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**The Ethical Challenges and Professional Responses of Travel
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P. Anthony Brinkman

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The Ethical Challenges and Professional Responses of Travel Demand Forecasters

by

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Abstract

Ethical Challenges and Professional Responses of Travel Demand Forecasters

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Doctor of Philosophy in City and Regional Planning

University of California, Berkeley

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Thirty years ago scholars first presented convincing evidence that local officials use biased travel demand forecasts to justify decisions based on unstated considerations. Since then, a number of researchers have demonstrated convincingly that such forecasts are systematically optimistic—often wildly so—for reasons that cannot be explained solely by the inherent difficulty of predicting the future. Why do modelers—professional engineers and planners who use quantitative techniques to predict future demand for travel and estimate its potential impact on built and proposed transportation facilities—generate biased forecasts and otherwise tolerate the misuse of their work? On initial consideration, it is tempting to surmise that corrupt modelers are responsible for biased forecasting. Indeed, corruption is the most common explanation of forecasting bias and tales of mercenary behavior are all too common in the field. Data from in-depth interviews with twenty-nine travel demand forecasters throughout the United States and Canada, how-

ever, suggest new and different ways to understand the suspect behavior of transportation planning professionals.

Those most likely to introduce bias and invite misuse of travel forecasts assume that their technical analyses have little, if any, impact on policy making. For many, this leads to disillusionment and requires responses to cope with feelings of marginalization. Others, untroubled by their apparent lack of influence, are complacent and need ways to avoid the ethical questions of practice. Both types of practitioners circumscribe professional roles and rely on the self-deceptive strategies of evasion and excuse making to mute their own disquieting realities that undermine positive concepts of self. The disillusioned wish not to see that they do not matter and the complacent that they do. Bias and misuse seem to be the unintentional byproducts of these attitudes.

Beyond enhancing the understanding of the systemic failures of travel demand modeling, this research suggests practicable steps to reform and outlines an agenda for future work. Attention to these matters is important, not just to avoid expenditures on projects and programs that cannot be justified on the basis of sound utilitarian calculations, but also to restore and preserve the credibility of a profession.

For Beth Howe

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INTRODUCTION

This story began nearly a half-century ago when travel forecasting rode the crest of the systems revolution, which promised an improved world by providing the technology that would make planning functionally rational at long last. Even though the promise of modernism could never be kept, the modeling profession survived the culture wars only to stumble on its own excesses (i.e., questionable ethical practices). By 1972 there were already indications that travel forecasts were plagued by bias that overstated the benefit of proposed projects (Kain 1972). Thirty years hence evidence of bias continues to mount while surprisingly little can yet be said with any degree of confidence about its cause. The study detailed here addresses this deficiency with the goal of improving public decision-making. It also outlines a research agenda designed to bring the issue of biased forecasting into greater focus and provide additional practicable steps to reform.

Briefly, traditional travel demand models comprise a series of mathematical equations that attempt to predict future travel behavior for a particular region based on forecasted socioeconomic variables, such as population and employment, and planned changes to the transportation system. Most commonly, planners judge the usefulness (i.e., accuracy) of these models by the extent to which they can reproduce observed travel patterns from actual—rather than forecasted—data for a region. While hardly an exact science, practitioners and scholars have formalized the travel demand modeling techniques used today over the last half-century since their introduction. Nevertheless, forecasters are responsible for evaluating the *reasonableness* of model inputs and outputs for each

step of the modeling process even though they may never participate in the actual development of the models they use. Although the details of each model are not particularly important for the issues raised in this research, their underlying premise is—namely, that transportation planners can forecast the future. In reality, models are highly imprecise, their inputs are extremely difficult to predict, and the formulations of future travel demand are almost sure to be inaccurate to some extent.

I designed each chapter that follows to stand on its own, hoping that this manuscript might prove more useful to a wider audience, particularly those like the gryphon Alice met in Wonderland who said impatiently, “No, no! The adventures first, explanations take such a dreadful time” (Carroll 1998, 91). While, in a bow to convention, the adventures, as it were, are at the end of this work, activists, practitioners and scholars alike (gryphons, too!) may easily move directly to the last chapters to survey the findings of this study and the analysis thereof. Most notably, chapter 5 constructs a multi-dimensional model of practice from modelers’ narratives about ethics, professional motivation and job satisfaction. In chapter 6, I interpret my findings and further synthesize the data to provide answers to the central question of this research: “How and why do modelers generate biased travel demand forecasts and otherwise tolerate the misuse of their work?”

For those who wish to gauge the evidence assembled for bias in travel forecasting and place it in its proper context, the first chapter summarizes the literature that (a) evaluates the reliability of individual travel demand forecasts and (b) seeks to interpret the prevalence and persistence of appraisal optimism. This treatment serves to not only bound the study, but also identify and explain the most puzzling gaps in our knowledge

about the use of technical data in transportation planning. Chapter 2 focuses on my unit of analysis—the individual modeler—and carves out the position that bias is always symptomatic of questionable ethical choices that modelers make in their work. By doing so, I provide the rationale for examining practice and practitioners here rather than institutions and political economy.

In the third chapter, I set the theoretical groundwork that guided my research by developing three consistent working hypothesis, which provide alternatives to the common assumption that corruption is responsible for biased forecasting. The term *working* is key here, for, as a Kuhnian, I recognize the danger inherent in traditional hypothesis testing that theory will unduly color findings. Hypotheses are most useful in social science research when they are used to inform inquiry. Therefore, grounded theory—the discovery of theory from data—also provides relevant reference points for interpreting the study findings. In fact, it was the modelers’ own words that, in the end, were the most crucial for guiding this work.

Finally, chapter 4 provides the methodological details of this study, which comprised a mail survey and a series of in-person interviews with travel demand forecasters. While neither sample is statistically valid for lack of randomness, they are broad enough to merit some subjective generalization.

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CHAPTER 1

BIAS IN TRAVEL DEMAND FORECASTS

Thirty years ago John Kain was the first to present convincing evidence that local officials use biased travel demand forecasts to justify decisions based on unstated considerations (1972, 40). Since that time, Kain and others have demonstrated that travel demand forecasts are systematically optimistic—often wildly so—for reasons that cannot be explained solely by the inherent difficulty of predicting the future. Assessments of the problem seem to generate more questions than they answer, however. Those searching for solutions find a myriad of prescriptions in the literature for reforming transportation planning processes. While these represent significant contributions to the discourse, most writers base remedies on diagnoses that rely more upon conventional wisdom and compelling narrative rather than convincing evidence. For instance, a number of very competent researchers have issued calls in the United States for Congress to reduce the federal share of capital funding for mass transit projects as a way to discourage rent seeking behavior by local officials (e.g., Pickrell 1992, 170). However, few, if any, have collected the data necessary to justify their appeals even though the theoretical and practical hurdles for doing so seem not to be particularly formidable. While buttressing prescriptive ideas with conjecture and incomplete data does not necessarily invalidate them, the lack of more systematic analysis raises the possibility that reforms may be misdirected or less effective and efficient than other interventions.

For those interested in the problem of biased forecasting, the story still has too many gaps and unsatisfying answers. The research needs listed below include questions that seek to further measure the problem as well as those aimed at explaining its causes and persistence. The immediate goal of this agenda is to place the research reported in subsequent chapters in the proper context. Its more lofty purpose is to initiate a discourse aimed at answering why there still exist such glaring research needs in this area. A clear understanding can perhaps most effectively summon a new effort of inquiry that will lead to better planning, not only in the provision of transportation infrastructure and services, but also other social goods.

FORECASTING AND THE IMPORTANCE OF ACCURACY

The travel demand forecasting methodology widely used throughout the world today was developed in the United States in the middle 1950s. It comprises a system of models commonly referred to as the urban transportation modeling system, or UTMS.* Although the intervening years witnessed many refinements to the modeling process, it remains even now largely unchanged in its fundamentals. Briefly, UTMS

...relies on statistical regularities that relate current travel patterns to current land use patterns and transport system characteristics, i.e., the levels and spatial distribution of employment; the numbers, location, and density of population and households; income and car ownership levels; and the capacities and performance of alternative modes. Predictions of future travel are obtained using these statistical regularities and projections of future land uses for the area in question. (Kain 1990, 185)

Only relatively recently have model developers begun to approach travel demand analysis in radically different ways that favor more explicitly behavioral approaches. It seems unlikely, however, that these new techniques will be any more transparent to consumers of travel forecasts and therefore no less likely to be misused.

* It is also sometimes called the urban transportation planning system, or UTPS.

The accuracy of travel demand forecasts matters, of course, only to the extent that those with standing (e.g., elected officials, voters, etc.) rely on these analyses for making judgments concerning transportation improvements. Pickrell raises this question implicitly by acknowledging the difficulty inherent in judging whether better (i.e., different) forecasts would have led to alternate outcomes (1990, xvii). It is, however, virtually impossible to know with any certainty how prominent a role forecasting plays in decision-making. Therefore, the interested reader must assume it has some significant explanatory power for transportation investment based in part on the fact that travel demand analysis is still widely conducted worldwide even in cases where funding agencies do not mandate it.*

In this light, and notwithstanding claims that there is no penalty for appraisal optimism (Walmsley and Pickett 1992, 11), a proliferation of flawed travel demand forecasts has predictable consequences. Policy makers may approve innumerable expenditures on projects and programs that cannot be justified on the basis of sound utilitarian calculations. The U.K. National Audit Office (UKNAO), however, seems to make the only attempt to quantify misdirected resources, albeit in an admittedly cursory fashion that considers only highway construction costs (1988, 25).[†] In addition to the opportunity costs associated with misdirected resources, projects based on optimistic demand projections can burden communities financially for decades. The Montreal Mirabel Airport is but one example (Goetz and Szyliowicz 1997, 264). Furthermore, there are indications that even when capital costs are borne at higher levels of government, transit improve-

* Nevertheless, this question is not unimportant and chapter 2 finds it considered in appreciably more depth.

[†] Flyvbjerg, Holm and Buhl measured the systematic underestimation of costs for transportation infrastructure projects (2002). Without a corresponding analysis of project benefits, however, they can conclude only that “[t]he misrepresentation of costs is *likely* [italics added] to lead to the misallocation of scarce resources” (2002, 290).

ments may saddle local jurisdictions with increased operating expenses and deficits without providing the corresponding benefits linked to increased ridership (Gómez-Ibáñez 1985, 350).

When decision-makers use travel demand forecasts primarily to evaluate the relative cost-effectiveness of multiple transportation schemes—an evaluation procedure termed alternatives analysis (later called major investment study, or MIS) and used widely in the United States for transit planning—overprediction of demand for all modes will favor more capital-intensive alternatives such as rail lines (Kain 1999, 386). This bias stems from the conclusion, drawn from a number of studies, that capital expensive modes become cost effective “only when [their] substantial capital costs and fixed operating expenses can be spread over large passenger volumes” (Pickrell 1990, xvii). Therefore, even mode comparisons that over-predict travel demand equally across alternatives not only introduce bias, but increase the potential financial consequences for making the wrong choice.

Unfulfilled promises also damage the credibility of the forecasting profession. The public disdain for travel demand analysts is unmistakable in the discourse that inevitably follows postmortems of troubled transportation projects. Some, too, speculate that opponents will cite erroneous forecasts to prevent investment in transportation improvements that ought to be built (Weyrich 1990, 2). Finally, the negative public sentiment generated by erroneous predictions and, more importantly, the political pressure on analysts to deceive are highly distressing to many travel demand forecasters and in many cases these feelings likely force good people to abandon the profession.

CONTEXT

Don H. Pickrell (1990; 1992) conducted the most comprehensive study of bias–systematic error introduced by personal judgment–in travel demand forecasting, although he carefully avoided using the term. Briefly, Pickrell reviewed ten fixed-transit guideway projects constructed in the United States between 1971 and 1987. He studied the heavy rail systems built in Washington (D.C.), Atlanta, Baltimore and Miami; the light rail lines operating in Buffalo, Pittsburgh, Portland (Oreg.) and Sacramento; and the peplemovers located in downtown Miami and Detroit in part because the documentation necessary to evaluate them was generally available. Of his sample, Pickrell makes no claim of statistical validity or comprehensiveness other than the “projects reviewed comprise a significant share of federally-financed investment in major transit capital improvements during the [1970s and 1980s]” (1990, 8). Among the significant findings, Pickrell’s analysis demonstrates that

...only the extensive rail rapid transit system under construction in Washington, D.C. experiences actual patronage that is more than half of that forecast, and even there ridership remains 28% below that originally anticipated. The number of passengers carried by new rail lines in Baltimore and Portland is somewhat below half of that forecast, while actual ridership on Miami’s Metrorail line, as well as on the light rail lines recently completed in Buffalo, Pittsburgh, and Sacramento ranges from 66% to 85% below its forecast levels. Similarly, the two downtown people movers constructed in Miami and Detroit carry 74% and 83% fewer daily passengers than were originally anticipated to use them. (1990, x)

Widely read and frequently cited, *Urban Rail Transit Projects: Forecast Versus Actual Ridership and Cost* (Pickrell 1990) remains the benchmark for other projects that seek to assess the accuracy of travel demand forecasts. The authority of the study stems from its thoroughness, in-depth documentation and the conservative nature of its results. The researchers used a multi-stage process to ensure the accuracy of their data. This process included multiple source data collection, verification of published figures and

circulation of assembled facts for critique to agencies responsible for the planning and managing of each project. The final report (Pickrell 1990) explains these provisions in detail and contains a 68-page appendix that meticulously documents the source of each figure the study presents. Hence, it is lauded widely as “a model of clarity in stating each assumption made” (Richmond 1998b, 15).

Where not clearly merited, Pickrell avoids incorporating assumptions favorable to his conclusions in the quantitative results. This reflects the fairness of his approach, which enhances the credibility of his analysis. Kain et al. calls Pickrell’s comparisons “clearly conservative” (1992, p. 14-22). For instance, the Washington Metro system reached the scale studied by Pickrell eight years later than planned. In that time, downtown employment—likely the most important demographic factor influencing Metro patronage—grew dramatically. Therefore, the implied precision of the ridership forecast is probably overstated. Had the system as planned opened on time, it would well have carried even fewer passengers in the equivalent forecast year (1990, 16-17). Pickrell probably also understates the discrepancy between forecast and actual ridership for the rail transit lines in Buffalo, Sacramento and Portland since the free-fare zones in those cities, designed to increase patronage, may not have been incorporated into the respective forecasts for these systems (1990, 16). In Los Angeles County, the rider-friendly fare structures of the Blue Line light rail service were clearly not part of the patronage estimates for it. According to one observer, this omission seems to have falsely vindicated the rail transit forecasts there (Richmond 1998a, 298).

Pickrell and others who examined the accuracy of travel demand forecasts faced many formidable obstacles as they worked to fashion credible conclusions. Most com-

monly, the units of forecast demand do not match the count data and agreement on conversion methodology is often problematic. This complication is most acute for those examining transit systems operating in the United States since U.S. transit agencies characteristically report patronage as boardings, or unlinked-trips, rather than the number of total trips, or linked-trips, used in most forecasts (Love and Cox 1991, 7; Kain and Liu 1995, p. 2-15, p. 3-3; Richmond 1998b, 17, 19, 53, 93). This makes it particularly difficult to substantiate specific claims of new transit trips. For example, consider a passenger that formerly commuted on a direct bus, but now travels by bus to a rail station and then transfers to a train to complete the same journey to work. The transit operator now reports this trip as two boardings (bus and train), rather than the previous one (direct bus). The commuter, however, still takes only one trip between the same origin and destination.

The problem of incongruous measures of patronage extends well beyond this example. In an English case study, Hall describes the difficulty of comparing travel demand forecasts for various airport alternatives made in terms of standard busy rate—the hourly rate of traffic movement reached or exceeded on thirty occasions during the summer (1982, 21). Similarly, consultants provided forecasts for the Tyneside (England) light rail transit system in morning peak hour boardings and passenger miles (Fullerton and Openshaw 1985, 197). With no conversion factors provided in the consultant's documentation, the procedure for scaling these up to equivalent annual figures for comparison with reports of actual system usage is left open to question. Pickrell encountered similar problems when converting average weekday ridership figures to their annual equivalents (1990, 55).

Frequently, too, the geographical scope of responsibilities for institutions that predict and measure travel demand changes over time increasing the chance that forecast area and subsequent reporting boundaries do not correspond. This was the case in Metropolitan Atlanta where the two-county demand forecast is difficult to compare with total transit ridership reported by the system operator for a four-county area (Pickrell 1990, 14). A similar problem hindered attempts to examine the accuracy of Chicago Area Transportation Study (CATS) travel demand forecasts. CATS expanded its study boundaries from portions of two counties to all of two and portions of four (Institute of Transportation Engineers 1980, 25). Also prevalent are troubles evaluating forecasts when the scale and timing of capital-intensive transportation projects subsequently change. These changes commonly challenged researchers studying mass rapid transit in developing countries (Allport and Thomson 1990, p. 7-4). Other notable difficulties in preparing this type of analysis involve problems locating and obtaining transit and highway demand forecasts (Allport and Thomson 1990, p. 7-4; Richmond 1998b, 16; Fullerton and Openshaw 1985, 188; UKNAO 1988, 12, 16), disaggregating total transit ridership forecasts (Pickrell 1990, 14, 15, 18) and assessing forecasts for systems and highway projects where the time span between projected completion and the forecast year is, at the time of the evaluation, still greater than the entire period the system or road has been open (Pickrell 1990, 10-11; UKNAO 1988, 16).

Although his job was far from easy, Pickrell managed to negotiate well the sizeable hurdles he encountered while examining travel forecasts. Efforts to discredit him have been “uniformly unsuccessful” and his work (1990; 1992) “remains widely cited in the scientific and professional literature” (Rubin, Moore III, and Lee 1999). Furthermore,

only one peer-reviewed journal has published an article that even attempts to challenge Pickrell's conclusions.* The often bitter criticisms leveled towards Pickrell in other forums are summarily empty and without grounds (e.g. American Public Transit Association 1990; Simon 1991; Vuchic 1991). If Pickrell's work stood in isolation, it is forceful enough to conclude that bias in travel demand forecasting is pervasive in analyses of U.S. rail transit projects that compete for federal funds. However, there are a number of studies that support the contention that the scope of bias is broader both with respect to mode and geography.

OTHER STUDIES

While no less than thirty articles report on the accuracy of one or more travel demand forecasts to some degree, aside from Pickrell (1990), only nine present research efforts that are rigorous enough to likely withstand critical review. A singular purpose, balanced approach and extensive documentation generally characterize these studies and set them apart. The three most recent of this group are Danish studies that overlap to some degree. The first, Skamris and Flyvbjerg (1997), presents findings from a study of large Danish bridge and tunnel projects. For the completed projects with published demand forecasts—the New Little Belt, Sallingsund and Farø Bridges—the authors conclude that the “actual traffic development was on average 9% below estimated traffic development, ranging from 27% above to 32% below the estimates” (142).

Flyvbjerg, Bruzelius and Rothengatter (2003) followed up on this study and extended it as part of a larger work that focuses on uncertainty in transportation planning. From their comparisons of forecast and demonstrated travel demand for the Channel

* See the discussion of Demery, Jr. 1994 below.

Tunnel and the Danish Great Belt and Øresund links, the authors present a number of key findings. First, the Eurostar trains that traverse the Channel Tunnel attracted only 18% of the forecast ridership in year-1 and after five years of operation, the Eurostar still carries less than half of the 15.9 million forecast for the first full operational year(28-29). Second, rail patronage on the Great Belt link approximately matched expectations for the first year, but seems to be stabilizing at about 93% of the forecast. Great Belt road traffic, on the other hand, is now more than double the first year estimate of 9,800 daily vehicle crossings. Lastly, early data indicate that both road traffic and rail patronage will fall well below the first year forecasts for the Øresund link(30-31). This work also reports briefly on the accuracy of a regional German forecast(31-32).

Flyvbjerg and Holm compiled what appears to be the largest sample of comparable data for assessing the accuracy of travel demand forecasts—210 highway and rail projects on five continents and twenty countries (Forthcoming). Most notably, their work shows that rail passenger forecasts overestimate demand by an average of 65% [(forecast-actual)/actual]. In contrast, the comparable figure for road traffic is -9%, an underestimate. Because the particular details of this study have yet to be released, these projects are not included in the tables, figures and summaries below unless otherwise noted. Yet, based on a synopsis contained in Flyvbjerg, Bruzelius and Rothengatter (2003), this study represents perhaps the most complete and varied description of the travel forecasting problem.

Skamris and Flyvbjerg themselves first identify two of the more important studies. The UKNAO conducted the earlier of these. It examines 161 road projects in England and Wales and shows forecasts for 39 of these to underestimate demand by more

than 20% of the actual traffic flows and 40 to similarly overestimate demand (1988, 17). Data suggest that the underestimates are more serious since they account for 58% of the estimated £386 million in misdirected resources (UKNAO 1988, 25).

The second study was performed under the auspices of the Transport and Road Research Laboratory. It compares the forecast and actual ridership of nine rail transit systems in developing countries and concludes that eight of the nine forecasts overestimated ridership—seven by more than 20% and five of those by more than 50% (Fouracre, Allport, and Thomson 1990, 10). This study evaluates a subset of thirteen systems located in Cairo, Calcutta, Hong Kong, Manila, Mexico City, Porto Alegre, Pusan, Rio de Janeiro, Santiago, Sao Paulo, Seoul, Singapore and Tunis. Unfortunately, it does not assign accuracy figures to individual cities so it is unclear which four systems are omitted from the evaluation of demand forecasts. The study does state, however, that “[o]nly in Manila and Tunis has the forecast traffic been approximately achieved, while in Calcutta, Porto Alegre, Rio de Janeiro, Santiago, Pusan and...Seoul patronage has been well below target” (1990, 10). Reporting on these same systems, a companion article by two of the co-authors reflects these city-specific findings, but also indicates that ridership in Hong Kong and Sao Paulo is falling short of forecasts (Allport and Thomson 1990, p. 7-5). Additionally, Allport and Thomson report that in Mexico City five of eight rail transit lines “f[a]ll a long way short of forecast,” yet do not provide an aggregate evaluation of the system (1990, p. 7-5).

Fullerton and Openshaw produced a comprehensive case study of the Tyneside Metro located in Northeast England (1985). They encountered many of the same problems as Pickrell did and, like him, they raised these and presented reasonable explana-

tions for their methodological decisions. For example, the 1982 ridership figures reflect patronage for a system that was not yet complete. Fullerton and Openshaw justify the use of these numbers for their comparison, however, by arguing that “the substitute metro buses will have loaded onto the network most of the trips that are likely to occur” (197). The authors also identify multiple travel demand forecasts for a single year. The report presents them all, but provides enough information about each to allow comparisons with other studies, including Pickrell’s, which focuses on the demand projections that were available when the choice among alternative transit improvement projects was made. The pre-build patronage forecast for the Tyneside Metro—the one used to justify funding—was 747 million boardings while the actual 1982 ridership numbered only 361.6 million—52% below the forecast (197).

The next two authoritative works are both British and examine estimates of future travel demand for U.K. transportation facilities. The more recent compares forecasts from 44 transportation studies—none project-specific—with actual trip volumes (Mackinder and Evans 1981). The report concludes that “trips by highway and by public transport were overestimated by averages of 30 to 35 percent respectively” (25). Brooks and Trevelyan produced a similar study two years earlier that focused on the predictive accuracy of travel demand estimates for thirteen road projects (1979). Among their key findings is that nine of thirteen travel demand forecasts overestimate traffic flows. They contend, however, that only two projects over-provided capacity (262). The report leaves open to question whether this reflects the magnitude of the overestimates, which can exceed 40% of actual (252), or the nature of the pre-1974 design standards.

Finally, Webber (1976), the earliest study that approaches the level of thoroughness later displayed in Pickrell's work, focuses exclusively on BART (Bay Area Rapid Transit), a heavy rail transit system then recently opened in the San Francisco Bay Area. BART carried 131,370 passengers in 1976, its fourth year of operation, which represents only 51% of the 1975 forecast of 258,496 prepared in 1961, the year preceding initial construction funding (85). Since Webber published his paper, many have provided their own perspective on BART in numerous studies and reports. However, in terms of patronage, there seems to be widespread agreement that BART failed to deliver as promised.

Uncritical reports. The literature contains a second tier of articles that also document the accuracy, or inaccuracy, of travel demand forecasts both in the United States and abroad. These articles, while still useful, suffer from one or more shortcomings, which should leave the critical reader uncomfortably skeptical to some degree. Four studies in this group, though relatively straightforward and thorough, in general lack a requisite critical assessment of the data presented. Warren (1995) evaluates ridership projections for the Saint Louis MetroLink light rail system without placing the forecast he uses in the proper context. Indicating only that the MetroLink operator generated the future ridership figures, the author does not report the year for which the forecast was prepared nor indicate that the operator prepared other forecasts. In fact, there was at least one other estimate of ridership and, while both forecasts do underestimate MetroLink patronage, the difference between forecast and actual demand was significantly different for each forecast (Richmond 1998b, 41-42). Likewise, a paper that assesses the demand forecasts for the New Jersey Transit Midtown Direct rail service is sometimes vague and

in places appears more an exercise in advocacy than a critical appraisal. The most glaring example is the abstract that exclaims, “It took a while to prove it, but here is a quick look at how close to the forecast the ridership is...” (Henry 1998).

A 1996 study by Muller is unique in that it evaluates forecast accuracy for U.S. highway projects (1996). It demonstrates that of the fourteen toll roads he examined, only three met or exceeded revenue projections. Revenues for the eleven underperforming projects missed estimates by 12% “to 75% in the initial years after opening. A majority missed or are likely to miss the revenue forecast in the second year by 40% or more” (16-17). Unfortunately, the author fails to consider the relationship between revenue and demonstrated demand even though the article seems to imply by its discussion of travel demand forecasting models that the relationship is approximately linear. Variable pricing in some form, however, might make revenue an invalid surrogate for travel demand. Even so, the differences between forecast and realized revenues in many cases are so large that the study likely has utility for generalizing about travel demand forecasts.

Another contribution with both utility and shortcomings tied to its uncritical approach is the Institute of Transportation Engineers (ITE) study published in 1980. It examined three transportation studies—none project specific—three air travel demand forecasts and revisited the BART project (Institute of Transportation Engineers 1980). This study, conducted by an ITE committee, is immediately suspect for its lack of focus and its unsatisfying explanation for selecting multiple project types. The selections do not seem dictated by methodology nor data availability as claimed. Rather the preamble implies that the decision on study projects likely represents a political compromise among committee members with varying agendas. The committee initially began analyzing

project specific forecasts before they abandoned the effort in the face of “admonishments” that such analyses would not be useful (25). The evaluation of BART, which adds little to Webber’s analysis, and the three airport passenger forecasts are termed “ancillary” and seem to be throw-ins.

Among other inconsistencies that cast doubt on the ITE report are (a) the evaluation of different variables across like project types (e.g., auto trips in one comparison and vehicle miles of travel in another), (b) the uncritical use of a self-evaluation by the forecasting agency for Metropolitan Milwaukee to demonstrate the highly accurate nature of the Milwaukee area travel estimates (25) and (c) the inclusion of misleading tables (31, 32). In one table, the committee calculates the numerical difference between forecast (X) and actual passengers (Y) for Washington area airports as $X - Y$, while in another table—essentially the same with identical column headings—the same figure for Dallas-Fort Worth Airport (DFW) is represented as $Y - X$. This results in totals for the “numerical difference” and “percentage difference” having the same sign in both tables, even though demand at DFW was overestimated and Washington’s underestimated.

Although unsatisfying on several accounts, the ITE study did include useful and credible data not before widely published, especially on the accuracy of large-scale transportation studies. In addition to the Milwaukee numbers, the report indicates that the Chicago Area Transportation Study forecast of average weekday travel for 1970 was optimistic by 10-14% and that the difference between the estimated and actual number of annual non-commercial auto trips in the Spokane, Washington region for 1975 was 8.1% of the observed figure (28).

Incomplete reports. A second group of tier-two articles also provides important information for documenting the precision of travel demand forecasts. These are often less useful, however, than the studies described above because they lack critical documentation and/or information to make forecast/actual travel comparisons meaningful. Principal in this category are three articles by Jonathan Richmond that, while helpful for understanding the history of particular projects, fail to present enough information to substantiate many key points (1991; 1998a; 1998b). For example, Richmond compares a forecast of 35,000 weekday daily passengers for the Blue Line of the Los Angeles light rail system at the end of the first year of operation with actual average weekday ridership after year-one of 27,500. Even though this forecast serves as the basis for important points—he includes this figure in all three works—it does not, however, seem to appear in any published reports or internal documents. In his dissertation he attributes the 35,000 forecast to a personal interview with the Deputy Executive Director of the Los Angeles County Transportation Commission (1991, 41). The 1998 articles contain no citation at all. In another instance, Richmond contends that forecasts for the San Diego El Cajon light rail line “were reduced for the alternatives analysis,” yet provides annual figures for the initial forecast and average weekday numbers for the subsequent ones without providing factors necessary to make the comparison transparent (1998b, 38-39). While there is no reason to believe that his contention is wrong, the absence of appropriate data such as this significantly reduces the article’s usefulness as a source of secondary data.

In spite of the sometimes incomplete nature of his work, Richmond provides forecast analyses for newer systems not published elsewhere (1998b). The Denver light rail line met expectations by carrying 117 average weekday riders more than the original de-

mand forecast of 13,000 (24). In San Jose, however, the light rail ridership was grossly overestimated. The observed totals for both 1992 and 1996 were 48% below the 1981 forecast for 1990 of 41,200 average weekday boardings (40). Finally, Richmond clarifies to some extent the accuracy of forecasts for the Saint Louis light rail (MetroLink) system by presenting critical forecasts for 1995 and 2000 and ridership numbers from two years, 1994 and 1996 (41-42). Although MetroLink patronage exceeds both forecasts, the magnitude of the difference between forecast and actual ridership in Warren (1995) is suspect compared with Richmond's description.

Richmond's work is also notable for its detailed description of the San Diego Trolley, which conventional wisdom holds, and cursory analyses (e.g., Walmsley and Pickett 1992) conclude, is a great success—at least in terms of patronage alone (see Gómez-Ibáñez 1985 for an economic perspective). Among other information, the treatment of the San Diego light rail ridership provides official forecasts and actual ridership numbers for the Blue Line for eight years between 1982 and 1995 (1998b, 37). While it shows patronage exceeding the 1995 forecast by 21%, it also demonstrates that ridership fell considerably short of the annual forecasts for the years 1982 through 1986. Finally, Richmond contributes to the literature on forecast accuracy by providing recent ridership figures for a number of systems that were the subject of earlier studies. More specifically, he lists the most recent patronage figures for seven of the rail systems—Baltimore (heavy rail), Buffalo, Miami Metrorail and Metromover, Pittsburgh, Portland and Sacramento—that Pickrell analyzed (1990). While none of these systems show significant ridership gains from the earlier study, Baltimore, Buffalo and Pittsburgh have actually seen ridership drop through 1995—through 1996 for Pittsburgh (chapter 2, *passim*). Richmond

also updates his own analysis of the Los Angeles Blue Line (1991) with ridership figures from 1996 that indicate the line will likely meet or surpass the initial forecast for the year 2000 (1998a, 298; 1998b, 26).

Two otherwise notable works (Walmsley and Pickett 1992; Mackett and Edwards 1998) are conspicuous for their key omissions. Walmsley and Pickett present the only analysis of the Grenoble (France) Tramway in a 1992 study. It concludes that actual ridership matched the demand forecast for the initial 8.8km line (1992, 6). The report fails, however, to provide references for the forecast, observed ridership and conversion factors the authors rely on to convert evening peak figures to daily total boardings. Although less acute, such incomplete documentation also raises doubts about the authors' treatment of the Tyneside Metro in the same report. The conclusions in this case very closely match the earlier work of Fullerton and Openshaw (1985). Surprisingly, though, Walmsley and Pickett never cite this study, which brings into question the authors' scholarship for lack of thoroughness or sin of omission.

Mackett and Edwards (1998) provide a wealth of information related to forecast accuracy. The most important contribution is their treatment of the Manchester (England) rail transit system—a project not commonly the subject of such studies. The data they present indicate that annual ridership in 1995 exceeded the forecast by about 23% (238). The failure, however, to qualify the patronage estimate, or otherwise place it in context, limits the usefulness of the analysis. Among the missing information is the forecast year, reasons for producing the forecast in the first place and an indication of whether other forecasts exist. The same article is also significant as a secondary source of information on travel demand forecasts and comparable rail system patronage. Rely-

ing on others, it updates actual ridership first presented in Pickrell (1990) for the Washington and Detroit rail systems. Washington Metro patronage improved from 72% of the original forecast in 1986 to 92% in 1993, while Detroit ridership dropped between 1988 and 1992 (239). Additionally, it reports on the Sheffield (England) Supertram actual ridership, which fell 24% short of the year-one forecast, although the final 7km of the planned 29km system was not in operation the entire year for which patronage figures were provided (240).

Beyond the significant omissions that seem to lessen the authority of Mackett and Edwards (1998), the authors also fail to adequately critique their sources. The most glaring example is the use of Hall and Hass-Klau (1985) to support conclusions about forecasting for the Tyne and Wear Metro (240). Hall and Hass-Klau's findings (1985, 142-43) differ radically from more complete analyses of the system (see Fullerton and Openshaw 1985; Walmsley and Pickett 1992) and the missing and incomplete references that they provide makes it impossible to determine why. Mackett and Edwards accept uncritically the Hall and Hass-Klau analysis and seem unaware of the competing studies, which, incidentally, were both published in their home of London. Likewise, the authors ostensibly have no reservations about Warren (1995), whom they cite without qualification (see discussion of Warren above).

Finally, the report of a U.K. Department of Transport evaluation effort lacks a number of key data. The study examines 41 English road projects and finds travel demand forecasts for 19 of these in error by more than 20% of the actual traffic flows. A 50% underestimate of demand and 105% overestimate represent the extremes (UKNAO 1988, 15). The most glaring omission is the failure to indicate how many erroneous fore-

casts overestimate and how many underestimate demand. Furthermore, except in the case of the extremes, locations of the subject projects do not appear in the documentation. In the absence of other identifying information (e.g., project completion date), this makes it impossible to determine whether any of these projects were included in other studies. Lastly, the absence in the report of details that describe the forecasts and traffic counts (e.g., dates) limits the ability to critically assess these comparisons.

Isolated accounts. A final group of articles in the second tier are best characterized as isolated accounts (Johnston et al. 1988, 468 footnote; Goetz and Szyliowicz 1997, 263; Dunphy 1995, 106-7; Hall and Hass-Klau 1985, 142-43; Love and Cox 1991, 16; Schumann and Tidrick 1995, 6, 13). The data are almost universally unreferenced in these reports directly related to forecast accuracy. The exceptions are citations from the Washington Post and of a consultant's unpublished table. Nevertheless, they do serve to corroborate findings from better-documented sources and therefore tables 1 and 2 include references to these. The sole source of data on the precision of patronage forecasts for the Edmonton, Calgary and Cleveland rail transit systems (Johnston et al. 1988) as well as Denver International Airport (Goetz and Szyliowicz 1997) are defined as isolated accounts. Therefore, these data are more questionable than others. Johnston et al. (1988) and Goetz and Szyliowicz (1997), however, are both peer-reviewed articles, which suggests the figures for these systems may be more reliable than other unreferenced material.

