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ON THE IMPACT OF THE AIRCRAFT'S AERODYNAMIC CHARACTERISTICS ON THE FLIGHT OPERATIONS SAFETY AND EFFICIENCY

Introduction

The aircraft's aerodynamic characteristics play a crucial role in determining of the Airline's flight operations safety and efficiency. In terms of design, aircraft have now for quite a long time been following a conventional configuration which presents a few practical advantages but is rather far from the theoretical efficiency limits, as it relies on the functional separation between payload-carrying and lift-producing elements. Key limitations of this approach include [1]:

the fuselage producing substantial drag but insignificant lift, which weighs heavily against aerodynamic efficiency (i.e., the ratio between lift and drag of the entire aircraft in representative operational conditions);

the concentration of very significant shear stresses and bending moments in small sections of the wing root, which then have to be reinforced adequately, adding substantial structural weight;

natural tendency to develop large tip vortexes, which result in an energy-dissipating and operationally hazardous turbulent wake.

Advanced aircraft configurations attempt to enhance the aerodynamic efficiency of the aircraft in representative operational flight conditions, compared to conventional designs. Various solutions have been proposed throughout the years [2–4], including hybrid wing-bodies (e.g., blended wing-body, flying wing), box-wing aircraft and advanced morphing aircraft technologies. Some of the key gains in such technologies include respectively 30 % increase in aerodynamic efficiency or 40 % reduction in induced drag. Despite the relatively high confidence in these theoretical efficiency gains and some successful operational experience in the defence sector, the actual adoption of these advanced concepts in the civil transport domain has been encumbered by the limited maturity of certain technologies and a lukewarm attitude by major aircraft manufacturers, which adopted a more risk-averse approach financially, resulting in further evolutions of the conventional configuration. More recently, the diminishing returns associated with further investments in conventional aerodynamic technologies is eliciting a more courageous attitude in embracing the new configurations.

For instance, Airbus has unveiled that the most advanced hydrogen aircraft concept being investigated for marketization in just a couple of decades is a blended wing-body [5]. The general and business aviation sectors also appear more interested in experimenting with some more advanced configurations and it is expected that this will also contribute to the large transport aircraft sector's willingness to develop and marketize the new concepts.

In general, the impact of the aircraft's aerodynemic characteristics on the flight operations efficiency can result in higher fuel consumption, reduced range, reduced endurance, and higher operational costs. Regarding this, aircraft manufacturers need to continually improve aircraft's characteristics to increase an efficiency of flight operations. The primary questions we aim to address in this article are as follows: How does aircraft's aerodynamic characterristics affect the overall effectiveness of flight operations? And how can this impact be avoided?

Analysis of the research and publications

There aren't specific researches related to the impact of aircraft's characteristics onto the safety and efficiency of flight operations, but here are some highly regarded references that comprehensively cover how aerodynamic characteristics influence inflight operations safety and efficiency.

In the encyclopedic work [6] by Daniel P. Raymer, author covers the relationships between lift, drag, lift-to-drag $\left(\frac{L}{D}\right)$, and their effects on range, endurance, and fuel efficiency. But this work covers every topic necessary to the understanding of aircraft design without any relation to flight operations efficiency. All topics in this work are presented from the point of view of the aircraft designer, not the specialist in any given topic area.

In another research [7] by John D. Anderson, Jr., covered detailed derivations of aerodynamic coefficients (C_L, C_D), induced drag, and performance analysis regardless to the flight operations efficiency.

In the [8] by E. L. Houghton and P. W. Carpenter focuses specifically on performance metrics (range, time, fuel burn) linked to aerodynamic design and also regardless to the flight operations efficiency.

Also in some classical papers we can find Breguet Range Equation – fundamental for jet aircraft range calculations as a function of $\frac{L}{D}$ and specific fuel consumption and Parasitic + Induced Drag Formulations – typical aerodynamic drag breakdowns used in performance optimization.

Problem statement

The assessment of the flight operations efficiency under aircraft's aerodynamic characteristics is a complex and multi-dimensional task that requires an understanding of aerodynamic basics and flight operations components and how aircraft's aerodynemic characteristics affect this processes.

