

Pandemic- resilient infrastructure

Enabling assets to absorb, adapt
and transform in the event of a
future infectious disease outbreak



Learning from the COVID-19 crisis

When infrastructures become part of the problem

A key lesson from the COVID-19 pandemic is that infrastructures such as schools, transport systems or sports and entertainment venues facilitate the spread of communicable diseases, so they cannot operate as normal. The immediate response in many countries to close infrastructure or reduce operations to minimal capacity has had a huge economic impact, with many countries facing recession and businesses struggling to remain financially viable, threatening progress on social outcomes.

To what degree can key infrastructure continue to play its role during an epidemic, while accounting for the need to reduce the risks of disease transmission among staff and users? This question is at the heart of what we at Mott MacDonald term pandemic-resilient infrastructure.

What do we mean by resilience?

The concept of resilience has become central to many aspects of our lives and is often used in the context of sustainable development, natural disasters, climate change or conflicts. Resilience can be understood as the ability of a system to absorb, adapt and transform when challenged by external threats and stresses, while still retaining control over its remit and pursuit of its primary objectives and functions.¹ This understanding can be applied to both sudden crises and long-term stresses.

Resilience involves actively understanding the risk landscape and determining where those risks are best owned and managed. Strengthening these components can reduce potential economic losses when a crisis occurs.²

Pandemic: A worldwide infectious disease outbreak.

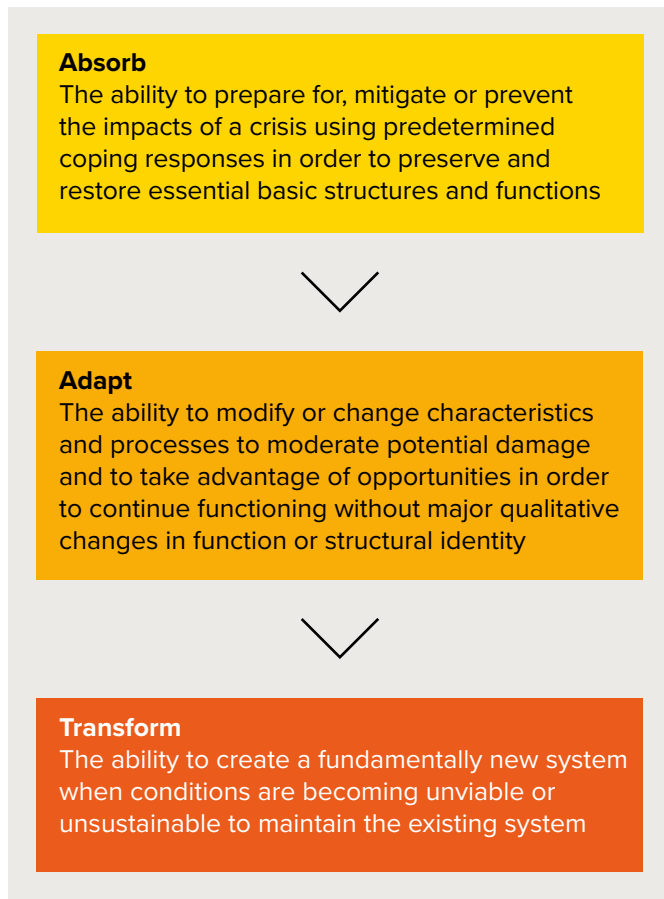
Resilience: The ability of a system to absorb, adapt and transform when challenged by external threats and stresses, while still retaining control over its remit and pursuit of its primary objectives and functions.



1. World Health Organization Regional Office for Europe. 'Strengthening resilience: a priority shared by Health 2020 and the Sustainable Development Goals'. World Health Organization, 2017. https://www.euro.who.int/__data/assets/pdf_file/0005/351284/resilience-report-20171004-h1635.pdf

2. Mitchell A. 'Risk and Resilience: From Good Idea to Good Practice'. OECD Development Assistance Committee Working Paper, 2013. http://www.oecd.org/dac/conflict-fragility-resilience/docs/Resilience_and_Risk_Good_ideas_Good_practice.pdf

The following diagram defines the three dimensions of resilience, adapted from the Organisation for Economic Co-operation and Development (OECD) and Institute of Development Studies (IDS).^{3,4}



By applying these aspects of resilience to the context of infectious disease threats, the three dimensions of pandemic resilience can be understood as:

1. **Absorb:** Be more resistant to pathogen transmission, demonstrating to users and authorities that appropriate and reasonable precautions are already in place to maintain basic essential services (transport, education, etc). These steps are taken in advance to anticipate and prepare – pandemic preparedness should be seen as an investment rather than a cost, similar to fire safety planning.
2. **Adapt:** Be more responsive to societal needs by enabling the continuity of services balanced against the risk of disease transmission, while maintaining public confidence, as government control measures permit. These measures flex depending on the current situation.
3. **Transform:** Be more versatile and enable certain types of infrastructures to perform a different role to their usual function in times of crisis.

