

3. Proactive Airport Risk Management in the Context of Global Economics Sustainable Development Ensuring

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3.1 CIVIL AVIATION ECONOMIC DEVELOPMENT PLANNING

Civil aviation economic development planning is one of the priorities for the strategic management system of aviation safety in the context of ensuring the sustainable development of the national economy. Only cost-effective civil aviation can be safe and secure. In 2019, there were 1,303 scheduled airlines in the world. They operated more than 31,717 aircrafts, using the infrastructure system of 3,759 airports, with the support of 170 air navigation service providers.

Direct effects. The aviation industry is a powerful catalyst for the economic activity, the creation of new jobs in airlines, airports and air navigation service providers which directly serve passengers. Aviation also directly creates jobs in the manufacturing sector (these are companies that produce aircrafts, engines and other vital technologies). Contemporary transport serves 4.3 billion passengers and 58 million tons, the aviation industry created 10.2 million direct jobs and added 704.4 billion USD to the world GDP. Aviation is a highly productive industry, measured in terms of GDP per employee (69,000 USD per employee per year), which is about three and a half times the average for the world economy as a whole. Air transport workers must be highly qualified, have developed competencies and sound practical experience [1].

Indirect effects. The economic benefits of aviation extend far beyond direct impacts. Indirect impacts include employment and economic activity of aviation suppliers: aviation fuel suppliers; construction companies; suppliers of aircraft components and equipment; organizations in the non-aviation sector of airports and the business sector. There are almost 11 million aviation-related indirect jobs worldwide. These indirect jobs were about \$ 638 billion. USD in global economic activity [1].

Induced effects. Expenditures of those who are directly or indirectly employed in the aviation sector and, at the same time, maintain additional jobs in other sectors. Nearly eight million jobs created are supported worldwide through aviation workers. The induced contribution of aviation to global economic activity is estimated at 454 billion USD [1]. The main economic indicators of world civil aviation are shown in Table 1.

Table 1. Analysis of operating, net economic results and variance of scheduled airlines of ICAO member countries (the period from 2009 to 2018) [2].

Year	Operating revenues USD (millions)	Operating expenses USD (millions)	Operating result		Net result ²	
			Amount USD (millions)	Percentage Of operating revenues	Amount USD (millions)	Percentage Of operating revenues
2009	475,800	473,900	1,900	0.4	-4,600	-1.0
2010	563,500	535,900	27,600	4.9	17,300	3.1
2011	642,300	622,500	19,800	3.1	8,300	1.3
2012	705,500	687,100	18,400	2.6	9,200	1.3
2013	720,200	694,900	25,300	3.5	18,100	2.5
2014	766,900	725,200	41,700	5.4	17,300	2.3
2015	720,500	660,700	59,800	8.3	37,500	5.2
2016	709,000	643,800	65,200	9.2	35,600	5.0
2017 ⁽³⁾	757,600	697,900	59,700	7.9	40,100	5.3
2018 ^(3,4)	814,200	763,300	50,900	6.3	33,400	4.1

Source: ICAO, *The World of Air Transport in 2018* - <https://www.icao.int/annual-report-2018/Pages/the-world-of-air-transport-in-2018.aspx>

The dynamics of growth of the commercial air transport fleet of ICAO member states in the period from 2009 to 2018 is shown in Table 2.

Table 2. Commercial air transport fleet of ICAO member states (the period from 2009 to 2018) [2].

