

Economic Analysis of Alternate Route Locations

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● **THE GREATEST** single, and all too often only, highway planning criterion for the comparison of alternate route locations has long been in terms of the road user benefit-cost analysis. More recently, planning engineers have begun to realize that highways cannot be located on the basis of cost to road users alone, and that there are many factors which enter into a route location. Some of these, but by no means all, are of interest to both the layman and the technician.

A few of interest to both are: (a) traffic service, (b) effect upon local planning objectives, (c) effect upon local traffic patterns and street networks, and (d) engineering — this latter only superficially to the layman.

Those of interest to technicians only are: (a) benefit-cost ratios and computations, (b) integration with "bookkeeping" type classification systems, (c) official requirements, and (d) engineering — in the exhaustive sense of the term.

In the final analysis, the actual worth of a highway facility to a community depends almost entirely upon the previously mentioned lay criteria. The professional criteria are, generally speaking, aids or tools in making a quantitative appraisal, but to place undue stress upon them against the lay criteria would be to confuse a means with an end.

Some of the difficulties in the mathematical analysis leading to the benefit-cost ratio are the many assumptions that must be made in arriving at traffic assignments. These assumptions enter into the development of diversion curves, travel times and other relevant basic data. Further assumptions are made in developing the value of the road user's time, motor vehicle operating costs and highway construction and maintenance costs. Differences in these basic assumptions may throw the final results either way, and therefore, the computations are only as good as the initial assumptions.

The difficulties with the origin-destination analysis are found in the fact that a complete analysis may not give a complete answer. Assumptions made about other routes in the area may be based on little or no actual data, and therefore, can be wrong or superficial. Screen line origins and destinations give little, or no, information on routes at right angles to the proposed new facility — yet, the new facility may have a profound effect on the existing ones.

In Connecticut, it has been concluded that the need is for an "area" approach to the traffic problem, based on land use or an equivalent method of appraisal. The gravity model method, developed by Alan M. Voorhees, may be the answer.

Presently, this method is being applied to a regional traffic problem in the Greater Hartford Area. Of the six major highway facilities, proposed for this area, three will be north-south expressways: (a) Interstate 91 through the center of the area on the west side of the Connecticut River, (b) Conn. 9 westerly of Interstate 91 to the north and overlaying it to the south, and (c) Conn. 2 on the easterly side of the river. The two east-west expressways will be (a) Interstate 84 through the center of the area and (b) US 44 northerly of Interstate 84. A circumferential, composed in part of US 44, Interstate 291 and Interstate 491 will complete the expressway system for the area. At this time, Interstate 91 northerly, and Interstate 84 easterly, from the City of Hartford are on the ground. Conn. 2 is under construction toward the south and the remaining facilities are in various stages of planning and design. So vast is the cost of this system that it is conceivable that not all of it will be completed within this generation.

In the development of this system, alternate locations were studied and traffic was assigned by standard O-D methods as the routes were proposed. Data from several roadside interview surveys were used to develop a composite traffic usage diagram of all the main streets and expressways in an attempt to determine the area-wide picture.

When assignment to the circumferential route was tried serious questions were raised, as to:

1. What traffic can be expected on the belt route?
2. What effect will the belt route have on existing streets and proposed expressways?
3. What new traffic will be induced, generated or shifted?

It was decided to use the gravity model method of analysis to resolve these questions and to check out the previously assigned traffic usage of the area network.

The advantages of the gravity model method are many, for example, speed and ease of analysis, and a more complete answer. Most important, is the fact that it is based entirely on forecasted land use, rather than traffic growth on the existing highway network. In most instances of a belt route problem, there are no existing parallel major streets or traffic arteries, and a belt route on the ground will result in an entirely new orientation of one area to another. This is why the area-wide land use approach is the only feasible applicable method to determine a properly integrated system in this area.