In this regard, improving an aircraft's aerodynemic characteristics leads to significant gains in fuel efficiency, operational range, payload capacity, environmental performance, and in flight operations efficiency in general. At the same time, aerodynamics is thus central not only to the performance of an aircraft but also to the economic and environmental viability of flight operations.

In view of the above, there's a detailed breakdown of the main ways in which these characteristics impact operational efficiency as follows:

First of all, Lift-to-Drag Ratio $\left(\frac{L}{D}\text{ Ratio}\right)$, as the ratio of lift generated to the drag experienced by an aircraft – higher $\frac{L}{D}$ ratio means the aircraft can produce more lift for less drag, resulting in lower fuel consumption, longer range, increased endurance and reduced operating costs;

Secondly, Wing Design, impacts as follows: Aspect Ratio – higher aspect ratio wings (long and narrow) are more aerodynamically efficient because they reduce induced drag; winglets – reduce wingtip vortices, which lowers drag and improves fuel efficiency; swept wings – common in high-speed aircraft to reduce wave drag, although they may compromise low-speed performance;

In the third, Airfoil Shape or the shape of the wing cross-section, affects: stall characteristics; maximum lift capability; overall drag profile; optimized airfoils can delay flow separation, reduce drag, and increase performance at specific flight regimes;

In the fourth, Surface Smoothness and Cleanliness, affects: laminar vs. turbulent flow – smooth surfaces help maintain laminar flow longer, reducing skin friction drag; impact on operations – regular maintenance to keep surfaces clean (e.g., de-icing, cleaning bugs) can preserve aerodynamic efficiency;

In the fifth, Control Surface Efficiency, affects: efficient ailerons, rudders, and elevators minimize unnecessary drag during maneuvers; poorly designed or deflected control surfaces can increase parasitic drag, reducing overall efficiency;

In the sixth, Aircraft Configuration and Weight Distribution, affects: clean configurations (retracted landing gear, minimal external stores) reduce drag; proper center of gravity placement ensures balanced flight, reducing trim drag and control surface deflections;

In the seventh, Cruise Efficiency and Optimal Flight Profiles, affects: aerodynamic design directly influences optimal cruising altitude and speed; efficient designs enable aircraft to cruise at altitudes where fuel consumption is minimized due to thinner air and lower drag;

And finally, Impact on Environmental Sustainability – the better aerodynamic efficiency translates to lower CO_2 and NOx emissions, that's why so many commercial Airlines with aerodynamically efficient fleets contribute to greener operations and compliance with environmental regulations.

So, based on this, the aircraft design process involves more than a series of mathematical calculations. Therefore, the aviation engineers who operate these calculations plus aviation managers are an essential ingredient in this process. First and foremost, it must be emphasized that any aircraft engineering design selection must be supported by logical and scientific reasoning and analysis. The aircraft's designer is not expected to select an aircraft configuration just because he/she likes it. There must be sufficient evidence and reasons that prove that the current aircraft configuration selection is the best. The main challenge in decision-making process is that there are usually multiple criteria along with a risk associated with each one. Regarding this, some scientific techniques and tools for aiding decision-making under complex conditions should be used. However, in most aircraft design projects, there are some stages where there are several acceptable design alternatives, and the designer has to select only one of them. In such cases, there are no straightforward governing equations to be solved mathematically. Thus, the only way to reach the solution is to choose from a list of design options. There are frequently many circumstances in which there are multiple solutions for a design problem, but one option does not clearly dominate the others in all areas of comparison. Based on this, there are three common criteria in most engineering aircraft design projects are as follows: (i) cost, (ii) performance, and (iii) safety (and reliability). In contrast, the aircraft does the best job in terms of speed (fastest to travel), but it is usually the most expensive option. It is evident that, for a typical traveler and designer, all the criteria matter. Thus, the question is how to come up with the best decision and the optimum vehicle.

An aircraft designer must recognize the importance of making the best decision and the adverse consequences of making a poor decision. In the majority of design cases, the best decision is the right decision and a poor decision is the wrong one. The right decision implies design success, while a wrong decision results in a failure of the aircraft's design. As the level of aircraft's design problem complexity and sophistication increases in a particular situation, a more sophisticated approach is needed.

