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IMPLEMENTATION OF THE GREEN FLIGHT INTO AIRSPACE OF UKRAINE

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Abstract. *The article deals with the analysis of the current Green Flight challenge in Ukraine, investigation of the factors that influence on Green Flights implementation, analysis of all systems that are corresponded to conception of Green Flights development, current problems and ways of their solution.*

Keywords: aircraft technology; Air Traffic Management; compatibility of technologies; Continuous Descent Operations; decarbonisation; Energy Management; fuel hedging strategies; Green Flight; modernisation; noise reduction; Perfect Flight; sustainable alternative fuels; User Preferred Routes; CO₂ emissions.

1. Introduction

Fast development of technologies in the last 50 years, shows the necessity quickly react on the environment question that is very important for the all world community.

One of the key objectives of the Europe 2020 strategy is to Reduce greenhouse gas emissions by at least 20 % compared to 1990 levels.

This is echoed in its flagship initiative “Resource Efficient Europe”, which aims to modernise and decarbonise Europe’s transport sector.

In this context, the 2020 strategy paper recognises that intelligent air traffic management would help to reduce aviation’s CO₂ emissions

The aviation industry contributes 2 % of man-made CO₂ emissions, 80 % of which are from flights of over 1,500 km for which there is no practical alternative mode of transport.

As demand for air transport grows, the aviation industry is committed to further reducing its CO₂ emissions improving fuel efficiency by 1,5 % annually until 2020.

It aims to achieve carbon neutral growth from 2020 and work to meet an ambitious goal of a 50 % reduction in net carbon emissions by 2050 compared to 2005 levels.

2. Analysis of researches

Ukraine is developing country, located in the centre of Europe, we are partnership of ICAO and EC organizations we must support and develop new strategies connected with reduction of CO₂ emissions [2].

Aviation is very rapidly evolving, and the demand of it services is also growing rapidly.

The last researchers in this sphere are concerned on the influence of its growing to the environment.

3. Perfect Flight

We have three components where we should make changes for improvement of eco-efficient flights. Schemes on Fig. 1 demonstrates us this elements.

All this elements are tightly connected and if we make changes in one of the three elements it will trigger corresponding changes in other elements.

Our task is analyse observantly existing technologies, ATM tools and operations, observe newly proposed systems and make priorities to that project that will give us the best result with the minor expences in the shortest period of time.



Fig. 1. Main elements of Perfect Flight realization

So, we can see that “Green Flights” is complicated system that consisted of many parts.

As we can see in the Fig.2 system includes different elements: procedures, organizations, equipment, invitations that are used in the world.

We must analyze all approaches and the most appropriate apply to the current system in Ukraine in order to improve the whole system and make it more environmentally friendly.

There are ten elements that related with eco-efficient flights mentioned above, lets analyze them in turn and then we will choose which of them are appropriate for aviation system of Ukraine.

Through government involvement in Fuel Hedging Policy and its material support, we must build continuous strategy of Green Flights realization.

Worldwide alternative fuels strategy is based around being the catalyst in the search for sustainable solutions for the production of affordable alternative fuels in sufficient commercial quantities to face the environmental challenges for aviation, but we should search for immediate solution of the

problem and use for its current technologies, instead of rely on future investigation of alternative fuels.

We faced with this problem, and we should solve it with the help of changes in current ATM, operations, aircraft procedures and so on, we cannot wait anymore.

