Forecasting Travel in Urban America

The Socio-Technical Life of an Engineering Modeling World

By: Konstantinos Chatzis

Citation:

Forecasting Travel in Urban America: The Socio-Technical Life of an Engineering Modeling World
By: Konstantinos Chatzis
DOI: 10.7551/mitpress/10359.001.0001
ISBN (electronic): 9780262374521
Publisher: The MIT Press
Published: 2023

The MIT Press

1 Counting and Forecasting Traffic in the Interwar Years

The American City and the Traffic Predicament

In 1900, there were only eight thousand or so registered motorized vehicles on American roads. At that time, they were probably viewed with amused tolerance, and treated both as an object of curiosity and a plaything for the rich. Very soon this was a thing of the past and two decades later the United States could pride itself on displaying one motorized vehicle for every 7.8 Americans aged fifteen years and over, a figure rising to a spectacular 3.2 ten years later. With such numbers on the rise,[1] it was obvious to everyone that the automobile was no longer the preserve of the wealthy, and it was already a cause for serious concern. As the numbers of motorists, essentially white men but also a small minority of women and black people,[2] steadily grew, stiff new demands were placed on existing urban streets. Having been designed for a carless landscape, the American city proved, more often than not, unable to respond adequately. As a result, from the early 1910s on the specter of congestion started haunting urban America. In 1913, New Yorkers suffered twice-daily traffic jams, and the situation had gotten so bad a decade later that, despite an increase in vehicles, the number of trips per auto was actually down.[3] "The traffic problem of New York . . . is the problem of all our cities," argued an observer in 1916. Furthermore: "Los Angeles feels it; it is an acute issue in Chicago; both are simply representative of dozens of other cities in which congestion, narrow streets, and automobiles have created a situation that requires a drastic remedy."[4]

Yet, congestion was not the only footprint of the automobile on the interwar urban landscape. Motorized vehicles very soon sadly distinguished themselves as an efficient deadly weapon as well. By 1915, automobiles slew 659 people in New York, comparing therefore extremely "favorably" with murder (260 people),[5] while some fifteen years later the death toll from motor vehicle accidents had risen to 32,929, a number that included 5,081 children.[6] Judged by any standards, these figures were definitively unbearable even for a "tolerant people" ready to express "willingness to suffer for the sake of progress."[7]

And there was more. As downtown traffic jams became more pronounced, and parking problems kept worsening,[8] numbers of businessmen in the central business district (CBD)[9] followed in the footsteps of many fellow downtown-dwellers by making themselves into suburbanites,[10] and experimented with new locations outside the city center.[11] This automobile-related exodus from downtown would in turn upset people who had financial interests in the central city as they saw the value of their properties dropping. And since most American cities of the time critically depended on their CBDs to feed the municipal budget with taxes, local politicians and urban managers also considered with much anxiety an eventual economic devitalization of the city center.[12] The auto industry also feared congestion, especially when sales began to fall by the end of 1923 for the first time.[13] In the early 1920s, the federal government also began to envision congestion and accidents as an economic disease to be treated imperatively. And as the car proved to be a material object, massively causing injuries and deaths, people with the professional habit of reading human lives through the cold language of numbers, namely insurers, were also seriously worried about the compensations they had to pay.[14]

In the 1920s, a wide range of "relevant social groups"[15] were variously confronted with the new car-induced urban landscape. Undoubtedly, the interests at stake were diverse, and the precise nature and intensity of concerns and worries expressed greatly differed from one group to another. Yet, a common sense of urgency about the need to take energetic action against the adverse effects of motorized vehicles upon the American city would take hold of them all.[16]

The New Science of Traffic Engineering

Belief in the capacity of science to solve all kinds of problems, and to produce "the greatest good for the greatest number"[17] was a lasting legacy of the period known as the Progressive Era (ca. 1895–ca. 1920).[18] Unsurprisingly, it was therefore to science that a nation, gravely concerned with the problems caused by the massive introduction of motorized vehicles in its major cities, would turn for help. Designated *traffic engineering*, the new science, immediately charged with the task of fulfilling the "two-fold purpose of facilitating movement and avoiding accidents,"[19] had no difficulties in finding people to serve it.

