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Aviation and Safety Basics

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ABSTRACT.
Air transport is the lead constituent of civil aviation, playing a major role in world economic activity and being one of the engines of economic growth. Demand for air transport is closely linked with economic development. For an industry that directly and indirectly supports the employment of around 60 million people, contributes over $2 trillion to global GDP and carries more than 3 billion passengers safety must be aviation's first and overriding priority. Besides this the key elements to maintaining the vitality of civil aviation is to ensure secure, efficient, and environmentally sustainable operations at the global, regional, and national levels. Aviation industry is one of the most striking examples of the existing dangers for human life, their sources and factors, in most cases – of a complex character. Threats of flight and environmental safety, aviation security, and their consequences are interdependent and determine each other. Addressing to them requires an integrated approach, implemented in aviation safety program.
KEYWORDS: air transport, benefits, costs, safety, security, environmental impact, sustainability

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I INTRODUCTION

In the past 100 years, more than 65 billion passengers have traveled by air. And the world has benefited from the advance of commercial aviation. Air transport traditionally experiences higher growth than most other industries, solidifying a positive trend in profitability. The global air transport network has doubled in size every 15 years since 1977 and between now and 2030 it is poised to double again. Demand for air transport is closely linked with economic development; at the same time air transport is a driver in an economy. To provide passenger, freight and mail services, air carriers, business aviation, and other commercial operators purchase a wide range of products and services from airports and air navigation service providers, manufacturing and service industries, which in turn depend on numerous suppliers. Fig. 1 shows these and others actors in the air transport industry. Currently it covers 1715 airlines, which operating a fleet of around 23000 aircraft serving 3750 airports through a route network of several million kilometers managed by 160 air navigation service providers (ATAG, 2012).

Fig. 1. The air transport industry today (ATAG, 2012)

Civil aviation includes air transport (commercial carriage by air), non-commercial flying (such as private flying), commercial non-transport (such as aerial crop dusting and surveying), infrastructure (such as airports and air navigation facilities), and manufacturing (such as aircraft, engines, and avionics). Air transport is the lead constituent of civil aviation, playing a major role in world economic activity and being one of the engines of economic growth. International Civil Aviation Organization (ICAO) estimates the direct contribution of civil aviation about 4.5 % of the world output in terms of real gross domestic product (GDP), representing in terms of the consolidated output of air carriers, other commercial operators and their affiliates (ATAG, 2014). Air transport also has important 'multiplier' effects, which mean that its overall contribution to global employment and GDP is much larger than its direct impact alone (Fig. 2). It creates direct and indirect jobs, promotes tourism and trade in addition to attracting foreign investments. The economic and social contribution of air transport to our global society is huge. Nearly 57 million jobs and $2.2 trillion in global GDP is supported by aviation. Some 40% by value of the world's manufactured exports and around 50 % of the international tourists are transported by air every year relying on the speed and efficiency of aviation to provide the goods and services required for modern life. The air transport industry's profitability in 2014 is owed primarily to improving global economic conditions, which underpinned robust growth in passenger and air cargo demand.

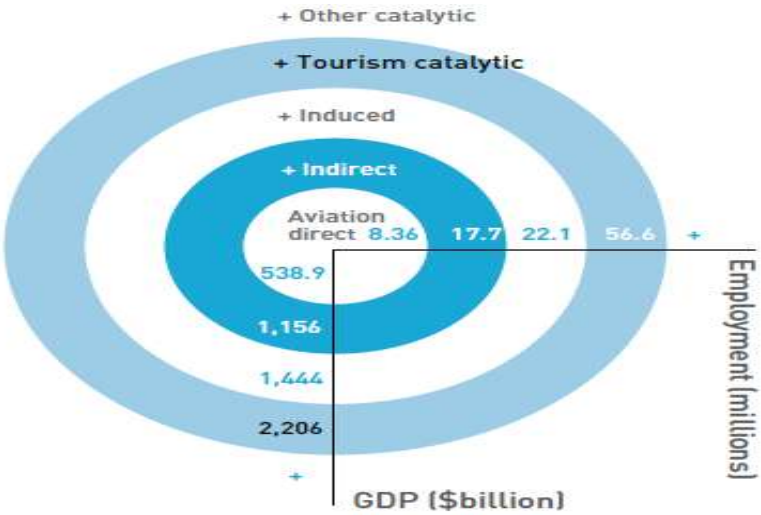


Fig. 2. Aviation's global employment and GDP impact (ATAG, 2014)

Demand for air transport is closely linked with economic development, there is one enduring industry 'fact' that traffic grows twice as fast as GDP. As economies grow, the burgeoning middle classes tend to travel more (Fig. 3). Those key growth economies are also where the highest growth in trips-per-capita are located. In emerging economies (comparing with mature economies, such as those of the United States and the United Kingdom), GDP growth has a bigger impact on air transport demand, as each unit of GDP generates more air travel in emerging economies than in mature markets. In 2014, this trend in demand was bolstered by significantly lower airline fares in markets outside the United States because of falling fuel prices. If any crisis happened (manmade or caused by nature like eruption of Eyfjallajökull, a volcano in Iceland, in April 2010, caused the largest breakdown in civil aviation since Second World War) the appropriate decline in transportation demand is observed (end of 1970s and beginning of 1980s – oil crisis, 1998 – Asian crisis, 2001 – 9/11 terrorist attack, 2008 – 2009 global economic recession) in Fig. 4. Decline in transportation demand may show the loss of expected profits, but the real loss is much more complicated, because a number of safety, security, inefficiency, and unsustainability issues may contribute greatly to damage/benefits assessments, directly and/or indirectly defining the total results of developments in the aviation sector.