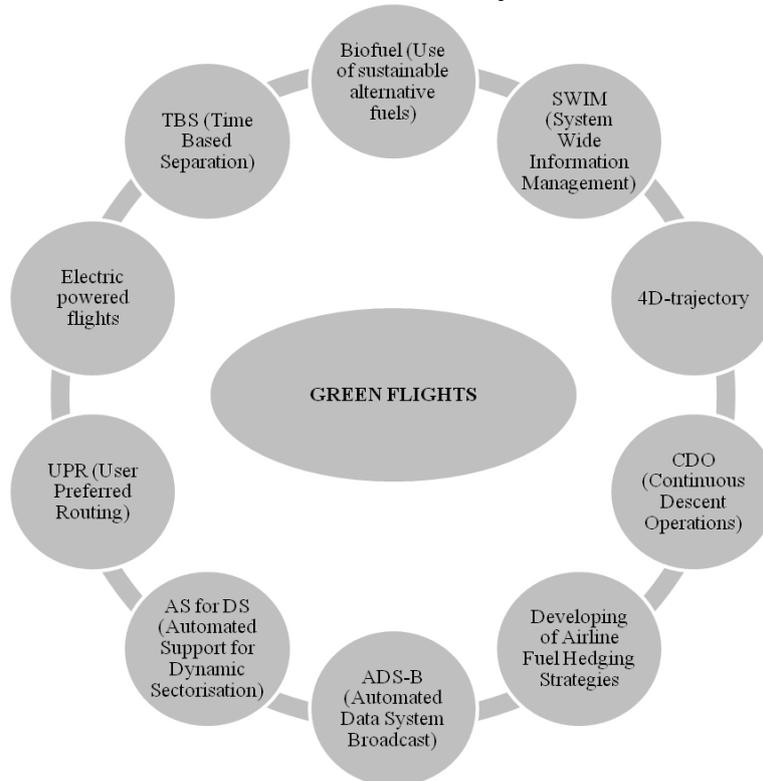


Fig. 2. Systems that are required for Green Flights realization

4. Brief description of the systems and ways of its implementation in Ukraine

Let's start with Biofuel, sustainable alternative drop-in fuels, produced from renewable resources, can reduce aviation CO₂ emissions by more than 50 %.

The emissions reduction is a result of the total lifecycle of the alternative fuel's production.

For the foreseeable future, aviation has no other option to power aircraft than drop-in fuel and finding a sustainable alternative to fossil fuels that can be produced in sufficient commercial quantities without competing with food crops and water is a priority [1].

But this element is under development and Ukrainian government can only participate in the research projects and assist financially such company as "Motor Sich" for developing alternative fuels.

5. System Wide Information Management

The concept of System Wide Information Management (SWIM) - covers a complete change in

paradigm of how information is managed along its full lifecycle, involving stakeholders from across the whole European ATM network.

System Wide Information Management is SESAR's most important enabler for assuring that the right information will be available with the right quality to the right person at the right time.

It covers all ATM information, including aeronautical, flight, aerodrome, meteorological, air traffic flow, and surveillance.

System Wide Information Management consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.

System Wide Information Management Infrastructure is the interoperable (runtime) technical infrastructure (Ground/Ground and Air/Ground) over which the data will be distributed.

Its implementation may, depending on the specific needs profile, differ from one stakeholder to another, both in terms of scope and way of implementation.

It will offer SWIM technical services based as much as possible on mainstream IT technologies. It will mostly be based on commercial off-the-shelf products and services, but it is possible that in some cases specific software may need to be developed. Typically the Pan European Network System and the Internet will provide the underlying basic Ground/Ground connectivity.

System Wide Information Management is very important element of the "Green Flights" system, this system influence on the other concepts which must be implemented to provide eco-flights.

For example Continuous Descent Operations (CDO) and User Preferred Routing concepts are required an accurate and updated information that can be given by SWIM.

System Wide Information Management is the one of key elements that give us opportunity to reduce CO₂ emissions, implementation of this system impact on the implementation of the other systems, that cannot work properly without such system like SWIM.

The one of the main task of our aviation authority is to take part in developing of the SWIM for Ukraine, and search ways how to implement it, because its implementation depends on the specific needs profile, differ from one stakeholder to another.

We must find out the best way of its implementation and propose our concept.

Without this system we cannot improve the current system, because as we know aviation is very complicated business where all elements are interconnected.

6. 4D-trajectory

Moving from Airspace to 4D-Trajectory Management entails the systematic sharing of aircraft trajectories between various participants in the ATM process to ensure that all partners have a common view of a flight and have access to the most up-to-date data available to perform their tasks. It enables the dynamic adjustment of airspace characteristics to meet predicted demand with minimum distortions to the aircraft trajectories.

On 19 March, a flight trial – prepared by SESAR members - going from Toulouse to Copenhagen and then Stockholm, successfully validated the sharing of trajectory information both in ground and airborne operations, and the capability of the aircraft to comply with time constraints in the en-route and approach phases of the flight.

The flight trial further confirmed that 4D offers important safety and environmental gains, as well as

increased flight predictability and overall network efficiency.

Our task is trying to apply 4D-trajectory in Ukraine, will prepare all required tools, test it in our airspace system, and then create new software for it further implementation.

7. User Preferred Routing

Extended implementation of direct routes to week days allowing for 24 h/7 day capability will result in:

Improved flight efficiency as a result of reduced average flown distance and reduced flight time;

Controller workload maintained within acceptable limits, despite capacity increase;

Environmental benefits from improved vertical guidance, resulting from reduced fuel burn and noise footprint.

It will be accessible only after implementation of 4D-trajectory, but we should be prepared for such types of flight and install procedures for it exploitation.

Usage of such kind of flights will reduce the flight times and as the result will be reduced CO₂ emissions and pilots can regulate the level of flight during approach and mitigate the noise level.

