DEVELOPMENT OF AIR TRANSPORT IN STATISTICAL TERMS
HOW AIR TRAFFIC SHAPES AEROSPACE ENGINEERING

This article covers how commercial air traffic in Europe changed during the last ten years in statistical terms, how air traffic will look in the nearest future and how aerospace engineering conform current and future noise emission regulations. Based on EUROSTAT statistical data article shows changes of: total European fleet, total number of passengers and number of airports. Future state prognoses prepared by EUROCONTROL describe situation in European skies up to year 2035. Current state regulations on noise emissions are described based on official ICAO documents. A brief comparison between past, current and future airplane will show how aircraft changed along with required certification regulations.

Keywords: air traffic, noise regulations, statistics, EUROCONTROL, EUROSTAT, research and development

1. INTRODUCTION

How do you get yourself, your family and friends and a stack of luggage on vacation on the other end of the continent? How do you get from Warsaw to London to sign that very important contract? Or how do you deliver a parcel that needs to be there as soon as possible? 80% of travelers say: by airplane. Air transport became relatively fast, reliable and inexpensive (especially in cheap flight airlines) way of travelling for many citizens of Europe.

First voices on increasing air traffic affecting the environment appeared in early 1970’s. Introduction on BAC Concorde and Tupolev Tu-144 and broad plans to introduce supersonic airlifter to major airlines lead to discussion on spreading

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the pollution in high troposphere and stratosphere. Scientific efforts on analyzing how jet engine affects the environment appeared at the end of 1980’s. Since then, in analyzing how anthropogenic actions affect the environment, air traffic became a separate factor. Most of the noise pollution occurs during take-off, when the aircraft is noticeably close to the ground. Most of the pollution with toxic components of exhaust gases is being done high in the troposphere. These two phenomena, along with increasing number of flights result in strict environmental regulations required while certifying an aircraft engine, an aircraft and even an airport. And this is only the beginning.

In order to show how air transportation changed among the years three numbers will be compared: total number of European airliner fleet, total number of EU passengers willing to travel by air, number of airports serving more than 150 000 passengers every year. These numbers are the most direct way to show the trends that occurred in the recent years. But past trends are not the most important issue that bothers engineers and officials. Future state prognoses are covered in Long Term Forecasts performed by EUROCONTROL. These forecasts can give a slight hint on how environmental regulations will look like in next twenty years, and how these brand new engines will have to work in the near future.

Armed with such knowledge, people in engineering offices are ready to create new green engines and aircraft.

2. MATERIALS AND METHODS

This article presents data on air traffic in Europe and European Union. Data covers total air traffic, that is: local traffic in each country, traffic across countries in research area as well as incoming and outcoming from research area.

Input data for this article is secondary statistical material taken from EUROSTAT. Data contains numbers of total European fleet, Airports serving more than 15 000 passengers per year and number of passengers per year. Time range begins from year 2004 and end on latest data available in EUROSTAT. Year 2004 is considered as a milestone in EU history due to the largest single enlargement of the European Union in terms of territory. Access of nine countries, including Poland, and significant update of statistical data are key factors in choosing this date.

Gathered data was put to descriptive analysis, trend analysis and chain growth analysis in order to show how the gathered numbers changed among the years.

The scope of this paper is how commercial aviation, airports, environmental requirements and engineering offices are affected by changes in air traffic. An attempt is made to show how a jet engine used to propel an airliner evolves by changes in environmental requirements.
3. Last Decade

First number to be shown is the total number of aircraft in the EU (Fig. 1). Trends for passenger aircraft and total number of aircraft show a slow increase of these numbers. Chain growth ratio of number of aircraft (Fig. 2) shows a rapid increase in year 2006 and stabilization afterwards. At this point situation on European skies is rather comforting. But comparing these numbers with Fig. 3 may change the perspective.

Fig. 1. Number of aircraft registered in the EU [3]

Fig. 2. Growth rate of aircraft (self study)
As by Fig. 3, number of passengers is increasing, at average 50 to 70 million passengers every year. The growth rates (Fig. 4) show large annual fluctuation of passenger count. Slowdown in year 2008 and decrease of passenger number in year 2009 are the aftermath of Financial Crisis of 2007-08. The situation recovers in years 2010-11. With roughly the same number of passenger airplanes (2007-11) this leads to rapid increase of passenger flights.

