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Contrasts Between American and European Practice and Success in Transportation Modeling Project Administration

by

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ROUGHLY 200 to 400 million dollars have been spent in the last 20 years on transportation modeling in the U.S. with relatively little to show for it in terms of actual applications which have stood the test of time. A diverse group of transportation modeling projects was studied to learn what factors in the process of project administration, especially interaction between decision makers and modelers, affect likelihood of useful modeling results from the decision makers' point of view. Particular emphasis was placed on contrasting European and American practice. The year-long study involved observation of the process, detailed interviewing and comprehensive questionnaires. The major findings are that probability of usefulness is greatly enhanced by 1) clear roles of decision makers and analysts, 2) similarity of background and value systems between decision makers and modelers, and 3) keeping projects small. European projects typically enjoyed a more favorable climate on each of these counts, and were usually perceived by the relevant decision makers' as being of substantially more use to them than are American projects to their users. This study was conducted under a grant from the Research Development and Demonstrations Branch of the Urban Mass Transportation Administration of the U.S. Department of Transportation.

THE PROBLEM

The problem concerning modeling in transportation is simple. Well informed people in the field have variously estimated for me that:

1) $8.5 million dollars was spent on transportation modeling by the U.S. Department of Transportation (DOT) in an 18 month period ending in 1970.

2) $300 million dollars was spent in transportation modeling by the U.S. government in the decade of the 1960's.

3) $200 million dollars have been spent on highway modeling (including repetitive applications) in the 1960's.

Anyway one looks at it, this means that including privately funded models by carriers, users and manufacturers, there must have been between $25,000,000 and $50,000,000 per year being spent in the late 1960's, in the U.S. alone. Why is there so little improvement in transportation to show as a result? The sums involved are the sorts of sums with which society has conquered diseases, developed new grains which have revolutionized world agriculture, and developed such revolutions in communications as radio, television, and communication satellites. Yet out of all these sums we have relatively little to show except what a colleague of mine once described as a $20,000,000 pencil—a device to write the letters and numbers on flight strips on a computer controlled terminal rather than by hand.

What is wrong? Is it bad work? Good work unrecognized? Elegant solutions of non-existent problems? Satisfactory work badly presented? Satisfactory work with documentation on the back of a stamp? Good work which never reached a conclusion? What? Why was so much money spent with so little to show for it? Are the relatively few true applications to such things as railroad classification yards, state highway planning and airline route simulation, worth 200 to 400 million dollars and 10 to 20 years of effort? Hardly.

WHAT WAS STUDIED

To learn what seemed to be going wrong with the transportation modeling process, a fourteen month study was undertaken under the auspices of the Research, Development and Demonstrations Branch of the Urban Mass Transportation Administration of the U.S. Department of Transportation. The objectives of the study were to look at the way modeling projects were managed not primarily at the particular techniques used.

Before going into details of the study, however, it would be wise to define what, in this context was meant by "model." For the purposes of this study a model is a computer-based simulation, optimization, or lengthy, simple computational exercise (a "spread sheet au-

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tomator"), all of which involve a very substantial number of discrete steps. Basic prediction "models" consisting of a single or a few equations, regression "models," or similar powerful but brief statements of essential relationships were, by and large, excluded.

The types of problems addressed dealt with any and all modes of transportation, with all kinds of traffic, with both research and operational problems, and with problems which ranged from almost wholly technical to the almost wholly social, political and economic. Some models attempted merely to describe behavior of a transportation system or phenomenon while others were virtually pure optimization models.

The participants ranged from pure public to pure private, included clients who were both staff and line personnel, modelers who were very closely positioned organizationally to the decision makers to those who were entirely from outside organizations not previously acquainted with the client.

The projects selected were from all over the United States, northern Europe, and the United Kingdom.

Every effort was made to get projects which were underway at the time of the study rather than long since completed, on the grounds that it was better to study current behavior and feelings than do a series of post mortems. Naturally some compromises were necessary. Hardly a project studied met every test perfectly.

THE KINDS OF PROJECTS WHICH WERE INCLUDED

The projects included may best be described by means of the characteristics in Table I.

Fully satisfactory data for analysis was obtained from both clients and modelers of fifteen of these (1-9 and 11-16). The remainder were "one sided," and though some valuable insights were gained from certain of them, none figured in the formal statistical analysis. A fair number of the projects had to be disguised for the purposes of publication.

As may be seen, the projects were a very mixed group according to almost any criterion one would wish to judge them by.

WHAT WAS DONE

Basically the study involved the fairly detailed study of a group of 25 projects. This study included one or more interviews with the principles of the project; an initial and very detailed questionnaire; actual observation of the participants by joining in meetings where possible; a second much revised and improved questionnaire focusing more exclusively on the actual project conduct rather than preliminaries such as project conception, drafting statements of work, consultations with possible modelers, proposal writing, etc.; and finally analysis of the data from the interviews and questionnaires.

WHAT WERE THE HYPOTHESES?

