CDRI
Coalition for Disaster Resilient Infrastructure

Global Study on Disaster Resilience of Airports

Five Steps towards Resilience of Airports

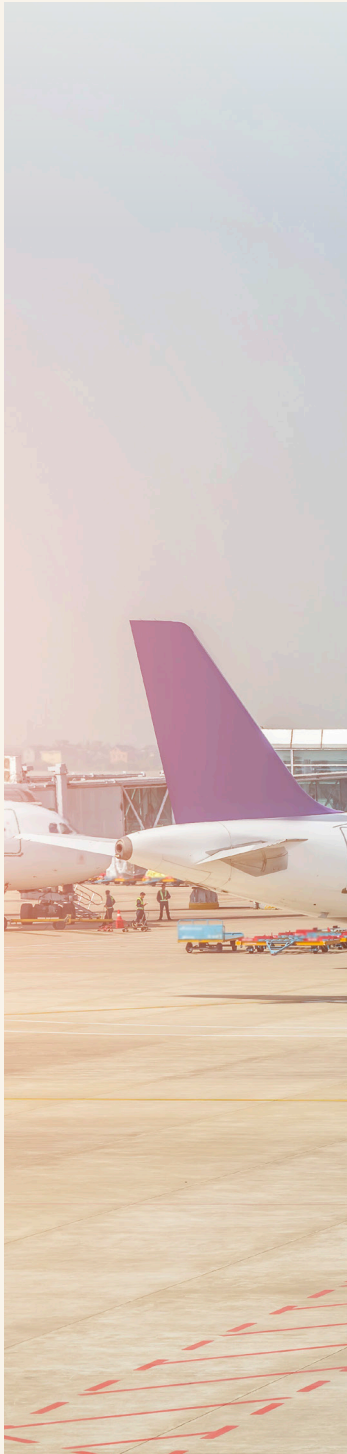
Disaster Resilience of Airports

Airports are critical infrastructure assets that play a fundamental role in efficiently transporting people and facilitating the movement of goods and services in an economy. Any disaster induced damage to an airport can have a significant impact on the entire economy. Airports are also closely interconnected with other critical infrastructure sectors, such as telecommunications, power and water, which means that any disaster induced disruption of such services will have far-reaching consequences for airports. Moreover, airports serve as vital lifelines providing rapid mobility support during disasters and humanitarian crises and can help countries cope with the devastating effects of climate-related disasters.

Global airport investment is projected to grow significantly by 2040. According to the "Future of Airport Industry to 2030" report by MarketsandMarkets, global investment in airports will rise from USD 200 billion in 2021 to USD 2.4 trillion by 2040, growing at a compound annual growth rate of 14.4%.[1]

The Airports Council International 2021 report forecasts a total of USD 2.4 trillion in Airport capital investments by 2040. Asia-Pacific is forecast to see USD 1.3 trillion of investment; Europe USD 427 billion; North America USD 400 billion; Middle East USD 151 billion; Latin America – Caribbean USD 94 billion; and, Africa USD 32 billion. These high levels of investment underscore the urgency of securing airport and related infrastructure from climate risks and ensuring long-term infrastructure resilience and sustainability in the face of increasing extreme weather events.[2]

In an increasingly disaster-affected world, these significant investments in airport infrastructure will be at high risk without the provision of disaster resilience measures at all levels of the project life cycle.



1 Future of Airport Industry Outlook worth $2,404 billion in 2040, MarketsandMarkets, 2024, (https://www.marketsandmarkets.com/PressReleases/future-of-airport-industry.asp#:~:text=According%20to%20a%20research%20report,at%20a%20CAGR%20of%2014.4%25

2 ACI World reveals capital expenditure needs for recovery and long term growth, ACI World, 2021, (ACI World reveals capital expenditure needs for recovery and long term growth | ACI World)

The Coalition for Disaster Resilient Infrastructure (CDRI) is an international organization and a global partnership of national governments, UN agencies and programmes, multilateral development banks and financing mechanisms, the private sector and knowledge institutions that aims to promote the resilience of new and existing infrastructure systems to climate and disaster risks in support of sustainable development.

Airport resilience is an important focus area for CDRI. Our ambition is to enable governments, airport operators, financial institutions and communities to recognize, prioritize, and act to enhance the resilience of airports.