TABLE 1
Forecast Travel Demand Relative to Actual Rail Ridership

Location (System or Line)		Related Article(s)	Location (System or Line)		Related Article(s)
Edmonton	Low	A, B	Los Angeles (Blue Line)	High [§]	E, P, Q, F
Manchester, UK	Low	C	Miami (Metromover)	High	N
Saint Louis	Low*	D, E, F	Miami (Metrorail)	High	N, A, E, O
San Diego (Blue Line)	Low [†]	E, A, B, F, G	Øresund link, DK	High	H, I
Denver	Similar	E, J	Pittsburgh	High	N, E, O
Great Belt link, DK	Similar	H, I	Portland, Oregon	High	N, E, F, O
Grenoble	Similar	G	Porto Alegre	High	K, L
Manila	Similar	K, L	Pusan	High	K, L
N.Jersey (Midtown Direct)	Similar	M	Rio de Janeiro	High	K, L
Tunis	Similar	K, L	Sacramento	High	N, E, F, O
Baltimore (Heavy Rail)	High [‡]	N, A, E, O	San Francisco (BART)	High	R, A, S
Buffalo	High	N, E, F, O	San Jose	High	E, F
Calcutta	High	K, L	Santiago	High	K, L
Calgary	High	A, B	Sao Paulo	High	L
Channel Tunnel	High	H	Seoul	High	K, L
Cleveland	High	A	Sheffield, UK	High	C, T
Detroit	High	N	Newcastle Upon Tyne, UK	High**	U, C, G, V
Hong Kong	High	L	Washington	High	N, O, W

Source: See first listed related article.

Note: Related articles are as follows: A (Johnston et al. 1988), B (Gómez-Ibáñez 1985), C (Mackett and Edwards 1998), D (Warren 1995), E (Richmond 1998b), F (Dunphy 1995), G (Walmsley and Pickett 1992), H (Flyvbjerg, Bruzelius, and Rothengatter 2003), I (Skamris and Flyvbjerg 1997), J (Schumann and Tidrick 1995), K (Fouracre, Allport, and Thomson 1990), L (Allport and Thomson 1990), M (Henry 1998), N (Pickrell 1990), O (Pickrell 1992), P (Richmond 1991), Q (Richmond 1998a), R (Webber 1976), S (Institute of Transportation Engineers 1980), T (Harris 1994), U (Fullerton and Openshaw 1985), V (Hall and Hass-Klau 1985) and W (Love and Cox 1991). Except for source (K) and (L) items excluding Sao Paulo, “similar” means actual ridership is within $\pm 10\%$ of forecast. With the exception of Sao Paulo, (K) and (L) do not provide numerical data on forecast accuracy by city. Mexico City is not reported since source (L) does not provide an aggregate forecast evaluation for the system.

*Warren (1995) shows that MetroLink exceeded a first-year forecast by (+)161.3%. Richmond (1998b) relies on an earlier first-year forecast to arrive at a comparable figure of +8.4% after the second year of operation.

[†]Richmond (1998b) provides the most lucid account of forecast accuracy for the San Diego Blue Line. He reports ridership exceeding the 1995 forecast by 21%. However, ridership fell considerably short of forecast for the years 1982 through 1986.

[‡]Pickrell (1990) provides data demonstrating 1987 ridership 59% below forecast. Johnston et al. (1988) contend ridership exceeded the forecast by 5%, but provide no details or references.

[§]Refers to 35,000 (average weekday daily passengers) forecast for the end of the first year of operation.

**Hall & Hass-Klau (1985) and Mackett & Edwards (1998) contend that the Tyneside Metro nearly met or exceeded ridership expectations. However, both base their conclusions on the same unreferenced forecast and ridership figures. In contrast, Fullerton & Openshaw (1985) and Walmsley & Pickett (1992) provide detailed documentation that demonstrates the difference between forecast and actual ridership [(actual-forecast)/forecast] was roughly -50%.

TABLE 2
Forecast Travel Demand Relative to Actual Airport Passengers

Location (Airport)		Source	Location (Airport)		Source
Washington (National)	Low	S	Denver	High	X
Dallas-Fort Worth	High*	S	Washington (Dulles)	High	S

Source: S (Institute of Transportation Engineers 1980), X (Goetz and Szyliowicz 1997).

Note: The number of actual passengers for all airports varied by more than 10% of forecast.

*Reflects the most recent of three forecasts.

TABLE 3
Forecast Travel Demand Relative to Actual Highway Traffic

Location (Project)		No. Pro- jects >1		Source	Location (Project)		Source	
DK (Great Belt link)	Low			H	UK (A590 Lindale)	High		Y
DK (Sallingsund Bridge)	Low			I	UK (A64 York)	High		Y
UK (A12 Colchester)	Low			Y	UK (M25 Potters Bar)	High		Y
UK (A2 Lydden-Dover)	Low			Y	UK (M55 Blackpool)	High		Y
UK (A66 Keswick)	Low			Y	UK (M62 Ousebridge)	High		Y
Georgia (400)	Low			Z	UK (M69 Coventry)	High		Y
Illinois (N.S. Tollway)	Low			Z	UK (England)	High	39	AA
UK (England)	Low	34		AA	UK (Wales)	High		AA
UK (Wales)	Low	5		AA	California (Foothill N.)	High		Z
UK (A1 Lemsford)	Similar			Y	Florida (Sawgrass)	High		Z
UK (A30 Camborne)	Similar			Y	Florida (Seminole)	High		Z
UK (M5 Exeter)	Similar			Y	Florida (Veterans')	High		Z
Dallas (North Tollway)	Similar			Z	Houston (Hardy)	High		Z
UK (England)	Similar	64		AA	Houston (Sam Houston)	High		Z
UK (Wales)	Similar	18		AA	Okla. City (Kilptrick)	High		Z
DK (Farø Bridges)	High			I	Orlando (Orange-Con.)	High		Z
DK (Little Belt Bridge)	High			I	Orlando (Orange-North)	High		Z
DK (Øresund link)	High			H	Orlando (Orange-South)	High		Z
UK (A55 Chester S.)	High			Y	Tulsa (Creek)	High		Z

Source: H (Flyvbjerg, Bruzelius, and Rothengatter 2003), I (Skamris and Flyvbjerg 1997), Y (Brooks and Trevelyan 1979), Z (Muller 1996), AA (UKNAO 1988).

Note: Source (AA) does not provide specific project locations. Source (Z) projects (toll roads) reflect forecast revenue relative to actual revenue for the most recent year. Source (AA) projects reflect forecast travel demand relative to predicted highway traffic for year-15 based on actual flows. The differences between forecast and actual traffic [(actual-forecast)/forecast] are within approximately $\pm 10\%$ for projects labeled "similar," except for source (AA) projects, which are within $\pm 20\%$. Does not include results of the U.K. Department of Transport study reported by the National Audit Office (UKNAO 1988) since they generally reflect only absolute error of the inaccurate forecasts.

TABLE 4
Forecast Travel Demand Relative to Actual Demand for Non-Project-Specific Studies

Location		No. Pro- jects >1	Source	Location		No. Pro- jects >1	Source
Germany	Low		H	Chicago	High		S
Milwaukee	Similar		S	Spokane	High		S
United Kingdom	High*	44	BB				

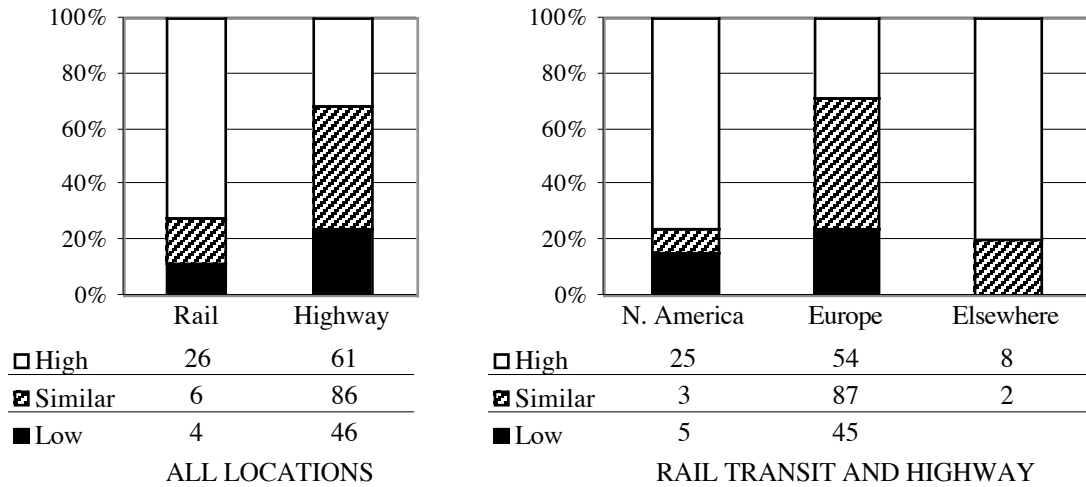
Source: H (Flyvbjerg, Bruzelius, and Rothengatter 2003), S (Institute of Transportation Engineers 1980), BB (Mackinder and Evans 1981).

Note: Except for source (H) item, “similar” means actual travel demand is within $\pm 10\%$ of forecast demand.

*Mackinder and Evans (1981) provide only average deviation from the forecasts aggregated by mode.

Tables 1 through 4 summarize the accuracy of travel demand forecasts that appear in the literature. Since the forecast evaluation procedures either are not specified in individual reports or vary considerably among projects and studies, it is not instructive—and in fact potentially deceptive—to provide a quantitative summary documenting the magnitude of the error without further research to reconcile the inconsistencies. Furthermore, since the projects and studies listed in these tables do not constitute a statistically valid sample, quantitative techniques have little utility for demonstrating widespread bias in travel demand forecasting for it. In spite of this, inspection of the evidence presented to this point suggests that bias in travel demand forecasting is pervasive in the United States and for rail projects globally (figure 1).

FIGURE 1
Forecast Travel Demand Relative to Demonstrated Demand by Mode and Location



Note: Does not include results of the U.K. Department of Transport study reported by the National Audit Office (UKNAO 1988) since they generally reflect only absolute error of the inaccurate forecasts.

Obviously, the numbers are not overwhelming. Only for particular modes in specific locations do the data approach a satisfying level of conclusiveness (e.g., highway projects in England). Further study is important for better understanding forecasting error. For those who acknowledge widespread bias, additional research is critical for formulating strategies to effectively ameliorate the problem. Those who remain skeptical would presumably value more conclusive findings, which may provide alternative explanations of the available data. Why then are there not more studies that seek to measure and describe the forecasting problem? Beyond suggesting ways to foster more research, the answers might provide insight into the origin of bias.

EXPLAINING THE RESEARCH VOID

“It is surprising that so few attempts have been made to identify the levels of forecast error...” (Fullerton and Openshaw 1985, 193). Although, judging by the literature, this sentiment is not widespread, neither is an understanding of why there remains a

dearth of research on the accuracy of forecasts. Informally, some in the academy feel that more recently estimates of travel demand have improved, which obviates the need for increased investigation. There seems to be no compelling evidence, however, to support this view, regardless of advocates' claims that forecasts are better now (American Public Transit Association 1990, 6, 8). At least historically, data for federally supported rail projects indicate that average error in forecasting increased from 44% to 80% over an approximately fifteen year period (Pickrell 1991, 5). One professor speculates that participants in the debate have concluded, at least temporarily, that they will never agree on the dimensions of the forecasting problem and therefore have focused their energies elsewhere.

Only Fullerton and Openshaw (1985) explicitly question why the research is inadequate. They conclude that "those who possess the necessary data lack the necessary will to investigate what could turn out to be their own off beam forecasts, while those with the necessary will lack the data that are needed" (1985. 193). The implication of stonewalling is clear and seems to correspond with the experience of at least one researcher who found some transit agencies less than helpful (Richmond 1998b, 16). Muses an observer, "[these operators] may, indeed, be positively reluctant to supply [forecast and ridership] information, which is understandable given that few systems entirely live up to their expectations" (Walmsley and Pickett 1992, 11). Some might object to this characterization of the problem by claiming that the data sought by reviewers are not generally available simply because they no longer exist or were never assembled. Even so, the failure to collect and archive such data by those in positions to do so sug-

gests that these planners have little interest in assessing their forecasts—claims of insufficient resources notwithstanding.

Another possible reason for this relative lack of research is that inaccurate travel demand forecasting has yet to attract grassroots attention. “Why doesn’t the public catch on eventually? Because...construction takes a long time and memories of the original promises are short” (Lave 1991, 12). Commonly, public agencies revise downward their demand forecasts as construction on transportation improvements nears completion. Such was the case for Denver International Airport (Goetz and Szyliowicz 1997, 263), BART (Hamer 1976, 70) and light rail in the Banfield corridor of Portland (Pickrell 1990, 4-5) to name three. Typically, this allows local officials to declare early success when initial demand exceeds the revised forecast. The Channel Tunnel for which later demand forecasts reflect greater optimism is the notable exception. Because of the project’s unique financing, the optimism served “to preserve the confidence of the shareholders and banks when cost overruns became apparent...” (Flyvbjerg, Bruzelius, and Rothengatter 2003). Even if unrealized promises produce a negative backlash, the elected officials who made them are usually no longer in office when construction is completed since project leadtimes are long (Bruzelius, Flyvbjerg, and Rothengatter 1998, 224). Alternatively, Moore explains the public’s lack of attention in economic terms, contending that, at least for rail transit,

[v]oters remain rationally ignorant because they can afford to...having better things to do than investigate the opportunistic assumptions underlying agency forecasts or undertake the calculations necessary to annualize the opportunity and replacement costs of the capital tied up by existing or proposed rail systems. (Moore II 1994, 50, 52)

In the case of tollroads, Muller believes that the “forecasting failures have drawn little attention because none have resulted in a monetary default” (1996, 20). The most recent data, however, suggest that may change.

In the United States, the federal government also conceivably plays a role in effectively suppressing research related to assessing travel demand forecasts. Curiously, more travel demand estimates have undergone scrutiny in Great Britain than in the United States. This appears attributable, at least in part, to recognition by UKNAO and—in England particularly—by the Secretary of State’s Standing Advisory Committee on Trunk Road Assessment and its predecessor that ex-post analyses are valuable (Brooks and Trevelyan 1979, 251; UKNAO 1988, 12). In contrast, after the U.S. Urban Mass Transportation Administration published Pickrell’s research, the U.S. Department of Transportation (USDOT) no longer seems eager to fund similar forays nor does the agency appear to have implemented any of the report’s recommendations. It is perhaps not responsible to speculate on the motivations of USDOT except to note that it has the enormously difficult task of balancing the competing demands of Congress, transit advocates and the highway lobby.

Transportation scholars that compete for the research dollars that USDOT controls have considerably less influence with the agency. If the ostensible reticence of USDOT to fund further studies on forecast accuracy is real, it behooves academics interested in future support to steer clear of the topic—and providers subsidized or contracted by USDOT to steer clear of the academics—even if the wherewithal for such a study is available from other sources. This dynamic may help explain why some researchers avoid tough questions when it comes to documenting forecasting bias. While instances of such

are by nature subtle, Johnston et al. are forthright in at least one account when noting that they are “unwilling to determine if the local elected officials directed the...staff to fudge the [operating and maintenance] assumptions” (1988, 467). This dynamic also raises questions about the responsibility of scholars and underscores the inherent difficulty of maintaining an independent voice within the academy amid pressure to satisfy colleagues and win the support of funders. In this light, Lave’s admonishment is unsurprising. “[There] is evidence of bias. We have a professional duty to examine and improve predictions” (1991, 10).

In some cases, methodological difficulties dissuade investigators from pursuing questions of forecast accuracy. Chief among these is the inability to employ a strict experimental or quasi-experimental design to explain forecasting error. Rarely are forecasting assumptions and methodology transparent and even more rarely are vintage models preserved in working order. As Pickrell and others have demonstrated, however, this does not preclude the production of useful and authoritative studies that not only document error, but also provide defensible conclusions concerning its origin. Besides unfamiliarity with alternative research techniques, reasons related to methods for failure to evaluate forecasting more closely may be political to some degree. An ITE committee claims methodological problems prevented it from examining the accuracy of forecast travel demand on major transportation facilities and, similarly, the Department of Transport in England questions forecast comparisons that employ less than ideal methods. The simplistic arguments that both present, however, seem merely justifications for abandoning efforts that might have produced findings unflattering to fellow professionals (Institute of Transportation Engineers 1980, 25; UKNAO 1988, 16).

An article by Demery (1994) in a prominent journal questions the usefulness of the comparison Pickrell and others make. This might indicate a wider skepticism about the utility of forecast evaluations that could help explain why there are not more such studies. Unfortunately, the lack of attention in the literature to Demery's article makes it difficult to gauge the extent to which his argument has currency with researchers. In isolation, reasons for ignoring an article are as attributable to the acceptance of its arguments as to their universal rejection. However, Demery's thesis contains no fatal flaw that might give cause to summarily reject it. Therefore, it does seem to merit consideration.

Briefly, Demery contends that capacity constraints on rail transit systems limit patronage. More capacity during peak hours, he argues, would produce greater ridership. In fact, others do suggest that some forecasts were well beyond the capacity of systems designed to accommodate them. Commenting on the Tyneside Metro, Walmsley and Pickett note that it is "difficult to see how the system could carry the forecast number of passengers" (1992, 9). Demery's argument, however, hinges primarily on the assumption that the capacity threshold at which travelers in the United States will select an alternate mode lies well below actual capacities of fixed-guideway vehicles. This is not the case in Hong Kong, Mexico City and Sao Paulo (Allport and Thomson 1990, p. 7-5), although variations in the availability of alternate modes presumably explain some of this difference. It would be a relatively simple task to test this premise and others that are key to the argument but ill supported. By choosing not to, the transportation research community might be signaling its ambivalence towards forecast evaluations, which effectively downgrades the priority such studies have among otherwise interested scholars.

Ultimately, the research void may, more than anything, stem from the implicit assumption of investigators that they understand the forecasting problem. This is a prediction of what Kuhn terms *normal science*, which “often suppresses fundamental novelties because they are necessarily subversive of its basic commitments” (1970, 5). For transportation planners and engineers, rejecting normal science means setting aside algorithms for less familiar research techniques designed to improve planning outcomes. The literature is littered with examples of suppressing or otherwise ignoring evidence of bias (i.e., a fundamental novelty) in travel demand forecasts presumably because it subverts an understanding of inaccuracy as simply flawed methods. According to Dunphy, “It is especially important to suggest improvements to the technical procedures needed to produce credible forecasts” (1995, 113). This conclusion is typical of those found in studies that focus on optimistic travel estimates. Other articles are conspicuous by their failure to acknowledge the systematic nature of the error they present (e.g., see Brooks and Trevelyan 1979; Mackett and Edwards 1998; Muller 1996; Walmsley and Pickett 1992). If Kuhn is right, though, “the very nature of normal research ensures that novelty shall not be suppressed for very long” (1970, 5). Indeed, some scholars do identify bias by name and have geared their research towards understanding it. Writes Lave, “The serious issue here is not accuracy but bias” (1991, 10).

UNDERSTANDING BIAS

Why are travel demand forecasts so seriously incorrect? Clearly, inadequate methods bear some blame for the problem. Most concede that the technical deficiencies of transportation models are significant. One expert is unequivocal in her criticism. “Transportation models used in planning practice today are not good models. They are

not internally consistent and they have no basis in behavior” (Giuliano 1998, 5). The utility of algorithms designed to predict changes in exogenous variables on which the models depend are even more questionable. At their best, these predictions sometimes amount to little more than educated guesses. What procedure, for example, would have foretold the declining real price of fuel over the last two decades? However, in spite of these shortcomings, flawed methodology alone cannot account for errors in travel demand forecasts. Three key findings support this contention.

First, forecasting errors are increasing over time (Pickrell 1992, 164) and more sophisticated modeling techniques have no apparent impact on the accuracy of forecasts (Mackinder and Evans 1981, 26). This serves to exonerate travel demand models and stands in contrast to claims by transportation practitioners that modeling has improved greatly and today forecasts are more highly scrutinized (Dunphy 1990, 38). Second, the magnitude of forecasting errors cannot be fully explained by methodological shortcomings. Pickrell concludes that “errors in projecting ridership...were so large that they are unlikely to be eliminated by technical changes in the way forecasts are produced” (1992, 169). Likewise, Mackinder and Evans could establish no relationship between the deviation of estimated demand from measured demand and either modeling techniques or the forecast error of exogenous variables (1981, 19-20).

Third, forecasting errors are systematic in nature. This finding is most damning to the conclusion that inaccurate estimates are simply the result of imperfect techniques—and travel demand modeling thus is inherently an inexact science. Unbiased forecasting will produce a random distribution of errors. However, nearly every rail study indicates that estimates of travel demand are usually optimistic, often wildly so.

Skamris and Flyvbjerg state that “the differences between forecast and actual costs and traffic...cannot be explained primarily by the inherent difficulty in predicting the future.

The difference is too consistent and too one-sided for this to be the case” (1997, 145).

Similarly, Pickrell contends that

[t]he planning process for many of the largest local infrastructure projects this nation has ever seen is systematically unable to produce reliable information upon which to base public investment choices. This failure does not simply reflect the difficulty of foreseeing the future course of inherently uncertain events, since virtually every error...steered the planning process in the *same* [italics in original] direction, namely towards the most capital-intensive rail transit option under consideration. (1992, 168-69)

Finally, Flyvbjerg and Holm conclude for their large sample that “[t]here is a massive and highly significant problem with inflated forecasts for rail projects. For two-thirds of the projects, forecasts are overestimated by more than two-thirds” (Forthcoming).

Evidence of bias is more problematic for other types of projects. Muller’s data suggests that the demand for toll roads in the U.S. is systematically overstated (1996). On the other hand, the UKNAO study—161 U.K. highway projects—does not uncover bias in the forecasts it evaluates (1988). Additionally, Flyvbjerg and Holm contend that “[t]here is no significant difference between the occurrence of inflated versus deflated forecasts for road traffic” (Forthcoming). Nonetheless, no one yet seems willing to conclude that biased forecasting is exclusively a rail problem. The knowledge base for highway traffic forecasting as well as other non-rail transportation demand analyses is still too narrow, if not entirely shallow.

Regardless, “[appraisal optimism] is arguably the greatest problem of all [in the evaluation of transportation projects]...” (Mackie and Preston 1998, 5). Similar statements are now common in the transportation literature and rarely if ever challenged. Dissenting articles are, by and large, relegated to rail advocacy publications and seem in-

tended solely to refute specific findings that cast doubt on particular projects or professionals. In fact, researchers have documented the reality of pervasive bias in rail patronage forecasts to such a degree that their focus has largely shifted towards understanding bias—its origin, cause and significance. An exchange in the *Journal of the American Planning Association* exemplifies this trend. Rather than objecting to Alan Black’s unflattering characterization of light rail transit analyses, which includes biased forecasts, James Moore takes issue with his failure to acknowledge the virulence of the problem. Moore retorts colorfully, “Having successfully unscrambled the eggs, he is reluctant to eat them” (1994, 51). How then is bias in forecasting understood? Corruption—deliberate and dishonest exploitation of power for personal gain—is the most common interpretation of the problem.

CORRUPTION

An enhanced image is usually the benefit to politicians for promoting the preparation and consideration of biased forecasts that favor capital intensive transportation improvements (Wachs 1990, 145). Favorable forecasts are usually necessary for winning financing of projects that recapture tax dollars sent outside local jurisdictions and bringing home the bacon plays well with local voters. Demand forecasts prepared after build decisions (e.g., the Grenoble tramway) appear to always be the most accurate. In some cases, unviable transportation projects enjoy support because they promise to remedy a collective citizen inferiority complex about the national and global standing of their city. For transit projects in particular, a “diminished expectation of financial performance” makes even bad projects popular (Johnston et al. 1988, 469). Some transportation investments are winning issues for politicians simply because they are not unpopular.

Light rail transit projects are less likely to generate opposition because they have few of the negative externalities associated with highways and other transit technologies (Johnston et al. 1988, 470).^{*} More broadly, transit is a “policy for all perspectives,” which Altshuler, Womack and Pucher found in their research.

Whether one’s concern was the economic vitality of cities, protecting the environment, stopping highways, energy conservation, assisting the elderly and handicapped and poor, or simply getting other people off the road so as to be able to drive faster, transit was a policy that could be embraced. This is not to say that transit was an effective way of serving all these objectives, but simply that it was widely believed to be so. (1979, 36).

Private consultants are presumably motivated by financial gain to provide bogus forecasts. A willingness to produce favorable estimates is sometimes important for obtaining and/or retaining lucrative contracts. In addition, less specialized firms stand to gain from optimistic assessments by providing the opportunity to compete successfully for engineering contracts related to construction of the project they were initially hired to study (Pickrell 1991, 4; Hamer 1976, 251; Wachs 1990).

By most accounts, the bias of travel estimates stems from the unjustified use of optimistic assumptions and hopeful external forecasts of critical variables to which the demand evaluation is highly sensitive. However, even when the technical details of the forecasting process are transparent, they can only suggest reasons for employing unrealistic inputs. Corruption is not a foregone conclusion since such a finding requires both evidence of *intent* and *self-interest*. Indeed, it is extremely difficult to firmly establish willful wrongdoing without the cooperation of professionals within consultancies and public agencies that prepare demand forecasts. Even then, it is very hard to identify the

^{*} Of course, there are examples of unpopular transit proposals, but these are rare. In Houston, Mayor Kathy Whitmire essentially fired the Chairman of the local transit board, Bob Lanier, for opposing a proposed heavy rail system. Lanier subsequently defeated Whitmire in her bid for re-election on the popularity of his position (Kain and Liu 1995, p. 4-25).

responsible parties and their particular motivations (Kain 1990, 184; Wachs 1990, 150) Without the proverbial smoking gun, investigators must construct circumstantial cases to arrive at a verdict of corruption. Some cases are, of course, stronger than others.

The deliberate use of highly optimistic projections of downtown employment by Dallas Area Rapid Transit (DART) is the most conclusive case of corruption by local officials and professionals. “DART also tried to hide unfavorable ridership forecasts from the public and seriously misrepresented these forecasts when they were finally released” (Kain 1990, 185). In both instances, “...advocates were clearly acting out of perceived self-interest” (Kain 1990, 193). Johnston et al. identify “manipulation” of ridership projections for the Sacramento light rail system and conclude that “the interests...of local political leaders tend to place them in support of rail projects” (Johnston et al. 1988, 465-66, 469-70). While not explicitly making the connection, the implication of corruption seems clear.

More circumstantial cases abound. As far back as 1972, Kain exposed misconduct by the transit operator in Atlanta (MARTA). In one instance, MARTA paid its consultant to prepare and present travel forecasts predicated on the unrealistic doubling of employment in two critical areas. This was done even though the consultant was obviously uncomfortable with the employment assumption (Kain 1972, 41). Additionally, the Southern California Rapid Transit District applied pressure on consultants in 1974 to alter modeling assumptions when preliminary analyses suggested rail rapid transit may be unnecessary in Los Angeles (Hamer 1976, 204) and the Houston transit operator refused outright to change unrealistic transfer penalties values in its forecasting models (Kain 1992, 489). Finally, the literature contains firsthand accounts of travel demand modelers

who were pressured to change their forecasts to satisfy superiors (Wachs 1990, 144). While self-interest is not an altogether obvious motivation in these examples, since it is consistent with the facts of each case and there are no compelling reasons to entirely exclude it, corruption seems to be a highly appropriate conclusion.

Lave likens the process of understanding biased forecasting to solving a mystery. He asks, “Can we establish motive, opportunity and means?” (1991, 10). For the most obvious cases of corruption, this is a relatively simple task. However, even when the verdict is more problematic, it is possible to construct a compelling narrative that leads to the wrong conclusion. This is where the metaphor breaks down. In court, the defense counsel must provide competing explanations for consideration by the judge or jury. Researchers, on the other hand, cannot always count on themselves or peers to play this role. In fact, they are apt to assume answers *ex ante* and discount evidence that does not fit their understanding (see Kuhn 1970). Unsupported by a preponderance of evidence, the widely held view that biased forecasting stems from corruption suggests broad acceptance of an inconclusive explanation. Kain observes that “...abuses similar to those [in Dallas] are commonplace and occur in varying degrees in virtually every metropolitan area, both in the United States and overseas” (1990, 193). While there is no compelling reason to doubt the veracity of Dr. Kain’s statement, the lack of empirical data to properly support it does seem to indicate a race to generalize. Not surprisingly, alternative explanations for bias are scarce.

OTHER INTERPRETATIONS

For the most part, alternative reasons for bias in travel demand forecasts are not well developed and therefore it is difficult to test such hypotheses. For example, Webber

describes an uncritical faith in the utility of BART as precluding a rational assessment of the system (1976, 106), while Kain, presumably describing the same phenomenon, lists an *unswerving and blind commitment* to rail as another possible cause of questionable behavior at DART (1990, 193). These and similar accounts provide little with which to craft a coherent explanation that can compete with the case for corruption. Even experienced professionals who reject corruption out of hand find it difficult to provide anything more than a defensive response to unsavory assertions.

...I resent the implication that anyone favoring rail transit is dishonest. I practiced planning for ten years, and sometimes I helped make forecasts of transit ridership. I didn't cheat, nor did my coworkers. Many knowledgeable people in transportation planning consider light rail a good option in certain circumstances. I know some of these people personally, and I do not think they are liars. (Black 1994, 53)

Several authors have tried to go beyond labels by providing a narrative that describes the phenomenon they identify. Mackinder and Evans speculate that "...local authorities might be expected to err on the optimistic side when estimating future growth in their area...because a predicted decline in the area's prosperity was [sic] unthinkable..." (1981, 14). Lave, contending that "idealistic motivations can...produce distorted forecasts," explains:

We all know planners who work for the cities, passing up lucrative consulting jobs. They envision a better environment in which increased transit use could solve many of our urban problems. So do I. But they are so certain about how people ought to commute that they have talked themselves into believing it is possible to make them behave that way.... Give such idealists the task of evaluating a transit project and you may find that they have consciously slanted the judgment calls in the direction of feasibility. (1991, 11-12)

Alternatively, Hamer interprets a process that leads *imperceptibly* to biased forecasts. He believes that rail advocacy

...reflects a nostalgic desire for a bygone period of urban life whose characteristics were shaped by primitive technology and low per capita incomes. In such a world, most workers were employed in the core and most residents lived in radial corridors and commuted by public transportation. Out of this posture flow the innumerable regional goals for the world of tomorrow. These in turn lead imperceptibly to forecasts that include spurious population and employment targets for the central [areas]. It is this framework, with its

prediction of rapid increases in downtown-oriented travel, that creates the statistical panic needed by advocates of rail rapid transit. Establishing the superiority of rail rapid transit is then a mere formality. (1976, xiii)

Finally, from a French study, are suggestions that poor travel demand forecasts stem from inattention. Key to this idea is a finding that when the impetus behind a rapid transit system comes from technically-oriented individuals, the proposals tend to concentrate on the technological aspects of the system with less emphasis placed on the financial and operational aspects, which include patronage forecasts (Walmsley and Pickett 1992, 12).

Taken individually, these fragmentary observations and incomplete narratives do at the least remind those seeking answers that there are possibilities, beyond corruption, for explaining bias in forecasting. Aggregately, they suggest that problems of cognition may be the source of bias. Richmond stands out as one of the few authors that have endeavored to test this theory, albeit tangentially. His comprehensive case study of the Los Angeles rail transit system demonstrates convincingly that a *failure of thought* was to blame for the questionable decision to build the Blue Line (Richmond 1998a, 296). In short, he shows that reason is often metaphoric and, as such, the usefulness of any conclusion depends on the aptness of the metaphor on which it was based. Thus, he begins to build a case against the conclusion that bias in forecasting stems from corrupt motives of politicians.

In spite of the Richmond's efforts to systematically explain bias, the corruption verdict still dominates. Why is this so? First, in the absence of a compelling alternative hypothesis, there is no impetus to challenge conventional wisdom and very few have provided alternatives that can compete with the rationale of corruption. Competing research paradigms (e.g., grounded theory) have yet to achieve widespread acceptance, at least among investigators and funders potentially interested in the questions of travel demand

forecasting. Second, alternatives must ostensibly come from other disciplines such as philosophy, psychology and cognitive science. However, unlike planning, there does not seem to be a multidisciplinary tradition in other fields related to transportation research. This is where the lack of a unifying paradigm in planning has been positive for the discipline. Third, few researchers interested in travel demand forecasting are likely familiar enough with the qualitative methods required to answer the question of bias regardless of the hypothesis. Even a cursory review of engineering, planning and economics curricula suggest that they are likely to stress quantitative skills at the expense of other research methodologies. This perhaps best explains why most investigators focus more intently on questions of methodology rather than those of motivation. Finally, entertaining an alternative to corruption can be threatening to some who might otherwise consider it. If transportation professionals explain human failure in forecasting in a different way, they may have to reconsider their own fallibility.

RESEARCH AGENDA

To some degree, the discussion above suggests a research program necessary to further describe and explain bias in travel demand forecasts. However, an agenda for further study bears encapsulating to underscore the most important research needs. Its presentation also provides the opportunity to introduce lines of inquiry not previously pursued in the context of travel forecasting.

DESCRIPTION—MEASUREMENT OF THE PROBLEM

Since a great majority of studies that examine the accuracy of travel demand forecasts describe the problem of bias—many ably—it is tempting to recommend that further research should be directed towards explaining the origins of bias. However, to do so,

one must ostensibly ignore the critical role an adequate description of the problem plays in *generating, crafting* and *establishing* credible explanations for it. An accurate description that challenges conventional wisdom can serve as a catalyst for studies that seek explanations. For example, the view that forecasts are better now than they were a decade ago has little to support it,* yet some point to this belief as a reason more have not examined travel forecasts in recent years. Changing a common conception such as this may spur more researchers to examine the problem, including its causes. Furthermore, exposing misconceptions provides investigators with a different perspective from which may stem new insights to test and refine. Consider Demery (1994) again. Had he provided the critical evidence necessary to more forcefully support his claim that capacity constraints of rail transit systems make travel forecast evaluations meaningless, would his analysis have been so universally ignored?