What was being sought in all this? Simply stated it was evidence concerning how the actions, attitudes and values of the participants, the techniques employed, and character of a project affected its likelihood of success. Success was measured according to the clients perception of the usefulness of the model to him. Thus it was possible (though it did not happen) to have a model which was a "failure" but judged very useful (i.e., highly instructive) by the client. Similarly it was possible to have a model which was judged in one fashion at, or shortly after, completion but viewed differently after a longer time had passed. This latter possibility was checked by studying another sample of "older" models. It proved rare that a model "improved with age." Most, if they did anything at all, deteriorated—often precipitiously.

A number of questions were therefore framed, in each of ten areas. These had to do with the following:

1. Relationship of the Decision Maker(s) and the Modeling-Team Project Director (contact).
2. Degree of Contact Between Decision Maker(s) and Project Director (Communication).
3. Personal Motivation of Decision Maker(s) (Desire).
4. Size of Project (Size).
5. Technical versus Social and Political Content of Model (Balance).
6. Public versus Private Nature of Decision Maker's Environment (Bureaucracy).
7. Complexity of Study (Complexity).
8. Degree of Formality of Project Planning (Formality).
9. Correspondence of Backgrounds of Decision Makers and Modelers (Backgrounds).
10. Usefulness of the work done (Decision Makers Final Reaction). These one word short titles are used subsequently to refer to these areas.

In addition the participants were asked what they would do differently another time, based on their experience in this project.

There were a number of questions in each subject area, each on a qualitative scale which was subsequently reduced to a scale of 0-10. Examples of these

TABLE I

SUMMARY OF PROJECT CHARACTERISTICS

Project	Mode of Transport	Client Organization (Pub.vs.Pvt.)	Client Type (Line vs. Staff)	Modeler Expertise (Tech.vs.Trans.)	Modeler Relationship to Client	Basic Nature* of Problem (Tech.vs.Soc.)	Treatment* of Problem (Tech.vs.Foo.)
1. Met.Trans.vs.Urb	Mnd-Surf.	Mult.-Pub.	Staff	.80 Tech.	Consultant	.95 Social	.50 Social
2. Urban Mgt.Wrkshp	Mnd-Surf.	Mult.-Pub.	.70 Staff	.60 Mgt.	Consultant	.90 Social	.90 Social
3. Airline STOL	Air	Corp.	Line	.75 Trans.	In-house	.90 Social	.75 Social
4. Airline Tac.Plan	Air	Corp.	Line	.75 Tech.	Consultant	.80 Social	.50 Social
5. Trans.Veh.Mvt.Sm	-	US Govt.	Staff	.85 Tech.	Consultant	.75 Tech.	.95 Tech.
6. Av. Forecasting	Air	Corp.	Staff	.80 Tech.	In-house	.80 Social	.50 Social
7. Veh.Sim. Model	-	Corp.	Line	.80 Tech.	In-house	.85 Tech.	1.0 Tech.
8. DOT Nat. Network	All	US Govt.	Staff	.90 Tech.	Ind.Agency	.90 Social	.75 Tech.
9. Freight Modal Sp	All	Corp.	.75 Staff	.50 Tech.	Consultant	.90 Social	.75 Tech.
10. Truck Linehaul	Truck	Mult.Corps	Line	.50 Trans.	Consultant	.75 Tech.	.75 Tech.
11. Coventry Bus Net	Bus	Pub. Corp	Line	.70 Tech.	Cons.(found)	.75 Social	.75 Tech.
12. Airline Crew Trn	Air	Corp.	Line	.60 Tech.	In-house	.60 Tech.	.90 Tech.
13. Container Ship	Marine	Corp.	Line	.75 Trans.	Cons(univ)	.90 Tech.	.95 Tech.
14. Rail Freight Pln	Rail	Pub. Corp	Staff	.60 Tech.	In-house	.50 Tech.	.80 Tech.
15. Maj.Urban Trans.	Mixed	Major City	Staff	.50 Tech.	.Sim-.Scons.	.90 Tech.	.95 Tech.
16. Reg.Highway Plan	Highway	Multiple Pub	Staff	.60 Trans.	Consultant	.95 Social	.75 Tech.
17. State"Hard Prob"	Mixod	State	Staff	.70 Tech.	.7 In-house	.95 Social	.60 Tech.
18. Adv.Modal Split	Mixod	US Govt.	Staff	.60 Tech.	Consultant	.85 Social	.60 Social
19. City Transit Mod	Mixed	Major City	Staff	.80 Trans.	In-house	.95 Social	.40 Social
20. Nat.Trans.Netwrk	Mixed	For.Govt.	Staff	.70 Trans.	Ind.Agencies	.20 Social	.50 Social
21. STOL Airports Lo	Mixed	For. Govt.	Staff	.60 Trans.	Cons(univ)	.90 Social	.60 Social
22. LCL Rail Shpmnts	Rail	Pub. Corp	.5 Line	.60 Tech.	In-house	.80 Social	.60 Social
23. 3rd London Airpt	Air	For.Govt.	Line	.60 Tech.	Special-In	.90 Social	.50 Social
24. City Streetsweep	Surface	City Dept.	Line	.90 Tech.	Univ-Stud.	.70 Social	.90 Tech.
25. Air Traf. Contrl	Air	-	Staff	.60 Tech.	Consultant	.50 Tech.	.90 Tech.