On the "supply side," both American universities and colleges were producing increasing numbers of graduates specializing in the various branches of engineering.[20] On the "demand side," there was a host of potential employers ready to listen to the claims and willing to enlist the services of professionals able to address traffic issues. As a matter of fact, starting from the late 1910s on and throughout the interwar period, many chambers of commerce, automobile clubs, car dealers, and public transport companies throughout the country regularly funded urban traffic surveys and other actions aimed at curbing congestion and accidents.[21] In addition to these local actors attached to a particular city or region, several nationwide stakeholders, including the National Automobile Chamber of Commerce, established in 1913, the Automobile Manufacturers Association (1911), the Automotive Safety Foundation (1937), and the insurance industry[22] would also systematically employ traffic engineers.

Besides working on a more or less permanent basis for large private actors, traffic engineers could also, following in the footsteps of urban planners,[23] establish themselves as private consultants, or sell their labor power to the first traffic engineering firms. Harland Bartholomew and Associates, set up in Saint-Louis in 1919,[24] and De Leuw, Cather & Company, founded in Chicago,[25] were among the first American consultancies specializing in traffic engineering. They would play, especially the second one, a significant role in the blossoming of urban traffic forecasting in the post–World War II years.

Not being content with playing second fiddle to the private sector, very soon all levels of government would also distinguish themselves as a home to traffic engineers. Hired by the city council of Pittsburg at the end of 1924,[26] Burton W. Marsh (1898–1989), a civil engineer who graduated from Worcester Polytechnic Institute and with a supplementary year of study at Yale University, is believed to have been the first full-time city traffic engineer in the United States.[27] In 1930, obviously enchanted by the prospect of seeing his salary shifting from $5,000 to $7,500, Marsh decided to change employer, and headed for Philadelphia.[28] There he worked for the city till 1933, before embarking on a thirty-one-year career at the American Automobile Association in Washington, DC. Marsh's case was not unique. By 1928, a dozen American cities had already resorted to the services of traffic engineers,[29] while some twenty years later there were more than eighty metropolitan areas and about a dozen counties employing this new sort of technical expert or having set up traffic divisions.[30]

It was through the Bureau of Public Roads, established in 1893 as the Office of Road Inquiry, that traffic engineers became members of the federal administration family.[31] In the middle of World War I, reflecting the emphasis that the Progressive Era reform movement placed on technical expertise, Congress passed the 1916 Federal-Aid Highway Act, which committed federal money to building rural roads for the first time.[32] Under the terms of the act, the states were charged with designing, building, and maintaining roads adapted to the new automobile era, whereas the BPR was vested with the authority to set technical standards while inspecting and approving plans, specifications, and construction. In order to perform its new missions, the federal agency began to expand, and, in April 1930, the permanent staff of the organization amounted to 976 persons, including 461 engineers.[33] States were also obliged to have a competent highway department in order to qualify for participation in the federal aid program.[34] By 1922, all state highway departments along with the BPR had joined the American Association of State Highway Officials (AASHO),[35] which was set up in 1914 with the purpose of providing mutual cooperation and assistance to the state highway departments and the federal government.[36] In 1921, a new Federal-Aid Highway Act shifted the emphasis from rural mail delivery to a national network of primary and secondary roads between cities while consolidating the partnership between the federal government and the states on the basis of a mutually accepted division of labor. Thus, state highway departments would continue being responsible for providing facilities for the use of vehicles, and the BPR, which in the early 1920s set to work on making itself into a research powerhouse in highway engineering,[37] would apportion the federal aid money among the state highway departments, approve their plans, supervise their projects, and provide state engineers with intellectual guidance based on "the best of the results of its researches, studies and efforts periodically."[38] Following the two acts, the BPR and, especially, the state highway departments hired a significant number of traffic engineers.[39] As a result, at the moment when the United States was about to engage in World War II, nearly 40 percent of the 580 or so traffic experts identified by Maxwell Nicoll Halsey (born in 1902), a graduate of the University of California at Los Angeles and Harvard University and a leading figure in the field of traffic engineering in the interwar period, were working for state highway departments.[40]

It would have been astonishing if this growing demand for traffic engineers in both the private and public sectors had not prompted the national academic system to react.[41] Traffic engineering seems to enter American higher education in 1920, when the University of Michigan offered a graduate course called Highway Transport Legislation and Traffic Regulations. At the turn of the 1930s seven universities at least, including MIT, were offering semester courses in traffic engineering, some of them on a graduate basis, while many others were providing some limited instruction in traffic engineering in connection with courses in highway and transportation engineering or city planning. Two-week intensive courses and conferences lasting for several days were also held at various places and at different points in time.[42]