Highway planning is no longer a linear problem concerned with running a road from one point to another in as short a distance as possible. It is now a broader problem of finding a highway's justification in the service it provides to the area. The highway is a functional element in the area plan, and with this sort of concept, its location depends less and less upon detailing considerations of grades, alignment, mass haul diagrams and narrow economic consideration of benefit-cost ratios.

At the Sagamore Conference on Highways and Urban Development the highway officials summarized some of the factors influencing urban highway locations as follows: (a) impacts on the community, (b) present and future traffic, (c) cost of development, (d) highway user benefits, (e) effects of expressway operations on local street system, (f) compatibility with local plans (g) aesthetic considerations and (h) national defense.

The city planner summarized the influencing factors also: (a) impacts on the community, (b) present and future traffic, (c) transportation costs, (d) impacts on local street pattern, (e) development of desirable land uses, (f) separation of different land uses, (g) aesthetic considerations and (h) national defense.

The basic thought for developing new highway facilities in urban areas is the keeping in mind that highway facilities find their justification, and their sole justification, in the services which they provide.

Discussion

Van Riper. — My remark is simply supplementing what Mr. Johnson had to say.

Assignment of traffic based on O and D information is a good, sound approach, but for urban expressways, the problem might arise that the feeder roads or streets and the access streets will not have the capacity to get the traffic to and from the expressway that the O and D analysis indicates the expressway would serve.

In many cases, particularly in downtown sections of cities, the streets are nearly up to capacity at the present time. In the case of an east-west expressway, it means imposing additional traffic on the northbound streets, and leads to this: After you have determined what your assignments are going to be; (that is, what volume of the traffic the expressway is to carry), may it not be necessary to take another look at your assignments, at your problems, and adjust those so as to take into consideration the capacity of the streets which are directly involved with interchanges, to bring that traffic to the expressway?

To my mind that is a realistic problem, and is a problem that you are generally going to meet in the planning of expressways and downtown sections of the metropolitan area.

Cherniack. — The reason I comment now is because the new concept has already been brought into the picture — and that is the word "land use", which is now becoming current, and it seems to be a magic word for disarming doubters, because highway engineers may not be very familiar with it, and because it is assumed implicitly that you can do a better job at estimating land use than you can highway traffic.

Now first of all — land use covers a multitude of sins — you have to group land uses into two parts. There is a residential land use and a non-residential use; the latter consists of commercial and industrial uses.

Certainly, as planners, we can take the undeveloped land that is developable, and sprinkle, as it were, residences throughout this area. With the employment of some traffic generation factors we can estimate what would arise out of those residential areas.

But when it comes to determining direction of flow we are really at sea, because who can tell where these industries and commercial establishments are going to locate.

And depending upon somebody's other than the planner's decision a radical change may evolve in the pattern of traffic from residential to non-residential areas. We cannot just implicitly assume that we have the tools for estimating that non-residential use to a greater degree than the estimating of the uses of highways insofar as we know about highway traffic services and highway services.

I want to point out that land use is a catch-all and that every time you have found some kind of factor that aids you in doing a better job in estimating residential land use, you are then on the spot to do some forecasting and estimating.

Johnson. — I would like to point out that we are ever getting closer to "land use designation," and in speaking to you, I was thinking of potential land use, not existing land use.

In Connecticut, there are 169 towns or municipalities, and of the 169, 140 have planning and/or zoning, covering 96 percent of the population and 76 percent of the land area, so we are not far from having 100 percent designation of land use in the state.

So with each little community having its own master development plan, we as highway planners must, of course, have our master plan relative to the development of the highway system, and we do. Admitting what you say, it is a guess at the moment as to what the attractiveness will be of one zone to another.

Shall I live here and work there, or vice-versa? We have to depend on a lot on Alan Voorhees'¹ analysis of the subject in guiding our analysis. We did have the incident in New Haven relative to the location of Interstate 491 in the four towns of New Haven, Hamden, North Haven and Wallingford. A few years back the legislature passed an act setting up a development corporation for those four towns, and it said that the highway department was to plan cooperatively with this commission the location of Interstate 491 as related to the development potential of the area.

