Climate ADAPT SHARING ADAPTATION KNOWLEDGE FOR A CLIMATE-RESILIENT EUROPE

Adaptation Option

Adaptation measures to increase climate resilience of airports

Description

Airports are often classified as national critical infrastructure because they play an essential role for both mobility and economic growth. However, due to their fixed infrastructures and high vulnerability to disruptive weather events, they are particularly vulnerable to the potential consequences of climate change, which can create both operational and commercial impacts. It is therefore necessary to develop resilience to climate-related risks in order to protect the vital airport infrastructure and ensure the service continuity of airport operations.

Airport resilience can be defined as the ability of operations and infrastructure to withstand and recover from external disturbances caused by current climate variability and future climate change, including slow onset events and effects of increased frequency and intensity of extreme events. These effects on airports are expected to occur at varying timescales and can be either intermittent or persistent. Impacts such as sea level rise and temperature increase will be experienced persistently but gradually, allowing longer-term planning. However, intermittent disruptive weather impacts such as heavy precipitation events or convective weather are projected to happen with an increased frequency and/or intensity due to climate change, therefore requiring measures which can be applied proactively according to the situation.

Building resilience to climate change while coping with significant traffic growth is a double challenge. Therefore, these two issues should not be dealt with in isolation, but in parallel. In particular, it is important to note that developing climate change resilience as part of on-going operational and infrastructure improvements can be the most efficient and cost-effective way to achieve this. If measures are being taken to develop an airport to accommodate a greater number of passengers and flights then climate resilience should be viewed as an integral part of this.

Burbidge (2016; 2018) provides a detailed overview of the main climate change risks affecting European aviation, their impacts on infrastructure and operation of airports and identified possible adaptation measures enabling to cope with climate-change induced challenges:

- **Heavy precipitation events** are likely to become more frequent according to climate scenarios. Heavy rain may impact airport throughput by requiring a greater distance between aircrafts. In addition, the existing drainage capacity of aerodrome surface may not be sufficient to deal with

more frequent and intense precipitation events, leading to an increased risk of runway and taxiway flooding. Underground infrastructure, such as electrical equipment, may also be threatened by heavy rain inundation. Possible adaptation measures should be aimed at improving the capacity and coverage of the drainage system and, in parallel, at increasing water resistance of underground infrastructure (e.g. waterproofing of electrical cables).

- **Decrease in annual average precipitation** is expected in some regions, in particular in Mediterranean. Insufficient precipitation may lead to lack of water and water restrictions which can impact both operations and infrastructure of airports. **Desertification** may cause sand damage of airframes and engine, encroachment of sand dunes to runways and apron may be experienced affecting operation of the airport. Amongst the suitable measures to be implemented are a new water management strategy focused on water saving, reusing of water and storing of rainwater and structural measures protecting runways from sand dunes.
- Increase of **annual and daily maximum temperature** is expected along with **heatwaves**, which are likely to become more intense and persistent. Risks for airport infrastructure include heat damage to tarmac surfaces of runways and apron in terms of deformation, with consequences on carrying capacity and durability. There will also be a need for increased summer cooling of airport buildings; some buildings may experience overheating leading to health issues for passengers and the staff. Risks of extreme temperature for operations include reduction of aircraft engine thrust which in turn affects runway length requirements for take-offs. Measures aimed at increasing the resilience to temperature rise can be divided into measures on airport buildings and equipment (air-conditioning, better insulation, development of green infrastructure) and measures on aerial infrastructure (new tarmac materials resistant to heat, extension of the runway, better equipment cooling).
- **Wind directions** are expected to change more frequently and rapidly, increased deviation from the prevailing wind direction may cause runways to experience more **cross-winds**. As far as the aerial infrastructure is concerned, damage caused by strong wind may occur and building up a new crosswind runway may appear essential to increase resilience of operations.
- Projections regarding the frequency, location and intensity of **storms** in Europe are uncertain, although many studies project that, in the longer term, the overall number of storms will decrease while the strongest storms will be more intense (particularly in Northern and Western Europe). Due to temperature rise and increased insolation higher **convection** intensity is expected causing disruption to operations, route extensions and associated delays. Larger, meso-scale **convective systems** may even have potential to affect several airports in the region. There are various adaptation measures to be considered to increase airports resilience against extreme weather, including wind-proofing of aerial infrastructure and re-routing of aircrafts.
- **Sea level rise** may lead to permanent inundation at costal airports and capacity loss unless preventive measures, such as constructing sea defences, are taken. In the longer term, the potential permanent capacity loss at some locations could have an impact on overall network capacity and operations. The impacts of higher occurrence of storm surges may be experienced in the shorter term and may result in a temporary reduction of capacity and increased delays.
- Despite the fact that **snowfall** is generally expected to decrease, there may be an increase in heavy snowfall days, or snowfall in new areas, which means that some geographical area needs to be prepared for heavy winter weather. If this is the case, it will be necessary to improve the airport´s winter maintenance capacity.