Year	Turbojet		Turboprop		Total aircraft All types
	Number	Percentage	Number	Percentage	
2009	20 332	87.4	2 932	12.6	23 264
2010	20 904	87.5	2 976	12.5	23 880
2011	21 543	87.7	3 009	12.3	24 552
2012	22 255	88.1	2 997	11.9	25 252
2013	22 893	88.2	3 061	11.8	25 954
2014	23 587	88.5	3 066	11.5	26 653
2015	24 259	88.7	3 093	11.3	27 352
2016	25 060	88.9	3 117	11.1	28 177
2017	26 100	89.3	3 136	10.7	29 236
2018	27 183	89.5	3 196	10.5	30 379

Source: ICAO, *The World of Air Transport in 2018* - <https://www.icao.int/annual-report-2018/Pages/the-world-of-air-transport-in-2018.aspx>

3.1 GLOBAL TRENDS IN AVIATION INFRASTRUCTURE DEVELOPMENT

In 2018, airlines worldwide carried about 4.3 billion passengers, registering 8.3 trillion commercial passenger-kilometers (RPK). Fifty-eight million tons of cargo was transported by air, reaching 231 billion cargo tonne-kilometers (FTK). Every day, aircraft carry nearly 12 million passengers and goods worth about \$ 18 billion on more than 100,000 flights. Statistics of world international and domestic air traffic in 2009 - 2018 are given in Table 3 [2].

Table 3. Statistics of world international and domestic air transportation in 2009 – 2018 [2].

Year	Passengers		Passenger-km		Freight tonnes		Freight tonne-km		Mail tonne-km		Revenue tonne-km	
	(millions)	Annual increase %	(millions)	Annual increase %	(millions)	Annual increase %	(millions)	Annual increase %	(millions)	Annual increase %	(millions)	Annual increase %
2009	2 488	-0.4	4 561 413	-1.1	40.0	-0.8	155 819	-8.9	4 620	-5.5	577 747	-4.3
2010	2 705	8.7	4 924 229	8.0	47.6	19.2	186 631	19.8	4 855	5.1	645 596	11.7
2011	2 870	6.1	5 248 140	6.6	48.7	2.2	187 191	0.3	5 006	3.1	677 631	5.0
2012	3 004	4.6	5 528 880	5.3	48.0	-1.4	185 239	-1.0	5 195	3.8	701 269	3.5
2013	3 138	4.5	5 832 564	5.5	49.1	2.3	185 975	0.4	5 586	7.5	731 033	4.2
2014	3 316	5.7	6 181 177	6.0	50.7	3.3	194 633	4.7	6 076	8.8	773 895	5.9
2015	3 556	7.2	6 644 666	7.5	51.0	0.5	197 131	1.3	6 549	7.8	821 174	6.1
2016	3 794	6.7	7 135 773	7.4	52.8	3.7	204 187	3.6	6 681	2.0	871 639	6.1
2017	4 062	7.1	7 707 118	8.0	56.6	7.1	222 996	9.2	7 449	11.5	945 904	8.5
2018	4 322	6.4	8 257 635	7.1	58.0	2.4	230 967	3.6	7 393	-0.7	1 004 763	6.2

Source: ICAO Air Transport Reporting Form A and A-S plus ICAO estimates.

Source: ICAO, *The World of Air Transport in 2018* - <https://www.icao.int/annual-report-2018/Pages/the-world-of-air-transport-in-2018.aspx>

Civil aviation statistics suggest that the growth of basic air traffic doubles every fifteen years, which is much more dynamic than the growth of most other industries. Since 1960, the demand for passenger, luggage, freight and mail has been steadily increasing. The development of technological progress and related investments are combined and make it possible to multiply the output of the aviation industry by a factor of more than 30. This expansion of air transport is extremely beneficial for the growth of the world economy, primarily for world production (global GDP), when measured in real terms, multiplied more than five times over the same period.

However, a structural analysis of air traffic volumes suggests that the dynamic growth of air traffic is consistently opposed by recession cycles. The aviation industry is an open system that is affected by a wide range of technical, natural, human and economic threats. For its part, it itself is a generator of significant threats to the environment. Among the most significant threats to civil aviation in the history of development are the fuel crisis (1973), the Iran-Iraq war (1981), the Gulf War (1991), the Asian crisis (1997-98), and the 9/11 terrorist attack, SARS pandemic (2003), global recession (2008) [1]. The civil aviation industry systematically opposes these negative trends and is itself one of the most effective tools for overcoming them. Fig. 1 shows the evolution of global air transport, taking into account external threats and the impact of their negative factors.

