SOCIETY for the HISTORY of TECHNOLOGY

Technology's Stories *June 2016*

Deferred Maintenance: The American Disaster Multiplier

Scott Gabriel Knowles DOI: 10.15763/JOU.TS.2016.6.1.02

Construction is a sacred rite in American life—it demonstrates vision.[1] In the rise of suburban developments, the flow of cars on an expressway, and the glimmer of skylines it embodies democracy.

At the same time, the willingness, the compulsion even, to build homes and infrastructure in difficult terrains defines the American construction boom of the postwar decades. As such, disaster has become the partner of American construction. Americans have since the 1940s rapidly and profitably built themselves into harm's way on the New Jersey shore, south Florida, the Texas coast, the wildfire corridors of California, on and on and on. In destruction we find scenes of horror, but also moments of transcendence—the heroism of rescue, the compassion of disaster relief. We also locate in disaster the seeds of reconstruction—a stimulant to the engineer, the banker, the builder, the real estate firm. These values are deeply wired into American technological enthusiasm.

But what of the interval between construction and destruction—the tedious, the scheduled, the largely invisible work of infrastructure maintenance? Maintenance never wins headlines, and neither does the failure to maintain (until disaster strikes). Maintenance isn't visionary, nor is it transcendent. Maintenance is missing from the skyline. Deferred maintenance becomes obvious when systems under stress fail. Sometimes these are "one off" events,

[1] This essay is an excerpt from a book project in draft: Scott Gabriel Knowles, *The United States of Disaster*, under contract for publication with the University of Pennsylvania Press—expected in 2017.

but more and more frequently deferred maintenance is revealed in the midst of predictable events like hurricanes or heat waves. Deferred maintenance is a slow disaster taking place every day across the nation.

In what has now become a textbook example of this process, the failure of the New Orleans "levee and dewatering system" in the aftermath of Hurricane Katrina (2005) demonstrates the multiplier effect of deferred maintenance. A more recent example of climate change as a deferred maintenance mulitplier comes by way of Hurricane Sandy (2012). In each case—despite very different environments, economic bases, and politics—we see clearly the ways that the bill of deferred maintenance comes due in the middle of a disaster.

The storm surge and wind effects of Hurricane Katrina were deadly and costly, but damage would have mostly likely been localized had it not been for the failure of the New Orleans levee system, resulting in the flooding of the Lower Ninth Ward, Gentilly, New Orleans East, Lakeview, St. Bernard Parish, and Plaquemines Parish. To date, the death toll of Hurricane Katrina stands at 1,836—though debate remains about that number.

It is important to recall that the Category 3 Hurricane Katrina that made landfall in Louisiana on August 29, 2005 was in itself only the catalyst of the disaster we now lump into the overall disaster called simply "Katrina." In its post-Katrina investigative report—*A Failure of Initiative (Katrina Report*)—a special federal commission found fault after fault with the New Orleans area protective levee system. The *Katrina Report* detailed the complexities of a protective infrastructure system designed and built by a federal entity but managed and maintained by a patchwork of local levee boards, municipal authorities, and state oversight authorities. The design and construction was carried out by the U.S. Army Corps of Engineers, and was built according to what is known as a "standard project hurricane," in this case one of a magnitude only expected once every 200-300 years.

The "standard project hurricane" is an imperfect tool—it's primary value being in its generalizable characteristics. It was not a surprise to the Corps of

Engineers that its standard project design for New Orleans could fail, and in fact preparations were in place by 2000 to supply "dewatering" assistance if the levees were overtopped by floodwaters. Indeed, the knowledge of this possibility led FEMA in 2004 to conduct a horribly prescient modeling exercise known as Hurricane Pam. The results of Hurricane Pam were catastrophic, with enormous human (over 60,000 dead projected) and material losses. Though only a model, the Pam exercise heightened awareness at FEMA and at the Corps of Engineers over the necessity to develop plans to respond "when not if" the New Orleans flood protection system would be surpassed by a storm. But, Pam-as-Cassandra was a poor lobbyist. What the Corps had not prepared for was the possibility that the scale of their design was not the true problem. Investigations by the National Science Foundation, the American Society of Civil Engineers, and the Corps itself would ultimately reveal that the structural design of the levees around New Orleans failed due to being eroded from underneath, in addition to some overtopping. From a design perspective it was a failure of a known weakness combined with the impact of a previously unimagined one.