In the midst of all these courses and conferences a specific organization stood out. Four years younger than the Eno Foundation for Highway Traffic Control established by William Phelps Eno (1858–1945) in 1921,[43] the Bureau for Street Traffic Research (BSTR) would very soon transform itself into a nationwide beacon of traffic engineering education and research.[44] The BSTR was originally set up at the University of California at Los Angeles in the summer of 1925 by Miller McClintock (1894–1960), the first Ph.D. holder in the field of traffic science.[45] Thanks to a grant of $10,000 received from Studebaker, the then well-known car company, McClintock and his research center moved to Harvard University in the same year. In 1938, the BSTR relocated again, and it was now housed by Yale University. While from 1926–1936 its one-year training program was on a graduate research basis only, starting from the academic year 1936–1937 formal traffic engineering courses were also given—there were five on offer in 1939–1940. By June 1939, the BSTR had already trained seventy-five men through its one-year graduate program, and approximately one hundred other people already in office were trained through its short courses established in the mid-1930s.[46] Bankrolled by various nongovernmental actors, the bureau was transferred in 1968 to Pennsylvania State University. Before it was eventually dismantled a dozen years later for lack of funding, it would produce some of the first manuals in the field,[47] and turn out 823 traffic engineers and transportation planners,[48] among them several famous urban travel forecasters in the post–World War II period (chapter 2).

Undoubtedly the major academic institution in the field of traffic engineering till the early 1950s, the Bureau for Street Traffic Research, which had been renamed the Bureau of Highway Traffic when it was housed by Yale University, would quickly become part of a wider network of actors aiming to promote research and efficient practices in highway and traffic engineering. The appointment of Thomas Harris MacDonald (1881–1957), a graduate of Iowa State College in civil engineering in 1904,[49] as head of the BPR in May 1919 would play a decisive role in the constitution and action of this network. In addition to cultivating the research potential of the organization he faithfully served for thirty-four years, MacDonald would actively participate in the creation of the Highway Research Board (HRB) in 1920 while figuring among its key backers over many years.[50] Bringing together all actors, both public and private, that mattered in transportation engineering at that time, HRB was eventually established as a unit of the Division of Engineering of the National Research Council under the charter of the National Academy of Sciences. Largely financially supported by the federal administration, HRB lacked the necessary human resources to design and conduct in-house research and development projects.[51] However, through its many committees—including the Committee on Highway Traffic Analysis created in 1922[52]—and its various meetings and multiple publications, starting with the annual *Highway Research Board Proceedings*, HRB proved instrumental in the development of highway, and, more generally, transportation research as well as in the communication and dissemination of new knowledge and original practices to both academics and practitioners.[53]

In light of the foregoing, it is obvious that as far as traffic engineers were concerned, the 1920s witnessed the emergence and the progressive consolidation of a series of elements and factors generally participating in the creation of a new profession.[54] To begin with, a vast array of anxious, even infuriated actors—think of the many grieving parents whose children had been victims of car accidents—exposed to increasing congestion and growing numbers of accidents, were actively looking for experts able to address the new traffic-related urban problems, while, among them, a number of potential employers were willing to hire traffic specialists and use their competences. The university system and other research-oriented institutions and organizations had also proved responsive to this growing social demand for traffic expertise. From the end of the 1910s, a series of periodical publications—be they specializing in highway engineering,[55] dedicated to planning and city management topics,[56] or aiming at a general public audience[57]—would also regularly welcome in their columns the prose of traffic experts.

Another attribute, and probably among the most material ones, characterizing a fully constituted profession, would see the light of day at the very end of the 1920s. For years, traffic engineers through the country had discussed the creation of a professional organization for sharing information and advancing their interests. In 1930 some of them decided it was time for them to take action. The Institute of Traffic Engineers (ITE)—now the Institute of Transportation Engineers—was set up in October 1930 as the professional association of American traffic engineers, and greatly helped make a collection of more or less separate practitioners into fellows of a single organization.[58] ITE was born as a tiny organization. Only nineteen persons participated in its foundation while the Great Depression made the first years of the institute into a moment of struggle for survival and recognition. Yet, ITE did survive as it saw several leading figures in the field, including McClintock, Marsh, and MacDonald, among its founders or joining the organization during the early period of its existence. As time went by membership numbers rose. In October 1944, the ITE numbered 294 traffic engineers,[59] while three decades after its creation it had more than 1,200 members, most of them graduates of a civil engineering department (67 percent) and employed by some level of government (71 percent).[60]

