US INFRA FACES NEW STRESSES

AFTER ANOTHER CONTENTIOUS ELECTION AMID A LOOMING GLOBAL HEALTH CRISIS, EXPERTS SAY INFRASTRUCTURE INVESTMENT IS AN AREA WHERE BOTH PARTIES MUST BRIDGE THE DIVIDE. AND ALL EYES WILL SOON BE ON PRESIDENT-ELECT JOE BIDEN AS HE LEADS EFFORTS TO STRIKE A BIPARTISAN INFRASTRUCTURE DEAL. BIDEN'S PLAN TO BUILD BACK BETTER INCLUDES MODERNISING HIGHWAYS, ROADS, AND BRIDGES, AND INVESTING IN ELECTRICAL VEHICLE, MASS TRANSIT AND HIGH-SPEED RAIL INFRASTRUCTURE – BUT EXPERTS SAY THE NEW DEMOCRATIC ADMINISTRATION WILL FACE CHALLENGES TO IMPLEMENTING SOME OF ITS INFRASTRUCTURE TARGETS IN THE FACE OF MOUNTING CLIMATE-RELATED AND MAN-MADE STRESSORS. BY PATRICK HARDER, CHAIR OF THE INFRASTRUCTURE GROUP, AND ALEXANDER BULKIN, AN ASSOCIATE IN THE INFRASTRUCTURE GROUP, NOSSAMAN.

In response to Covid-19, US passengers are limiting travel on public transit to essential trips or finding alternative methods of transportation altogether. While this sharp drop in ridership is the result of well-placed fear, the decline also reveals a more concerning trend – people everywhere are losing trust in the country's ability to build and maintain resilient transportation systems. Resilience, in the transportation context, is defined by the FHWA as "the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions". Put simply, resilience means keeping transportation assets relevant and operational in a changing world.

In a year such as 2020, it is easy to see why outdated transportation planning initiatives failed to deliver safe, relevant, and nimble transportation assets. From extreme climate events and social unrest, to global health crises and rising inequalities, last year brought forth new and more extreme challenges than ever before. The pandemic, as difficult as it is, must be a wake-up call to stakeholders that future-proofing transportation systems will not only require upgrading physical assets, but also changing political, economic, and social agendas. Through a proactive and holistic integration of policy making, community involvement and strategic investment, the US can draw on its already existing tools to implement the changes needed for a more resilient transportation infrastructure in the future.

The stressors

- *Climate-related stressors* – In order to build more resilient transportation systems, it is imperative for stakeholders to understand both the immediate stressors currently affecting transportation systems, and the impending stressors that pose significant risks moving forward. The first and most widely researched transportation stressor is climate change. Climate change threatens transportation systems both acutely through extreme weather events and chronically through gradual changes. Over the last forty years, there have been 273 natural disasters each costing the USA US$1bn or more in damages. Hurricanes are by far the costliest, averaging US$21.2bn per event. Severe storms, which are less destructive but more frequent, have had an average cost of US$2.1bn per event. The National Oceanic and Atmospheric Administration, which tracks natural disasters, reports that the number of billion-dollar disasters recorded each year continues to grow. In fact, there has not been a single year since 2002 where the number of major natural disasters fell below five.

  While natural disasters have had devastating effects on US transportation systems, climate change has also gradually degraded the transportation infrastructure. Throughout the country, we have seen higher temperatures cause pavement to soften and expand, resulting in rutting and potholes. Warmer temperatures have also led to winter precipitation falling as rain instead of snow, causing more landslides and washouts. In coastal areas, sea level rises and storm surges have had massive impacts on road and rail infrastructure. In fact, approximately 60,000 miles of coastal roads in the US are already exposed to flooding from storms and high waves.
- *Man-made stressors* – In addition, man-made stressors such as congestion, gentrification, and social unrest continue to impact transportation systems across the country. Whether in the form of trucks stalled in traffic, cargo stuck at overwhelmed seaports, or airplanes waiting on crowded runways, congestion costs the US

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an estimated US$200bn a year. Furthermore, increased congestion and rising living costs in urban centres continue to push vulnerable populations, such as the working class and elderly, farther away from public transportation hubs, creating "transit deserts" or areas where much needed transportation services are inaccessible. In many cities, the areas with the shoddiest access to public transit are the most impoverished – and the lack of investment leaves many Americans without access to jobs, medical care, quality groceries, and good schools. With growing inequalities in US society, people are taking to the streets to protest for change. These protests are having material effects on several major cities' transportation systems as transit authorities are forced to shut down to avoid potentially dangerous situations.

