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BRIAN BALKUS • JUNE 9, 2022 • **ARTICLES**

Why America Can't Build

Edgar Guerra/Bixby Creek Bridge, Monterey

The goal of the 2009 Sepulveda Pass Freeway Expansion Project seemed simple. A carpool lane was to be added to reduce congestion on a 10-mile stretch of Los Angeles's I-405 freeway, the second most congested road in the U.S. However, this brought exceptional technical and logistical challenges—the project required carving through a

mountain, demolishing and replacing three overpasses, and moving a 60-year-old street, all alongside a freeway that saw 500,000 commuters daily.

After four years of congestion and construction, and with the project a year behind schedule, Sepulveda was trying everyone's patience. One of the people fed up with the project was Elon Musk. His daily commute to and from SpaceX's headquarters was taking over an hour due to construction delays. He went to Twitter with his frustration and began openly speculating about buying tunnel boring machines (TBMs) to drill under Los Angeles, offering to pay for the cost of adding more workers to the project. When he investigated TBM technology he discovered that it hadn't improved in decades—a snail moves 14 times faster than the best drill. A year after his initial tweet, Musk launched the Boring Company, a tunneling technology company devoted to building TBM that can "beat the snail."

Starting a construction technology company is an unusual response to the frustration caused by infrastructure projects, but another one of his moves was more traditional. He donated $50,000 to a political pressure group to exert influence on the project and speed its construction. The carpool lane was finished in 2014.

Despite political and logistical obstacles, Kiewit, the construction firm overseeing the project, managed some aspects of the project well. The company oversaw a bridge demolition that was completed 17 hours ahead of schedule in an event that the national media had anticipated being a "Carmageddon," due to its potential impact on L.A. traffic.

But this logistical competence masked underlying issues that had doomed the project from the start. When Kiewit first began digging at the site it discovered nine miles of utility lines that its client, Los Angeles Metro, didn't know about. Disaster struck again when a novel vertical retaining wall design began buckling; it turned out that metal straps connecting the panels had broken and the wall had to be demolished. This resulted in a wave of lawsuits and project shutdowns. More lawsuits and pressure would come; a Bel Air landowner's lawsuit forced the redesign of an on-ramp near the Getty Museum while a local group demanded the Mulholland Bridge be redesigned.

This required extensive, time-consuming negotiations that froze the

project, with costly equipment and workers left idle. The relocation of utility lines and redesigned structures added enormous costs. Protecting just one undocumented drainage culvert on the project cost nearly $30 million. All these changes created what Kiewit would later describe in a lawsuit as a "bureaucratic quagmire," with the firm having to double its personnel working on the project to 300 people, just to manage changes and pay for cost overruns.

The construction work itself required ramp and lane closures that were poorly announced by Metro, and its official detours were widely mocked as indecipherable "roads to nowhere" that left motorists lost and stranded. The result was a project that, instead of alleviating traffic, inflicted gridlock on motorists for half a decade.

The Federal Highway Authority's investigation of Sepulveda found that seven of the 13 largest causes of the delays to the project were related to undiscovered utilities. Other Metro oversights include failure to obtain right of way access and mismanaging the design change process. After years of litigation, the L.A. Metro issued a nearly $300 million settlement to Kiewit, stating "frankly there were deficiencies" in how it managed the project.

Sepulveda was completed more than a year behind schedule for $1.6 billion dollars—55 percent over its initial budget. Because it was the result of a series of negotiated agreements with local groups, aesthetically it is an incoherent hodgepodge. In one section a pattern of birds was sand-blasted into the walls after a series of 20 meetings with nearby homeowners. In other sections, plain retaining walls stretching up to the height of a six-story building are in place.

The entire $160 million-per-mile road lane project, and the five years of gridlock it created, were justified by the promise of shaving one minute per mile off commute time for its users. The final indictment of the project was a Metro study that found that Sepulveda had actually made commute times longer.

Inflection Point

Sepulveda's cost and schedule overrun aren't even the worst of it. Just as unattainable as a shortened commute is the Californian dream of building

a bullet train that could take you from Los Angeles to San Francisco in under three hours. In 2008, a year before the Sepulveda project began, the state tried to turn this dream into a reality after voters approved a 512-mile high-speed rail (HSR) project. Amid failing overseas wars and financial crises, at the time it could've become a symbol of renewal not just for California but the entire country. Instead, it came to exemplify a dysfunctional government that lacks the capacity to build.

