation. In this case, the aircraft will be equipped with new, more modern electronic equipment, some structure elements can be changed, a new engines, new repair technology can be used, etc.

In general case the aircraft development and modernisation strategy are the following (Fig.3.). Instead of conventional development the airplane is 'overdesign' at the beginning of its development. During design the new methods and technology are taking into account that would be available to start of production. The aircraft actually developed have technical condition not changing during commercialisation. However the later developments can result to higher goodness factors. Therefore after 12 - 15 years the aircraft goodness factor can be and has to be increased with use of methods of modernisation.

So, the initial question is that, is it enough to modernise the old fighters or not.

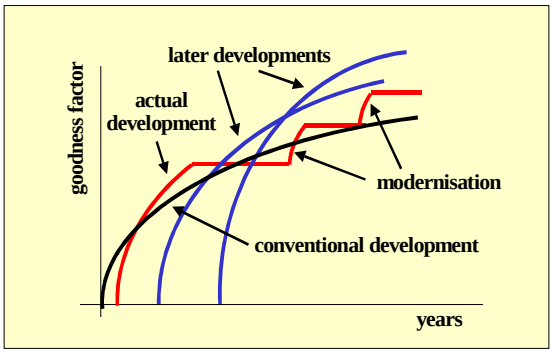

Fig. 3. Applied modernisation strategy (explanation in the text)

2. The possible modernisation of MíG type fighters

The Hungarian Air Force operates two different type of MíG. The MíG-21 designed after Korea experience as a high-performance short-range air-superiority fighter. Since 1955 it has been developed to have good all-weather capability, and with steady improvement in range and weapons. This type of fighter has built in up to 20 modifications and becomes to most extensively used fighter in the World.

The Hungarian MíG-21 fighters so old aircraft that their modernisation was not a question. The leaders of Hungarian Air Force well understood that, the safety support with spare parts could not organise for this type of fighters. However there was a good proposal for their modernisation. Two Israel companies proposed to supply the MíG-21 by electronic elements of F-16 and LAVI. The proposal includes the new radar, multifunction onboard computer, GPS system, new navigation system, weapons control, etc. But there is no information about the change of the 30 years ago developed gas turbines, increasing the manoeuvrability, spare part support.

The another fighters operated by Hungarian Air Force are the MíG-29. This type of aircraft was developed 20 years ago. It seems the MíG-29 has the best aerodynamic and flight mechanical characteristics from the modern fighters. At least they very liked by pilots. Unfortunately the reliability, the service

life are very low and the cost of operation is too high. They have some problems with radio-navigation systems, reconnaissance and target system, weapon controls, etc.

We can define the following tasks for modernisation of MíG-29:

- development of the electronic systems including the change of transponder, radio system, radio-navigation system, laser inertial radio-navigation system, GPS,
- change of weapons and weapons control,
- increasing the service life
- reducing the total life cycle cost
- solving the safe support with spare parts.

Finally, after modernisation of MíG-29 still we will have the following problems:

- the service and calendar life are too small,
- cost of operation is too high (see Fig. 4.)

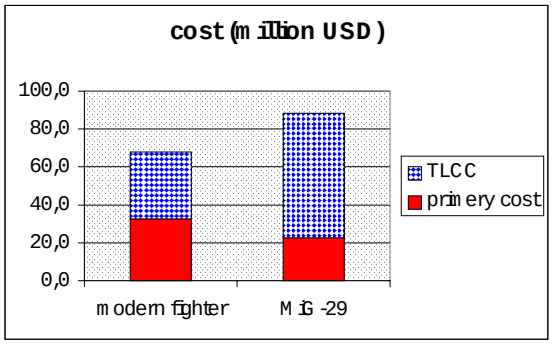

Fig. 4. Comparison between the primary and total life cycle cost (TLCC)

- no proposal for increasing the service life of gas turbines,
- too high cost for giving them multifunctionality,
- they will not have real interoperability.

So, the problem of Air Force development in the East-European countries will not solve by modernisation of old fighters.

3. Future mission and role of fighters

The tasks of fighters can be defined as:

- guarantee the air space sovereignty,
- defence of the home territory,
- participation in coalition operations.

The countries having poor economy or/and small territory should have the multifunctional fighters with fast turn around for solving these tasks.

The modern fighters are the aircraft of fourth generation, characterised by the followings:

- real multifunctionality (reconnaissance, air combat, ground operation support at least),
- full digital system of aircraft, engines and weapons control,
- excellent communication and data link between the pilots, operators and fighters giving good situation detection,
- excellent aerodynamic and flight mechanical, tactical characteristics in closed combat,
- their takeoff weight relatively small, the airplane has small and special surface for reducing its reconnaissancebility,
- comprehensive weapons options, the fighter after software change can be equipped with the new weapons, too,
- principally reduced total life cycle cost,
- excellent flexibility in operation and survivability in war situations,
- etc.

It seems there is not real and good definition for classification of fighter generations. We think the different generation can be defined more easily on the following basis:

- first generation: fighters with gas turbine engines,
- second generation: supersonic fighters,
- third generation: fighters equipped with the developed radar systems,
- fourth generation: fighter with fully digitised control systems - software aircraft.

Principle, the fourth generation fighters can be called as software aircraft, because the price of software, software development is may be greater then price of hardware part, e.g. primary cost of airframe.

In any case, the cost, namely the total life cycle cost of operation may be the most important factor for the countries with poor economical background. In reality the total cost of operation of 30 fighters can reach 4000

million USD during 20 years. It is the three times greater amount then primary cost Fig. 5.)

