Mental Barriers to Learning and Creativity in Transportation Planning

Jonathan Richmond

Planners and politicians tend to render the complex in black-and-white. Technological metaphors play an important role in this process of self-delusion which results in impoverished planning. Analysts rely too much on quantitative techniques because they provide an illusion of science and certainty. Politicians are too easily swayed by the vivid imagery of technological solutions, ignoring the difficult, abstract questions of social values and goals which should be addressed before any technology is chosen. These themes are explored with the aid of a case study of transportation planning in Southern California.

> Two things fill the mind with ever-increasing wonder and awe the more often and the more intensely the mind is drawn to them: the starry heavens above me and the moral law within me.
>
> —Immanuel Kant
> *Critique of Practical Reason*

When Copernicus argued in 1543, that the earth rotates daily on its own axis and moves annually around a stationary sun, he was attacked by a Lutheran follower, Melachthan, since "the eyes are witnesses that the heavens revolve in the space of twenty-four hours" (Kuhn, 1957). Because we all see the world through the eyes of our own experience and values, each theory carries its own set of assumptions which gives it meaning. Only through awareness of the shortcomings besetting the way we receive and deal with information do we stand a chance of finding a more ready path to understanding.

But not only are we unaware; we do not seek to be more aware. We suffer, says Boulding (1968), from agoraphobia, "the fear of open spaces, especially open spaces in the mind." We identify with and are reassured by recognizable forms: we try to blot out the void and disorder of the unknown over which we have no control. Though one can only be wise, warned Harold Laski in 1930, "if he admits that his knowledge of the subject is mainly a measure of his ignorance of its boundaries," we delude ourselves into believing that we have successfully closed in on the essence of the subject under study in an effort to escape from the reality and consequences of our ignorance.

Thus, says Ackoff (1981), "we usually try to reduce complex situations to what appear to be one or more simple solvable problems. This is sometimes referred to as 'cutting the problem down to size.' In so doing we often reduce our chances of finding a creative solution to the original problem."

Pacey (1983) illustrates just this phenomenon by relating the problems associated with simple hand pumps used at village wells in India. While about 150,000 new pumps had been installed by 1975, as many as two-thirds of them were simultaneously out of order.

Engineers identified faults and corrected defects, but pumps continued to break down. "What at first held up solution of the problem," writes Pacey, "was a view of technology which began and ended with the machine... People in many walks of life tend to focus on the tangible, technical aspects of any practical problem, and then to think that the extraordinary capabilities of modern technology ought to lead to an appropriate 'fix.'"

Progress required the realization that this was more than just an engineering problem. A "breakthrough only came when all aspects of the administration, maintenance and technical design of the pump were thought of in relation to one another...Arrangements for servicing the pumps were not very effective. There was another difficulty, too, because in many villages, nobody felt any personal responsibility for looking after the pumps..." Without an adequate administrative system to keep the pumps in good working order, repairing a pump could provide no more than a short-term solution: without proper maintenance—something local people could provide if shown how—it would soon be out of order once more. "It was only when these things were tackled together that pump performance began to improve."

Schön (1983) emphasizes the need for "problem setting ...a process in which, interactively, we name the things to which we will attend and *frame* the context in which we will attend to them," but finds that "from the perspective of Technical Rationality, professional practice is a

process of problem solving." Our uncritical tendency to take problems as "given" and our failure to probe the alternative contexts in which they may be set, may not only lead us unsuspectingly down the wrong path, but also keep more productive avenues beyond sight. Thus, while the defective village pumps were automatically seen as a technological problem to be "solved," without inquiry into the context in which the defects existed, the key to curing the problem – which lay outside the technological domain – remained inaccessible.

"Our technology – the subject of our predictions"– says Schön (1967), "also helps to determine the theories under which we make predictions, since it provides the metaphors out of which our theories are made." This article will show how technological metaphors can tacitly frame the context in which professional analytic work and political decision-making are conducted, masking from view the more basic issues upon which both should depend.

Two different metaphors implicit in processes of analysis and decision-making will be made explicit. On the one hand, the tendency for the analyst to formulate and tackle a problem through the lens of the technique he uses – rather than reflect on the nature and context of the problem at hand before choosing any techniques – will be shown to give quantitative methods both a distorting and controlling power over his view of the world and the conclusions he reaches. A theory of action will be presented which is rooted in a desire for closure, for the mind to select simple but inadequate concepts to deal with conditions of complexity. Quantitative models are desired, it will be argued, because "it is comforting to imagine that someone in this topsy-turvy world has an *answer*" (Winner, 1975). Such models provide a determinate answer with the scientific appearance of authority, but they can distract us from exposing the fundamental problems we face.

On the other hand, the inclination for politicians to view questions of technology choice from the perspective of a superficially attractive technology, rather than from a discussion of social values and goals, will be shown to result not in the choice of a particular technology for its abilities to resolve a particular problem, but in the determination of both goals and solutions according to the symbolic appeal of particular technologies. While analysts find security in the apparent certainty of answers derived from quantitative techniques, politicians, it will be argued, draw on the comforting solidity of the physical and the obvious, focusing technology choice on a machinery brought into view not so often by our particularly human conceptual abilities as by our equally human emotions and fears. Technologies are thereby selected because of their intuitive appeal as cure-all solutions.