TABLE I (CONTINUED)

Project	Techniques Used In Model	Size of Project	Degree of User Interaction	Est.Freq. of Model Use	Location of Project	Degree of Usefulness To DM
1. Met.Trans.vs.Urb	Complex	Medium	Low	0	US	Low
2. Urban Mgt.Wrkshp	Simple	Med-Sm	Very-Large	3-10	US	Good
3. Airline STOL	Med.Complex	Medium	Medium	1	US	Good
4. Airline Tac.Plan	Complex	Medium	Medium	20-200	US	Good
5. Trans.Veh.Mvt.Sm	Medium	Medium	Med.-Low	0-1	US	Low
6. Av. Forecasting	Medium	Medium	Low	10	US	Low
7. Veh.Sim. Model	Med.Simple	Medium	Low	50	US	Low
8. DOT Nat. Network	Med.Complex	Large	Low	5	US	Fair
9. Frieght Modal Sp	Med.Simple	Med-Sm	Low	0-1	US	Low
10. Truck Linehaul	Complex	Large	Med.-Low	10-200	US	Good
11. Coventry Bus Net	Med.Complex	Small	Medium	1-2	Britain	Good
12. Airline Crew Trn	Medium	Small	Med.-Low	2-20	Europe	Good
13. Container Ship	Complex	Medium	Med.-Low	20-1000+	Europe	High
14. Rail Freight Pln	Med.Complex	Large	Medium	5-20	Europe	Good
15. Maj.Urban Trans.	Med.Complex	Very Large	Low	1	Europe	Fair
16. Reg.Highway Plan	Medium	Med.Large	Med.-Low	1	Europe	Fair
17. State"Hard Prob"	Med.Simple	Medium	Low	1-2	US State	Low
18. Adv.Modal Split	Complex	Medium	Low	1-5	US	Good
19. City Transit Mod	Medium	Large	Very Low	1	Eurone	Low
20. Nat.Trans.Netwrk	Med.Complex	Very Large	Very Low	1-2	Europe	Fair
21. STOL Airports Lo	Simple	Medium	Great	1	Europe	Good
22. LCL Rail Shpmnts	Complex	Medium	Low	1-2	Europe	Fair
23. 3rd London Airpt	Medium	Very Large	None	0-1	Britain	Low
24. City Streetsweep	Complex	Small	Low	0	US City	Low
25. Air Traf. Contrl	Med.Complex	Medium	Low	1	US	Fair

*Nature = Author's estimate of intrinsic character of problem. Treatment = Author's estimate of how problem was actually treated (though not necessarily viewnd) by modelers.

- Not reported to protect disguise.

questions are given below. The answers to the questions in each area cluster were then averaged for each project. Another factor, formed Role Recognition was introduced based on the interviews and observation above. Basically it measured the degree to which the participants recognized the distinctions between the role of decision maker and analyst in their case. In addition the differences in the responses, both absolute and net, between the participants in each project were noted (Correspondence of Response: Absolute and Net). Finally all were asked how they had felt about the prospect for useful results early in the project (avg early). The results of the responses and their summarization is presented in Table III.

MAJOR CONCLUSIONS

First it may be said that there are no simple answers to the question of why some modeling projects produce results perceived as useful while others do not. It is not as simple as saying (as is often done):

"The modelers are just a bunch of God damned academics who don't know beans about transportation!"

"The clients are all incompetents who couldn't tell a good model from a bad one and don't want to leave!"

"All we need is the right hardware so the mayor can come in and look at the multi-color, multi-image, multi-media, multi-processed displays, and with his hands on the levers vary the par-

Table II

Examples of Questions on Second Questionnaire

No.	Question	Side	Scale point 1	Scale point 2	Scale point 3	Scale point 4	Scale point 5	Scale point 6	Scale point 7	Scale point 8	Scale point 9
1.	To what extent did Decision Maker delegate his role in controling the progress of the study as opposed to personally attending to monitoring of study?		DM delegated all matters concerning project	DM wanted only major problems brought to him. His representative was major modeler contact	Decision Maker delegated some matters but was always reachable and informed	Decision Maker delegated little. His representative dealt only in DM's absence	DM didn't delegate. He read all memos, saw modelers on request, attended all meetings				
13.	To what extent did contacts during the study's progress involve the same individuals as opposed to different people? (BOTH scales please.)	DM side	never the same people	sometimes the same key people but often different individuals	much of the time the same key people but often others	all meetings involved the same people					
		PD side	never the same people	sometimes the same key people but often different individuals	much of the time the same key people but often others	all meetings involved the same people					
24.	Degree to which client organization is public in character.		indv. prop.	closely held corp.	small publicly held corp.	large publicly held corp.	top 10 publicly held	quasi-public corp.	govt. corp.	major indep. govt. agency	direct govt. agency
30.	To what extent were the project's objectives spelled out in advance? (By "operational terms" is meant terms which are very concrete, permitting clear subsequent evaluation as to whether objectives were met.)		not at all	general objectives given in a few sentences	moderately complete statement of overall goals	fairly completely and in moderately operational terms	completely, in great detail and in very specific operational terms				
35.	How would you characterize the similarity or difference in backgrounds of the DM's and PD specifically?		complete contrast	few similarities	some similarities	fairly similar	virtually identical				

ameters for life in his city and we'll be home free!"