So, when we analyzing current models, we have to say that these models do not incorporate adequate solutions that enhance flight operations efficiency regarding the aircraft's aerodynamic characteristics. So, its necessary to present a set of comprehensive techniques to be used in the development of flight operations to increase their level of adaptation to aircraft's aerodynamic characteristics. There is not only target adaptation from a functional perspective, but also from an operational perspective. Consequently, taking into account all the aforementioned inputs, it is crucial to develop a comprehensive set of decisionmaking systems for airlines, encompassing both strategic and tactical planning. Applying scientific methods to solve and analyze these issues is of utmost importance.

Problem solution

To create a mathematical model of the impact of the aerodynamic characteristics of an aircraft on flight operation efficiency, we have to establish relationships between aerodynamic parameters and performance metrics like fuel consumption, range, endurance, and operational cost.

Therefore, for this mathematical model initially we have to establish the Key Aerodynamic Parameters and Perfomance with Efficiency Metrics (see Table 1):

Table 1

Key Aerodynamic Parameters and Performance & Efficiency Metrics

Key Aerodynamic Parameters	Key Performance and Efficiency Metrics
Lift coefficient, C_L Drag coefficient, C_D Lift-to-drag ratio, $\frac{L}{D}$ Wing aspect ratio, AR Oswald efficiency factor, e	Fuel consumption, F Range, R Endurance, E Specific Fuel Consumption, SFC Operational Cost per km or hour, OC

Besides, the created mathematical model have to accurately predict the impact of an aircraft's aerodynamic characteristics onto the flight operation efficiency. This model should also take into account such factors like lift, drag, and stability, and how these influence fuel consumption, range, and maneuverability. By analyzing these aerodynamic properties, this model will be capable to optimize aircraft design and flight procedures for improved efficiency.

By analyzing the model's predictions, engineers and operators can make informed decisions about aircraft design, flight procedures, and operational strategies to enhance efficiency. For instance, the model can help in determining the optimal flight altitudes, speeds, and control surface settings for fuel-efficient flight, according to a study on aircraft flight performance models [6, 9, 10].

As we are discussing about the Mathematical Model Structure:

a) Lift-to-Drag Ratio and Efficiency

The aerodynamic efficiency is often defined as:

$$\frac{L}{D} = \frac{C_L}{C_p}. \quad (1)$$

Drag coefficient can be expressed as:

$$C_D = C_{D_0} + \frac{C_L^2}{\pi e AR}, \quad (2)$$

where: C_{D_0} – parasite drag coefficient; AR – Aspect Ratio; e – Oswald efficiency number.

b) Breguet Range Equation (Jet Aircraft)

$$\frac{L}{D} = \frac{C_L}{R = \frac{v}{SFC} \cdot \frac{L}{D} \ln\left(\frac{w_i}{w_f}\right)}. \quad (3)$$

where: v – true airspeed; SFC – Specific Fuel Consumption; W_i, W_f – initial and final weights.

This equation shows how increasing $\frac{L}{D}$ improves range for a given aircraft configuration.

c) Fuel Consumption

Total fuel consumption over a distance *D* can be approximated by:

$$F = \frac{D \cdot SFC}{v} \cdot \frac{D}{R}. \quad (4)$$

Substituting the Breguet range model, fuel consumption becomes inversely related to $\frac{L}{D}$.

d) Cost Function

Let the operational cost *C* per mission be expressed as:

$$C = C_f + C_{fix} + C_{time} \cdot \frac{v}{D}, \quad (5)$$

where: C_f – fuel cost per unit mass; C_{fix} – fixed operational cost; C_{time} – Cost per hour of operation.

So, higher aerodynamic efficiency (higher $\frac{L}{D}$) reduces *F*, hence reducing *C*.

The overall operational efficiency (E_{op}) regarding to the aircraft aerodynamic characteristics can be captured as a function of aerodynamic efficiency in summary equation:

$$E_{op} \cdot \propto \frac{L}{D} \cdot \frac{v}{SEC}. \quad (6)$$

The mentioned above mathematical model highlights the quantitative relationship between the aircraft's aerodynamic design characteristics and flight operations efficiency and can accurately predict the impact of an aircraft's aerodynamic characteristics onto the Airline's flight operations efficiency.

