

Effects of Climate Change on Aviation Business and Economics

Effects of climate change on aviation business and economics include both physical risks such as flight delays or airport closures and related costs, and contractual, regulatory or legal compliance risks. There may also be risks due to the scarcity of critical resources. Aviation business operations and financing may be affected by all of the potential climate change impacts identified in the Climate Impacts Factsheets. In the shorter-term, effects to business and economics are more likely to be associated with disruptive events, such as extreme weather events like storms or extreme heat, which can lead to delays, cancellations and infrastructure damage. In the longer-term, gradual but persistent impacts, such as temperature change or sea level rise, may lead to business and economic effects such as changes in tourist demand and damage or loss of infrastructure.

Potential Effects

- Increased weather volatility as a result of climate change can have effects on all aspects of operational performance such as scheduling, flight planning, connectivity of flights, safety planning and trajectory optimisation. Climate change can also cause direct impacts to critical aviation infrastructure, causing secondary effects on business and economic capabilities. This section provides specific examples of these effects by climate change impact category.

Sea level rise:

- Potential need to reinforce or relocate airport infrastructure due to sea level rise.
- Potential effects for local tourism industries if airport use becomes constrained or parts of territories become inundated. This can be a particular challenge for Small Island Developing States that are more exposed to sea level rise.

Increased intensity of storms:

- Costs from operational impacts such as delayed or cancelled flights, and costs due to infrastructure damage.
- Reduced access to ground transportation.
- Potential effect on jet engine performance and maintenance requirements due to storm damage.
- Closure of airports due to extreme events.
- Airports may be used during a weather event to provide shelter and support to disaster relief, which can have business and economic effects.

Temperature change:

- High-heat days can increase cooling costs in terminals and other infrastructure such as Air Traffic Control (ATC) towers, whilst employees may also be impacted by higher temperatures.
- Rising temperatures may necessitate a reduction in payload (passengers or cargo) which could have an economic cost. There may also be a fuel penalty.
- Persistently higher temperatures, particularly at popular tourist destinations, may alter demand for air travel to certain locations, which may increase or decrease revenue streams.
- Demand changes impact fleet and schedule planning by airlines, as well as infrastructure and workforce planning by airports, and Air Navigation Services Providers (ANSPs).
- Travel demand to popular winter tourism destinations may be affected if less precipitation or higher temperatures deteriorate snow conditions or shorten the winter-sports season

- Thawing of permafrost may lead to costs to reinforce or rebuild runways, whilst heat damage to airfield surfaces may also incur repair or replacement costs.
- Colder temperatures in northern climates could lead to flight cancellations if aircraft are not certified for extremely low temperatures. There may also be an increase in heating costs for terminals and other infrastructure.

Precipitation Change:

- Increased precipitation can cause flooding and flood damage to both runways and infrastructure. This flooding can impact operations by reducing capacity and increasing delays and cancellations, all of which have financial implications due to lost revenues, increased operating costs and passenger inconvenience.
- Ground transport links may be disrupted due to precipitation impacts preventing crew and passengers from reaching the airport. Unexpected heavy snowfalls are assumed to have similar financial implications.
- Some geographic areas are projected to experience more drought, which can have business and economic effects if water becomes scarce for aviation operations or it influences changes in tourism demand at a destination.

Changes in wind:

- Changes in, or deviation from, the prevailing wind direction at airports can affect runway utilisation and schedules, reduce airport and aircraft operating efficiency, capacity, and may impact safety. It may also change the criteria for approach and departure procedures and reduce flight arrival and departure punctuality, all of which will incur costs.
- Extreme storms and strong winds can cause flight delays and cancellations, with associated economic losses and passenger inconvenience. They can also damage or destroy transport assets.
- Changes to the jet stream could impact both flight times and fuel costs for transatlantic flights.
- There may also be an increase in Clear Air Turbulence leading to increased injuries to passengers and crew and damage to aircraft.

Changing Icing Conditions:

- Freezing rain can cause delays or cancellation of flights, with financial implications. There may also be increased de-icing requirements and associated costs, with additional risks of financial penalties if run-off quantity or quality exceeds environmental limits.

Desertification:

- An increase in dust storms could increase the presence of silicates in jet engines, which, when melted, can adversely affect the performance and increase maintenance requirements of jet engines. This can have financial implications.
- Sand may damage airframes and engines whilst sand storms may disrupt operations.

Changes in biodiversity:

- There may be an increase in both costs for wildlife management and costs from wildlife damage to aircraft (e.g. from bird strikes).
- There may also be damage to landscaping and an increase in maintenance costs due to changes in local wildlife or an increase in invasive species.

Interconnections:

- If one airport is directly impacted by climate change, other parts of the network may be affected indirectly, which can cause ripple effects across multiple business and economic sectors.

- In particular, if there is disruption at a hub airport this will have a knock-on effect for the flights which depart from that airport, the destination airports, and passenger connections, all of which can have a financial cost.
- Impacts may also affect the wider transport network.

Financial challenges as a barrier:

- There are financial costs associated with adaptation and the costs of implementing adaptation strategies could be prohibitive.

Adaptation and Resilience Measures ¹

- Limiting business and economic effects involves good planning and well-informed business decisions, which may benefit from activities such as climate risk assessments.
- For infrastructure decisions such as retro-fitting, redesign or relocation, a decision-making process such as a cost benefit analysis may be required, along with taking into account factors such as cost versus level of resilience and criticality (See the Risk Assessment and Adaptation Measures Factsheet).
- Operational measures to increase robustness and flexibility, and measures such as information sharing and training to improve operational resilience may have an initial financial cost, but by improving resilience they may ultimately reduce overall financial costs.
- Airports to consider planning measures to have adequate energy, food and water supplies to care for stranded passengers during extreme weather events which may close the airport for a significant time, and to coordinate with airlines in the event of needing to evacuate passengers before or after an extreme weather event.

Financial challenges as a barrier:

- To mitigate the financial challenge of adaptation, top management buy-in will be necessary.
- It may not be possible to adapt all infrastructure and systems such that no projected impacts of climate change are ever realized.
- While the scientific community is in broad agreement that the global climate is changing, there is still some uncertainty surrounding when climate change impacts are projected for specific regions and what those impacts may be.
- Resilience will likely be a combination of adapting infrastructure and developing processes and plans to respond to impacts quickly and efficiently as they happen.
- It will be necessary to make decisions based on costs and benefits in order to ensure critical elements are protected.

Sources and Additional Information:

2018 ICAO CAEP WG2 Task O7.0 Climate Adaptation Synthesis Analysis

¹ Specific adaptation and resilience measures for each impact are covered in the associated factsheet and in the full Synthesis document.