Design failures were just the beginning. Or perhaps it's more accurate to say that the design failures were exacerbated by deferred maintenance—a deferral resulting from the unique governance system of the New Orleans area levee system. The *Katrina Report* summarizes the difficulty as one in which: "different local organizations involved had the effect of diffusing responsibility and creating potential weaknesses. For example, levee breaches and distress were repeatedly noted at transition sections, where different organizations were responsible for different pieces . . . The different organizations also have different agendas, and sometimes these can thwart efforts to improve the safety of the overall system."[2] This uniquely American approach to decentralized governance meant that once the system was built, its retrofits and maintenance were left to

[2] *A Failure of Initiative: Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina*, (Washington, D.C., U.S. G.P.O., 2006), 91-92.

locals who may not have had the funds or the technique necessary to get the job done.

In effect, Katrina exposed not only technological weakness, but also deferred maintenance, and in doing so it also exposed a deadly combination of technological and governmental missteps. In addition to the staggering death toll of Katrina, the storm topped $150 billion in direct costs and bankrupted the previously solvent National Flood Insurance Program. Over ten years out economists disagree on the long-term impact of the storm on the local economy. Federal relief programs and investments in reconstruction brought local employment rates above the national average for years after the disaster. However, such calculations do not take into account long-term environmental impacts of the storm—and the numbers are necessarily skewed towards looking at a population that could remain and rebuild. Those that left are not part of these calculations. The "slow disaster" of Katrina continues today, with almost 100,000 citizens—members of a Katrina diaspora—never returning to their city.

Unlike Hurricane Katrina, which exposed the vulnerability of a city due to a single technological system failure, Hurricane Sandy exposed the aggregated vulnerabilities of multiple overlapping systems. Striking the most densely populated counties in the United States, and the largest media market in the world, Sandy represents perhaps the most anticipated, most recorded, most analyzed disaster in American history. And yet, Sandy's most consequential impacts were related not to a dramatic levee failure, but rather to more mundane concerns such as the location of back-up generators in buildings and the placement of railyards. Similar to Katrina, the deferred maintenance of systems—in this case transportation—led to a slow disaster that extended for months after the singular "disaster event" of Sandy was over. The different approaches taken by New York City and the state of New Jersey demonstrate how even two close neighbors, facing similar hazards, may act very differently when it comes to taking seriously the entangled threats of slow disaster and deferred maintenance.

New Jersey Transit (277 million annual rider trips) and the New York Metropolitan Transit Authority (MTA, 1.7 billion annual subway trips) rank among the busiest, and the most vulnerable transportation systems in the nation. Each has been affected in the past by flood-related damage, though direct hurricane hits are rare in the New York City metro region. With documented sea level rise happening along the Eastern seaboard, and following a tremendous 2007 storm causing subway system damage, New York City's Mayor Michael Bloomberg ordered a climate change mitigation study for the MTA. The result was the "MTA Adaptations to Climate Change: A Categorical Imperative report" (2008). The expected impacts of predicted increases in precipitation, heat, and sea level rise go well beyond the normal problems of maintaining the nation's busiest urban transportation system. The study indicates that the MTA to that point had developed no policies to prepare for climate change adaptation, and in order to begin doing so it needed to develop a climate database in order to "provide a sound scientific-technical foundation for making the best strategic . . . decisions as to how to optimally adapt to these forecast climate changes."[3] In a far-sighted observation, the report's authors noted that climate change adaptation—if based in sound data and prioritized—could in fact overlap with regularly scheduled maintenance. "Adaptation," the authors conclude, "occurs on different time scales and is tied to opportunities and risks in an environment with fiscal, political, economic, social, and also technical and engineering processes at work." Without going to the taxpayers for more money, adaptation planning could, it was hoped, address "low hanging fruit" adaptation measures like "increasing pumping and fan capacities for subway and other tunnel operations to achieve greater resiliency to flooding and other environmental hazards."[4] Maintenance, in this mindset, is an opportunity to keep the trains running, and also to prepare for the worst disasters over the horizon.