Thus, using the above mathematical model, the aircraft design sequence, taking into account the impact of aerodynamic characteristics on the flight efficiency, moves from requirements to aircraft configuration and its aerodynamics & stability characteristics, than to propulsion & structure and further flight testing, with aerodynamic efficiency $\left(\frac{L}{D}\right)$, drag minimization, flow behavior) influencing nearly every decision. At the same time, aerodynamic efficiency is considered early since it determines range, fuel consumption, and payload capability.

Given the above, the approach for making decision to select/determine the best alternative for aircraft structure and its characteristics regarding to the flight operations efficiency is to take five steps, as follows:

The first step is the specification of all available alternatives to be included in the consideration. Generation as many aircraft design concepts as possible using the brain storming technique. However, given the resources required to include and consider all alternatives, it's required to give considerable thought to reducing the alternatives to a manageable number.

The second step consists in selecting the best aircraft design is to identify and establish the criteria, which serve later as the guidelines for developing the options. Some aircraft design references employ the term "figures of merit" instead of criteria.

The third step is to define the metrics. The metrics are defined as a shorthand way of referring to the criteria performance measures and their units. Metrics are the tool to overcome a noncomparable complex situation by establishing a common evaluation scale and mapping each criterion's metric onto this scale. So, each aircraft design option may be rated with respect to each criterion using this common scale. Typical metrics for measuring the aircraft's performance are maximum speed, take-off run, rate-of-climb, range, endurance, turn radius, turn rate, and ceiling etc.

The fourth step is to deal with criteria that have unequal significance. A aircraft designer should not frequently treat all criteria as being equally important. The designer must try to ascertain how important each requirement (i.e., criterion) is to the customer. The simplest approach is to assign numerical weights to each criterion (or even at a metrics level) to indicate its importance, relative to other criteria. These weights ideally reflect the designer's judgment of relative importance. Judgment as to whether one aircraft design alternative is superior to another may be highly dependent on the values and preferences of the evaluator. In some cases, the aircraft's designer has no way other than relying on personal "feelings" and "judgments" for the basis of the numerical weights.

The final fifth step – is to select the alternative which gains the highest numerical value. It is expected that the output of the decision-making process will yield the most desirable result. The aircraft's designer may conduct the decision-making process by developing a software package to minimize or maximize a specific index. In case there are uncertainties in evaluating criteria, a sophisticated robust decision-making rule should attempt to incorporate the uncertainties into the decision-making process. One of the difficulties of dealing with uncertainties is coming up with the probabilities of the uncertain parameters and factors. This is best performed in a process referred to as "sensitivity analysis".

When we are looking for early stages of aircraft's design and by employing brainstorming, a few promising concepts are suggested that seem consistent with the scheduling and available resources. Prior to committing resources and personnel to the detail design phase, an important aircraft design activity – feasibility analysis – must be performed. There are a number of phases through which the system aircraft design and development process must invariably pass. Foremost among them is the identification of the customer-related need and, from that, the determination of what the system is to do. This is followed by a feasibility study to discover potential technical solutions and the determination of system requirements. It is at this early stage in the lifecycle that major decisions are made relative to adapting a specific aircraft design approach and technology application, which have a great impact on the lifecycle cost of a product. At this phase, the aircraft's designer addresses the fundamental question of whethertoproceed with the selected concept. It is evident that there is no benefit or future in spending any more time and resources attempting to achieve an unrealistic objective. Some revolutionary concepts initially seem attractive, but when it comes to the reality, they are found to be too imaginary.

Therefore, the feasibility study distinguishes between a creative aircraft design concept and an imaginary idea. Feasibility evaluation determines the degree to which each concept alternative satisfies the design criteria. In the feasibility analysis, the answers to the following two questions are sought: 1) Are the goals achievable, are the objectives realistic, or can the aircraft's design requirements be met? 2) Is the current aircraft design concept feasible? If the answer to the first question is no, the aircraft'sdesign goal and objectives, and hence the design requirements, must be changed. Then, irrespective of the source of the design requirements – either direct customer order or market analysis – they must be changed.