In a Southern California which demanded increasing mobility by car, it seemed only natural to build massive freeway systems. With hindsight we now question the wisdom of such narrow-sighted programs, but fall into a similar trap by assuming that all ills can be cured by building a network of railways. By failing to test our intuitions, we ignore the central value questions which might help us decide if the technology *should* have a place in our society, and are deflected from paths to potentially more creative solutions.

This article will start with several examples from outside transportation to develop a general theory which will be used to help explain the puzzles to be observed in the main focus of the article: a case study of transportation planning processes in Southern California. Examples will be given of both the reductionistic use of computer models by analysts, and the superficial intuition-led use of technological metaphors by politicians. Both a reliance on computational procedures and the promotion of a given technology as panacea provide easy ways out. But not only does the reductionism exhibited in both cases fail to make the "big questions" go away, but the abrogation of responsibility to confront the more basic questions may lead to decisions to whose consequences we are blind through the tacit imposition of an ethos which we would reject were we aware of it.

Patterns of the Mind

We have a paradox: the mind is more than a machine, but we increasingly deny the power of mind over machine by behaving in more machine-like ways.

Machines are determinate formal systems; they work on the basis of concepts programmed into them. A computer deals with information according to a set of rules encapsulated in its program. These rules form the boundaries within which the system operates.

Computers, says Searle (1985) are syntactical symbol processors: lacking the semantical content of a mind, they have no way of attaching *meaning* to symbols. A computer simulation may produce an "optimal" solution which involves destroying a low-income community, polluting the atmosphere or damaging areas of natural beauty to make way for a new freeway. But the computer has no way to inquire into its own system of inquiry, no way to judge that system unethical and move to a new way of looking at the world beyond the assumptions within which its program must operate.

The mind, in contrast, is directed by intentionality – "the beliefs, fears, hopes and desires" characteristic of "Free Will"– which the machine, locked into its program, can never possess. "If somebody predicts that I am going to

do something, I might just damn well do something else," says Searle. The planner's commitment "to serve the public interest" (AICP, 1981) may lead him to question whether it is *right* to perform certain acts on *people*, and from such an awareness challenge the tenets of the system of evaluation which led to such a "solution." Such reflection may guide him to alter his perspective; he thereby tears himself from a bounded view to better provide for the clients he is to serve.

The ability to escape from the constraints of a narrow system of inquiry, and to do so on the basis of a never-ending ethical debate, necessarily elevates mind above machine. Yet, in our yearning for simplicity, we fall easily into the steady rhythm of mechanical ways.

Consider the following problem: you are given the three numbers 2, 4, 6, and told they conform to a simple relational rule. You are to discover the rule by suggesting sets of three numbers, and being told the numbers conform or do not conform to the rule. You may try as many sets of numbers as you wish before announcing what you think the rule is.

The rule is, simply, "three numbers in increasing order of magnitude." But if you are like 23 of the 29 subjects tested in the experiment of Wason (1960) or like the two of three graduate students tested by this author in the transportation doctoral seminar at MIT, you will have got it wrong at first attempt. In nearly all cases, incorrect rules were sufficient, but not necessary: "increasing intervals of two," for example. "The point is not that most subjects failed to give the correct rule at their first announcement, but that they adopted a strategy which tended to preclude its attainment." By successively giving sets of numbers meeting the test of sufficiency, they confirmed their existing but erroneous beliefs, while success required "a willingness to test those intuitive ideas which so often carry the feeling of certitude."

Alexander (1965) asserts that designers, "limited as they must be by the capacity of the mind to form intuitively accessible structures," do not perform such tests. Quite the reverse, "the mind's first function is to reduce the ambiguity and overlap in a confusing situation" since "it is endowed with a basic intolerance for ambiguity."

The complexities of modern design problems, he suggests, are like the difficulty of complex arithmetic: they cannot be completed in one jump. "Complexity defeats us unless we find a simpler way of writing it down." Designers, he says, rarely confess their inability to solve the complex problems which confront them daily. "Instead, when a designer does not understand a problem closely enough to find the order it really calls for, he falls back on some arbitrarily chosen formal order. The problem, because of its complexity, remains unsolved" (1964).

Brewer (1973) demonstrates this phenomenon at work in planning practice in his account of modeling efforts for the community renewal program of the City of San Francisco. He shows how "arbitrary weights" were frequently applied without a theoretical basis for assigning them. Particularly disturbing was the unfounded use of analogies from chemical kinetics and physics. "The assumptions, built into the rent pressure relationship," for example, "are offensive to sense, common or otherwise. . . . If a model builder has never been sensitized to the details of a specific empirical context, one should not find fault with his great inferential leaps, from decaying isotopes to decaying houses or from expanding and collapsing magnetic fields to expanding and collapsing rentals."

It was not simply that a bad job had been done, as one operations researcher Brewer interviewed pointed out, but that the city planners wanted to ask detailed questions which the model could not address. But, says Brewer, "even though the model can't answer 'those kinds of questions' it was decided to build in so much detail that those questions nonetheless appear to be asked." It may thus be possible to provide the appearance of simple answers to complex problems; but such action does not make the problems go away.