- Climate change may cause changes to both local **biodiversity and wildlife migration patterns**, as well as a potential increase in wildlife hazards. Changing migration patterns could affect aircraft operations and increase the potential for bird strikes.

Above overview highlights the wide variability of potential climate change impacts on European airports, which might affect a very diverse range of infrastructures and operations, as well as their high local specificities. Therefore, actions aiming to improve airport adaptation capacity (i.e. understanding the problems, assessing the problems, selecting and implementing adaption measures, communication and airport stakeholders' engagement) need a local approach.

Additional Details

- IPCC categories
- Stakeholder participation
- Success and limiting factors
- Costs and benefits
- Legal aspects
- Implementation time
- Lifetime

Reference information

- Websites
- Source

Adaptation Details

IPCC categories

Structural and physical: Engineering and built environment options, Structural and physical: Technological options

Stakeholder participation

The main stakeholders involved in the process aiming at increasing climate change resilience of airports are airport operators, aircraft operators (airlines), air navigation system providers and engineering and construction companies providing implementation of the adaptation measures. These stakeholders are supported by research and consulting companies providing risk and vulnerability assessment, climate projections, weather forecast and strategic planning services.

Success and limiting factors

Success factors for initiating, drafting and implementing climate change adaptation plans of airports include the availability of sufficient information, effective involvement and cooperation of relevant stakeholders, sufficient financial resources and policy support.

The set of adaptation measures which are widely considered to be cost-effective are those that also address operational needs of an airport e.g. increasing airport capacity in terms of number of passengers and aircraft movements while contributing to building resilience to climate change. These measures are classified as “low-regrets”, “no-regrets” and “win-win” measures. Other cost-effective measures include so-called “soft” measures such as training of airport staff and sharing of best practices with other airports in the region.

Also the trade-offs may be experienced as adaptation measures of airports may introduce vulnerabilities. For example, airport may start to experience crosswinds but have no crosswind runway. This may entail the need for a new runway causing the change in procedures and airspace redesign which, in turn, may incur an additional environmental risk due to the redistribution of noise impact around airports.

Costs and benefits

The cost of implementing construction and operation measures at airports varies significantly according to the specific measure, airport size, climate region and climate challenges addressed. Basically, the measures building resilience of existing infrastructure, e.g. wind-proofing of aerial equipment are less expensive in comparison with newly built infrastructure, e.g. a new runway addressing higher occurrence of cross-wind.

Win-win measures that address both the development issues of the airport (due to the gradual growth of air traffic) and, at the same time, their climate change resilience have the greatest benefit. As far as implementation of these measures is concerned, there would be no conflict between promoting the economic interests of the airport and implementing measures adapting the airport to climate change, which, if implemented separately, could significantly affect the airport's economy. Therefore, the motivation of stakeholders is higher and it is easier to allocate financial resources for these projects.

The sources of funding of measures are typically airport operating companies which can be supported from public budgets or by means of European financial instruments.

Legal aspects

While implementing the adaptation measures, the national and European policies dealing with protection of the environment and climate system should be taken into account. Moreover, the adaptation measures must comply with internationally established aviation standards and rules to ensure reliability and safety of air transport. The Aviation Strategy for Europe recognizes the crucial role that aviation plays in promoting economic growth, job creation, trade and mobility in the EU, and emphasizes the importance of high safety standards for the competitiveness of the sector in the EU. In 2015, the Commission presented a revised European Aviation Safety Programme, which describes how aviation safety is managed in the EU.

Implementation time

Typical time needed for preparing and implementing the whole adaptation strategy for an airport is in the order of years, normally between 1-3 years. However, the implementation of individual measures may take only months if well prepared and carried out effectively. The crucial aspects of smooth implementation of adaptation strategy are efficient cooperation of stakeholders involved and sufficient financing sources available.

Lifetime

The lifetime of construction measures implemented at the airport is virtually unlimited if well maintained. The lifetime of operational measures is dependent on the allocation of institutional and personal resources, and the involvement and cooperation of stakeholders.

Reference information

Websites:

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ACRP (2012). Airport Climate Adaptation and Resilience. Airport Cooperative Research Programme Synthesis (ACRP), Washington.

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Key Type Measures:

C1: Physical and technological: Grey options, C2: Physical and technological: Technological options

IPCC adaptation options categories:

Structural and physical: Engineering and built environment options, Structural and physical: Technological options

Climate impacts:

Non specific

Adaptation Approaches:

Adaptation Measures and Actions

Sectors:

Disaster Risk Reduction, Transport

Governance level:

Local (e.g. city or municipal level)
National

Geographic characterisation:

Global

Case studies related to this option:

Assessing adaptation challenges and increasing resilience at Heathrow airport