Based on this, there is an algorithm of feasibility analysis process (fig. 1) [9, 10]:

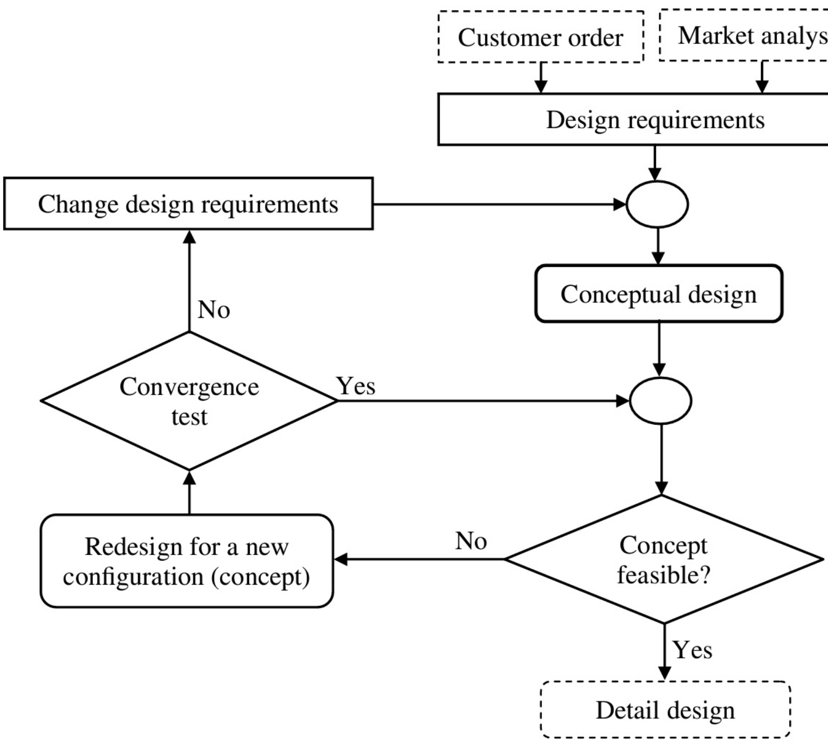

Fig. 1. The algorithm of feasibility analysis process

When the answer to the second question is negative, a new concept must be selected. Finding the answers to these questions is not always easy. To determine the answers, other professionals besides design engineers such as financial experts or manufacturing engineers – must often be involved in the feasibility study. The feasibility analysis will refine the aircraft's design requirements and narrow down the initial promising design concepts to a few feasible ones. It is at this stage that uncertainties are identified. When several concepts are analyzed and the convergency test illustrates that none of the promising concepts are feasible, the customer is informed that the objectives are not achievable within the current limits of science and technology. At this time, it is recommended that the customer reduces the level of his/her expectations. In contrast, the results of a feasibility study will significantly impact the aircraft's operational characteristics and its design for producibility, supportability, disposability, and detectability. The selection and application of a given technology or given materials has reliability and maintainability implications, will influence manufacturing operations, and will affect the aircraft's operating cost.

For instance, the composite materials may have reduced the aircraft weight but will certainly influence the reliability, maintenance, and entire lifecycle. All these considerations should be dealt with during the feasibility study before a commitment is made to pursue extensive aircraft design activities. The systems engineering approach has a systematic view of feasibility analysis. Thus, a primary objective of systems engineering is to ensure proper coordination and timely integration of all systems elements (and the activities associated with each) from the beginning.

After all, the issue of legal liability is crucial to an aircraft design engineer. Liability is basically part of the system of civil law. In civil law, the issue is not one of innocence or guilt; it is a question of who is at fault in a dispute, or who violated an agreement, or who failed to fulfill obligations.

