Climate change impacts on airports and measures – case of Schiphol Airport

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Introduction

Climate change risk is a growing concern in aviation, considering the effects of sea-level rise, storm surges, increase of extreme rainfall, changes in wind patterns, increase of average and maximum temperatures, increase in the number of extreme weather events and the increase in lightning strikes. In its 2016 Environmental Report[1], the International Civil Aviation Organization warned that rising temperatures caused by greenhouse gas emissions will increasingly affect the ability of aircraft to take off.

Climate change will likely lead to more extreme weather events, exacerbating the effect on airports that are already affected and putting at risk those that have not yet experienced climate-related adverse effects.

Given the significant value of the asset base at a typical medium to large scale airport which can run into the billions, combined with the complexity and interdependency of the various airport systems and supply networks, this situation is undesirable.

TABLE 1: Five incremental key actions to enhance resiliency of airports

Nr.		Key action	Climate stressors (Climate Adaptation Synthesis Report, ICAO, 2018)
Climate adaptation	1	Flood protection	sea level rise
	2	Dealing with weather extremes	increased intensity of storms, changing precipitation, temperature change, changing icing conditions, changing wind,
	3	Achieving a good water quality and a healthy eco system	desertification, changes in biodiversity
Sustainable	4	Adaptive airport city planning	enhancing airport use and passenger convenience
	5	Greening' airport operations	sustainable solutions and innovations to improve local climate and energy management)

1 ICAO, International Civil Aviation Organization (2017), 'Annual Report of the Council – 2016', Montréal, Canada.
2 Dolman N. (2016), 'Creating water sensitive airports in times of climate change', 5th Singapore International Water Week (SIWW), Singapore.

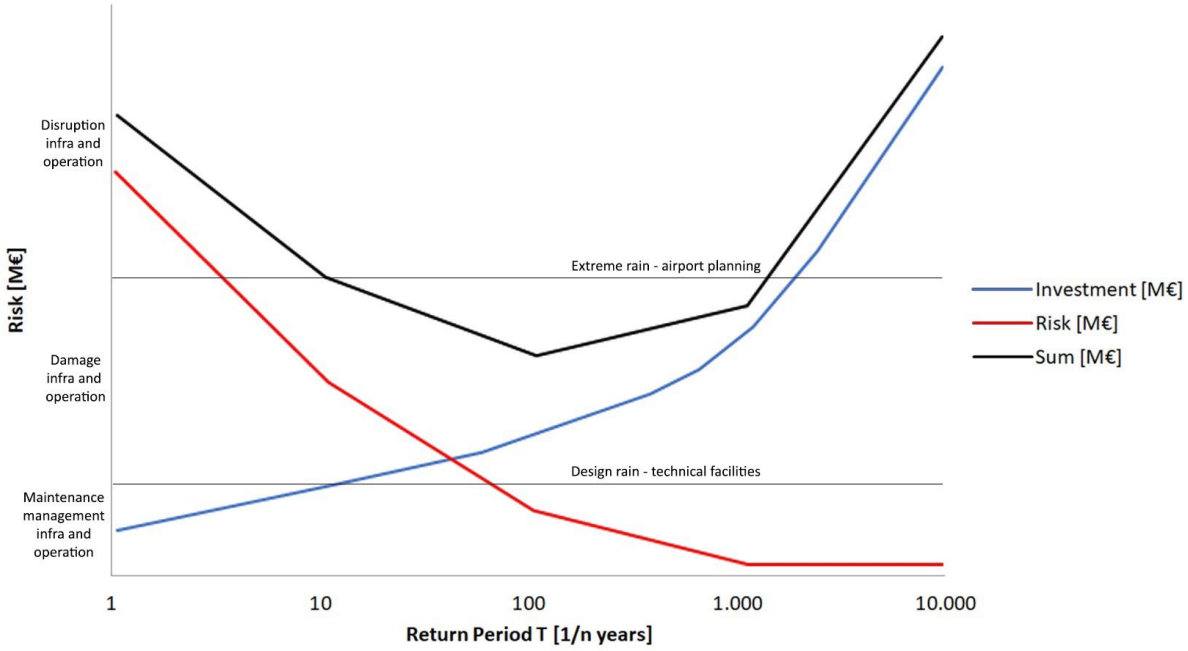

FIGURE 1: Schiphol pluvial flood risk evaluation, based on Rijkswaterstaat smarter investment strategy to reduce flood risk (adjusted for this article, Amsterdam Airport Schiphol, 2017)

One airport which is seizing the opportunity to build resilience to climate change into its airport planning is Amsterdam Airport Schiphol, the Netherlands, a low-lying airport built on reclaimed land in the Polder Haarlemmermeer, which faces water challenges daily. Schiphol's situation is extreme; Europe's most preferred airport is situated approximately 4.5 meters below sea level.