Moen (1984), having studied economic growth potential due to oil shale development in Colorado, similarly states that while "an ideal population projection method would provide estimates of the numbers and characteristics of immigrants and outmigrants detailed enough to plan for community needs," the task is not only "formidable" but "impossible, since data on future employment may be withheld, misrepresented, or even unknown by industry. Consequently, projections may be highly unreliable not only in the long run but from day to day."

Despite the "For Sale" signs "now the local logo" resulting from the failure of oil-shale-fired growth in one area, Moen reports that "the response to the failure of forecasting in Colorado and elsewhere has been the development of increasingly complicated models that require more and more assumptions about future events, as well as about relationships among variables and the stability of these relationships—all of which may increase the possibility of error and illusion of precision." Such efforts, says Moen, are "high-tech quantitative answers to what is essentially a political and ethical problem."

Mathematical modeling, and especially computer modeling, has, however, become commonplace in all social endeavors of academia, consulting and government, so much so that according to operations researcher John Mulvey (1983), "many educated people treat computers and the ensuing recommendations as objective fact."

But while the apparent complexity of high-powered computer tools lends them authority, all quantitative models, however complicated, must simplify the complexity of the world they represent. To find patterns, "rules" are needed to decide both what is relevant information and what is to be rejected, and how the chosen information is to be processed. As Wachs (1982) says, "there is relatively little theory derivable from the social sciences to help one arrive at reasonable core assumptions." Such assumptions, which tend to unduly reflect what Godet (1979) refers to as the "better lit" aspects of reality are chosen subjectively, not determined objectively, but color the whole analysis of which they form the fabric.

A mathematical statement has no social content: it is correctly computed to the extent that it follows the rules of mathematics. But mathematical statements, though themselves empty, may powerfully *organize* information, and will do so through the assumptions under which they are set up. Just as Melachthan's eyes filtered information to form his picture of the universe, so mathematical algorithms form partial pictures of the world which lack *necessary* truth. Danger lies when, according to Hoos (1969), "in the absence of clearly specified limits and conditions, the assumptions and biases of the analyst are taken as representative of the real system under study."

Leamer (1983) finds that a regression of murder rate on variables thought to influence murder "leads to the conclusion that each additional execution deters thirteen murders with a standard error of seven. That seems like such a healthy rate of return that we might want just to randomly draft executees from the population at large." But the conclusion changes when the set of variables thought relevant to the model is altered. A result which looked convincing under one set of assumptions loses credibility when those assumptions are changed. "Individuals with different experiences and different training will find different subsets of the variables to be candidates for omission from the equation." So a right winger will look to the punishment variables and regard others as doubtful, while "an individual with the bleeding heart prior sees murder as a result of economic impoverishment."

So the conservative "finds" that execution has a strong deterrent effect upon murder, while the liberal "finds" that execution actually encourages further murder.

The death penalty case—"perhaps the single most important legal use of multiple regression thus far" (Fisher, 1980)—presents a two-fold problem: in the first place the outcome is most heavily influenced by the prior beliefs inculcated into the assumptions, rather than by the data they purport to analyze; but, secondly, and on a deeper level, not only are the assumptions employed in the procedure subject to "bias," but the procedure *itself* reflects a point of view—the implicit belief that the death penalty *should* be used if it will deter murder—which might be rejected were it to be brought to the surface and subjected to critical attention.

The use of statistical analysis thus distracts us from deciding whether society *should*—as a matter of principle—have the right to kill someone, a debate which is embarrassing because it exposes the roots of our ethical values, lays them open to criticism, and leaves us uneasy since there is no unique "sure" solution. It is tempting for those on both sides of the death penalty debate to stand behind the illusion of science provided by the apparent precision of econometric technique. But when opponents become entangled in technical arguments over the alleged deterrent effect of capital punishment, their case is weakened because the "right to kill" is tacitly (if unintentionally) presupposed by the calculus employed. (See Kelman, 1982 and Macintyre, 1977 for penetrating discussion of the assumptions of utilitarianism.)

The El Monte Busway...

Quantitative techniques, then, are not simply subject to abuse; their use for "honest" purposes may imply a set of beliefs which their users might reject were they aware of them. 'The quantitative approach tends to divert our attention away from the evaluation of the concepts and variables themselves...," says Young (1979). "We can therefore be drawn into an uncritical acceptance of the overall framework of theories and approaches to nature and society."

Passenger Rail in Southern California

Commuter rail thrives in many East Coast cities which depend on it to bring workers to town in the morning and send them home in the evening. Traditional urban centers —concentrated foci of employment activity—sit at the core of transportation networks branching out to suburbia.

But the low density and widespread distribution of both population and economic activity in Southern California generates a complex pattern of transportation demands between a myriad of origins and destinations. This pattern calls for service more similar to a telephone network (which connects anywhere to everywhere) than to rigid linear-based public transportation; this does not augur well for rail "solutions."

The train is being chosen in California in reaction to the era of road building and the cult of the car, now seen as selfish and wasteful. The train, moreover, not only avoids roads, but carries deep romantic connotations dating back to an era when we apparently travelled easily and in grace, and when congestion, pollution and energy abuse were neither terms in the vernacular nor discomforts to the senses.