[3] Klaus Jacob et. al., "MTA Adaptations to Climate Change: A Categorical Imperative," Metropolitan Transportation Authority, 2008, 37.
[4] } Ibid., 40-41.

A Federal Transportation Administration study released in 2011 documents the ways the municipal and state transportation systems had begun to prepare for climate change. New York City's adaptation planning was cited as an example for other cities to emulate. In that same year, Hurricane Irene caused a billion dollars in damage to New Jersey, and 300 million dollars in damage to New York State. Following Irene, New Jersey Transit undertook its own climate change vulnerability study. The report authors conclude grimly that "NJ TRANSIT is already experiencing many of the climate impacts (flooding, excessive heat, larger storms) that are expected to occur in the Northeast over the next 20 years. . . . these patterns are expected to continue and become more frequent and intense over time. The longer term projections . . . indicate that up to 3 percent of New Jersey land mass could be at risk."[5] It is not clear that New Jersey Transit took any clear steps in reaction to the study, at least not that helped when Hurricane Sandy made landfall in October of 2012.

A post-Sandy investigation done by New York City public radio station WNYC has looked closely into the divergent paths taken by the MTA and New Jersey Transit at this critical moment. The WNYC investigation finds that "MTA's plan called for moving its trains out of low-lying yards hours before the storm; each movement was precisely clocked out. And even though the MTA had also never seen storm surges like Sandy, that didn't dissuade officials from carrying out the plan."[6] In New Jersey, Governor Chris Christie was apparently disengaged from pre-storm transportation planning. Despite several days of warning, New Jersey Transit was not able to move its rolling stock out of harm's way. Instead, the Meadows Maintenance Complex and Hoboken yards were used, sites of intense storm surge flooding during Sandy. In the end, the MTA's tunnels were flooded, a costly disaster-within-the-disaster that has initiated

---

[5] First Environment, Inc., "Resilience of NJ TRANSIT Assets to Climate Impacts," 2012, 3-4.

[6] Andrea Bernstein and Kate Hinds, "How New Jersey Transit Failed Sandy's Test," WNYC, 13 May 2013. http://www.wnyc.org/story/292666-njtransit-sandy/

another round of planning efforts to make the subway system less likely to flood. However, only 19 of the MTA's 8,000 railcars were damaged. In New Jersey, 25% of New Jersey Transit's railcars were flooded, at a cost of $120 million. WNYC's scathing analysis concludes that the New Jersey Transit disaster "followed years of missed warnings, failures to plan, and lack of coordination under Governor Chris Christie, who has expressed ambivalence about preparing for climate change."[7]

Is it asking too much for public officials to react quickly when fresh data indicates that the maintenance of public goods like rail systems is now going to require both maintenance AND climate change adaptation to be simultaneous acts? As the case of Hurricane Katrina shows, initial design and construction errors can lie in wait until the right disaster exposes them. An even more disturbing takeaway from Katrina is that the failure to adequately maintain a complex technological infrastructure can be a shared failure stretching out over decades—the slow disaster is revealed only when catalyzed by enough water and enough wind in too short a time. The dual case of New York's MTA and New Jersey Transit demonstrates the political will necessary to layer a new challenge on top of the existing challenges of keeping busy systems running and just keeping up with regular maintenance. Though climate change itself may prove to be the longest disaster in American history, the problem of transforming projected data into real infrastructure policy has not (and will not) play out according to one best practice. Hurricane Sandy has, though, already emerged as a turning point moment. Mayors and Governors across America are being asked: after Sandy what is your plan to prepare our infrastructure for climate change?

Bibliography

Bernstein, Andrea and Hinds, Kate. "How New Jersey Transit Failed Sandy's Test." WNYC. 13 May 2013.

---

[7] Ibid.

First Environment, Inc. "Resilience of NJ TRANSIT Assets to Climate Impacts," 2012, 3-4.

Jacob, Klaus et. al. "MTA Adaptations to Climate Change: A Categorical Imperative." Metropolitan Transportation Authority. 2008: 37.

U.S. G.P.O. A *Failure of Initiative: Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina* (Washington, D.C., 2006): 91-92.