The Global Study on Disaster Resilience of Airports

In 2023, CDRI released the first phase report of the Global Study on Disaster Resilience of Airports (GSDRA)[3] which documented the various aspects of airport resilience and mapped perceptions of airport authorities and stakeholders about the impact of increasingly frequent extreme weather events and changes in the built environment in and around airports.

The three research questions the study sought to address were:

1. **What is the current perception of hazard and disaster exposure of airports?**
2. **How do airports perceive their resilience to climate, environmental and natural hazards?**
3. **What are the current practices in airport resilience?**

111
Airports

54
countries

As part of the study, CDRI conducted questionnaires and focused group discussions covering 111 airports in 54 countries to understand the dynamics of disaster impact, risk assessment practices, and adaptive capacity of airports.

The findings from the study reinforced the need for adaptation and risk mitigation strategies for airports to effectively respond to risks posed by climate change and environmental factors as also highlighted by the Intergovernmental Panel on Climate Change (IPCC).

Airport resilience against rising sea levels, extreme weather and shifting precipitation patterns was perceived to be essential to avert damages to airport infrastructure leading to disruptions such as flight cancellations, delays, compromised safety, and impacts such as loss of revenue & investment. The study also emphasized the importance of the frequency of risk assessment, resilience planning and of integrating sustainable practices within airport lifecycle to align with global climate objectives.

CDRI advocates for **"Five Steps towards Resilience of Airports".** These should be followed by governments, airport operators and other stakeholder institutions to start understanding disaster risk to their assets and chart ways to enhance resilience. The benefits to airports and areas where CDRI can provide support are clearly outlined.

3 Global Study on Disaster Resilience of Airports Phase 1, CDRI, 2023 (https://www.cdri.world/upload/pages/1762327614929272_202304050923global_study_disaster_resilience_airports_phase-1_cdri_final_report.pdf)

Five Steps
towards Resilience of Airports

1 

Conduct Periodic Vulnerability Assessments (PVAs)

2 

Upscale PVAs to Comprehensive Assessment of Risk and Resilience

3 

Establish a broader understanding of risk appetite of airports

4 

Collaborate with stakeholders to enhance airport resilience practices

5 

Create a cohesive institutional arrangement for collaboration and knowledge sharing towards an Integrated Disaster Resilience Plan

1 Conduct Periodic Vulnerability Assessments (PVAs)

What is a Periodic Vulnerability Assessment (PVA)?

Periodic vulnerability assessments are minor and recurring assessments which include systematic and continuous processes of identifying, analyzing, and prioritizing potential weaknesses and gaps within an airport's infrastructure. This proactive approach aims to assess the likelihood and potential impact of various hazards, enabling airports to effectively address vulnerabilities, enhance resilience and thus safeguard their critical assets.

Why it should be conducted

Periodic vulnerability assessments enhance the resilience of airport infrastructure and help in identifying, analyzing and prioritizing vulnerabilities and risks across an airport's physical infrastructure including its operations and technological systems.

An up-to-date understanding of risks supports airports to effectively manage evolving threats and bolster disaster response capabilities. In 2023, only 71 percent of the airports surveyed were conducting PVAs, out of which only 55 percent engaged in annual PVAs, while nearly 27 percent undertook evaluations every two to five years[4]. PVA's include critical airport assets like runways, terminals, power and communication systems.

4 GLOBAL STUDY ON DISASTER RESILIENCE OF AIRPORTS PHASE 1, CDRI, 2023, Page (58), (https://www.cdri.world/upload/pages/1762327614929272_202304050923global_study_disaster_resilience_airports_phase-1_cdri_final_report.pdf)