II AIR TRANSPORT STATISTICS

Air transport statistics show that passenger, cargo, mail and aircraft movements will continue to grow. Demand for cargo and passenger services, measured in freight tons/kilometers (FTKs) and in revenue passenger kilometers (RPKs), respectively, accelerated in 2014. This reflected an upturn in the global economy and an increase in world trade. Business confidence strengthened to its highest level since 2011.Overall, the international traffic growth along with the growth in domestic markets in developing countries, coupled with different economic growth rates among Regions, created varying patterns of growth and the regional disparities were noted (Table 1).

The figures released by the ICAO confirmed that some 3.6 billion passengers made use of the global air transport network for their business and tourism needs in 2014. The annual passenger total is up approximately 5 % (both for international and domestic transportation) compared to 2013 and is expected to reach over 6.4 billion by 2030 based on current projections. The number of aircraft departures reached 38 million globally during 2014, establishing a new record and surpassing the 2013 departure figure by more than one million flights. ICAO also confirmed that scheduled passenger traffic grew at a rate of 5.2 % in 2013 (expressed in terms of revenue passenger-kilometres or RPKs), slightly above the UN body's July 2013 projections.

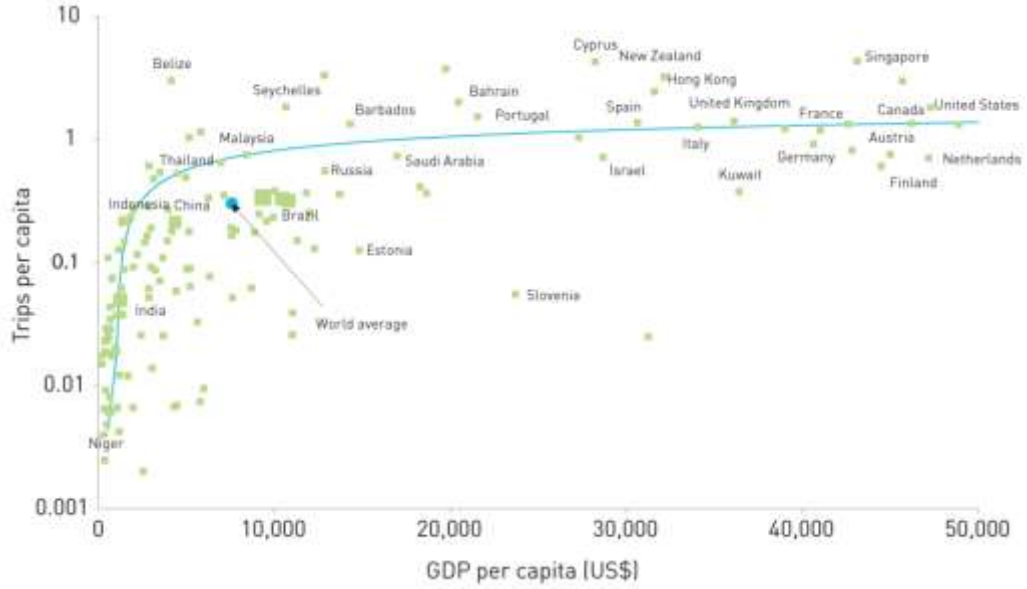


Fig. 3. Trips per capita dependence from GDP per capita (Boeing, 2013)

Fig. 4. World air travel and GDP growth, 1971 – 2010 (Boeing, 2013)

Table 1. Medium-term Passenger Traffic Forecasts for Global and Regional Scheduled Passenger Traffic (passenger-kilometers performed, PKP) (ICAO New Release, 2013)

Region of airline registration	Annual Growth Rates (%)				
	History		Forecasts		
	2011	2012	2013	2014	2015
Europe	9.5	3.9	4.4	5.5	6.2
Africa	0.9	4.2	5.2	5.7	6.0
Middle East	9.2	13.7	10.2	11.2	10.8
Asia/Pacific	6.8	6.4	5.5	6.4	6.8
North America	2.4	1.3	2.3	3.3	3.8
Latin America/Caribbean	11.1	8.6	7.6	8.7	8.0
World	6.5	4.9	4.8	5.9	6.3

The 2013 forecasts are in line with the preliminary estimates for 2012-2013, according to which world traffic should increase by up to 6.0 % compared to 2012 levels (Fig. 5). In reality, RPKs between regions of the world grew at an accelerated rate on 5.4% in 2013 and further expanding up to 6.1% in 2014. Overall growth in passenger traffic mirrored positive economic growth worldwide, it reflected the increase in demand that resulted from improvements in the global economy. Current expectations of a 4.2 %t annual Gross Domestic Product (GDP) at Purchasing Power Parity (PPP) growth rate for the world economy over 2014–2015 should translate into world air traffic growth 5.9 and 6.3 % in terms of passenger-kilometres performed (PKP) respectively.

Air transport capacity, expressed in available seat-kilometres (ASKs), increased globally also by 4.6 % in 2013. Average passenger load factor increased slightly in 2013, by about one-half a percentage point compared to 2012, or 79.1 %. At 80%, the passenger load factor in 2014 stayed close to the record high levels of 2013. This was the result of increased passenger volumes and consolidation and disciplined capacity management. In 2014 the cargo load factor, though, remained weak, at around 45%.

