

A Guide for Resilience Planning at Airports



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Introduction

Since aircraft first began to fly and carry passengers for hire, there has been the potential for the failure of critical assets.

Furthermore, with the increased integration of numerous complex systems to safely and efficiently handle the vast number of airplanes and passengers, along with the economic and environmental constraints placed on the aviation system today, the potential for significant ripple effects from a single failure has never been greater. It has been through this long-term push for greater system efficiency that key elements of resilience have been lost or overlooked when planning for or maintaining critical operating infrastructure. Recent trends indicate that airlines, passengers, and politicians are also demanding that airports become increasingly resilient and that the integrity of the National Airspace System (NAS) no longer be vulnerable to disruptive events that occur at a single airport.

Operational issues at a single airport can impact the entire NAS and can have ripple effects worldwide. Nothing better illustrates this point than the catastrophic failure of the electrical system at the Hartsfield-Jackson Atlanta International Airport (ATL) in 2017, which shut down the airport for several hours, crippled operations, and resulted in tenant airlines losing upwards of \$50M in revenue. Critically, the effects of the power outage reverberated across the NAS, resulting in the immediate re-routing of hundreds of arrivals and the cancellation of thousands of domestic and international flights over the course of the following week. ATL isn't alone—high-profile operational disruptions have recently occurred at a number of airports across the country, including Los Angeles International Airport, McCarran International Airport, and John F. Kennedy International Airport.



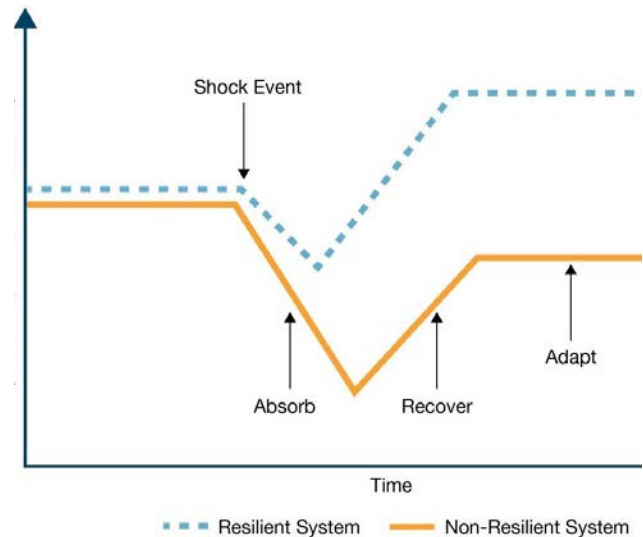
Defining Airport Resilience

Resilience is the ability to resist, absorb, and recover from or successfully adapt to adversity or a change in conditions, while still retaining the same controls on function and structure.

An organization achieves resilience by recognizing threats and hazards and making the necessary adjustments that introduce or improve future protection efforts and risk reduction measures. Resilience to an adverse event occurs in three phases, as shown below:

- **Before** – resist through prior prevention and mitigation planning
- **During** – absorb through prior response planning
- **After** – adapt through prior recovery planning

Current resilience-related topics usually focus on the impacts of climate change—such as sea-level rise, increased storm surge, and extreme weather events—and typically involve physical infrastructure. However, an organization's ability to resist, absorb, and adapt fundamentally hinges not just on building things, but also on its business and planning processes. For example, constructing barriers to combat sea-level rise at a coastal airport is a component of resilience, but it may not be the only resilience-based hurdle the airport faces. The airport may have internal planning and management process or workforce issues that prevent the construction or maintenance of the



barriers in a timely and cost-effective manner. Accordingly, resilience should be viewed as having four qualities, or "dimensions," which include:

- **Technological** – the ability of inter-connected physical systems to perform to acceptable/desired levels.
- **Organizational** – the ability to effectively and efficiently manage the physical components of the systems through "culture," which includes capacity, planning, training, leadership, experience, and information management.
- **Social** – the ability to reduce the vulnerabilities of internal and external workforces and local communities.
- **Economic** – the ability to initiate, accelerate, or stop the processes related to emergency management and recovery.