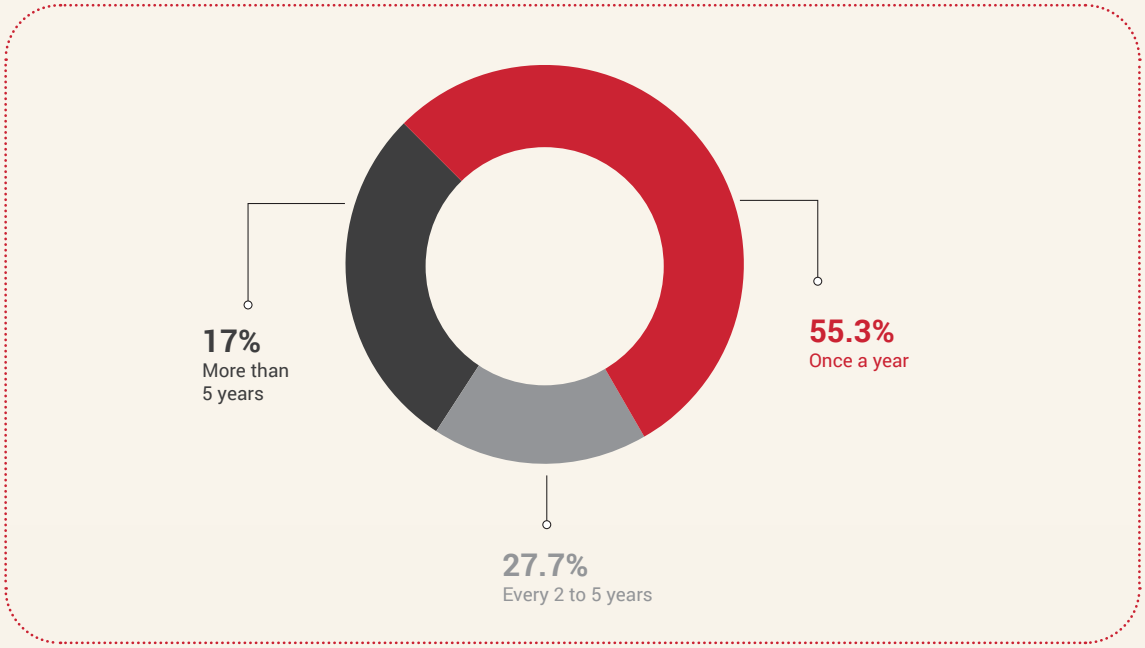


Figure 1: Frequency of PVAs amongst PVA-conducting airports (%)

Who should do it?

Airports should periodically conduct this exercise on their own as per their geographical and governance contexts. The International Civil Aviation Organization's risk assessment matrix and framework is one of the widely accepted methodologies in the industry that can serve as a benchmark[5].

5 Climate Change: Climate Risk Assessment, Adaptation and Resilience, ICAO Environment, 2022 (https://www.icao.int/environmental-protection/Pages/Climate-Change-Climate-Risk-Assessment,-Adaptation-and-Resilience.aspx)

2 Upscale PVAs to Comprehensive Assessments of Risk and Resilience

What is a comprehensive assessment?

A comprehensive assessment of risk and resilience is a systematic and thorough evaluation of the ability of an airport to withstand and recover from disruptive events. Such an assessment takes into consideration all prior PVAs and adds all other aspects of airport operations, including physical infrastructure, organizational structures, and emergency response procedures. The goal of such assessment is to identify and prioritize potential threats, assess vulnerabilities, and develop risk mitigation strategies to enhance resilience[678]. An airport's resilience is gauged by its performance prior to, during, and after natural hazard-induced disruptions.

Why it should be conducted

Challenges emanating from hazards[9] such as storms, heavy precipitation, flooding, extreme heat and icing, drought, and volcanic activity vary in complexity and nature of impact. An incomplete understanding of such probable impacts may deter the post-disaster performance of airports, creating severe economic and financial impediments; thus, highlighting the need for comprehensive assessment and preparedness measures to strengthen resilience in the face of such challenges.

6 Sources:
ICAO International Standards and Recommended Practices, Annex 14 - Aerodromes - Volume I - Aerodromes Design and Operations, ICAO 2022 (https://store.icao.int/en/annex-14-aerodromes)

7 NATIONAL RESILIENCE GUIDANCE, FEMA 2024 (https://www.fema.gov/sites/default/files/documents/fema_national-resilience-guidance_august2024.pdf)

8 Airport Cooperative Research Program (ACRP) 192, TRB's COOPERATIVE RESEARCH PROGRAMS (https://crp.trb.org/acrpwebresource13/acrp-research-report-192-airport-management-guide-for-providing-aircraft-fueling-services__trashed/)