Existing fleet is supposed to deliver people and freight 24 hours a day, with very short overhaul periods, even shorter times to refuel and reload. Grounded aircraft generates loss instead of profit. Increasing number of flights generates yet another problem. All airplanes need an airfield with proper infrastructure to perform flight operations, basic maintenance, serve passengers and so on.

Surprisingly, the number of main airports is not following the trend set up by number of passengers. As seen on Fig. 5 number of main airports (serving more than 150 000 passengers a year) remains roughly the same, with very slight increase in research period. Change in number of main airports (Fig. 6) is caused by
Development of air transport in statistical terms...  

varying number of passengers, rather than closing and opening airports. Decrease of number of airports in year 2009 is the aftermath of the Economy Crisis. Total number of airports varies among the years. This number includes small and medium airports such as club airfields and regional airports. Total number of airports (including registered regional and club airports) was under more influence of crisis and changed more rapidly.

Fig. 5. Number of airports [4]

Fig. 6. Growth rate. Number of airports (self study)
4. NEXT DECADE, NEXT TWO DECADES

Trends presented in previous section may not give the full perspective. Years 2001-2012 show a significant increase in air traffic in Europe. Expansion of the EU in year 2004, Financial Crisis of 2007-2008, Arab Spring trampling through the Middle East and Northern Africa all have their reflection in air movements on the continent. These factors make the predictions harder than simple extrapolation of data.

In order to show how air traffic will change, EUROCONTROL prepares medium and long term forecast for IFR movements. These forecasts are used mainly for planning purposes for airlines.

Medium Term Forecast, prepared in September 2013 (latest available at editing this article) covers flight movements in EU airspace for years 2013-2019. Forecast is divided into short-term outlook for years 2013-2014 and long term – covering years up to 2019.

As forecast states, after 2014, the traffic growth in Europe stabilizes at around 2.5% increase per year showing rates higher in the 2015-2016 horizon (+2.7%) than in the 2018-2019 horizon (2.4%).

Figures 7 and 8 show, that the growth is not uniform across Europe. While the growth in percentage terms is much weaker in the more mature markets of Western Europe, it is still the busiest States (Germany followed by France, Italy and UK) which will see the greatest number of extra flights per day between now and 2019 (Fig. 2). Turkey will both be the fastest grower (5% as average annual growth rate) and the biggest contributor of new flights to the European network in 2019 through both its domestic flights and international arrivals and departures.

Medium term forecast takes into account limited capacity of airports. Airport expansion is not taken into account in this prognosis, therefore figures presented are constrained.

Long term forecast, published in June 2013 covers IFR flight movements for years 2013-2035. Because of the range, the forecast is more robust and is divided into four scenarios [1]:

- **Scenario A: Global Growth (Technological Growth):** Strong economic growth in an increasingly globalised World, with technology used successfully to mitigate the effects of sustainability challenges such as the environment or resources availability.

- **Scenario C: Regulated Growth:** Moderate economic growth, with regulation reconciling the environmental, social and economic demands to address the growing global sustainability concerns. This scenario has been constructed as the ‘mostlikely’ of the four, most closely following the current trends.
Scenario C*: Happy Localism: this scenario is introduced to investigate an alternative path for the future. With European economies being more and more fragile, increasing pressure on costs, stricter environmental constraints, air travel in Europe would adapt to new global environment but taking an inwards perspective. There would be less globalization, more trade inside EU (e.g. Turkey joining Europe is important in this scenario). Also, slow growth of leisure travel to outside Europe, however certainly more inside EU. More point-to-point traffic within Europe. It does not mean that Europe does not grow or does not adapt to new technologies and innovation but its main focus is “local”. Although this scenario is mostly based on scenario C (as its name indicates), it also inherits some aspects of
other scenarios like higher fuel prices or low business aviation traffic of scenario D.

- **Scenario D**: Fragmenting World: A World of increasing tensions between regions, with more security threats, higher fuel prices, reduced trade and transport integration and knock-on effects of weaker economies.