Why do we need pandemic resilience in our infrastructure?

We are witnessing the unprecedented impact of the COVID-19 pandemic on social and economic outcomes across the world.^{5,6} It is clear that countries across the economic and development spectrum were unprepared to cope with such a shock to their systems as even global superpowers struggle to keep both their population's health and their economies afloat.

As infectious disease outbreaks increase in frequency in a globalised world,⁷ we must improve preparedness and build for pandemic resilience. Resilient systems and infrastructure should incorporate both proactive and reactive capacities to better manage a range of possible scenarios. Additionally, reduced risk of infectious disease transmission is beneficial even during non-pandemic times. A lower occupational risk of staff becoming ill could lead to less sick leave, benefitting companies and society alike.

3. Mitchell A. 'Risk and Resilience: From Good Idea to Good Practice'. OECD Development Assistance Committee Working Paper, 2013. http://www.oecd.org/dac/conflict-fragility-resilience/docs/Resilience_and_Risk_Good_ideas_Good_practice.pdf

4. Béné C, et al. 'Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes'. IDS Working Paper, 2012. <https://doi.org/10.1111/j.2040-0209.2012.00405.x>

5. World Bank. 'Poverty and Distributional Impacts of COVID-19: Potential Channels of Impact and Mitigating Policies'. April 2020. <http://pubdocs.worldbank.org/en/980491587133615932/Poverty-and-distributional-impacts-of-COVID-19-and-policy-options.pdf>

6. United Nations Development Programme. 'Socio-economic impact of COVID-19: Briefs and Reports'. <https://www.undp.org/content/undp/en/home/coronavirus/socio-economic-impact-of-covid-19.html>

7. Smith KF, et al. 'Global rise in human infectious disease outbreaks'. Journal of the Royal Society, Interface, 2014. <https://doi.org/10.1098/rsif.2014.0950>

Mott MacDonald's response

Infrastructure epidemiology

For an organisation like Mott MacDonald, with a clear focus on improving social outcomes, COVID-19 has been a call to action, urging internal collaboration and connected thinking among our global health, infrastructure and innovation experts to address important and urgent problems. Actions to respond to the COVID-19 pandemic in various sectors (including rail, bus and air transport, buildings and schools) have come together in our new discipline of infrastructure epidemiology.⁸

Infrastructure epidemiology is a cross-sectoral approach combining Mott MacDonald's diverse expertise to strategically advise on risk reduction and mitigation strategies backed by the most up-to-date epidemiological evidence, tailored to each client and setting, in compliance with government guidelines.

The immediate objective was to help our clients restart their services while better managing risks of virus transmission to employees and the public. Building on this, we have developed risk analysis tools tailored to different sectors, aimed at supporting decision-making, strengthening the leadership of infrastructure operators and regaining public confidence in using infrastructure facilities. The active involvement of epidemiologists allows us to respond to the fast-evolving evidence base around COVID-19 and to think through the implications of different kinds of pandemics.

With a longer-term view to navigating our way out of the current crisis and to anticipate future infectious disease threats, Mott MacDonald is expanding its understanding of pandemic resilience applied to different types of infrastructure to improve the design and operation of facilities and systems. Pandemic-resilient infrastructure incorporates preparedness and contingency planning for different scenarios, including varying restrictions put in place by government authorities, and operational considerations such as business viability. Our pandemic resilience work is backed by a track record of digital innovation, our drive for excellence and connected thinking.

8. Mott MacDonald. 'Infrastructure epidemiology: A public health-based approach to help asset owners and operators restore services and build confidence for a pandemic-resilient future'. <https://www.mottmac.com/download/file?id=38727&isPreview=True>



How can we help?