8. Continuous Descent Operations

Continuous Descent Operation is an operation, enabled by airspace design, procedure design and ATC facilitation, in which an arriving aircraft descends continuously to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix.

The effects of aircraft noise and atmospheric emissions can cause constraints at aerodromes and increase operational costs. To help mitigate these issues, CDO offers a flexible continuous descent and approach flight path that delivers major environmental and economic benefits without any adverse affect on safety [3].

Consequently, the rapid, widespread deployment of harmonised, capacity-friendly versions of the CDO technique throughout Ukraine, even on a limited basis (that is, limited by hours of operation and commencement height), will be beneficial to all Ukrainian ATM system and will empower the network to respond positively to environmental challenges.

Moreover, future changes to the airspace architecture and the widespread availability of harmonised support tools for controllers, which will ensure lateral and/or vertical segregation without impeding the optimum profile, will allow CDO to

evolve to usage for longer periods of the day and commence from higher levels – the ultimate aim being 24 operations from Top of Descent.

The principle of CDO is an approach procedure that allows descending on an optimum basis.

The CDO involves the management of the aircraft configuration (flaps, speed brakes, landing gear, and thrust) by the pilot (known as descent energy management) to use the minimum required thrust on a variable glide angle into an airport.

The first step that must be taken into account is the outdated vehicles that are used by Ukrainian airlines which cannot provide appropriate level of technical characteristics required for CDO.

So, we should solve such problems: calculate TOD (top of descent) for all types of aircraft that will be executed CDO, calculate suitable profile for flight that depends on aircraft type, aircraft weight, weather, wind, temperature, retraining of pilots on the course of descent energy management.

On the State basis provide programs to change the old aircraft to the new, it is very expensive changes but it will greatly improve safety level and reduce CO₂ emissions, State should implement it gradually and provide corresponding financial support.

9. Developing of Airline Fuel Hedging Strategies

We should realize that aviation is also a business process, and we always will be constrained with management dilemma between protection and production.

Hedging fuel costs is widely practiced by most international airlines but its theoretical justification is weak.

Airlines do something the industry calls 'hedging' to protect fuel costs.

Hedging broadly means locking in the cost of future fuel purchases.

This protects against sudden losses from rising fuel prices.

Locking in fuel prices also prevents sudden gains from decreasing fuel prices.

So airlines hedge fuel to stabilize fuel costs.

Fuel is about 15 % of the airlines' costs.

Other costs are less volatile than fuel prices, so hedging fuel stabilizes overall airline costs.

More stable costs also mean more stable profits. Its important for Airlines at first sight, but as we remember aviation is complicated and interconnected system and CDO are depended on profile of flight which in turn depends on aircraft weight, and aircraft weight is greatly changed with the amount of fuel.

Naturally pilots will not think about the environment or energy safety management when they can earn additional money due to differences in price of fuel in the airport of departure and airport of arrival.

So, we need to regulate on the State level a policy of permanent hedging of fuel costs because it should leave expected long-run profits unchanged, and propose some projects of fuel hedging to the Euro Control Commission as one of the element that will be led to realization of environmentally friendly flights.

10. Electric powered aircraft

Electric powered aircraft – is a future solution of the problem, nowadays we have such aircraft, but they only have been tested and not ready for implementation yet.

Today's environmental and energy concerns compel aviation to go "Green".

Green Flight Challenge sponsored by Google was announced at Air Venture 2009 in Oshkosh, the first time in history that full-scale electric powered aircraft will fly in competition.

There were aircraft include those propelled by gasoline, bio-diesel, hydrogen, and electricity.

We should pay attention on the development of future technologies and invest money to leading Ukrainian academies and companies that work in that sphere.

I think, we should put into operation new projects which will include collaboration with international academies and companies that are engaged in investigation of new technologies and are interested in improvement of environment.

11. Time-based Separations

Time-based Separations project will aim at defining and investigating the relevance of a new concept of operation applied to the arrival phase of flights.

The actual distance based separations are to be replaced by time intervals, and/or speed compensation as applicable.

The Time-based Separations project will investigate the possibilities of preventing loss of runway capacity under strong wind conditions while maintaining the required level of safety in:

- Assessing a new concept of separation based on time intervals as opposed to current RADAR or ICAO Wake Vortex separation criteria defined as distances;

- Investigating the use of longitudinal separations of less than 3 NM;

- Exploring the possibilities of compensation of wind effect by aircraft speed adjustment and associated required ATC techniques.

After Validation of the Time Based Separation (TBS) concept at London Heathrow Airport was found out that the TBS concept is viable from a safety and human performance assessment perspective; and could deliver significant benefits in terms of recovering the reduction in landing rate currently experienced with Distance-based Separation in headwind conditions, with the resulting beneficial impact on the environment and the predictability and efficiency of operations.