Jet fuel prices fell substantially during 2014 – starting the year at $130 per barrel and finishing it at $75 per barrel. The average for the year was $116.6 a barrel, and although this is still within the high range for the past three years it is some 6% lower than the previous year's average of $124.5 a barrel. For airlines, however, the benefit of falling fuel prices was partly offset by hedging practices and the appreciation of the US dollar.

The world's major aircraft manufacturers are expected to have delivered more than 1,500 new commercial aircraft by the end of 2013 and have recorded orders for an impressive 2,800 new aircraft. There was also an increase in aircraft deliveries in 2014 to 1,627 new aircraft. The in-service fleet rose to 26,000 aircraft, the number of seats available in the fleet rose to 3.5 million, adding 5% capacity to the market globally. Together with more efficient processes now being implemented by airline and airport operators, as well as improved flow management and performance-based air navigation, these environmentally-friendly aircraft will contribute positively to continued and sustainable air transport development. More than 20 thousands aircraft are needed over the next 20 years (Boeing, 2013).

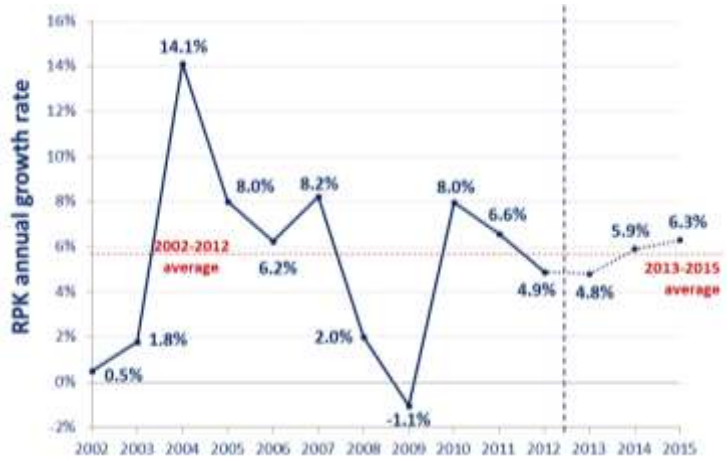


Figure 5. World passenger traffic annual growth rates history and forecast (ICAO New Release, 2013)

For an industry that directly and indirectly supports the employment of 56.6 million people, contributes over $2 trillion to global GDP, and carries more than 3 billion passengers and $5.3 trillion worth of cargo annually, safety must be aviation's first and overriding priority. Besides this the key elements to maintaining the vitality of civil aviation is to ensure secure, efficient and environmentally sustainable operations at the global, regional and national levels.

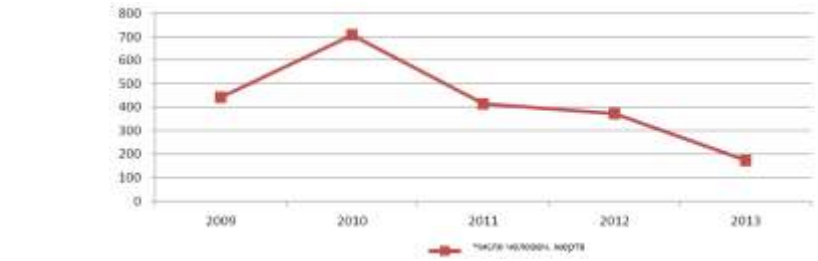
III SAFETY ISSUES FOR AVIATION SECTOR

Continuous safety enhancements have a direct and positive impact on the overall efficiency and environmental performance of the global air transport system. They promote the viability and profitability of commercial air transport operations, as well as public confidence in air travel. As for aviation safety, there were 99 aircraft accidents (9 fatal) on scheduled air services in 2012, a decrease of 21 % from 2011, when 126 accidents were reported (ICAO, 2013a). The number of fatalities in scheduled operations worldwide decrease of 10 %. The global accident rate decreased by 24 % to 3.2 accidents per million schedule departures versus 4.2 accidents per million scheduled departures in 2011.

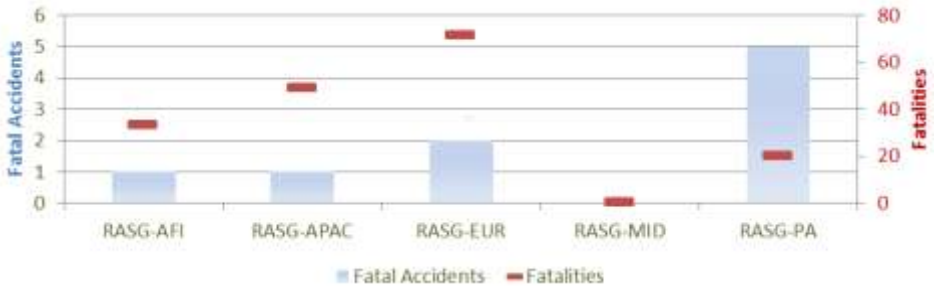
Based on statistical data, the air transport system experienced a marginal overall increase of scheduled commercial departures in 2013 compared to the year before (ICAO, 2014). Although the number of fatal accidents involving scheduled commercial operations remained steady at nine during 2013, fatalities themselves

were down a significant 53.5 % from 2012, dropping to only 173 compared to 372 the previous year (Fig. 6a, Fig. 6b). Using 2010 as a baseline, fatalities have fallen by a whopping 76 % and 2013 represents the third consecutive year in which air transport fatalities have continued to decrease.