9 GLOBAL STUDY ON DISASTER RESILIENCE OF AIRPORTS PHASE 1, CDRI, 2023, Page (36), (https://www.cdri.world/upload/pages/1762327614929272_202304050923global_study_disaster_resilience_airports_phase-1_cdri_final_report.pdf)

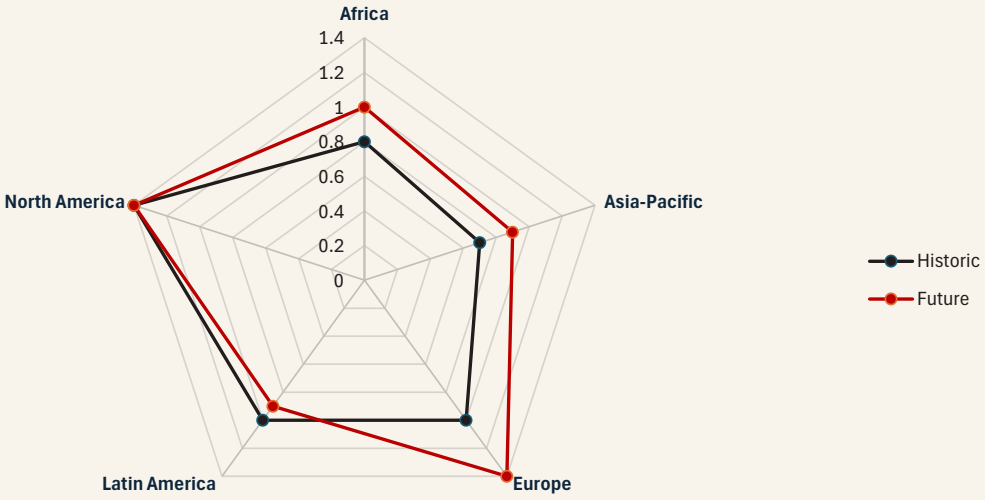


Figure 2: Average severity of impact from hazards

The hazard severity rating system ranks the severity of any hazard from 0 to 5, with 5 being the highest level of severity[10]. Figure 2 shows global hazard severity from various hazards, with extreme storms having the highest level of severity across all the surveyed airports followed by extreme precipitation.

Two pivotal benchmarks that define the resilience of an airport are the time taken:

- To resume operations; and,
- to enable complete recovery and restoration of normal airport functions.

Any comprehensive assessment of risk and resilience should have indicators to cover both these pivotal benchmarks. However, 71 percent of the surveyed airports have conducted only vulnerability assessments. Vulnerability assessments are just a part of comprehensive risk and resilience assessment. Hence, it is important that all airports conduct comprehensive assessments to ensure comprehensive resilience planning and robust preparedness of airport facilities against the entire spectrum of potential hazards.

Comprehensive assessments can achieve various long-term benefits. The results from these assessments allow airports to prepare for disruptions, efficiently allocate resources, and swiftly resume operations after a crisis. It also enables the implementation of targeted adaptation & resilience measures, ensuring effectiveness of response strategies.

The vulnerability of an airport's access roads, water supply and waste management system also pose a significant challenge due to potential jurisdictional complexities. Therefore, a systemic and collaborative approach is required to ensure systemic resilience of airports.

Who should do it?

Airport operators should take the lead in carrying out such assessments with help from international knowledge institutions. Relevant government departments may provide data and issue methodological advisories for standardizing such assessments across their country to make them comparable.

10 GLOBAL STUDY ON DISASTER RESILIENCE OF AIRPORTS PHASE 1, CDRI, 2023, Page (35), (https://www.cdri.world/uploads/pages/1762327614929272_202304050923global_study_disaster_resilience_airports_phase-1_cdri_final_report.pdf)

3 Establish a broader understanding of the risk appetite of airports.

What is risk appetite?

Risk appetite is the degree of risk exposure towards a natural hazard that an airport is willing to accept. It is a crucial factor in determining the balance between cost-efficiency and future-proofing resilience strategies. A higher risk appetite implies greater tolerance for disruptive events in exchange for perceived benefits, while a lower risk appetite prioritizes minimizing the likelihood of disruptions even at the cost of flexibility or cost-effectiveness.

Why does it need to be understood?