Beyond providing an impetus for further work, better descriptions of the forecasting problem enable researchers to produce more concise explanations. Perhaps the most pressing need is to better understand the value of geography—a surrogate for institutions particular to a country or group of countries—and mode as independent variables for predicting bias. Of the ten rigorous reports on travel forecast accuracy, six focus exclusively on European projects. Excluding Flyvbjerg and Holm (Forthcoming), the details of which are not yet available, European projects represent 80% of those reviewed above (table 5). Furthermore, there are no authoritative reports on travel estimate precision for highway projects beyond Europe with the possible exception of Flyvbjerg and Holm (Forthcoming). In the United States, this represents a significant barrier to generalizing

*Bent Flyvbjerg and his colleagues conducted the only truly rigorous studies of forecast accuracy since 1990 (Flyvbjerg and Holm Forthcoming; Flyvbjerg, Bruzelius, and Rothengatter 2003; Skamris and Flyvbjerg 1997).

and exposes investigators to charges of being “anti-rail extremists” (see Vuchic 1991, 16-18). Broader reviews both in terms of mode and geography would, among other things, help researchers determine whether prescriptions aimed at improving forecast accuracy are sufficient and properly directed. For example, Pickrell (1992, 170) recommends changing how the public sector funds capital improvements for rail transit in the United States to ameliorate the problem of bias. However, a greater understanding of the funding mechanisms and forecast accuracy for rail transit systems in other countries would serve to further test the idea by isolating the funding variable.

TABLE 5
Project-Specific Travel Demand Forecast Evaluations

Mode	Project Location			Total (%)
	North America	Europe	Elsewhere	
Rail	19	7	10	36 (15)
Highway	14	179	0	193 (82)
Air	4	0	0	4 (2)
Total (%)	37 (16)	186 (80)	10 (4)	233

Source: Tables 1-3.

Note: Total percentages may not equal 100 due to rounding.

Finally, without a better reading on the extent of the problem, the value of alternate explanations and the accompanying prescriptions for reform are open to question. Regardless of aggregation, estimating the percentage of travel demand forecasts scrutinized in any particular study or group of studies is critical. Although limits on the availability of essential data makes it extremely difficult to construct a statistically valid sample, understanding the scope of the problem is important to justify generalizations. Obviously, a conclusion about estimates of travel demand for highways in Canada, for instance, will have greater force if investigators evaluate 10 percent of such projects rather than just 1 percent. Mackinder and Evans began their investigation by producing an ex-

haustive inventory of transport studies with pre-1971 base years for projects constructed in the United Kingdom—118 in all—before selecting an appropriate subset of 44 to examine (1981, 3-4). Likewise, in 1988, UKNAO counted a total of 237 road sections opened in England and Wales since 1980 of which they evaluated roughly two-thirds. This approach appears unique to these two studies among those employed to examine travel forecasts. Investigators can enhance both the ease of constructing such inventories and the ability to select samples more randomly in the future by acting proactively to archive critical information. Researchers have complained about the dearth of necessary data to carry out forecast evaluations for nearly two decades (see e.g., Fullerton and Openshaw 1985). Taking on the function of archivist or promoting efforts that require or otherwise encourage preservation of key documentation, would have most certainly provided researchers the means to say much more about this problem than they can currently. Bias in travel demand forecasts does not seem to be going away. Therefore, such planning should start now.

EXPLANATION—REASONS FOR THE PROBLEM

Few scholars buttress explanations for bias in travel forecasts with empirical data. This does not mean that compelling narratives supported by largely anecdotal evidence are not meaningful. On the contrary, these accounts provide fertile ground from which to cultivate hypotheses that form the basis of explanatory studies. However, researchers have been slow to move ahead with this work. Only three case studies clearly identify reasons why particular forecasts are biased and, furthermore, the question is ancillary to each one of them (see discussions above of Kain 1990; Richmond 1991; Johnston et al. 1988). Additionally, these studies all focus on light rail transit projects in the United

States, which suggests there are substantial limits to their combined power for explaining forecasting bias more broadly.

Beyond exhibiting a general lack of attention to reasons for biased forecasting, the literature exposes two glaring research needs relative to understanding bias. First, investigators need to focus on the part individual modelers play in producing biased estimates of travel demand. When Bruzelius, Flyvbjerg and Rothengatter consider a lack of accountability as responsible for bias, the only actors they fail to mention are the technicians (1998, 425). While some (e.g., Hamer 1976) implicate consultants to some degree, it is rare to see blame directed at the professionals who produce the numbers. Pickrell comes close when he states that “[a] wide margin of forecasting error may...signal analysts’ complicity in demonstrating the purported technical superiority of projects that could not prevail in an unbiased evaluation...” (1992, 159). Only Wachs explicitly considers the role of modelers (1989; 1990). Unfortunately, while his are important contributions to the discourse, Wachs’ work does not lend itself well to generalizing beyond the anecdotal cases he presents. Perhaps the failure to question the actions of modelers stems from a common conception that they are relatively unimportant players in the forecasting drama whose only alternative to scripted lines is to play the moral hero. Regardless, the search for answers must include not only top-down studies like those of Johnston et al. (1988), Kain (1990) and Richmond (1991) that seek to understand the suspect actions of decision-makers, but also bottom-up ones that will question why modelers produce biased estimates.

Second, there is a conspicuous need to both recognize and understand the *ethical* questions inherent in explaining bias in forecasting. Ostensibly, Wachs is the only one

who uses any form of the term “ethics” in the context of travel demand estimation. On the contrary, regardless of actor, it is common to find accounts of questionable behavior in the forecasting discourse couched in innocuous ways. In an early piece, Hall mentions how details of a crude modeling approach were “tucked away in an appendix of [a] report” and then continues on to explain the technical details without comment on the ethical implications of such an action (1982, 66). Without comment, Walmsley and Pickett explain that “any forecasting procedure...will produce a range of estimates, and proposers may—consciously or not—be tempted to plump for the optimistic end of the range...” (1992, 11). Finally, Black, apparently unconcerned that citizens lack the same perspective as policy makers for assessing travel forecasts, asks rhetorically, “if a majority of citizens prefer rail to bus and are willing to pay for it—as sometimes indicated in elections—then who can say that they are wrong?” (1993, 158). The purpose of these examples is not to disparage the authors. Obliviousness to important questions does not necessarily imply complicity or lack of scholarship. Rather, it is simply to show that ethical considerations in forecasting, as in other professional activities, are often neglected.

More generally, the dearth of rigorous empirical research in the broader context of professional ethics is striking. What little there is usually fails to hit the mark and produce the valuable first hand accounts of ethical challenges that emerge in practice. Addressing planners in particular, Darke laments the current state of affairs:

The dominant emphasis is ... to seek to generalise either by a ‘top-down’ approach using established theories and concepts in the broader subject of moral philosophy and ethics or by attempting to place particular practice accounts into a broader framework of planning theory or policy process which runs the risk of losing the particularities of the policy context. (1996, 6)

Hendler’s collection of essays (1995) does present a number of case studies on ethics that include some critical context, yet Darke concludes that their authors race to generalize

and do not provide a sufficient base of empirical knowledge. In any case, none of these focuses on the unique ethical challenges of forecasting.

A study by Davis is a notable exception to this trend to generalize (1992; 1998). It involved sixty in-depth interviews with engineers at ten separate companies to understand the ethical dimensions of their technical communication with superiors. While the study only indirectly raises issues central to travel demand prediction, it demonstrates the utility of empirical research on ethics that pays close attention to context. Another good example of empirical research in professional ethics is John Forester's article on judgment and learning in transportation planning (1994). This article presents a detailed interview with a single transportation planner and, again, while it does not broach the ethical issues inherent in travel forecasting, it demonstrates that, by letting the facts speak for themselves, a detailed account of practice can be highly instructive.

The needs for adequately describing and explaining bias in travel demand forecasting are disturbingly broad and imply a dearth of research in professional ethics that extends beyond consideration of erroneous travel estimates. This study is a contribution to the literature on forecasting bias and addresses the most glaring need detailed above—understanding the ethical challenges of travel demand forecasters and how the responses of these practitioners contribute to or retard the production and use of biased analyses.

CHAPTER 2

THE ETHICAL DIMENSIONS OF TRAVEL DEMAND FORECASTING

A critical starting point for this study is the assumption that bias systematically pervades travel demand forecasts. An equally important distinction accepts forecasting bias as symptomatic of questionable ethical choices that modelers make in their work. These choices—or actions—are ethical in nature for two reasons. First, choices comprise more than practical, purely logical or analytical acts uninfluenced by considerations of right and good. In the public realm of planning, questions of values—what is worthwhile and desirable—and those of ethics—what is right and good—are, for all intents and purposes, synonymous. They are also inescapable in planning practice since it is impossible to restrict the influence of professional action and because no degree of science or methodological sophistication can provide understanding from a universally valid and unbiased point of view. Modelers who reject this characterization ostensibly accept the myth of value-neutral expertise, which Innes calls society’s “soothing fantasy” (1990, 39). Attached to professional experts, it is more appropriately termed a *convenient fiction* since it requires no purposeful effort to operationalize—society by and large conceptualizes professionals as purveyors of truth—and, unlike “soothing,” it does not imply need. The myth is merely useful to experts.

Second, the decisions of modelers have an ethical cast because they affect the interests and well-being of individuals who depend on their expert advice, i.e., modelers have power, which implies duties and obligations owed to others. Regardless of the ex-

tent to which travel demand forecasting matches formal definitions of a profession or individual forecasters that of professionals, modelers, as technical experts, accept the power and privilege that society grants to professionals as a condition of practice. *Opting-out* is not possible for those who wish to continue working in the field since declining the professional role requires repudiation of the modeler's specialized skills. However, because real power implies the freedom to select means and ends for its exercise, society confers power and privilege on professions subject to "their willingness and ability to contribute to social well-being and to conduct their affairs in a manner consistent with broader social values" (Frankel 1989, 110). Travel demand modeling, therefore, is a pursuit inherently fraught with ethical questions that extend beyond narrowly defined interests of self, employer or client. Each forecast reflects the ethical deliberations—or lack thereof—of their authors, and bias must be interpreted in this light.

THE CONVENIENT FICTION

The convenient fiction of value-neutral expertise comprises two discrete, though interrelated, components. The first presumes that decisions on the means and ends of planning are separable. This distinction allows planners to maintain a distance between their work and the goals—or ends—to which they direct plans and programs. In this frame, planners recuse themselves from processes that seek to discern worthwhile and desirable objectives for a community of stakeholders. Once defined, political leaders summarily "hand down" the desired ends to planners who search for the best way to realize them. Planners who do acknowledge entering the political fray preserve the value-neutral fiction by claiming to compartmentalize their roles so as to limit value considerations exclusively to questions of ends.

In practice, of course, the work of planners, including travel forecasts, rarely, if ever, remains isolated from considerations of ends. The boundary between the two domains, if it exists at all, is far too permeable. Even in political forums where participants do not query staff planners or explicitly consider technical work, stakeholders are commonly familiar with analyses that indirectly and in various ways* inform the choice of ends. This is clearest in postmodern accounts of practice that describe “all planning-related utterances...as *replies* to other utterances” and contend “the meaning of...utterance[s] will always go beyond the conscious control of the[ir] author[s]” (Throgmorton 1993, 120). More devastating to this dichotomy, however, is the role analysts play in sanctioning ends by fitting means to them. This is an inherently value-laden act that commends ends to others as being good.

To illustrate this point, suppose the goal of a repressive regime is to remain in power at all costs. An advisor (i.e., technical expert) might reasonably conclude that the most efficient way to do so is the identification and murder of political rivals. In this scenario, who will say that the advisor’s action is value-neutral? The act of simply providing the analysis implies a value commitment whether it is to the perpetuation of the regime or something more expedient. Furthermore, the particular advice imparted in this example implies a value commitment to standards of efficiency over, say, justice. Even Max Weber who first articulated this theme of separable realms in detail seemed to recognize that it “leads to embarrassing and morally troubling results” (Forester 1993, 71). Certainly, then, the actions of planners do not remain apart from the clearly value-laden questions of ends. However, in cases where related plans and programs—of which fore-

* See the discussion of relevance below. Carol Weiss’ enlightenment model has, perhaps, the greatest explanatory power for how analyses influence the choice of ends.

casts may be an integral component—permeate deliberations on political aims, objectivity—the second component of the convenient fiction—can still redeem the value-neutral illusion, if only in theory.

The late twentieth century epistemological debates, however, largely invalidated the idea that objectivity—freedom from interpretive bias or prejudice—is possible. Even in closed systems characteristic of the natural sciences where human intentions and motivations are not factors, an “arbitrary element, compounded by personal and historical accident, is always a formative ingredient of the beliefs espoused by a given scientific community...” (Kuhn 1970, 4). The promise of science to provide a methodology that allows humans to rise above their subjective limitations is unkept. Individual and cultural bias, emotions, and errors in judgment and perception all work to influence the questions analysts ask, the methodologies they employ and the relevance they place on the data they generate (Lakoff and Johnson 1980, 187).

These post-positivist facts remain hidden to some extent because modern knowledge projects, including those in the social sciences, display a marked preference for measurement and quantification and contemporary society still tends to venerate numbers and treat them as though they represented certainty. While some blame the latter on an innumerate public (Best 2001, 19), the former reflects attempts to solve the seventeenth century problems of induction that Francis Bacon first constructed and David Hume later formulated in the 1740s. Most simply, the problems beg an answer to the following question. How does one collect facts that do not follow from received opinion or theory and then move from these to systematic knowledge?

To all intents and purposes these problems were never solved, because from a philosophical perspective they [are] unsolvable. As long as one assigned the phenomena of nature—or, even more questionably, an abstraction like economy or society—the kind of

prominence that Bacon had done, it [is] impossible to devise any method *except a mathematical one* [italics in original] for moving from observed particulars to general principles. (Poovey 1998, 317)

In other words, only quantification can hope to save induction as a method of knowledge production. At the time Bacon wrote, however, the concept of neutral numbers was not common.

William Petty initially tied numerical representation to impartiality. By 1662, he had taken up the question of how best to determine the value of Irish land for the purpose of taxation. However, because he had substantial holdings in Ireland, his primary challenge was to convince the Crown that personal interest had no bearing on his recommendation. Petty responded by creating a multi-step mathematical formula for computing the value of land, which was unique in his era because it relied on facts that

...were conjectural rather than observed, and...described abstractions rather than historical events. Despite these striking differences, he claimed for his facts the same degree of epistemological authority that [others] claimed for experimental facts, but he did so based not on collective witnessing but on a peculiar mixture of claims about the precision of numerical representation and the impartiality of expert interpretation. (Poovey 1998, 123)

For instance, Petty provided merely an interpretive figure for the natural value of land—he equated it to the measure of an average agricultural worker’s labor over three life-times—based on a life expectancy figure that could not have been accurate (Poovey 1998, 129). In the end, however, his formula was a source of authority for him, since it drew “on the epistemological connotations of certainty associated with mathematics without directly raising the issue of either experience... or interpretation, which [especially in Petty’s case,] could always be called self-interested” (Poovey 1998, 130).

The story of William Petty is more than an interesting digression. It suggests that the deep historical roots of the convenient fiction hold the keys to its persistence. Moreover, the crudeness of its initial formulation has utility for exposing the fiction for what it

is, since its augmentation and refinement in subsequent centuries renders it, to some degree, unrecognizable today.

In the context of travel demand forecasting, a notable addition to the fiction was a formal role for the expert. Foreshadowed by Petty—and others even earlier—the recasting of political economy as a mathematical science and formation of the first professional organizations for natural scientists and political economists in the early nineteenth century “laid the groundwork for making the expert essential to (what was understood as) legitimate knowledge” (Poovey 1998, 16). Although power was certainly a motivation for promoting compartmentalization of intellectual skill, efforts to institutionalize the position of expert were, more accurately, further attempts to solve the problems of induction. In some formulations this entailed separating the collection of data from its interpretation. In all cases, this meant turning over the enterprise of knowledge production to (presumably value-neutral) professionals (Poovey 1998, xxiv). Woodrow Wilson’s late nineteenth century definition of the expert role in analysis of public policy bridges this history to the present by providing, in his conceptualization, a prototype of the modern transportation planning professional that the post-war systems revolution served to refine and institutionalize (Wachs 1985, 521).

Of course an accurate description of the convenient fiction cannot deny the success of modern science, much of which is based on the idea of objectivity and specialized expertise. This, in part, explains the fiction’s persistence. However, these successes tend to be clustered in the natural sciences and some disciplines of engineering. In these fields, where solutions depend on understanding relatively closed systems that are directly observable, the ability to make relatively accurate measurements and replicate

findings by multiple methods is more characteristic. In contrast, the policy sciences—planning, public policy, economics and the like—focus on problems of open social systems. The intentions and motives of social actors, which are not directly observable, commonly influence these “wicked” problems (Rittel and Webber 1973). Accurate measurements are more elusive and experimentation defies replication. This distinction suggests a continuum where some results are deemed more objective than others. Nelson uses just such a construction in pointing out that “policy sciences provide a sort of lens that may shed useful light; complete objectivity, however, is an impossibility because every ‘language (and the policy sciences are surely languages, at least in part) imposes its own categories and paradigms on the world of experience’” (1987, 58).

This continuum, however, is useful only for ascribing relative certainty to results. It works against better practice in policy sciences by implying that more and better methods—usually interpreted as more quantification and better precision—can provide structural explanations for social problems. This is the false promise of positivism that leads some to believe that, with the right tools, the behavior of commuters is as describable as the behavior of electrons. It also diverts attention. Modelers, in particular, may “tend to ignore or dismiss considerations for which reasons of a certain type cannot be given—for example, quantifiable or at least empirical data—thus ignoring intangibles” (Vesilind and Gunn 1998, 30). These omissions have the potential to color their analyses by either leaving important questions unaddressed or accepting inferior assumptions because they are based on empirical or quantitative data, not because they are superior to more subjective judgments. In the San Francisco Bay Area, officials denounced estimates of ridership produced using a computer model for a proposed transit system extension as “an in-

accurate reflection of the extension's importance." They surmised, probably correctly, the reason was that modelers had "not found a way yet to quantify the advantages of a service that will take people directly to their workplace in downtown..." (San Francisco Examiner, 19 March 1990).

While it is certainly true "that the social professions were misled somewhere along the line into assuming they could be applied scientists—that they could solve problems in the ways scientists can solve their sorts of problems" (Rittel and Webber 1973, 160), such an observation is perhaps unnecessarily narrow for exposing the myth of objectivity. Most basically, "methodological directives [are insufficient] by themselves to dictate a unique substantive conclusion to many sorts of scientific questions" (Kuhn 1970, 3), regardless of field. "Measurements always involve choices" (Best 2001, 52), including simple quantitative ones. Indicative of this is historian Mary Poovey's discovery that in "nineteenth-century texts, as in most texts that purport to describe the material world, even the numbers are interpretive, for they embody theoretical assumptions about what should be counted, how one should understand material reality, and how quantification contributes to systematic knowledge about the world" (1998, xii).

In some ways, it is curious that the convenient fiction persists even in fields such as planning where postmodern sensibilities have long prevailed. On the other hand, when one considers the fiction's capacity for maintaining power relations and providing a sense of security and control to both professionals and laypersons, the question no longer seems difficult. Regardless of the answer, the convenient fiction serves to blind professionals, including modelers, to the ethical decisions they make everyday. They are, in a word, inescapable.

RELEVANCE

In addition to the pervasiveness of value decisions in forecasting, another critical support for the ethical framework of practice detailed above is, of course, the contention that forecasts, and by extension modelers, affect the interests and well being of others. At least from a strictly teleological viewpoint, if forecasts have no relevance, the ethical questions go away. Indeed, both participants and observers of planning processes question the bearing that forecasting has on policy. Most commonly, they challenge conventional thinking by asserting that intended consumers of travel demand estimates either ignore forecasts in their deliberations or accept them as something other than unbiased assessments (see below). Although it is difficult to appraise the extent and degree to which these claims find currency within the academy, their standing suggests an additional explanation for why the research on the accuracy of travel demand forecasts is so seriously lacking.

PROBLEM-SOLVING MODEL

The relatively few studies that examine the influence of technical transportation data seek to understand whether and how the decision-making process deviates from the traditional problem-solving model. In this model, which is likely familiar to all analysts, a pending decision drives the generation and interpretation of technical data. Scholars also commonly refer to it as the *scientific* or *rational* model. “A problem exists and a decision has to be made, information or understanding is lacking...to select among alternative solutions, research [i.e., forecasts] provides the missing knowledge. With the gap filled, a decision is reached.” Most importantly, “the expectation is that [new knowledge] clarifies the situation and reduces uncertainty, and therefore, it influences the decision

that policy makers make” (Weiss 1979, 427). Perhaps surprisingly—perhaps not—this idealized model of knowledge use has little explanatory power.

A case study of the planning process that preceded formal selection of light rail transit for Sacramento indicates that “the local community was highly skeptical of the findings of any evaluation study” (Johnston et al. 1988, 468). Likewise, Cunningham and Gerlach, reporting on their field investigation into the ways information informs decisions on airport ground access, conclude that there is “substantial reason to believe decision makers have little confidence in the results of modeling” (1998, 50). Both research efforts suggest that quantitative data broadly, and travel demand forecasts more narrowly, played little formal role in decision-making for their lack of authoritativeness. This point is underscored in the Sacramento case when one considers that light rail transit was rated as the best alternative according to only one of eleven technical indicators (Johnston et al. 1988, 464).

It is, of course, even more difficult to gauge the extent to which travel demand estimates directly affect transportation investment decisions when forecasts, regardless of their accuracy, seem to support the project selected as was the case in Los Angeles, San Diego, San Jose and Portland. Interviews with key stakeholders in Los Angeles convinced Richmond that “decision makers had made up their minds prior to the conduct of technical analysis” for the Long Beach light rail line (1991, 123). He is similarly convinced that the decision to proceed with construction of light rail transit lines in San Diego, San Jose and Portland preceded forecasting (123), while Pickrell is more circumspect in his assessment of the Portland project as well as those in other cities (1990, xvii).

Two additional empirical studies that explore decision-making related to major transportation investments reflect the others in that they implicitly test the accepted decision-making structure. While not addressing data use explicitly, they show that the problem-solving model is merely an idealized version of reality (Goetz and Szyliowicz 1997; Edwards and Mackett 1996).

This emphasis on assessing the normative value of the problem-solving model reflects a primary focus of transportation researchers on improving planning outcomes by redefining what counts as knowledge and/or restructuring the decision-making process to various degrees. For example, Johnston et al. advocate “a system that gives primary weight to performance criteria but that invokes additional legitimate local criteria...” (1988, 472) and Goetz and Szyliowicz recommend “a decisional framework that emphasizes flexibility...” (1997, 278). The knowledge–action link is only of secondary interest. For those interested in understanding the relevance of technical analyses, however, such research efforts have only limited utility. They can only confirm and reshape expectations of data use within a narrowly circumscribed sphere. A broader view, on the other hand, preserves centrality of the idea that knowledge lives independent of expectations.

“As a society we must be pretty confident [knowledge] does have an influence, or we would not keep producing studies and statistics directed to policy” (Innes 1990, 1). The overriding question for modelers, therefore, is not whether travel demand forecasts play the role professionals assign to them, but rather “how do they fit into the processes through which public actions are devised and implemented” (Innes 1990, 1). Outside of the transportation context, scholars in the United States began to ask this and related questions by the mid-1970s in response to widespread disillusionment over the failed

federal policies of a decade earlier. Beyond confirming the questionable nature of widely held assumptions about how decision-makers use information, this research generated sufficient empirical evidence to assemble a number of competing and complementary decision-making models to rival the descriptive capabilities of the problem-solving construct (see e.g., Weiss 1979; Dutton and Kraemer 1985). Unfortunately, it is extremely rare to find accounts of this type in the transportation literature. Whether it is because nearly the entire post-war research program of the USDOT has been oriented toward supporting the problem-solving decision-making process (Wachs 1985, 522) or that transportation planners and theorists generally ignore one another (Wilson 2001, 2), it is difficult to assess the precise impact of travel forecasts on the interests and well-being of others.

POLITICAL MODEL

When modelers and transportation scholars recognize the descriptive deficiencies of the problem-solving model, they are most likely to subscribe to the political model of decision-making (Innes 1988, 78) because it seems to fit well both their experience and the available empirical data. This approach to decision-making posits that decision-makers have taken a stand on policy choices that technical analyses are not likely to shake. “In such cases, research...becomes ammunition for the side that finds its conclusions congenial and supportive. Partisans flourish the evidence in an attempt to neutralize opponents, convince waverers, and bolster supporters” (Weiss 1979, 429). Because they address a different set of questions from those considered here, however, discourses that detail the political model in most contexts—including transportation planning—usually

serve to focus attention on only a limited number of ways analyses may be influential in this decision-making structure.

Martin Wachs, for example, has written extensively on the political uses of travel demand forecasts (see e.g., 1982; 1987; 1989). In doing so, he highlights the most egregious, yet still often unrecognized, abuses of technical analyses by both modelers and policy makers such as the preparation and presentation of biased forecasts under the guise of technical objectivity. Yet, his characterizations of political decision-making do not illuminate other, less objectionable, ways that forecasts are used politically. This narrow focus may, in part, lead modelers to conclude that forecasts are only relevant in the political pattern of decision-making when they are misrepresented and/or when access to complete information is not available to all interested parties.

The following quotation illustrates this point both by characterizing the political uses of transportation plans, which rely on forecasts and other technical analyses, in an exclusively negative light and equating information in the political decision-making model with planning that “does not matter.”

One might argue, therefore, that a concern with transportation planning process is irrelevant, taking the view that real planning does not occur in formal planning processes, or in the preparation of plans, but through project entrepreneurship, bargaining and the exercise of political power. Transportation plans, then, either add sanction to what has already been decided or provide technical information that shifts the power among competing interests. I agree that this is sometimes the case, but if it is true that planning does not matter, it should not be that way. (Wilson 2001, 3)

Richmond, too, fails to emphasize the broader range of forecast utilization in political settings. “Technical work, in short,” he writes, “is seen by some to be capable of having some positive role in terms of avoiding potentially bad choices, but only in a very broad sense” (Richmond 1991, 117). He then continues by taking issue with even this very modest claim.

Indeed, post-decision rationalization is not necessarily a pejorative and can utilize forecasts and other technical data to serve several useful and proper functions. Attempts to persuade cloaked as searching for the truth has the benefit of exposing otherwise transparent political deals to public critique and evaluation (Meyers 1996, 441). This, in turn, provides “a tool for nonexperts, both citizens and legislators, to understand and question proposed plans or to demand the application of different standards” (Innes 1988, 84). Furthermore, the exercise of legitimating choices can increase the likelihood of implementation by “commend[ing] the decision to others without whose consent it cannot be made effective” (Lindblom and Cohen 1979, 82). Finally, “[t]o the extent that the research, accurately interpreted, supports the position of one group, it gives the advocates of that position confidence, reduces their uncertainties, and provides them an edge in the continuing debate. Since the research finds ready-made partisans who will fight for its implementation, it stands a better chance of making a difference in the outcome” (Weiss 1979, 429).

The important point is that the political model of decision-making is likely very complex and demonstrated dysfunctionality must not blind modelers to the broader implications of their analyses. Simplifications that characterize the process as a solely dishonest enterprise work to limit modelers’ ethical considerations within this frame to questions of complicity. And laments over the legitimating function of forecasts—Richmond calls it “depressing” (1991, 112)—serve primarily to tacitly suggest that ethics matter only within the small sphere of largely idealized (i.e., problem-solving) decision-making.

ALTERNATIVE MODELS

Modelers also run the risk of underestimating the impact of their work if they fix their gaze too intently on decision-making. Decision-making processes, after all, are merely a subset of potential ways technical analysis can have influence. Almost certainly the problem-solving and political models of decision-making do not constitute the universe of formulations that link knowledge to action in transportation planning even though the literature devoted to this field identifies few alternatives. Since other models conceivably match the experience of some travel demand forecasters and related professionals in various contexts of practice, this is probably more indicative of multiple and competing research needs and interests within the academy rather than a conclusion that the utilization of transportation analyses is confined to a relatively few decision-making typologies. In particular, Weiss' enlightenment model of research utilization and variations on Innes' interactive model of knowledge influence are the alternate accounts most likely to further explain the relevance of transportation planning.

The enlightenment model eschews the problem-solving assumption that analyses directly affect policy. Rather, in this conception,

...research provides the intellectual background of concepts, orientations and empirical generalizations that inform policy. As new concepts and data emerge, their gradual cumulative effect can be to change the conventions policymakers abide by and to reorder the goals and priorities of the practical policy world. (Weiss 1977, 544)

For example, the Portland LUTRAQ initiative seems to have changed the way stakeholders in other planning efforts think about how land use affects travel patterns through, among other things, introduction of new modeling approaches like a pedestrian friendliness factor for predicting trip generation. Efforts by the U.S. federal government

to develop a tour-based model—Transims—may also have impacts that are independent of any particular forecast.

The interactive model describes a social learning process in which “participants’ understandings and opinions evolve through discussion rather than from questions and answers, and experts play an educative and participatory role themselves as they learn from nonexperts” (Innes 1988, 86). A not unimportant ingredient in this discourse is the formal knowledge (i.e., analysis) that technical professionals bring to the table (Innes 1990, 33). This approach is similar in form to Weiss’ interactive model (1979, 428-29) and Dutton and Kraemer’s consensual perspective (1985, 8-9). They differ substantially, however, on the important question of two-way learning. Weiss seems to assume that developing common understanding is a cumulative process in which actors collectively contribute to fill knowledge voids while Dutton and Kraemer define their consensual idea as essentially an act of negotiating. In contrast, a key to Innes’s interactive model is recognition that participants, including technical experts, modify their opinions and understanding through the process, which is iterative in nature.

“When it really comes down to it, there is not much that can be said with confidence about how knowledge influences policy” (Innes 1990, 1). Therefore, only the presumption of sweeping models, modelers and technical analyses can reasonably ensure that the ethical deliberations of travel forecasters do not discount important considerations. Underestimating the relevance of their forecasts does not make ethics go away. To paraphrase Carl Jung, bidden, or not bidden, ethical questions are present.

ETHICAL CHALLENGES

Any description of the ethical challenges that travel demand forecasters face is speculative, to some degree, since first hand accounts of modeling practice are rare in the literature (see chapter 1). Nevertheless, findings of empirical research on professions—those stemming not only from the limited examination of forecasting, but also from related sub-disciplines of engineering and planning practice—coupled with an epistemological understanding and familiarity with the tasks and duties characteristic of travel forecasters' work, can suggest the most problematic ethical questions that are present to modelers. Identifying these questions can serve normative functions. More importantly for this work, though, they provide a starting point for constructing hypotheses to which research may be directed for understanding pervasive bias in travel demand forecasts.

By identifying the steps necessary for effective ethical behavior, Howe (1994, 10-11) provides useful clues for naming the most pressing—and thereby most formidable—ethical challenges of travel demand forecasters. First, one must recognize those practice situations that pose ethical issues. Most broadly, this requires seeing both the limits of technical analysis and the influence modelers wield independent of the content of such analysis. These discoveries, in turn, demand critical self-reflection.

Through reflection, [analysts] can surface and criticize the tacit understandings that have grown up around the repetitive experiences of a specialized practice, and can make new sense of the situations of uncertainty or uniqueness which [they] may allow [themselves] to experience. (Schön 1983, 61)

Second, professionals must be able to make right and good choices. Principally, this demands that modelers understand their moral obligations and to whom they are owed. Finally, after decisive deliberation, experts must act. This implies, in part, that forecasters have the will to act, which is not axiomatic.

ISSUES

Responsible demand forecasters must recognize that problems related to individual decisions concerning travel are social and often intractable. As such, professional judgments, all of which bear the stamp of human values and interests, play a far greater role in their analysis “since the scope of technical expertise is limited by situations of uncertainty, instability, uniqueness, and conflict” (Schön 1983, 345). For engineers, however, acknowledging the wicked nature of questions in their purview may be particularly problematic since their discipline is generally defined by its methods rather than—like policy sciences—its clientele and/or the nature of its concerns. Although some concede that certain classes of engineers deal with exclusively *tame* problems (Rittel and Webber 1973, 160), others do not seem willing to make this concession. “Because engineering is inextricably tied to people,” writes Vesilind and Gunn, “it cannot be just an applied physical science; it is also an applied social science” (1998, 35). Whatever the case, wittingly or not and regardless of professional background, travel demand forecasters, like other planners, are “player[s] in a political game, seeking to promote [their] private vision of goodness over others” (Rittel and Webber 1973, 169).

At its root, then, the challenge for modelers in this regard is to view all professional (i.e., value) judgments—even seemingly minor ones—as ethical choices since, in aggregate, they color every analysis. However,

[b]ecause forecasts are prepared by large organizations, such as consulting firms which are in turn employed by government departments, and because complex computer models and data bases are managed by teams, it is invariably difficult to identify one person or small group of people who can be held responsible for critical decisions, such as the making of core assumptions, which lead to self-serving outcomes. The larger the number of people involved, and the greater the complexity of the forecasting procedures, the less likely it is that each participant in the process will feel morally responsible for the consequences. (Wachs 1990, 150)

Armstrong, Simon and Dixon agree that this “moral distance” stems from “the division of labour, which emphasises responsibility for only a limited task, [and] the rise in bureaucracy” (1999, 14). They name a third contributing factor, however, “the rise of the expert, with the concomitant concern for the practice of specialised skills and of technical solutions to problems.” In addition to distancing, this works also to blind analysts to the broader implications of their professional deeds.

To act ethically, therefore, modelers must see too that their actions may have different meanings than they intend them to have because “every analysis shapes...attention and concerns in selective ways” (Forester 1993, 42). Even “[s]tatistics [e.g., on congestion] direct our concern; they show us what we ought to worry about and how much we ought to worry” (Best 2001, 160).

When they speak [and write], analysts act: they notify, inform, alert, point out, designate, ask, warn, and so on....[A]nalysts are not apolitical problem-solvers or social engineers. Instead, they are actually pragmatic critics who must make selective arguments and therefore influence what other people learn about, not by technically calculating means to ends..., but by *organizing attention* [italics in original] carefully to project possibilities, organizing for practical political purposes and organizational ends....How analysts organize attention is the central political problem of their practice. They must stress some issues and downplay others. They clarify some opportunities but obscure others. (Forester 1989, 18, 19)

Clearly, then, modelers, in their position to call and direct attention, have greater power than that which extends merely from their monopoly of technical expertise. Likewise, their ethical considerations reach beyond questions of inputs and methodology to the rightness of communicative acts and the goodness of the ends they serve. Forecasters must appreciate that how they speak, gesture and write determines, at least in part, what their analyses convey. However, because attention shaping is fundamentally an activity of everyday ordinary language use, modelers often do not realize how much of it they actually do when they communicate (Forester 1993, 49). If analysts ignore or fail to see

fully how they influence the responses of various policy actors, they risk acting unethically by unnecessarily distorting communications. They also blind themselves to the interests they unwittingly serve, thereby abdicating their professional autonomy.