"The trouble is the managers don't understand what the real problems are!" or

"You never see those guys. They take your money, disappear for 6 months and then come back with a solution to some problem you never heard of!"

Things are more complicated. Virtually every one of the projects which failed, failed, for a **combination** of reasons while almost every one which succeeded did so in spite of one or more individual factors which were against it.

With that as a basis it may nevertheless be said that a detailed qualitative and quantitative analysis indicated that in general:

- Role recognition was the strongest favorable factor. This factor is moderately, positively correlated with communication ($r = .3534$) thus subsuming some of its effect.
- Correspondence of backgrounds was the next strongest favorable factor.
- Complexity of the project was the strongest negative factor. This factor is positively correlated with size of project ($r = .6722$) thus subsuming it to a great extent.
- "Europeans" of the project was a third strong factor.
- Formality, desire, and bureauracy did not appear to bear significantly in a direct way on project success.
- Balance and contact were inconclusive since the questions concerning the former appeared to have been frequently misunderstood while the latter exhibited a definite negative sign. A plausible but untested explanation is that the decision makers who do not delegate are nonetheless not readily accessible to modelers, thus compounding the problems of project administration rather than reducing them.

Thus on the scale of 10 used, 0 being totally useless and 10 completely useful, the most representative relationship in terms of regression results was:

$$\begin{aligned} \text{Decision Makers Final Reaction} &= -2.829 \\ &\quad + 1.628 \ \text{Degree of Role Recognition} \\ &\quad + .964 \ \text{Correspondence of Backgrounds} \\ &\quad - .380 \ \text{Complexity} \\ R^2 &= .714 \\ &= 1.479 \end{aligned}$$

Thus one would conclude that, in effect, projects start out with a handicap (the intercept of nearly —3 on the scale of 10) which must be overcome. If these important variables are halfway decently represented (say their means of except 0 or 1 for Europe) one has:

	— 2.829	(due to the Intercept)
	+ 5.317	(due to Role Recognition)
	+ 4.756	(due to Correspondence of Backgrounds)
	— 1.976	(due to Complexity)
DM's Final Reaction =	5.268	

TABLE III

SUMMARY OF INDIVIDUAL PROJECT RESPONSES

	DM FINAL.	ROLE REC.	CONTACT.	COMMUNICN.	DESIRE..	SIZE PROJ.	BALANCE.	BUREAUCCY.	COMPLEXTY	FORMALITY	BACKGRNDS.	EUROPEAN.	USEFULNESS: DM FINAL.	USEFULNESS: AVG. EARLY	...PONDENCE OF RESPONSE: NET	...PONDENCE OF RESPONSE: AES
1. MET. TRANS. VS. URBAN AMENITIES	0	2	2	6	5	5	5	10	6	3	2	0	0	2	25	47
9. FREIGHT MODAL SPLIT MODEL	1	2	2	6	6	5	6	5	5	5	4	0	1	5	-3	47
6. AVIATION FORECASTING PACKAGE	2	1	3	3	2	5	2	4	5	4	5	0	2	5	-122	127
7. VEHICLE SIMULATION MODEL	2	2	4	6	6	5	2	4	6	6	5	0	2	8	-24	70
3. AIRLINE STOL MODELING STUDY	5	4	4	5	5	3	4	4	3	4	5	0	5	7	4	34
15. MAJOR URBAN TRANSPORTATION PROJ.	6	4	4	6	3	6	3	10	8	4	7	1	6	5	-39	72
14. PLANNING MODELS FOR RAIL FREIGHT	6	4	4	6	8	5	3	8	5	5	4	1	6	7	-16	41
5. TRANS. FACILITY VEH. MVTS. SIM.	6	2	1	6	2	5	1	10	5	5	6	0	6	7	-32	58
11. COVENTRY BUS NETWORK STUDY	6	5	3	6	6	5	5	7	7	6	4	1	6	7	-41	75
2. URBAN MANAGEMENT WORKSHOP	7	4	2	7	4	4	6	10	4	5	6	0	7	6	-2	34
16. REGIONAL HIGHWAY PLANNING STUDY	7	4	1	4	4	7	2	10	5	3	5	1	7	7	34	50
4. AIRLINE TACTICAL PLANNING MODEL	7	4	2	6	4	5	3	4	6	7	4	0	7	5	8	32
12. AIRLINE CREW TRAINING SCHED MOD.	7	4	3	7	6	3	6	1	3	4	4	1	7	7	-11	11
8. D.O.T. NATIONAL NETWORK MODEL	7	3	2	6	6	5	3	10	5	4	7	0	7	7	-22	46
13. CONTAINERSHIP LOADING MODEL	10	4	3	7	7	4	2	1	5	4	6	1	10	6	1	23

Thus one may see that in general for these modeling projects, if people have a modest understanding of who is to do what for whom, have moderately similar backgrounds, and avoid more than moderate complexity, they have a good prospect of producing results that the decision makers view as slightly more useful than not.