2014 was a year of contrasts for aviation safety. The global jet accident rate, measured in hull losses per 1 million flights, was 0.23 (in 2013 the global jet hull loss rate was at 0.41) – the equivalent of one major accident for every 4.4 million flights. That is the lowest rate in the history of aviation. Of 38 million flights, 12 resulted in fatal accidents (versus 16 in 2013 and the five-year average of 19), only 3 of which involved jet aircraft. 2014's overall accident rate was of 1.92 accidents per million sectors flown, 14% lower than 2013's overall accident rate of 2.24 and 23% below the previous five-year (2009-2013) average of 2.48, fig. 7. But 2014 will be remembered for the high number of passenger fatalities – 641 versus a five-year average of 571 – and for two extraordinary and tragic events involving MH 370 and MH 17. In early 2015, another high-profile tragedy occurred when Germanwings 9525 crashed in the French Alps with 150 lives lost.



a)



b)

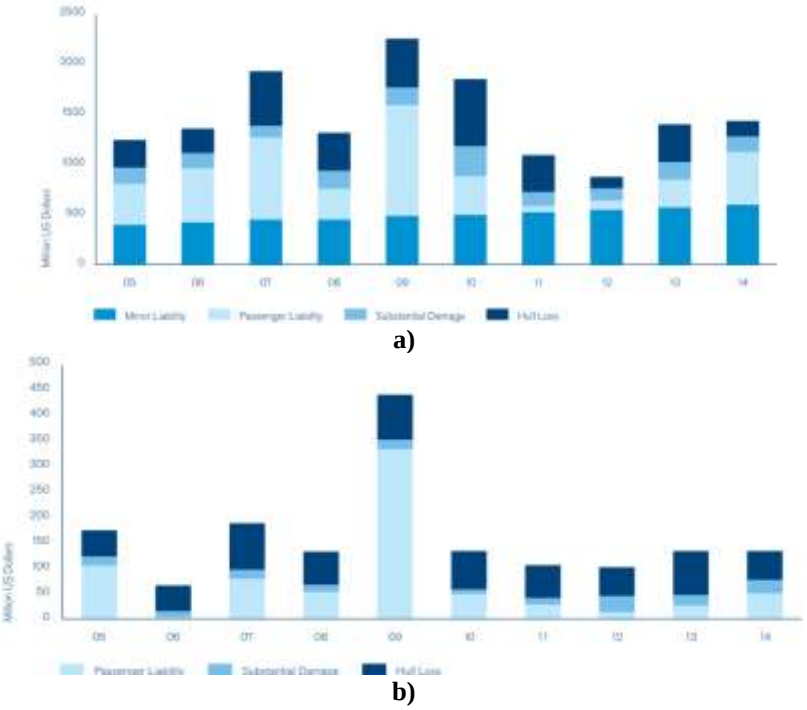
Fig. 6. Fatalities trend (a) and fatal accidents/fatalities by region (RASG – Regional Aviation Safety Groups) (ICAO, 2014)

The tragedies in 2014 of MH 370 and MH 17 and in 2015 of Germanwings 9525 are anomalies. But over the past 20-30 years any marked improvement in level of flight safety (in relative performances) did not happen. Aircraft manufacturers predict that potentially, by 2030, there will be one commercial aviation accident every three months, based on the current accident rate and the expected recovery in air traffic growth (ICAO, 2013b). This is an unacceptable societal risk, which if realized would undermine the sustainable economic viability of the aviation industry. In order to address this clearly unacceptable societal risk there is a need, complementary to the sharing of safety data, for a consolidated and industry-wide approach to safety knowledge management, building on the foundations of State Safety Programmes and operators' Safety Management Systems (SMS). SMS includes organizational structures, accountabilities, and procedures. Each airline and other flight and/or service provider is responsible for establishing an SMS, focusing on SMS consistency globally.

Fig. 7. All Aircraft Accident Rate (IATA Member Airlines vs . Industry, 2005-2014): includes substantial damage and hull loss accidents for jets and turboprops (IATA, 2015)

IATA has obtained the estimated costs for all losses involving jet and turboprop aircraft over the last 10 years (Fig. 8a, Fig. 8b). The figures presented are from operational accidents and exclude security-related events and acts of violence. IATA Six-Point Safety Strategy must ensure that it is relevant and comprehensive in approach to identifying organizational, operational, and emerging safety issues, including: reducing operational risks, such as controlled flight into terrain (CFIT), loss of control in-flight (LOC-I), and runway excursions (runway safety); enhancing quality and compliance through audit programs; advocating for improved aviation infrastructure, such as the implementation of PBN approaches; supporting the consistent implementation of SMS; encouraging recruitment and training to enhance quality and compliance through such programs as the IATA Quality and Training Initiative and ICAO's Multi-Crew Pilot License; and identifying and addressing emerging safety issues, such as lithium batteries.