At the time California began accelerating the development of its HSR system it only had 10 employees dedicated to overseeing what was the most expensive infrastructure project in U.S. history. It ended up 14 years (and counting) behind schedule and $44 billion over budget. Incredibly, the state has not laid a single mile of track and it still lacks 10 percent of the land parcels it needs to do so. Half of the project still hasn't achieved the environmental clearance needed to begin construction. The dream of a Japanese-style bullet train crisscrossing the state is now all but dead due to political opposition, litigation, and a lack of funding.

Despite its failure, the HSR project inaugurated the U.S.'s megaproject era. Once a rare type of project, by 2018 megaprojects comprised 33 percent of the value of all U.S. construction project starts. An alarming number of these have spiraled out of control for many of the same reasons that killed the California bullet train. The decade that followed the financial crisis was a kind of inflection point in the industry; this was when construction projects became noticeably worse and when the long-term implications could no longer be ignored. One of the most cited studies of the U.S.'s declining ability to build reviewed 180 transit megaprojects across the country, revealing that today, U.S. projects take longer to complete and cost nearly 50 percent more on average than those in Europe and Canada.

Having joined Kiewit in 2010, I witnessed these changes first-hand. I have since moved on, but have remained in the broader industry, including working on what are called "strategic pursuits"—the process by which companies compete for megaprojects. This experience has provided insight into the mechanics of how these projects are awarded and why they so frequently fail.

I joined the industry at one of its lowest points in decades. The lifeblood of a construction company is its backlog—that is, contracts it has been awarded but has not yet started. When the backlog runs low contractors

are said to be "hungry," which can result in them accepting risks they normally wouldn't. Following the financial crises everyone was hungry, and Kiewit was no exception. But it was soon awarded a project it would come to regret: the $1 billion Sepulveda Pass Freeway Expansion Project. By the time it was completed, Kiewit faced over half a billion in losses, which would be the worst project loss in the company's 138-year history.

But the failure of these projects has a value of its own. It's representative of the industry writ-large, and of the causes behind the U.S.'s great infrastructure stall.

The Principal-Agent Problem

Kiewit is one of the largest construction firms in the world, and has made its reputation by building some of the biggest and most complex projects in modern U.S. history. Founded by two immigrant bricklayer brothers, its leadership passed down to one of the founder's sons, Peter Kiewit, who grew up on its construction sites. Peter turned a small family business on the edge of ruin after the Great Depression into a construction superfirm. After completing $500 million in projects for the U.S. military over the course of the Second World War, often on seemingly impossible schedules, Kiewit was transformed by the long boom that followed the war. It built everything from large portions of the Interstate Highway system, massive classified military infrastructure, nuclear power plants, to Major League Baseball stadiums.

Today Kiewit is led by around 2,500 people who have been selected to join the ranks of the company's employee-owners. To achieve this status requires working brutal hours for years and demonstrating exceptional commitment and competence. It has also led to the company being run somewhat like a cult. The founding myth of that cult is that it can deliver any project no matter the obstacles.

But it has had multiple megaprojects end in disaster in the years following the financial crises. A company that built its identity around delivering the toughest projects is now regularly failing to do so, with recent Kiewit endeavors like Sepulveda showing us why America can't build anymore. Construction projects are undertaken within a legal and regulatory system that presents persistent, costly obstacles, while projects are being overseen by agencies who lack the resources and in some cases even the expertise to

manage them.

Sepulveda's numerous lawsuits and stakeholder conflicts are an example of a phenomenon that can be traced back to the passage of the National Environmental Policy Act (NEPA) in 1969. NEPA mandates developers to provide environmental impact statements before they can obtain the permits necessary for construction on huge swathes of infrastructure.

Shortly following the passage of NEPA, California's then-governor Ronald Reagan signed the California Environmental Quality Act (CEQA) into law, which required additional environmental impact analysis. Unlike NEPA, it requires adopting all feasible measures to mitigate these impacts. Interest groups wield CEQA and NEPA like weapons. One study found that 85 percent of CEQA lawsuits were filed by groups with no history of environmental advocacy. The NIMBY attitude of these groups has crippled the ability of California to build anything. As California Governor Gavin Newsom succinctly put it, "NIMBYism is destroying the state."