Autonomy, of course, is a necessary component of professional practice. When clients supervise, direct or otherwise control professionals, the relationship is morally questionable because it violates a key societal expectation. Sometimes, compromised autonomy is obvious to the professional, if not the public. A client prescribing acceptable ridership forecasts is one familiar example. On the other hand, like analysts in relation to stakeholders, institutions can imperceptibly shape the attention of their members. For instance, it is not difficult to imagine how uncritical professionals, socialized in the culture of their agency or firm with its values embedded in an implied and complex system of sanctions and rewards, unknowingly serve ends more suited to perpetuating the organization and status quo than serving a critical formulation of the public interest. Setting aside the question of their capacity to affect change, perceiving the coerciveness of the institutions for which analysts and planners work is crucial for reclaiming autonomy. In short, “[i]f planners ignore those in power, they assure their own powerlessness” (Forester 1989, 24).

OBLIGATIONS

Ethics are concerned with duties and obligations. These “allow us to live together, to experience a life in which we can rely on others and they can rely on us” (Howe 1994, 3). For the modeler who fully appreciates both the limits of analysis and the far-reaching influence of professionals, the most difficult ethical task may be discerning the particular professional obligations s/he owes to the public. Certainly, obliga-

tions to colleagues and immediate clients can be problematic, however the codes that typically govern modelers are usually fairly specific about the former and the latter are often implicit in consulting contracts and formal and informal terms of employment. Obligations to the public are murkier for several reasons.

First, unlike elected officials, modelers are not directly accountable to the public. This distance makes it more difficult for forecasters to perceive the demands society places on them as professionals. Furthermore, such a system is slow to correct itself. Whereas, politicians are subject to the swift judgment of the ballot, the time lag is great for society to reward or punish the deeds of a profession. Of course, it would be a grave error to construe such a comparison as an endorsement of liberal democracy generally or as a means for policing professions in particular. Clearly constitutional structures can never fully ameliorate the inequalities and exclusions that stem from distorted communications and material forces of capitalistic political economy (Dryzek 2000, 17-18). To the contrary, granting representative democracy too privileged a place may in fact make ethical behavior more problematic by calcifying the central principle that civil servants are solely accountable to the public through elected officials. However, when the actions of politicians conflict with their obligations to the public, a modeler's judgment may legitimately trump loyalty to superiors (Howe 1994, 30). Herein lies a second reason why obligations to the public are more elusive—they take precedence over those to colleagues, clients and interest groups. This requires modelers to be vigilant and actively question the means and ends of those in positions to decide. This is particularly difficult when conflicts are not obvious and other professional responsibilities compete for attention. Third, and finally, even among individual professions, there is simply not a unitary defi-

inition of the public interest. Moral absolutism aside, the obligations professionals owe to the public are always open to debate without one.

The question of what actions are morally right and obligatory is particularly contentious when the answer hinges on the goodness of their consequences. This teleological approach to ethics presents more problems because codes of professional conduct are relatively silent with respect to the question of good ends. Society too has come to no sort of consensus on this issue, which may also explain professionals' lack of attention to it. Whatever the case, judgments on the goodness of ends are arbitrary to a great extent. For example, mobility—optimizing the movement of people and goods—is an idea central to the analysis of most transportation systems. Why, however, should this utilitarian concept of good take precedence over accessibility, which elevates equity considerations? The choice of ends can, and perhaps should, be informed by the preferences of others. These choices, however, ultimately require individual judgment and as such, demand reflection, deliberation and, in some cases, a fair amount of hand wringing.

When professionals attempt to distance themselves from value-laden questions like those that concern ends, they risk exclusion from decision-making processes (Nelson 1987, 50; Langmyhr 2000, 679) and invite misuse of their work by others (Wachs 1998, 4). Since, however, withdrawal organizes attention in the same way that engagement does, such attempts can never be successful. Even silence cannot separate professionals from ethical concerns because, in most contexts of practice, it implies a choice that reflects what is right or good. Furthermore, because passive communications are open to a wider range of interpretations, analysts may unwittingly serve the narrow interests of some decision-makers at the expense of their obligations to the public through perceived

acquiescence. The challenge for modelers, therefore, is to be passionate advocates for what they believe by placing their values (i.e., conception of the public interest) in competition with others (Wachs 1998, 4). Indeed, Small and Winston suggest that “[t]he best method of presentation is one that makes it possible to understand and justify political decisions that are in the interests of the citizenry at large, while embarrassing those who would make decisions favoring only narrow interest groups” (1999, 170).

Society, of course, has expectations of professionals that stand apart from the ends analysts choose to serve. This is why a purely teleological approach to ethics is difficult to defend. For example, *covert* advocacy without regard to its consequences is widely considered a breach of the public trust because it violates societal norms of sincerity—the expectation that one is acting in good faith (see e.g., Wachs 1990, 141-43; Innes 1990, 14; Langmyhr 2000, 683). Fundamentally, when modelers—and professionals more generally—create or otherwise perpetuate an expectation through their actions or failure to act, they normally generate a moral obligation to satisfy it. Conversely, it is dishonest to engender or fail to expose an expectation that is impossible to meet.

False expectations are common features of the transportation planning landscape. Although clearly some laypersons recognize the inherent bias and inaccuracy of travel demand forecasts, many others very likely do not. Wachs observes that effected citizens seem “to assume that forecasts of future need...are executed with objectivity” (1987, 76) and others suggest that travel forecast reliability premises the critical choices of local transportation officials (Pickrell 1990, xvii; Johnston et al. 1988, 460). These expectations of impartiality and conclusiveness—artifacts of modernity—are particularly intractable because they remain embedded in many of the codes that govern modelers and laws

that sanction their work. For example, in its code of ethics, the American Society of Civil Engineers (ASCE) requires “objectivity” of its members. Additionally, U.S. federal transportation legislation since enactment of the 1962 Highway Act prescribes planning processes that not only imply analysts stand outside the systems they study, but also so emphasize quantification they presume a level of accuracy unwarranted by current modeling techniques (Wachs 1985, 522).

From a deontological perspective, then, the most formidable task facing morally responsible modelers is challenging the expectations that their work is objective and exact. This obligation is even more difficult because it threatens the stable system of rules and procedures within which technical analysts usually operate (Schön 1983, 328). More tightly circumscribing the limits of expertise, for example, can undermine the positions decision-makers construct on the weight of ostensibly value-neutral and highly accurate forecasts. Clearly, modelers have a duty to take proactive steps that go beyond the technical disclosures that practitioners commonly see as the extent of their ethical concern (see e.g., Colman 2000, 1-2). The converse—silence and inattention—is ethically suspect because it too shapes attention and therefore fails to satisfy public expectations of truthfulness and legitimacy.

Less well defined are obligations modelers owe to the public as active participants in the planning process. Clarifying these ethical responsibilities is particularly problematic because most stakeholders continue to expect that technical experts can, and will be, apolitical. Beyond behavioral norms such as honesty and fairness, the public tends to believe that supposedly objective criteria should guide the practice of technical experts. Therefore, when modelers shed their value-neutral trappings, they must rely more heavily

on their own understandings, moral orientation and conception of the public interest to formulate a satisfying and ethically responsible approach to advocacy. The questions are many and the answers elusive. Do modelers have a special obligation to be self-critical? This is perhaps the most pressing issue.

Many theorists believe it is incumbent on analysts, as well as others, to surface and challenge their assumptions, tacit understandings and individual biases to avoid serving narrow interests (Innes 1990, 34; Schön 1983, 61). While Schön concedes that institutionalized contention—the countervailing model of advocacy, which pits the claims of established interests against those who advocate for the less powerful—has “undeniable social utility,” he also notes that it has “led to the polarization of society, to pendulum swings from one extreme position to its opposite, to stalemate, and to frustration at [the] inability to manage a vital, cumulative process of societal inquiry” (1983, 349-50).

Stalemate is a term that certainly can characterize efforts to identify and address the misuse of technical data in transportation planning (see chapter 1) and polarization is evident in the name calling that distinguishes the discourse surrounding inflated rail transit demand forecasts in the United States. For example, Dunphy labels as “cynics” those who question the downward revision of ridership estimates (1995, 104). In fact, quantitative appraisals seem especially susceptible to highly contentious, and usually fruitless, debate. Wachs notes that people tend to criticize evaluations prepared by their opponents, while readily accepting incomplete analysis that supports their own positions (1989, 477; see also Wildavsky and Tenenbaum 1981, 253-55). Best goes even further by contending that “advocates respond to challenges to their numbers with outrage: at best, their opponents are misinformed; at worst, the competing figures are outright lies” (2001, 158-59).

The question of right actions takes on an added dimension when planning proposals generate little or no opposition. Lawlor contends that “analytic practice in adversarial contexts raises more difficult questions of ethics” (1996, 114). However, this view seems to stem entirely from an uneasiness about planners in advocacy roles—the lack of a tangible alternative notwithstanding—and analysts’ attendant focus on persuasion. Rather, agreeable planning processes likely comprise greater moral challenges since they are no more inclusive, informed and free from distorted communications than contentious ones. In fact, questioning and critique can work to expand the search for creative solutions as well as indicate appropriate stopping points by signaling meaningful consensus. Without these cues, poor analysis often endures to influence decisions (Best 2001, 128-29) and ethical practice may require modelers to be more proactive to ensure their work foremost serves the public interest.

WILL TO ACT

“Moral obligations are obligations to others that are expected to be binding regardless of their personal consequences” (Howe 1994, 3). Since these may require individuals to take actions that are unpleasant or that involve personal sacrifice, the will to act ethically is always problematic to some extent. The risks, such as to one’s livelihood, can be very real. However, more immediate, albeit less weighty, threats loom for modelers who seek to act in morally responsible ways. Those who embrace their advocacy may initially seem less credible to the public (Goldman and Brinkman 1998, 8) and forecasters who acknowledge the true limits of their technical expertise “will give up the rewards of unquestioned authority, the freedom to practice without challenge to [their] competence, the comfort of relative invulnerability [and] the gratifications of deference” (Schön 1983,

299). Travel demand forecasters may also be less likely to act since the consequences of *inaction* seem mild compared with those in other fields. Different from that of many technical experts, like construction engineers, misconduct by modelers simply does not put lives at stake. Perhaps for this reason too, members of the professional organizations that commonly govern modelers rarely act decisively (i.e., bring charges) to discipline their peers. And even when professions are vigilant, their power to deter improper behavior is limited because modelers may, and often do, avoid professional affiliations.

There are, or can be, tangible benefits to acting and seeing this may make it easier to summon the courage to act. For example, Schön contends that “recognition of error, with its resulting uncertainty, can become a source of discovery” (1983, 299) and others conclude that admitting to technical uncertainty increases the political acceptability of technical analysis (Johnston et al. 1988, 472). All told, though, modelers may require a greater determination to act ethically than other professionals because in the most common practice situations right and good choices usually do not engender public support and approval. Admitting uncertainty and exposing biases run counter to the prevailing modernist view of how professionals should behave. In essence, forecasters must not only resist pressures within their own agency or firm to accept a dated conception of practice, but also work against a societal inertia, which at its most benign denies them the encouragement that can perhaps make the difference when the resolve to act ethically is lacking.

The ethical dimensions of travel demand forecasting seem to be both varied and multi-faceted. However, there is little anyone can say with great certainty about the practice without the necessary empirical data from which to draw conclusions. Does

modeling practice represent a unique test of the analyst's ability to recognize ethical issues, capability to reason effectively about them and will to act in morally responsible ways? If so, is this enough to explain the chronic and systemic bias characteristic of travel forecasts generally? In many respects, modelers face the same ethical challenges that other professionals come up against. What then are the dynamics of travel demand forecasting that work to place modeling under a singular cloud of suspicion? These questions lie at the heart of this study.

CHAPTER 3

THEORETICAL CONSIDERATIONS

The objective of this research is to understand why, and, to a lesser extent, how, modelers (a) generate biased travel demand forecasts and (b) tolerate the misuse of their work. Modelers are culpable to some degree for the misuse of their work by others because, for the most part, forecasters* are (a) aware who will use their work and how and (b) not without the means to influence the behavior of wrongdoers. Michael Davis came to this conclusion after studying in-depth the professional practices of engineers (1998, 178).† A secondary goal of this study is to collect data necessary to suggest practicable steps to reform.

To these ends, the investigator developed and tested a number of working hypotheses, which hinge on accepting or rejecting the premise that modelers as a group are corrupt. In addition to hypothesis testing, the investigator also relied on grounded theory—the discovery of theory from data—to provide relevant predictions, explanations, interpretations and applications (Glaser and Strauss 1967). While certainly not failsafe, such an approach can work to uncover hidden meanings and reduce the likelihood that theory will unduly color findings.

* For purposes of this research, the terms “forecaster” and “modeler” are synonymous.

† Modelers commonly hold degrees in civil/transportation engineering and identify themselves professionally as engineers.

WORKING HYPOTHESES

On initial consideration, it is tempting to surmise that travel demand forecasters as a group are corrupt and those with high ethical standards have abandoned the field or experience difficulty finding work within it. Some modelers are indeed corrupt and modify forecasts for various reasons (see chapter 1). Mercenary behavior is not uncommon among modelers hired to produce travel forecasts. Sometimes, in fact, analysts make little effort to hide it. One consultant, asked about modifying travel forecasts, replied to a researcher, “If I refused to do it, basically, I’m going to end up out of business” (Richmond 1991, 113). Therefore, since corruption—deliberate and dishonest exploitation of power for personal gain—is a common explanation for biased forecasting, it serves as the null hypothesis.

In cases where an individual modeler is, to some degree, innumerate or otherwise unqualified to prepare travel forecasts, s/he may be responsible for biased analyses even though an incompetent professional ostensibly produces merely inaccurate work. Recall, however, that forecasts are the work of many hands. Because inexperienced and under-trained analysts are unable to critically assess their work and that of others, they effectively abdicate their professional judgment (i.e., professional responsibility) on important matters including inputs, methodology and reasonableness of fit to those who would bias the analysis through their involvement. Since a lack of vigilance provides opportunity for the corrupt, the incompetent modeler cannot escape guilt. Intentionally perpetuating the charade of qualified professional certainly fits the definition of corruption. The modeler profits personally by exploiting the power of professional autonomy to maintain gainful employment.

If modelers are indeed corrupt, institutions of practice may be to blame. Consider the codes of ethics and professional conduct. Nearly every one, including those most often binding on professionals that prepare travel demand forecasts, leaves the “burden of compliance” entirely to the individual practitioner (Walton 1999, 2).

If he has the moral strength and the personal support-system to go it alone when the crunch comes, then he can adhere to the code and do the right thing irrespective of consequences. But this is virtually a definition of a moral hero—someone who stands out from the rest of us because of extraordinary courage and dedication, [and] willingness to suffer for the sake of the code....The price is too steep for most of us, and most of us, if forced, will have to choose employment over moral integrity as professionals. (Walton 1999, 2-3)

Absent the provision of sanctions for wrongdoers and a pledge of active support by peers at times when the code is tested, few will choose the role of moral hero. Such is particularly problematic for “modelers because the profession does little to discipline planners who fudge data or deliberately misrepresent the truth through technical manipulation of data or models” (Wachs 1989, 477).

In Hirschman’s terms, declining the part of moral hero is akin to choosing loyalty over voice. Those who opt for the remaining alternative of exit—leaving the profession—in effect concentrate the corrupt in the field of travel demand forecasting. This self-selection is reinforced by institutional arrangements that foster venality. For example, to compete with other cities for capital dollars, federal rules mandate the use of models to verify that proposed transit systems meet quantitative standards. This generates a sustained demand for travel forecasts. By extension, it also provides consultants with an opportunity to garner significant financial rewards by simply providing local officials with forecasts that meet federal requirements for funding. It is entirely conceivable, therefore, that corrupt individuals interested primarily in material compensation are more likely to

choose a travel demand modeling career than those for whom ethical questions are more troublesome.

If forecasts are inaccurate merely because modelers are dishonest, it is, perhaps, sufficient to understand the reasons why corruption is widespread in the field and suggest from the data ways to eliminate it. However, if modelers are *not* corrupt—a conclusion supported by experience and an abundance of anecdotal evidence (see Wachs 1987, 77)—simply accepting the proposition fails to meet the objectives of this study. In the latter case, the researcher must also describe both how and why ostensibly thoughtful and well-meaning transportation professionals systematically make questionable ethical choices, which bias their work. Three explanations present themselves: self-deception, *role-singularity* and *role-schizophrenia*.

SELF-DECEPTION

Self-deception is perhaps the most difficult diagnosis since there is no consensus on the phenomenon or even on its characterization. Even at the most basic level, it is difficult to identify a mainstream view of self-deception (Dupuy 1998, xi). Yet, “[f]or those within the psychoanalytic profession, and presumably within the educated laity, there has been little question of the existence of self-deception” (Gergen 1985, 228). Even scholars who deny the possibility of self-deception, nonetheless implicitly recognize a phenomenon so named when they provide alternate explanations for it (e.g., wishful thinking or weakness of will). Szabados captures this point by asking the doubters rhetorically, “[i]f self-deception could not possibly exist, then why did we nevertheless have to invent it?” (1985, 144).

Snyder calls self-deception the determined “process of holding two conflicting self-referential beliefs, with the more negative belief being less within awareness” (1985, 35). This definition—as well as others that broadly describe self-deception as willful behavior motivated by the deceiver’s self-view—is apt for constructing a compelling narrative that ties self-deception to bias in travel demand forecasts because it provides a plausible alternative motive for purposeful actions that might otherwise seem corrupt. Relying on a number of devices (e.g., rationalization), modelers who bias their analyses may deceive themselves into thinking that their offending conduct conforms to personal standards of right and good in order to preserve a positive sense of self. Though willful, such behavior fails to qualify as corruption because it is not deliberate in the sense that it is carefully thought through. Rather, it is “prereflective” (Szabados 1985, 155). Transportation researchers seem to agree. Richmond believes “self-delusion” and not dishonesty may sometimes be to blame for skewed travel forecasts, although he supplies few details to connect the affliction in modelers with its supposed manifestation (1991, 112). Flyvbjerg, addressing rationalization strategies specifically, arrives at the same conclusion. “A rationalized front,” he writes, “does not necessarily imply dishonesty. It is not unusual to find individuals, organizations, and whole societies actually believing their own rationalizations” (1998, 228).

Rationalization as excuse making is a means of self-deception that may be particularly inviting for analysts that experience external pressure to fudge their forecasts. Individuals rely on excuses to resolve the conflict between the beliefs that one is responsible for a negative outcome and one is also a good person (Snyder 1985, 36). The latter reflects a widely held assumption by psychologists that human beings are motivated to

preserve a positive self-image. The former can be thought of as culpability for any behavior that violates societal norms. If a forecaster fails to act ethically when pressure

TABLE 6
Excuse Making Strategies Applied to Travel Demand Forecasting

	Excuse	Potential Manifestation (internal or external)
Reframing Performance: Lessening the negativity of a bad act		
Failure to comprehend the badness of an action	“It really wasn’t serious.”	Contention that forecasting irregularities did not change the build/no-build outcome
Underestimating the harm of an action	“It didn’t really hurt anyone.”	Belief that forecasts do not affect decision-making
Victim derogation	“They’re not worth considering.”	Demonization of highway builders and SOV commuters
Messenger derogation	“They’re frequently wrong.”	Questioning the expertise of critical citizen groups
Transformed Responsibility: Lessening the degree of responsibility for a bad act		
Consensus-raising: Showing that others would behave similarly under the same circumstances		
Task difficulty	“Anyone would have failed.”	Insistence that the political environment of forecasting is un navigable.
Bad luck	“It wasn’t meant to be.”	Blaming a fickle electorate for unsupportive leaders
Coercion	“I had no choice.”	Transferring blame to those in authority
Projection: Ascribing personal shortcomings to others	“Everybody does it.”	A focus on malfeasance of other modelers, especially consultants
Consistency-lowering: Showing that one does not always act so badly in the same circumstances		
Intentionality plea	“I didn’t really mean to.”	Assumption of value neutrality
Effort-lowering assertions	“I didn’t really try.”	Claims that resources to perform the work were insufficient

Source: Adapted from Snyder 1985, 37-42.

to do otherwise may be overwhelming, it is reasonable to conclude that s/he resorts to specific excuse making strategies to maintain a benign view of himself or herself (table 6). Doing so works to push the negative belief to the background—places it less within awareness—thus preserving the modeler’s positive image and accomplishing the deception.

An unqualified modeler may also rely on self-deception to preserve a sense of self-worth. Although the excuses outlined in table 6 can remain essentially the same, the negative belief such a modeler pushes to the background is that s/he is not technically competent to perform the work that s/he is doing. The deception keeps poor modelers from recognizing their forecasts as probably highly inaccurate. More pertinent to this research, it likely distracts under-qualified forecasters from seeing the greater implications of their actions—or inaction—which, as described above, includes complicity for introducing bias through inattention.

Evasion is another technique that forecasters might employ to manipulate or otherwise twist evidence to deceive themselves. It merits mentioning here because it too matches available narratives of practice and is consistent with Snyder’s definition of self-deception. Someone who ignores evidence for p , fails to seek evidence for p as faithfully as s/he pursues evidence for not p , or selectively focuses attention on evidence for not p , is evading. This is a process that can lead to self-deception by pushing the belief in p beyond awareness.

Strategies of evasion are perhaps most conspicuous in the context of modal boosterism—the practice of uncritically promoting a single mode of transport over others. Boosterism is well documented in the literature of transportation planning although rarely

ascribed to forecasters explicitly. Even so, it seems reasonable to assume that modelers are represented in this group to some degree. A booster who forecasts travel demand is most likely to introduce bias into analyses when his or her judgments on the operating characteristics and context of various transportation technologies are not supported by a preponderance of the evidence. Few observers of transportation planning processes have difficulty identifying cognitive dissonance of this sort. For instance, Black insists that “some people...have a fascination with rail that does not mesh with the widespread desire to make public services cost-effective and keep taxes low” (1993, 158). Still others observe, more pointedly, that boosters commonly believe buses are operationally inferior to rail transit, the latter which they consider inexpensive to build and operate (Kain et al. 1992, p. 11-1, pp. 14-7 to 14-8; Hamer 1976, 249).

Possibly because transportation research has traditionally not been very open to multidisciplinary inquiry, the literature provides little empirical evidence that self-esteem is at stake when one’s favored technology proves to be a poor match for the problem at hand. There are, however, subtle indications that such a link may exist. First, some scholars explicitly claim that boosters have an emotional attachment to a particular form of technology (Black 1993, 158) and others use the term “romance” or “romantic notion” to convey the same idea (Webber 1976, 106). These characterizations are consistent with philosophers’ and psychologists’ descriptions of a deep-seated emotional need to explain away and reinterpret evidence (Szabados 1985, 149)—a need many suggest is bound up in ideas of self (Martin 1985). Second, transportation scholars who broach the subject of boosterism exhibit a widely-held bafflement about the origin of modal boosterism (see

e.g., Kain et al. 1992, p. 14-7; Webber 1976, 106). This indicates that a satisfying explanation may lie outside of traditional transportation disciplines.

Third, and finally, those who speculate commonly surmise that nostalgia is at the root of boosters' beliefs (Hamer 1976, xiii; Webber 1976, 106). Similarly, Kain names childish fascinations as the source of some modal dogma (1988, 199). Both cases indicate that positions on transportation technology may be tied to people, places and events in the past, even those, perhaps, from childhood where the most enduring negative self-concepts take form. According to psychoanalysts, these concepts of self engender behavior aimed to compensate for, or divert attention from, them (Branden 1971). Viewed too narrowly, such actions may indeed seem puzzling.

Beyond modal boosterism, self-deception by purposeful evasion may be useful for fostering the idea that travel forecasts are authoritative beyond widely-accepted limits. Such a belief can buttress conceptions of self worth because precision correlates highly with the value of any analysis. When forecasts are more precise, their value increases. When forecasts are more valuable, the standing of their authors similarly rises. Although he does not name it, Hamer seems convinced that something like self-deception by selective focusing (i.e., evading evidence that threatens prized beliefs) is at work among transportation planning professionals who fail to recognize the limitations of their methodology—and/or that of those who prepare inputs for their forecasts. He provides examples of transit planners who believe “in the infallibility of very long-range forecasts” and others who “seem incapable of comprehending the simple fact that [some ridership] projections are meaningless” (1976, 174, 248). Basing travel demand forecasts on problematic assumptions is also consistent with this framing of the problem.

An unrealistic view of travel forecast precision may also enable forecasters to more easily set aside concern for how others use their analyses. The more precise a forecast, the less able others are to twist interpretations of it. Therefore, when modelers deceive themselves about the exactness of their work, their need for concern over how others represent it becomes less pressing. This dynamic most readily explains the common practice of placing confidence in decision-makers to use forecasts as they were intended. If the margin of error for a particular forecast is very small, there is little reason for worry whether someone represents the prediction as *gospel truth*.

ROLE-SINGULARITY

Role-singularity refers to the tendency among modelers to accept the role of dispassionate technician to the exclusion of others, regardless of context.* The dispassionate technician role stems from the objectivist position that...

[t]here is an objective reality, and we can say things that are objectively, absolutely, and unconditionally true and false about it. But, as human beings, we are subject to human error.... Science provides us with a methodology that allows us to rise above our subjective limitations and to achieve understanding from a universally valid and unbiased point of view. Science can ultimately give a correct, definitive, and general account of reality, and, through its methodology, it is constantly progressing toward that goal. (Lakoff and Johnson 1980, 187)

Modelers who adopt the dispassionate technician role are usually objectivists grounded in the empiricist tradition—positivists—who believe observation and experiment (i.e., the methodology of science) are the keys that provide access to unconditional truth. As such, they readily accept the myth of value-neutral expertise and strongly favor quantification and measurement over other methods of inquiry.

* This role corresponds to Howe's traditional technician. The two central themes of traditional technicians' approach to practice are the importance of technical analysis and the planners' deference to elected officials (1994, 115).

Role-singularity threatens ethical practice in several ways. Foremost, quantification runs the risk of introducing bias into forecasts because it limits understanding of complex systems to a relatively small number of measurable variables. What remain hidden are qualitative considerations, which may have the same (or more) explanatory power as those that are gauged numerically. The National Council on Public Works Improvement noted as much back in 1988 when it expressed concern that technical studies “ignore unquantifiable benefits from infrastructure investment” and implored policymakers not to exclude such benefits from consideration “simply because they have at hand a measure of a project’s quantifiable benefits” (Congress of the United States Congressional Budget Office 1988, 134). Furthermore, since quantitative results are seemingly unambiguous (Johnston et al. 1988, 460), an undue focus on them may create expectations that the modeler cannot hope to satisfy for those who would assume an objective analysis.

Disregarding important elements of a problem also tends to separate modelers from important value-laden questions. It shifts responsibility for addressing, or not addressing, these questions to others, often elected officials, and provides them with the opportunity to use forecasts for their own purposes without expecting even an objection from their authors (Wachs 1998, 4). As chapter 2 explains, though, dispassionate technicians cannot escape the need to make value judgments in their work. “Asking one question, rather than another, [or no question at all] is an ethical act in that the answers to different questions imply the implementation of alternative sets of possible outcomes with divergent impacts on the lives of different people” (Richmond 1995, 302). Dispassionate

technicians sometimes fail to recognize this and run the risk of not adequately considering the ethical implications of their decisions.

This seems to have been the case for modelers that shared their experiences in pilot interviews conducted by the investigator as preparation for this research. However, one particularly thoughtful modeler, after initially dismissing the idea that he was not value-neutral in his work, reflected for a moment and expressed his concerns that he was not adequately addressing distributional equity because he did not know how to evaluate it. He concluded that he introduced bias by omitting fuller consideration of the issue. “The only place I don’t feel comfortable is on the equity side. Because it’s not just an issue of whether [considering equity is] to be done or not, but [how] you would do [it]... That’s a nagging issue.”

Transportation planning discourses are rife with indicators of positivist orientations, the most common of which are challenges to the advocacy role of professionals. Technicians seem to accept as given the view that professional behavior is by definition disinterested. For example, an Institute of Transportation Engineers report warns that “[t]he credentials of those making forecasts should be kept in mind when reviewing plans based on [their] forecasts. Vested interest groups or parties will tend to make assumptions [sic] which will be most favorable to their cause” (Institute of Transportation Engineers 1980, 34). Lost on these ostensibly well-meaning engineers is the untenable nature of the value-neutral position they claim for themselves. They persist, perhaps, in part because an unwavering faith in their own objectivity prevents them from undertaking the type of critical self-reflection necessary to surface personal prejudices.

The combination of psychological certainty it can provide and the universal human need for security, control, and order helps explain why objectivism and the dispassionate technician role are so attractive (Johnson 1993, 124). Moreover, since abandoning the notion of an objective reality and its uncompromising confidence in science raises troublesome issues that are much easier to ignore than to resolve, preserving them simplifies practice. This is a likely reason why modelers place extreme confidence in computers (Richmond 1995, 309). Doing so provides an excuse for disregarding complex problems that are not easily deconstructed and solved computationally. These motives are central to the broader interest of professionals to maintain confidence in their methodology, which Schön identifies in his description of symptoms associated with role singularity.

Practitioners cut practice situations to fit professional knowledge. They may become selectively inattentive to data that fall outside their categories. They may use “junk categories” to explain away discrepant data. They may try to force the situation into a model which lends itself to the use of available techniques...All such strategies carry a danger of misreading situations, or manipulating them, to serve the practitioner’s interest in maintaining his confidence in his standard models and techniques. (1983, 44-45)

A failure of professional education may also be responsible for persistence of the objectivist view and the abundance of dispassionate technician forecasters. The training of modelers is deeply rooted in the tradition of positivism and, by most accounts, forecasters schooled as engineers are likely to graduate without ever being exposed to alternative concepts of knowledge and truth. Although, in many disciplines, especially social sciences, the culture wars have installed post-modernism in a prominent position alongside objectivism and other philosophies, graduates from planning and policy analysis programs who choose careers as modelers are still likely to consider themselves objec-

tivists. Why? Probably, in part, these students chose forecasting because it seems to offer more security, control, order and simplicity than other sub-fields.

Self-selection may also be the reason engineering and some planning scholars tend to be empiricists and/or rationalists (i.e., objectivists). For the same reasons they adopt objectivist conceptions of truth (security et al.), faculty members may choose academic life since it usually avoids involvement in the kinds of messy situations practice includes (Baum 1996, 132). Professors who do recognize the greater epistemological questions, however, are sometimes reluctant to introduce them for fear that few students would be interested (Davis 1998, 13).

ROLE-SCHIZOPHRENIA

Role-schizophrenic modelers covertly, and alternatively, accept two conflicting models of their role. They operate as dispassionate technicians “who analyze data to discover the truth and to arrive at the best course of action” and at other times as *advocates*, “who use data and models to prove that a course of action preferred by a client or employer is the best choice in a given situation” (Wachs 1989, 476-77). Theorists, primarily those from the social sciences, formally recognize this dichotomy in the distinction between formal *demonstration* of a position and policy *argumentation*.

First, demonstration is possible only within a formalized system of axioms and rules of inference. Argumentation does not start from axioms, but from opinions, values or contestable viewpoints; it makes use of logical inferences, but is not exhausted in deductive systems of formal statements. Second, a demonstration is designed to convince anybody who has the requisite technical knowledge, while argumentation is always directed to a particular audience and attempts to elicit or increase the adherence of the members of the audience to the theses that are presented for their consent. Finally, argumentation does not aim at gaining purely intellectual agreement but at inciting action, or at least at creating a disposition to act at the appropriate moment. (Lawlor 1996, 113)

Since it violates norms of pragmatic communication, the use of travel demand forecasts in an advocacy role is clearly unethical when participants in the policy making

process do not clearly recognize the modeler's contribution as advocacy. However, the investigator does not classify role-schizophrenia as a practice of corrupt modelers because forecasters subject to this diagnosis are not fully aware that they alternatively assume different roles and do not discern the point at which they shift between them.* "Many [forecasters]...are transformed in subtle steps from analyst [i.e., technician] to advocate by the situation in which they perform their work" (Wachs 1982, 567). It seems reasonable that this dynamic can also work in reverse.

Regardless of intent or context, however, covert advocacy—an integral component of role-schizophrenia—colors travel demand forecasts by introducing bias to convince. All too often, though, the ethical dimensions of this practice are neither recognized nor contemplated. Illustrative of this are comments by one modeler, regarded widely as thoughtful and self-reflective, that explained bias away as merely giving a proposed transportation improvement "the benefit of the doubt by setting all assumptions at either the lower or upper end of a reasonable range of values" (Handy 1989, 11).

Those who assume the advocate role, if only at times, seem to understand that science cannot deliver what objectivists promise it can. However, argumentation, as presented above, does not entirely abandon science nor fully embrace subjectivist ideas. Therefore, while inviting, it is inaccurate to say that the roles of dispassionate-technician and advocate conflict because they respectively assume the antipodean positions of objectivism and subjectivism. Rather, the conflict seems to emerge from the subjective questions compartmentalization of roles raises. These have to do with timing—when should modelers be advocates—and ethics—who should modelers serve?

* This premise demonstrates the aptness of the *Schizophrenic Illness Is Role Shifting* metaphor.

Scholars who acknowledge the utility and sometimes appropriateness of the advocate role for policy analysts (e.g., modelers), yet fear that unfettered advocacy damages the profession and reduces analysts to nothing more than lobbyists, have proposed various systems to circumscribe role domains. For example, MacRae bases guidelines that seek to match role to context on a complex schema for defining properties of policy arguments. He contends that the technician role is suited for “reasoned proposal selection” and that of advocate for “adversarial argumentation” (1993, 293). Regrettably, the boundaries established by this framework, as well as others, lack sound theoretical footings. In spite of their coherent logic, the rules can seem arbitrary and are often too nebulous to be of use to practitioners. Lawlor implicitly acknowledges these inadequacies when he asserts that “the tension between advocacy and dispassion will always be problematic for policy analysts...” (1996, 114).

The attraction of the dispassionate technician role, in part, rests on its premise of unequivocal service to science and truth. However, when modelers function as advocates, the question of allegiance is problematic for most. In this context, professionals commonly find themselves torn between loyalty to an employer or client and an obligation to serve an often vague conception of the public interest. The codes of ethics that traditionally bind travel demand forecasters provide little helpful guidance for resolving dilemmas such as this. For example, the Code of Ethics and Professional Practice of the American Institute of Certified Planners (AICP) specifies at once “[a] planner’s primary obligation is to serve the public interest” and “[a] planner owes diligent, creative, independent and competent performance of work in pursuit of the client’s or employer’s in-

terest...consistent with the planner's faithful service to the public interest" (American Institute of Certified Planners 1996, v).

Indeed, "[t]here are few ethical guideposts included in the education of professionals...to suggest how...choices [between advocacy and objectivity] should be made" (Wachs 1987, 77) and modelers could certainly benefit from an increased emphasis on ethics in their training as well as more precise codes of conduct to govern their work. More fundamentally, though, planners and engineers would be better off if they dispense with the advocacy-technician dichotomy entirely and recognize that one can simultaneously be both problem solver and promoter. The disconnect seems to stem from the absolutism of positivist thought, the adherents of which see it as standing in opposition to most other paradigms. There are, however, pluralist models of practice that include functionally rational action. Phenomenology and experientialism are but two (see respectively e.g., de Neufville 1983; Johnson 1993).