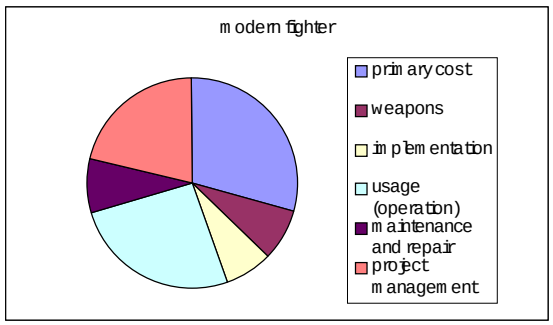

Fig.5. The component of the total life cycle cost

The specific features of the modern fighters can be summarised in form shown on the Figure 6.

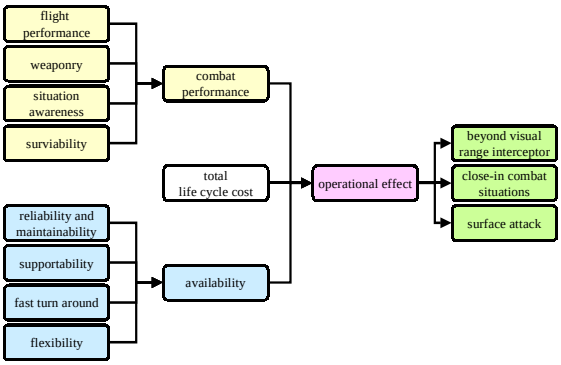

Fig. 6. The mean specific features of the modern fighters

Today the fighters are used as one, may be a very or most important, elements of the advanced air battle system. The change in strategy of fighter application as shown on the figure 7. circulated by SAAB makes not easier decision about the air force modernisation. Here is the revolution in the defence system. The defence will be based on the net centric system including the dominant battle air control, integrated control and command system and the precision weapon systems.

Sometimes we can meet opinions of several politicians according to which we have to wait with our air force modernisation until change in defence strategy.

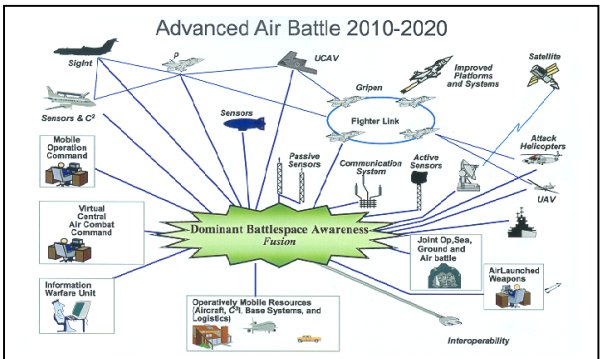

Fig. 7. The change in strategy of the defence system

4. Evaluation of fighter efficiency

From the technical point of view, according to the air force modernisation the most important question is how to choose the fighter best for the given country.

All experts were defined that, the best fighter that, which has a minimum life cycle cost at the acceptable level of operational effectiveness. But there is no good method or parameters for evaluation of the fighter operational effectiveness.

We think that the best fighter is that which can solve its tasks with the maximum probability at the minimum cost. Therefore we were introduce a new evaluation factors:

- integral efficiency factor of fighter operation

$$E_1 = \frac{\sum_{i=1}^{n} k_i P_i}{TLCC} \quad ,$$

- integral efficiency factor of air force operation

$$E_1 = \frac{\sum_{i=1}^{n} k_i P_i}{TLCC - I} \quad .$$

where i = 1, 2, … n, number of task has to be solved by air force,
k – weighting factor,
p – probability of solving the given task,
TLCC – total life cycle cost,
I – incoming, or benefit from operation of the new fighter.

In ordinary case, the air force has to solve three, four different tasks: close-in air combat, ground operation support, reconnaissance, long distance coalition operation. The weighting coefficient can be the different for different countries depending on the real geographic and political situations.

The probability of solving the given tasks can be calculated by application of different simulation methods. The models have to base on the advanced flight mechanics and combat simulation.

The incoming from operation of given fighters depend on the technology level of the aircraft and the country going to operated those aircraft. In simplified case, the offset program (Fig. 8) gives great possibilities for reducing the primary cost of new fighters.

For the East-European countries the extra advantage can be defined, because the technology transfer. After jointing to the offset programs, the industry of these countries can take part in the well-developed production processes. They will work on the high technology level with application the quality management. And they will generate new and higher level of requirements to their suppliers. So the general level of industry will be increased.

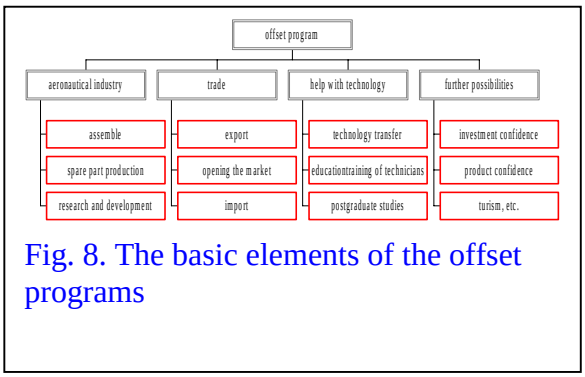

Fig. 8. The basic elements of the offset programs

Summary

This lecture deals with the problems of air force modernisation of the East-European new democratic countries. These countries have Russian made fighters become morally old. Their fighters have to be modernised or they have to change them. The given countries have economical crisises during last decade. So, the change of fighters for them generates a great problem.

After making more clear the principle of aircraft modernisation, the authors were outlined some specific future and role of modern fighters. Finally they recommend two specific efficiency factors for evaluation the operational effects of new fighters.

The general conclusion is that, the East-European new democratic countries with poor economy should have to have not a big number of new fighters, but those fighters should be the high technology product. These countries with buying the new fighters can touch the new level of technology influencing on their economy and forcing their industrial activities.