Our pandemic resilience service

Mott MacDonald aims to deliver better social outcomes and build upon ongoing initiatives in the public and private sectors to make cities and communities healthier and greener, by adding layers of protection against the risk of epidemics. We aim to mainstream pandemic resilience into all relevant sectors and services in order to minimise the impact of current and future infectious disease threats on the operation of infrastructure services as well as disruption to lives and revenue, thereby delivering better value to our clients.



Our offer includes:

- **Risk assessment service:** Company or asset-specific risk assessments for infectious disease threats. We apply our '7R' criteria to assess resilience: risk avoidance, robustness, redundancy, resourcefulness, rapidity, recovery, regulatory compliance.⁹
- **Feasibility assessment and due diligence:** Assessing infrastructure plans, projects and operations, verifying that these include basic features that would render them more viable during epidemics.
- **Preparedness planning:** In the event of an infectious disease threat, develop standard operating procedures (SOPs) in each type of infrastructure, defining the basic services to be maintained and the means to do so in terms of people, systems, hardware/software and resources.
- **Contingency planning:** Develop SOPs for different risk level scenarios as defined by the appropriate government authorities, in a similar manner to security and weather events.
- **Customer experience planning:** To help manage the use of infrastructure services to help users feel confident.
- **Dynamic demand/capacity modelling:** To assess the implications of various interventions and provision for contingent space and facilities.
- **Adaptable design of buildings:** In the event of a pandemic emergency, facilities which may otherwise be unused or under-used can continue to serve an important purpose for society. This can help build more efficient public sector investments. For example, designing exhibition or sports centres that can swiftly be converted to emergency health facilities, quarantine centres or patient recovery wards.

9. Building on the 6R model described in 'Flood Resilience' Philos Trans A Math Phys Eng Sci. 2020 Apr 3; 378(2168): 20190212. Published online 2020 Feb 17. doi: 10.1098/rsta.2019.0212

Examples of building pandemic resilience across sectors

The following examples illustrate how Mott MacDonald incorporates pandemic resilience into different types of infrastructure services.

Aviation

Air travel has been hard hit by COVID-19 as a result of lockdowns and closed borders. Since early March 2020, Mott MacDonald has been engaging with clients in the aviation industry with a focus on enhancing safer operation of airports during different stages of the COVID-19 pandemic. Activities include advising on strategies for reducing transmission of the virus in airports, identifying and programme managing the introduction of technologies to reduce human interactions as well as reducing the number of touchpoints, and integrating pandemic control in customer services manuals. We have also developed a detailed risk model that provides quantitative assessments of the efficacy of different interventions on SARS-CoV-2 transmission, based on social distancing, human contact and touchpoint reduction across the asset as well as operational environments.

In addition to incorporating best practices learned during the COVID-19 pandemic so far, the longer-term strategy for pandemic-resilient airports involves:

- Expanded application of technologies including facial recognition, radio frequency identification (RFID), employee and passenger apps, and congestion surveillance to manage flows, reduce people density and contact, and minimise delays within the building.
- Replacement of self-service touchpoints with facial recognition check-in, contactless payments and pre-authorisation to fly before travel.
- Assessing airflows and ventilation in terms of air quality and recirculation.
- Integrating procedures for pandemic events, to be mainstreamed alongside existing procedures for weather events and changes in security levels.
- Adapting airports to become primary control points for the regional and international spread of communicable disease, developing an integrated approach including security, immigration and customs.

Rail and bus transit systems

Public transit systems including rail, metro and bus networks have suffered loss of revenue during the COVID-19 pandemic due to drastically reduced use of services. Mott MacDonald has engaged with numerous public transportation authorities around the world to understand their concerns and guide them through decision-making on risk reduction strategies and building customer confidence. Our technical experts across transit and health have held workshops to enable public transit owners and operators from different cities to learn from each other and discuss innovations and ideas. A key issue to consider during a pandemic is public confidence – systems will not be able to maintain services during a crisis if users abandon the system due to lack of trust. Resilience planning, therefore, needs to involve communications plans to ensure that public and staff are reassured that the transit system has passenger and staff safety at the heart of operations.

Incorporating pandemic resilience into public transit systems also involves:

- New technologies such as self-cleaning surfaces, touchless access options and crowd control and monitoring systems.
- Building easy-to-clean materials into new facilities and replacing difficult-to-clean materials in existing facilities.
- Real-time information on occupancy and crowding, communicated to passengers for informed decision-making and to operators for managing operations and making measured business decisions.
- Assessing airflows and ventilation in stations, platforms and on carriages/buses.
- The ability to turn an open-access system into a regulated-access system if necessary.
- Creating a pandemic preparedness plan specific to the system and testing scenarios that may unfold based on the evolving pandemic and local regulations.

