

The American Interstate Highway System as Infrastructure: A Model Case Study

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Bruce E. Seely

Dean, College of Science and Arts
Michigan Technological University

The term “infrastructure,” which we now associate with the large technical systems upon which modern life depends, initially applied to permanent military facilities such as bases, airstrips, and dry docks. Economists by the 1950s included large-scale public works and utilities (roads, railroads, sewer and water systems, and power grids) in this category, and by the 1990s computer networks and fiber-optic “information superhighways” fit as well. Historians Joel Tarr and Gabriel Dupuy labeled these the “technological sinews” of modern society.¹ Certainly such a description applies to the U.S. National System of Interstate and Defense Highways, which the Federal Highway Administration labeled “...the Greatest Public Works Project in History,” although the Chinese National Trunk Highway System recently may have exceeded the U.S. high-speed express highway network in length.²

The case of the U.S. Interstate system provides a vehicle for examining three general characteristics of infrastructure, concepts that resonate in the existing literature.³ First, That size and scale translates into enormous complexity due to interrelated technical, social, economic and political challenges, making infrastructure prototypical *sociotechnical systems*.⁴ Often years are required to build public support and accumulate

¹ Joel A. Tarr and Gabriel Dupuy, *Technology and the Rise of the Networked City in Europe and America* (Philadelphia: Temple University Press, 1988).

² Quotation from U.S., Department of Transportation, Federal Highway Administration, “History of the Interstate Highway System,” <http://www.fhwa.dot.gov/interstate/history.htm> (accessed June 13, 2014); for data on mileage, see Dr. Jean-Paul Rodrigue, Department of Global Studies & Geography, Hofstra University, “The Geography of Transport Systems,” <http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/interstatemileage.html> (accessed on June 13, 2014).

³ Bruce E. Seely, “The Secret is the System,” *Wilson Quarterly* 32, no. 2 (Spring 2008): 47-49, 51-58; and idem, “The Saga of American Infrastructure: A Republic Bound Together,” *Wilson Quarterly* 17 (Winter 1993): 18-39. Examples of studies of infrastructure include Pat Choate and Susan Walter, *America in Ruins: Beyond the Public Works Pork Barrel* (Washington, DC: Council of State Planning Agencies, 1981); Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present*. Baltimore: Johns Hopkins University Press, 2000; and more recently ASCE, 2013 Report Card for American Infrastructure, <http://www.infrastructurereportcard.org/> (accessed on August 30, 2014).

⁴ This concept was explored in a series of conferences and proceedings volumes inspired by the work of historian Thomas Hughes. See Renate Mayntz and Thomas Parke Hughes, *The Development of Large Technical Systems* (Frankfurt am Main: Campus Verlag ; Boulder, CO: Westview Press, 1988); Todd R. LaPorte, *Social Responses to Large Technical Systems: Control or Anticipation* (Dordrecht; Boston : Kluwer Academic Publishers, 1991); Jane Summerton, *Changing Large Technical Systems* (Boulder, CO.:

the financial resources necessary for constructing these systems. Second, infrastructure systems have long-lived impacts, but often those impacts differ rather significantly from the original visions of the designers and planners. Moreover, because of their size and scale, these systems are difficult to change and they tend to focus future possibilities into specific paths. Third, the benefits of infrastructure networks often are not evenly distributed across society, for elites in the economic order are more likely to enjoy the early fruits of infrastructure projects. The history of the Interstate highway program opens windows that highlight each of these patterns, while at the same time affording insight into how and why the Interstate system evolved as it did. Indeed, with these ideas in mind, we can better grasp the significant differences that we find between the initial goals proposed during the 1930s and the role of these highways into the 21st century.

Interstate Highways as Model Infrastructure

1. Large complex Systems

The most basic feature of infrastructure is their size and cost; these are large projects. Moreover, that scale and scope almost always introduces complicated social, economic and political challenges which can be more difficult to resolve than the more narrowly-defined technical obstacles. Hence these *sociotechnical systems* require significant time to plan and then to construct.

The U.S. Interstate highway system almost perfectly demonstrates these tendencies.⁵ The American highway system, of which the Interstate system is the final component, was not established until 1916; before that only a few eastern states had established road networks. The patterns of the initial system-building efforts have continued to shape the American highway system. These included a federalist governance system of shared financial responsibilities and authority. All construction efforts rest in the hands of state highway agencies, which were required to meet minimum standards for expertise and freedom from political interference. The federal agency (the Bureau of Public Roads, later the Federal Highway Administration) on the other hand focused its efforts on

Westview Press, 1994); Olivier Coutard, *The Governance of Large Technical Systems* (London; New York: Routledge, 1999).