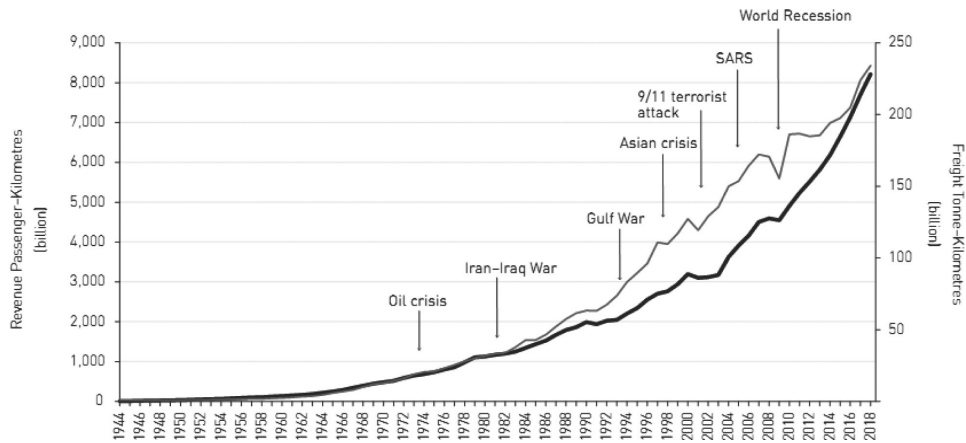


Fig. 1. Evolution of the development of world air transportation taking into account the impact of the fuel crisis (1973), the Iran-Iraq war (1981), the Gulf War (1991), the Asian crisis (1997-98), the terrorist attack 9/11 (2001), SARS (2003), the global recession (2008) [1].

Source: ICAO, ACI, CANSO, IATA, ICCAIA, ATAG, ABBB, *Aviation Benefits Report 2019: The Industry High Level Group (IHLG)*, 2019.

3.2 THE FUTURE OF THE EUROPEAN AND GLOBAL AIRPORT INDUSTRY

3.2.1 FORECASTS OF AIR PASSENGER TRAFFIC OF ICAO, ACI, CANSO, IATA, ICCAIA, ATAG AND ABBB.

The figure shows an analytical graph of the growth in air traffic from 1995 year forecast up to the year 2045[1]

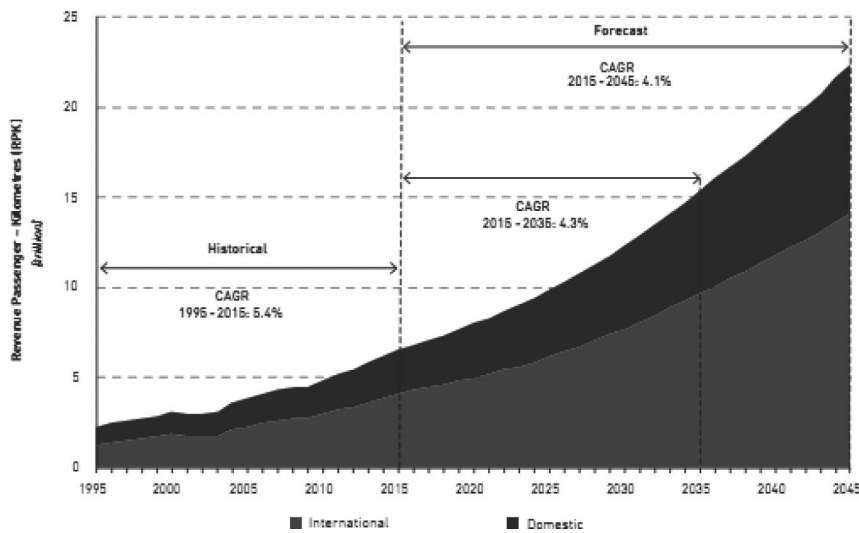


Fig. 2. Total passenger traffic: history and forecast 1995 -2045

Source: ICAO, ACI, CANSO, IATA, ICCAIA, ATAG, ABBB, *Aviation Benefits Report 2019: The Industry High Level Group (IHLG)*, 2019.