DIFFERENCES IN BEHAVIOR OF EUROPEAN AND AMERICAN PROJECTS

If one proceeds further to analyze the above projects according to their European or American character one notices some interesting distinctions. Figure 1 shows scatter diagrams of each variable separated according to the project's source: European (triangles), or American (circles). It will be seen that in almost every instance the mean of the European projects is higher than that of the American.

If the regression methodology is pursued, one finds that the next variable which one wants to introduce after those mentioned in the previous section is the dummy 0-1 variable, "European." Adjusted for loss of degrees of freedom the R^2 drops slightly from that for the result given earlier ($R^2 = .710$ vs. $R^2 = .714$), and the standard deviation increases very slightly ($\sigma = 1.489$ vs. $\sigma = 1.479$). Specifically, the result is:

Decision makers Final reaction =	— 1.996	
	+ 1.345	Degree of Role Recognition
	+ .977	Correspondence of Backgrounds
	— .452	Complexity
	+ .988	Europeanness
R^2 =	.710	
σ =	1.489	

Note that the effect of introduction "European" was primarily on the intercept value, and to a lesser extent on the coefficients of Role Recognition and Complexity. All three effects are in the same directions, that is toward a reduction in index of estimated Decision Makers Final Reaction. If, as before, one illustrates the application of this equation using the means of the respective variables, means of the American projects for those nine, and similarly, the means of the six European projects for those. One has:

American	(mean)		(mean)	European
— 1.996		Intercept		— 1.996
3.586	(2.66)	Degree of Role Recognition	(4.16)	5.604
4.776	(4.89)	Correspondence of Backgrounds	(5.00)	4.885
— 2.260	(5.00)	Complexity	(5.50)	— 2.486
	(0)	Europeanness	(1)	
4.106		Est. D.M. Final Reaction		6.995