⁵ This section is drawn from previously published work, including Bruce E. Seely, *Building the America Highway System: Engineers as Policy Maker*. ((Philadelphia: Temple University Press, 1987); Mark H. Rose and Bruce E. Seely, "Getting the Interstate System Built: Road Engineers and the Implementation of Public Policy, 1955-1985" *Journal of Policy History* 2 (Winter 1990): 23-56; "Visions of American Highways, 1900-1980," in Hans-Liudger Dienel and Helmuth Trischler, eds., *Geschichte der Zukunft des Verkehrs: Verkehrskonzepte von der Frühen Neuzeit bis zum 21. Jahrhundert*. Deutsches Museum Beiträge zur Historischen Verkehrsorschung, vol. 1. (Frankfurt, New York: Campus Verlag, 1997), pp. 260-79. Other sources include U.S., Department of Transportation, *America's Highways: A History of the Federal-Aid Highway Program, 1776-1976* (Washington, DC, c. 1976); information on the web at U.S. Department of Transportation, Interstate History, <http://www.fhwa.dot.gov/interstate/history.htm> (accessed August 30, 2014). Of special note are articles by Richard F. Weingroff of the Highway Administration in the agency's magazine, *Public Roads*. Links to these articles can be found at U.S., Department of Transportation, Federal Highway Administration, "The Interstate System - History," <http://www.fhwa.dot.gov/highwayhistory/interstate.cfm> (accessed August 30, 2014).

oversight and inspection of state activities, and supported research, shaped standards, and built technical capacity in the state road building agencies. Underlying this federal-aid partnership was the policy assumption that technical expertise – i.e., engineers -- was more efficient than the decisions of elected political figures. Therefore the enabling legislation directed that the states focus federal-aid funds on a limited network of roads linking the leading population centers rather than the entire network of more than two million miles roads (in 1916).

By the end of the 1920s, the results of this approach to road building was evident in steadily improving standards of construction in the states, increasing levels of research, and the general completion of most of the federal-aid network of 170,000 miles of primary and secondary federal highways in the states. But highway departments also faced challenges posed by rapidly growing numbers of motor vehicles, most notably finding funds to pay for the road building program. The gasoline tax soon addressed this issue, as every state collected gasoline taxes by 1930. The other big challenge was traffic congestion within cities, which were not included in the federal-aid program or most state systems. The leadership of the Bureau of Public Roads began working with state officials in Michigan to institute a process of data gathering that could be translated into maps showing the areas of greatest traffic and need. By 1937, this approach to state-wide highway planning surveys was being instituted in every state, paid for with federal-aid funds. The data from this initiative provided the foundation for the Interstate system.

The data became available just as the U.S. Congress was debating the creation of a system of express highways modeled on the German *autobahnen*, primarily as a means of combating unemployment. Several Congressmen envisioned a network of express highways consisting of five to six north-south highways and three to four east-west routes. But the statewide planning survey data suggested little need for cross-country highways. Railroads remained the primary carriers for long distance freight traffic, with trucks functioning as local haulers within 50 to 150 miles. Railroads were losing passengers quickly to automobiles, but highway congestion in urban areas was the most pressing problem facing highway engineers, not transcontinental service. Because federal and state planners already were straining to meet existing needs, they rejected the German approach of building roads in advance of demand. Autobahn-style express roads in the country side seemed extravagant, so BPR engineers proposed an alternative system of about 38,000 of improved highways located with an eye to traffic needs – including in cities. The map the BPR released in 1937 in a famous report titled *Toll Roads and Free Roads* laid out their vision; it provided the first draft for the Interstate system.⁶

The outbreak of World War II temporarily halted efforts to implement the 1937 plan. But planning for the postwar period accelerated by 1943, with roads identified as an important element in the strategies designed to prevent a return to the Depression. In 1944 Congress approved legislation modeled on the BPR's 1937 vision, creating a

⁶ See "Der americanishe Blick auf die deutschen Autobahnen. Deutsche und americanische Autobahnbauber 1930-1965," *Werkstatt Geschichte* 21 (December 1998): 11-28; also H.S. Fairbank, "Statewide Highway Planning Surveys," *Civil Engineering* 7 (March 1937): 178-81; and *Toll Roads and Free Roads*, House Document, House Doc. No. 272, 76th Congress, 1st session, April 27, 1939.