Both air passenger traffic and air freight traffic are expected to more than double in the next two decades. By 2045, passenger traffic will reach over 22 trillion RPKs with a growth of 4.1 per cent per annum, and freight will expand by 3.6 per cent annually over the same time period, to 573 billion FTKs. This growth holds tremendous

economic potential, which will support all States in achieving the UN's 2030 Agenda for Sustainable Development. In 2036, aviation will provide 98 million jobs and generate USD 5.7 trillion in GDP, a 110 per cent increase from 2016. The future growth of air transport will likely depend on sustainable world economic and trade growth, as well as declining airline costs and ticket prices. Other factors, including regulatory regimes (such as liberalization of air transport), technological improvements and fuel costs will also impact future growth. If growth were to slow due to restrictive trade, immigration, political factors and increasing fuel price, the total number of jobs supported by the air transport sector (including air transport supported tourism) could be 12 million lower by 2036 than the base forecasts. In this scenario, the contribution of the air transport sector to world GDP would be USD 820 billion (2016 prices) lower, with an additional USD 390 billion lost through lower tourism activity. To encourage this projected growth in a sustainable manner and produce inclusive and productive development and employment, aviation must continue to develop coherent policies with tourism, trade and other transport sectors. A national or regional policy framework consistent with ICAO's standards and policies, and with globally accepted good regulatory practices, can unlock the full value of aviation. New technologies and procedures should also be adopted to further improve connectivity and modernize infrastructure while minimizing any possible adverse impacts of this growth on the environment [3, 4].

3.2.2 TOP 20 OF EUROPEAN AIRPORTS

The European airport system is one of the most developed in the world. The Table 4. shows the operating results of the 20 largest airports in Europe [5].

Table 4. The operating results of the 20 largest airports in Europe

Rank	Airport Code	Airport Name	Total movements (000s)	Share of Total (%)
1	EHAM	AMSTERDAM	508.3	2.38
2	LFPG	PARIS CDG	482.7	2.26
3	EGLL	ONDON HEATHROW	476.0	2.23
4	EDDF	RANKFURT	475.5	2.23
5	LTBA	STANBUL ATATURK	451.1	2.11
6	EDDM	MUNICH	401.8	1.88
7	LEMD	MADRID BARAJAS	387.5	1.81
8	LEBL	BARCELONA	323.5	1.51
9	LIRF	ROME FIUMICINO	297.4	1.39
10	EGKK	ONDON GATWICK	285.9	1.34
11	LSZH	URICH	263.5	1.23
12	EKCH	OPENHAGEN	259.3	1.21
13	ENGM	OSLO GARDERMOEN	251.2	1.18
14	ESSA	TOCKHOLM ARLANDA	248.9	1.17
15	LOWW	VIENNA	240.1	1.12
16	EBBR	BRUSSELS	232.7	1.09
17	LFPO	PARIS ORLY	232.1	1.09

18	EIDW	DUBLIN	222.3	1.04
19	EDDL	DUSSELDORF	221.1	1.04
20	LTFJ	STANBUL GOKCEN	214.1	1.00
Other	-	-	14,878.7	69.68
Total	-	-	21,353.8	100.00

Source: EUROCONTROL, European Aviation in 2040. Challenges of Growth, Annex 1: Flight Forecast to 2040, European Organisation for the Safety of Air Navigation, 2018.