Figure 1

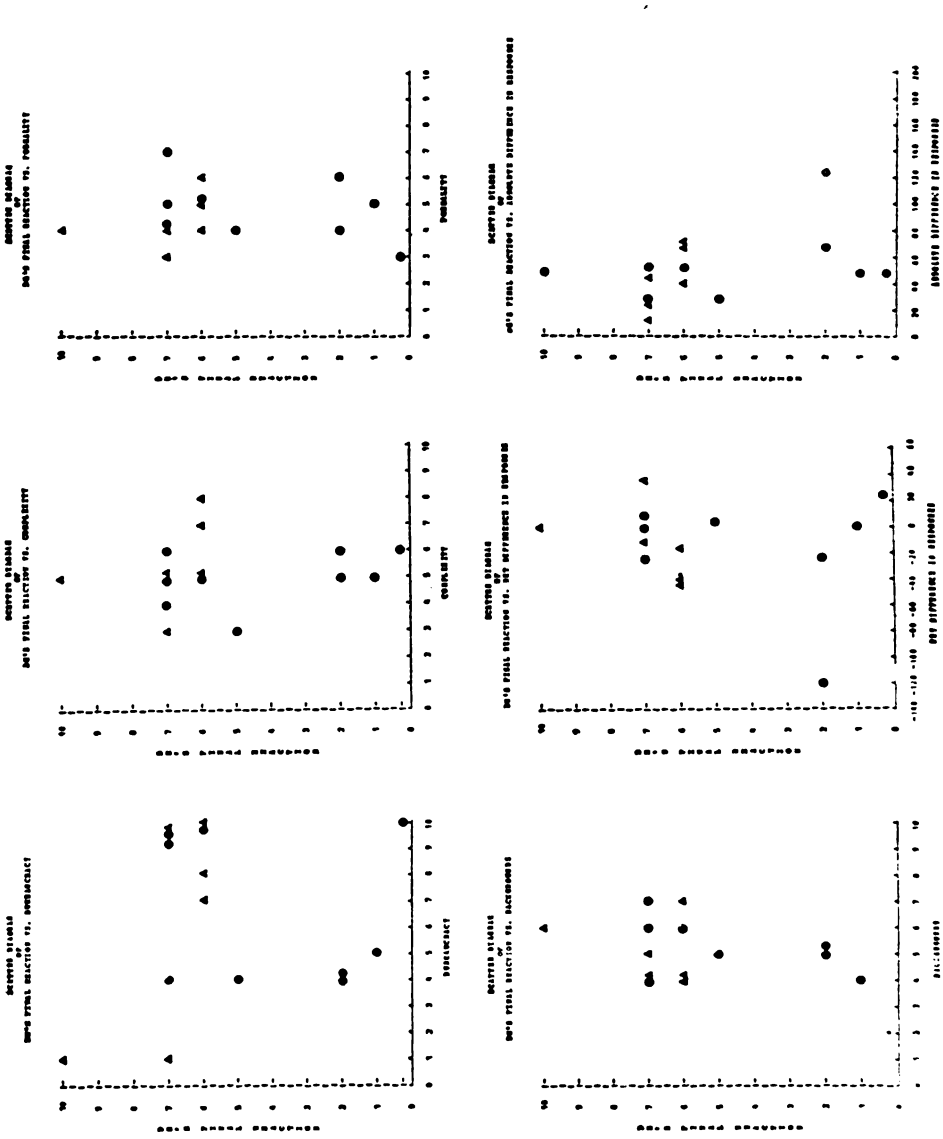
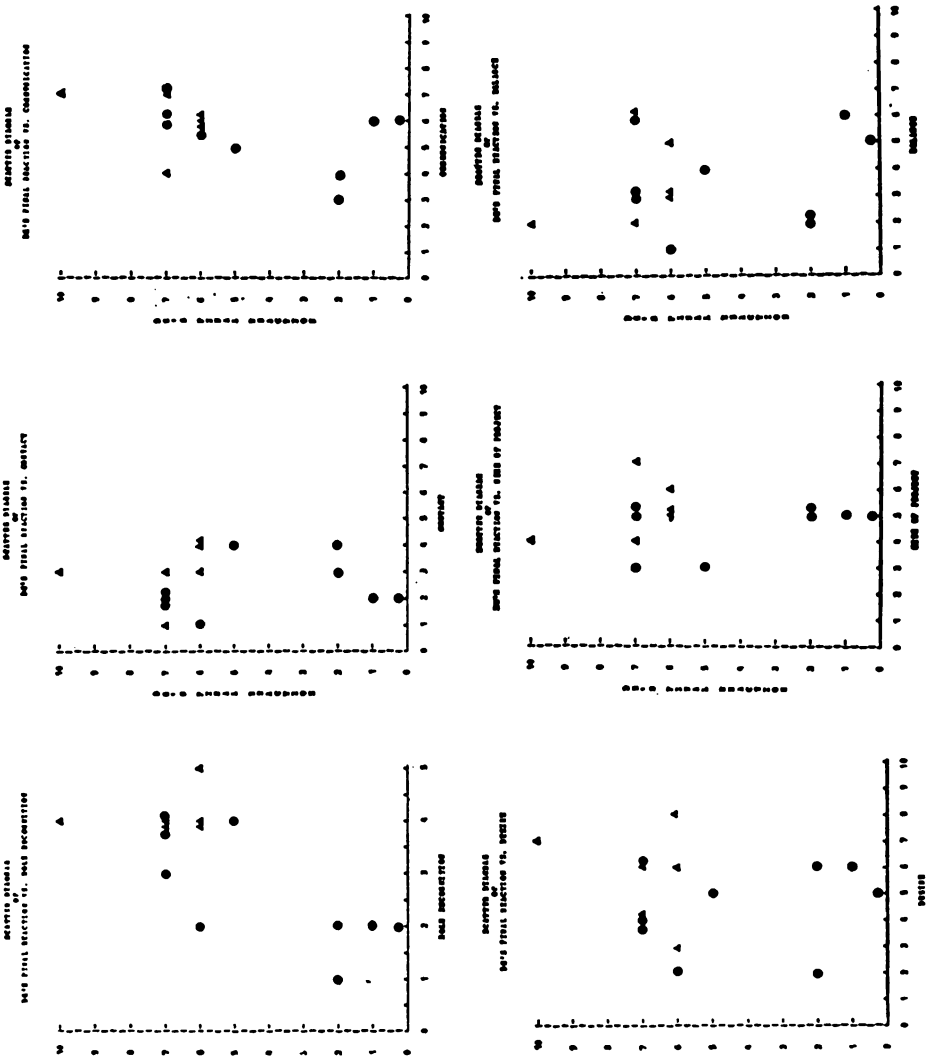


Figure 1
(continued)



The advantage for European projects is, everything considered, striking. Nothing observed in additional projects from which incomplete questionnaire data was obtained would lead me to conclude that these results are suspect. Quite the contrary, the observation of other projects tends to reinforce them.

One naturally must be cautious in ascribing too much significance to the individual affects of the various coefficients in this latter case since there is a small but non-trivial correlation of Role Recognition with European (.20). Nevertheless, it is clear that, in general, European projects exhibit:

1. Greater Role Recognition
2. Greater Correspondence of Backgrounds and between Decision Makers and Modelers, and
3. Less Complexity,

each of which increases the likelihood of the results being perceived as useful, in addition to the still remaining residual advantage (which presumably subsumes the effects of unidentified factors) of nearly a full point on the scale of 10, for simply being European.

One might feel that given the above result, modeling projects, even American ones, had a reasonably good chance of success. This would be too optimistic a conclusion, however. The reason is that there is still too great a chance for one factor to be dangerously low which usually creates a cloud over a project even though the others may be satisfactory.