Following in the footsteps of the many engineering associations that had preceded it, the ITE immediately equipped itself with its own periodical press.[61] And there is more. Any transportation practitioner today is very likely to come across the *Traffic Engineering Handbook* (7th edition, 2016), the first two editions of which date back to 1941 and 1950 respectively.[62] Providing traffic engineers with "basic traffic engineering data as a guide to best practice,"[63] the *Handbook* probably also served to remind other professions in competition with traffic experts, especially city planners, that traffic engineering had definitively come of age, and traffic engineers were now a force to be reckoned with.[64] The original *Traffic Engineering Handbook* had fifteen chapters and two appendices, while Halsey's textbook, also published in 1941,[65] incorporated twenty-four thematic units. Within less than two decades (1920–1940), American traffic engineering proved able to produce enough knowledge and practices to fill hundreds of pages with words and mathematical symbols as well as diagrams and charts. Among the many products traffic engineers collectively crafted during the interwar period, some would pave the way for the birth and growth of urban travel forecasting after World War II. Deserving of special mention are *traffic surveys*, especially those designed to identify auto trip origins and destinations, and a series of early, albeit rather timid, inroads into *travel forecasting*.

Traffic Surveys in the Interwar Years

Judging from the opinions expressed by leading traffic experts in the early 1920s, such as the New Yorker Nelson P. Lewis (1856–1924) and McClintock himself, a mood of optimism was prevalent about the capacity to erect a "traffic control system making possible a safer and more convenient use of *existing facilities*."[66] Along with several traffic-control techniques introduced in the 1910s, including stop signs, one-way streets, left-turn bans, or painted lines to delineate traffic lanes,[67] the 1920s witnessed the rapid development and implementation on a large scale of new technical and legal undertakings aiming to make the most of the existing urban road system, ranging from various systems of automatic traffic lights along major urban thoroughfares to the design of new traffic codes accompanied by educational efforts targeted at the various street users.[68]

Yet, as increasing flows of cars kept flooding the streets of American cities, traffic engineers started looking for solutions going beyond the existing facilities. Considered one such solution in the 1920s was the "Major Traffic Street Plan" that typically called for infrastructure improvements such as opening new roads, and organized streets into a hierarchical system on the basis of their traffic burden.[69] Along with traffic control techniques, Major Traffic Street Plans did provide some temporary congestion relief, but as more and more American households were adopting the automobile as their favorite means of transportation, the Plans eventually proved unable to eradicate traffic jams and other car-related scourges. Traffic engineers did not lay down their arms, however, and by the early 1930s a radical solution was already looming on the horizon in the shape of an original "techno-political"[70] object: The *urban freeway*, depicted by its proponents as the ideal artefact to help people move fast yet safely.[71] The term seems to have been coined in 1930 by planner Edward M. Bassett (1863–1948) to denote freedom of movement, and referred to a specific kind of highway to which there was no vehicular access from abutting properties, and for which at widely separated points the authority in charge would locate entrance and exit points. Although before the outbreak of World War II only a few places had constructed any significant portions of this new kind of urban street,[72] the urban freeway, labelled also by contemporaries as expressway, express highway, throughway, motorway, limited way, major traffic highway or superhighway, was here to stay.[73]

Yet, in order to properly *locate* and *size* new urban freeway networks one had better know a lot about the transportation patterns and mobility needs of its potential users in the *present*, and, even better, in the *future*. Traffic surveys, hopefully providing such information, were among the iconic achievements of American traffic engineering in the interwar period. As with any practice-oriented science worth its salt, the then fledgling science of traffic was in urgent need of data gathering in order to "substitute accurate facts of an engineering character for guesswork in the formulation of plans for the reduction of street friction and conflicts."[74] As a matter of fact, most of the actions undertaken and the tools devised in the 1920s with a view to mitigating the effects of traffic-related scourges largely relied on an "avalanche of printed numbers"[75] collected through a great variety of traffic surveys. Among them, the "cordon counts," and, especially, the origin and destination (O&D) traffic studies, following a series of changes and refinements, would become, after World War II, part and parcel of urban travel demand modeling.