The three phases and four dimensions of resilience should be ever-present considerations throughout the planning process.

Shock Events vs. Chronic Stressors

Discussions of resilience often focus on a "shock event" where there is a catastrophic failure of an asset or system that requires an immediate and often very costly allocation of resources (e.g., the power outage at ATL).

Unfortunately, what frequently gets missed or drowned out in these post-event discussions are the seemingly trivial or insignificant events that generally occur prior to the more serious disruption. Shock events rarely occur in isolation—instead, they are often a manifestation of a series of related or cascading smaller "chronic stressors" that occur days, weeks, and even years, before a serious event. Chronic stressors come in all shapes and sizes—they might be unknown issues, or they might be known issues that are being addressed, or, worse, they might be known issues that are being ignored (due to either lack of resources or organizational dysfunction).

A serious discussion on resilience also encompasses the management of risks on a day-to-day basis to address, mitigate, and avoid chronic stressors, that may cumulatively result in a future shock event. Proactively addressing chronic asset- and system-based stressors, for example, by repairing or replacing aging facilities and infrastructure and incorporating critical system redundancies, can prevent stressors from becoming catastrophic failures. Proactively allocating resources up front to avoid or address existing chronic stresses is a risk-based approach that can effectively prevent or at least mitigate both future additional chronic stresses and shock events.

In an airport setting, multiple stakeholders typically share responsibility for the previously described shock events, but the entire community (including the responsible stakeholders) are usually deeply impacted. Each event can potentially be avoided, or at



Shock Events

- Utility/fuel delivery disruption
- Terror/cyber attacks
- Critical infrastructure failure
- Natural disasters
- Severe weather events
- Pandemics
- Aircraft emergencies
- Aircraft grounding events
- Exit of hub carrier



Chronic Stressors

- Capacity constraints
- Deferred maintenance
- Aging infrastructure
- Economic downturn/recession
- Climate change impacts, such as extreme and more frequent weather events
- Socioeconomic vulnerabilities, such as workforce development and transportation access


least mitigated, but these events ultimately result from the culmination of chronic stresses that have been inadequately addressed. At virtually every airport, key assets can be several decades old and industry projections continue to show passenger demand that is greater than most airports have ever experienced. Importantly, in an environment where there is only so much funding to go around and there is a focus on new construction, the capital budgeting process typically beats out operational budget considerations. As such, addressing these chronic stressors in a timely and responsible manner is critical to not only each airport, but to the entire NAS.

A Changing Paradigm

Until recently, shock events have been generally thought of as discrete, time-bound events, such as an aircraft accident. If an aircraft accident occurs, there's a defined start and end to the event, which involves a defined group of stakeholders. While in some cases this still remains true, the current COVID-19 pandemic is an example that has forced airport operators to deal with an unrelenting and continuous shock event. While there was a beginning, the ending is still uncertain, and the impacts of the pandemic have and continue to ripple throughout the entire organization, involving all stakeholders and all lines of airport business.

The resilience paradigm is also shifting away from a one-off mindset to a repeated, more frequent (and severe) pattern of events. This is particularly true for climate-change-related events, where 100- and 500-year rain and flood events, for example, used to occur once over that time period, but are now occurring on an annual basis. The increasing severity and frequency of weather events in particular—such as storm surge, heat waves, and heavier rainfall events—are only now beginning to strain existing airport infrastructure and the available resources (e.g., manpower and funding) necessary to address the impacts.

In the past, airport resilience has focused almost exclusively on critical operating infrastructure. However, the COVID-19 pandemic has helped lay bare important issues related to equity, social justice, community relations, and workforce development. In essence, the “human element” has come to the forefront of how society and business operate. Because airports are often described as “mini-cities” and are significant local and regional partners, they too must consider these issues as critical pieces of airport resilience puzzle. Additionally, the pandemic has forced many airport employees to operate in a work-at-home (WAH) environment, which has placed considerable strain on how airports conduct their daily business. Existing management systems and processes have had to adapt to support WAH-related changes in staffing levels, schedules, and effectiveness in addressing customer needs, while also maintaining a safe, secure, and efficient airport.