Aircraft design engineers and manufacturers are responsible and liable for harm done by their product or design to a customer or third party. Thus, a designer has the responsibility to act in a careful and prudent manner. The negligence is applied to a designer when the product was defective or a design created a concealed danger. Thousands of disasters have occurred throughout aviation history, for a great number of which the aircraft designers (not the pilots) have been responsible. Disasters include aircraft crashes, mishaps, and accidents. In all of these cases, harm (bodily or financially) has been done to a customer or to the public. The primary source of such incidents is the designer's carelessness in design, error in calculations, or lack of prediction of the future. In the area of accident prediction, Murphy's Law applies which states: If any event can happen, it will happen; or anything that can go wrong will go wrong.

The threat of liability law suits must spur on aircraft's designers and manufacturers to be more sensitive to safety issues and to address them in more creative and innovative ways. The liability threat should not have a stifling effect on creative design and technological innovation. For this reason, the employment of safety factors is highly recommended. Some National Aviation Regulations have addressed this issue in many ways, but it does not suffice; aircraft designers and all involved engineers must be prudent and careful in the design process. A prudent design strategy is to employ the utmost care; to anticipate relevant wrongful events; and to incurporate some features into products to make them more robust.

It is important to note that about one-third of aviation accidents are because of CFIT (controlled flight into terrain). When a pilot makes a mistake and hits a mountain, a designer has almost no influence on this incident. Not every pilot mistake has a solution by the aircraft designer; some mistakes may be avoided by design, but not all.

An aircraft designer must pay attention to a phenomenon referred to as the design-induced pilot error and investigate the interaction between his/her design and pilot error. Pilots are human and are prone to make mistakes. However, an aircraft designer should make sure that the design does not induce or contribute to the pilot error. Some flight fatal accidents are the unlucky convergence of a series of circumstances started with a pilot's minor error. When an error by the pilot inadvertently occurs, the design of the aircraft should not mitigate the error.

Certain aircraft designs have pilot-error accident rates double or triple that of others because their design makes pilot errors more likely. An aircraft with poor stability and controllability is trickier to land in a gusty crosswind. An aircraft with multiple fuel tanks and fuel gauges makes it harder to keep track of the fuel spending.

Also an aircraft bad design may cause a pilot to make a mistake, and sometimes, an odd chain of circumstances may link up at just the wrong time. An example of a bad cockpit design is the placement of a flap handle next to a landing gear lever, making it possible to raise the gear rather than the flaps after landing. A simple example of a convenient way to prevent stall is to have stall warning light and horn sounding.

There have been some accidents where a pilot has pushed a mixture knob and shut an engine off completely, when he/she meant to pull the throttle and reduce power. To prevent aircraft design-induced pilot error, use different colors, textures, and shapes for control knobs. It should not be easy for a pilot to make mistakes; rather, a mistake should be very hard to do. So, that's why the aircraft designer should build extra safety systems to reduce the possibility of pilot error.

So, that's why the aircraft's design and therefore it's aerodynamic characteristics play a crucial role in determining of the Airline's flight operations safety and efficiency.

Conclusions

As a conclusion, we can state that the aircraft's design and therefore it's aerodynamic characteristics play a crucial role in the Airline's flight operations safety and efficiency.

Therefore, the more aerodynamically efficient aircraft (high $\frac{L}{D}$, low C_{Do}) requires less fuel and incurs lower operating costs, especially over long flights. Based on this, the proposed model highlights the direct quantitative relationship between aerodynamic design and flight operation efficiency and can accurately predict the impact of an aircraft's aerodynamic characteristics onto the flight operation efficiency.

This study focuses solely on the impact of the aircraft's aerodynamic characteristics on the performance and efficiency of flight operations. Future research will explore new models that will increase flight operations effectiveness regarding the aircraft's aerodynamic characteristics.

REFERENCES

[1] Global Aviation Industry High-Level Group (2019). Aviation Benefits Report 2019, Airport Council International (ACI), Civil Air Navigation Services Organisation (CANSO), International Air Transport Association (IATA), International Civil Aviation Organisation (ICAO) and International Coordinating Council of Aerospace Industries Association (ICCAIA).

[2] ICAO 2019, Annual Report of the Council to the Assembly, report n., International Civil Aviation Organization (ICAO).

[3] Sabatini R., Gardi A. Sustainable Aviation: An introduction. Aerospace Sampler, 2024. p. 7–27.