Lack of aviation accidents and incidents does not necessarily mean the absence of danger. But very often potential hazards with probable adverse effects are not taken into account before the aviation accident/incident happen. Rationally sound integration of the need to prevent hazards with consequences in human activities is an example of the mentality of insurance, i.e., management processes should be implemented with the assumption of the risk of such hazards and advance to guarantee identification of hazards, their risk assessment and implementation of appropriate measures for their control.



a)

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Fig. 8. Accident Costs (2005-2014): a) Jet aircraft; b) Turboprop aircraft (IATA,2015)

In the air transportation system air traffic is centered on airports. Airports offer access to essential infrastructure and services that facilitate air transport. In addition, airports can play a critical role for economic development on local, national, and regional levels. The effective and efficient development and functioning of airports is therefore important for the sustainable development of air transport in particular and the economy as whole. But at the same time for the population living in the vicinity of airports, this implies involuntary exposure to a number of impacts, including the risk of aircraft accidents. Current inventory of environmental problems in the aviation sector groups the issues into seven categories: aircraft noise, air pollution near airports, global phenomena (global warming and climate change), airport/infrastructure construction (landscape-transforming factor), water/soil pollution near airports, airport waste management, and aircraft accidents/incidents.

Safety is a top priority and that includes the health of passengers throughout the travel experience. The increasing number of air travelers suggests that in future more of them will be affected by public health events and that international promulgation of communicable disease is increasingly likely to be an important factor by which future pandemics are initially disseminated. As large numbers of the global population are potentially involved in health events for example ranging from 18 000 to over two million estimated deaths in the three pandemics of the last 60 years, a small reduction in risk from effective management in the aviation sector can be expected to have a significant impact on the number affected by ill-health (ICAO, 2013c). Since 2003, there have been four important public health events that have adversely affected aviation: 2003 – Severe Acute Respiratory Syndrome (SARS); 2009 – Influenza A (H1N1) pandemic; 2011 – Fukushima nuclear accident caused by the Japan earthquake; and 2014 – Ebola pandemic. Public health events can seriously impact air transport operations as demonstrated by a reduction in passenger numbers of 80 % and 40 % to Hong Kong and Mexico respectively, at the onset of the SARS outbreak and the Influenza A pandemic. Further major public health events can be expected in future. In such events, just 1% reduction in mortality because of good management in the aviation sector through activities such as traveler screening for disease at airports, identification and management of on-board cases. Appropriate notification to the public health authority at destination and efficient communication procedures to inform travellers of action to take if they become ill could reduce the global number of fatalities by between 180 to 20,000. The development and execution of measures to combat public health emergencies are the responsibility of states through their public health authorities, not airlines. In this regard, it is critical for WHO (World Health Organization) member States to coordinate their responses to health emergencies (Ebola, SARS, influenza, etc.) to avoid the imposition of a patchwork of differing measures across different States. Failure to do so will result in confusion for passengers, inefficient implementation of measures to contain Ebola and a disproportionate operational burden on airlines. It is important for states to base their procedures on WHO guidelines and existing internationally agreed standards and procedures. WHO does not recommend any ban on international travel or trade, on the contrary the WHO is still actively encouraging airlines to keep operating to affected areas, as this is often the only way to ensure that much needed medical supplies and medical professionals can access those affected areas.

The nuclear accident in Japan demonstrated that not only public health events involving communicable disease can adversely affect air transport operations. The scope and name of the CAPSCA (on 1 January 2013 the *Cooperative Arrangement for the Prevention of Spread of Communicable Disease through Air Travel* became the *Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation* with the same acronym, CAPSCA) programme was therefore amended to take this into account (ICAO, 2013c). Assuming funding is available, the programme CAPSCA will continue to be extended to address all types of public health events, biological, nuclear, and chemical, including terrorist related incidents.

Air transport is an important factor by which pandemics are initially disseminated. Furthermore, aviation is adversely and severely affected by such events, as are the economies of States and businesses that rely on it. Without CAPSCA, expected adverse health and economic effects may be amplified due to suboptimal responses by the aviation sector to international public health events.

Environmental factors inside airport area are impacting in combined manner: at the same time people are influenced, for example, by risks of air pollution, aircraft noise and accidents. Population, living in the vicinity of airports, can not avoid such a combined effect, performing daily activities, for example, work, shopping, school work, rest, etc. These factors also interact with each other. Anxiety associated with aircraft accidents may increase annoyance, formed by the noise, and vice versa. Other factors may change the total impact also.

Aviation safety is seen as a complex property of the air transport system to perform its functions without prejudice (or with minimal damage) to the system itself or the people in whose interest it develops. The main its components are *flight safety*, *aviation security* and *environmental safety* (environmental protection) (ICAO, 205b, Zaporozhets A., Blyukher B., 2014). Maximum attention is paid by ICAO to these components, although other types of safety (fire, informational, and economic) can be prioritized. As the global forum for cooperation among its Member States and the world aviation community, the ICAO sets and evolves Standards

and Recommended Practices (SARPs) for the safe and orderly development of international civil aviation, establishing for the 2014-2016 triennium the following five comprehensive strategic objectives:

- enhance global civil aviation safety;
- increase the capacity and improve the efficiency of the global civil aviation system;
- enhance global civil aviation security and facilitation;
- foster the development of a sound and economically-viable civil aviation system;
- minimize the adverse environmental effects of civil aviation activities.

Generally speaking the concept of safety is complex and difficult to understand in all its entire dimensions, physical, social, psychological, and, therefore, difficult to promote (Montreal Declaration, 2003). Safety is not defined as a total absence of hazards and its objects are not to eliminate all the risks. Safety is a state in which hazards and conditions leading to physical, psychological or material harm are controlled in order to preserve (protect) the health and well being of individuals and the community. In principle, safety is a fundamental right and it is essential for the attainment of health, peace, justice, and well being. The effective safety enhancement requires an integrated approach, which takes into account several aspects in a framework that allows them to be viewed comprehensively. Safety is the result of a complex process where humans interact with their environment, including the physical, social, cultural, technological, political, economic, and organisational environments. Safety legislation, safety standards, and management objectives should all reflect the safety and sustainable development context, and that standards applied by some countries may be inappropriate and of unwarranted social and economic costs to other countries. Steps shall be taken for ensuring provision of adequate emergency services including the provision for police, fire fighting, medical and paramedical facilities, and disaster management services to all persons and communities.