Adriana Gianturco, Governor Brown's transportation administrator, was a champion of the rail cause. Under her aegis, new AMTRAK trains became part-funded by the State of California and plans were hatched for commuter rail operations throughout Southern California. One of them, connecting Oxnard, sixty-six miles northwest of Los Angeles, with Union Station near LA's central business district, started operation.

Oxnard Commuter Rail

Initial ridership forecasts for the proposed Oxnard commuter rail service were not encouraging and, under instructions from superiors, Caltrans (California Department of Transportation) staff "adjusted" the assumptions of their model to predict greater numbers of riders. Final projections of 1,286 daily passengers in each direction would never materialize: during four months of operation, ridership peaked at only 175 daily passengers in each direction and, in February 1983, the new Republican Deukmeijian administration moved to suspend service.

The obvious interpretation of this story would focus on the deliberate inflation of projections; but such a perspective allows more significant ethical issues to escape attention.

A more critical eye might complain that the computer model was wrongly employed even *before* "adjustments" were requested. The methodology failed to properly account for problems passengers would face getting between stations and their homes and places of work, and for the low frequency and poor timings of the proposed service. All of these factors would discourage people from using the train, and would provide a greater disincentive than the model allowed for. According to this view, more sensitivity should have been shown in setting up the model, or a better model should have been chosen or developed.

But the problem goes deeper when we appreciate that the model was not just inappropriate for estimating demand, but wholly inadequate to the task of inquiring into how transportation might be appropriately provided to serve society.

Analysis started with the assumption of a given technology—rail. There was no consideration of alternatives, nor even an attempt to define the objectives of the service, which might be more properly stated in terms of alleviating congestion and pollution, saving energy and providing mobility to those who might otherwise be denied it.

With demand as implicit surrogate for these objectives, the degree to which the ultimate goals might be achieved is obscured. The relations of the equations are allowed to influence outcome, regardless of whether they imply a socially justifiable theory. Arriving at such a theory is the most intractable and difficult problem; but the desire for a neatly-bounded problem definition makes for avoidance of such issues, and a supposedly value-neutral mathematical representation attractive.

We cannot blame the model for failing to ask the deeper social questions. The model is only part of a system of inquiry that excludes such debate. But the model diverts attention from such questions. Just as the death penalty modelling implicitly assumed that capital punishment *should* be used if a certain deterrent effect could be established, it is implicit in the Oxnard modelling that rail service *should* be provided if a certain "demand" can be established. The "fact" that we see demand projected satisfies us that the service can meet "need." We are therefore led to exempt ourselves from investigating both what "need" actually is, and alternative ways it might be provided.

"Few forecasters engage in blatant falsification in order to receive a commission or promotion," says Wachs (1982). "Many, however, are transformed in subtle steps from analyst to advocate by the situation in which they perform their work." In the Oxnard case the modelers *did*

respond to pressures for increased projections. We should be more concerned, however, about what they were doing before that pressure was applied. "Caught in a net of language of our own invention," says Alexander (1964), "we overestimate the language's impartiality." In their initially "honest" use of a standard approach, the Caltrans analysts were adopting a language which tacitly framed the debate, its assumptions unquestioned.

Los Angeles – San Diego Bullet Train

In March 1982, the newly-formed American High Speed Rail Corporation announced plans to provide high-speed rail service between Los Angeles and San Diego. The Corporation produced *findings* of demand forecasts by Arthur D. Little consultants which pointed to massive ridership and a profitable balance sheet.

The point, once more, is *not* that we need a better model. The sophisticated computerization was no more than a facade. If first we ask what transportation is *for*, the simplest of techniques enables us to realize that the bullet train – an import serving the densely concentrated population centers of Japan – is unsuited to meet the complex intra-regional needs of dispersed Southern California.

But to ask what transportation is for we have to do more than produce a model. Even if it were possible to predict *exactly* how many people would ride, it would not relieve us of the responsibility to ask why it is that they *should* ride on a bullet train rather than take another means of transportation and to investigate the spillovers, beneficial or otherwise, that might affect the region and economy as a whole. To ask these questions properly one should not start with the bullet train at all, but with the idea of social need.

Los Angeles' most successful transit project...

Without more than the consultant's assurances of profitability, the state legislature almost unanimously approved a bill to provide up to $1.25 billion in tax-exempt revenue bonds for high-speed rail. Subsequent examination of the Arthur D. Little demand projections shows that their sophistication lies only in their falsehood: the vast majority of the state Legislature had voted to support a project backed only by an impenetrable labyrinth of computerized distortion (Richmond, 1983).

The inherent appeal of the plan to the legislators is not difficult to see. To many Democrats, the plan meant more public transportation. It meant emptier freeways, a cleaner environment, and jobs in constructing and operating the enterprise. To Republicans, the bullet train shone as an example of capitalism working at its best: profitable private enterprise providing benefits without cost to the state. The technology itself was symbolic of those benefits: no attempt was made to probe beyond the bullet train's

shiny exterior to see if these outcomes would actually result. In this example we see interaction of the two forms of reduction under discussion: the power of a computer model to provide "verification" reinforced the politicians' untested and erroneous belief in the benefits to be derived from a symbolically compelling panacea, and stopped debate.