It is also destroying the U.S.'s ability to build nationally. The economist Eli Dourado reported in *The New York Times* that "per-mile spending on the Interstate System of Highways tripled between the 1960's and 1980's." This directly correlates with the passage of NEPA. If anything, the problem has gotten worse over time. Projects receiving funding through the $837 billion stimulus plan passed by Congress in the aftermath of the financial crises were subject to over 192,000 NEPA reviews.

The NEPA/CEQA process incentivizes the public agencies to seek what is often termed a "bulletproof" environmental compliance document to head off future legal challenges. This takes time, with the average EIS taking 4.5 years to complete. Some have taken longer than a decade. A cottage industry of consultants is devoted to completing these documents, earning themselves millions in fees.

The NEPA consultants are just one of the numerous types of consultants that benefit from the way we build. Most infrastructure in the U.S. is built through a huge number of state and local agencies: for example, there are 51,000 community water systems alone in the U.S. This decentralized structure makes it much more difficult to develop the depth of expertise needed to manage the complexities posed by megaprojects. Often, the multiple public agencies that are involved with projects also have

overlapping authorities, creating bureaucratic delays and slowing decision making.

The expertise problem is compounded by the fact that agencies are often staffed with a workforce of people either just at the beginning of their careers or near the end of them. Those at the beginning tend to leave if they are ambitious, which leaves senior positions in the hands of agency lifers. Because of this dynamic, and the fact that it is not economically feasible to have the wide range of expertise needed in-house, public agencies employ engineering consulting firms. These firms fill a valuable niche. If you are building a complex project—say, a long-span bridge or a desalination plant—you want advice from someone who has designed and built dozens of them. The problem arises when you become too dependent on such advice.

The High-Speed Rail project was undermined by such a failure. At its peak, the agency responsible for the project, the California High-Speed Rail Authority, had fewer than 30 permanent employees managing the $105 billion project. Instead of hiring staff, the Authority relied heavily on outside consultants. These consultants were well paid, with the primary consultant compensation for HSR at $427,000 per engineer, compared with the Authority's in-house cost of $131,000 per engineer. This structure creates a principal-agent problem where they are incentivized to maximize their billable hours. As a California State Auditor assessment of the project noted, consultants "may not always have the state's best interest as their primary motivation."

This lack of in-house institutional expertise leads to bad decision-making. Bent Flyvbjerg, a professor at Oxford University who has written extensively about megaprojects summarized the problem when asked about California's HSR project: "If you depend on consultants to know what you are doing then you are in real trouble…a good balance is where the owners are not outsourcing all the knowledge. A bad balance guarantees a bad outcome."

The pitfalls of this lack of balance appeared before large parts of the project began. In 2014, Dragados, the contractor for a 63-mile section of the HSR, proposed radical design changes that they projected could save $300 million. The fact that Dragados's bid was $500 million lower than its competitors and that it rested upon a design concept that had not been

thoroughly vetted should have caused alarm. As a senior engineer who worked on the original environmental compliance document for HSR and reviewed the concepts told the *Los Angeles Times,* "it is mind-boggling they would entertain some of the things that Dragados proposed."

Dragados's approach may have been driven by the fact it didn't have the experience of its competitors; it had never built a rail project in the U.S. before and needed an edge to be selected. It was a measured risk because it knew there were ways to limit its financial exposure if its design ideas didn't work. A *Los Angeles Times* investigation of the project in 2021 found Dragados had issued 273 change orders for additional payment and had completed less than 50 percent of its planned work four years after its section was supposed to be complete. Its design ideas had been almost completely abandoned as unworkable and Dragados's section of the work was $800 million over budget.

The principal-agent problem arises with union construction labor as well. Skilled union workers, such as electricians and carpenters, make solid hourly wages, but their pay really explodes with overtime. A 2011 study by the Real Estate Board of New York found that some union crane operators made up to $500,000 a year in pay. Union contracts mandate unnecessary positions as well, to the benefit of its members. The same study found 50 workers in unnecessary positions such as relief crane operators on the World Trade Center Project, including 14 unproductive employees making $400,000 a year at the project.