In summary it is very easy for a project to slip over into a morass of complexity and misunderstanding, and very difficult to raise a project above a level of modest success (almost impossible in fact with models of other than almost purely physical systems).

WHAT MAY BE DONE?

One may divide the question of what American project participants may learn from Europeans to keep modeling projects from falling into the abyss into two parts: what may be done given present knowledge and what may be done to improve the state of knowledge.

What may we do based on present knowledge? Quite a few things: not the least of these is simply to face up to the fact that the simple probabilities are that a modeling project will not fare well, and that steps may be taken and should be taken to correct the problem. For example:

Project Conduct

1. Clearly articulate the roles to be played by both client and modeling groups making certain that the distinction between decision maker and analyst is clearly understood and accepted. Take care to make certain that the modelers understand their role as staff and the distinction between that and the line position the decision maker holds. Staff people analyze and present the impacts of alternative programs to the decision makers. The decision makers correlate these with other information and choose. This distinction is better understood in Europe than in the U.S. though I encountered classic cases of failure to understand this in both places.

2. Employ modelers with backgrounds as similar as possible to those of the decision makers, in as close a relationship as possible to the decision makers, based preferably on past record with this client (rather than on, say, the size of the modeling organization or its revenue) and based on their knowledge of transportation rather than modeling. American projects often tended to go to outside consultants many of whom were large, and specialists primarily in computers (usually mostly business applications) accounting, the physical sciences. Universities, interested primarily in modeling techniques, are also often given jobs. These typically produce less useful results for decision makers than smaller consultants who know the problem, or in-house groups. European projects typically used in-house groups and, while there are obvious problems in doing so, they fare better. Outside groups are fine, however, if a close relationship is built up over time. Putting socio-technical modeling projects out for bid is often fatal, since you get a new group each time which almost certainly doesn't understand the problem, else they would have bid higher.

3. Keep the models short, simple and specific. That is, do not permit one's enthusiasm for technique or letting the computer do it, to induce one to try to build large monolithic programs which attempt feats in terms of uninterrupted computation without human review and intervention. Avoid to the extent possible complex techniques. Avoid an LP if a simulation will do. Avoid a big simulation if a still simpler technique will do. Avoid the general purpose model if a special purpose model will do (it always will). General purpose models almost always fail, as one informant quipped, "For two reasons, input and output!"

Beyond this, based as much on the interviewing and direct observation as the specific project data, one may add.

1. Go to great lengths to get out into the table (and into written memorandum) the client group's goals, objectives, values, and interests concerning the various potential parameters and constantly evaluate these. European projects seem to do this better because they tend to talk about things more rather than depending solely on written statements of work. The written statements are vital but not sufficient. Distances in the U.S. often work against frequent meetings during the course of a project. In Europe it is usually much easier to drop in on one's counterpart.

2. Make conscious efforts to constructively confront problems rather than smooth them over or accept the will of the most powerful participant.

3. To further the above, employ a "coordinator" a person from neither the decision making nor the modeling group to act as a chairman, translator, go-between and general early warning system for the project. The best example of this technique as "preventive medicine" is in an European corporation, though I have encountered U.S. firms who also employ such people, though more commonly only toward the end of

a project or as part of the draft report review process. Invariably the people who use coordinators are those who are already among the best qualified anyway, illustrating that the greatest problem of all is in a sense recognizing the possibility of a problem.

4. Conduct substantial detailed feasibility studies before undertaking large studies. Then review them. Often the feasibility study is enough.

5. Employ joint client/modeler teams, but not as a substitute for direct decision-maker availability or participation.

6 Halt the project if either, problems arrive which though confronted are important but unresolved or if early in the work the decision maker is pessimistic concerning the likelihood of useful results. A phenomenal amount of money is wasted by people who ought to have known better, and in fact did know better.

7. Contract for essentially technical problems models on a fixed price basis, but for socio/economic problems use a more open ended basis.

In summary it may be said that there appears to be no substitute for knowing who is doing what to whom, for "knowing your poison" and for simplicity.

WHAT MAY EUROPEANS LEARN FROM AMERICANS?

The situation is not entirely one sided. There are some things the European project participants may learn from Americans. One is to perhaps be a little more ambitious in what they undertake. Certainly one reason American models fail is a sort of frontier "We can beat [i.e., model] the world!" Psychology. They try to, and are sometimes surprised when it doesn't work out. European projects on the other hand—often tend to be less ambitious than they could be, given the otherwise favorable climate. Doubtless this is due, in part, to budget constraints which are typically much greater in Europe. We in the U.S. are learning to live with greater budget constraints now also. But it would be as wise of the European project planners to be more ambitious often times, as it would of the American to be less so.

NEW HYPOTHESES

The clear importance of Role Recognition and of similarity of Backgrounds and value systems leads me to my concluding thoughts. Why is it that Role Recognition is higher in Europe than the U.S.? Is it the egalitarian tradition in America that anyone may aspire to any position that makes even the lowest programmer feel perfectly comfortable deciding to eliminate an alternative without asking anybody? Is it because governments and business are generally less participative in Europe, with decisions being typically taken at a higher level and with subordinates used to, and understanding this situation and role?