Since urban mass transit had long antedated motorized vehicles in the American city,[76] it is no wonder that the first significant traffic surveys were conducted by mass transportation companies.[77] According to contemporaries, it was the city of Philadelphia that carried out, with the help of the consulting office Ford, Bacon & Davis, the "most comprehensive traffic count ever undertaken" in 1912.[78] The data collected were later transferred to Hollerith punched cards, and were processed by the Statistical Service Company with the help of the electric tabulators of the day.[79] The resulting origin and destination matrices, in modern parlance—where each cell represents total traffic between two particular sections of the city—were then used to draw a number of conclusions as to the probable ridership on the proposed extension system of the city's subway and elevated lines. Philadelphia's example was soon emulated by a number of other large metropolitan areas. Detroit and Boston, both in 1915, then Chicago (1916), and Pittsburgh (1917) undertook in their turn origin and destination surveys for their mass transit systems, often with the help of local university resources.[80]

Some of these undertakings, in Pittsburgh and Chicago for example, included a car component as well. But as time went by and car numbers on the urban streets soared, the automobile began to generate its own traffic investigations. It was Chicago that pioneered a cordon study to count all vehicles entering and leaving the downtown district in June 1916,[81] while other large cities followed suit, including Pittsburg in 1920[82] and New York in 1924.[83] By 1930, cordon studies had already become a routine device in the field of traffic engineering.[84] Useful, even indispensable, as they might be, however, cordon counts can report "*only the number*, and perhaps the type, of vehicles passing certain points within specified periods of time. Such counts will show where there is necessity for providing additional highway facilities, but they are not enough to *indicate the best route that such highways should follow*. For this purpose, it is necessary to know both the *origin and destination* of all the vehicles concerned."[85] These O&D surveys of automobile traffic first emerged in the first half of the 1920s, before witnessing a dramatic development and extension over the next decade. More complicated and advanced in both design and execution than the cordon counts, since they determine not only the number of vehicular trips but also the locations where they begin and end, and, often, the purpose for which travel is undertaken as well as the route taken and the intermediate stops eventually made, O&D surveys would complement cordon counts to soon become the principal method of obtaining data for planning major urban traffic improvements.[86] The various methods used for conducting O&D studies in the interwar period can be subsumed into two large families. The first groups together survey techniques that, like cordon counts, allow information to be collected on the origin and destination of motorists' trips in an *indirect* way, and without *soliciting* any interaction with the driver.[87] For example, in a large traffic survey carried out in the city of Detroit in 1936, the license numbers of cars parked in the city's CBD—that is, the destination of the trips—were recorded, and the place where the parked car was usually garaged, as indicated by the registry list, was assumed to be the origin of the trip to the central city.[88] If the approach illustrated by the 1936 Detroit traffic study isolates the observer from the observed, the second large family of O&D surveys requires, on the contrary, the active collaboration of the driver as the main source of information. Though not the only actor involved,[89] the Bureau of Public Roads would distinguish itself as a past master at designing and carrying out—often with the help of the states and other local governments—O&D surveys based on *interviews* with drivers.

The measurement and analysis of highway traffic were among the challenges that the federal agency attacked as a matter of priority, starting with a complete investigation of the California highway system in 1920.[90] Among the first surveys of the period, the one for Connecticut that was conducted between September 1922 and September 1923 deserves a special mention. Immediately hailed as the "most comprehensive program ever attempted,"[91] it departed from the previous studies carried out under the aegis of BPR in that it was much more research-oriented and the first to employ tabulation machines and make use of an interview-based O&D survey. Given its research orientation, BPR engaged John Gordon McKay, the author of a recent Ph.D. dissertation in economics in 1922.[92] Installed as chief of the BPR's Highway Economics Division, McKay was to work for the federal agency for several years, while his name featured many times in the member list of the HRB's Committee on Highway Traffic Analysis in the 1920s and 1930s. McKay's engagement would not be an isolated act. Throughout the interwar period, BPR hired several persons with academic credentials who participated in the many transportation surveys[93] done under its direction before World War II.[94] The first transportation surveys conducted by the BPR were statewide in scope and had little, if any, urban components. Although the first comprehensive traffic survey in an urban region involving the bureau was for Chicago in 1924, it was the Cleveland Regional Area Traffic Survey of 1927 that proved a milestone in the slow transformation of BPR from a mostly rural actor into a significant urban one. A very extensive survey that counted traffic at 973 points on the roads of the regional area, the Cleveland study was not just another routine interview-based origin and destination survey because along with the origin and destination of their trip, drivers were also asked a series of additional questions, ranging from the exact route followed to their reasons for choosing it.[95]