3.2.3 FLIGHT FORECAST TO 2040 OF EUROCONTROL/STATFOR

Flight Forecast to 2040 (European Aviation in 2040 Challenges of Growth), after consultation with STATFOR User Group members and EUROCONTROL experts, represent 4 scenarios of European civil aviation development. In summary, these scenarios are: 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 resource availability; Regulation and Growth: Moderate economic growth, with regulation reconciling environmental, social and economic demands to address the growing global sustainability concerns. This scenario has been constructed as the ‘most-likely’ of the four, most closely following both the current trends, and what are seen as the most-likely trends into the future; 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. Happy Localism: this scenario investigates an alternative path for the future. With European economies being exposed to shocks, increasing pressure on costs, stricter environmental constraints, air travel in Europe adapts to new global environment but taking an inwards perspective. There is less globalization, more trade inside EU. Also, less 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 Regulation and Growth scenario, it also inherits some aspects of other scenarios like higher fuel prices or low business aviation traffic of scenario Fragmenting World [5].

Table 5. Summary of the input assumptions per scenario

	Global Growth	Regulation and Growth	Fragmenting World	Happy Localism
2023 traffic growth	High ↑	Base →	Base →	Low ↓
Passengers				
Demographics (Population)	Aging UN Medium-fertility variant	Aging UN Medium-fertility variant	Aging UN Medium-fertility variant	Aging UN Zero-migration variant
Routes and Destinations	Long-haul ↑	No Change →	Long-haul ↓	Long-haul ↓
Open Skies	EU enlargement later +Far & Middle-East	EU enlargement earliest	EU enlargement earliest	EU enlargement latest

High-speed rail (new & improved connections)	20 city-pairs faster implementation	20 city-pairs	20 city-pairs faster implementation	20 city-pairs later implementation
Economic conditions				
GDP growth	Stronger ↑	Moderate →	Weak ↓	Weaker ↓↓
EU Enlargement	+5 States, Later	+5 States, Earliest	+5 States, Earliest	+5 States, Latest
Free Trade	Global, faster	Limited, later	More limited, even later	None
Price of travel				
Operating cost	Decreasing ↓↓	Decreasing ↓	Decreasing ↓	No change →
Price of CO ₂ in Emission Trading System	Moderate	Lowest	Lowest	Highest
Price of oil/barrel	Low	Lowest	Highest	High
Change in other charges	Noise: ↑	Noise: ↑	Noise: ↑	Noise: →
	Security: ↓	↑ ↑ Security: ↑	Security: →	Security: ↑
Structure				
Network	Hubs: ↑↑ Middle-East ↓ Europe ↓ Turkey ↑ Point-to-Point: N. Atlantic ↑↑	Hubs: ↑↑ Middle-East Europe&Turkey ↑ Point-to-Point: N. Atlantic ↑	Hubs: Middle-East ↑↑ Europe&Turkey ↓ Point-to-Point: ↑ N. Atlantic	No change →

Source: EUROCONTROL, European Aviation in 2040. Challenges of Growth, Annex 1: Flight Forecast to 2040, European Organisation for the Safety of Air Navigation, 2018.

Airport capacities are the limits on the ground of the forecast. For some airports, capacities are set to vary between scenarios implying different consequences on the air traffic.



Fig. 3. Map of the 111 airports for which future capacity plans have been considered (top 20 highlighted in red).
 Source: EUROCONTROL, European Aviation in 2040. Challenges of Growth, Annex 1: Flight Forecast to 2040, European Organisation for the Safety of Air Navigation, 2018.

The analysis shows that the capacity plans are concentrated in the busiest 20 airports, which are aiming for a 28% expansion. In total, the top 20 airports are adding capacity for 2.4 million new flights (arriving and departing runway movements).