Risk appetite defines the boundaries within which an organization operates, shaping its strategies and decision-making processes. Understanding and defining risk appetite is crucial as it enables organizations to align their actions with their capacity to withstand potential adverse impacts. This clarity aids in proactive risk management, allowing for informed choices and optimized responses to uncertainties. Ultimately, a well-defined risk appetite is instrumental in safeguarding assets reducing operational disruptions and ensuring long-term resilience.

Who should do it?

Airport operators should conduct studies to understand their own risk appetite by taking help from sector experts. Relevant government departments may provide data and issue methodological advisories for standardizing such assessments across their country to make them comparable.

Establishing Risk Appetite for Amsterdam Airport

Schiphol International Airport, Amsterdam – a major airport in the Netherlands is situated below sea level on reclaimed land due to which it is continually facing flood risk. To reduce its vulnerability to pluvial flooding a significant investment is required, which will be offset by the benefits of minimizing potential damage and operational disruptions. In 2017, a detailed pluvial flood stress test, complemented by insights from Schiphol's airside experts, led to an updated flood impact assessment. This assessment detailed the likelihood and severity of pluvial flooding affecting the airport and associated direct and indirect costs. The analysis established a "risk appetite," indicating an optimal tolerance for extreme rainfall events, expected roughly once in 100 years (T100). This tolerance levels led to more stringent criteria than existing design standards.

4 Collaborate with stakeholders to enhance airport resilience practices.

What is effective collaboration?

Effective collaboration entails local and regional engagement fostering partnerships and communication with local governments, emergency services, community organizations, neighboring airports and other relevant agencies. The goal is to collectively plan, prepare, and implement strategies that enhance the airport's resilience towards disasters. It involves coordinating response plans, sharing resources, conducting joint exercises and aligning efforts to ensure a cohesive and effective response to potential hazards or emergencies that could impact airport operations. The result of such effective collaboration is to clearly delineate the scope of responsibilities for the airport, local and regional authorities as well as other relevant stakeholders' groups for the different hazards which the airport is exposed to.

Why is it important?

Airports and government authorities at all levels are mutually dependent for adaptation planning. Therefore, it is critical to ensure effective resilience planning, engagement with authorities at various levels. In this way, it allows for assessing the overall risk and assures a shared responsibility.

Who should do it?

Enhancing airport resilience practices is a collaborative effort. It requires support from all relevant stakeholders including all airports, government institutions and regulators, and international knowledge institutions. Regulators should create a necessity and an environment to mandate and empower such collaborations by institutionalizing them.

Building Resilience Through Collaborative Governance

Adopting a comprehensive and systemic risk approach in resilience projects involves incorporating critical assets, such as airports, into the assessments. This methodology emphasizes collaboration across various local & regional departments, including respective sectoral associated beneficiary operators and other stakeholders' municipalities, and commercial & private entities like airline operators, and cargo supply chains, and is beneficial to enhance resilience against various hazards. For example, while a water management board may bear primary responsibility for protection against sea-level rise, airports remain key stakeholders in adaptation planning due to their vulnerability and impact. Conversely, managing the effects of extreme rainfall falls under the airport's jurisdiction but also significantly impacts surrounding communities and infrastructure. This interconnectedness necessitates robust partnerships and coordination among all governing bodies to ensure cohesive, effective action in mitigating risks and enhancing resilience.

5 Create a cohesive institutional arrangement for collaboration and knowledge sharing towards an Integrated Disaster Resilience Plan.

What constitutes an Integrated Disaster Resilience Plan?

An integrated disaster resilience plan is a comprehensive strategy developed by organizations, communities, and other relevant stakeholders to prepare for, respond to, recover from, and mitigate the impacts of disasters. An integrated plan combines different aspects of disaster management into a cohesive framework, integrating efforts across multiple sectors and stakeholders.

Why is it important?

Integrated disaster resilience plan ensures a more robust, coordinated and effective response to emergencies, safeguarding not only the airport but also neighbouring communities. Most airports have individual emergency response plans which contain protocols for actions to be taken during calamities. In most cases though these plans do not address the financial consequences of disasters. When a disaster strikes, it impacts not only the airport but often the entire region. Therefore, an integrated approach which includes stakeholders of all kinds including institutions with interdependencies like power and water supply becomes essential.

Who should do it?