Ironically, the Great Depression proved overwhelmingly favorable to American roads. With a quarter of the civilian labor force in the throes of unemployment, roads proved an excellent place where large numbers of people could be "put to work,"[96] and work relief money be usefully spent. Transportation surveys, regarded as a weapon in their own right in the fight against the unemployment of "white-collar personnel,"[97] greatly benefited from these Department of Public Works-friendly circumstances. They especially received a strong stimulus from the Hayden-Cartwright Act passed by Congress in 1934, which allowed up to 1.5 percent of federal aid highway funds appropriated for any year by any state to be used for studies into the nation's highway system. One of the prime objectives of these actions was to assemble factual data that would help the federal and state administrations to fulfill a twofold purpose: to determine "where highway-user revenues[98] should be spent to *benefit the greatest number of motorists*,"[99] and to devise a "rational method for apportioning road-user taxes assuring adequate maintenance and needed development of state-administered highways and benefits to urban and rural taxpayers in *strict proportion to the tax payment of each group*."[100] A new kind of survey, named the "Road-use Survey," was therefore devised with a view to achieving these objectives. While traditional traffic surveys involved "the actual observance of the vehicles at some point of their travel on a given trip," the new Road-use Surveys depended upon "interviews with the owners of motor vehicles[101] during which a complete enumeration is made of all or a large part of the travel performed in the vehicles of the interviewed owners throughout a specified period of time, usually twelve months."[102] It was during the same Road-use Surveys that the Bureau of Public Roads specialists worked more systematically than they did in the past to classify the various automobile trips of American households according to the *purpose* for which they were undertaken.[103] Both the interview approach and the travel classification schemes based on the trip purpose would be greatly developed within post–World War II urban traffic forecasting.

Suggested by the BPR, which assigned a resident engineer to each state to this end,[104] and conducted by the state highway departments in the second half of the 1930s, Road-use Surveys were based on an impressive number of interviews. During a first wave covering seventeen states, no fewer than 198,809 drivers of private cars and another group of 71,941 truck drivers spoke at length about their mobility practices.[105] These surveys produced an unprecedented amount of information about the travel patterns of American households of the day. In an ironic twist of fate, while these state-wide planning surveys were largely undertaken to evaluate the needs of the *rural* (intercity) highway system, they eventually revealed and emphasized the importance of *cities* in the production of traffic on the nation's roads. The gathered data showed, in fact, that most trips were short and traffic was primarily urban in nature.[106]

What were the BPR staff members to do with all the numbers produced? How would they translate pieces of information into a course of action? Here is the answer given by the intellectual father of post-1935 highway planning surveys, Herbert Sinclair Fairbank (1888–1962), a graduate of Cornell University in 1910, the editor-in-chief of *Public Roads* for many years, and a truly "educated man" who "read a great deal," and "tried to bring economists" into the Bureau of Public Roads as well as economics into the "thinking" of its staff.[107] Fairbank argued that since data clearly show that the city is the "place where the most people *want* to travel short distances,"[108] and given that traffic engineers' ruling concern "is to *read aright* the manifestation of *human desires* in respect to highway movement,"[109] public servants have a duty to provide their fellow citizens with what the latter obviously are yearning for: urban freeways enabling—and also constraining, it should be added[110]—urbanites to move fast and safely across their metropolitan areas.[111] Vested with the authority quantification provides,[112] considering itself the bearer of the "common good" in the domain of mobility, consistently developing a rhetoric of public interest, the BPR would throw all its weight, based on the power of numbers combined with that of federal money, behind the urban freeway, hammering home the message that it was the "one best way" of curbing urban traffic-related scourges while meeting at the same time the desires of American households. The BPR's insistence on urban freeways eventually paid off with the Federal-Highway Act of 1956, which translated what started as an interwar innovation into a massive urban reality in the 1960s (read more on this in chapter 2).