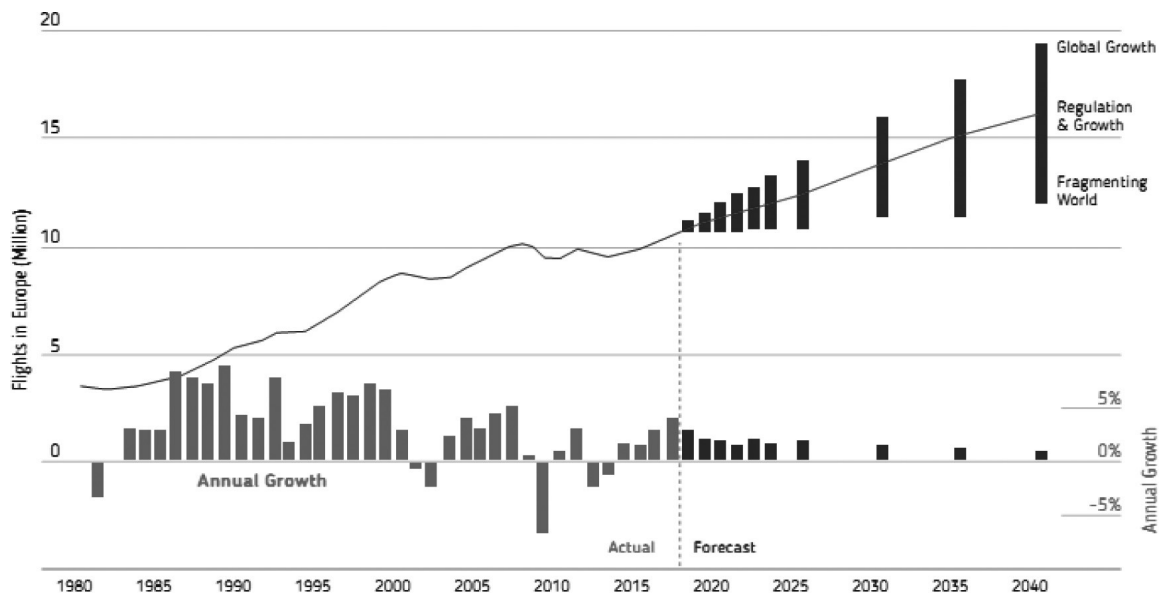


Fig. 4. In Regulation & Growth flights increase by 53% between 2017 and 2040.

Source: EUROCONTROL, European Aviation in 2040. Challenges of Growth, Annex 1: Flight Forecast to 2040, European Organisation for the Safety of Air Navigation, 2018.

Since 2016, European traffic (IFR movements) has passed the 10 million flights per year (again). By 2040, the traffic is expected to grow beyond 16 million of flights in Regulation and Growth, and even close to 20 million in Global Growth. This corresponds to a total growth between 53% (Regulation and Growth) and 84% (Global Growth), a rather slower growth rate than before 2008 [5].

Table 6. Summary of the key traffic values expected in the four scenarios for Europe by 2040.

Scenario	IFR Flights (million) 2040	Total growth 2040/2017	Average annual growth 2040/2017	Extra flights/day (thousands)
Global Growth	19.5	84%	2.7%	24
Regulation & Growth	16.2	53%	1.9%	15
Happy Localism	14.9	41%	1.5%	12
Fragmenting World	11.9	12%	0.5%	4

Source: EUROCONTROL, European Aviation in 2040. Challenges of Growth, Annex 1: Flight Forecast to 2040, European Organisation for the Safety of Air Navigation, 2018.

Each scenario paints a picture of a different future:

In the most-likely scenario, Regulation and Growth, there will be 16.2 million flights in Europe in 2040, 53% more flights than in 2017. That is an average growth of 1.9% per year, around half of the historical rates between then 1960s and the 2008 previous peak. There will be a slow-down in growth rates from 2035 as market become more mature, economic growth decelerates and as the capacity limits become an issue.

Global Growth is the most challenging scenario. Starting from the high-growth scenario of the 7-year forecast, Global Growth is supported by quite strong economic growth, a high propensity to fly, wide range of open skies agreements (compared to other scenarios) and relatively low fuel prices (similar as Regulation and Growth). This scenario records 19.5 million flights in 2040 in Europe, corresponding to 83% more flights than in 2017. In this scenario, growth rates are averaging 2.7% per year over the 23 years: up to 2025 average annual growth rates are expected to stand at 3.1% per year, capitalising on the recent traffic recovery, while the 2030-2040 period shows more moderate—but sustained in the long-term--growth rates of 2% per year. This decelerating trend is explained by a mix of factors: market maturity, larger aircraft, and capacity constraints at airports.