Threats (causes, factors) of flight and environmental safety, aviation security, and their consequences are interdependent and determine each other. Addressing to them requires an integrated approach, implemented in aviation safety program (ICAO, 2013d). For example, the objectives for the transport sector of the European Union (EU Transport Programme) are provided to build Intelligent Transport Systems (ITS), which must significantly contribute to a cleaner, safer, and more efficient transport system (Directive, 2010): "The application of information and communication technologies to the road transport sector and its interfaces with other modes of transport will make a significant contribution to improving environmental performance, efficiency, including energy efficiency, safety and security of road transport, including the transport of dangerous goods, public security and passenger and freight mobility, whilst at the same time ensuring the functioning of the internal market as well as increased levels of competitiveness and employment".

IV EFFICIENCY OF THE AIR TRANSPORT SYSTEM

Air transport has become an essential element of the global transportation system that ensures the mobility of consumers and enhances the viability of the global economy. Air transport system contributes to the displacement of people and goods over long distances - quickly, comfortably and economically.

Technological changes, aimed on improving efficiency of the air transport system, are supported by continuous investment in aviation research and development of new techniques and new technologies. This is the basis of its rapid growth, contributing to the development of global production, trade and tourism. Development of aviation technologies is stimulated by many factors, among which the priorities are changing all the time, but aviation safety factor always comes first – of highest priority, Table 2.

Table 2. Priorities among the factors of civil aviation development

1950-1970	1970-1980	1980-2000	After 2000
Flight safety	Flight safety	Flight safety	Flight safety
Speed	Economical efficiency	Environment protection	Aviation security
Distance	Comfort	Economical efficiency	Environment protection
Comfort	Resources	Resources	Economical efficiency

Efficiency of civil aviation is determined by the completeness of implementation of listed in Tab. 2 factors. Efficiency indicates how resources are used (e.g., vehicles, personnel, fuel, time, funding) for production and meet demand. The effectiveness indicates a range of changes in service provision and industry infrastructure for resources usage reduction per unit of output. Air travel should be simple, smooth, and hassle free. Industry collaboration aims to transform the passenger experience through implementation of global standards and innovative solutions. Commercial aviation is built on global standards that make an integrated international air transport system possible. Passengers take for granted their ability to travel

practically anywhere in the world on a single e-ticket paid for in a single currency and issued at a single location.

Aircraft are increasingly more efficient, using very light composite materials, flying on sustainable alternative fuels, and research and development continues to seek further technological advances and clean energy sources. The concept of efficiency must cover a wide range of topics, including possible external costs (environmental, social) to improve the safety (Fig. 9).

Fig. 9. Safety – Environment – Efficiency Circle

Transport efficiency represents the relationship between the use of resources, costs, and productivity (Fig. 10). Broadly speaking the transport efficiency includes (covers):

- capital, operating and maintenance costs;
- cost to the consumer, depending on the speed of transport, duration of delays, congestion, the cost of transportation usage, rates;
- consumers and companies benefits (revenues minus expenses);
- performance, which is expressed, for example, by the cost of travel per passenger or passenger revenue for the transport time;
- transportation and the proposed services capacities;
- load factor for freight and public transport, etc.

The aviation industry has managed to successfully halve unit costs in real terms over the past 40 years (Fig. 10). However, all of those efficiency gains have been passed through to customers in lower prices. This has created a lot of value for customers, a good thing, but the problem is that it has left airline equity investors unrewarded for providing their capital.

The application of an approach of the kind described here to the process of aviation safety improvement would ensure that States and aviation service providers could implement safety improvements more efficiently, and thus be better prepared to respond to the safety challenges of the future. It is suggested that a safety knowledge management approach should be built on the following principles and elements (ICAO, 2013e):

a) *Comprehensiveness*. Complete coverage of best practices from all segments of aviation, different geographical regions, and varying operational environments;

b) *Traceability*. The origin of the best practices, regulatory requirements, safety management practices and evidence of resilience and vulnerabilities must be traceable;

c) *Accessibility, Quality and Credibility*. Universal access for aviation safety professionals is key. The safety knowledge itself must be credible and reliable;

d) *Availability and ease of use*. The number of aviation safety knowledge elements is vast. An intelligent mechanism with a rapid search capability to locate the desired information is essential;

e) *Flexibility*. The approach and the related process would need to be sufficiently flexible to allow for changes in structural elements; and

f) *Efficiency and sustainability*. The approach must not impose any additional burden on the aviation community, and should make full use of existing processes and tools.