From Current Traffic Counts to Travel Forecasts

Surveys tend to account for the present, but they can also help to take care of the future. Not content with gathering evidence for current traffic on American roads, traffic experts sought to forecast traffic on the network for the years to come, since a facility that "will not meet traffic demands during [its] expected life is a poor investment, resulting in traffic congestion and early reconstruction."[113] It was during the Maine transportation survey, the field work for which was done from July 1 to October 31, 1924, that a *statistical model*, based on the method of least squares, was first used by the Bureau of Public Roads to estimate future highway traffic.[114] The inputs of the model were the traffic counted at several stations for one week each year from 1916 to 1924 inclusive in combination with the evolution of the registered cars and the population of the state during the same period. Despite the smallness of the sample, BPR researchers were able to show that "traffic and registration are in nearly constant ratio from year to year."[115] Moreover, they also succeeded in establishing another close statistical relationship between the annual total population of the state and the total of motor vehicle registrations each year. Using the predicted population of some future year, obtained from the Bureau of the Census for example, BPR could first forecast future vehicle registration, and, from this, future traffic on the highway system.[116] BPR would apply the aforementioned forecasting approach in several other surveys conducted in the 1920s,[117] and obtained rather encouraging results.[118] At the beginning of the following decade, while keeping the same general statistical-centered methodology, BPR specialists would change the variables used for traffic forecasting, as the study of the accumulated data up to that time seemed to indicate "a much closer relationship between gasoline consumption and traffic volume than between registration and traffic volume."[119]

Although the BPR unarguably dominated the landscape of interwar traffic engineering, it was by no means the sole actor. As has amply been seen, American cities and traffic consultants working on their behalf were also significant parts of the traffic engineering community of the day and contributed to expanding the body of knowledge and practices in respect of traffic counting and even forecasting. Two major metropolitan areas, New York and Boston, would prove even more adventurous than the Bureau of Public Roads in their attempts to estimate future traffic. While the federal agency was generally content with assuming a five- to ten-year projection into the future, planning documents drafted on behalf of these two cities and dating to the 1920s contain traffic predictions for the year 1965 (figure 1.1)!

In order for such a bold move to be undertaken, a new kind of traffic forecasting approach was devised by consultants working for these two metropolitan areas. In 1926, BPR specialists were arguing that the "most scientific method of future traffic prediction is by projecting past traffic trends" since this "method has been found accurate in the prediction of population, business conditions, railway traffic, and other economic factors."[120] The leading traffic engineer and planning consultant, Ernest Payson Goodrich (1874–1955), a graduate of the University of Michigan and the first president of the Institute of Traffic Engineers,[121] was more skeptical about the scientific virtues of such a modeling approach, which relied on mere statistical correlations between variables without providing any explanation for the traffic patterns observed.[122] While offering his services to the Regional Plan of New York and Its Environs in the mid-1920s,[123] Goodrich would develop instead a new modeling line, named by its author as the "distribution method." The latter "assumed that the traffic radiating from any one district to all other districts in the area, a county being the unit considered, is *inversely proportional* to the distance between the districts and *directly proportional* to the automobile ownership in the districts."[124] At about the same time, another leading figure of the community of city planners of the day, Robert Harvey Whitten (1873–1936), then working for the city of Boston, would build on Goodrich's "distribution model" to propose an even more pronounced Newtonian version of it.[125] From an analysis of the data gathered through an extensive origin and destination study conducted in Boston in 1927,[126] Whitten stated that the traffic between any two pair of districts varies directly with regard to the motor vehicle registration of those districts and *inversely* with regard to the *square* of the distance between them.[127] Although the historian can find some (rare) traces of this modeling approach in the 1930s,[128] the traffic engineering community was to wait another thirty years or so before the ideas put forward by Goodrich and Whitten in the 1920s resurfaced in post–World War II America (see chapter 2).

By comparison with the tremendous development that urban traffic forecasting would undergo in America after the end of the World War II, the