[4] Sabatini R. Sustainable Aviation Technology and Operations: Research and Innovation Perspectives. Aerospace Sampler, 2025. P. 46–72.

[5] Kechidi, M. (2013). From'aircraft manufacturer' to'architect–integrator': Airbus's industrial organisation model. International Journal of Technology and Globalisation 7(1): 8–22.

[6] Daniel P. Raymer, Aircraft Design: A Conceptual Approach, Seventh Edition, 2024. – ISBN (print): 978-1-62410-715-3; eISBN: 978-1-62410-729-0.

[7] John D. Anderson, Jr., Fundamentals of Aerodynamics, Sixth edition. McGraw-Hill Education, 2017. 1154 p.

[8] Houghton E. L., Carpenter P. W., Flight Performance of Aircraft, Seventh edition. Elsevier: ISBN: 0081001940, 2016. 688 p.

[9] Mohammad H. Sadraey. Aircraft Design: A Systems Engineering Approach, 2nd Edition. Aerospace Sampler, 2025. P. 2–20.

[10] Dominic J. Diston. Computational Modelling and Simulation of Aircraft and the Environment, Volume 2: Aircraft Dynamics. Aerospace Sampler, 2025. P. 22–45.

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ЩОДО ВПЛИВУ АЕРОДИНАМІЧНИХ ХАРАКТЕРИСТИК ЛІТАКА НА БЕЗПЕКУ ТА ЕФЕКТИВНІСТЬ ЛЬОТНОЇ ЕКСПЛУАТАЦІЇ

Аеродинамічні характеристики літака відіграють вирішальну роль у визначенні безпеки та ефективності польотів авіакомпанії. Вплив аеродинамічних характеристик літака на ефективність польотів може призвести до збільшення витрати палива, зменшення дальності польоту, зменшення тривалості польоту та збільшення експлуатаційних витрат. У зв'язку з цим виробникам літаків необхідно постійно вдосконалювати характеристики літаків, щоб підвищити ефективність польотів авіакомпаній у майбутньому. Ця робота зосереджена на впливі аеродинамічних характеристик літака на загальну ефективність польотів та на тому, як можна уникнути цього впливу. Метою цієї статті є представлення нового підходу до оцінки впливу аеродинамічних характеристик літака на ефективність польотів. ***Методи:*** *У статті описано метод вимірювання часу виконання, який підвищує ефективність польотів авіакомпанії щодо аеродинамічних характеристик літака.* ***Результати:*** *Аналітична модель впливу аеродинамічних характеристик літака на ефективність польотів.* ***Обговорення:*** *Запропонований новий підхід дозволить підвищити ефективність польотів авіакомпанії щодо аеродинамічних характеристик літака. Подальші дослідження будуть спрямовані на вивчення нових моделей, які підвищать безпеку та ефективність льотної експлуатації щодо аеродинамічних характеристик літака.*

Ключові слова: літак; аеродинамічні характеристики; льотна експлуатація; безпека; ефективність.

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The aircraft's aerodynamic characteristics play a crucial role in determining of the Airline's flight operations safety and efficiently. The impact of the aircraft's aerodynamic characteristics onto the flight operations efficiency can result in higher fuel consumption, reduced range, reduced endurance, and higher operational costs. Regarding this, aircraft manufacturers need to continually improve aircraft's characteristics to increase future Airline's flight operations efficiency. This work focuses on the impact of the aircraft's aerodynamic characteristics onto the overall effectiveness of flight operations and how can this impact be avoided. The purpose of this article is to present a new assessment approach of the impact of aircraft's aerodynamic characteristics onto the flight operations efficiency. ***Methods:*** *The article* *describes the runtime method which increase the Airlines flight operations efficiency regarding the aircraft's aerodynamic characteristics.* ***Results:*** *An analytical model of the impact of aircraft's aerodynamic characteristics onto the flight operations efficiency.* ***Discussion:*** *The proposed new approach will allow to increase the Airlines flight operations effectiveness regarding the aircraft's aerodynamic characteristics. Future research will explore new models that will increase flight operations safety and efficiency regarding the aircraft's aerodynamic characteristics.*

Keywords: aircraft; aerodynamic characteristics; flight operations; safety; efficiency.

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