Light Rail in Los Angeles—A Problem of Politics or Mind?

The problem of politics is the need to form agreement on an agenda. Politics tends to both limit and fragment agendas to deal with a myriad of constituencies and the public at large. But the popular belief that "interests" are responsible for inadequate agendas ignores the more fundamental controlling mechanism: the language in which politics is conducted.

Voters would be puzzled if they saw on their ballots propositions asking if they approved of love or belonging, of fairness or equality. "Of course we do," they would reply, complaining that these were not issues.

Similarly, candidates of all persuasions agree on the need for "effective transportation systems," but are regarded with suspicion if they fail to declare just how they plan to attain such a lofty goal.

For politicians, like the people they serve, it is difficult to think and talk in terms of values and goals. They must instead use lower-order metaphors within the ready grasp of the mind: they must talk of the "need" for freeways or trains to do what Churchman (1979) calls "making polis," to make ground upon which to meet their electorate. Analysts are drawn to quantitative techniques because of the clean-cut certainty they appear to provide. Similarly, "it is undoubtedly simpler" for decision-makers "to deal solely with concepts for which there are physical referents than to try to relate abstract concepts such as security or belonging to the design of transportation systems" (Wachs and Schofer, 1969). So freeways and trains enter the political picture with all the connotations of history, aesthetic and symbolism with which they are associated. The technologies are only means, enabling us to get somewhere; they are not ends. But they become subjects of discourse without discussion of the goals that drive them to be there. There is no consideration of possible alternative transportation technologies which might be implied by such goals (were we to seek them); or of the basic values upon which these goals ultimately depend. Higher-order concepts—values and goals—of which we are unaware are nonetheless tacitly imputed and carried forward to return our sins.

For the following example we move from the computer room to the committee chamber to show that the affinity for closure on the part of the analyst is paralleled by the predisposition to technological reductionism on the part of the decision-maker. We shall see that the politician's tendency to take technology as given, and as an appropriate basis for choice without consideration of the underlying values represented by that technology, is similar to the analyst's desire to present problems as determinate, quantifiable, and soluble without investigation of the context in which they are set.

The transcript of the Executive Committee meeting of the Southern California Association of Governments on September 1, 1983 (SCAG, 1983a), presents a revealing illustration of this problem at work. At this meeting, Professor Melvin Webber of the University of California, Berkeley and Professor John Kain of Harvard University reviewed the agency's Regional Transportation Plan (SCAG, 1983b), a document which emphasized the development of a system of light rail ("trolley") lines to serve the Los Angeles region.

Webber attributed the failure of San Francisco's Bay Area Rapid Transit system (BART) to the difficulty of getting to and from stations: it was often faster to drive or to take the bus. Buses can collect passengers throughout residential areas, so they can complete the whole trip in one vehicle. Buses can therefore provide a journey which is in many cases quicker and more convenient than one which requires a separate trip to a BART station and a transfer to the train. Webber emphasized that people consistently chose to travel on the basis of trip time and cost, and not because of the quality or aesthetics of the ride itself.

> The reason we failed to eliminate traffic congestion is that the cost of accessing a rail system is high, and I think that's as true here as it was in the Bay Area or more so. The reason it's probably more so is that your land use pattern is not linear, you don't match a railroad's geometry.

Kain said his "overall impression of this is that your transportation planners are trying to impose a 19th century technology on a 20th or 21st century city." He told the politicians that rail transit worked in high-density residential corridors where people could either walk to stations or reach them by short high-frequency feeders. But in Los Angeles residential development is "far below" that in areas where rail rapid transit successfully operates, and the street system is more developed and parking both more available and less expensive.

Kain stressed the case for express buses, and the need to:

> use highways effectively. . .More importantly, I can't understand on any rational basis at least, the fascination with light rail. . .I think

> I have some sense of the reason for it; it has to do with the popularity of Lionel toy electric trains.

Light rail, he emphasized, is no more than a slow express bus system with the disadvantage that the route is fixed, while Los Angeles needs a flexible system.

> I don't see any merit to it other than kind of a romantic, non-rational attraction. It's more costly; it's slower, has lower line-haul speeds, has substantially inferior door-to-door capabilities, less capacity. I just cannot think of any merit to it; it's just incredible that it has the attraction that it has.

Following this, Councilman Snow asked Professor Kain if he had "thought about sub-regions for light rail. I live near a corridor that's highly impacted; the average peak-hour travel time is eleven miles per hour. I don't know what the costs of putting in an express busway would be, but if you add a bus, you slow down overall traffic."

Kain repeated that express buses are a much more flexible technology than light rail, which is "strictly a kind of combination of a sort of technical irrationality and a love affair with trains."

Mayor Pro Tem Longville now joined the conversation, expressing his skepticism over findings that "potential patrons find the buses to be equally attractive to rail... Just on personal experience and discussions with other people, I find that very hard to swallow."

Webber repeated that survey results indicated that:

> comfort and even safety were relatively low down the scale, but certainly the decor of the vehicle had nothing to do with their preferences. What mattered was overall door-to-door travel time and overall cost in money.