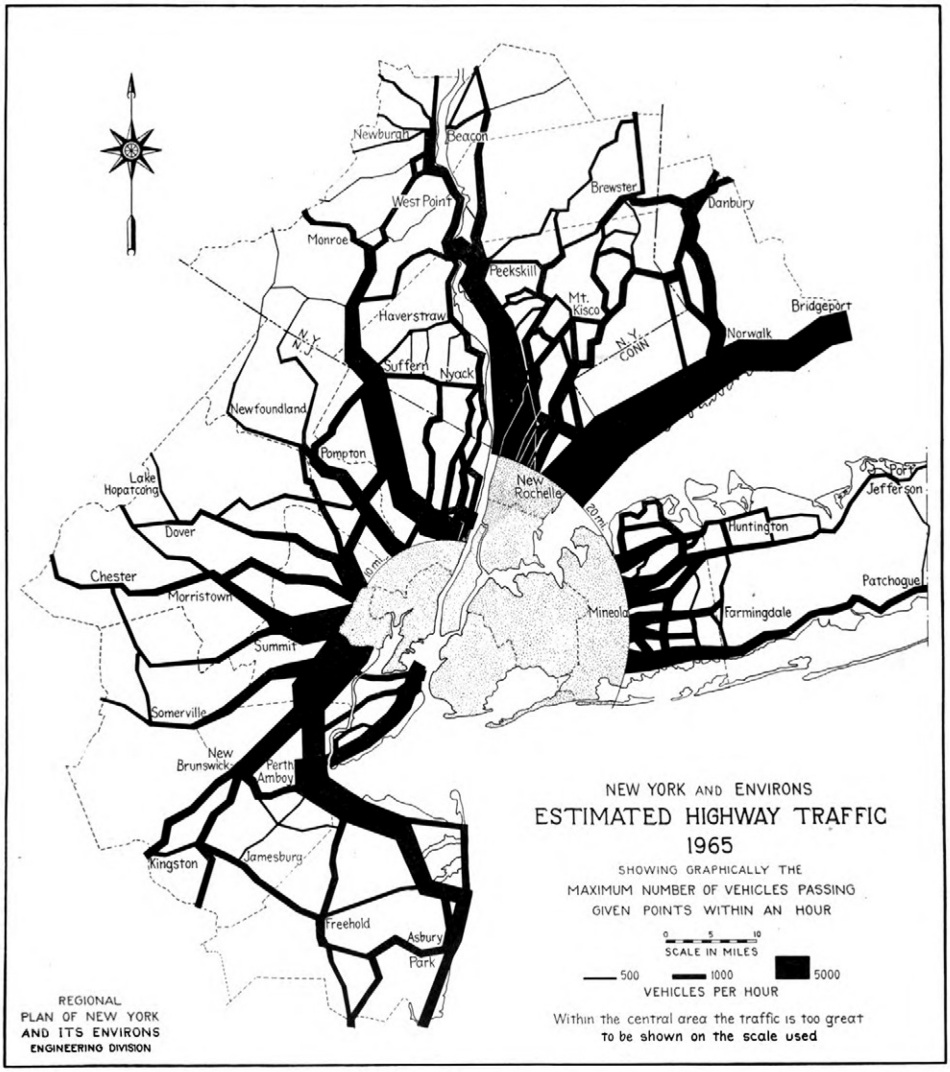

Figure 1.1

New York and Environs Estimated Highway Traffic for Year 1965. *Source:* Harold M. Lewis (in collaboration with Ernest P. Goodrich), *Highway Traffic in New York and Its Environs, Including a Program, by Nelson P. Lewis, for a Study of All Communication Facilities Within the Area* (New York: Regional Plan of New York and Its Environs, 1925), 107.

harvest of the interwar years seems rather poor. However, it was during the Roaring Twenties and the Great Depression that the seeds of the future were planted since a number of preconditions[129]—be they professional, organizational, material, or ideological—for the postwar blossoming of urban travel demand modeling came to be met, and several elements of the would-be UTDM social world, albeit mostly in an emerging state, appeared for the first time.

The MIT Press would like to thank the anonymous peer reviewers who provided comments on drafts of this book. The generous work of academic experts is essential for establishing the authority and quality of our publications. We acknowledge with gratitude the contributions of these otherwise uncredited readers.

This book was set in ITC Stone Serif Std and ITC Stone Sans Std by New Best-set Typesetters Ltd.

Library of Congress Cataloging-in-Publication Data

Names: Chatzis, Konstantinos, author.
Title: Forecasting travel in urban America : the socio-technical life of an engineering modeling world / Konstantinos Chatzis.
Other titles: Engineering studies series.
Description: Cambridge, Massachusetts : The MIT Press, [2023] | Series: Engineering studies | Includes bibliographical references and index.
Identifiers: LCCN 2022033313 (print) | LCCN 2022033314 (ebook) | ISBN 9780262048101 (paperback) | ISBN 9780262374514 (epub) | ISBN 9780262374521 (pdf)
Subjects: LCSH: Urban transportation—United States—Mathematical models—History. | Traffic estimation—United States—Mathematical models—History. | Urban transportation—Forecasting—Social aspects—United States.
Classification: LCC HE308 .C53 2023 (print) | LCC HE308 (ebook) | DDC 388.40973—dc23/eng/20230221
LC record available at https://lccn.loc.gov/2022033313
LC ebook record available at https://lccn.loc.gov/2022033314

10 9 8 7 6 5 4 3 2 1