The recent return to traffic growth has been vigorous, and there are newer growth drivers - long-haul, low-cost, new aircraft types, middle class growth in China, changes in propensity to fly – which are under-represented in our forecast models because of their short histories. For this reason we recommend that, in addition to the most-likely scenario Regulation and Growth, particular attention is paid to Global Growth.

Happy Localism, although starting from the same 2023 traffic levels as Regulation and Growth, follows almost the same pattern in growth but at a slower pace as the economy is expected to develop less rapidly in this scenario from 2023 onwards. Moreover, this scenario includes higher fuel prices as well as higher load factors than in Regulation and Growth. The growth rates are expected to level off from 2025 onwards, resulting in 1.3 million fewer movements in Happy Localism compared to Regulation and Growth in 2040.

Lastly, Fragmenting World starts from the low- growth scenario of the 7-year forecast, where a lot of factors hinder the traffic growth: high oil prices, slow economic development, no free trade agreements with outside

Europe partners, high price of travel etc. This scenario points to stagnation of traffic as it records 11.9 million flights in 2040 in Europe, 12% more than in 2017. In this scenario, growth rates are averaging 0.5% per year over the 23 years. In 2040, the final number of flights in Fragmenting World corresponds to the expected number of flights by 2022 in the most-likely scenario or the expected number of flights by 2020 in Global Growth [12].

3.2.4 FORECAST OF LEADING AVIATION MANUFACTURERS AIRBUS AND BOEING.

The results of the EUROCONTROL forecast are generally confirmed by the forecast of the leading aviation manufacturers AIRBUS and BOEING. Regarding this forecast, the long term growth potential for our industry is confirmed:

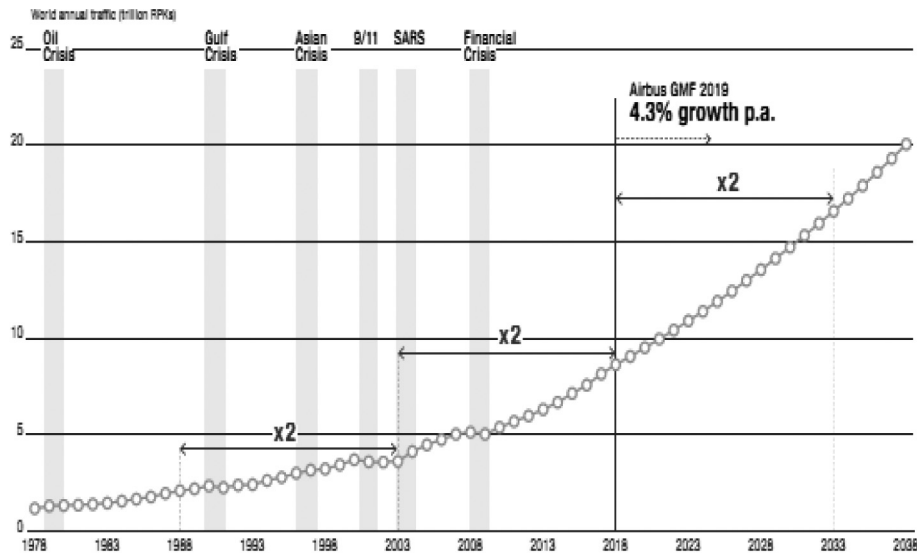


Fig. 5. World annual traffic forecast 2019 -2038

Source: AIRBUS S.A.S., CITIES, AIRPORTS & AIRCRAFT 2019-2038, AIRBUS S.A.S. Cedex, Blagnac 2019.