Five actions for Climate Resilient Airports

In 2015 Amsterdam Airport Schiphol presented its Water Vision 2030 that has been considered as Schiphol's climate adaptation strategy. This strategy sets out the ambition to cope with the risks of climate change, airport planning and water management activities to 2030 and beyond. Following experience from practice in the Schiphol Water Vision 2030 a set of five incremental key actions to enhance climate resiliency have been developed (Table 1), also known as the Climate Resilient Airports (CRA) framework.

The CRA framework helps airports to develop their climate change adaptation pathway to achieve long-term goals and ambitions. In the short- and medium-term, first steps are needed, preferably in line with the 2018 Airport Council International (ACI World) resolution and policy brief on 'Airports' Resilience and Adaptation to a Changing Climate', and the ISO 14090 'Adaptation to climate change - Principles, requirements and guidelines'.

Flood impact assessment

Making Schiphol Airport less vulnerable to weather extremes and (pluvial) flood risk means additional investment. At the same time Schiphol will benefit in avoided damages and disruption of operation. Based on a comprehensive pluvial flood stress test (2017) and the judgement of Schiphol's airside experts, a flood impact assessment was adapted. The flood impact assessment illustrates the chance (frequency) and extent of pluvial flood risk to expected damages and disruption of operation, translated to (direct & indirect) cost. Figure 1 shows an optimal protection level of an extreme rainfall event close to once per 100 year (T100). This level of protection implies stricter requirements than current design standards.

Extreme weather effects and floods can result in delay of flight operation or even in a (temporary) shutdown. In general, most stakeholders of the airport are financially affected when a shutdown occurs. In 2010 some airports in

Europe experienced the largest air-traffic shut-down since the 2nd World War, in response to concerns that volcanic ash ejected during the 2010 eruptions of Eyjafjallajökull in Iceland would damage aircraft engines. The controlled airspace of many European countries was closed to instrument flight rules traffic. Amsterdam Airport Schiphol in the Netherlands estimated a loss of €25 million of having no air transport for one day[3].

Water robust Schiphol and Strategic Investment Plan

Following the flood impact assessment, Schiphol's management team decided on a T100 pluvial flood adaptation pathway and initiated the "Flood resilient Schiphol" program. The goal of this program is to adapt existing infrastructure and mitigate flood risk effects on operations. Although an estimate was given on the required budget, a more detailed roadmap with strategic (annual) investments was needed. In 2020 a more detailed financial risk evaluation was done, which resulted in the Strategic Water Investment Plan 2020-2030. This plan consists of a blue masterplan, water storage assignment per sub-area and developments, as well as the strategic investment costs and planning.

A distinction has been made between (already planned) projects and additional measures required to meet the "flood resilient Schiphol" ambition. A geo-based management tool was developed, to benchmark and report on climate risks and airport developments. Concrete measures consist of realizing extra water retention and robust water connections, besides "sponges" (e.g. green roofs and rainwater collection for toilet flushing) and alternative water storage under parking lots and along runways. In response to the disruption caused by COVID-19, Schiphol announced in 2021 that it is adjusting its construction schedule. Schiphol has found itself in the same position as other organizations where it needs to cut costs and achieve an optimal balance between short-term investments and the need for capacity in the future. Based on the new "flight plan" of airports developments and projects the Strategic Water & Climate Investment Plan is recalibrated and updated accordingly.

3 Dolman N., Sindhamani V., Vorage P. (2021) Keeping Airports Open in Times of Climatic Extremes: Planning for Climate-Resilient Airports. In: Brears R.C. (eds) The Palgrave Handbook of Climate Resilient Societies. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-42462-6_8