Presumably, honest modelers who understand the dynamics and importance of role and are taught to think critically about ethics could, and would, avoid the pitfalls of not only role-schizophrenia, but of the other maladies that characterize the hypotheses set forth above. Yet, beyond the issue of poor preparation for practice, a theory that ties together and makes sense of the multiple explanations for the dysfunction of travel demand modeling would be useful, although not essential, for guiding the data collection and analysis of this research. The following discussion develops a case for one in particular without excluding others that emerge from the data.

THEORETICAL GROUNDING

The three working hypotheses all maintain that bad decisions by honest modelers, and not technical deficiencies, are responsible for poor forecasting. Furthermore, the tentative explanations share a number of possible reasons modelers act in questionable ways. Yet, in spite of these congruities, no single unifying thesis immediately emerges that provides a stable theoretical framework and common thread with which to weave together these positions. Such a theory would (a) prove consistent with the above hypotheses that explain how well-meaning transportation professionals systematically make questionable ethical decisions and (b) go beyond them to answer why. The field of cognitive science may provide the theoretical grounding necessary for understanding the systematic failures of travel demand forecasting.

“...[S]uppose the real explanation for decisions which to the analytical mind appear strange lies in the way the mind perceived [sic], simplifies, and acts on complex phenomena” (Richmond 1998a, 296). This supposition lies at the heart of what promises to make sense of the ethical lapses of travel demand forecasters—conceptual metaphor theory. It was developed in large part by George Lakoff in the late ‘seventies. Since then, linguists and cognitive scientists have tested, refined and debated it widely (see in particular Lakoff and Johnson 1999). More recently, Lakoff employed it to describe the ideological divide of American politics (1996). At about the same time, Jonathan Richmond introduced formal metaphor theory to the field of transportation planning in articles that detail why rail transit systems in Los Angeles and Sydney that make poor use of scarce resources enjoy nearly unanimous local support (1998a; 1998c).

METAPHOR THEORY

Lakoff and Johnson fault as simplistic the common view that metaphor is only a characteristic of language and merely a “device of the poetic imagination and the rhetorical flourish” (1980, 3). They contend that the human conceptual system is metaphorically structured and defined—human thought processes are largely metaphoric—and therefore metaphor is pervasive in everyday life (6). Lakoff and Johnson discuss the concept of argument and the conceptual metaphor ARGUMENT IS WAR to illustrate how metaphor structures a common activity. The salience of their example warrants the lengthy quotation.

[The] metaphor ARGUMENT IS WAR...is reflected in our everyday language by a wide variety of expressions...[such as “y]our claims are *indefensible* [all italics in original] [” and “h]is criticisms were *right on target*.]...It is important to see that we don't just *talk* about arguments in terms of war. We can actually win or lose arguments....Though there is not physical battle, there is a verbal battle, and the structure of an argument—attack, defense, counterattack, etc.—reflects this. It is in this sense that the ARGUMENT IS WAR metaphor is one that we live by in this culture; it structures the actions we perform in arguing.

Try to imagine a culture where arguments are not viewed in terms of war,...[but rather] where an argument is viewed as a dance...In such a culture, people would view arguments differently, experience them differently, carry them out differently, and talk about them differently. But *we* would probably not view them as arguing at all: they would simply be doing something different...[The] difference between their culture and ours...[is] that we have a discourse form structured in terms of battle and they have one structured in terms of dance. (4-5)

Viewed in this way, metaphors have the power to define reality. The world is too complex to understand in any comprehensive sense. Metaphors allow humans to use concrete ideas rooted in experience to reason about and understand abstract concepts. This simplification function operates by forcing acceptors of a metaphor to focus only on those aspects of their experience that the metaphor highlights. This ultimately leads the thinker to regard the entailments* of the metaphor as being true. For example, if a person reasons about cities as organisms (a common metaphor reflected in the expression “this is

* Entailments are commonly stated in the form, “if x then y, therefore if x' then y' .”

a dead neighborhood”), s/he may focus on the city as being ill (i.e., his or her experience with living things) and regard as true the entailment, or inference, that blight is like a cancer and must be removed to keep the city healthy. Therefore, according to Lakoff and Johnson, such “truths” may be true relative only to the reality defined by the metaphor (1980, 157-58). Such an account runs counter to the objectivist claim that meaning is disembodied and truth is absolute. Rather, meaning is always grounded in the acquisition and use of a conceptual system and truth is based on understanding (197).

In contrast to objectivism, it is not at all obvious by this account that conceptual metaphor theory is at odds with the subjectivist view of the world. However, this indeed is the case. Subjectivism is based on five core assumptions: meaning is private; experience is purely holistic; meanings have no natural structure; context is unstructured; and meaning cannot be naturally or adequately represented (224). Each of these hinges on the fundamental assumption “that experience has no natural structure and, therefore, there can be no natural external constraints upon meaning and truth” (224). Lakoff and Johnson insist that this premise contradicts metaphor theory since “our experience is structured holistically in terms of experiential gestalts. These gestalts have structure that is not arbitrary. Instead, the dimensions that characterize the structure of the gestalts emerge naturally from our experience” (224).

It is impossible to think about subjective experience and judgment without metaphor (Lakoff and Johnson 1999, 59). Lakoff and Johnson illustrate this by contending that it is very difficult to reason about similarity without the SIMILARITY IS PROXIMITY metaphor. The necessity of metaphor is a particularly important conclusion for this and other research that attempts to identify ways to ameliorate societal problems because it

precludes suggesting the elimination of metaphoric thought. In fact, thinking metaphorically is what makes possible abstract scientific theorizing (128). However, a great deal of language “is so heavily conventionalized that much of it does not seem obviously metaphorical. But we could not understand [it] without presupposing the metaphorical systems...from which [the] language is generated” (Johnson 1993, 53). Consider MORE IS UP. Without this metaphor, the phrase, “prices are rising,” would seem utterly ridiculous.

Metaphor theory rests on the three main findings that form the core of *second-generation* cognitive science. Namely, “[t]he mind is inherently embodied, [t]hought is mostly unconscious, [and a]bstract concepts are largely metaphorical” (Lakoff and Johnson 1999, 3). Second generation cognitive science, in Kuhn’s terms, represents a scientific revolution and as such one would expect resistance to the new theories it ushers in from “the specialists on whose area of special competence they impinge” (1970, 7). True to form, two common objections, raised as questions, challenge the credibility of metaphor theory. First, can “scientific inquiry in the study of mind in general...ever produce results not determined by some philosophy or other”? (Lakoff and Johnson 1999, 75). Yes. Where one has five to ten sources of converging evidence produced using the broadest range of methodologies, the chances of any particular methodological assumption skewing the results of an inquiry is relatively small (79). Second, “[i]f conceptual metaphor is part of the cognitive unconscious, if we have no conscious direct access to it, how do we know it exists at all?” (81). Convergent evidence, again, is what is crucial. Lakoff and Johnson report that “nine major kinds of convergent evidence have contributed to the conclusion that conceptual metaphor is cognitively real” (82). These include three types of generalization evidence, evidence of historical semantic change and evi-

dence from psychological experiments and studies of spontaneous gestures, language acquisition, sign language metaphors and discourse coherence (81-86).

METAPHORIC REASONING ABOUT TRANSPORTATION

Although data that describe forecasting practice in particular are scarce, implicit examples of metaphoric thinking and their abundance in the broader transportation planning literature, both academic and popular, indicate the promise metaphor theory has for illuminating the dysfunction of travel demand modeling. Consider the following accounts. A 1989 survey of 600 King County (Seattle) residents indicated strong support for a rail transit system. In spite of overwhelming evidence to the contrary, they thought it would relieve traffic congestion (Dunphy 1990, 38). A planner from the Metropolitan Transportation Commission explained why a proposed congestion pricing demonstration project on the San Francisco-Oakland Bay Bridge failed to garner needed support. “A major obstacle was convincing people that small changes in traffic cause big delays. Most just wouldn’t believe that a 6% reduction in traffic would bring such a large time-saving. Their intuition that we would need to price everyone off the bridge to reduce the back up was too firmly rooted” (Heminger 1998, 30). In both of these cases, it seems, metaphoric reasoning about transportation systems led to the cognitive dissonance reported.

Without access to the comments on which the above observations were made, it is impossible to identify with great certainty the metaphor(s) at work here. Most individuals, however, rely on ROADS ARE BLOOD VESSELS* to make sense of transportation problems and the conclusions in these examples are certainly consistent with it. The most im-

* Terms common to transportation planning discourses stem from this metaphor, such as arterial, flow and obstruction.

portant entailment of this metaphor for transportation is that traffic movement changes in proportion to road capacity. Unlike transportation systems, though, the human vascular system maintains a relatively constant volume. This is where the metaphor breaks down and can lead to flawed conclusions like those above.

The simplification function inherent in metaphoric thought focused attention only on those aspects of experience that the metaphor highlighted—new transportation system capacity reduces congestion. Other aspects—small changes in traffic cause big delays—were not ignored, they simply were not recognized. A different metaphor for reasoning about traffic is needed to capture other characteristics of congestion. *VEHICLES ARE GAS MOLECULES* may well be apt for understanding the non-linear generation of congestion under maximal flows.

When a flowing gas encounters a bottleneck, for example, it becomes compressed as the molecules suddenly crowd together—and that compression travels back through the stream of oncoming gas as a shock wave. That is precisely analogous to the well-known slowing and queuing of cars behind a traffic bottleneck: as cars slow at the obstruction, cars behind them slow too, which causes a wave of stop-and-go movement to be transmitted “upstream” along the highway. (Budiansky 2000 22)

Notice the use of the term “upstream” to refer to traffic on a network. This only makes sense with *ROADS ARE BLOOD VESSELS* or some similar metaphor. Otherwise, a stream—a current of fluid—such as flowing blood, is not coherent in the context of highways. The complexity of transportation systems seems too great to understand without the simplification mechanism that comprises metaphorical reasoning. Yet, the inquisitive who rely too heavily on one metaphor do so at their peril because metaphors shroud as much as they illuminate.

If, indeed, the failures of travel demand forecasting are rooted in incognizant reasoning based on inappropriate metaphors, a curious paradox emerges. That which uncon-

sciously undermines modeling practice—simplification of complex concepts—also serves as its guiding principle. Transportation models, in fact nearly all models, are metaphoric representations of complex problems and recognized as such by most modelers. Much of the effort made to advance the state of the art in travel demand modeling, therefore, is focused on developing new simplifications to further minimize bias. An MIT researcher characterized the forecasting challenge this way: “A fundamental modeling problem is adequately representing a decision process that has infinitely many feasible outcomes in many dimensions. The key to solving it is simplification in a way that still produces valid results” (Ben-Akiva 1998, 42).

CONSISTENCY

The working hypotheses, taken as a whole, and metaphor theory are by no means mutually inclusive. Rejecting one does not preclude accepting the other(s). Conceivably, there are other hypotheses consistent with metaphor theory that explain how well-meaning transportation professionals systematically make questionable ethical decisions as well as other theories consistent with one or all of the working hypotheses that explain why. However, any hope of accepting both theory and hypothesis demands consistency. Can the three working hypotheses presented above be understood in the context of metaphor theory? Yes.

Self-deception is the most obviously consistent of the three hypotheses because the cognitive dissonance that defines self-deception is also a major symptom of metaphoric thought, which focuses attention on some aspects of a problem while failing to recognize others. Furthermore, although self-deception is a conscious act, it is not neces-

sarily inconsistent with metaphor theory. For while metaphoric reasoning is largely subliminal, it is by no means restricted to the unconscious.

Reconciliation of role-singularity with metaphor theory requires a different account of how the dispassionate technician works. According to objectivists, the work of technicians is based on rational choice, which is considered “literal, logical, disembodied, dispassionate, and consciously calculable” (Lakoff and Johnson 1999, 515). They conclude modelers in this role analyze (i.e., reason about) data to discover truth and arrive at the best course of action. However, this conclusion stands in stark contrast to metaphor theory. Second-generation cognitive scientists provide the necessary alternate view.

Briefly,

[r]esearch...shows that the theory of rational choice has a metaphorical structure and that metaphorical thought plays a crucial role in its application in any context....The rational actor model is...a human imposition, an attempt to use a certain mathematics and at least three layers of metaphor to model...idealized situations. (Lakoff and Johnson 1999, 515)

The details of Powell and Lakoff’s research are beyond the scope of the immediate discussion (for an in-depth treatment, see in its entirety Lakoff and Johnson 1999, chapter 23). Suffice it to say, the theory of rational choice would make no sense at all without metaphorical interpretation.

Finally, the interchange of roles inherent in role-schizophrenic behavior is easily understood as instances when distinctive sets of metaphors alternately dominate reason. The dominant group of metaphors at any one time hides the reality defined by the alternate set and in so doing keeps the modeler from having to reconcile the advocate and technician roles, and, in some cases, from even having to recognize the conflict.

The theory outlined here guided this study from its inception without binding the research to traditional conclusions based on accepting or rejecting formal hypotheses. The methodology outlined in the following chapter reflects this orientation in its predominantly qualitative approach and open-ended style. Together, the theoretical discussion and details of the research design provide a broad and solid vantage point from which to holistically interpret the wealth of data collected for this study.

CHAPTER 4

METHODOLOGY

The primary source of data for this study is a series of in-depth qualitative interviews with travel demand forecasters. Interviewing is particularly attractive for a project such as this because it can provide data suitable for holistic and interpretive research as well as hypothesis testing. Also important for this work are the results of a mail survey of modelers that the investigator conducted prior the above referenced round of interviews. Both quantitative and qualitative data contributed to the findings of this study.

SURVEY

The survey of travel demand forecasters was immediately useful for locating important issues to raise in the interview portion of the data collection and providing a list of modelers willing to participate as an interview subject. The quantitative data later served primarily as a check on the accuracy and balance of the qualitative data from the interviews. Beyond the conclusion of this study, the database of survey responses promises to serve as a rich data source from which to better understand the practice and context of modeling, and design important, effective and efficient follow-on research of the forecasting profession.

SAMPLING

The survey target population was the set of all individuals who were employed in the United States and Canada in a professional capacity to model travel demand since

1965.* Sudman et al. characterize populations of this type as elusive because the costs of locating them are substantial (1988, 991). There are three reasons why the target population identified here is expensive to place. First, travel demand modeling is not a regulated profession. Travel demand modelers do not require a license or registration to practice their profession. Therefore, an inclusive listing of practicing modelers does not exist. Many modelers do hold memberships in any of a number of professional organizations related to transportation planning. However, the membership lists of these organizations are of limited usefulness because they are biased (members are self-selecting), inefficient and not comprehensive. Included in the issue of comprehensiveness is the problem of locating individuals who once worked as modelers, but who subsequently changed careers.

Second, the nature of this study excludes the use of an employer sample to identify modelers. Since the types of organizations that typically employ modelers are narrowly defined—most modelers work for state departments of transportation, designated metropolitan planning organizations and planning consulting firms—the investigator could have conceivably used multistage sampling techniques to draw a representative sample of modelers by first constructing an appropriate sample of employers. Unfortunately, this sampling strategy depends on the cooperation of employers to identify the modelers in their organizations. Since the survey for this study asks about instances of malfeasance, such cooperation is problematic. This strategy, on its face, also excludes modelers who have switched careers.

* The selection of this population is arbitrary, to some degree. The limit on geography reflects financial constraints on data collection. Not extending the practice window beyond 1965 ensures that the population includes only forecasters who have practiced since the field fully developed

Third, the training requirements of travel demand modelers are not narrowly defined. This makes it difficult, if not impossible, to use alumni/alumnae databases to locate and sample the target population. Modelers come from a variety of educational backgrounds. Some have graduate degrees, while many do not. The academic departments modelers train in are also varied. Degrees in engineering and planning are most common among modelers, but other disciplines, such as geography and economics, are also represented (table 7). Even if it were possible and practical to construct an educational profile of the typical modeler and identify a list of schools that provide its distinguishing education, the data needed from each institution to draw a representative sample may not even be available. Databases of alumni/alumnae associations and universities are often incomplete and their data not rich enough to be useful to investigators. Furthermore, universities and alumni/alumnae associations are often constrained by stringent rules governing the distribution of personal data.

The investigator relied on non-probability sampling techniques to construct the survey sample. This choice does not reflect a lack of practicable probability sampling methods—a common rationale for using ad hoc samples. The obstacles inherent in the sampling strategies alluded to above, with adequate funding, are by no means insurmountable. The rationale behind the sampling decision also runs counter to the usual motivations of limited resources and convenience (Kalton 1983, 90). Quite simply, one cannot justify the costs of drawing a scientifically random sample for this survey. There is no debate over the primary issue raised in the proposed survey. At least privately, those within the travel demand modeling profession, and interested observers outside it, acknowledge that modelers are culpable for the failures of travel demand forecasting.

TABLE 7
Post-Secondary Degrees of Survey Respondents

Field	Degree				Total
	Associates	Bachelors	Masters	Doctorate	
Engineering	4	235	152	23	414
Planning	–	41	180	10	231
Geography	–	75	23	2	100
Social Science Other	–	55	11	4	70
Technology Other	4	16	16	9	44
Economics	–	34	8	1	43
Political Science	–	39	2	–	41
Humanities	–	37	2	–	39
Business	–	15	14	–	30
Mathematics and Statistics	–	20	2	2	24
Public Administration	–	3	20	–	23
Physical Sciences	–	16	3	1	20
Other	–	10	7	–	17
Environmental Other	–	9	–	–	9
Not Reported	1	32	20	7	60
Total	9	637	460	59	1,165

Note: Single degrees in multiple fields (e.g., co-majors) reported more than once.

This absence of a controversy makes a description of the problem in statistically defensible terms not particularly interesting. Is it valuable to “objectively” generalize about the target population? Certainly. However, the benefits of being able to do this do not warrant the costs of collecting the required data.

The use of an ad hoc sample for this survey was appropriate because it is efficient and provides the data necessary to meet the objectives of the study. An important goal of the survey is to describe the ethical dimensions of travel demand forecasting in sufficient detail to aid the design of an effective interview instrument for the second phase of this project. Surveying as exploratory work is common and using ad hoc samples can produce the desired data (Sudman, Sirken, and Cowan 1988, 991). Howe and Kaufman were able to design their qualitative research into planning ethics on a survey that employed an ad hoc sample of 614 public planners (1981, 266). They developed an interview instru-

ment for it from important questions the survey raised and relied, in part, on the statistics from that survey (e.g., non-response rate) to draw a suitable sample of planners to interview (Howe 1994, 341-42).

SAMPLE FRAME

The survey sample frame is the set of all individuals whose names appear on the mailing list of the Travel Model Improvement Program (TMIP). The TMIP sponsors, the Federal Highway Administration, the Federal Transit Administration, the Office of the Secretary of Transportation and the Environmental Protection Agency, established TMIP in 1992 to conduct research designed to improve travel demand and supply forecasting models. The sponsors conduct TMIP in four activity tracks: near term improvements, longer term improvements, data collection and outreach. The Texas Transportation Institute (TTI) is responsible for major work in the outreach track. It serves as the clearinghouse for research findings, coordinates research and provides training and technical assistance intended to help transportation planners improve their models and skills. As part of its efforts, TTI established a bulletin board and home page on the World Wide Web (<http://tmip.fhwa.dot.gov/>) and publishes a free bi-monthly newsletter for those interested in improving travel models and forecasts.

Understanding that it would serve as the sampling frame for the project survey, the TMIP sponsors agreed to share their outreach mailing list. The database was originally a list of attendees of various TMIP conferences. It functions today principally as the TMIP Newsletter mailing list. TTI staff updates the database monthly from requests received by telephone, facsimile, courier and electronic mail. TTI includes a form in each newsletter for use in submitting additional names for inclusion in the database. Ad-

ditionally, the TMIP homepage publicizes the newsletter and invites interested individuals to subscribe.

Using the TMIP database as the sample frame had two distinct advantages. First, the database is particularly efficient for the task at hand. This is because the focus of the TMIP newsletter is sufficiently narrow that it has no mass audience outside the modeling profession. Second, there was no compelling reason to believe the sample frame is not at least tolerably representative of the target population. (This representativeness will allow analysts to make some subjective generalizations from the survey data about the target population and provide a rich sampling frame for selecting interview subjects.) The geographic coverage of the database is acceptably broad, which is also reflected in the practice locations of the survey respondents. As a group, modelers who participated in the survey work, or once worked, in the District of Columbia, all fifty U.S. states and one-half of all Canadian provinces (table 8). The survey responses moreover suggest that the sample frame includes a full range of ages, employer types and position levels, although they do indicate the sample over-represents mid-career professionals with responsibilities

TABLE 8
Most Recent Practice Location of Survey Respondents ($n = 593$)

AK	2	IA	7	MO	7	OH	18	VT	2
AL	9	ID	4	MS	2	OK	2	WA	24
AR	2	IL	16	MT	2	OR	19	WI	11
AZ	9	IN	9	NC	24	PA	11	WV	3
CA	50	KS	5	ND	2	RI	1	WY	2
CO	9	KY	7	NE	5	SC	11	AB	2
CT	6	LA	3	NH	3	SD	4	BC	19
DC	10	MA	25	NJ	14	TN	8	MB	1
DE	1	MD	17	NM	8	TX	27	ON	4
FL	33	ME	4	NV	7	UT	2	QC	1
GA	11	MI	15	NY	36	VA	18	*	26
HI	1	MN	10						

*Not reported

that range beyond those solely of a technical expert (figure 2 and tables 9-10). In relation to the general population, women and non-Caucasians are underrepresented, 11% and 14% of respondents respectively. This is, however, more likely indicative of a profession long dominated by white males than sample bias.

FIGURE 2
Age Frequency Distribution

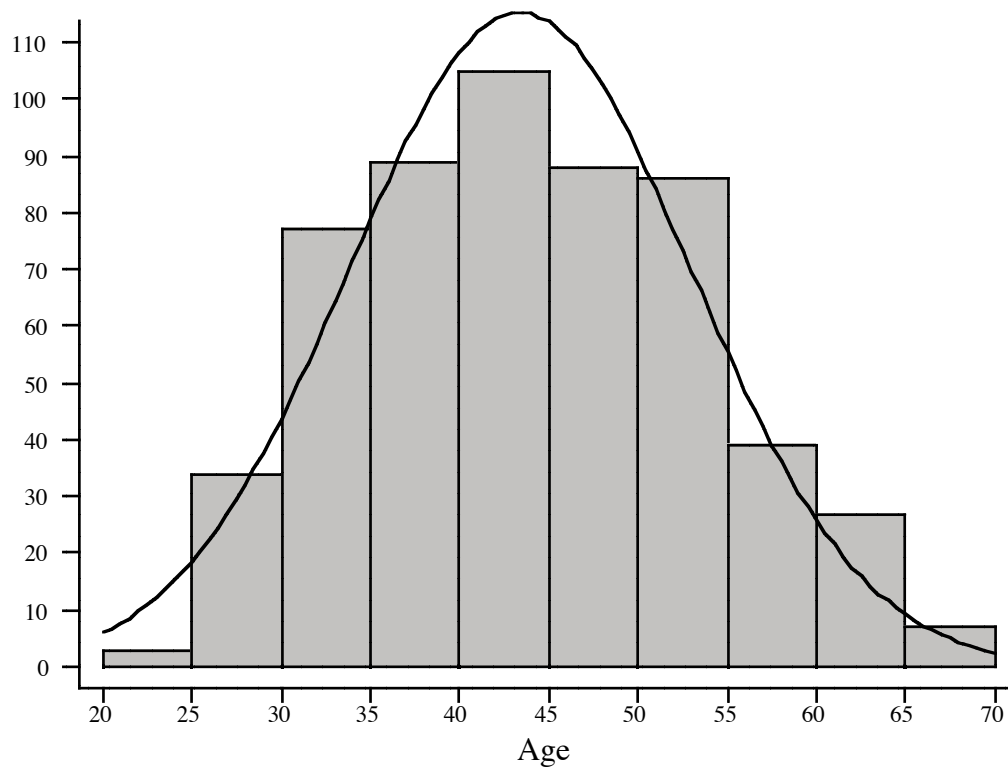


TABLE 9
Most Recent Modeling Employment of Survey Respondents (*n* = 579)

Public		Private	
Federal	5	Consulting Firm	132
State/Provincial	123	Non-Profit	2
Regional	220	Independent Contractor	9
Local	86	Other	1
Not Specified	1		
Total	*435	Total	*144

*Not reported = 14

TABLE 10
Most Recent Modeling Position of Survey Respondents

	Years of Modeling Experience (all positions)	Not Re- ported	0-4	5-9	10-14	15+	Total
Technician		14	49	48	25	21	157
Project Manager		19	55	78	88	101	341
Director		9	6	13	15	44	87
Not Reported		3	–	–	–	–	8
Total		45	110	139	128	171	593

POPULATION AND MODALITY

After removing institutional entries and those of non-practitioners (e.g., university professors), the TMIP database comprised 1,350 records. Since this is a manageable sample size for a self-administered survey, the sample frame functioned as the survey population (i.e., every individual on the TMIP mailing list received a request to participate). The survey instrument also solicited the contact information of other modelers.* Responses to this request increased the survey population by 346, the database for which ultimately comprised 1,696 unique entries. Since former colleagues are in the best position to identify individuals who no longer work as modelers, this strategy for expanding the survey population was particularly attractive for locating this elusive population. Constructing a sample from sources other than the TMIP list also worked to counter self-selection bias inherent in the TMIP list.

The investigator conducted the survey using a mail questionnaire. Beyond those of convenience and cost, several factors motivated this choice. First, the telephone numbers available for the survey population were primarily for places of business. This being the case, a telephone survey was impractical because respondents might have been uncomfortable providing details of questionable professional behavior while at work. In

* A separate form was provided for submitting this information. See appendix 1.

this setting, modelers may have provided inaccurate and incomplete answers or refused to respond at all. Second, a self-administered survey allows respondents to remain anonymous. To receive accurate responses to delicate questions in this survey, investigators likely needed to guarantee some respondents full anonymity. Finally, modelers are well educated and presumably have good command of the issues raised in the survey. This minimized concern that the survey instructions and questions might be confusing and skew answers.

To improve response rates, each questionnaire bore a one-dollar US coin (two-dollar CND coin for Canadian addresses) as a thank you to participants for thoughtfully completing the questionnaire in a timely fashion. Additionally, thirty days after mailing the questionnaires, the investigator sent a follow up letter and duplicate survey package to those individuals who had not yet responded. To further increase participation and also encourage candid responses, the individual questionnaires bore no identifier, which served to preserve the respondents' anonymity. A coded postcard included with the questionnaire identified the respondent and, when returned, notified the study staff that the questionnaire had been dealt with appropriately (figure 3). Available evidence suggests that this is a highly reliable procedure (Fowler 1993, 47) and it prevented respondents from receiving unnecessary follow-up reminders. It also served the purpose of more precisely defining the survey population. Incorporation of these provisions, designed to minimize non-response, and the well-educated and motivated nature of the survey population likely explains the exceptionally high response rate of 47% (table 11).

FIGURE 3
Survey Postcard

**PLEASE RETURN THIS CARD REGARDLESS
OF YOUR STUDY PARTICIPATION**

*It preserves your anonymity and informs us not to remind you to return
your questionnaire.*

Check one

I am sending this coded postcard at the same time that I am putting
my completed questionnaire in the mail.

I am not a member of the intended survey population and have dis-
carded my questionnaire. If I have information that could increase
the size of your survey sample, I will complete and return the Col-
league Information form.

TABLE 11
Survey Sample

Size (%)	1,260 (74)	Returned Questionnaires (%)	593 (47)
Ineligible Respondents* (%)	436 (26)	No Response (%)	667 (53)
Mailed Questionnaires (%)	1,696 (100)	Size (%)	1,260 (100)

*Individuals indicating on the return postcard (figure 3) that they are not members of the intended survey population.

DESIGN

The survey instrument for this research is an adaptation of a questionnaire developed by Elizabeth Howe and Jerome Kaufman at the University of Wisconsin for studying professional planners' ethics (Howe 1994, 350-68). Their questionnaire was particularly valuable as a prototype because it provided a proven approach for understanding the multi-dimensional nature of professional role orientation, which is a large focus of this research.

The survey included 45 statements on a variety of forecasting issues worded in such a way as to provide insight into a) the roles each modeler is apt to assume in her practice and b) the values that may or may not color his analysis. Each of six additional questions provided a scenario with ethical dimensions likely to be encountered in transportation planning practice. These items provided empirical data for better describing the context of practice while, perhaps, also indicating the planning tactics and the benefiting stakeholder groups that might influence ethical choices.

In addition to collecting information on employment and socioeconomic and educational background as independent variables with potential explanatory power, the questionnaire also asked about professional affiliation and whether the survey participant's employer provided payment for professional dues. In theory, modelers that hold membership in professional organizations should have a greater awareness of, and commitment to, ethical conduct. Employer payment of professional fees is a likely surrogate of employer support for higher standards of ethical behavior.

Volunteers from the Metropolitan Transportation Commission—the San Francisco Bay Area MPO—and Dowling Associates—a traffic engineering and transportation planning consulting firm based in Oakland, California—pretested the draft survey instrument in early 2000 prior to distribution of the final questionnaire during the spring and summer (appendix 2). The pretest was most useful for gauging the time required to complete the survey, evaluating skip patterns and identifying ambiguous wording. It also identified questions with particularly low response variation, which were modified or dropped from the final version of the questionnaire.

INTERVIEWS

Following the survey the investigator conducted 30 in-depth in-person interviews, which lasted from ninety minutes to three hours. The interviews took place in a span of ten weeks during the summer and autumn of 2000 throughout the United States and Canada. This compact schedule aimed to limit distortions in findings introduced by the passage of time. For example, study participants interviewed early in the process may have discussed their experience with other modelers. Since travel demand forecasters are, by and large, a closely-knit group, conceivably these discussions may have filtered back to other participants not yet interviewed and consequently skewed their responses. Interviews spaced closely together reduce the chance that history will vary responses among study participants. To encourage participation and increase the quality and quantity of information collected, the investigator scheduled each interview at the convenience of the participant and discouraged meeting in the workplace. Interviews with members of the opposite sex were held in hotel conference rooms. Overall, the investigator conducted 12 interviews in hotel suites, 9 in hotel conference rooms, 7 in the workplace and 2 in eating establishments. In every instance, the workplace interviews were seemingly private.

SAMPLE

The sample frame for the interview portion of this project is the set of 202 modelers who volunteered on the survey questionnaire to discuss their experiences. This represents 34% of respondents or 16% of the survey sample. Because the sample frame is self-selected, it was impossible to draw a statistically random interview sample. Therefore, practical considerations and a strategy of maximum variation guided efforts to draw an appropriately diverse sample. The sample reflects the need to balance resource con-

straints with a desire to distribute the interviews as broadly as possible geographically. The latter reflects concern that particular cultures of planning, often state specific, might color the results of the study (Howe 1994, 11). To complete the interviews within the prescribed ten-week period, interview sites had to be generally restricted to groupings of three that one interviewer could efficiently visit within the span of four days. Still, the interviews took place in 20 U.S. states and four Canadian provinces.

Because gender might be important for understanding some response variation, the investigator took care to include a representative subset of women in the sample. Thirteen percent of survey respondents were female and 10% of the interview sample was as well. Similarly, the investigator ensured that the educational profile of the sample reasonably matched that of the survey respondents since, in theory, formal training is a key determinant of professional behavior related to ethics (table 12). Finally, the investigator made a deliberate attempt to increase the representation of private sector modelers over the level observed in survey responses. The investigator adopted this approach because conventional wisdom sometimes holds that corruption is concentrated in private consulting firms. Ensuring each group had sizable representation in the sample provided the best chance to test this informal hypothesis (table 13).

TABLE 12
Master's Degrees of Survey Respondents (%)

Field	All Re- spondents	Interview Volunteers	Interview Subjects
Engineering	132 (22)	55 (27)	6 (20)
Planning	161 (27)	61 (30)	11 (37)
Planning and Engineering	19 (3)	5 (2)	1 (3)
Other	103 (17)	33 (16)	4 (13)
No Degree	178 (30)	47 (23)	8 (27)
Total	593 (100)	201 (100)	30 (100)

Note: Total percentages may not equal 100 due to rounding.

TABLE 13
 Most Recent Modeling Employment of Survey Respondents (%)

Field	All Re- spondents	Interview Volunteers	Interview Subjects
Public	435 (73)	138 (68)	18 (60)
Private	144 (24)	61 (30)	12 (40)
Not Reported	14 (2)	3 (1)	
Total	593 (100)	202 (100)	30 (100)

Note: Total percentages may not equal 100 due to rounding.

DESIGN

To ensure continuity, the investigator conducted every interview for this study. The interviews were open-ended and guided by an interview protocol (appendix 3). This protocol, or guide, was intended to ensure that the interviewer collected the same information from all participants by covering the same material during each interview. The open-ended format allowed the interviewer to spontaneously word questions, probe emerging issues and build lines of inquiry that best illuminate the subject matter.

The overriding purpose of the interviews was to document in specific context the decisions travel demand forecasters make that have a bearing on the accuracy of their work and the process by which they came to them. This descriptive account identified why outcomes occurred as they did and why modelers made the choices that they did. By relating the outcomes and behaviors to context and circumstance, the analyst was able to go beyond the primary research questions of this study to an understanding of what might have been. This allowed the researcher to further illuminate the current ethical dilemmas of modelers and map possible alternative outcomes to modeling actions.

The survey responses of travel demand forecasters were instrumental in identifying topics and questions for inclusion in the interview guide. Areas of discussion for the interview included: the constraints modelers work under; the context of individual prac-

tice and modelers' potential influence over politicians; the responsibilities of the client, the modeler and the politicians who are the ultimate consumers of travel demand forecasts; issues of confidentiality and privacy; conception of professional role or roles; and career satisfaction. Since the survey questionnaire returned by each participant in this phase of the study contained data on previous employment, education and related items, it was not necessary for the interviewer to collect personal information.

The findings detailed in the following chapter do not justify generalization to a wider population since neither sample is scientifically random. They describe only a very small group (30) of professional travel demand forecasters who volunteered to speak about their practice and its ethical dimensions. Inferences about a larger population are only speculative. Nonetheless, this research is valuable because it provides scarce empirical data needed to guide and motivate the study of professional ethics. Davis places the study of professional ethics in the wider field of what he terms, “the philosophy of professions” and explains that the importance of empirical knowledge lies in its ability to stimulate and properly focus inquiry.

To do the philosophy of any particular profession, philosophers need empirical knowledge of the sort historians, sociologists, and other social scientists typically provide. In its absence, philosophers will, at best, see nothing philosophically interesting in professions or, at worst, waste much time on problems that do not exist. (Davis 1992, 41)

The words of the professionals quoted in the balance of this work demonstrate that the “philosophy” of travel demand forecasting *is* interesting. Let them point to the problems that urgently deserve attention.