- The commercial aviation industry has been resilient to external shocks, traffic has grown x2.4 since 2000; Traffic forecast to double in the next 15 years; forecast confirms a 4.3% average traffic growth p.a. over the next 20 years; demand for 39,210 passenger and freight aircraft over the next 20 years.
- 36% for aircraft replacement, and 64% for growth; more than 14,200 aircraft will be replaced with ~38,360 passenger aircraft and 850 new build freighters; the services market is forecast to deliver a cumulative US \$4.9 trillion over the next 20 years [6]. Traffic has proven to be resilient to external Shocks and doubles every 15 years [Source: ICAO, Airbus, CFM, 2019].

The forecasts of leading world and regional organizations and leading manufacturers of aircraft allow us to conclude that the global civil aviation system is developing dynamically. These challenges require the development of an effective management system, flexible adaptive airports and aerodromes infrastructure and the use of modern air transport technologies by the airports. The subsequent chapters of the monograph are devoted to these aspects [3]. Until March 2020, these predictions were practically not in doubt among researchers. However, the negative factor of the COVID 19 pandemic, as well as the low level of predictability of the level of its further spread and the effectiveness of the countermeasures, will definitely lead to serious adjustments to the optimistic forecast data. The world's airlines are even preparing for a possible voluntary termination of almost all international and domestic flights due to declining demand. In total, according to preliminary forecasts of the International Air Transport Association (IATA), airlines could lose more than \$ 250 billion due to the pandemic. In this case, their revenue will fall by more than 40% in 2020. Sydney consulting company CAPA is

even more pessimistic. It predicts that the coronavirus pandemic could lead to the bankruptcy of most airlines around the world by the end of May if the authorities refuse to agree on steps to avoid such a situation [7].

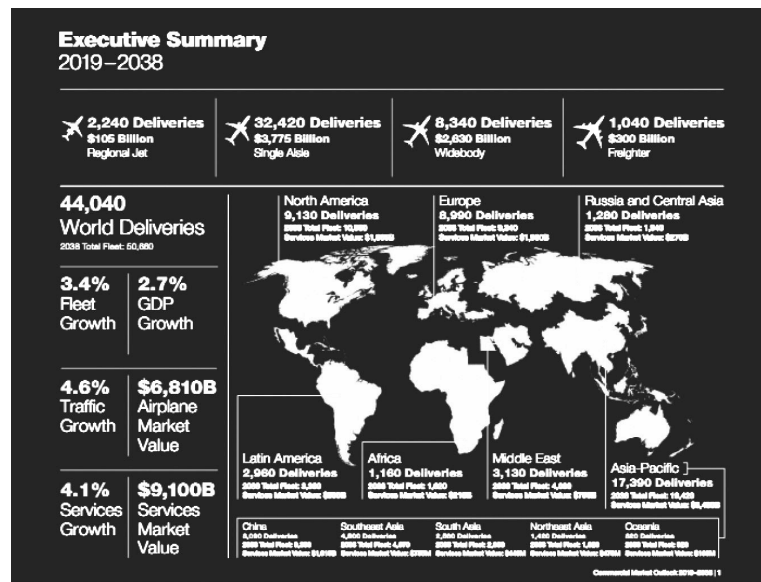


Fig. 6. Commercial Market Outlook 2019-2038

Source: Boeing Commercial Market Outlook 2019-2038, 2019.

The airport system is a part of the transport complex, which is an important component in the structure of the global economy and a link between all components of economic security to ensure the basic conditions of life and development of states and society [8]. At first glance, the main task of economic security of airport system is to find adequate answers to the threats identified in the planning of economic development of airports and in the implementation of measures for the development of aviation infrastructure. And this is a really correct definition, but the assessment of economic threats is an integral part of all the logical blocks of the structural and functional scheme of strategic management of aviation safety in terms of sustainable development of the global as well as national economy. Thus, proactive airport risk management is the key to maintaining the reliability and sustainable development of the national economy.

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