Kain added:

> I've come to these technological proposals with a very high level of skepticism that largely arises from my experiences over 20 years all throughout the world that people just have an incredible fascination with technology, an incredible hope and belief that somehow simple technologies are going to solve complex problems. Then, invariably, when you look at things carefully, it turns out that the technological solutions are not where it's at, that sort of nitty-gritty careful hard work in terms of management using appropriate technologies—what people think of as ordinary kinds of technologies—that's where you get your improvements. You don't get them out of some kind of simple technological fix.

But this did not stop Councilman Wagner from saying:

> I appreciate your comments regarding cost-effectiveness, or lack thereof, of a rail-type system. But I also have the same skepticism that was expressed earlier about the consumer acceptance of an extensive bus-type system.

The Councilman cited his readiness to use the rail system in England, where he would not be happy to take a bus.

> I don't know if that's a psychological problem or what, but in terms of a system it doesn't do any good to have the most cost-effective and most flexible system in the world if the ridership simply doesn't materialize.

Webber now mentioned that Golden Gate Transit's improved bus service was "attracting middle-class users in very large numbers," while Kain explained that bus service in London suffers from congestion and poor management. A well-run *express* system would do much better. Professor Webber opined that BART passengers could have been carried by express bus for one-fortieth of the total cost. "A large part" of the proposals in the SCAG Regional Transportation Plan were "just pure waste," offered Professor Kain.

Mayor Mikels asked how much capital investment would be put into rail under a market system, and Mayor Pro Tem Longville commented that the original "Red Line" light rail had been dissolved by a conspiracy of bus operators while "the grossly disproportionate wear and tear on the roadways caused by heavy vehicles such as buses, which is nowhere near captured by what they're charged to operate on those, has to be considered a substantial subsidy."

Commentary

The discussion between Professors Kain and Webber and the SCAG politicians was circular. The professors would present the case as they saw it, the politicians would make remarks indicating they had not absorbed the information the academics had presented, and the professors would repeat their message once more, increasingly forcefully.

The politicians were focused on the idea of a system of light rail lines. They felt sure that highways were problematic, remembered the supposedly successful "Red Cars" and encapsulated their values of what a transportation system should do in the symbol of a trolley car.

Repeatedly we see evidence of the politicians' "sense" experience of technology—the hard end-product of transportation. They had travelled on buses, and could not believe that buses could provide as effective—or more

The flexibility of the bus allows passengers to be collected from a large area...

effective—a service as rail. They saw buses as replicating existing poor patterns of operation, and could not appreciate that, if designed well, the express bus could be an effective answer. Irrelevant comments, such as complaints about wear and tear on roads (ignoring the cost of rail track maintenance) and "psychological" objections to bus use (which continued after repeated evidence had been offered in refutation) simply showed that the politicians were only looking at the surface of the problem. In the same way that the narrow technological approach failed to solve the problem of the village pumps because it ignored the context in which the problem was set, the SCAG politicians were ineffective in addressing Southern Californian transportation problems when they ignored the context in which those problems were set. In the same way that subjects failed to try to falsify intuitively-appealing—but incorrect—solutions to number-series problems and thereby kept themselves from finding the answer, the politicians resisted attempts to falsify their deeply-held beliefs. Light rail to them *represented* their ideals; there was no call in their minds for an attempt at falsification.

To have searched for transportation solutions on the basis of goals would have required them to drop the image of light rail as symbolic of higher-level objectives. It would have required them to reflect on the values they wished to invoke, and to inquire into the alternative contexts into which the problem might be set. Not only would an appreciation of the consequences of each technological option emerge from such a discussion, but the problem would come to be defined in non-technological terms. Technological choice would then be the end-product of more basic discussion of social issues: it would be part of a larger conception of design. But to act that way would require abstract thought, an admission of doubt and uncertainty. As Professor Kain pointed out, the bus was less glamorous, and required complex "nitty-gritty" work. Rail, in contrast, was a neat ordered concept, indeed a comfortable symbol of those deeper needs and values; direct exposure to and discussion of those needs would have made politicians vulnerable to an appreciation of limits and the unknown.

In refutation of this reading of events, it might be suggested that the politicians are doing no more than playing politics. If constituents are pleased by the provision of trolley cars, politicians will have a better chance at re-election. But when we ask *why* the politicians might think constituents would be pleased by such action, we realize that it is because there is no conception of possible alternatives. In Los Angeles, for example, the bus system—though well-run under the circumstances—is slow and unappealing. There is no awareness of the possible use of principles not currently in practice to create a supreme bus system, and such a conception is available to neither

politicians nor electorate. There is a dislike of congestion and pollution which did not exist when the "Red Cars" reigned. There *are* fond memories of the "Red Cars," which seemed to do such a good job, and the weight of those memories translates into decision-making.

Technologies are solid and identifiable. They provide something to grapple with where the more basic considerations of values and wants leave us vulnerable and perplexed. Technology is an effective language of "making polis." Yet as representative of our deeply-held values and related goals, it falls short. The failures of social choice are the failures of the human mind.