Scenario C: Regulated growth is considered to be the most likely at point of publishing the report. This forecast predicts 14.4 million flights in Europe 2035, which is 1.5 times more than in 2012. That creates an average growth of 1.8% per year. Forecast predicts that in 2025 traffic growth will decelerate due to predicted economic slowdown and reaching the capacity of airports.

As in medium term forecast, growth is not uniform across Europe. Due to lower starting point in calculations, more growth is expected in Eastern countries. This however is not the full view on the situation. While growth will be faster in the East (see Fig. 9), it is still mainly the big western countries that will need to deal with the greatest increase in the number of flights (Fig. 10).

Fig. 9. Average annual growth (scenario C: Regulated Growth) [2]

Fig. 10. Total traffic in 2035 [2]
Presented forecasts show, that air traffic in Europe will grow significantly in the next few years. With no actions taken, two paths are available. On one hand, running such traffic on existing fleet with airports (reaching maximum capacity) located near city centers will create an environment filled with constant aircraft noise. On a preventive side, noise emission regulations are being tightened nearly every year. And the only way to conform strict regulations is to use state of the art engines and airplanes, because in this case, silence is golden.

5. THE LAW REGULATIONS

5.1. Differences among the world

Every craft intended to get airborne needs to acquire specific certificates that confirm its airworthiness. Aircraft noise standards are described in such documents as:

- FAR PART 36 regulations,
- ICAO Annex 16 volume I,
- CAEP requirements.

Local regulations of specific countries and airports

It is important to point out that these requirements goal is not in restraining airlines and aircraft manufacturers but in limiting and reducing the number of people affected by aircraft noise.

5.2. CAEP Regulation

ICAO’s current environmental activities are largely undertaken through the Committee on Aviation Environmental Protection (CAEP), which was established by the Council in 1983, superseding the Committee on Aircraft Noise (CAN) and the Committee on Aircraft Engine Emissions (CAEE) [13].

The current structure of the Committee includes three working groups and four support groups. The working groups deal with the technical and operational aspects of noise reduction and mitigation, with the aircraft noise and emissions issues linked to airports and operations and with the technical and operational aspects of aircraft emissions. One support group provides information on the economic costs and environmental benefits of the noise and emissions options considered by CAEP, one addresses models and databases issues, one deals specifically with the ICAO Carbon Calculator and the last one is aimed at scientific understanding of aviation environmental impacts.
About once a year, CAEP meets as a Steering Group to review and provide guidance on the progress of the activities of the working groups. So far, CAEP has held eight formal meetings: in 1986 (CAEP/1), 1991 (CAEP/2), 1995 (CAEP/3), 1998 (CAEP/4), 2001 (CAEP/5), 2004 (CAEP/6), 2007 (CAEP/7) and 2010 (CAEP/8). Each formal CAEP meeting produces a report with specific recommendations for the consideration of the ICAO Council. These reports are saleable Publications.

The Council acts on recommendations from CAEP in the light of any comments received from the Air Navigation Commission and, if there are economic aspects, from the Air Transport Committee. In the case of recommendations to introduce or amend Standards and Recommended Practices, there are established procedures for consulting States, after which the final decision rests with the Council.

5.3. ICAO Annex 16

Historically the oldest and presumably the most important regulations are stated in ICAO Annex 16 – Environmental Protection, Volume 1. First issue of this document was released in year 1981. At time of writing this article the latest issue is 6th, released in year 2011. Document contains standards (not strict requirements), Recommended Practices and Guide of the noise certification of aircraft that are operated in international air navigation, in accordance with the classification set out in the individual chapters: Each chapter describes different noise measurement points (Table 1) and noise levels for specific aircraft types:

a) Chapter 2 describes requirements for subsonic, jet engine propelled aircraft certified before 6th November 1977. With exceptions;
b) Chapter 3 describes requirements for:
   - Subsonic, jet engine propelled aircraft certified between 6th November 1977 and 1st January 2006,
   - Propeller driven aircraft (MTOW over 8618 kg) certified between 1st January 1985 and 1st January 2006;
c) Chapter 4 describes requirements for:
   - Subsonic, jet engine propelled aircraft certified after 1st January 2006;
   - Propeller driven aircraft (MTOW over 8618 kg) certified after 1st January 2006.

Separate Chapters contain information on light aircraft (Chapter 7) and helicopters (Chapters 8 & 11) and will not be discussed in this paper.