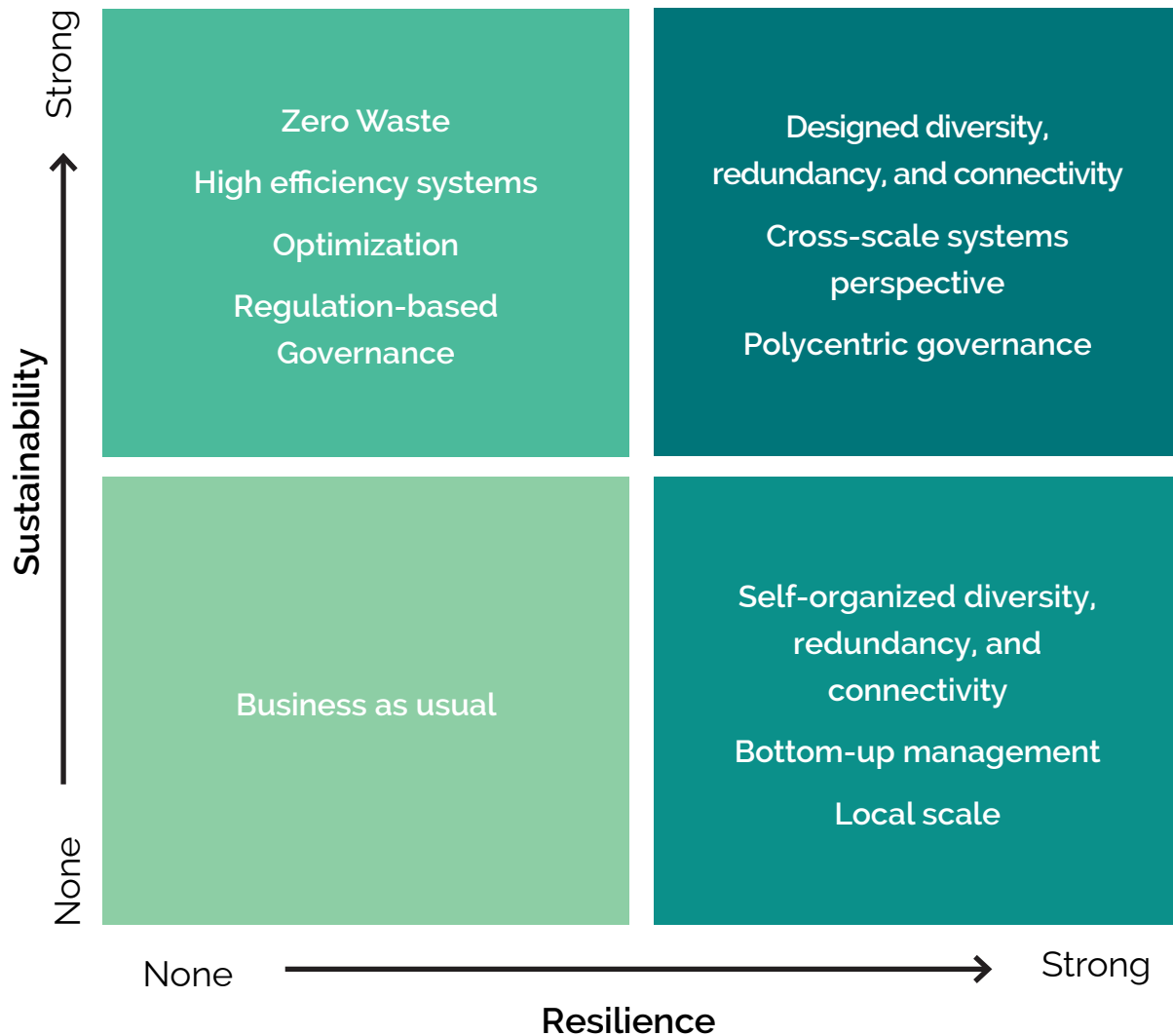


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Resilience vs. Sustainability

Sustainability refers to the long-term ability to continue to engage in a particular activity, process, or use of natural resources that meets the needs of the present without compromising the ability of future generations to meet their own needs.