CHAPTER 5

FINDINGS

The discourses of the travel demand forecasters who participated in the interview phase of this study suggest a taxonomy that provides important clues for understanding why modelers produce biased forecasts and allow others to misuse their work. Universal themes also emerge from the data when considering the steps that Howe (1994, 10-11) identifies as necessary for effective ethical behavior. Viewed from this point of reference, the narratives of every modeler in the interview sample are remarkable for how little they reveal about taking the second and third steps of acting ethically—making good and right choices and summoning the will to act. They are also noteworthy for the problematic nature they suggest about the first—distinguishing practice situations that pose ethical issues.*

Attempts to gauge the success of any endeavor, of course, require a benchmark by which to measure it. This is no less true when assessing the extent to which individual modelers take the steps necessary for effective ethical behavior. In such a case, the evaluator must adopt a standard of ethical practice as the basis for interpretation. While there are certainly competing conceptions of what it means to be a morally responsible travel demand forecaster, none are widely articulated nor commonly accepted. Therefore, the model of right and good forecasting set forth by the author in chapter 2 serves

* Because the findings detailed in this chapter emerged entirely from the data, and are therefore not reflected in the working hypotheses of this study, the broader mail survey was not useful for supporting, explaining or amplifying them. For primarily the same reason, the survey was only marginally more useful for understanding the answers to the research questions (see chapter 6).

this purpose. Recall that this model requires forecasters to see both the limits of their technical analysis and the influence that they wield independent of it. Most critically, modelers must understand that their actions may have different meanings than they intend them to have because every analysis, utterance and omission shapes attention and concern in selective ways. Put most simply, the ethical questions of practice reach beyond those of inputs and methodology to the rightness of communicative acts. Ethical practice also demands that forecasters question the goodness of ends they serve. This means modelers must outwardly place their values in competition with others to both define and affirm the public interest for which they work.

DIFFICULT STEPS

Every interviewed forecaster demonstrated at least some difficulty cognizing situations that pose ethical issues by failing to provide a complete and/or consistent picture of the ethical challenges of practice. Most commonly, modelers—thirteen in all—seemed either not to recognize the concept of a public interest or responsibility to it by repeatedly failing to include citizens in discourses with the interviewer about cliental matters. Without an appreciation for the public interest, forecasters mistakenly narrow the scope of their ethical concerns. Contends one modeler, leaving out any discussion of a higher purpose, “[the quality of one’s work] is between their boss, their client and their conscience.”*

Conspicuous by its absence, too, is a demonstrated understanding of the influence forecasters wield independent of the content of their analyses. Seven modelers confine

* “Conscience” is unlikely to be a catchall that includes the public interest in this case because the forecaster in question indicates she has no empathy for the end users of her work. When later the interviewer suggested that the general public may not be aware that forecasts are not as precise as they appear, she replied, “Let people feel about the number the way they want to feel.”

ethical considerations strictly to their technical work. When pressed, they view only fabrication of inputs and outputs as unethical and, furthermore, define such very narrowly—as producing numbers with absolutely no basis. Considerations of right and good beyond the clearest of abuses seem not to enter these professionals’ deliberations.

In terms of being ethical versus unethical, I think you have to go pretty far to be unethical. It’s more likely that there is shoddy workmanship or sloppy documentation of assumptions with a strong bias that would be professionally unsatisfying—professionally unsound—but not necessarily unethical.

The contradictions and vacillations of modelers over issues that should be central to their ethical considerations may also signal failure to fully appreciate the challenges of practice. Most common are inconsistent personal assessments of one’s ability to be value neutral and the potential for bias each brings to his or her work. Twelve modelers indeed made conflicting claims or wavered on such topics. Additionally, a group of eight struggled to define and subsequently redefined their appropriate professional role. Of these, some explicitly reject the role of advocate while, at the same time, describing political decisions they routinely make in favor of particular alternatives and/or methodologies. Others reluctantly acknowledge their advocacy while maintaining a technician orientation that defers to the seeming authority of the numbers that forecasters produce. Still others reject any specific conception of their role, discarding advocate and technician characterizations as well as other suggestions. Finally, two in this subgroup relied on the PLANNERS ARE LAWYERS metaphor to suggest the appropriate role of modelers, but later acknowledged the shortcomings of such, not because it infers that loyalty to client is always paramount, but merely because it wrongly assumes that the public is aware this is the case. One ultimately settled on PLANNERS ARE ADVERTISERS after returning to the issue of role throughout the interview, clearly distressed that he had not provided a person-

ally satisfying answer to the original query. This metaphor addresses the expectation shortcoming, but is still inconsistent with the idea of an overriding public interest.

Inconsistencies, changes of course, wavering and even simplistic answers provide persuasive evidence that forecasters in this study do not reflect deeply on the complexities of their professional work. These indicators are common to the narratives of most participants and often extend beyond issues of ethics. Statements that directly acknowledge the foreign nature of the interviewer's questions, however, and answers so laden with uncertainty as to do the same are the strongest indications that critical reflection about practice may be lacking. The responses of eight modelers can plainly be placed in this category. For example, when asked whether and how personal bias is reflected in his analyses, one forecaster admits, "I don't know. I guess I have never really thought about that a whole lot." Furthermore, responses such as "I would hope so," "I guess" and "that's an interesting question" were not uncommon among members of this group.

Most certainly, the transcripts hold examples of sophisticated thinking about issues of good and right in the context of practice. With the exception of two professionals, though, these are simply overshadowed by responses that reflect quite the opposite. The two modelers who did overall display critical thought and reflection about ethical issues, nonetheless, provide few, if any clues, why they should distinguish themselves this way.

For forecasters, does difficulty seeing the ethical issues inherent in modeling practice represent the most formidable barrier to acting ethically or, because it is the first of several sequential steps, do most modelers simply never get beyond it to confront the others? The data at hand do not provide a satisfying answer because they yield relatively

few examples where interview subjects reflect on questions of right and good and consider their capacity to act on the answers. Without equivocation, only eight modelers positively asserted ethical obligations they owe to others. Most commonly they described responsibilities to ensure the reasonableness of modeling assumptions and to acknowledge the limits of analytical tools. Shared, but less common, are expressions of duties to maintain loyalty and surface bias.

Perhaps surprisingly, more modelers raised the third-step issue of action than those who discussed the second, what right and good action entails—thirteen versus eight. Furthermore, only four modelers talked about both (table 14). How, one might ask, can some advance through this sequence, while seeming to skip a prerequisite step? Rather than passing over key issues, the nine modelers in question indicated by responding to prototypical cases of wrongdoing in forecasting that they likely internalized the second step. Individuals commonly decide unconsciously and unreflectively what they should do in clear, unproblematic cases because there is little or no question about the right course of action (Johnson 1993, 80). The forecasters in this instance considered objecting to the political misuse of their analyses and the inferior work of colleagues or contemplated refusing to provide projections based on biased assumptions, substandard methodology and/or insufficient data.

TABLE 14
Evidence of Steps to Effective Ethical Behavior of Interview Subjects

Step 3	Step 2		Total
	Yes	No	
Yes	4	9	13
No	4	12	16
Total	8	21	29

All four subjects who failed to proceed to step three after addressing step two work in what the investigator subsequently describes in greater detail as engaged practice, where ethically questionable practices rarely present themselves for a number of reasons. The fact that they consider the question of right and good, instead of simply ignoring it, is probably best understood as an indication of self-selection, which finds the most thoughtful modelers seeking out professional opportunities where ethical practice is not usually problematic.*

Of the thirteen modelers who broached the issue of action (step 3), three reported instances where they refused to compromise their analyses for the political advantage of bosses or clients. Although none lost their jobs, they all indicated that their careers suffered as a consequence of their actions. Judging by the experience of the three that forged ahead, the key to holding the ethical high ground is a reputation for professional work that extends beyond one's own agency or firm.

Pressure was brought to bear on me to make the outcome favorable....I didn't fear retribution—I resented the pressure. I had concerns about the long-range implications in terms of my situation at the agency. I guess to be honest about it, my situation got a lot worse before it got better. I had a hard time getting a raise and maintaining my status, much less advancing within the organization....I was confident that I had support on the board from people who recognized that I was doing a good job and I was confident of widespread support on the staff and also very confident [that] in [the state capital] my work was appreciated.

While the second modeler's experience was similar, the third, without such external support, reported that his colleagues soon regarded him as a "disgruntled employee", which may explain why he failed to establish a lengthy tenure at any one firm.

The balance of these thirteen forecasters (ten) did not act when confronted with questionable practices. Seven claimed that they had very little leverage to do so because either their job or standing was at risk, while the remaining three individuals seemed

* See the discussion of engaged practice below for a more in-depth treatment of this point.

simply to lack the will to act. In the latter cases, profit and advancement seemed to trump concern over questionable practice.* Discussing perceived widespread use by modelers of optimistic assumptions to provide forecasts acceptable to their clients, one principal for a small consulting firm explained, “I don’t believe in playing the martyr for a long length of time.”

Beyond the intimation that leverage may play a role in determining who will act—this was a valid predictor in 9 of 10 cases—it remains unclear what distinguishes those who chose to speak-up. All ten who display a willingness to act, however, demonstrated a general dissatisfaction with their positions. Those displaying no will to act fall squarely into the camp of modelers who are complacent.†

Broadly, then, modelers who participated in this study had difficulty recognizing the ethical issues that practice poses and rarely consider fully issues connected to the other steps of effective ethical behavior. At first, this observation may seem unexpected because much of what has been written about the challenges of professional practice focuses on questions of choice and action, which suggests their primacy. This scholarly bias, however, likely reflects a propensity to gravitate towards the more remarkable rather than any tacit agreement that recognition is easy or less problematic than other steps. Howe alludes to such a predisposition while reflecting on her own research with Jerry Kaufman. “I think that there is a tendency (I see it in myself and Jerry) to be most interested in the dramatic or heroic or terrible cases, because they lend themselves to the most analysis” (1997). As it turns out, a propensity of scholars to set aside the mundane may leave important descriptors hidden that can lay bare the source of bias in forecasts.

* Chapter 6 explores the reasons for (in)action more fully, including the question of venality.

† A detailed discussion of complacency as a distinguishing characteristic of modelers follows.

IMPACT

When searching for reasons why modelers fail to take notice of important ethical questions, it is important to consider how forecasters appraise the impact of their own work. Recall that many decisions modelers make, even seemingly small ones, have an ethical cast precisely because they affect the interests and well-being of individuals who depend on the forecaster's expert advice (chapter 2). If forecasters believe that they have no impact, the ethical questions for them—from a teleological perspective, anyway—go away. Modelers, as it turns out, not only distinguish themselves by perceptions of their professional influence, but also by the degree to which these assessments correspond with job satisfaction. The differentiations, which broadly categorize forecasters as “engaged”, “complacent” or “disillusioned” (table 15), can help explain how forecasters respond to ethical challenges of practice.

TABLE 15
Typologies of Modelers' Practice Based on
Individual Appraisal ($n = 29$)

Professional satisfaction	Impact on public decision making	
	High	Low
High	Engaged (5)	Complacent (9)
Low	–	Disillusioned (15)

ENGAGEMENT

The five engaged modelers are unique among study participants for their demonstrated belief that what they do has an important impact on policy decisions. Each readily described instances in which his or her analyses clarified the planning context and reduced uncertainty, thereby influencing the decisions of policy makers. Furthermore, this influence correlates absolutely with meaningful involvement—engagement—that extends

beyond the technical responsibilities of modeling. In addition to developing models and producing forecasts, these analysts, unlike others in this study, have an important place at the table with stakeholders where choices are made. As one participant described it, “they provide forecasts and interpret them in the context of diverse planning concepts.” These modelers implicitly link involvement to impact in their accounts of practice, the following of which is representative of other engaged forecasters.

A lot of MPOs [metropolitan planning organizations] don't even have the opportunity to give [state] DOTs [departments of transportation] traffic forecasts. DOTs and their consultants just come up with numbers as they see fit. So just being given this role we consider kind of an inroad that we've made. Then, the next step is being part of the decision-making process that interprets those numbers and makes project decisions using those numbers. That also is, I think, unheard of, maybe, nationally that we'll be sitting at the table with the project designer helping them to interpret our numbers and then helping make decisions about how the design responds to those numbers.

Since studies on research utilization and technical indicators suggest that the problem solving model of data use has relatively little explanatory power (see chapter 2), it is possible that the five engaged forecasters may be mistaken about their impact, i.e., their claims of influence might not be factually accurate. Without detailed individual case studies, however, it is difficult to say with any degree of conclusiveness what the case may be. Nonetheless, it seems reasonable to accept them as essentially reflecting the reality of practice because (a) the relative number of engaged forecasters in the sample is small and (b) the picture of engagement that these modelers combine to paint contains numerous and rather detailed examples of situations where impact was said to be significant. Nonetheless, the question is not unimportant and deserves future consideration.

Two factors, or independent variables, help explain why engagement is a centerpiece of practice in some agencies. First, leadership seems to be a *sine qua non* of engaged forecasting. Participants in this study use various forms of the term leadership to describe the qualities of agency directors and department heads who value modelers for

more than their technical skills. These leaders promote expanded planning processes and the involvement of those (i.e., modelers) who can make them successful. One forecaster is very careful to point out that the director of her department made sure she was “in all the meetings and all the discussions...” from the time she first came to the agency fresh out of school.

Leaders also afford modelers a level of institutional autonomy. Several engaged modelers talked about the “flatness” of their organizations where superiors and subordinates consider one another peers and modelers have freedom to speak to the media and external stakeholders without restriction or sanction. Explains one analyst,

“I might go to my staff director and say, ‘I think this is wrong. I think we should go out on the record that this was done incorrectly.’ Theoretically my staff director might say ‘no’ and then I might feel the need to personally go outside and bring that out to the public.”

“Would your organization allow that?”

“My organization would be very patient with that. Yes. My organization would be very patient.”

Presumably, this latitude to act provides modelers with the *professional* credibility they need to be effective in various planning processes. Seeming to reflect this level of autonomy, an engaged modeler echoed his study peers by proudly explaining that he has always been able to use model inputs with which he feels comfortable.* Additionally, and perhaps paradoxically, leaders seem to promote and enhance engagement by supporting the choices modelers make in their work. This helps forecasters better resist external political pressures to arrive at particular conclusions in much the same way that autonomy keeps internal forces at bay. Three engaged modelers specifically credit this type of leadership for making their jobs easier.

* Those familiar with modeling practice at any level will recognize this statement as more of an exception than a rule.

Reputation—the second predictor of engagement—also works to shield modelers from pressure to alter their analyses in addition to helping them retain their place at the table where decisions are made. Forecasters with expanded responsibilities to planning processes, in one way or another, credit an organizational legacy of high technical standards for their ability to chart an independent course and stay involved.

The MPO has an extremely well thought of reputation around the metropolitan area, around the state and even around the country. *And that just helps tremendously....* The entire thirty-some year history has been very well met, technically based, and we haven't had any problems....I can absolutely see—and have heard it happening in other parts of the country—that if you do not have the reputation that says, “This is a reliable organization, they don't play games, they tell us what they're doing, they explain to us their process. It's an open process.” If you don't have that and you don't follow that path, then yeah, who knows what could happen to you. And yeah, you'd have pressure and, no, you probably couldn't stand up to it because [even if you have] the best intentions, if there's not twenty years worth of good reputation behind you, it's a heck of a lot harder to toe the line in the first year than [it] is in the twentieth year.

Other modelers in this study also discuss long-established technical standards of practice and obliquely link them to involvement. One forecaster discussed at length the MPO of a region not his own to illustrate the importance of reputation.* When asked to explain how this particular organization came to be held in such high regard, he alludes to both standards and engagement.

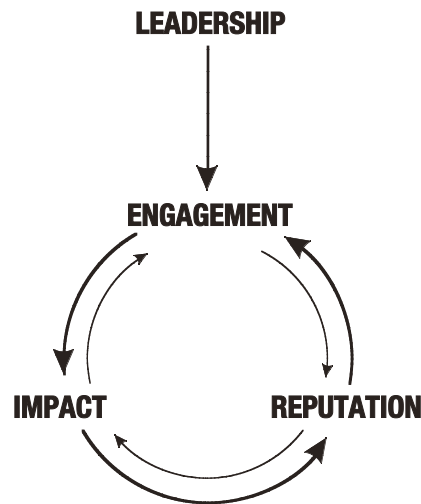
I think it is because they have been in place for so long. They have been doing this stuff since the 'sixties. It is established over the years. There is a long period of time consistently doing the same thing and working with everyone in the region. Everyone in the region feels they are part of the process. They may disagree with some of the elements, but on that end, those guys know what they are doing.

Taken together, the accounts of these five forecasters suggest, but by no means define, a model of practice where technical experts have an impact on policy decisions through active involvement with stakeholders in planning processes (figure 4). This engagement stems from leadership that commends the modelers and their professional con-

* This modeler is not included under the engagement category. Coincidentally, the MPO that he comments about employs an engaged modeler from the interview sample.

tribution to those who decide. Successful outcomes (i.e., positive impact) demonstrate the value of modelers' technical analyses and interpretation thereof, which establishes and maintains a long-term reputation for the rational planning process. While the interviews fairly well establish the relationship of leadership to engagement, understanding how engagement, impact and reputation relate to one another is more problematic. It is certainly possible to interpret these steps as proceeding in reverse order where modelers establish their reputation through their involvement and have influence because of it. Impact on successful outcomes then begets further engagement. Whatever the case, the conclusions of this research do not hinge on the exact form of the model. Therefore, it is perhaps most helpful to view these relationships as mutually reinforcing where influence flows in both directions, thereby strengthening the links regardless of sequence.

FIGURE 4
Idealized Model of Engaged Practice



The narratives of modelers in this study suggest that organizations with a tradition of forecaster involvement, particularly MPOs, benefit from political geography. In two

of five cases, engaged modeling takes place in areas where there is a regional balance of influence. No single large jurisdiction dominates. In the words of one modeler, “...there’s no 800-pound gorilla sitting at the table.” Therefore, he continues, “there’s motivation for everyone to build a consensus.” In such an environment, stakeholders are perhaps more receptive to the participation of parties they perceive as having something valuable to offer (i.e., independent analyses) and modelers are more likely not to be beholden to one powerful player for influence and funding. Adds another analyst, “having to balance interests seems to give them the ability to hold the line.” Since such a political setting is not a necessary condition for engaged practice, however, it is probably better conceptualized as a catalyst for the establishment and maintenance of wholly inclusive processes.

It is also worth noting that the impact modelers felt they have on planning decisions is a very satisfying aspect of practice. Of the five, some do specifically credit the *influence* of their work as personally fulfilling. “There was no question that, when we got to the end of the process, the technical data played a role and it was certainly rewarding to know that what we were doing meant something.” Others, though, were more likely to characterize their *involvement* as meaningful. “One of the most gratifying situations I’ve been in is...being able to talk [to stakeholders] about what the model suggested conceptually...it informed the group.” It does, however, seem reasonable to equate involvement with impact in these latter cases because of the cause and effect relationship (i.e., impact proceeds from involvement) these modelers’ descriptions of practice intimate.

Professional satisfaction in influence, however, does little to explain why this particular group found themselves in professional environments where involvement and technical analyses for problem solving are meaningful. Finding satisfaction in such is not a unique characteristic of engaged modelers and one would not expect it to be. The design professions are, after all, defined by their common purpose to serve some conception of the public interest.* The engaged modelers do share other characteristics. Four of five work for public agencies, the fifth served as a principal for his own relatively small firm after employment for years with a large city. Members of this group have also logged long tenures with their employers and occupy middle to upper management positions. The exception is a relatively young modeler. His remarks, though, suggest he has every intention of remaining with his organization over the long term. Agency, tenure and rank, however, do not seem satisfactory predictors of forecasters for whom impact overrides other incentives. More likely, these are artifacts of a self-selection process in which modelers so inclined seek out public agencies where profit (another strong incentive) is secondary, tenure reflects job satisfaction and rank is a function of experience.

As mentioned above, four of the five engaged modelers did consider questions of right actions and good ends, which represents half of those in the sample who did so. This *may* indicate that engaged forecasters are more critical and thoughtful than others, which might mean they make more proactive employment choices (e.g., seeking positions in agencies and firms known for competent leadership). Their reflective nature might also reflect certain leadership skills that they bring to their work that could be

* Most broadly, the design professions include planning, engineering and architecture. A planner's primary obligation is to serve the public interest, engineers should hold paramount the safety, health and welfare of the public and architects must thoughtfully consider the social and environmental impact of their professional activities.

credited with involved processes. There is, however, very little to confirm such speculation. Only one individual indicated that he specifically sought out a position of the kind he currently occupies and most modelers are reticent to claim credit for leadership (perhaps this itself is a leadership quality!). One, however, does take this step, exclaiming quite sincerely, "...you have to have people like me in California, Chicago and in Miami. That is why I said all big MPOs need to have a person like me [to maintain high standards]."

DISILLUSIONMENT

A plurality of modelers in this study—fifteen—comprise a group of practitioners best described as disillusioned because reality fails to match their expectation that forecasts should inform a rational model of decision making. Modelers are discontent because they neither consider nor understand how post-decision rationalization—of which their travel demand forecasts often play an important role—can serve useful and proper functions such as exposing otherwise hidden political deals to public critique and increasing the likelihood of implementation (chapter 2). In this study, modelers who address the political uses of their forecasts never employ positive terms to describe these functions. Betraying a degree of wistfulness, one principal of a small firm explained how little impact his work seems to have.

The longer I've been in the business, the more apparent it has become to me how unimportant forecasts are in decision making. We spent an enormous amount of effort producing numbers on ridership...and the decision makers find a way to ignore those data if they wish to. Transportation projects are rarely built or not built based on travel demand forecasts.

Similar conclusions are apparent in the responses of eight other disillusioned modelers. And although two hedge by claiming some significant amount of influence for themselves, their inability to provide supporting examples leaves one feeling that their

contentions were based more on wishful thinking than real experience. Two modelers avoided answering the question about impact directly. Coupled with personal accounts of practice that betray the limited reach of their work, these evasions seem designed only to avoid considering a troubling aspect of practice. The four remaining disillusioned modelers are unable to gauge the currency of their forecasts and remain unsure how they are used. Nonetheless, they do seem to suspect their own powerlessness.

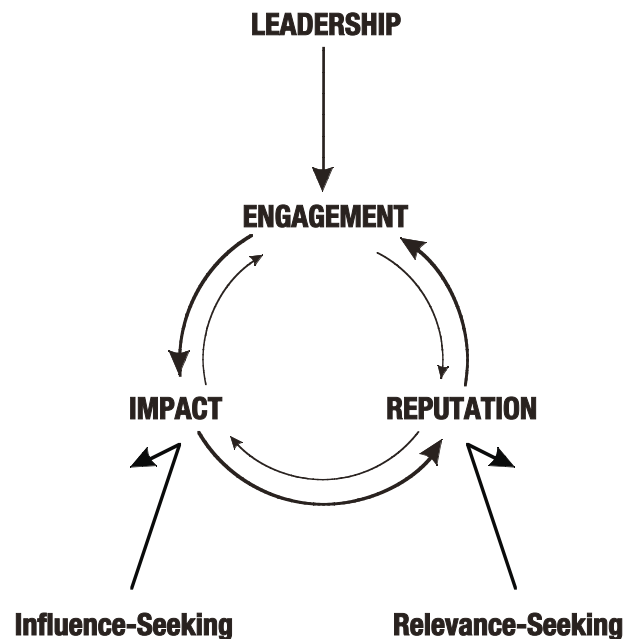
A frustrating aspect of working at [this agency] is that there's not much communication from upper management about whether or not any piece of information that was handed to them is actually used in the decision....They don't tell us whether it influenced their decision or not. And it would be really helpful to know. It would be both helpful *emotionally* and practically....I tend to think most of the time they ignore it.

The narratives of disillusioned modelers reveal a two-tiered incentive structure, which adds a layer of complexity for understanding the motivations of these forecasters. Like engaged modelers, seven of the fifteen indicate that influence to affect policy decisions is the primary component of job satisfaction. Four, however, spoke of a base-order need to be relevant—logically connected with, and important to, the matter in hand (Random House Dictionary, s.v.)—when explaining their professional frustrations. The balance of forecasters in this category (four) described both influence and relevance when they discussed the keys to professionally satisfying practice. In all cases, analysts displayed their want for relevancy by expressing a general desire to be useful and heard. “I almost feel [modeling] is the only way I differentiate myself from Joe Blow who works in the city planning office,” explains one forecaster. “Anybody can do that. It is something that differentiates me and makes me needed.”

The two-tiered construct does not invalidate the impact–satisfaction nexus characteristic of disillusioned and engaged modelers. By definition, to be influential, one must also be relevant. The converse, however, is not true and those who set their sights

on the more immediate task of avoiding marginalization do not indicate whether they care about influence. Nonetheless, as noted above, the design professions are defined by their common purpose to serve some conception of the public interest. Therefore, it is reasonable to assume that influence is a goal too of modelers who merely struggle for relevancy. Along the dimensions of their categorization—impact and satisfaction—the disillusioned and engaged stand opposite of each other (table 15, above).

FIGURE 5
Idealized Model of Engaged Practice and the Aspirations of Disillusioned Modelers



In the broadest sense, the disillusioned seek what engaged modelers enjoy—impact on policy. It is worth considering, therefore, the plight of disillusioned modelers in the context of engaged practice (figure 5). The relevance-seeking forecasters might be thought of as pursuing a favorable reputation as an intermediate step to impact since both reputation and relevance depend upon the estimation of others. On the other hand, the

influence-seeking likely view impact as the immediate prize. Without the leadership necessary to spawn engagement, which acts as a gatekeeper, these efforts can never be successful in this idealized model. This may explain why the interviews hold no accounts of triumph over marginalization.

TABLE 16
 Motivations of Disillusioned Modelers ($n = 15$)

Autonomy Challenged	Technical Proficiency	
	High	Low
Yes	Influence (7)	–
No	Influence and Relevancy (4)	Relevancy (4)

Among the disillusioned, only those concerned with influence reported instances where stakeholders and decision makers presented challenges to their professional autonomy (table 16). This suggests a group of professionals who are indeed connected and important to the planning processes for which they provide analysis, albeit in a way that seems, at least to its members, to yield little influence. This finding also seems to indicate that the modelers for whom relevance is an issue may have genuine reason for concern. Certainly if a modeler is truly irrelevant, one would not expect players in a political game to spend time worrying about what their forecasts might reveal. In fact, several modelers preoccupied with relevance are receptive to scrutiny and the participation of others in the planning process out of proportion to the rest of the interview sample. “The kind of [intense] scrutiny that you were describing is ever so rare and, if it happens, it’s like we almost welcome it because it’s [attention].” For them, any interest in their work, no matter how obtrusive, is welcome.

Of the interview subjects in this study, a small group (four) demonstrated a lack of technical proficiency, which suggests that they are not minimally qualified for the work they are doing.* Three particular response patterns, each characteristic of at least a majority of the modelers in question, support this finding. First, conspicuously absent from forecasters' descriptions of their concerns are references to the models they use. When asked technical questions, these modelers were unable to provide a technically detailed response and post-processing evaluation of outputs, as well as calibration, seemed to be foreign subjects to them. This appears to corroborate the observation of a model developer in the sample who complained that many forecasters know how to operate software without understanding the models behind it. Second, "unskilled" forecasters focus the bulk of their attention on issues of data collection, which seems to imply that the measure of a forecast rests primarily with the quality of its inputs. Third, and most conclusively, these modelers confirmed suspicions by acknowledging, sometimes rather openly, that they did not have the requisite training or knowledge for their jobs. For instance,

My background was in natural resources and water quality and I was hired to be a transportation planner. This was right after ISTEPA passed...The director really didn't understand the transportation planning process and felt that by bringing in somebody with [my] background, I would know less than he would so I wouldn't make him look bad. That was alluded to by somebody else, [not] something I came up with on my own.

Intuitively, it makes sense that relevance would be at stake when competency is an issue. Without the necessary technical proficiency, the other, more tangible rewards of practice that modelers identify—influence, respect of peers and wealth—are not available. Unfortunately, though, "knowledge & training" exhausts the list of individual-level variables identified in this study that can help predict disillusionment. The policy con-

* According to eleven in the sample, failure to fully understand models and the modeling process is a widespread problem of travel demand forecasters.

texts and organizational environments within which forecasters practice, however, do seem to have some power for explaining the relevance-/influence-seeking dichotomy of disillusioned modelers.

Judging by the locally dominant model of data use or failure to use technical analyses in any recognizable way, relevance-seeking modelers generally work in regions where there is a unitary political player or relatively broad agreement on the number and nature of needed transportation improvements. In these places, policy makers can, and do, ignore travel demand forecasts when technical analyses do not support their political position and/or local preferences. In fact, one-half of the relevance-seeking sub-group talked explicitly about the issue of ignored professional work. In contrast, influence-seeking modelers practice more often where transportation issues are contentious and the use of data is restricted to the political model. Granted, these patterns of data use are highly idealized. Yet their consistency with the earlier finding that challenges to autonomy are foreign to those seeking relevancy does serve to further recommend them.

The type of immediate employer for which forecasters work may also help locate them within the disillusioned archetype. Influence-seeking modelers work mostly in private firms (5 of 6), while the relevance-seeking are clustered in public agencies and independent practice. Certainly, consultancies do not have exclusive claim to political and highly contentious work, nor do other types of organizations deal wholly with tamer tasks. The tendency of government, however, to hire consultants when forecasts are likely to be disputed is a common theme among a variety of modelers who discussed their experience. Outside experts can be highly effective in providing political cover for decision makers. For example, this modeler did not hesitate when asked how the model-

ing process might change if it came under heavy scrutiny by a public interest group. “We would probably hire outside consultants because you can put them out front... You can say, ‘the outside consultant did it, so it must be more objective,’ which everyone knows is bullshit.”

Finally, and more broadly, if the earlier assessment of engagement is accurate, one might reasonably deduce that a dearth of leadership is likely to blame for the characteristic detachment of disillusioned modelers. In fact, two-thirds of the frustrated forecasters confirm this theory by providing examples where upper management threatened their professional autonomy, isolated them, and/or failed to provide support when the numbers might, or did, disappoint. This disheartened modeler seems to touch on all three. “Most of my career I really haven’t had much power to do anything. The people that I’ve worked with have not raised me up by saying, ‘Here, you need to listen to this guy.’ They tended more to say... ‘we don’t want you rocking the boat.’”

COMPLACENCY

The nine modelers not yet classified believe, like the disillusioned, that their work has little significant impact on policy making. Five members of this group claim that their analyses are unimportant and avoid hedging, while two merely suggest that their influence is minimal. The last two equivocate by implying that their work sometimes informs policy—without examples—and later acknowledging that the rational problem-solving model is very often dysfunctional. What sets this entire group apart is a collective lack of concern with its circumstance.* This study participant echoes the sentiment expressed by fellow modelers that are best described as complacent. “As a citizen and a

* This is a curious quality for members of a profession that claim a responsibility to serve the public.

worker, I have very little impact. It doesn't frustrate me in particular....I don't really get my satisfaction from making an impact on policy. If I did, I would do something else."

What explains this complacency? An initial interview subject, clearly disillusioned, provided the first clue. "I personally don't enjoy the process enough to do it just for the sake of the process. I know people who...love pushing the numbers around....[The numbers] don't move me [enough] to stay in this field." For a majority of complacent modelers, the technical challenge of forecasting is their primary source of satisfaction. This challenge and its welcomed nature were common themes of six and dominated their discussions of motivation. Some called hands-on modeling fun, while others more directly credited the personal test that forecasting represents for their fulfillment. When asked how they stay interested even though their impact is minimal, others were more animated. "I think it's the beauty of the models and the attractiveness of the data. Scrolling, looking for zeros and asterisks....The science. The mathematics." A mid-level planner added, "I have always loved puzzles and [modeling] is just solving enormously complex puzzles. I really enjoy doing that."

The three remaining modelers that are also untroubled by their lack of influence, did not speak directly to the question of incentives. They did, however, occasionally make reference, and otherwise allude to, the financial rewards of travel demand forecasting. For example, when asked why he concerns himself with the reasonableness of input assumptions, one private-sector modeler named no loftier purpose than to protect the reputation of his firm and, by reasonable inference, his income. In the absence of an obvious alternative and considering that all in this group work for consulting firms where

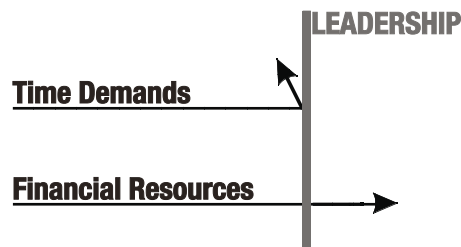
salaries are traditionally more competitive, material compensation might be these complacent modelers' leading motivation for working in the field.

It is worth noting here that for two complacent forecasters, the technical challenges of modeling, in isolation anyway, were not altogether enough to keep them satisfied with their career. They, like some of the disillusioned, indicated that they were bothered by feelings of irrelevancy, explaining, for instance, that outside scrutiny is good because "it's nice to know people are interested." This might have been puzzling, except that these two particular forecasters also provided indications that they are not entirely competent to perform the work that they do. One had difficulty explaining model calibration and the other, when faced with a technical question beyond his expertise confessed, "To a large extent I am relying on the judgment of people who know a lot more about models than I do. Hopefully they know what they are doing." These hybrids seem to have identified a necessary component of personally rewarding technical challenges—respect of peers. This is confirmed by another modeler—also complacent—who contends that the acceptance of her work by colleagues, both within and outside her organization, is what validates her. If you produce an inferior product, your peers will not pay attention she said and, after some thought, concluded, "I guess the punishment fits the crime."

Complacent modelers are similar to their disillusioned counterparts in how policy and organizational setting helps explain the internal dichotomy of their set. All three who seem primarily motivated by money work as consultants and commonly experience pressure to produce forecasts that support their clients' political positions. One individual even went so far as to say that there is an implied pressure to lie. In contrast, the model-

ers who most enjoy solving the modeling puzzle report very little, if any, interference in their work. Perhaps this subset works in the same type of environment as disillusioned modelers who seek relevance where decision makers seem to have the freedom to ignore unfavorable analyses, thus freeing forecasters to concentrate unimpaired on their own intellectual pursuits. Recall that two complacent individuals do, in fact, struggle with feelings of irrelevance, which implies that there is little attention paid to their work. Furthermore, only one of the six who look for technical challenges works in the private sector, which closely mirrors the percentage of the relevance-seeking group.

FIGURE 6
Idealized Model of Complacent
Leadership



Finally, another modeler suggests the possibility that the supportive actions of superiors are what provide the freedom to perform technically sophisticated work. This individual contends that the challenges would be smaller and the emotional rewards less significant without someone in charge who ensures the time and financial resources are available to both do original and interesting work and share it with colleagues in forums such as Transportation Research Board meetings. From this account, leadership—in the term’s most neutral sense—acts like a semi-permeable membrane, rather than an isolating barrier, that deflects the demands on forecasters’ time by others while allowing the resources necessary to do good technical work to flow (figure 6). Even though other mod-

elers did not explicitly raise these issues of resources and flexibility, it is nonetheless a plausible explanation that bears further study.

