# After the Baltimore bridge collapse, we need clear-eyed assessments of the risks to key infrastructure

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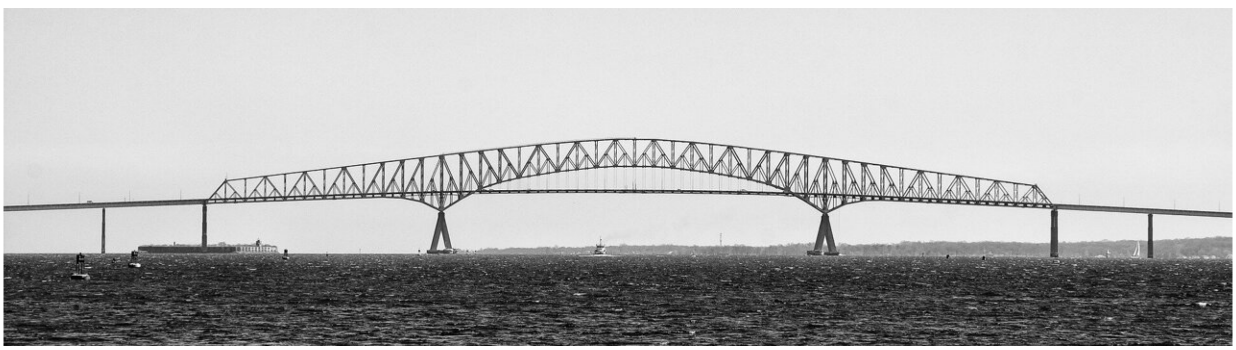

Credit: Pixabay/CC0 Public Domain

Catastrophic collapses of major bridges are thankfully rare. Notable examples in the last couple of decades include the failure of the I35-W in Minneapolis in August 2007, and the collapse of the Morandi bridge in Genoa 11 years later. When such events do occur, public attention is understandably focused on the nature of the collapse, which can extend over hundreds of meters in seconds, and its underlying causes.

Whether because of an extreme loading event or an accident, these supposedly rare events in the life of a bridge still need to be assessed before they happen, and mitigation measures taken in accordance with all the potential consequences. This type of analysis is known as a "risk-based consequence assessment." The cost of taking additional measures in the near term can prevent major adverse consequences further down the road.

With many of these structures being over 50 years old, we often hear that a bridge's condition may have been compromised by deterioration and increased traffic loads—both in the size and frequency of vehicles. Also, older bridges were designed to standards that have been superseded by new knowledge and technology.

While these factors have helped convince some politicians to increase their infrastructure budgets, including through the Bipartisan Infrastructure Deal in the US, the tendency has been to focus on stronger, more resilient new structures and on higher maintenance for existing structures. The latter makes it easy for politicians to show the money spent has had a positive impact, because it results in an overall reduction in the number of bridges classified as obsolete or deficient.

Given the enormous scale of the bridge maintenance problem—the American Road Transportation Builders Association has estimated that one in three US bridges needs repair—it makes sense to spread available funding widely. However, this approach can have serious shortcomings if it does not set clear priorities based on the scale of potential consequences from accidents and failures.

One of the two central pylons of the Francis Scott Key bridge in Baltimore was rammed by a 300m-long container ship at around 1.30am on March 24, leading to progressive collapse of the bridge's entire truss within four seconds.

Although the 47-year-old bridge had been found to be in a "fair" condition during its most recent inspection in 2008, and was "fully up to code" according to Maryland's governor after the collision, experts agreed that a catastrophic collapse was to be expected given the magnitude of the ship's impact. Maintenance workers were on the bridge at the time filling potholes, including the six people who died.

## Direct and indirect consequences

Bridge collapses due to vessel collisions have happened before and unfortunately will happen again. In a similar incident in 1980, the Sunshine Skyway bridge in Tampa Bay, also a steel truss structure, was hit by a barge, resulting in 35 casualties due to the collapse of over 400m (1,300ft) of its span.

Around the world, the American Association of State Highway and Transportation Officials has reported 31 major bridge collapses due to vessel collisions between 1960 and 2002, resulting in 342 deaths.

The latest, the destruction of the Francis Scott Key Bridge, has cut off one of three transport links across the Patapsco river in the busy Baltimore port area. Given its importance as a transport hub, this will have major economic implications that could have been anticipated.

More than 30,000 vehicles that were using the Key Bridge daily now have to seek alternative routes. Significantly, the other two local crossings are via tunnels, which imposes limits on the type of traffic that can cross the river because the transporting of hazardous materials through tunnels is prohibited.

Shipping traffic into and out of the Baltimore port has been suspended until further notice. Removal of the debris will be a complex operation, and work to ensure all vessel types can navigate the river safely will take time. Further restrictions will then need to be in place when the new bridge is constructed.

There are already signs that supply chains around the world are being affected by the bridge collapse, especially in the car and light truck sector, and in farm and construction machinery.

The economic consequences of this catastrophic event will be substantial at both city and state level. Early estimates on liability insurance payouts suggest the total cost may exceed US$1.5 billion (£1.2 billion).

Judging by what has happened after past bridge collapses, there could be negative impacts on jobs and the local economy: about 14,000 people work in the port itself, and another 140,000 are employed in related services.

Above all, six people lost their lives. But the human cost could have been much worse if the incident had taken place during rush hour. Had the impact occurred with a vessel carrying hazardous materials, the environmental costs could have been dramatic as well.

Given what we know from previous incidents about the severity of ship-bridge collisions and major bridge collapses, it was clear this bridge was of critical importance.

A number of mitigation options are available to bridges, including the installation of protection devices around the bridge supports (pylons) in the form of fenders or artificial islands, to deflect a ship or lessen the energy of a collision.

For bridges in general, there are measures that can help on the ship side too, such as requiring the use of tugboats or introducing stricter limits on speeds, depending on the type of cargo and vessel size. It is not clear, however, whether these would have made any difference in the case of the Baltimore bridge collapse.

Above all, by undertaking a risk-based consequence assessment every decade or so, authorities that are responsible for vital infrastructure can help visualize changing risks and prioritize their responses appropriately. In the case of river bridges, ever-increasing ship sizes, speedier turnaround times and higher cargo volumes have all increased the risks—and the costs of a catastrophic collision or collapse.



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