Hospitals and healthcare facilities

Throughout the COVID-19 pandemic, Mott MacDonald has provided advice and support on the establishment of temporary healthcare facilities through the repurposing of existing buildings such as conference centres and stadiums. This has given us first-hand experience of the challenges when transforming a building's purpose from its original function.

In addition, we have been supporting the evaluation of remote primary care consultations in the UK, as part of a series of quality improvement initiatives to reduce the risk of disease transmission and to promote improved resilience going forwards.

The ways in which people interact with healthcare services are changing, with wider acceptance of the virtualisation of care and a reduced demand for face-to-face consultations. This provides opportunities to address the skills gap through more flexible working patterns, making services more resilient and sustainable, as well as reducing the need for physical consultation rooms, enabling more flexible use of GP surgery spaces. These changes contribute towards a more resilient sector, and there are lessons in harnessing digital tools that can be applied across other sectors.

Pandemic-resilient healthcare facility design for the future includes:

- Use of design and materials that make healthcare facilities more resistant to infectious disease spread.
- Redesign of healthcare systems with more emphasis on digital infrastructure, giving a better balance of digital and physical infrastructure which reduces the need for meeting, consultation and waiting areas at healthcare facilities.
- Design of healthcare facilities for greater emphasis on inbuilt flexibility and adaptability, in terms of both the layouts and services infrastructure, to allow clinical and non-clinical areas to be transformed to deal with surge capacity.
- A move to more campus-based healthcare estates allowing better separation of clinical services and patient flows.
- Flex capacity designed into healthcare estates through a planned approach for commissioning temporary modular accommodation alongside and connected to the permanent physical estates. Furthermore, at a more strategic level and city planning scale, designing adjacent non-healthcare buildings (eg university accommodation) with inbuilt repurposing capacity.



This document (the 'Document') has been produced and shared with our business partners to set out options for the promotion of compliance with good international industry practice and international lenders' standards. It should not be used for any other purpose. No user of the Document ('User(s)') may rely on the content or information expressed in the Document. Any intellectual property rights arising from the Document are owned and held by Mott MacDonald Limited.

Please note, the information in this Document is not a legal opinion or advice and should not be relied upon or treated in any way, including as a substitute for obtaining such specific advice. Please consult us for any further qualified and detailed advice.

We accept no duty of care, responsibility or liability to any User(s) of this Document. No representation, warranty or undertaking, express or implied, is made and no responsibility or liability is accepted by us to any User(s) as to the accuracy or completeness of the information contained in this Document. We disclaim all and any liability whether arising in tort, contract or otherwise which we might otherwise have to any User(s) in respect of this Document, or any information contained in it.

We accept no responsibility for any error or omission in the Document which is due to an error or omission in data, personal data, information or statements supplied to us by third parties (the 'Data') or is due to an error or omission in documents and resources referenced in the Document (the 'Resources'). We have not independently verified the Data or the Resources or otherwise examined them to determine their accuracy, completeness or sufficiency for any purpose.

Information displayed in the Document is current only as of the date of the production of the Document and we accept no responsibility for updating such information or opinion. It should, therefore, not be assumed that any such information continues to be accurate subsequent to the date of production of the Document.

By using this Document you agree to be bound by this disclaimer. Under no circumstances may the Document or any extract or summary thereof or reference thereto be disclosed or used or attributed to Mott MacDonald without this disclaimer. If you do not agree to be bound by this disclaimer, you must discontinue using this Document now and should destroy the Document in such case.

This disclaimer and any issues, disputes or claims arising out of or in connection with it (whether contractual or non-contractual in nature such as claims in tort, from breach of statute or regulation or otherwise) shall be governed by, and construed in accordance with, the laws of England and Wales to the exclusion of all conflict of laws, principles and rules. All disputes or claims arising out of or relating to this disclaimer shall be subject to the exclusive jurisdiction of the English and Welsh courts to which the parties irrevocably submit.

Opening opportunities with connected thinking.

For more information contact:

Douglas Wilson
Global lead – Advisory Services
douglas.wilson@mottmac.com

Anthony Huszar
Account leader – International Health
anthony.huszar@mottmac.com

mottmac.com