The basic findings of this study detail how the travel demand forecasters who participated think about the components of right and good professional practice. Most remarkably, every forecaster demonstrates at least some difficulty seeing the practice situations that pose ethical issues. Commonly, they do not recognize the concept of a public interest nor understand that they have influence independent of the content of their analyses. These findings also describe a number of possible motivations for action—and inaction—based on how individual modelers perceive their impact on policy and find satisfaction in their work. Disillusioned forecasters believe that what they do makes little difference on policy and seek the relevancy and influence characteristic of the engaged forecasters' self-appraisals to meet their expectations for what constitutes meaningful work. Complacent modelers, while also believing that their impact is minimal, primarily find satisfaction in the technical challenges of modeling and therefore are content to accept their perceived marginalized role. Both orientations have much to say about bias and misuse of travel forecasts.

What disillusionment and complacency leave unaddressed here are the more substantive questions of this research—how and why forecasters make questionable choices. Development and discussion of answers to these is the purview of the next chapter where the findings undergo analysis and subsequently suggest a rich follow-on research agenda.

CHAPTER 6

ANALYSIS

Why do modelers generate biased travel demand forecasts and tolerate the misuse of their work? To some extent, the findings of this study (chapter 5) suggest a number of reasons, which the investigator considers more fully below. More immediately instructive, however, are answers to the secondary research question, “*how* do travel demand forecasters introduce bias into their work and allow others to misappropriate their analyses?” A fuller and more comprehensive description of modelers’ actions can provide a better understanding of why forecasters do what they do. Of course, without measures of bias it is difficult to say with precision how the individual behavior of modelers affects their forecasts and how others misuse them. Nonetheless, the reflections and accounts of practice collected for this study do provide the converging evidence necessary to properly develop and support conclusions about how forecasts fail to meet expectations.

To some, it may seem artificial to consider the research questions singly. The free- and wide-ranging conversations that typified the interviews, however, often individually yielded answers to only one of them. Separating the two provides the room to interpret the how/why linkages more broadly and guards against focusing too intently on only those that are most obvious. The greater uncertainty of the assumptions required to answer both study questions finds them considered in this final chapter where explanations are more tentative and the follow-on research can begin to suggest itself.

INTRODUCING BIAS AND INVITING MISUSE

At first review of the transcripts, establishing the link between modeling and forecasting bias is not a particularly challenging task. No less than five modelers provided detailed examples in which colleagues either shopped for favorable input data, relied on unreasonable assumptions or deliberately shaded numbers to support particular policy positions. Perhaps more remarkably, well over one-third of the interview subjects described instances where they had a hand in introducing bias into demand forecasts. Some indirectly acknowledged their complicity by condemning the work they helped to produce. “In my professional experience,” claims a consultant, “every one of the plans to which I’ve been a party had a political spin.” In greater numbers, others tended to be less guarded. These professionals revealed that off-model considerations sometimes influenced their technical work. “I think many of us tended to be on the liberal side of our estimates because we wanted to see the project develop.” In a very few cases, admissions went beyond providing a preferred alternative the benefit of the doubt to outright misrepresentation. One was particularly brazen in his account. “I knew what my board wanted and I had the model over there telling me, ‘Hey, I can’t give you the numbers that are going to be that good.’ Well, I’ve had to close the door of my office and go in and totally fabricate numbers.”

In some cases, the origin of bias in travel forecasts is not so obvious. Eight of the twenty-nine modelers in this study acknowledge instances where they knowingly produced forecasts of dubious quality for lack of sufficient resources. “So often we don’t have the data to actually validate the models because it is just not collected. It is irritating that we don’t go out there and have a better process for getting that information.” Al-

though inferior work is intuitively a source of inaccuracy, it is not immediately clear whether and how such may be responsible for biased numbers. Where modeling proceeds without adequate time and money, though, forecasters must make other difficult choices. In these cases, it is plausible that methodological shortcuts borne of expediency reflect personal prejudices and the data collected with scarce resources may be that which is least likely to invalidate favored projects.* Admittedly, there is very little direct evidence to support the view that poor forecasting produces biased forecasts. The problem of sub-par work, however, appears to be real and underestimating its impact may leave important linkages hidden.

Although they may not be directly responsible for introducing bias into forecasts, a number of modelers compound the problem by remaining silent when they recognize bias and/or the inferior forecasting of others. For various reasons, five modelers claim to look the other way at times. Silence can also contribute to misuse. Two additional forecasters chose not to speak up when others misrepresented their work. “We try not to be too abrasive or too noisy when we feel that our numbers have been somewhat misused....We will consciously not go to the planning and policy board and say, ‘they misused our numbers!’”

Both bias and misuse might also stem from general inattentiveness. Three analysts are direct about their lack of vigilance by simply acknowledging that they do not spend time worrying about bias or misuse. Other indicators are less apparent. In at least five cases, interviewees would not respond directly to questions that ask about sources of bias and, when they did, often would not provide consistent answers (and sometimes not

* Clients willing to accept inferior products conceivably may be less likely to rely on travel demand forecasts for rational planning.

even lucid ones). While this may signal a reticence to be frank, one might also ascribe it to a lack of reflection combined with desire to sound authoritative. If one never thoughtfully considers the issue of bias, it may find its way into forecasts unnoticed by those who prepare them. Four modelers displayed inattentiveness by providing answers to questions that seem at odds with what others observe about travel forecasting. Two put a great deal of blind faith in their colleagues and the profession more generally to identify both inadvertent and deliberate modeling bias. “Others are checking,” explained one such modeler, “so it should be caught.” Focusing on misuse, the others contend, without elaboration, that their work is not wrongly used even though neither modeler described involvement with the planning process beyond producing forecasts. Overall, these questionable assertions should probably not be classified as examples of cognitive dissonance because the forecasters who made them are ostensibly unaware of evidence to the contrary. Rather, they seem simply not to have pursued (i.e., been attentive to) data that might challenge their beliefs.

Half of the analysts who agreed to interviews for this research invite misuse of forecasts by circumscribing their professional role. Most commonly, modelers insist that they should be apolitical technicians and only produce requested forecasts. “We should simply present the numbers and then let the process, either the political process or public participation process, determine whether the project should continue.” This response is typical of ten modelers. Three in this group, however, do open the door slightly by acknowledging at least some responsibility to internally provide direction and voice concerns. Similarly, eight modelers do not believe they are culpable for the misuse of their work and do not concern themselves with how others might misrepresent their forecasts.

In every case the respondent assigns that responsibility to someone else or claims the task to be unmanageable. “A million people could take [my work] and march off with it. You don’t have any control over it. It’s public information. You generate it, you try to document it, make clear what your assumptions are, but...it gets used and abused.”

A final way modelers potentially provide an opportunity for others to misuse their work is by overselling the capacity of mathematical models to accurately and precisely predict future ridership and/or traffic flows. In most cases, overselling is a sin of omission, which results when forecasters fail to temper unreasonable expectations, identify model deficiencies and acknowledge the inherent uncertainty of travel forecasts. Overselling allows partisans to market favorable forecasts as something akin to the results of scientific experimentation. Several modelers suggest as much when they describe how their bosses explain to decision makers that they (i.e., forecasters) are the ones “doing the science.” Without implicating themselves, a handful of analysts claim that overselling is endemic within the forecasting profession. Seven, however, admit that they themselves do little to dispel the “aura of wizardry” that surrounds the numbers they produce. “‘The modeling process came up with the numbers.’ I will say that at times, because it conveys a sense of authority, especially if you want to make the point. You don’t want to create a lot of issues or challenges.”

THREATS TO ETHICAL BEHAVIOR

When reviewing the interview transcripts for indicators of whether and how modelers introduce bias into their work and invite its misuse, one cannot help but be struck by the overall dearth of such in the narratives of the engaged forecasters. Not coincidentally, it seems, this corresponds with similarly few reported instances when modelers feared

that doing what they felt was the good and right might be called into question. What are these threats to ethical behavior that force modelers to make sometimes-difficult choices? The data suggest four that place ethical practice at risk; two external—political pressure and indifference—and two internal—mode bias and positivism.

Thirteen of the 29 modelers in this study reported receiving at least some political pressure from management, clients or decision makers to provide forecasts that support favored projects. This is not surprising and supports the findings of others that suggest such pressure is ubiquitous in the field of forecasting (see Kain 1972; Hamer 1976; Wachs 1990; Kain et al. 1992).^{*} Some accounts, like the following, describe subtle pressure. “[They say], ‘if you do this, we will help you here, if you don’t do this—’ Actually, [they] don’t even say it. People are sophisticated. [Its implied].” Others experience the pressure more directly. “[My boss] was one of those guys who would schmooze with the commissioners and, if they wanted something, he’d tell you to do it no matter how wrong or unethical it might be.” In any case, though, it doesn’t take much imagination to see how this dynamic threatens ethical work.

Indifference, or potential indifference, seems to influence the choices of modelers in three ways. First, it encourages analysts to hide, or at least not acknowledge, the uncertainty of their forecasts. According to many modelers in the sample, “people take numbers literally” and expect modelers to have precise answers like “the turning movements at any intersection 25 years into the future.” Following up, the interviewer asked, “are agencies forthcoming about the level of uncertainty?” “I think they find if they do that, the whole process loses credibility.” When modelers present their work with ranges or caveats attached and the credibility of the forecast suffers, the argument goes,

^{*} Chapter 1 considers the motivations of those who seek particular forecasting results.

stakeholders stop paying attention (i.e., become indifferent) to their work. Seven modelers subscribe to this position and over half of these provide examples of where they relied on the authority of the number to deflect criticism. To them, it seems, the perceived price is too high to be forthcoming. Although this dynamic has garnered little attention as a threat to practice, except occasionally amongst practitioners writing on the TMIP list-serve, there are other signs that something like it is at work. Notably, a team of forecasters at Argonne National Laboratory criticized the Wisconsin Department of Transportation when the latter insisted that “any predictive model will be subject to substantial criticism.” They added, further, “No one knows the future for sure.” The Argonne group responded,

There now exists appropriate, scientifically accepted methodologies for analyzing the underlying processes and dynamics that form the components of secondary impacts associated with highway development....[The Wisconsin] perspective is antithetical to...the scientific method (Schoepfle, Krummel, and Nagle 1999)

Second, there are indications that the threat of indifference may persuade modelers to remain silent when they encounter poor forecasting or would prefer a different use of their own numbers. To do otherwise, four modelers explained, would be to risk exclusion from the planning process. A number summed up their thoughts on this point by claiming, “you must pick your fights to be effective.” Third, and finally, indifference may actually promote the production of forecasts with higher levels of uncertainty than even modelers may be comfortable providing. One forecaster confessed that he sometimes made forecasts when he felt the resources available to do the job were clearly insufficient and it was better to produce no number than one with outrageously wide confidence intervals. Like those who do not speak up, he explained failure to provide the requested numbers endangered his participation in the planning process. Although it was

rare for analysts to reflect on the ethical dimensions of producing highly inaccurate work, a considerable number (eight) complained that they often did not have the resources to do a good job. In light of this, anything like indifference that unduly threatens modelers' ability to refuse a job may affect the overall quality of travel demand forecasts.

The internal threats to ethical forecasting are potentially more intractable because they stem not from context, which is directly observable and therefore more easily controlled, but rather from personal orientation. Four modelers admit to using their forecast to uncritically promote transit over other modes. Using a unique analogy, one individual explains his mode bias as a hedge against boredom. "If [you] did not have opinions about...it, [modeling] would become boring and tedious if you don't care about it. If you were a Navy officer in submarines, it's okay to think that the submarines should get more money than the aircraft carriers." The other three were more direct about the bias they introduce into their forecasts. One admits giving transit the benefit of the doubt to better match expectations, explaining that the model is biased against transit anyway. There is no inherent reason to reject the characterizations of the models with which they work. The ostensibly subjective nature of their intervention, however, leads one to conclude that highway bias was never the overriding motivation behind their deeds.

Finally, a widespread threat to proper forecasting is the positivist orientation demonstrated by sixteen modelers who discussed their work. Recall that positivism can threaten ethical practice by limiting understanding of complex systems to a relatively small number of measurable variables (chapter 3). Modelers risk introducing bias into their forecasts by not considering qualitative considerations, which may have the same (or more) explanatory power as those that are gauged numerically. It also shifts respon-

sibility for addressing (or not addressing) important value-laden questions to others and provides an opportunity for them to use forecasts for their own purposes.

Most commonly, modelers revealed their positivist leanings by discounting the role of professional judgment in forecasting. The phenomenon of uncritical forecasting without reliance on professional judgment even hatched a new verb for it—black-boxing—as in, “they were black-boxing it.” Some modelers were reserved in their comments about the power of their methods and what they see as the small role for professional judgment, but some were rather adamant. “All of the changes or the adjustments that we do in highways, as well as transit, are based on data or theory that cannot be challenged.” Positivist forecasters also frequently defended their ability to entirely set aside their values as they work and touted their success in doing so. One modeler even went so far as to claim for himself the role of “arbiter of truth.” This forecaster was unequivocal in her response.

“Is it possible for you to be fully value neutral in the work that you do?”

“Yes. It’s a science. It’s separated. Just like a doctor operates on a drug addict. It’s just a body. You just go in and do what you usually do. I think your agenda pops up. I’m a cyclist. It pops up. What about bicyclists? What about bicycles? Well, what about them? You kind of put it aside. I truly believe it. Otherwise, I wouldn’t be in the business.”

ARCHETYPES, BIAS AND MISUSE

Based on the archetypes of practitioners developed in chapter 5, how might one expect the behaviors and threats that explain bias and misuse to be distributed among modelers and to what extent does the data refute or confirm this? The internal threats—mode bias and positivism—are difficult, if not impossible to predict with the data at hand and must be set aside temporarily. Nonetheless, there is still much to compare theory with action.

THE ENGAGED

Because engaged modelers have an important place at the table where choices are made, it seems reasonable to assume that this provides an opportunity for forecasters and stakeholders to learn. Presumably, stakeholders come to see that the boundaries of technical analysts' professional expertise extend well beyond the numbers that they produce. Modelers in turn realize that they can admit uncertainty without harming their credibility. Indeed, some narratives do indicate that something like this does occur.

I'm a modeling guru but, you know, I feel that having been involved in a couple of these task forces and been involved in broader policy questions in the plan, that that informs my modeling and makes me really more comfortable with my modeling. Because I don't have to feel like I have to have some kind of crystal ball, like oh, "This is the number in the year 2021."...So we have fairly high powered elaborate modeling going on, but it's taking place in the context of citizen involvement and us being frank with environmental advocates and the business community that, we don't have a crystal ball, but here's a responsible, technically defensible forecast. And then we actually developed scenarios. We said, "Well, this could be one higher scenario, this could be one lower scenario, what do you think?" And they, the broader community, came to understand that these weren't crystal ball numbers, but these were a series of responsible forecasts that gave us a range of futures.

Engagement, it seems, makes it easier for modelers to do the good and right thing because it removes the greatest disincentive for acting ethically—diminished credibility. By engaging stakeholders, thoughtful and reflective forecasters acknowledge uncertainty without jeopardizing their value to the decision-making process. This allows them the freedom to surface their biases and those of others, making it less likely that bias will find its way into their forecasts. It also gives the modeler a continued role at the table in most transportation planning exercises, which makes it easier to monitor how others use their work and provides a forum for objecting when and if it is necessary.

True to theory, only one engaged modeler reported indifference as a threat to practice. The modeler in question is concerned, although not greatly, about losing his role in the planning process when, on rare occasions, he feels the need to (a) object to

how his work is characterized to outside interests or (b) refuse to provide forecasts that he feels uncomfortable producing.

Admitting uncertainty can sometimes undermine the authority of the forecasts with the engineering community. Because they're looking for a number, period. So, quite frankly, you might say [we] posture our results in a way that gives us an air of authority. I truly try to be honest in saying it could be this or it could be that or it could be this range or it could be outside of that range. But, I don't find myself resorting to saying, "Here's the number..." I don't think the other extreme of abdication, saying I have no idea what it's going to be, which is really a valid response, [is right either]. Then we abdicate our role and our voice at the table.

This suggests that sometimes engaged practice can be tenuous and its perpetuation requires attention and care. Similarly, a second engaged forecaster—the only private consultant in the group—warned that trying to do too much might be counter-productive and intimated that he saved his energies to correct the most egregious acts that affect the production and use of forecasts.

While engaged modelers are possibly the most thoughtful and reflective, they have blind spots when it comes to questions of ethics. Most notably, they tend not to see that their obligations to the public take precedence over those to clients and colleagues. In all cases, asked to name their customers, the engaged—not unlike others—never considered the broader public until they were provided with the necessary cues. The only remaining account of questionable behavior by an engaged forecaster is a single case of circumscribing role, where one claimed to have no responsibility for ensuring the use of her technical work. Overall, though, failure to understand the primacy of obligations to the public does not seem to be a “fatal flaw” for the engaged, because they seem never to have been forced to choose. It may, however, become more problematic should conflicting demands emerge in their practice.

THE DISILLUSIONED

For disillusioned modelers, the picture of practice is not as rosy and requires some sort of measured response. Recall that influence-seeking forecasters experience varying degrees of political pressure to bias the results of their analyses. Pressure is symptomatic of the political model of decision-making that is a fixture in regions where disillusioned modelers practice. According to this model, decision-makers take a stand on policy choices that technical analyses are not likely to shake (chapter 2). Forecasts then become, borrowing from Weiss again, “ammunition for the side that finds its conclusions congenial and supportive. Partisans flourish the evidence in an attempt to neutralize opponents, convince waverers, and bolster supporters” (Weiss 1979, 429). When technical data does not provide the fodder necessary to support the stands of transportation policy makers, pressure falls on modelers to prepare and present biased forecasts under the guise of technical objectivity. Relevance-seeking modelers, on the other hand, do not generally report pressure to influence the outcomes of their analyses. Their work seems simply to be ignored. Nonetheless, they, too, are disillusioned because they believe, or otherwise suspect, that their forecasts do not play the direct role in policy making that they think they should.

Overall, this state of affairs is likely invalidating for disillusioned forecasters. According to psychologists (see chapter 3), this type of dynamic places self-esteem at risk. It may, therefore, force these modelers, each in their own way, to formulate a response that will preserve a positive conception of self.* Accordingly, a few disillusioned

* This conclusion implies no judgment. Acts designed to preserve, or otherwise enhance, self-esteem are instinctual and value-neutral by definition. Threats to positive ideas of self are powerful motivators and, as such, can encourage ethical as well as unethical behavior. When absent, they can also explain inaction, which the case of complacent modelers serves to illustrate.

modelers fight, some take flight (i.e., seek new employment) and the rest find ways to cope. All three modelers described in chapter 5 who reported instances where they refused to compromise their analyses for the political advantage of bosses or clients come from the ranks of the disillusioned. An additional troubled modeler resorted to covert action to get what he sees as the facts out. This transit planner felt compelled to stop the release of overly optimistic numbers.

When they had the public announcement of the opening, I tried to get the press office in DOT to change the official number. They would only change the intermediate year numbers, not the final year numbers. I have thought about [challenging the numbers publicly] a couple of times. The only way [to do this] is to leak information to certain people. I think I have only maybe done that just a little bit ahead of time.

Sometimes the fight response, perhaps reflecting the inadequacy of other strategies, was neither confrontational nor covert. One particularly thoughtful and reflective forecaster arrived at the interview for this research with self-authored unpublished article, which illustrates his frustrations after years of practice. It is essentially a plea for a place at the table where expectations are realistic and the stakeholders recognize the value of forecasts for informing difficult decisions. It concludes, “Oh, how I long for the day when people will look to me for my thoughtfulness and wisdom instead of an answer from a computer manual.” *Planning* subsequently published an abridged version of this article (Fowler 2000).^{*} Brian also switched jobs since the interview—joining those who relied on the flight response—no doubt searching for, and hopefully finding, his opportunity to practice as an engaged modeler.

Three modelers, including Mr. Fowler, have either found new employment as travel forecasters or are considering doing so. Perhaps ultimately they will choose to exit the field. Another three have either left forecasting entirely or are seriously contemplat-

^{*} This participant graciously waived his right to participate in this study anonymously so that his article could be quoted here.

ing a different career. Sometimes this stems not only from disillusionment, but also of fatigue from trying to ameliorate the most common problems they face in practice. Most revealing is this exchange. “So there is at least a glimmer of hope that what you’re doing in your unit might have some effect on policy?” “It probably won’t be under me because I don’t have the emotional energy to make it happen at this point.” If it represents a brain drain, exits from the travel forecasting field may negatively impact the profession. They could, however, have a cleansing effect should those considering departure see coping as their only alternative. Such is the case since coping behaviors, perhaps more than anything, represent the greatest threat to unbiased forecasting.

Most broadly, coping mechanisms are particular strategies that modelers use to preserve their sense of self when they choose neither to fight nor look elsewhere for better opportunities. Intuitively, coping is a two-step process. Initially, the modeler must act to neutralize the external threats to ethical practice—political pressure and indifference—and then frame their actions in such a way that they preserve self-esteem. The next section addresses the latter more fully. The former reflect the many ways, catalogued above, that forecasters introduce bias and invite the misuse of their work. In essence, “caving” to the forces that threaten practice reduces the pressure of politics and indifference, albeit only temporarily.

Because they do not report pressure to influence the results of their analyses, one would not expect the strictly relevance-seeking modelers to have a hand in introducing bias into demand forecasts. This seems generally to be the case. The lone exception is a transit forecaster who responded to pressure by spinning numbers to justify a federal Congestion Management and Air Quality (CMAQ) grant—ostensibly an isolated case

where his numbers were not entirely ignored. Since overselling is a passive act that depends on the interest and attention of stakeholders, the relevance-seeking should not be represented among those who act in such a way. Here too, the data seems to support the theory. None of the relevance seeking, including this time those who also seek influence, confessed to or demonstrated overselling.

Finally, among those seeking relevance, one would also not expect cases of inattention to poor forecasting or the misuse of numbers by others because this requires that (a) these forecasters recognize sub-par forecasts and (b) others are interested in their work. The lack of technical competence and the indifference that plague the relevance-seeking suggests that these requirements are rarely, if ever, met. Indeed, there is no evidence on which to conclude that this group is inattentive in this way. These three special cases for relevance-seekers aside, the disillusioned, as a group, do demonstrate all the actions that can lead to bias and misuse.

THE COMPLACENT

With few exceptions, it seems reasonable to expect that complacent modelers, who neither claim nor seek influence on policy, will be inattentive to what their forecasts say and how others use their numbers. In theory, the ethical questions—from a teleological perspective, anyway—cease to exist if they believe that their work has little or no impact. This frees them to practice without concern for issues of right and good. For the data to fit, however, a different interpretation of complacent modelers' motivation for overselling their methods and forecasts is required. Recall that influence-seeking forecasters seem to oversell to maintain their credibility and the professional deference others afford them. This understanding does not predict overselling for the complacent. Over

half of the complacent modelers, however, do indeed fail to acknowledge the uncertainty of their numbers. A reasonable explanation for these cases is that such behavior is merely a symptom of inattentiveness since no practitioner provides a convincing rationale to the contrary. The account that points most definitively at the inattentive conclusion claims no intention to mislead.

The uncertainty has not been discussed before because people have just been happy to have any kind of reasonable answer that uses responsible methods. I don't think it's been so much a matter of practitioners not disclosing the risks or uncertainty for reasons of self-interest as it is the underlying understanding that people want a simple answer.

The inattentiveness characteristic of complacency may also allow bias to find its way into travel forecasts, especially when expediency takes priority.

What you end up doing is making up numbers using, quote, professional judgment...But there's a great deal of uncertainty about how accurate those numbers are and you usually end up saying, "Well, it's not going to make a land's worth of difference so I'm not going to lose any sleep over it."

All three complacent modelers that are primarily motivated by material rewards confess to producing inferior analyses at times when resources are lacking, which does not contradict the intuitively obvious. In contrast, only one complacent modeler who is inspired by the technical challenge of forecasting acknowledged being party to sub-par work. There is no clear explanation for this apparent outlier, except that he represents the only consultant in the technical subgroup (the other three consultants wholly comprise the material rewards subgroup). Perhaps even when concern for profits and losses requires compromises, as is sometimes (often?) the case in consultancies, they are such that they do not overshadow the intrinsic enjoyment of the task for those so motivated.

Finally, the technically-inspired complacent modelers do not, overall, describe ways in which they directly introduce bias into their work. This is consistent with expectations because they, like the relevance-seeking, experience few, if any, challenges to

their autonomy. The one notable exception reports that he experiences pressure once a year to demonstrate that new projects in the state planning document conform with federal air quality regulations, which he considers an empty exercise. He admits to making unreasonable assumptions to produce the required numbers so that he can return, relatively undisturbed, to his model development work. “Each year you’re asked to make a determination and there’s a lot of pressure to make it. We do it and it’s off everybody’s radar for eleven months.” Remarkably, the three reward-driven modelers, who likely experience pressure to produce particular numbers do not report biasing their results. This is difficult to explain. Perhaps the best one can do is note that those with little to justify their actions beyond material rewards might be reticent to describe all that they do to achieve their desired goals.

IS IT VENALITY?

Much of the discussion above—indeed much of that in chapter 5, too—suggests the possibility that many of the modelers interviewed for this study may be corrupt. The most likely candidates include the modeler who confessed to fabrication of numbers and the three inattentive forecasters presumably motivated by monetary rewards. Some might also include the coping disillusioned modelers who refuse the role of moral hero and capitulate to the forces that threaten practice. As the null hypothesis, a verdict of corruption requires only the rejection of alternate hypotheses. Before examining the data to seek alternative explanations for bias, however, it may be helpful to ask whether the transcripts contain any direct evidence of corruption to gauge the appropriateness of assigning the null hypothesis to corruption.

Overall, the data provide very little to suggest that modelers as a group are corrupt. The actions of only one modeler seem to approach the definition of corruption—*deliberate* and dishonest exploitation of power for personal gain. Although some of his words were previously presented, they merit repeating here for further consideration.

I knew what my board wanted and I had the model over there telling me, ‘Hey, I can’t give you the numbers that are going to be that good.’ Well, I’ve had to close the door of my office and go in and totally fabricate numbers....I’ve done that before and I’ve done that at an administrative level, which really kind of got to me. I had a rationale for doing it.

Although his comments may seem damning, this particular modeler neither admitted to nor denied wrongdoing, nor could he articulate the rationale to which he alludes. The actions of other suspect modelers are equally inconclusive because they lack clear cases of misconduct or any acknowledgement of inappropriate activity.

In addition, if corruption is common in the field, it would serve to reason that at least some modelers should be able to provide details of wrongdoing by fellow practitioners. Instead, only a few professed knowing of corrupt activity and even then the information was second-hand and included few particulars. Short of posing a direct question about corruption on the mail questionnaire—a potentially off-putting strategy that likely would not produce reliable results while also possibly skewing others responses—there is no apparent way to use a survey to identify corrupt modelers. By carefully framing the preamble to the questionnaire and inviting frank responses, the investigator hoped that corrupt individuals, should there be any, might identify themselves through their responses to the open-ended question of the survey. However, no one provided any such clues and therefore, on this point at least, the survey is inconclusive.

It is, of course, conceivable that dishonest professionals are the least likely to come forward because it reflects poorly on them as individuals. To some, this might

seem self-evident even though there is little in terms of hard evidence to support such a contention. However, is it also, if not equally, plausible that corrupt modelers might be *more* likely to discuss their wrongdoing with researchers because they either (a) believe their contribution might lead to structural changes that will make it easier for them to practice honestly or (b) want to provide a voice to engender some type of public understanding. Richmond, it seems, did not have to go to extraordinary lengths to find a confessing modeler (1991, 113), albeit one with ready excuses for his misdeeds.

EVASION

It would be easy to describe the fifteen cases of role circumscribing in this study as *merely* symptoms of the positivist orientations that modelers revealed. Certainly, this is a connection that should not be discounted since it so neatly matches the theory of role-singularity developed in chapter 3. The answer, however, may be more complex. Modelers may actually deceive themselves into accepting or retaining positivism as a way to avoid unpleasant realities. Recall that one who ignores evidence for *p*, fails to seek evidence for *p* as faithfully as s/he pursues evidence for not *p*, or selectively focuses attention on evidence for not *p*, is evading (chapter 3). This process can lead to self-deception by pushing the belief in *p* beyond awareness. Ostensibly, the *p* for disillusioned modelers who display a predilection for circumscribing their role is the upsetting reality that they are marginalized and bear responsibility for the misuse of their work. Evasion, in these cases, serves as a coping mechanism where the primary goal is to preserve self-esteem. After all, if one wishes to be more relevant and have greater impact on policy, as the disillusioned do, it is counterproductive to introduce greater separation from the planning decisions one hopes to influence.

Should this theory be accurate, the belief that the complacent who circumscribe role push beyond awareness is likely to be they have no obligations to others that extend beyond providing methodologically sound forecasts. There are subtle signs that self-deceptive evasion may be at work in this way. One complacent consultant rejected out-of-hand a suggestion that he may have a responsibility for ensuring that the modeling caveats he provides to clients find their way into the hands of the public. “It not my responsibility to solve all the world’s problems,” he said. This sounds more like an attempt not to think about difficult questions than a reasoned profession of dogma. Because the symptom of role circumscribing does not change with the added complexity of self-deception, the data do not provide the evidence necessary to confirm this theory. There is, however, nothing apparent to invalidate it and therefore it should be tested more directly in follow-on research.

There are other beliefs in which forecasters of every type seem to place unquestioning faith. These are *unsupported* by both professor and the body of knowledge assembled over the years by others. As such, these seem to signal that even more in this sample depend on evasion to avoid other disquieting realities. By far the most common errant certainty, displayed by four modelers, is the conviction that other groups (e.g., the state DOT, the profession itself) and individuals police travel forecasting to prevent abuses. Two analysts seemed likewise convinced that stakeholders don’t misuse data. One suggests it is impossible to misuse technical data because it is available for critique and the other contends that unfavorable forecasts at worst are only ignored. Other examples of uncritical thought are statements that the general public commonly recognizes the uncertainty of forecasts and the values held by clients most always mirror those of the

community for which forecasts are prepared. Each cherished belief can be interpreted as providing, through evasion, either a way to cope or a mechanism to distance oneself from the unwanted ethical complexities of practice.

Recognizing evasion, in many instances, required the interviewer to note acts of omission. The modeler, whose quotation opens this section on venality, provides the most striking example. When gently asked to reflect on the rightness or goodness of his questionable behavior, the forecaster very quickly took up another topic. He was not untrusting. Rather, he seems never to have thought about the moral implications of his actions and he clearly did not want to do so. Ostensibly, he pushed beyond his awareness the belief that what he did was wrong—presumably to preserve a belief that he is a good person. Similarly, four modelers shied away from the interviewer’s use of the term “ethical”. Two reframed his questions to describe “good” or “best” practice, ostensibly to avoid consideration of their actions as potentially wrong and/or bad. To the same end, the other respondents simply pushed away the ethical characterization. One did so quite casually. “I assume that you felt it wasn’t ethical for the consultant to do that?” “Heh, heh,” the analyst replied. “Not so much ethical as...[un]needed.” In a later interview, an MPO staffer was more direct when asked comparable questions. “Is that an ethical question? Does it have an ethical dimension to it?” She replied, “I don’t want to respond [to that] in the area of ethics.” In contrast, other modelers subject to the evasive judgment ultimately confess to not considering important questions, yet they too are unable or unwilling to go beyond these acknowledgements.

What would have happened if we’d gone out and make a big stink about the alignment of one line? It may have caused such a brew-ha that the thing would have been derailed. It’s a tough ethical issue. I don’t recall thinking about it at the time.

EXCUSE MAKING

In addition to evasion, modelers in this study relied on a number of excuse making strategies to rationalize their ethically questionable behavior. Like evasion, this form of self-deception also resolves the conflict between beliefs that one is responsible for a negative outcome and one is a good person (chapter 3). The complacency of modelers is perhaps no place more evident than in the excuses that aim to underestimate the harm of an action. Six forecasters explained away their inattention to potential bias and misuse by contending that these do not really matter. Consider, for instance, the following.

The responsible way to forecast traffic for that project...is to go in there and use this [one particular] model. Go in there and update it. Carve some of that stuff out of the local comprehensive plan. You go and micro-calibrate a model to get what you really want. That would be the responsible way of doing that. I'm probably not going to do that. The project is already developed and I think the design is probably going to be whatever it's going to be anyway. I don't have time.

This modeler, too, does not believe it is worthwhile to be vigilant.

"If you hear [your work misrepresented], do you have a responsibility to step in and say, 'Wait a second!'"

"There have probably been times when we haven't done that, but I think that is our responsibility. We should step in and tell them they are misrepresenting it."

"...Why is it that you don't bother to correct things that are in there?"

"It is not going to change anything."

In both examples, the forecasters use excuses to lessen the negativity of their questionable acts, which, while perhaps making them feel better about themselves, work to turn their attention away from questions of bias and misuse.

It is difficult to know with a great deal of certainty whether these and other excuses are sincere (i.e., does the individual truly believe them) or merely statements of convenience to justify one's actions. The only apparent hint that the transcripts provide is the response of one modeler that suggests he may recognize his self-deception. "[Do you] lose any sleep over [overselling the numbers]?" "If I thought that [what] I was do-

ing had any major impact on anything, I might. [*laughter*] Maybe that's why *I'm telling myself* it isn't important." Whatever the case, sweeping self-assessments of influence are likely never to be correct. Policy outcomes by which these and just about every modeler in this study judges his or her impact are merely a product of decision-making processes, which represent only a subset of potential ways technical analysis can have influence. Weiss' enlightenment model and Innes' interactive model provide alternatives for transportation planners to understand the knowledge to action link in their practice. Recall, too, that modelers, in their position to call and direct attention, have greater power than that which extends from their analyses. How and when they speak, gesture and write—or fail to—determines, in part, what they convey and how they influence the responses of various actors. The only answers available to the inquisitive here are self-deception or dishonesty. There is simply no sound basis for claiming that the modelers are right.

There are further reasons to believe that the excuses of modelers are self-deceptive. Three forecasters, one of each archetype, identify rationalization as a fixture of practice. Two talk of others and do not claim such behavior for themselves. "All human beings rationalize. I haven't seen a human being who doesn't rationalize their behavior. They don't say, 'I am evil.'" The second illustrates her point by imagining what a criminal might say to himself. "I think the guy who robs the bank probably has some way to justify [it] to himself. 'Well, I really need that money and those people don't.'" The third individual, however, does place himself in the picture. This modeler describes creatively reevaluating his forecast to keep a project moving ahead. He does so, in his words, "to feel that I haven't wasted my time for 3 months." At the end of his account, he confides, "I can rationalize to myself that I'm doing the right thing."