Table 1 and Table 2 contain a brief summarize of maximum noise levels and their measurement points. Noise levels and measurement points are not rigid. Maximum noise levels are logarithmically dependant from Maximum Take-Off Weight (MTOW) of certified aircraft. Highest noise levels are for heavier aircraft, with MTOW above 385 000 kg. Annex 16 fully describes weather requirements,
flight procedures and equipment setup for proper measurements. Noise levels are presented in EPNdB (Effective Perceived Noise dB). This unit is not measurable in a direct manner. EPNdB calculations are based on measurements of noise level (measurements of acoustical pressure), spectrum of noise level and corrected with sustainability factors and noise damping of air (also dependant on weather). Methods on how to establish a measurement point, calculate correction factors from weather, wind, inaccurate measurement point are described in Annex or in its Addendums. Data presented below is an excerpt from chapters 2, 3 and 4 from 6th edition of ICAO Annex 16 (Table 1).

Maximum noise levels gained from Annex 16 are below 108 EPNdB. In comparison: Heavy traffic generates around 85dB, pneumatic road drill – circa 100dB, live rock concert generates circa 110-115dB noise. Exposition to noise level higher than 110dB for over 15 minutes may result in hearing damage. Short term (less than 10 minutes) exposure to 120 results in hearing damage, 130 dB is considered as a threshold of pain, 150dB causes eardrum rapture, while 194dB is considered as theoretical limit for sound barrier at 1 atmosphere of pressure.

Noise levels appear to be high. But such levels occur only in the nearest vicinity of the airport. Concerning that nearly any main airport in Europe is surrounded by a large perimeter, nearest housing areas are subjected to noise levels that are safe, but may be considered as annoying. Also, many airports create their own noise requirements and do not allow air traffic operations of aircraft not conforming to such.

Table 1

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Noise measurement point per ICAO Annex 16 [14]</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Name</td>
</tr>
<tr>
<td>2</td>
<td>Sideway</td>
</tr>
<tr>
<td></td>
<td>Fly-by</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
</tr>
<tr>
<td>3, 4</td>
<td>Sideway (jet)</td>
</tr>
<tr>
<td></td>
<td>Sideway (prop)</td>
</tr>
<tr>
<td></td>
<td>Fly-by</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
</tr>
</tbody>
</table>
Table 2
Maximum noise levels per ICAO Annex 16 [14]

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Noise measurement point</th>
<th>Engine count</th>
<th>Maximum noise level (EPNdB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Sideway</td>
<td>N/A</td>
<td>108-102</td>
</tr>
<tr>
<td></td>
<td>Fly-by</td>
<td>N/A</td>
<td>108-93</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>N/A</td>
<td>108-102</td>
</tr>
<tr>
<td>3, 4</td>
<td>Sideway</td>
<td>N/A</td>
<td>103-94</td>
</tr>
<tr>
<td></td>
<td>Fly-by</td>
<td>1 or 2</td>
<td>101-89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>104-89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>106-89</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>N/A</td>
<td>105-98</td>
</tr>
</tbody>
</table>

5.3. Local requirements

One of the airports with most strict noise requirements is London Heathrow. It is the third busiest airport in the world, serving more than 70 million passengers in 2012 and handling more international passengers than any other airport in the world [11].

In order to prevent nearby housing areas from noise effects, particularly at night, Heathrow airport introduced their own regulations for incoming and outgoing traffic. Air traffic Control at Heathrow Approach Control guides traffic incoming from four major routes into one approach stream. When possible, Controllers advise the use of Continuous Descent Approach (CDA). CDA allows for a smooth, constant-angle descent to landing (Fig. 11). A continuous descent approach starts ideally from the top of descent, i.e. at cruise altitude, and allows the aircraft flying its individual optimal vertical profile down to runway threshold [10].

![Fig. 11. CDA approach (solid line) vs. Standard approach (dash line)](image-url)
Night-time flights at Heathrow are subject to restrictions. Between 23:00 and 07:00, the noisiest aircraft (rated QC/8 and QC/16) cannot be scheduled for operation. In addition, during the night quota period (23:30–06:00) there are four limits:

- A limit on the number of flights allowed;
- A quota count system which limits the total amount of noise permitted, but allows operators to choose to operate fewer noisy aircraft or a greater number of quieter planes;
- QC/4 aircraft cannot be scheduled for operation;
- A voluntary agreement with the airlines that no early morning arrivals will be scheduled to land before 04:30.