While resilience principles and goals can align with sustainability, resilience focuses primarily on avoiding and surviving adverse and unexpected events (see lower right box in the graphic below), often through diversity and redundancy, whereas sustainability focuses on achieving and maintaining a longer-term positive environmental equilibrium (upper left box), generally through efficiency. However, even though they can be contradictory and the end goals may be different, they can and should co-exist within the same organization (upper right box).



A Template for Airport Resilience

The Federal Aviation Administration's (FAA's) focus on Irregular Operations (IROPS) and Continuity of Operations Planning (COOP) has shown that one of the key challenges in responding to a shock event is ensuring clear and effective communications across the complex inter-dependent (yet sometimes siloed) systems that comprise the NAS.

Both IROPS and COOP are currently focused on responding to a shock event after it happens. While this is an important part of resilience, a more crucial consideration is the development and implementation of comprehensive and coordinated plans that minimize or prevent chronic and shock event-related risks. In addition to managing the day-to-day risks associated with faulty or aging equipment and systems, airport operators must also demonstrate leadership during shock events, by providing clear, consistent, and efficient communications and supporting response efforts.

Resilience Management Plan

A resilience management plan (RMP) is an enhanced COOP plan that provides a systematic, proactive management approach to enhancing an organization's ability to respond to shock events and address chronic stressors to ensure the integrity of critical physical and human systems, that connect infrastructure and operations. Importantly, a robust RMP enables an airport to apply smart



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management and decision-making principles, which are based on the long life-cycle of airport assets and infrastructure, and ensure that those efforts are properly aligned with efforts of the FAA, tenant airlines, communities surrounding the airport, and other key stakeholders.

Addressing resilience requires more than just a static plan; it involves a dynamic planning process achieved through thoughtful, organization-wide decision-making, which eventually becomes engrained in the organization's culture. Just as the FAA has identified a Safety Culture as being a key part of a Safety Management System (SMS), embracing a resilience risk-based approach

should become an integral part of an airport's culture and decision-making process. Many management systems, including the SMS, are based on four pillars, and an RMP should adopt a similar approach that includes:

- Resilience Policy and Objectives
- Risk Management Processes
- Resilience Assurance System
- Resilience Promotion Program

It is important to note that an RMP should complement existing management systems and facilitate the communication between other similar systems so that all risks can be fully understood. In an airport setting, it is difficult for one individual or even one department to effectively identify and understand the consequences of all resilience-based risks. Instead, accountability for resilience-based decision-making should be distributed among leaders throughout the organization.

Planning Boundaries

As previously discussed, the classical perspective on maintaining continuity of operations generally focuses on critical operating infrastructure; however, the resilience paradigm is shifting fast. Utilities and security can no longer claim sole title to critical operating infrastructure. The people involved in operating and maintaining airport infrastructure and the communities that support the airport are also considered critical to the continuity of operations. As such, a comprehensive resilience plan should touch on all lines of airport business, but a risk-based approach to developing an RMP can help airports identify and prioritize key assets, systems, and infrastructure. It is important to note that critical assets are not just physical things (like runways and terminals), but also people (like airport and tenant employees), and processes (like capital planning and facility/asset management plans).



Critical Airport Assets

- Delivery and distribution systems for:
 - Potable water
 - Electricity
 - Natural gas
 - Mobility fuels (e.g., Jet A, gasoline, diesel)
- Sanitary and stormwater management
- Building envelopes
- Command, control, and communications (C3)
- Security (physical and cyber)
- Human Resources
- Procurement/supply chain/logistics
- Capital and Operational Expenditure (CapEx/OpEx) processes

Approach to Resilience Planning

An RMP can be developed from scratch or it can be a logical evolution of an existing sustainability plan, master plan, or strategic plan. However, the following is important to note:

- Master and strategic plans are useful tools to developing a thorough understanding of key current and future issues and to providing a strategic roadmap for future capital development, but they are, effectively, static snapshots in time. Airports are constantly confronting change, thus requiring on-going, dynamic operational management—including sustainability and resilience concerns—to be captured in a management plan.
- Sustainability plans usually include dozens of daily decision-related measures, which can often result in numerous (and sometimes unexpected) follow-up initiatives; therefore, a management system framework is needed to manage downstream decisions.