TABLE 17
Excuse Making Strategies Applied to Interviewees

Reframing Performance: Lessening the negativity of a bad act	Modelers*			Excuse	Manifestation
	E	D	C		
Underestimating the harm of an action	0	4	2	“It doesn’t really matter.”	Complacency–Belief that inferior forecasting does not affect policy
	1	1	0	“It didn’t really hurt anyone.”	Claiming lives not at stake; bad project will be good project someday
Failure to comprehend the badness of an action	0	1	0	“The forecast was ultimately pretty good.”	Crediting coincidental accuracy to deflect criticism
Victim derogation	0	2	1	“They should know.”	Not acknowledging advocacy; not acknowledging uncertainty of forecasts
	0	2	0	“They wouldn’t understand.”	Not acknowledging uncertainty of forecasts (elitism)
	0	0	1	“They just don’t want things.”	Dismissing concerns of the public
Messenger derogation	0	1	0	“They’re wrong.”	Dismissing need to consider induced travel
Transformed Responsibility: Lessening the degree of responsibility for a bad act					
Consensus-raising: Showing that others would behave similarly under the same circumstances					
Task difficulty	0	3	4	“Anyone would have failed.”	Blaming insufficient resources for inferior analyses
	0	1	1	“It can’t be helped.”	Methodological, practical and legal objections for tolerating bias and misuse
Projection: Ascribing personal shortcomings to others	0	2	2	“My bias neutralizes bias of others.”	Transit mode bias
	0	0	1	“Everybody does it.”	Explaining actions relative to the abuses of others
Coercion	0	2	0	“I had no choice.”	Claiming livelihood at stake
Consistency-lowering: Showing that one does not always act so badly in the same circumstances					
Intentionality plea	0	1	0	“I didn’t really mean to.”	Blaming inexperience for being party to fabricated forecasts

Source: Adapted from Snyder 1985, 37-42.

*The number of modelers who used excuse at least once by type. Engaged (E), Disillusioned (D), Complacent (C).

Table 17 summarizes the many excuses that modelers seem to employ. The most common relates to task difficulty and reflects the aforementioned problem of having insufficient resources to produce reasonably precise forecasts. As one might expect, the engaged forecasters as a group failed to rely on excuses. The distribution of excuses among the other two archetypes reflects no established pattern, which very well may indicate that self-deceptive excuse making can serve a coping role as well as a distancing one.

Overall, there is much to recommend role-singularity and self-deception as alternatives to the verdict of venality. Many data, however, defy neat categorization. Viewed this way, it is fair to say that the working hypotheses were too complex to adequately test in open-ended interviews that had other objectives. In other words, the components of self-deception and role-singularity not specifically noted in this analysis should not be so quickly discarded. There are many accounts that recommend them and a more narrowly focused data collection effort may provide grounds for accepting some aspects of these hypotheses. Role-schizophrenia and the null hypotheses of corruption, on the other hand, have little to support them and likely can be safely abandoned.

CHAPTER 7

SUMMARY AND RECOMMENDATIONS

The modelers interviewed for this study distinguish themselves by the perception of their professional influence and the degree to which these assessments correspond with job satisfaction. Engaged forecasters are unique for their demonstrated belief that what they do has an important impact on policy decisions. In addition to developing models and producing forecasts, these analysts have an important place at the table with stakeholders where choices are made. Organizational leadership and long-term reputation are key for establishing and maintaining engagement as the centerpiece of practice in some agencies and firms. These factors are also important for reducing the external threats to ethical practice. They shield modelers from pressure to alter their analyses and they allow them to admit uncertainty without risking harm to their credibility.

By far the largest group of modelers stands opposite of the engaged along the impact and satisfaction dimensions of their categorization. These practitioners are disillusioned because reality fails to match their expectation that forecasts should inform a rational model of planning. Some of this type practice in places where the political model of decision-making is dominant. Pressure commonly falls on these analysts to prepare and present biased forecasts under the guise of technical objectivity. The other disillusioned modelers report no pressure to influence the outcomes of their analyses. Their work seems simply to be ignored. Yet the indifference faced by the latter is presumably as invalidating as the pressure experienced by the former. Both threats to ethical practice

force disillusioned modelers, each in their own way, to formulate responses that will preserve a positive conception of self. Accordingly, a few fight, some take flight and the rest find ways to cope.

Initially, coping modelers must act to neutralize the external threats to ethical practice—political pressure and indifference. This they do in a number of ways that introduce bias into, and invite the misuse of, forecasts. They shade assumptions and numbers to support particular policy decisions, produce sub-par forecasts, remain silent when they recognize bias and/or the inferior forecasting of others, act in inattentive ways, circumscribe their professional role and oversell the capacity of mathematical models. In essence, they “cave” to reduce the pressure of politics and the weight of indifference, albeit only temporarily.

Like the disillusioned, complacent modelers too believe that their work has little significant impact on policy making. What sets this group apart is a collective lack of concern for its circumstance. The technical challenge of forecasting is the primary source of satisfaction for most complacent modelers, while the balance seems lead only by material compensation. With few exceptions, however, complacent modelers exhibit the same bias-introducing and misuse-inviting behavior as the disillusioned. Their actions, though, are best explained by a want to distance themselves from the ethical complications of practice rather than the need to cope. Put most simply, the disillusioned wish not to see that they do not matter and the complacent that they do.

Perhaps surprisingly, the data provide very little to suggest that modelers as a group are corrupt. It seems that the forecasters of this study not represented among the engaged unwillfully frame their actions to preserve self-esteem. This self-deceptive be-

havior helps modelers avoid their own unpleasant realities—the disillusioned that they are marginalized and bear responsibility for the misuse of their work and the complacent that they have obligations to others that extend beyond providing methodologically sound forecasts.

The most obvious recommendation the findings of this research suggest is a concerted effort to develop and *require* design professionals to complete a rigorous curriculum on professional ethics. The details of such lie outside the purview of this study. Let it therefore suffice to suggest that the academy should emphasize the theory of ethical practice over prototypical case studies that reinforce its most basic tenets. Most professionals pledged to the public interest undoubtedly already recognize that they should not lie, steal or cheat. The most pressing task is fostering an appreciation for all practice situations as potentially posing ethical issues. This promises to be an even greater challenge than one might imagine because engineers and planners may stand too close to questionable practice to recognize its dysfunction.

For example, regardless of how any individual professional might frame the pertinent ethical issues, attempts by others to affect the results of one's technical analyses would seem to raise a flag of caution that the situation involves choices for the technician that comprise more than practical, purely logical or analytical acts and therefore require some consideration of what is right and good to formulate a proper response. Yet, the modelers in question seem desensitized to—not unaware of—the political realities of the environment in which they work. Take for instance the lackadaisical reply of one such modeler to a query about his overall job satisfaction. “Most of the time [I'm satisfied],

except for the amount of work sometimes and some of the political pressures that come up.”

In contrast, the public seems sometimes to have an equal, but opposite, reaction to reports of political interference in technical work when they surface. Media attention is not uncommon and press questions often reflect a measure of shock that such things happen at all. Consider, for example, the rash of recent reports following assertions by Donald Sweeney, an economist for the Army Corps of Engineers, that top commanders asked him to alter the results of a his Upper Mississippi River navigation system study to justify expansion of several major locks and dams. Public amazement stood against a quotidian response typical of professionals when a somewhat astonished reporter asked Sweeney about his professional relationships after his allegations came to light. Sweeney replied in a level voice,

...at the working level of the professional economists in the Corps and other planners, I received very strong support and the people would kid with me and say things like, “Where’s the story here, this goes on every day,” that this problem of altering analysis was endemic throughout the Corps of Engineers. (Edwards 2002)

A second immediate need is to create institutions of practice that promote and sustain inspired leadership in both the public and private realms of transportation planning. Many data indicate that leadership is key to providing opportunities for modelers who seek it (i.e., the disillusioned) to work as engaged professionals. Engagement obviates the need for the type of coping that threatens ethical practice and provides an environment where thoughtful reflection and action are prized.

Such interventions, however, do little to address the abuses of complacent modelers. It is difficult to interpret the complacent behavior of travel demand forecasters as anything other than a fundamental breach of professional standards of ethical conduct.

Ostensibly, these professionals accept the power and privilege that society grants to them as a condition of practice without fulfilling their corresponding obligation to contribute to social well-being and to conduct their affairs in a manner consistent with broader social values (i.e., to serve the public interest). Because the concepts of power and privilege are broad, it would be a mistake to conclude these have not been extended to modelers who object that their work does not find currency within the traditional problem-solving or political models of decision-making. Autonomy and deference are but two of the most obvious examples of benefits the public cedes to technical professionals.

What is most troubling about the complacent modelers is not their detachment. Rather, it is their lack of disillusion that is so disconcerting. True, disillusionment comprises a distinct set of threats to ethical practice. Unlike complacency, though, it is not a stable state. The disillusioned do not quietly accept their plight. They fight for greater influence, cope or, finding no relief, move on to a different career. The complacent, on the other hand, remain in obscurity, practicing quietly to the delight of the decision-makers most able to identify them and hidden from those that are concerned with the state of the profession. Unseen, there is no way to reconnect them with the public interests they supposedly serve. And with this connection severed, the complacent may play havoc with the institutions of practice, by biasing analyses, otherwise misleading the public and abdicating their professional role.

What then can be done about the complacent beyond providing a more comprehensive ethical education? Perhaps nothing, directly. Greater accountability, however, begins with a better understanding and appreciation of the problem. Efforts to confirm the finding of complacent practice and begin discourses aimed at broaching this possible

problem are significant contributions and should be encouraged by all who value the credibility of travel demand forecasts.

Because this study represents an early attempt to understand the broader complexities of travel demand forecasting, any efforts to confirm or refute the findings and conclusions presented here serve a particularly useful purpose. Perhaps the most valuable follow-on research one could undertake at this point is a reconstituted survey based on this work. Since the financial constraints of this project dictated that the mail survey precede the interviews, the empirical data available to construct the theory that informed it was lacking and consequently yielded precious few meaningful details about modelers and their practice. More than anything, this reflects the dearth of empirical research on modeling practice and that of allied fields (see chapter 1) as a source of a priori assumptions for use in generating theory by logical deduction. What the mail survey did confirm through an exhaustive factor analysis is that, indeed, modelers do overwhelmingly adopt the technician role, which reflects the positivist thought characteristic of so many interviewees. None of the many potential predictors of this orientation, however, were statistically significant. Equally unexplained was a pro-transit factor that merely suggests the potential for mode bias among the larger population of forecasters.

True to Glaser and Strauss (1967), though, the data provided in the interviews served as a source of discovery and provides the refined theory necessary for informing further data collection. A new survey effort, therefore, may have potential for testing the findings and conclusions of this study and providing remarkable results from which to generalize about the universe of travel demand forecasters. On the other hand, even armed with a more cultivated theory, the questions at the heart of this research may per-

haps be too complex to answer in any meaningful way except through personal in-depth interviews.

Two questions in particular merit further consideration. The first relates to self-esteem and its role in predicting the coping of disillusioned modelers and the distancing of those complacent. The conclusion that modelers' questionable actions are tied to their conception of self is tentative, to an extent, because the interviewer did not specifically ask forecasters to reflect on how their circumstance made them feel about themselves. Relying on the methodologies of psychology, it may be possible to achieve a more complete understanding of how self-esteem dictates professional behavior.

The second question is motivated by a blind spot in the findings. Namely, what explains individual responses to disillusionment? There are few clues that suggest why some modelers, for example, choose to fight attempts to unduly influence their forecasts and others merely cope. The answer may indicate ways to encourage the fight response as an approach for reducing bias and transforming practice. On the other hand, this question may not be the right one. A nested decision structure may, perhaps, better describe the actions of disillusioned modelers. For instance, disillusionment may evoke fight in most modelers with leaving and coping representing defensive responses to a battle viewed no longer viable. If this is the case, the many modelers who are not seen as complicit, might be rightly thought of as defeated. This suggests that a labor-union-type role for professional organizations might be more attractive to modelers and more effective for ameliorating the dysfunctions of practice.

The stories and accounts of practice by the modelers who participated in this study were invaluable for challenging conventional wisdom about travel demand forecasters and the use of technical data in planning. If the forecasters assembled for this research are representative of the profession at large, the problem of biased forecasting has little to do with venality and ambition. Rather, it relates to unmet expectations and hidden opportunities to work constructively in alternate decision-making environments. Beyond indications that modelers are not corrupt, the findings should serve as a source of hope and pride for those concerned with the transportation planning profession. Indeed, some modelers are thoughtful, self-reflective and sometimes engaged in meaningful practice. Above all else, their stories are inspirational and provide the normative direction for correcting that which ails us.

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APPENDIX 1
COLLEAGUE FORM

COLLEAGUE INFORMATION

We need your help to increase the size of our survey sample. If you have colleagues or former colleagues who now, or once, work(ed) as travel demand modelers, we would like the opportunity to also invite them to participate in our survey. Although *your response on this form is entirely optional*, you will assist us greatly by providing the names and addresses of your contacts below.* We will not disclose from whom we acquired the information you provide. It is particularly important for us to locate individuals in private practice and those who once worked as modelers, but who have subsequently changed careers.

Please return this form in the postage-paid return envelope provided. If you completed the enclosed questionnaire, please remember to include it with this form. Thank you!

Name		Prefix <input type="checkbox"/> Dr. <input type="checkbox"/> Mr. <input type="checkbox"/> Ms.
Address		
City	State/Province	Zip/Mail Code

Name		Prefix <input type="checkbox"/> Dr. <input type="checkbox"/> Mr. <input type="checkbox"/> Ms.
Address		
City	State/Province	Zip/Mail Code

[room for two additional entries provided on original form]

* Please use the back of this form and/or additional sheets to provide additional contacts.

APPENDIX 2

MAIL QUESTIONNAIRE

SURVEY OF PROFESSIONAL ETHICS

A study of North American travel demand forecasters, past and present, designed to frame the ethical challenges they face and understand their professional responses to them.

This questionnaire should take you about 30 minutes to complete. Your participation is strictly voluntary and all responses will remain confidential. Furthermore, you have the option to remain anonymous and skip questions you do not wish to answer. If you would like to comment on any questions or qualify your answers, please use the margins, the back of this questionnaire or a separate sheet of paper.

Even if you do not believe that you satisfy the requirements for participation in this survey, please continue through Section I. Doing so will determine your eligibility, instruct you how to avoid receiving follow-up reminders to participate and explain other ways you can help with this research.



This study is supported through the Institute of Transportation Studies at the University of California, Berkeley and conducted under the auspices of the Institute of Urban and Regional Development, University of California, Berkeley.

Return this survey to:

Ethics Survey
University of California,
Berkeley
Institute of Urban and
Regional Development
316 Wurster Hall
Berkeley, CA 94720-1870

I. Eligibility

We designed this question to determine if you are a member of our target population.

Are you, or have you been, employed as a travel demand modeler in Canada or the United States? (For our purposes, we define travel demand modeler as an individual that develops, modifies and/or employs algorithms to predict future travel volumes to inform public policy.)

No

(If no) Inasmuch as our purpose is to learn, firsthand, more about travel demand modelers and their work, we do not need your answers to the remainder of the questions. We do, though, need your help to increase the size of our survey sample. If you can provide us with the names and addresses of individuals that are members of our target group, we would greatly appreciate your assistance in this way. To provide contacts anonymously, simply complete the attached colleague information form and return it using the enclosed postage-paid envelope.

In any case, thank you for your willingness to answer our questions. You may discard this questionnaire. However, please mark accordingly and return the enclosed postage-paid postcard so that we know not to remind you to participate in this study.

Yes

II. Experiences

We would like to begin the formal part of this survey by asking about your current professional practice as a travel demand forecaster. Reflect on your own work and provide responses that most closely match your experience. **If you no longer work as a travel demand forecaster, consider your most recent modeling position when answering the questions in this section.**

1. Choose five of the following items that are/were most important to you in this position. Rank the five that you chose with "1" indicating the highest priority and "5" the lowest. (Do not use any number more than once.)

___ Quality of your work

___ Autonomy in performing your job

___ Material compensation

___ Respect of elected or other high level officials

___ Security of the job

___ Ability to influence policy decisions

___ Inherent interest of the work

___ Respect or recognition from the community

___ Service to the community

___ Respect of other professionals with whom you work

2. Do/did you discuss with peers ethical issues that emerge(d) in your work? (Check one)

YES NO

3. Did you ever have a disagreement over issues of ethics with superiors in your agency/firm? (Check one)

YES NO

4. Did you ever leave a modeling job (either this position or a previous one) over an ethical issue? (Check one)

- YES NO

5. Please describe an instance when you were faced with an ethical dilemma in your work. How did you resolve it? Please continue on the back cover of this questionnaire if necessary. If you use identifying information, we will remove it to protect your identity.

III. Employment

The questions in this section ask about your modeling position. **If you no longer work as a travel demand forecaster, please describe your most recent modeling position and the organization for which you worked at the time.**

1. In what state or province do/did you work in this position? _____

2. In terms of population, what is the largest size jurisdiction for which you prepared analyses in this position? (Check one)

- | | |
|---|---|
| <input type="checkbox"/> Over 5 million | <input type="checkbox"/> 250,000 to 500,000 |
| <input type="checkbox"/> 1 million to 5 million | <input type="checkbox"/> 100,000 to 250,000 |
| <input type="checkbox"/> 500,000 to 1 million | <input type="checkbox"/> Under 100,000 |

3. Consider the jurisdiction you described in Question 2 above. At the time of your most recent analysis, was it considering a major infrastructure investment (more than \$100 million USD) within five years for the following purpose?

a. Highway expansion (Check one)

- YES NO

b. Highway expansion (Check one)

- YES NO

4. Do/did you personally present your analyses to anyone outside of your agency/firm in this position? (Check one)

- YES NO

5. Which of the following most closely characterizes your current/last position? (Check one)

- Technician Project manager Director

6. Listed below are kinds of groups that you might have/had contact with in your job. Choose up to three with which you worked most frequently over the last year in this position. Rank the groups that you chose with “1” indicating the largest amount of contact and “3” the least. Finally, of those left unranked, indicate with a “0” any group with which you very rarely or never had any contact. (Zero is the only number you can use more than once. Some items might be left blank.)

- | | |
|--|---|
| <input type="text"/> Citizen groups | <input type="text"/> Staff of public agencies, i.e., not your own |
| <input type="text"/> Contractors/Consultants | <input type="text"/> Decision-makers, e.g., elected officials |
| <input type="text"/> Community leaders | <input type="text"/> Other people in your agency/firm |

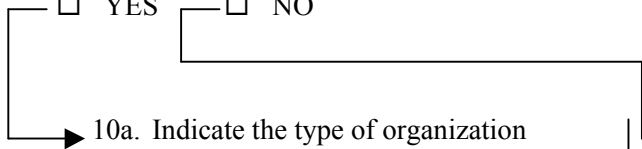
7. How many years have/did you work(ed) in this position? _____

8. Now consider your entire professional career to date. Indicate your *total* number of years experience as a travel demand forecaster by type of organization for which you worked. Do not include experience in positions where your primary job was not modeling.

- | | |
|--|---|
| <input type="text"/> Federal Government | <input type="text"/> Private Consulting Firm |
| <input type="text"/> State/Provincial Government | <input type="text"/> Non-Profit Advocacy Organization |
| <input type="text"/> Regional Government or Agency | <input type="text"/> Independent Contractor |
| <input type="text"/> Local Government | <input type="text"/> Other (specify) _____ |

9. Are/were you a public employee in this, i.e., your current/most-recent, position? (Check one)

- YES NO



10a. Indicate the type of organization for which you work(ed) in this position. (Check one)

- Federal Government
- State or Provincial Government
- Regional Government or Agency
- Local Government

11a. Indicate the sub-organization that best describes your work unit. (Check one)

- Department of Transportation
- Metropolitan Planning Organization
- Air Quality Planning District
- Planning Department

10b. Indicate the type of organization for which you work(ed) in this position. (Check one)

- Private Consulting Firm
- Non-Profit Advocacy Organization
- Independent Contractor
- Other (specify) _____

Skip from here to Question 12 on the next page.

12. Before taking this position, where you ever employed by an agency/firm for which your current organization prepares(ed) analyses directly or indirectly? (Check one)
- YES NO
13. In the last ten years, how many executive directors, or equivalent, has your organization employed? If you no longer work as a modeler, answer based on your final day of employment with your organization. (Check one)
- 1-2 3 4 5 MORE THAN 5 DON'T KNOW
14. Was the Executive Director, or equivalent, of your organization ever previously employed by an agency for which your organization prepares(ed) analyses directly or indirectly? If you no longer work as a modeler, answer based on your final day of employment as a modeler. (Check one)
- YES NO DON'T KNOW

IV. Attitudes

In this section, you will find a series of statements about modelers, planners and issues related to travel demand forecasting. (For our purposes, we consider all modelers to be planners to some degree.) They are strongly worded to try to elicit differences of opinion between people. This gives them a black and white quality, which may not always feel comfortable to you. However, we would like you to provide the answer that comes closest to your real opinion. The set of items may also seem contradictory or inconsistent. We are in no way trying to trick you. There are no wrong answers. Each question has six possible responses. By each statement, enter the number between "1" and "6" that corresponds to your answer on the horizontal scale provided.

1	2	3	4	5	6
strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

- ___ 1. Overemphasis on accommodating the auto seriously impairs the quality of urban life.
- ___ 2. Planners have a responsibility to advocate the development of mass transit systems because they are more efficient and less polluting than automobile travel.
- ___ 3. If people want to drive cars, they should be able to even if it costs the taxpayers money for highways, parking lots and other automobile-oriented facilities.
- ___ 4. Planners should not place a great deal of emphasis on mass transit as a solution to urban problems.
- ___ 5. Public policies should make it as difficult as possible for people to drive alone.
- ___ 6. If a planner's recommended alternative is not selected by policymakers, s/he should not try to change that decision.
- ___ 7. Plans should stand or fall on their technical quality and internal logic.
- ___ 8. Planning should be placed in the governmental structure so that planners can easily get involved in political disputes that relate to their areas of competence.
- ___ 9. Planners should keep their notions about public policy in check, resisting public revelation of strong attitudes, which might raise doubts about their objectivity.
- ___ 10. Planning is primarily a political activity.
- ___ 11. Planners should allow their values to influence their plans.

	1	2	3	4	5	6
	strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree
_____	12.	If planners meet opposition to their plan from non-governmental interest groups, they should try to neutralize or counter act it by mobilizing support in favor of the plan from other interest groups.				
_____	13.	Planners should lobby actively to defeat proposals that they think are harmful, even if it means challenging powerful interests.				
_____	14.	Planners should try to influence decisions primarily by dissemination and facilitating the use of technical planning information.				
_____	15.	Planners should be open participants in the planning process, staking their values in competition with others, and openly striving to achieve their ends.				
_____	16.	A modeler's job is to predict and provide alternatives that meet some grander unified vision.				
_____	17.	When forecasting travel demand, the political process should determine which, and how many, scenarios to model.				
_____	18.	Modelers should carry out the will of the people while giving them clear information about what choices are available and the consequences of those choices.				
_____	19.	Modelers are culpable for the misuse of their work by others.				
_____	20.	The quality and depth of analyses done by planners has little to do with their effectiveness.				
_____	21.	A high quality of life includes a good balance of transportation choices.				
_____	22.	People have a right to control what kind of people live in their communities with them.				
_____	23.	Planning, as a field, has become too concerned with the demands and concerns of low income and minority groups.				
_____	24.	Planners should undertake an impact analysis for any major proposal that comes before them to see what its effects are on low income and minority groups.				
_____	25.	A planner may have to work covertly to gain support for planning policies.				
_____	26.	Technical expertise is sometimes most useful as a screen for building political support for a plan.				
_____	27.	If a plan is accepted by decision-makers (i.e., implemented), the planning process is a success, even if the adopted plan is an inadequate piece of analysis technically.				
_____	28.	Modelers who try to manipulate technical analyses to promote their own political agenda are worse than the politicians they complain about.				
_____	29.	Modelers should prepare analyses even when accuracy of the input data is highly questionable.				
_____	30.	Modelers are responsible for explaining the details of their analyses to citizens.				
_____	31.	The "best" transportation plan is the one that works "best" across all future scenarios even if it is not the "best" for the most likely scenario (i.e., future state of the region).				
_____	32.	People's desires are rarely uniform and do not lead to any objective definition of the public interest. Therefore, planners should focus on organizational goals (e.g., equity).				

	1	2	3	4	5	6
	strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree
___	33. Competition between jurisdictions for federal and state dollars corrupts the travel demand modeling process.					
___	34. Politicians are only interested in technical analyses that support their views.					
___	35. The right of property owners to benefit from increases in the value of their property can legitimately be limited so that land can be preserved in its natural or agricultural state.					
___	36. Pollution in cities from the use of automobiles should be reduced, even if it requires such measures as parking bans or heavy auto use taxes.					
___	37. Concern for protecting the environment is important, but planners should temper that concern by recognizing that other legitimate objectives which come in conflict with environmental protection may be even more important.					
___	38. Planners have become too much concerned with protecting the environment.					
___	39. Developers, in responding to market forces, are only giving people what they want.					
___	40. There should be tighter controls on private development to protect the public interest.					
___	41. Private developers have little or no concern for the good of the community as a whole.					
___	42. Planners know better what community needs are than do residents—that is what they are trained to do.					
___	43. While citizens should be kept aware of developments during the planning process, they should not get deeply involved in the technical work.					
___	44. Planners should involve citizens in every phase of the planning process.					
___	45. Citizen groups should not have veto power over plans.					

V. Scenarios

On the following pages, there are a number of short scenarios involving ethical issues for modelers. Each one is followed by three questions concerning the behavior the scenario describes. We realize that the reality is more complex than these short scenarios can portray. However, answer as honestly as you can, given the information presented. Your responses are completely confidential, so please be frank. (Complete questions “a” and “b” by circling the number on the scale from 1 to 5 that corresponds to your answer.

1. A consultant estimates the demand for a new light rail transit route to be about 2,000 passengers per day, but the chairman of the county board of supervisors urges her to reconsider the assumptions and rework her models until the demand rises to 12,000 daily riders. The higher numbers are needed to justify a federal grant. The consultant favors construction of the line if we numbers are needed to justify a federal grant. The consultant favors construction of the line because of the social benefits she believes it will provide and adjusts her modeling assumptions to achieve the 12,000-rider threshold.

- a. The consultant’s action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

2. A modeler, employed by the county, concludes that a new commuter rail line proposed from a largely undeveloped region of the county to the central metropolitan business district will attract only one-tenth the number of riders needed to make the line viable. The county transportation planning staff is likewise convinced that this would be a tremendous waste of taxpayer dollars. The President of the county board questions this conclusion. Despite the best efforts of the planning staff to convince her otherwise, the President generates enough public support to commit significant funding to study the question further. Before the board votes on further funding, the modeler writes an editorial for the local newspaper defending his position. The modeler uses only information available to the public in his letter and does not identify himself as a county employee.

a. The modeler's action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

3. The director of the metropolitan planning staff enters into a covert agreement with the state Secretary of Transportation to support widening a state highway, which the director opposes because of its potential to accelerate suburban sprawl. In exchange, the Secretary recommends state funding for a needed new light rail line in the director's jurisdiction.

a. The director's action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

4. Consider Scenario 3 above. The director explains to the staff lead modeler that he supports the highway project because it would ensure state support for the light rail project that promises to significantly improve accessibility for low-income groups in the city. Although the modeler believes that the state highway should not be widened in the absence of adequate land use controls, she considerably softens her technical criticism of the study and recommends going ahead with the highway project at the next planning commission meeting without additional justification.

- a. The modeler's action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

- b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

- c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

5. A transportation planning staff prepares a study that supports the construction of a new light rail system for a major metropolitan area. The proposed system substantially increases suburban mobility at the expense of already sub-par transportation services in low-income sections of the city. This fact is not clearly presented nor included in the final report. One transportation planning staff member provided assistance on his own time to a low-income citizens group to explain the subtleties of the plan and organize its opposition to the plan.

- a. The staff member's action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

- b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

- c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

6. A modeler prepared the analysis of a new highway project proposed for a largely undeveloped area of the county. Although she did not fabricate data, she gives the proposed highway project the benefit of the doubt by setting all assumptions at either the lower or the upper end of a reasonable range of values.

- a. The modeler's action is:

1	2	3	4	5
clearly ethical	probably ethical	(not sure)	probably unethical	clearly unethical

b. If faced with such a situation, I would:

1	2	3	4	5
do it	probably do it	(not sure)	probably not do it	not do it

c. Have you experienced a similar situation in your work as either a participant or bystander? (Check one)

YES NO

VI. Background Data

We would now like to ask you some background questions to help us interpret our results. If there are not enough items for your answers, e.g., you have two master's degrees, use the margin.

1. Gender (Check one)

Male Female

2. Age: _____

3. Ethnicity (Check all that apply)

- Black/African-American
- White/Caucasian
- Indian/Native American
- Hispanic/Latino
- Asian/Pacific Islander

4. Check (and specify, should your degree not be listed) each degree that you hold, if any. Indicate, also, in what field and in what year you earned your degree(s).

	DEGREE	FIELD	YEAR
<input type="checkbox"/>	Bachelor's	_____	19____
<input type="checkbox"/>	Master's	_____	19____
<input type="checkbox"/>	Doctorate	_____	19____
<input type="checkbox"/>	_____	_____	19____
	<i>Other</i>		

5. If you have a degree, indicate in which country the awarding institution is located. If you took college coursework, but do not have a degree, indicate in which country you studied.

	COUNTRY			<i>Please Specify</i>
Bachelor's Degree	<input type="checkbox"/> United States	<input type="checkbox"/> Canada	<input type="checkbox"/> Elsewhere	_____
Master's Degree	<input type="checkbox"/> United States	<input type="checkbox"/> Canada	<input type="checkbox"/> Elsewhere	_____
Doctorate	<input type="checkbox"/> United States	<input type="checkbox"/> Canada	<input type="checkbox"/> Elsewhere	_____
Course Work--No Degree	<input type="checkbox"/> United States	<input type="checkbox"/> Canada	<input type="checkbox"/> Elsewhere	_____

6. Are you currently employed as a travel demand forecaster? (Check one)

YES NO

7. Indicate each professional organization related to your work as a modeler of which you are a member. Check the corresponding box if your employer provides payment for your dues.

ORGANIZATION	EMPLOYER PAYS	ORGANIZATION	EMPLOYER PAYS
<input type="checkbox"/> AICP	<input type="checkbox"/>	<input type="checkbox"/> ITE	<input type="checkbox"/>
<input type="checkbox"/> APA	<input type="checkbox"/>	<input type="checkbox"/> TRB	<input type="checkbox"/>
<input type="checkbox"/> ASCE	<input type="checkbox"/>	<input type="checkbox"/> Other (specify) _____	<input type="checkbox"/>

8. In general, how would you characterize your political views? (Circle the number that most closely corresponds to your answer.)

1	2	3	4	5	6	7
progressive		liberal		moderate		conservative

VII. Interviews

In addition to your survey responses, we need further help with our continuing research on ethics and travel demand forecasting. If you are willing to participate in a follow-on study designed to further examine the professional conflicts and dilemmas that modelers face and their responses to them, please provide your name, address, telephone number and electronic mail address below. Inclusion of these items will *not* jeopardize the anonymity of your responses on this questionnaire. Your participation would involve a 2-3 hour private in-person interview with a principal investigator scheduled later this year at a time and location convenient for you. Your participation and the information you provide will remain strictly confidential.

Name			Prefix <input type="checkbox"/> Dr. <input type="checkbox"/> Mr. <input type="checkbox"/> Ms.
Address			Telephone Number – Daytime
			Telephone Number – Evenings
City	State/Province	Zip/Mail Code	Electronic Mail Address

Your contribution to this effort is greatly appreciated! Please take a moment now to seal your completed questionnaire and Colleague Information form in the provided postage-paid envelope and drop it in the mail with your marked postcard. Thank you again for taking the time to participate in our study. We wish you every success in your career.

If you would like a summary of survey results, send an electronic message with the subject “Survey Results Request” to pabrink@uclink4.berkeley.edu. We will make certain that you get a copy. In addition, we will provide you with any references there may be identifying articles that detail this study and the follow-on research stemming from it.

Portions of this survey were adapted from questionnaires on planners’ ethics developed by Professors Elizabeth Howe and Jerome Kaufman in the Department of Urban and Regional Planning at the University of Wisconsin-Madison.

APPENDIX 3
INTERVIEW GUIDE

I. PROLOGUE

Thank you for granting this interview. You are one of thirty modelers that I am interviewing this year to examine the ethical challenges travel demand forecasters face in professional practice and identify how they respond to them. As you may know, almost all accounts of practice that deal with these issues are anecdotal. My aim is to approach the subject in a more rigorous way to test common assumptions about travel demand modelers and their practice.

This study is funded in part by the National Science Foundation and the University of California Transportation Center, which is supported by the U.S. and California Departments of Transportation. As stated in the written agreement to participate, you may refuse to answer any question that I pose and you also have the option to end this interview at any time. Your identity will be closely guarded. Should I quote you in my work, all identifying information will be removed.

Because the most illuminating accounts of practice are contained in the richness of narratives, I invite you to be as detailed as possible in your responses. Your thoughts and insights on a multitude of issues are important to the success of this research.

As I indicated in my correspondence, this interview is scheduled to last from 2-3 hours. I always aim for two hours, but I like to have the latitude to continue should we encounter topics that are important to examine in more depth. We can take a break at anytime you would like.

II. GENERAL

A. Please tell me a little about your practice. Your agency/firm?

1. Statutory responsibilities?
2. Geography of your jurisdiction (boundaries, demographics)?

B. Would you briefly describe your professional responsibilities?

1. What are your duties on a typical forecasting project?
2. What previous professional modeling experience do you have?

- C. Would you expand on your educational background? How did you get into the modeling field?
- D. Please describe for me some of the forecasting projects on which you typically work.
- E. Please describe a typical work day. With whom do you interact most often?
- F. How is information exchanged between your agency/firm and your clients/customers?
- G. What do you like about your job? Dislike?

III. PHILOSOPHY

- A. Who are your clients/customers? How does the public fit into your scheme of clients and customers, if at all?
- B. How do you view the modeler's role as educator? When, if ever, is education an important/legitimate part of your work?
- C. In your view, what are the responsibilities of the individual stakeholder groups in the modeling process?
 - 1. Clients?
 - 2. Decision-makers?
 - 3. Interests groups?
 - 4. Citizens?
 - 5. Forecasters?
- D. How, if at all, do modelers influence decisions?

IV. ASSUMPTIONS

- A. Who defines the assumptions used in your models? The alternative future scenarios?
- B. How, if at all, do (should) you challenge questionable assumptions? What is the usual outcome?
- C. How, if at all, can the quality and quantity of the data you use be improved?

V. TECHNICAL

- A. How do (would) you demonstrate the impact of interventions (or lack thereof) that are not easily quantifiable?
- B. How do you recognize a good model when you see one?
- C. What role does professional judgment play in your practice?

VI. ETHICS

- A. How, if at all, do your values color the results of your analyses?
- B. What ethical challenges emerge in your work?
- C. What courses, if any, have you had that addressed ethics? How did you come to take these?
- D. How is the issue of ethics broached in your work, if at all?
- E. At the end of the day, what, if anything, commonly leaves you feeling unsettled about your analyses?