The Search for Churchman's Systems Approach

Imagine Kant under the night sky, looking out and achieving understanding within, two infinities—of endless reality and fathomless reason—converging in his self. From the spot where he stands the universe broadens out "into an unbounded magnitude of worlds beyond worlds and systems of systems and into the limitless times of their periodic motion, their beginning and continuance." But the "moral law," through which the interminable skies are understood, "begins from my invisible self."

While the world may exist independently of ourselves, Kant tells us, we can only perceive it—via our vision and other senses—as interpreted by our reason. As seen through our mind's eye, the world comes into existence by passing through the tacit filter of knowledge, experience and beliefs that go to make up our individual identities. As each of us is different, so will each of our views of the world be unique. If we seek understanding, we must therefore continuously question the way we look at phenomena and the way we bound our universe.

Churchman (1982) calls for "an 'unbounded' systems approach which must include a study of humanity, not within a problem area, but universally." Churchman is firmly a rationalist; he believes in the power of reason. But his approach does not consist of applying a narrow set of criteria to a given "problem;" rather, it involves opening up the boundaries of inquiry, guided by ethical principles. It regards all systems as part of larger systems, all parts given relevance only in relation to all other parts of all other systems. "Those of us who practice social science learn the hard way that there are no simple questions and that the process of addressing a specific question will eventually require answers to more and more questions." Thus "planners should search not for ways to make the prison or the hospital run more smoothly, but for the reasons why we have things like badly-run prisons and hospitals."

There is no place in Churchman's systems approach for the isolated modeling of "demand" for a commuter rail service. Such work, detached from the larger picture, is representative of a form of analysis with ethical assumptions of which we are unaware. We might not wish to conduct such analysis were those assumptions to be made explicit. There might be a place for quantitative modeling, but only when subservient to and informed by debate of the larger ethical questions which are not susceptible to quantification; the choice of a system of inquiry is itself central to such ethical discussion. Likewise, discussion of the case for a particular technology should only follow debate of the social goals to be served; the politicians should broaden their deliberations instead of focusing quickly on eye-catching and intuitively-attractive "solutions."

But with this systems approach, we quickly run into difficulties. The Southern California stories immediately become bound up in a criss-cross of complexity. The modellers who previously had a "black box" model they could take off the shelf, are now left perplexed, with no given place to start. They had a formula; now they face a void.

To the politicians, the trolley car formed a symbol of solidity on which to meet and hold political discussions. It was difficult even to make them evaluate light rail in comparison to the alternative of an express bus system. Such choice required reference to abstract notions of interaction patterns, demand and performance characteristics. There was a comfortable, dominant (though faulty) sense of what the physical technology was, and it was easier not to go beyond that.

More than this, though, the express bus system and the trolley each implies a set of values. These were touched on indirectly through mention of goals such as congestion and pollution reduction. Yet the conversation never really got behind the values implicit in the *agenda*—those of an elite middle class for whom *either* system would represent a greater subsidy per journey than the local buses used mostly by low-income residents who already pay, and would continue to pay, a larger share of operating costs than would the express bus or rail users.

The Long Beach trolley would pass through the low-income areas of Compton and Watts. But the systems approach asks why money should be spent on a symbolic transportation system rather than to provide for the more pressing needs created by poverty. While one view might regard the trolley as a messenger of hope for the area, another might point out that it was of irrelevance in meeting the real needs of community revitalization.

The discussion could expand to ask what kind of society we would like to have, what kind of city we would like to live in, how transportation related to other pressing needs, and what priority transportation planning should

be given relative to those needs. The problem becomes ever more complex, its solution more uncertain, and our yearning for a "quick fix" greater: we prefer to reject complexity.

Conclusion

Reality contains for us untold numbers of what Rittel and Webber (1973) call "wicked" problems: whereas a correct solution may be found to a mathematical equation which is thus "tamed," there is no one solution to a social problem, no one place to look, no one procedure to follow, not even a definition of success. If we have such difficulty in solving a number series problem for which there *is* a given solution, how much deeper is our trouble in facing problems for which there is no one "right" solution.

Our will for order and identity fool us into treating "wicked" problems as if they were "tame" ones. We don't have a "correct" theory of "the good," and even though we do have a capacity for moral thought—a capacity machines lack—we opt for more secure machine-like ways of dealing with information. We pretend we are being scientific by couching our social science in mathematical terms, by creating large models we see as "value-free." Technological choice, by the same token, rests on the intuitive appeal of a technological solution, rather than on what it can actually do for us.

Were we to look behind our metaphors we might see that they do not represent our ideals as we assume they do. Means to ends—be they equations or trolley cars—all carry assumptions which represent ethical perspectives. If we have not explicitly chosen these perspectives, we may not only be unaware of them but also allowing them to sketch the genetic blueprint of society uncriticized and perhaps unwanted.

The need for security makes our view small. Yet if we allow our minds to reject the complexity that is inevitable of human life, we will have an impoverished, futile planning process. Until we all—analysts, planners and politicians alike—begin to examine our assumptions and to see social issues as the "big" unbounded questions they are, we will produce narrow "answers" to tritely-defined "problems," and provide no solutions at all. □

The author gratefully acknowledges the comments several individuals supplied on earlier drafts of this paper. The continued support of Donald Schön and Martin Wachs is particularly appreciated. Responsibility for the inadequacies which remain, of course, remain with the author.