system of about 40,000 miles. The plan was to construct highways matching the scale of traffic, so lightly-traveled roads in many western states were planned for two lanes. Multi-lane express highways were envisioned only in high traffic areas – read cities. In 1947, the states and the BPR agreed upon a map of the network, reserving about 2,500 miles for routes into and through cities. However, no funds were authorized for the new roads in 1944. Congress then tied itself in knots for more than a decade, debating how to fund this large road network. Not until 1952 was the first small appropriation approved -- \$25 million, a drop in the bucket. Moreover, other highway systems at the federal and state level also needed attention as a flood of traffic exploded onto postwar roads. But it simply appropriating more money was not, by itself, the answer. Many states were increasingly unable to find the required dollar-for-dollar match of federal-aid funds. As total federal-aid funding rose from \$675 million toward \$800 million annually in the late 1940s, this problem became acute. A few Eastern states sold bonds backed by toll receipts to initiate construction of a few high-speed roads modeled on the Pennsylvania Turnpike (itself opened in 1940 using work relief funds). And New York, California, Illinois and Michigan were leaders in initiating urban freeway projects. But most states made no progress on the Interstate program.

Not until 1956 would Congress agree upon a funding and construction plan. In this case accepting concepts developed primarily by federal highway engineers. Key features included a plan to place all tax revenues collected from gasoline sales and other levies on motor vehicle users into a highway trust fund only for road construction. The funds were restricted to the 41,000 mile Interstate system, which would consist of high-speed express highways running from rural areas into the cities. As importantly, the trust fund removed the annual struggle legislators had faced to find the funds for road building. The initial price tag of \$25 billion still caused some concern, but Congress was assured the funds would be there when needed by road builders. The trust fund thus removed most of the political baggage that had hindered passage of funding legislation. Moreover, the revenue was sufficient to remove the key impediment on the states, and Congress now required states to match only ten percent of the cost of the Interstate program, and states in the west with significant federal lands had to provide even less.

Over the next 25 years, the system of 42,500 miles grew through piecemeal congressional actions to a total of more than 47,000 miles.⁷ The great majority of the system was completed by 1980, by which time these roads had become the fundamental artery of the nation's transportation system. Numerous technical issues were resolved in the course of building these roads, with a key development being the mechanization of construction by private machinery producers and contractors. Ohio lead the way in implementing the use of photogrammetry, which utilized aerial photographs to simplify route planning and location. Most states introduced standard bridge designs and adopted standard pavement specifications that sped construction and eased oversight and inspection. Safety became an important part of the design process for the first time in the form of lighting, guard rails, lane dividers and many other elements. Most importantly, roads were designed for

⁷ Additional information for this section from Mark Rose and Bruce E. Seely, "Getting the Interstate System Built: Road Engineers and the Implementation of Public Policy, 1955-1985" *Journal of Policy History* 2 (Winter 1990): 23-56.

high speeds, with gentle curves and slight grades, even in urban areas despite the area of land this approach required. As a result, the Interstate network, which consisted of one percent of the nation's road system, carried almost 25 percent of the nation's traffic.

A great many elements of this historical sketch match nicely the general patterns of infrastructure systems. First, it took a long time to develop this network of high-speed highways. Plans were being developed in the 1930s, which provided the basis for political approval of the system in the mid 1940s. But political turmoil over funding in the immediate postwar years delayed large-scale construction efforts until significant financial and political innovations in the mid 1950s finally permitted large-scale construction activity. These political and economic challenges were at least as challenging as the technical issues. Even then, the work took longer than the original plan of fifteen years, and the cost was significantly greater than estimated. Construction started quickly in the late 1950s, but many state highway departments were not prepared to design or manage projects at the higher standards of Interstate roads. By 1960, 10,000 miles were completed and another 10,000 miles were open by 1965. In 1970, 30,000 miles were in use, but more than a decade was required to complete the final 10,000 miles. And the last section of I-70 through Glenwood Canyon in Colorado was not completed until October 1992. By that time, many sections of the original routes had been rebuilt, and the original \$25 billion price tag had increased to \$114 billion in nominal dollars - \$425 billion in 2006 dollars. In sum, the Interstate network is the prototypical large technical system.