Similar statistics can be found on other projects; an investigation into the costs of the East Side Access rail project in New York, which cost nearly $3.5 billion for each new mile of track, found that only 700 of the 900 workers being paid on the project were needed. A TBM, which is largely run automatically and typically staffed with under 10 people, ostensibly had 25 or 26 people working on it. Because you can't drill without a TBM, and you can't build a high-rise without a crane operator, these union workers have inordinate power.

A common retort to the claim that union labor drives up costs is that other countries, especially in Europe, have both high union participation and lower project costs. But it is widely recognized in the industry that unions increase project labor costs by 20 to 25 percent on average in the U.S.

The fundamental problem isn't unions per se, but rather the way that unions operate within parts of the U.S. system. The Netherlands has strong unions, but the Port of Rotterdam has been automated to an extent that has proven impossible in the U.S. due to union resistance. As the president of the International Longshoremen's Association, Harold Dagget, recently put it, his union will "fight tooth and nail" against further automation in the U.S. Any attempt at real construction innovation runs into similar barriers at every level of the system. There are too many layers of permission needed to innovate, including groups whose interests run counter to innovation.

Innovation in physical work ultimately means substituting or complementing labor through technology to improve productivity. If your pay depends on overtime, you want inefficiency. The average dockworker at the Port of Los Angeles makes over $100,000 a year, largely due to overtime. The majority of foremen and managers earn more than $200,000, and the mariners who guide ships in and out of the port average nearly $450,000.

The result is that innovation is inhibited by both labor resistance and a decentralized government bureaucracy that has neither the incentives nor the capability of driving real change. Perhaps it should not be shocking that U.S. construction productivity has fallen by half since the 1960s according to research conducted by the consulting firm McKinsey.

The Future

These twin problems are only getting worse. President Biden has signed executive orders strengthening construction unions and increasing the stringency of NEPA requirements. Meanwhile, consulting firms are already promoting to investors the lucrative opportunities presented by the anticipated wave of retirements at public works agencies. Up to 41 percent of the construction industry's workforce is nearing retirement age as well, and the construction industry has an estimated worker shortage of 650,000 people, partly because many who left the industry following the financial crises never returned.

Meanwhile, trillions of dollars are projected to be spent on the infrastructure needed to decarbonize our economy, address crisis-level drought in the western U.S., and replace aging bridges and highways. These

trends all point to a future where we lack expertise and capacity at every level of the construction industry while regulatory costs only increase.

The result is that the U.S. gets less and less every year for every dollar spent on construction. This means decline.

Should the U.S. ever commit to a developmentalist strategy, it will have plenty of examples to learn from. Between 1995 and 1999, the City of Madrid designed and built 39 new metro rail stations, laid 35 miles of rail—including 23.5 miles which required expensive tunneling—and completed all work at an average cost of $65 million per mile. It has subsequently completed multiple other phases of similar size with similar results.

How did Madrid accomplish this? It used simple modular designs for each station and did not use any new construction techniques, novel engineering designs, or train technology. When tunneling segments, instead of using one TBM as is typical, it deployed up to six at a time—a number previously unheard of. Most importantly, Madrid ran its construction crews 24 hours a day, seven days a week, and achieved consistent worker productivity gains. Reducing complexity and repeatedly building the same simplified design made iterative improvements possible.

This kind of solution isn't as easily copied as it may appear. The reason Dragados's bid was given credibility by the Authority is likely that it is a subsidiary of the company that built the Madrid project. It is one of many European construction giants that expanded into the U.S. market following the financial crises when their home markets contracted.

By selling lower costs and a sophisticated approach that was proven to work in Europe these firms were awarded megaprojects across the U.S. Many of these projects have blown up in similarly spectacular fashion, such as Dragados's HSR project. Meanwhile, U.S. firms have completed megaprojects in Europe and elsewhere at costs that would not be possible in places like New York or California. The problem isn't that Kiewit or Dragados have forgotten how to build; it is that we have made it impossible for even the best builders to succeed in America.

However, not every building environment in the U.S. is the same. Roughly 40 percent of U.S. megaprojects are in New York, California, or Texas. While megaprojects run into issues everywhere, the Texas projects have a

significantly better track record than either of its coastal peers.

Other states have learned from their example. Arizona explicitly studied lessons learned from Texas when building the largest public works project in its history, the $1.7 billion Loop 202 South Mountain Freeway Project. By using a non-standard project delivery approach, this project was completed in 2019 in fewer than 1,000 days, an estimated three years earlier than what would normally be expected. Early coordination between the contractor and engineer ensured that the design issues that appeared on Sepulveda or HSR were avoided, saving the project an estimated $100 million.