Jonathan Richmond, a Visiting Lecturer in the Department of City and Regional Planning at Chapel Hill for the 1986/87 academic year, is a doctoral candidate in Transportation Planning at MIT.

and brought to downtown.

REFERENCES

Ackoff, Russell L. (1978), *The Art of Problem Solving*, New York: Wiley.

AICP (1981), *Code of Ethics and Professional Conduct*, adopted by American Institute of Certified Planners, September 10.

Alexander, Christopher (1964), *Notes on the Synthesis of Form*; Cambridge, MA: Harvard University Press.

_____ (1965), "A City is Not a Tree," *Architectural Forum* 122 no. 1, 58-61 & no. 2, 58-62.

Boulding, Kenneth E. (1968), "The Ethics of Rational Decision," in *Management Science* v.12 no.6, B-161–B-169.

Brewer, Garry D. (1973), *Politicians, Bureaucrats and the Consultant*, New York: Basic.

Churchman, C. West (1979), *The Systems Approach and its Enemies*, New York: Basic.

_____ (1982) *Thought and Wisdom*; Seaside CA: Intersystems.

Fisher (1980) "Multiple Regression in Legal Proceedings," *Columbia Law Review*, May. 702-736.

Godet, Michel (1979), *The Crisis in Forecasting and the Emergence of the "Prospective" Approach*, New York: Pergamon Press.

Hoos, Ida R. (1969), *Systems Analysis in Social Policy*, Research Monograph no. 19, London: Institute of Economic Affairs.

Kelman, Steven (1982), "Cost-Benefit Analysis and Environmental, Safety, and Health Regulation: Ethical and Philosophical Considerations," in *Cost-Benefit Analysis and Environmental Regulations: Politics, Ethics and Methods*, The Conservation Foundation, reprinted in ed. Wachs, Martin, *Ethics in Planning*, New Brunswick NJ: The Center for Urban Policy Research, 1985.

Kuhn, Thomas S. (1957), *The Copernican Revolution*, Cambridge, Mass.: Harvard University Press, cited in Krige *op. cit.*

Laski, Harold (1930), "Limitations of the Expert," originally in *Harpers*, reprinted in *Chemtech* April, 1974, 198-202.

Leamer, Edward E. (1983), "Let's Take the Con out of Econometrics," in *American Economic Review*, March, 31-43.

Macintyre (1977), "Utilitarianism and the Presuppositions of Cost-Benefit Analysis: An Essay on the Relevance of Moral Philosophy to the Theory of Bureaucracy," in ed. Sayre, Kenneth, *Values in the Electric Power Industry*, Notre Dame" University of Notre Dame Press, reprinted in ed. Wachs, Martin, *Ethics in Planning*, New Brunswick NJ: The Center for Urban Policy Research, 1985.

Moen, Elizabeth W. (1984), "Voodoo Forecasting: Technical, Political and Ethical Issues Regarding the Projection of Local Population Growth," in *Population Research and Policy Review* 3, 1-25.

Mulvey, John M. (1983), "Computer Modeling for State Use: Implications for Professional Responsibility," paper given at *American Academy for the Advancement of Science* meeting, Detroit, May.

Pacey, Arnold (1983), *The Culture of Technology*, Cambridge, Mass.: MIT Press.

Richmond, Jonathan E. D. (1983), *Slicing the Cake: The Case for a Los Angeles–San Diego Bullet Train Service*, Tustin CA: City of Tustin.

Rittel, Horst W. J. and Webber, Melvin M. (1973), Dilemmas in a General Theory of Planning, *Policy Sciences* v.4, no. 2, 155-169.

Schön, Donald A. (1967), "Forecasting and Technological Forecasting," in *Daedalus* 96, 759-770;

_____ (1983), *The Reflective Practitioner*, New York: Basic.

Searle, John (1985), *Minds, Brains and Science*; Cambridge MA: Harvard University Press.

Southern California Association of Governments (1983a), Transcript of *SCAG Executive Committee Regional Transportation Plan Workshop*, 1 September.

Southern California Association of Governments (1983b), *Draft Regional Transportation Plan*, June.

Wachs, Martin and Schofer, Joseph L. (1969), "Abstract Values and Concrete Highways," in *Transportation Quarterly* 23, no 1, 133-155.

Wachs, Martin (1982), "Ethical Dilemmas in Forecasting for Public Policy," in *Public Administration Review*, November/December, 562-567.

Wason, P. C. (1960) "On the Failure to Eliminate Hypothesis in a Conceptual Task," in *Quarterly Journal of Experimental Psychology* 12, 129-140.

Winner, Langdon (1975), "Complexity and the Limits of Human Understanding" in ed. La Porte, Todd R., *Organized Social Complexity* 40-76, Princeton, NJ: Princeton University Press.

Young, Robert M. (1979), "Why are Figures so Significant? The Role and the Critique of Quantification," in ed. Irvine, John, Miles, Ian and Evans, Jeff, *Demystifying Social Statistics*, London: Pluto Press.