2. Long-lived Impacts

The second pattern of infrastructure programs is the way their impacts are not just large, but long-lived. This is because the systems are not moveable or easily changed. Therefore these systems tend to guide possibilities along particular pathways. Yet it is also true that the benefits of these systems often differ from those envisioned by the original designers and planners, as later users find new and innovative ways to utilize these technical networks.

Again, the Interstate highway network matches this pattern very well. I have already noted that these roads became the most heavily-used element of the U.S highway system. Their existence clearly enabled the emergence of long-haul trucking as a direct competitor to railroads, furthering the problems private sector railroads had been encountering for some time. Importantly, the Interstate program did not cause this general reliance upon the motor vehicles in some deterministic fashion. Rather, it is more accurate to see the road system as a reflection of the American public's deep acceptance of the automobile. Similarly, in urban areas, the combination of expressways and airports advanced the prospects of commercial aviation in the postwar period. But once the system was in place, it became difficult to move away from the decisions that had been locked into concrete and steel. These highways locked society into certain ways of doing things.

Some of these deeper impacts of the Interstate program can be found in the geographic and spatial patterns that emerged after the construction of the road system.⁸ The Interstate highway system did not *cause* the suburban development in the vicinity of American cities. These communities had originally emerged after the introduction of street rail systems in the 1890s. But Interstate highways definitely facilitated the movement of people to these new communities marked by low density housing and a reliance upon automobiles rather than public transit for access. Indeed, this became the postwar norm in most U.S. cities, once Levittown on Long Island near New York City proved the concept, as it were, in 1947. During the 1950s Los Angeles quickly became the epitome of this new pattern of suburban sprawl and commuting distances up to 100 miles. Atlanta and Houston, among others, followed this pattern at slightly later dates, although not to the extreme of Los Angeles. Houston, in fact, exists without a central downtown as it has developed several nodes of commercial and retail activity.

A plethora of social and economic changes accompanied this reorganization of the city and the shift to the suburbs. For example, the enclosed suburban shopping mall, growing out of earlier strip malls and outdoor shopping centers, quickly became the preferred venue for retail activities after the concept was pioneered in the Midwest in the mid 1950s. Architect Victor Gruen was the key figure after he designed the first regional (i.e., larger) shopping complex, the Southdale Center in Edina, Minnesota in 1956. His model spread quickly, as his firm designed at least 50 shopping malls. Other changes showed the same pattern of locating activities in places accessed mainly by automobiles. Fast food restaurants and motels were two other examples of the emerging automobile culture that Interstate roads facilitated. Many retail operations began to gravitate to Interstate exit ramps, especially at the intersection of two Interstates. Indeed even outside of cities it rapidly became apparent that the presence of an Interstate access ramp was crucial to the growth and perhaps the survival of a community. In all of these ways, then,, Interstate highways became shapers of economic and social activity.

But as exciting as these developments were to suburban residents – and suburban property owners – they generated a very different response among many planners and

⁸ Christopher Finch, *Highways to Heaven: The Auto Biography of America* (New York: HarperCollins Publishers, 1992); George Ritzer, *The McDonaldization of Society* (Thousand Oaks, CA: Pine Forge Press, 2004). On malls in particular, see James L. Farrell, *One Nation under Goods: Malls and the Seductions of American Shopping* (Washington, DC: Smithsonian Books, 2010); and Jeffrey M. Hardwick and Victor Gruen, *Mall Maker: Victor Gruen, Architect of an American Dream* (Philadelphia: University of Pennsylvania Press, 2004). John A. Jakle and Keith A. Sculle have been studying the spatial and physical aspects of the American roadside for two decades and have authored several important books on the different physical presences there. See *The Gas Station in America* (Baltimore: Johns Hopkins University Press, 1994); *Fast Food: Roadside Restaurants in the Automobile Age* (Baltimore: Johns Hopkins University Press, 1999); *Lots of Parking: Land Use in a Car Culture* (Charlottesville: University of Virginia Press, 2004); *Motoring: The Highway Experience in America* (Athens: University of Georgia Press; Chicago: In Association with the Center for American Places at Columbia College, Chicago, 2008); *The Garage: Automobility and Building Innovation in America's Early Auto Age* (Knoxville: The University of Tennessee Press, 2013); John S. Jakle, Keith A. Sculle and Jefferson S. Rogers, *The Motel in America* (Baltimore: Johns Hopkins University Press, 1996); and John A. Jakle, *Signs in America's Auto Age: Signatures of Landscape and Place* (Iowa City: University of Iowa Press, 2004).