Airport regulators should work towards creating a cohesive institutional arrangement so that airports are able to reach out to all stakeholders for co-learning, knowledge sharing and creating an integrated disaster resilience plan.

Cohesive Institutional Framework for Disaster Resilience in The Netherlands

The Netherlands employs a comprehensive and integrated approach to disaster resilience, facilitated through its division into 25 security regions. Each security region is responsible for ensuring the safety of its inhabitants and visitors by coordinating efforts across multiple domains, including fire services, medical assistance, public order, safety, and disaster and crisis management. A key aspect of this integrated approach involves each security region's responsibility to prevent and combat fires, which includes maintaining well-equipped and trained human resources. Additionally, these regions are tasked with risk preparedness by developing specific risk profiles and tailored strategies for managing potential disasters and crises. This framework promotes a cohesive institutional arrangement for collaboration and knowledge sharing, ultimately fostering a unified, disaster-resilient national strategy.

Benefits for Airports

1

Conducting thorough risk assessments allows airports to identify critical assets & prioritize risks therefore strategically prepare for disruptions, efficiently allocate resources and swiftly resume operations after crises.

2

Identification of vulnerabilities enables cost-effective resource allocation and the implementation of targeted resilience measures, ensuring effective response strategies.

3

Integrated disaster resilience plan has the potential to help significantly mitigate the impact of disasters. By identifying risks, implementing preventive measures and having effective response strategies in place, a robust plan can minimize the damage caused by disasters. Ultimately, the ability to resume and recover more swiftly after a disaster is a significant benefit of a comprehensive resilience plan.

4

Integrated disaster resilience plan not only mitigates the impact of disasters but also contributes to the continuity of operations, safety and cohesion of communities and organizations.

Proactive risk management through comprehensive risk and resilience assessments fosters reduced damages to infrastructure assets , minimizing disruptions and their impact on overall airports operations.

5

Challenges for Airports

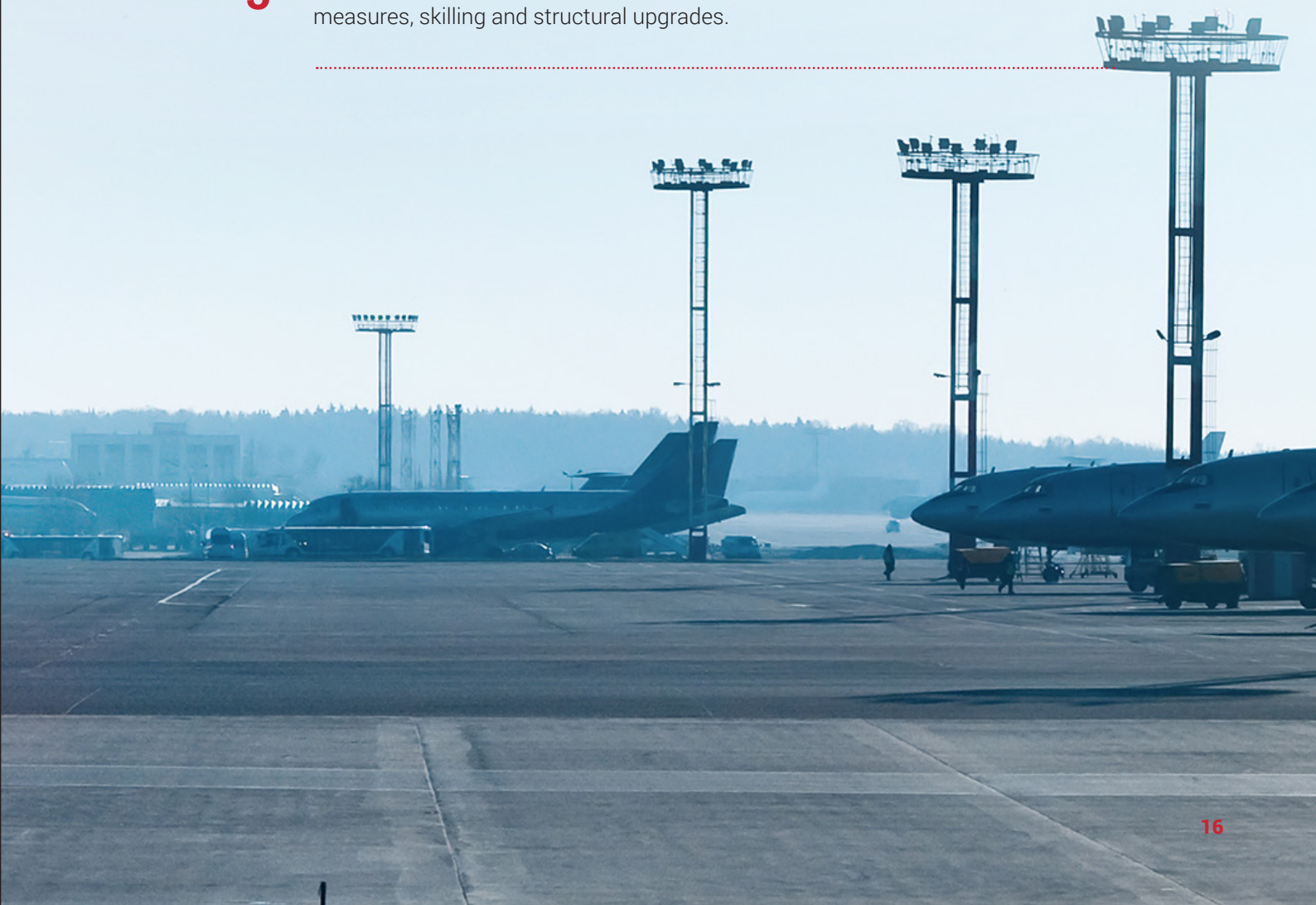
1. Unavailability of region-specific risk assessment frameworks suited to geographic contexts, standards, varied operational landscapes, ownership and mandate are not readily available.