Texas and Arizona are both "merit shop" states, which in practice is synonymous with non-union. They also have a much less stringent regulatory environment. As a result, much of our industrial capacity is being built in these states. And these industrial projects are achieving remarkable productivity gains. Per the Bureau of Labor Statistics, productivity in industrial building construction went up 70 percent from the mid-2000s to 2015, even outpacing the productivity growth in manufacturing over the same time.

A prime example is Tesla's recently completed Austin "Gigafactory," a building three times the size of the Pentagon that was completed in 18 months. Like Madrid, Tesla relied on modular construction and other proven methods to increase productivity and speed. These strategies are widely employed on energy and industrial projects in the merit shop states, from semiconductor fabrication plants in Arizona to utility-scale solar projects in Texas. Renewable energy developers often work with the same engineering, procurement, and construction (EPC) companies on repeated projects, enabling iterative learning and productivity improvements on each subsequent project.

In the energy sector, these techniques are being employed on genuinely innovative projects. For example, the energy company Oxy is currently in preconstruction on a $1 billion direct air capture (DAC) plant in Texas. DAC plants remove carbon dioxide from the air and then convert it into concentrated carbon that can be sequestered or re-used. By using modular construction techniques, standardized design, and the same group of project participants, it plans to achieve economies of scale and drive down costs over time.

This approach requires Oxy to know it will likely lose money on the project. It is a $1 billion experiment that has no real parallel to public-sector infrastructure projects. That is because none of the public agencies can afford a costly project it knows will likely fail. Real physical innovation requires a trial-and-error approach and a tolerance for risk and loss.

Historically, the only group in the U.S. capable of this approach has been the federal government. Through the Defense Advanced Research Projects Agency, it funded the research that led to the creation of many of the fundamental technologies of our modern economy, such as the semiconductor. This story is well known, but what is less recognized is that NASA and the Department of Defense were the primary buyers of semiconductors and other computer technology for years. The government funded the creation of the technology and the market, both of which are required for physical innovation.

There are promising technologies emerging that could fundamentally alter how we build. Examples range from quantum sensors which could eliminate the risk posed by unknown underground conditions, to 3D printers that can print everything from the concrete base of wind turbines to structural steel components. But there is no systematic attempt to further these new technologies, invent new ones, or deploy them at scale on real-world projects.

Improving construction productivity requires institutions that can serve the role DARPA, NASA, and the DOD played in the technology industry while simultaneously creating a more permissionless environment for innovation. One approach is to create a state institution to serve this role. Another would be to expand the use of public-private partnerships (P3), the model used to deliver the South Mountain and Madrid projects. The P3 project delivery method has been proposed for multiple hyperloop projects in the U.S. and could enable the creation of public-sector equivalents of Oxy's DAC project.

More recently, geopolitics has forced Germany to act as an example for accelerating the development of new infrastructure. Germany has experienced the same megaproject issues as the U.S. and for many of the same reasons. But facing the urgent necessity of replacing Russian gas, the German government is set to pass a law that will waive procedural requirements mandated by the E.U., including its version of NEPA, to

accelerate the construction of liquified natural gas infrastructure. Sometimes the most innovative thing to do is to just cut through the red tape and build.

Like Germany, the U.S. regularly shows that its current stall is ultimately a political choice. In February 2017, heavy rain damaged the nation's tallest dam, Oroville Dam, creating the risk of catastrophic and deadly flooding in the Sacramento valley. Over 180,000 people living downstream along the Feather River in Northern California were evacuated from their homes. As in the current German case, the risks posed by inaction necessitated a bypassing of the usual rules.

Within 10 days of the damage incident, Kiewit was awarded a contract. A little over two weeks later Kiewit's team and equipment were fully mobilized at the site. After only 165 days Kiewit had brought the dam's main spillway into working condition. It then completed a second phase where it built a 1.2 million square foot spillway—an area so large that 25 NFL regulation-sized fields could fit inside it. The combined project was completed in only 18 months.

When the barriers to construction are removed, the U.S. can still build big things, even in California. Given the U.S.'s resources, excellence in building is a choice. But sticking with the status quo represents another type of choice; it is a decision to accept decline.

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