urban officials.⁹ Indeed, urban business groups and elected officials had been among the strongest supporters of the Interstate program, but now they watched with horror as their hopes withered. Central business districts, the members of chambers of commerce had hoped, would benefit from the easy access Interstate expressways afforded to downtowns. Even as city dwellers flocked to the suburbs, urban retailers confidently predicted that the new roads would permit the owners of those new single-family homes to shop at the showcase department stores within the urban core. Cities promoted the expressways, often in combination with redevelopment programs (i.e., slum clearance and removal) as the salvation of cities. Alas, their hopes were remarkably off base. In city after city, the movement of residents to the suburbs largely marked the end of their attraction to downtown business districts. Why struggle to drive downtown, fight traffic on congested city streets, and find an expensive parking place when the glistening new malls offered acres of free parking near many stores under one roof? City after city saw downtown department stores close and move to malls, turning cities into shells of their former selves; economic vitality shifted to the suburbs. By the mid 1960s, city centers were marked by empty stores and blighted residential areas.

This was only one of the unanticipated consequences associated with the emergence of the Interstate network, for shopping was not the only activity that moved out of congested center cities. Trucking companies found that locations at the intersection of major Interstate routes were much more convenient, as freight movement shifted from railroad stations. Indeed, by the 1980s large firms that today emphasize logistics – United Parcel and Federal Express, for example -- deliberately situated themselves at Interstate locations near airports and rail links, allowing them to choose the best transportation mode for the service. This possibility of multimodal transportation services that had been long discussed, but they became possible only when a new landscape of de-regulated rail and truck service took shape after 1980. But the Interstate system became the crucial connector of all forms of transport. Similarly, in the 1990s the first e-retailers grafted their business models onto this superstructure, as Amazon took advantage of the Interstate system to deliver packages on a next-day basis to computer-based shoppers. Various accounts celebrated the importance of fiber optic communication systems in allowing these developments, which ironically now threaten the viability of the malls opened in the 1950s and 1960s. But in fact, the capacity of the Interstate system to serve this new business model is an often overlooked aspect of on-line shopping.

This review only scratches the surface of the impact of the location of the Interstate highway system. The family vacation in a packed car became a reality for millions of middle class suburbanites, spawning the explosion of campgrounds, motels, and other elements of modern leisure life. Few Americans can imagine traveling anywhere without using Interstate roads; areas without access to the Interstate truly seem to exist off the beaten path. All of this indicates the ways in which large infrastructure networks become essential to economic and social life, foreclosing options in the process. Despite the arguments of some conspiracy theorists, urban streetcar systems did not disappear from

⁹ Information for this section from *The States and the Interstates: Research on the Planning, Design, and Construction of the Interstate and Defense Highway System* (Washington, DC: American Association of State Highway and Transportation Officials, 1991).

American cities because of a plot by General Motors to sell more motor busses. The story was much more complicated than that. Low-density suburban neighborhoods were not well suited to any railed transit system and even busses seemed ill-suited to meeting the needs of residents. The urban expressways developed with federal funds reinforced the economic obstacles that urban transit systems faced, but the reality was that American culture celebrated the freedom of the road as defined by ownership of an automobile. Thus the Interstate confirmed the tendency of infrastructure networks to shape future developments in ways obvious and subtle.

3. Benefits Unevenly Distributed

The final pattern of infrastructure projects is the tendency of these systems to deliver their impacts unevenly. There is nothing earth shattering in this assertion, for most new technologies spread through society from those first able to afford them to later adopters who access technical possibilities only after prices and other barriers are removed. The Interstate program offers a number of particularly clear instances of such uneven benefit distribution.

The most obvious examples of disparities in terms of the benefits and costs of the Interstate program can be found in the cities. Even before funding for Interstate projects became available, federal officials and their municipal counterparts began urban renewal projects in the late 1940s and early 1950s, the term serving as a euphemism for slum removal in many cases. Pittsburgh's efforts in these areas were among the most celebrated in the country, as the city successfully cleaned up the air and then built showcases such as the Golden Triangle at the confluence of the Monongahela and Allegheny rivers. The Interstate program provided another source of funds for urban renewal projects, for road builders had quickly discovered that the land they needed for their roads was much less expensive in blighted areas. That many municipal political and business officials sought to remove these neighborhoods anyway made them willing allies of the road builders' plans. Robert Caro's biography of Robert Moses describes how this quintessential planners and builder operated in the nation's largest city, but by the 1960s the connection between urban freeways and redevelopment – another euphemism for slum clearance – was well established.¹⁰