So, we should try to conduct the experiment of TBS concept at one of the airports and weigh all pros and cons of its implementation.

We must observantly learn the scenario of TBS at London Heathrow Airport and remake it for our standards.

It will greatly reduce noises and CO₂ emissions.

12. Automatic Dependent Surveillance Broadcast

Automatic Dependent Surveillance Broadcast (ADS-B) provides a highly accurate and effective means for air traffic controllers to provide air traffic surveillance services outside of radar coverage.

An aircraft with ADS-B determines its position using GPS.

The aircraft then broadcasts that position at rapid intervals, along with identity, altitude, velocity and other data.

Dedicated ADS-B ground stations can receive the broadcasts and relay the information to air traffic control for precise tracking of the aircraft.

ADS-B data is broadcast every half-second on a 1090 MHz, digital data link and, like radar, is limited to "line-of-sight."

The ability of a ground station to receive a signal depends on altitude, distance from the site and obstructing terrain.

The maximum range of each ground station can exceed 250 nautical miles. In airspace immediately surrounding each ground station, surveillance coverage will extend to near the surface.

Automatic Dependent Surveillance Broadcast equipage is mandatory for operations at/above FL290 from 12th December 2013.

But for lower airspace it is not mandatory and pilots must be aware that aircraft without ADS-B and not under air traffic control may be operating in some class of airspace and will not be visible or known to ATC.

Automatic Dependent Surveillance Broadcast concepts are widely used in Ukraine, and its operational abilities give us opportunity to make flights more eco-efficient.

We must develop all functional abilities of that system and with the help of it develop new green routes.

It is cost efficient because we have that system, we should only change routes during descent/climb stage of flight, calculate Top of Descent for aircraft, that often make flights, organize courses of Energy Management for pilots that will take part in this project.

13. Automated Support for Dynamic Airspace Sectorisation

Automated Support for Dynamic Airspace Sectorisation-this project was created for the purpose of workload and complexity optimisation at local level, this improvement relates to the Dynamic Management of Airspace Configuration in a global approach through wider areas up to the regional level.

The objective is to manage the airspace as a continuum to meet the users' expectations.

This automated support optimises airspace configuration based on workload and complexity, avoiding inconsistencies and side effects in the activation of airspace structures.

It encompasses sectors organisations based on predefined basic airspace volumes, interfaces between En Route and Terminal Area, activation of free route airspace structures, management of Variable Profile Areas and Cross Border Areas, dynamic airspace configuration to answer to the User Preferred Routing concept.

The system provides support for the assessment and comparison of different airspace configurations, for the decision making process, taking into account different kind of parameters, and for the monitoring of the implemented solutions in order to make best use of the available airspace and human resources at any given time.

We should take part in this project, because as we have understood aviation is interconnected system and one of the elements cannot exist without implementation of the other one.

So, User Preferred Routing concept cannot exist without Automated Support for Dynamic Airspace Sectorisation, especially this concept combined with UPR will greatly reduce CO₂ emissions and noise level.

14. Conclusions

There are a lot of ways to reduce noise level and CO₂ emissions.

We have considered main of them and propose some recommendations for its implementation in Ukraine.

We want to accent again your attention that aviation at all is very complicated and interconnected system, also it is business that must bring profit.

We have very hard problem to combine provision of aviation as business process at the same time provide high level of safety and conduct the flights as more environmentally friendly as it can be.

It's really great challenge, but all world society are directing their power to solve it.

First of all Ukraine must connect to all "Green" projects and develop own strategy for their solution.

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Наведено нові концепції розвитку авіації, які спрямовані на зменшення забруднення навколишнього середовища вихлопними газами, зниження шумів та раціональне використання наявних ресурсів. Розглянуто галузь авіації як бізнес підприємство, яке має приносити прибуток. Особливу увагу приділено системам гармонійного розвитку авіації, які є найактуальнішими для України.

Ключові слова: альтернативне паливо; вуглекислий газ; забруднення навколишнього середовища; екологічний політ; інноваційні методи організації польотів; шуми.

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Приведены новые концепции развития авиации, направленные на уменьшение загрязнения окружающей среды выхлопными газами, снижение шумов и рациональное использование имеющихся ресурсов. Рассмотрена отрасль авиации как бизнес предприятие, которое должно приносить прибыль. Особое внимание уделено системам гармоничного развития авиации, которые являются наиболее актуальными для Украины.

Ключевые слова: альтернативное топливо; загрязнение окружающей среды; инновационные методы организации полетов; углекислый газ; шумы; экологический полёт.

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