Changes in technology and people's preferences will also stress US transportation systems moving forward. For example, fuelling systems and infrastructure are on the verge of a major transformation as electric vehicles continue to grow in market share. Similarly, the emergence of autonomous vehicles is likely to result in several changes to transportation infrastructure. For example, subscription services to autonomous fleets may gain traction, thereby reducing the need for parking, or increased infrastructure capacity may be needed if large numbers of people decide to live in rural areas and commute via autonomous vehicles

Inadequate plans

Despite the rising frequency and magnitude of the stressors discussed above, state and local transportation agencies have sometimes failed to adequately adjust their resilience strategies accordingly. A review of the FHWA Climate Resilience Pilot Program revealed that all twenty-four participating transportation agencies continue to focus their resilience strategies on two areas: (1) assessing and managing risks stemming from direct physical impacts, and (2) investing in robustness, which entails strengthening and fortifying existing transportation assets.

While these strategies are important elements of effective transportation planning, they fail to accurately address the suite of stressors affecting transportation assets. For example, the risk-management models currently employed by transportation agencies to bolster resilience rely on historical climate data, which have been increasingly regarded as inaccurate among the scientific community, meaning that what used to be normal is not normal anymore. In the context of climate change, this means the climatic extremes of the past can no longer be considered the outer limits of what US climate extremes are or may become. For example, a 100-year flood could now be expected to happen more frequently than once in a 100-year period; thus, it may become a 50-year flood, or less. This climatic volatility has broad implications. Dams, levees, and bridges are now challenged to withstand extreme conditions that designers used to think were impossible. Communities across the country, especially those in areas vulnerable to sea level rises, drought, or floods, are faced with even tougher conditions than forecast by experts.

Further, while upgrading physical assets through a robustness-based approach is a key aspect of effective transportation planning, it is not sufficient on its own to ensure a resilient transportation system. Robustness-based investments fall short for one critical reason – they fail to address the interconnected nature of transportation systems. To illustrate, imagine a transportation agency spends millions of dollars upgrading a bridge to protect from hurricane damage. After construction is complete, a hurricane ravages the area, leaving the bridge unscathed, but nevertheless inaccessible as roadways leading up to it are damaged. Robustness-heavy investments ignore the the idea that resilience must be understood as not only the vulnerability of a specific asset to stressors, but also how stress on one part of the transportation system can spill over to other areas. Due to these shortcomings, transportation planners have begun to adopt new strategies that aim to mitigate risks in an integrated way.

Planning drivers

Behind these news strategies lies one key truth – resilience reflects uncertainty. Indeed, it is our inability to know what combination of stressors will occur in the future that must guide our planning. If the future was predictable, resilience would lose its importance. But since the future is unpredictable, it is necessary to plan for a wide range of possible conditions. Executing these strategies requires a multi-disciplinary approach, which draws on the principles of redundancy, responsiveness, and coordination.

Redundancy, applied to the transportation context, is the existence of numerous routes or means of transport between the same two points. Redundancy is vital to the healthy function of transportation networks as it helps to provide utility during disasters, and minimises economic disruptions stemming from inefficiency. Take for example the 2018 Camp Fire, which left 27,000 fleeing Californians trapped in gridlocked traffic due to inadequate evacuation routes. If California had invested in redundancy, several lives and millions of dollars would have been saved. Another practical example can

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be seen when looking at the Virginia Avenue tunnel in Washington DC through which 20 to 30 cargo trains travel each day. Before its reconstruction, the tunnel had a single rail line, forcing many freight trains to wait while others passed through. This bottleneck disturbed the movement of goods and needlessly caused economic harm.

Next, and equally important is the principle of responsiveness. Responsive transportation systems harness the power of technology to allow for automated monitoring and shorter feedback loops. To address critical stresses to the transportation system, such as congestion and network chokepoints, IT-enabled equipment such as field devices and sensors should be integrated into transportation assets. Enhanced monitoring and control capabilities will boost resilience by providing more swift and detailed information to transportation managers as to operating conditions and performance. This technology has the potential to reduce response times, thereby deterring unexpected shutdowns such as those faced by several metropolitan transit systems after protests and marches broke out following the murder of George Floyd.

Finally, coordination means that knowledge is shared, planning is collaborative and strategic, and responses are integrated for mutual benefit. With federal infrastructure funding trending in a negative direction and state and municipal budgets shrinking due to Covid-19, policy makers must step up to authorise innovative funding and financing mechanisms for resilience-based transportation infrastructure investments.

Transportation agencies must also refocus their data collection efforts to uncover the underlying reasons why traditionally overlooked population segments, such as the disabled and elderly, are unable to access public transit. By focusing on this information, leadership can make productive steps toward increasing investment in neighbourhoods that historically have been shortchanged when it comes to transportation funding.

Conclusion

Implementing the changes necessary for a more resilient transportation infrastructure requires a holistic integration of technology, transportation planning, and community involvement. It is imperative to understand and design an integrated system that will bolster transportation resilience in cities, survive stresses and shocks and be better prepared for black swan events. We need to emphasise the significance of system interconnectedness, appreciate the potential for cascading failures and deploy an approach that suitably addresses the intricacies within and between integrated systems. Future-proofing US cities with continuous long-term strategic planning and investments in a scalable but intelligent transportation infrastructure system provides our best hope for achieving resilience.

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