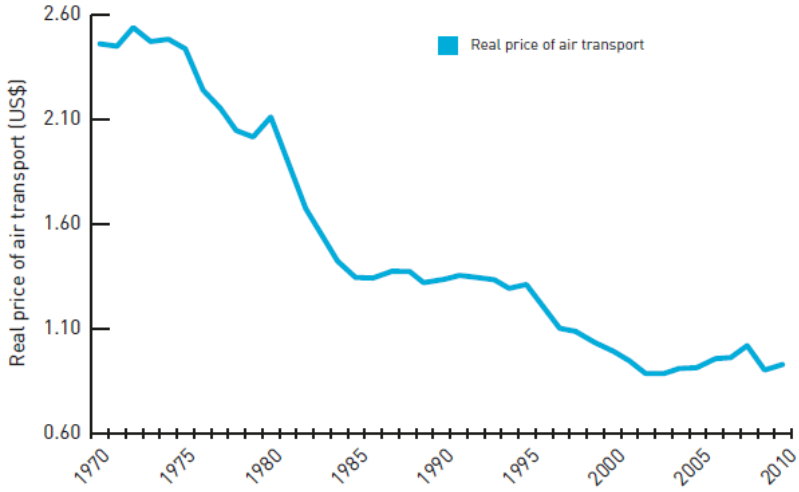

Fig. 10. Real price of air transport per tonne·kilometre, 1970 – 2010 (ATAG, 2014)

Quality extends the concept of transport efficiency, reflecting the personal advantages, but largely synonymous with efficiency. The quality indicates how transportation means and services are used for consumers, including their safety, reliability, flexibility, comfort, accessibility, purchasing consistency, and convenience.

Quality covers a wide range of topics, which include:

- *safety and security* - ensuring the delivering of passengers and cargo to the destination without damages (intact);
- *flexibility* - adaptability to a variety of needs or conditions, which are available length of routes, types of vehicles, changing the direction of routes, ease of entry into the sphere of service out of it, different sizes and types of cargo, as well as the size and volume of traffic, simplicity of use, timeliness and availability of information, compliance with the payment system
- *comfort* - creating amenity conditions for passenger during the travel, both inside and outside the vehicle;
- *accessibility* - ensuring access to transport and to information about transportation services;
- *purchasing consistency and convenience* - the consumer perception of transportation costs, including the costs of access and movement.

  In general, the economic development policies to improve quality of life in the region is developed taking into account the following factors:
- *profit* – growth of economic well-being of the population in the region as a result of their income increase;
- *select the type of work* – increasing the list of available types of work, resulting in improved growth opportunities for the well-being of the population and increase profits in the region;
- *select of type of activities* – expanding opportunities for social and recreational types, thus improving a quality of life;
- *stability of work and profits* (thanks to the diversity of the economy), which reduces vulnerability to economic downturns;
- *attractiveness of the region* for workers and businesses, which contributes to its improvement or creation of cultural and recovery systems.

V SUSTAINABLE AIR TRANSPORTATION

With projected growth of aviation traffic in a future it is essential to insure through today actions that subsequent generations can continue to enjoy the benefits of air transport tomorrow and on environmentally sustainable basis. Sustainable growth calls for us to meet the needs of today without depleting the resources needed for future generations, or causing undue environmental degradation. The aviation industry is united in its commitment to manage and reduce its environmental impact. ICAO, first of all, is working with aviation industry stakeholders and every time emphasizing a value of a globally-harmonized approach to address aviation's environmental impact. The industry is conscious of aviation's environmental impacts and its contribution to climate change. Air transport is responsible for only 2% of man-made carbon emissions annually. But the industry recognizes that it must work even harder on behalf of the environment to achieve long-term sustainability. Its highest-profile environmental issue today is carbon (CO_2) emissions. The aviation industry committed to an approach in reducing emissions that encompasses three goals: improving fuel efficiency an average of 1.5% annually to 2020; capping net emissions through carbon-neutral growth from

2020; cutting net emissions in half by 2050, compared with 2005. To achieve its three carbon-emission goals, aviation industry has adopted a four-pillar strategy comprising improvements in technology, operations and infrastructure, and market-based economic measures.

Efforts to minimise the impact of aviation on environment have always played an important role in aircraft design and engine manufacturing. Furthermore, every aspect of current operations both in the air and on the ground is being examined to see how the industry can be made cleaner, quieter and more carbon-efficient. Aviation sector has achieved remarkable success to the extent that aircraft produced today are 80 percent more fuel efficient and 75 percent quieter than those produced in the beginning of aviation jet era. Innovative ideas, green technologies, and use of renewable energies will inspire the work and research in aviation sector and its constant drive to move towards its truly sustainable future.

The main objective of environmental safety management systems (EnvSMS) is the creation and maintenance of a necessary level of protection of vital interests to guarantee favorable conditions for the safe and sustainable development of individuals, society, and environment. The main element of modern EnvSMS evaluation is an assessment of risk and of the probability of negative impacts of various anthropogenic factors and their consequences. Therefore, in aviation context the primary objective of environmental safety study is identification of anthropogenic factors that can lead to the violation of environmental safety, particularly for the population in the vicinity of airports.

The class of anthropogenic environmental safety consists of threats and hazards produced by the following factors: chemical, physical, biological, landscape-transforming, information, innovative design or operational. In particular, the operational factors are defined by malfunctions in technologies, systems and designs, insufficient human performances and their errors, and malfunction in information systems which allow the management and control of the overall ergatic systems and conditions of the outer environment, inside of which the ergatic systems are operating. Among these man-made environmental threats and hazards there are specific factors associated for instance with the uncontrolled exploitation of lands near the highways, railways, and airports for industrial and residential construction.