But the outcome of the urban renewal process should not be considered a surprise, compared to the unexpected impact that Interstate highways had on urban business districts. Poor and black residents on the margins of society most commonly found themselves in the paths of the new highways in many American cities. The reason was straight-forward from the roads builders' perspective. By the late 1950s, highway engineers were under pressure to build highways to meet the needs of motorists irritated at traffic congestion. And as drivers demanded more roads yesterday, Congress investigated the seemingly slow start of the road construction program in the late 1950s. The pace of construction was slowest in the cities, ironically where the congestion was often the worst. This was not surprising, as the challenges facing urban expressway builders were the most daunting. But public pressure and Congressional hearings added

¹⁰ Robert A. Caro, *The Power Broker: Robert Moses and the Fall of New York* (New York: Knopf, 1974).

urgency to state highway department efforts to advance construction efforts. As a result, many highway engineers and elected officials alike chose to place little emphasis upon public hearings or other means of gathering input from residents. Moreover the cost of land in the cities prompted all planners to look at blighted neighborhoods not only as eyesores but also as prime locations for locating urban freeways. Thus a combination of motives helped shape road building work in the cities. As historian Raymond Mohl notes in perhaps the best overview of the impact of the Interstate program on the cities, "In retrospect, it now seems apparent that public officials and policy makers, especially at the state and local level, used expressway construction to destroy low-income and especially black neighborhoods in an effort to reshape the physical and racial landscapes of the postwar American city." By the 1960s, according to Mohl, 37,000 housing units per year were being destroyed to build the Interstates and planners assumed a total of 1,000,000 people would be displaced by the time the system was completed. As early as 1957, a federal housing official observed with dismay, "It is my impression that regional personnel of the Bureau of Public Roads are not overly concerned with the problems of family relocation."¹¹ Not surprisingly, historian Mark I. Gelfand commented that "No federal venture spent more funds in urban areas and returned fewer dividends to central cities than the national highway program."¹²

Carol Hoffecker has described how this process worked in Wilmington, Delaware, as the highway department proposed scenarios for three different routes. One cut directly through low-income neighborhoods of blacks and Polish-Americans; another bisected upper-class communities; the third completely skirted the city in marshland east of downtown. The last was rejected out of hand for failing to bring people into the city; the second was never seriously considered for political leaders knew that the well-to-do residents would not stand for a road through their areas. That meant Interstate 95 cut through the inner city, although few of those affected understood what was happening. Especially tragic were the loss of schools and churches that had provided a focus to these communities. And the quarter mile wide highways acted as imposing walls, cutting resident off from each other. Later the bypass east of town was added to allow long-distance drivers and truckers to completely miss the city center, but the upper-class neighborhoods were never touched by Interstate highways.¹³

Eventually, however, resistance to road building began to spread beyond poor neighborhoods. Public intellectual Lewis Mumford used newspaper opinion pages and essays in leading magazines to launch a steady drumbeat of complaints about the impact of highways on cities and urban life; many of these were assembled into his collection,

¹¹ Raymond Mohl, "The Interstates and the Cities: Highways, Housing, and the Freeway Revolt," Research Report, Poverty and Race Research Action Council, 2002, pp. 3-4.

¹² Mohl, "The Interstates and the Cities," p. 1; quotation from Mark I. Gelfand, *A Nation of Cities: The Federal Government and Urban America, 1933-1965* (New York, 1975), 222.

¹³ Carol E. Hoffecker, *Corporate Capital: Wilmington in the Twentieth Century* (Philadelphia: Temple University Press, 1983).