These observations closely align with the FAA's recent shift from a "one-size-fits-all" master plan approach to the issuance of both updated planning and guidance documents and new guidance focused on the daily and proactive management of challenges. There is inherent value in the master plan process, but there must also be a robust and comprehensive management system. As such, an RMP should integrate and leverage the strengths from both planning approaches.

An RMP should be developed and implemented in a multi-phase approach, enabling an airport to simultaneously: (1) engage in actions that will facilitate organizational culture change and (2) educate internal and external stakeholders and generate buy-in.

An RMP Should Include:

- Strategy and Visioning
- Analysis and Assessment
- Planning and Documentation
- System Development
- Processes for Reviews and Updates

Stakeholders

An RMP helps an organization focus on adopting a highly collaborative, whole-system management approach to put strategies, plans, and processes in place that ensure an airport is able to safely and efficiently maintain the continuity of operations. Because RMP development can be a complex and lengthy process, it requires the collaboration of not only multiple departments across the airport organization, but also with airport tenants and consortiums and other key external stakeholders, which may include:

- FAA's Airports District Office
 - Communities surrounding the airport
 - Regional planning organizations
 - Department of Homeland Security
 - State department of transportation
- Engagement should include outreach (e.g., workshops) to educate all stakeholders likely affected by the outcomes of the RMP on the principles of resilience. These touchpoints can provide an opportunity to develop a shared understanding of critical planning milestones and to solicit feedback/input related to the focus areas, strategies, and management plan.

Engagement sessions should also involve coordination with other entities and airport users that may already have, or are in the process of developing, similar plans.

Risk Management

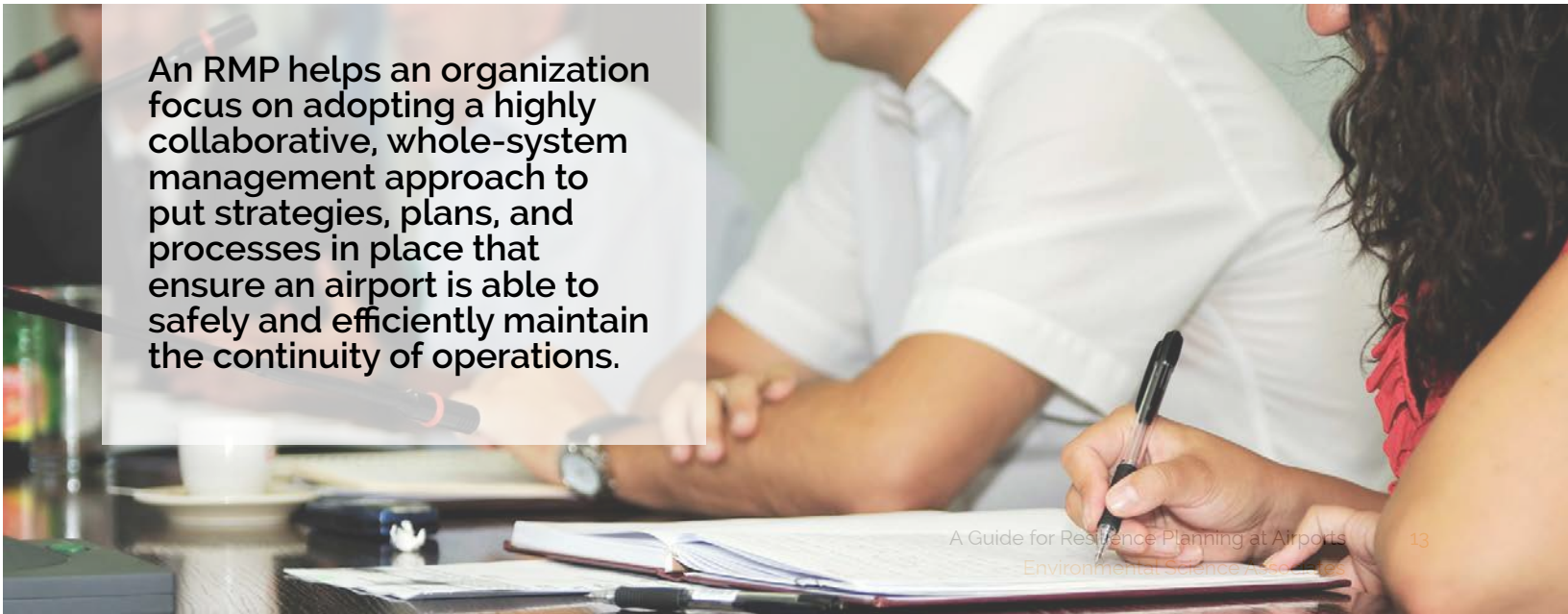
Current resilience-based planning efforts generally tend to focus on 'shock events' rather than 'chronic stressors,' which are a critical element of resilience planning. Resilience thinking should address both known risks, as well as identifying new or previously unidentified risks. An RMP's intended approach to risk assessment and management should be generally consistent with the U.S. Department of Transportation's pilot program, which created a risk model to evaluate the resilience of the numerous assets overseen by the Federal Highway Administration.