Civil aviation airports create anthropogenic pressure on environment due to the simultaneous presence of hazardous constituents of different genesis and the unfavorable positioning of their sources. Placement and functioning of different stationary objects (mechanical and galvanic stations, storages for fuels and lubricants, painting stations and pumps for petroleum products transportation, boiler installations), vehicles, etc., in the powerful commercial aviation systems cause the convergence in time and place of a significant number of hazardous factors (threats), and significantly enhance their negative impact on the population around airports. The dominant environmental hazards specific to airports are traffic accidents, notably aircraft accidents and incidents.

The ICAO Airport Planning Manual, first published in 1999, includes a discussion on third party risk issues in its Part 2 on Land Use and Environmental Control (ICAO, 2005). Third party risk is in many ways similar to local air quality and noise issues in that it impacts mainly the population living close to airports: this population gains certain economic, employment, or other benefits from air traffic but is also subject to its negative effects. Noise and third party issues also carry similar implications in terms of zoning and land use planning: different levels of protection zones with respect to noise and risk exposure can be established around airports, restricting land use, and further developments. Third party risk is therefore not merely a safety issue, although the accident rates (based either on historical data or modelling and simulations) used in risk calculations are naturally related to aviation safety. Environmental problems might arise from aircraft accidents while incidents involving dangerous goods carried as cargo are likely to occur only under exceptional circumstances. The quantities of dangerous goods carried on aircraft are so small that they only pose environmental hazards of a very localized nature. In the event of accidents, fuel spills could be of environmental concern but a fire is a much greater risk. Action taken to improve aviation safety helps to reduce the likelihood of these problems.

Sustainable management is critical. Currently in aviation sector it covers more safety and environmental issues as before. For example, safety may include more deeply the occupational conditions and operational safety training for staff/personnel and aspects of aircraft airworthiness like removed parts from end-of-life aircraft will go back into service for newish ones. Any recyclables should profit for environmental issues of aircraft manufacturing and operation, ensuring aviation stakeholders environmental stewardship continues at end of service. Every solution for environment benefit must be weighed against operational feasibility, economic reasonableness, and safety. Safety must be overriding principle (Zaporozhets O., 2014).

Targets of civil aviation industry growth include an increase twice in traffic over the next 10 years. In addition to the expectations of the public about reduction of the time of transportation, aviation safety at the beginning of the XXI century will be even more important. Security, including performance of air transport operations, guaranteed implementation of a wide range of interrelated political, economic, technical, organizational, legal, and other measures. In a strategic management plan, which, for example, is the function of

"umbrella" in the national transport programs, safety is fully integrated into the context of sustainable transport systems.

Air transport contributes to sustainable development. By facilitating tourism and trade, it generates economic growth, provides jobs, improves living standards, alleviates poverty, and increases revenues from taxes. Increasing cross-border travel is a reflection of closer relationships developing between countries, both from an individual perspective and at a country level. Despite the challenging economic climate over the last few years sustainable aviation and its signatories have continued to offer significant economic and social benefits to the national and world economics.

Here are the principles of sustainable access to transport services (Guiding principles, 1996):

1. People in its sole discretion have the right to access to other people, places, goods and services.

2. State and transport associations should ensure social, interregional and intergenerational equity in the provision of services to all people, including the poor, rural population, people with disability. Transport systems are critical elements of a strong economy, but can also contribute directly to restructuring of the company and increase the quality of life.

3. Development and operation of transport systems should be designed to protect people's health (physical, mental and social), guaranteeing people's safety and improve their quality of life.

4. All individuals are responsible for the state of the environment.

5. Developers' decisions concerning development of the transport system are responsible for implementation of integrated planning approaches.

6. Transportation needs must be satisfied with the prevention of pollution to protect human health, global climate, biodiversity and integrity of ecological processes. Various human activities can overwhelm limited environmental capacity of the environment (ability to absorb pollution), physically altering or destroying it and using resources more rapidly than they recover. Efforts should be directed at the development of a transport system that minimizes the physical and biological press, while remaining within the assimilative and regenerative capacities of ecosystems and respecting the terms and conditions of the existence of other environmental species.

7. Transport systems must efficiently use lands and other natural resources, ensuring preservation of the living environment and other requirements for maintenance of biological diversity.

8. Decision-makers, concerning the development of transport systems, should fully take into account the costs, reflecting the true social, economic and environmental costs to ensure that their customers receive fair pay. Sustainable transport system must be cost-effective. In the transition to a more sustainable transport system all costs should be fairly distributed in current prices.

Air transport offers a vital lifeline to communities that lack adequate road or rail networks. In many remote communities and small islands access to rest of the world and to essential services such as health care is often only possible by air. Aviation's speed and reliability are perhaps most immediately apparent in the delivery of urgently needed assistance during emergencies caused by natural disaster, famine, and war. Air services are particularly important in situations where physical access is problematic.

VI CONCLUSIONS

Aviation industry is one of the most striking examples of the existing dangers for human life, their sources and factors, in most cases are of a complex character (Zaporozhets A., Blyukher B., 2014). In classification of environmental problems of air transport processes the ICAO considers disasters and accidents, which are usually the factors of flight safety, but at the same time they are the sources of environmental hazards around the airports, i.e., manmade (technogenic) hazards, as a consequence, may generate the sources of danger to the environment (ICAO, 2005b). With air traffic projected to double in the next 15 years, current and emerging safety risks must be addressed proactively to ensure that this significant capacity expansion is carefully managed and supported through strategic regulatory and infrastructure developments. In all of its coordinated safety activities, ICAO strives to achieve a balance between assessed risk and the requirements of practical, achievable, and effective risk mitigation strategies.

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