2. There is a lack of standard data collection protocols, and methodologies consistent with differing hazard severity, operation landscapes and geographical contexts

3. Insufficient professional capacity to anticipate and adequately prepare for potential risks and difficulty in aligning risk appetites due to multiplicity of external factors beyond jurisdiction, such as access roads, water and waste management.

4. Airport resilience stakeholders have diverse agendas, priorities and mandates, complex jurisdictional boundaries and varying operational scales which makes it difficult to engage in the absence of a centralized platform.

5. Immense investment is needed towards resources for inculcating preparedness measures, skilling and structural upgrades.



How can CDRI help?

CDRI may contribute to enhance resilience of airports in the following ways:

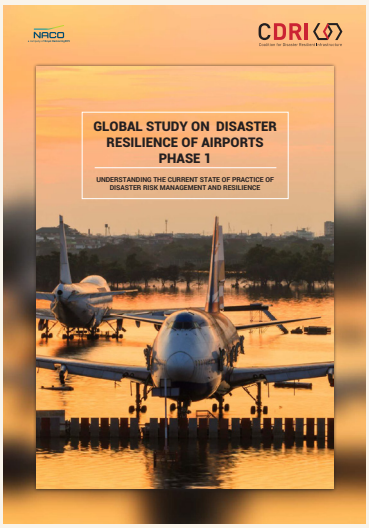
1. Provide technical assistance for creating better risk-informed project reports, risk and vulnerability assessments, and inclusion/integration of resilience components into operation manuals and maintenance processes.

2. Support in envisioning and developing an institutional structure and ecosystem for achieving a holistic regional approach towards airport resilience that includes all relevant stakeholders

3. Facilitate and provide a platform for knowledge sharing, dialogue and collaboration between airport operators, international aviation authorities, governments, insurers and other relevant stakeholders.

4. Leverage and mobilize the technical expertise and knowledge available with the coalition members to build a repository of best practices, assessment guidelines and mitigation strategies including impactful knowledge products

5. Initiate new and innovative research, comprehensive assessment studies and capacity strengthening programmes for airport professionals, policy makers, regulators and other stakeholders for integrating and enhancing airport resilience.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GLOBAL STUDY ON DISASTER RESILIENCE OF AIRPORTS PHASE 1
UNDERSTANDING THE CURRENT STATE OF PRACTICE OF DISASTER RISK MANAGEMENT AND RESILIENCE


CDRI
Regional Insights from Global Study on Disaster Resilience of Airports
Phase I

Coalition for Disaster Resilient Infrastructure

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