An RMP should empower users to proactively look to identify, understand, and mitigate risks to avoid operational incidents. The ability to understand risks and the resources required to mitigate those risks strengthens the strategic capital planning process. Managing risk requires understanding both the probability of an eventual system failure and the system impact of failure, and the outcome of creating that comprehensive risk understanding directly supports management decision-making for allocating scarce resources.

Conceptual Principles

Every airport is different, with each having their own unique considerations and associated priorities. However, the following principles would inform the basis for developing an RMP at any airport:

- Project Framework
- RMP Visioning
- Inventory of Strategic Assets and Infrastructure
- Determine Requirements
- Risk Assessment
- Identify Strategic Focus Areas
- Develop Focused Management Plans and Processes
- Stakeholder Outreach
- Develop a System for Resilience Management
- Develop Resilience Promotion/Education Programs
- Develop Electronic Resilience Management Tools
- Structure for Regular Reviews



An RMP helps an organization focus on adopting a highly collaborative, whole-system management approach to put strategies, plans, and processes in place that ensure an airport is able to safely and efficiently maintain the continuity of operations.

It is important to note that, while developing and implementing an effective RMP may seem like a daunting and expensive endeavor, it is a scalable and airport-specific process. Each airport and the challenges it faces will be different. For example, many of the risks associated with operating the world's busiest airport will likely not be the same as those associated with a small-hub airport, and where there is alignment, the magnitude of those issues will likely be vastly different. What won't change, regardless of organization size, are the fundamentals of the resilience planning process, which include: strategy and visioning; analysis and assessment; planning and documentation; system development; and processes for reviews and updates.



CONCLUSION

Airports are constantly at risk to minor and major disruptions that could have adverse ripple effects throughout the organization, NAS, and/or broader global economy.

However, many of the risks airports face can be prevented or mitigated through a comprehensive approach to managing existing assets and infrastructure, across the built environment and within an organization. It is therefore up to airport organizations to be proactive and constantly adapt by recognizing threats and hazards early and making the necessary adjustments that introduce or improve future protection efforts and risk-reduction measures.

An RMP is a comprehensive strategy that provides airport operators with a systematic, proactive management approach to enhancing an organization's ability to respond to shock events and address chronic stressors, thereby ensuring the integrity of critical physical and human systems. An RMP is complementary to existing management systems and facilitates communication between other similar systems so that all risks can be identified, understood, and mitigated to avoid operational incidents. The result of a well-integrated RMP is enhanced organizational response, preparedness, and confidence during times of uncertainty.

Please reach out to [Neal Wolfe](#) for more information or questions about this article.