A trial of “noise relief zones” ran from December 2012 to March 2013, which concentrated approach flight paths into defined areas compared with the existing paths which were spread out. The zones used alternated weekly, meaning residents in the “no-fly” areas received respite from aircraft noise for set periods. However, it was concluded that some residents in other areas experienced a significant dis-benefit as a result of the trial and that it should therefore not be taken forward in its current form [11].

The Quota Count (QC) system was introduced on Heathrow in 1993. Each aircraft is classified and awarded a grade, called a Quota Count, based on how much noise it generates. Quieter aircraft are given a smaller grade. Aircraft are classified separately for landing and take-off. Take-off quota count values are based on the average of the certificated flyover and sideline noise levels at maximum take-off weight, with 1.75 EPNdB added for ICAO Annex 16 Chapter 2 aircraft. Landing quota count values are based on the certificated approach noise level at maximum landing weight minus 9.0 EPNdB [12].

Noise classification for aircraft is described in Table 3. Examples of aircraft classified in the QC system are presented in Table 4.

Noise levels required by Heathrow Airport are far stricter than those stated in ICAO Annex 16. Such restrictions result in relatively noise friendly environment around Heathrow. ERCD report 1101 – Noise Exposure Contours for Heathrow Airport, prepared by Environmental Research and Consultancy Department of British Civil Aviation Authority shows the effect of Heathrow Airport traffic on nearby locations. Report prepared in year 2010, presents number and location of households affected by specific noise levels generated by Heathrow air Traffic (Fig. 12).

Noise contours (Fig. 12) show that:

- 83dB of perceived noise is present at the terminal area.
- 72dB of perceived noise is present in nearest vicinity of runways.
- Noise lower than 66dB is present outside the airport.

60dB noise is comparable to normal office space or restaurant rustle. 70dB sounds like moderate traffic and may be annoying for some people.
Table 3

<table>
<thead>
<tr>
<th>Noise Classification</th>
<th>Quota Count</th>
</tr>
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<tbody>
<tr>
<td>Below 84 EPNdB</td>
<td>Exempt</td>
</tr>
<tr>
<td>84-86.9 EPNdB</td>
<td>0.25</td>
</tr>
<tr>
<td>87-89.9 EPNdB</td>
<td>0.5</td>
</tr>
<tr>
<td>90-92.9 EPNdB</td>
<td>1</td>
</tr>
<tr>
<td>93-95.9 EPNdB</td>
<td>2</td>
</tr>
<tr>
<td>96-98.9 EPNdB</td>
<td>4</td>
</tr>
<tr>
<td>99-101.9 EPNdB</td>
<td>8</td>
</tr>
<tr>
<td>Greater than 101.9 EPNdB</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 4

<table>
<thead>
<tr>
<th>Aircraft type</th>
<th>QC Departure</th>
<th>QC Arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbus A320 family</td>
<td>0.5 – 1</td>
<td>0.25–0.5</td>
</tr>
<tr>
<td>Airbus A380</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Boeing 737 Classic</td>
<td>0.25–0.5</td>
<td>1</td>
</tr>
<tr>
<td>Boeing 747-400</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Boeing 747-8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Boeing 757-200</td>
<td>0.5</td>
<td>0.25</td>
</tr>
<tr>
<td>Boeing 767-300</td>
<td>1 – 2</td>
<td>1</td>
</tr>
<tr>
<td>Boeing 777-200ER</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Embraer 145</td>
<td>0.25</td>
<td>0.25</td>
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</tbody>
</table>

This concludes that Heathrow airport restricts the movements of really loud airships to prevent its neighbors from aircraft noise. Presumably, Heathrow restrictions will lower the acceptable noise levels even more, due to increasing air traffic and urban sprawl around the airport.
6. WHAT HAPPENS IN R&D AND ENGINEERING OFFICES

Presented requirements are, among others, customer’s request. Final product, whenever it’s an engine, full aircraft or any other system being part of such, must be in conformance with noise certification standards. Otherwise such product will be considered as not airworthy. And in the final run, will not sell. Engineering departments in aerospace companies are required to suit their designs to certification standards.