What about Backgrounds and values? Does an Establishment really exist in the United Kingdom for example, to such a greater extent than in the U.S. so that there is, indeed, simply a much greater chance that two people who meet on such a project will be from much more nearly the same social class, background and education? What will happen to this as British higher education increasingly becomes less confined to a thin upper stratum? Will they then find themselves with administrators dealing with bright young modelers from totally different backgrounds (including the new Commonwealth nations) with whom they have the same totally non-communicative discussions that, say, an American auto manufacturing executive now might have with a modeler who a few years ago lived in Harlem? If these Americans are trying to discuss a model of urban transportation and the statement is made that, "It's very important that we make the resource allocation, including land use, really optimum," the other may agree vehemently, not realizing at all that their objective functions are so far apart (even opposite) that they have not communicated at all!

What about southern Europe? Are cultural factors and value systems different enough to make modeling success substantially different? What about underdeveloped countries, whose potential applications of transportation modeling would appear to be very great? And perhaps most intriguing what about European modelers working in the U.S.? Americans in Europe? How do they fare?

Research is continuing on this subject, though at a reduced level. The concentration initially is in the values area using the Allport-Vernon-Lindzey "Study of Values." It is hoped that further results of interest from this work may be reported in 1974.

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IT WOULD BE generally agreed that the optimum transportation policy is one which would result in a system which performed the necessary functions with the least consumption of economic resources subject to the service standards desired. In such a system, the various modes would compete freely among themselves, each receiving the traffic for which its inherent advantages made it best suited. Direct government regulation of transportation would be minimized, and such regulation as was present would be indirect—relating to the construction and maintenance of infrastructural facilities, the stimulation and preservation of competitive forces, and so forth. Such a system is clearly different from most.

In such a transportation environment, one question which must be faced is the question of intermodal competition and the impact of government tax policies thereon. The objective of such tax policies should presumably be fiscal neutrality—that is, nothing in the tax structure ought to interfere with the inherent advantages of the competing modes. This position suggests that each mode of transport should pay the full costs incurred by government in providing publically funded facilities. Such is the position taken by Canada's National Transportation Act of 1967. It is necessary therefore to explore different methods of setting the requisite user charges which would recoup—through time—the government's outlays.

One need undertake no more than a cursory review of the literature to demonstrate that a central issue in such a debate is the question of highway finance. It is the intent of the present paper to explore the entire question of highway finance, and to discover the policy implications of different methods of financing roads, streets and highways. As is customary in such discussions, the initial step in the analysis is to separate that portion of cost associated with non-vehicle uses of the physical plant from that associated with vehicle uses. In other words, the portion of total costs to be borne by landowners because of their desire for access to their land would be determined at this stage. The intent here is to employ the theory of location (site) rent in making this separation. Then, given an improvement in the highway network, the landowner contribution to the cost of the same would be based upon a before and after comparison of the entire structure of land rents.

The second part of the paper proposes to apply the theory of incremental cost to the problem of the separation of cost responsibility among classes of highway users. Implicit in the approach is a high degree of disaggregation. It suggests that there should be a stratification of vehicles by type and a further stratification of highways by quality. There are, then, a multiplicity of cost dimensions which must be considered.

Finally, it is necessary to determine the appropriate level of user charges for each class of vehicle on each class of highway. Three alternative bases for the establishment of such charges would seem to exist. These are: (1) full costs should be recovered in each year of a given facility's life; (2) full costs should be recovered only at capacity levels of utilization; and (3) full costs should be recovered over the entire life of the facility, the revenue-cost comparison for any particular year being irrelevant. The focus of the discussion will be on the consequences of these alternatives for intermodal competition in transportation.

It will be noted that no mention has yet been made of two pressing issues in the area of highway transportation—investment criteria and congestion. With regard to the former, the minimum criteria should presumably be that future highway projects be self-financing.[1] As will be demonstrated later, the third-mentioned method of setting the user charge is the best approach, and the question of this particular investment criteria then solves itself. The most serious congestion problem relates to week-day peak periods of demand. As such traffic is essentially work-associated, and involves joint demand of parking facilities, attention will be focused on the latter. The judicious application of pricing principles to parking will be shown to be one promising solution to congestion.

The Policy Issues:
Some General Observations:

The basic policy issue involved in the debate on highway finance revolves around the question of railroad-highway transport competition. Railroads are forces to build and maintain their own roadbeds, and to this obligation certain costs are clearly attached. In rate setting, they are forced to allocate these costs among various units of traffic, presumably with the objective of recovering the total over the life of the facility. Truckers, on the other hand, have their roadbed facilities provided by the government, and pay for them on some sort of user charge basis. This is a considerable advantage in itself, for it converts what is a fixed charge for the railroad into a variable cost for the trucker. If the truckers are paying their full share of highway costs, no problems arise. If they are paying less than their full share, then truckers are being subsidized by