*The Highway and the City.*¹⁴ Other critics followed with sharp critiques with snappy titles such as the *Pavers and the Paved* and the *Highwaymen*. But eventually the most successful arguments against road building came from the strengthening environmental movement of the mid to late 1960s. Part of the resistance came as a result of the manner in which highway engineers found that parks and other environmentally sensitive areas were almost as suitable as blighted neighborhoods for roads, from a land acquisition perspective. Taken together, the opposition to road construction -- the first serious resistance ever -- crystallized into a “Freeway Revolt.” It was focused in the cities at first, but soon protesters devoted attention to areas of environmental beauty and significance; resistance to road programs began to gain traction by the end of the 1960s. The era of NIMBY – not in my backyard --- had arrived. The result was nasty court fights in New Orleans, Boston, Philadelphia, Washington, DC, and most notably in San Francisco, that produced a string of court rulings against the road building projects, in some cases stopping them completely. Building upon those rulings were legislative initiatives, such as the National Environmental Policy Act, that mandated environmental impact statements and public hearings concerning any project using federal funds, altered the landscape of highway planning and construction. A pivotal response by politicians to the public outcry was to remove engineers from control of the nation’s road building programs. The man who had spearheaded the fight against the inner Interstate ring in Boston became head of the Massachusetts Department of Transportation in the early 1970s. A journalist assumed control of the Mississippi highway program, and governors who had always before favored roads, such as Richard Lamm in Colorado, began to tell road engineers that their plans were not going to get built. At the federal level, political appointees replaced engineers as the key policy makers in the Federal Highway Administration. Indeed, only two engineers have ever headed the Department of Transportation itself.¹⁵

But how much had these efforts really changed the Interstate highway system? Certainly a public policy process was in place that allowed citizens to have a louder voice in the details of the highway programs. The programs therefore seemed more responsive to the wishes of citizens, especially as environmental regulations required attention to many more factors in determining highway construction plans. Indeed, many younger engineers consider the later Interstate projects, such as the section of I-70 through Glenwood Canyon in Colorado, to be much better technical designs precisely because the engineers and designers considered a wider array of factors. Road engineers tended to be less satisfied that the highway trust fund could be “diverted” to the construction of bicycle paths or highway beautification; older engineers resented the longer planning process that also increased overall costs. But by the 1970s, the entire approach to road

¹⁴ Lewis Mumford, *The Highway and the City* (New York, Harcourt, Brace & World, 1963).

¹⁵ See Raymond A. Mohl, “Stop the Road: Freeway Revolts in American Cities,” *Journal of Urban History* vol. 30 (2004): 674-706; *idem*, “The Interstates and the Cities: The U.S. Department of Transportation and the Freeway Revolt, 1966–1973.” *Journal of Policy History* vol. 20, no. 2 (2008): 193-226; also James J. Casey, Jr. and Howard Rosen, *The Politics of Congestion: The Continuing Legacy of the Milwaukee Freeway Revolt* (Kansas City, MO: Public Works Historical Society, 2000); also Helen Leavitt, *Superhighway – Super Hoax* (Garden City, NY, Doubleday, 1970); and Albert Benjamin Kelley, *The Pavers and the Paved* (New York: D.W. Brown, 1971).

work had been altered by the new rules and the diminished place of engineers and technical experts in the implementation of American highways. Ironically, the drive to quickly build Interstate roads into cities created opposition from citizens who had usually before supported road construction. The strategy backfired almost completely, changing the entire political landscape of road building in the U.S. The era of engineering dominance in the American highway program was ended.

But while designs were changed and wider public considerations about participation, and the importance of environmental concerns were brought into the view of highway planners, the overall impact of the Interstate program was largely unchanged. The fact of the matter is that the transportation system of the U.S. continues to rest primarily upon the automobile and motor vehicles. In many communities, the car is the only option for many residents. Rail passenger service is gone from most communities and seems unlikely to return. Intercity bus services is equally spotty. Even sidewalks for pedestrians are not found in many communities; bicycle paths and bicycle lanes remain unusual elements of urban transport systems. It is true that some alternatives, such as transit and light rail have gained a foothold in federal policy with separately funded programs. But the fact of the matter is that the funding for highways and that for alternatives is in no way comparable. American transportation spending is still deeply tied to the automobile.

None of this is the fault of the Interstate system, and the specific outcomes identified here are not the result of deliberate efforts on the parts of the engineers and policy makers who started the U.S. on the path to building a high-speed highway system in the 1930s. But this rapid historical sketch of the Interstate programs suggests that in many ways, ranging from size and scale, the length of its development and construction, to its deep impacts on cities and differential benefits to residents constitutes the perfect example of infrastructure. Just as cities were reshaped in the 1960s under the combined impetus of urban renewal programs and Interstate construction, so has the nation's transport network been defined and constrained in many unintended ways by the decisions to build the Interstate network. But perhaps the final analysis, the fact that the system remains so tightly tied to the automobile despite concerns and complaints confirms the enormous inertia of infrastructure systems. This may be one of the most important insights about the nature of infrastructure.