In the 1960’s, lack of environmental standards allowed the creation of Concorde. First flown in 1969, introduced in 1976 still remains the state-of-the art of aerospace engineering. No restrictions on noise and emissions resulted in the fastest (after TU-144) passenger airliner in the world. Extensive use of the Concorde led to discussion on impact of supersonic and stratospheric flights on the environment. Because of Concorde, the JFK Airport in New York decided to research noise emission around the airport. Concorde’s flight ceiling of over 18 km brought up a discussion on effect of injecting toxic components of exhaust gasses in higher troposphere. This research finally evolved in environmental standards that we know today.

Modern constructions are designed is somewhat different way. The flagship of Airbus fleet, the A380, was designed specifically to Heathrow noise standards.
This rather clumsy looking aircraft features distinct aerodynamic solutions allowing it to (literally) fit the runways and taxiways of main airports and fly relatively quiet. The A380 is fitted with two types of engine: Rolls-Royce Trent 900 or Engine Alliance GP7000. Both engine types allow the aircraft to achieve well under the QC/2 departure and QC/0.5 arrival noise limits under the Quota Count system set by London Heathrow Airport, which is a key destination for the A380. The A380 has received an award for its reduced noise [6].

Latest child of Boeing, the B787 Dreamliner presents solutions that were never used in aircraft of comparable size and role. Composite wing with raked wingtips (Fig. 13), swept more than wings leading edge, provides efficient lift with minimized wingtip vortex effects. The Trent 1000 or General Electric GEnx-1b engine nacelles are fitted with chevrons, reducing the noise level of the engines exhaust duct [13]. The engines themselves present the top-notch design with nearly 10 bypass ratio, advanced fan blade geometry and fuel efficient combustors.

This is the present state. Strict future regulations will require an aircraft that today look like taken live from sci-fi movie.

One of the concepts was delivered by Airbus in early 2011 (Fig. 15). New concept plane utilizes a distinct aerodynamic line. High aspect ratio wings for lower drag and better lifting characteristics, U-tail empennage reducing weight and performing more efficiently in wider speed range. Blended engine nacelles reduce drag and improve cabin comfort as well as external noise characteristics. The fuselage of the new concept aircraft is elliptical instead of circular, to provide more cabin space. Airbus states, that their concept aircraft will be manufactured with use of “intelligent” materials and technologies [7]. Everything will be extremely ecological, with renewable power sources, sustainable and environmentally friendly. Details on this project are not yet available. Airbus claims, that research and development on materials required to create this aircraft has begun. New concept aircraft should fly between year 2030 and 2050.
7. CONCLUSIONS

Observing how air traffic, airships and aerospace environmental regulations change shows a quite characteristic pattern. A new improved flying people carrier is introduced to public, making flying cheaper, more accessible and more environmental friendly. More people decide to use air transport thus congesting airspace around airports. Living near airport starts to be a chore, due to aircraft noise. Noise and environmental regulations limit noise levels around airports. Due to limitations inflicted on aircraft and powerplants, new improved people carrier is introduced to public, making flying cheaper, more accessible and more environmental friendly. And the patter repeats.

And it will continue for some time, so developing aircraft and engines that are quiet and environmentally friendly is a top priority for aerospace research and development. And there is still room for improvement.

REFERENCES

Streszczenie

W artykule opisano zmiany w natężeniu europejskiego ruchu lotniczego na przestrzeni ostatnich dziesięciu lat, prognozy ruchu lotniczego w najbliższej przyszłości, a także dążenia inżynierii lotniczej do spełnienia aktualnych wymagań środowiskowych. Na podstawie danych EUROSTAT pokazano zmiany w liczbie samolotów w europejskiej flotcie powietrznej, całkowitej liczbie pasażerów i liczbie lotnisk. Prognoza przygotowana przez EUROCONTROL obejmuje okres do roku 2035. Opis obecnie obowiązujących regulacji prawnych oparto na przepisach ICAO. Pokazano, jak zmiany przepisów dotyczących środowiska wpłynęły na modyfikację samolotów.