Using our state-wide O-D survey we made traffic assignments to alternate locations through the valley, and the commission, through a very fine staff of technicians, used the gravity model method, with surprising closeness of results relative to the turning movements at the interchange locations.

Admittedly, they did not have the through traffic data which we had, but our turning movement volumes at the interchanges were identical or nearly identical with theirs, so we were satisfied that it was a good method, and incidentally, these results came from a method still in the process of evolution, a method that has a high potential for development.

Or course, it is not always true that you will have as good a technical staff working on such an analysis. We have to depend wholly upon the local planners to do the land-use analysis for us. In the instance of Hartford, in which the local town planners did not have this analysis completed, the planning engineer for the city took it upon himself to head up and coordinate the land-use plan for all the surrounding towns so that we would have the pattern to work with.

We have not completed this analysis, and I cannot tell you how good it is going to be, but we are faced with this problem: How do you assign traffic, circumferentially, particularly when it is intersected by as many expressway facilities as are found in a metropolitan area?

¹"A General Theory of Traffic Movement," Institute of Traffic Engineers, 1955.

Cherniack. — When you assign traffic by the gravity method, you make the assumption that land uses are thus and so, residences will be in certain places, and there will be certain zones that the town planning commissions have designated as locations for potential industrial development. My point simply is this: that merely in the designation of an area as an industrial or as a residential development we are not always sure that the business people who are going to develop the land either as residences or as commercial-industrial development will see eye to eye with the planners, and the gravity model merely says that if the planner is correct in his spacial distribution of residences and industrial locations, then the traffic volume will be derived by the gravity model formula. It is an answer, but it might not be the answer.

Johnson. — I think it is quite fortunate that we have an over-all expressway plan for the Hartford area that guides the planner in designating the land use of the area. They know, for example, that the Hartford Bureau Reservoir area is a "dead" area, in which there can be no development; it is all water supply system.

But for the other areas, they have got the over-all plan—each of the communities—with respect to guiding them to the designation of land use. Planning and zoning in Connecticut is not something treated lightly. There is legislation at the state level, which most towns have recognized the value of adopting. It has been tested in court and has held up in court, so that when the town does develop its master plan and says "this is an industrial area and this is a residential area" and the residential areas differ inherently from the industrial areas it is rather difficult to bring about a zone change, because an industry wanting to locate there is not going to get in without a court case.

The court invariably upholds the planning and zoning master plan, so that there is good assurance of foreseeable use of land-use planning in Connecticut.

Moskowitz. — I think there is an area of agreement here, but what is bothering Cherniack is that regardless of what legal designation you put on a given piece of land, there is no assurance that this is going to be filled up. In other words, somebody has to guess what is going to happen in the future. Whether they guess the total amount of traffic that this road will develop or whether they guess that there will be so many thousand employees of a certain type of industry, you are still guessing something that is going to happen in the future.

Zettel. — Mr. Johnson indicated the land-use planners were working from the transportation system you have laid out, whereas, frequently the land-use planners like to go around the other way. Of course, this is an interrelated thing.

Now, you lay out your transportation system and that controls your land use. I submit that this is what you are suggesting: You have laid out a transportation system which will have a very important bearing on the land uses. One wonders then, if you laid this out before you had the land-use information?

Johnson. — Well, the system was laid out cooperatively with the community on the basis of the O-D analysis, which we have completed, and now, of course, we are concerned with lane use, not land — how many lanes in this particular vicinity.

Zettel. — That is, now you have your system laid out, and now you are speculating as to the land use for the design of the system.

Ester. — I was particularly interested in Mr. Johnson's reference to right angle traffic, or it might be feeder roads, or cross-road traffic into your main arteries.

We are finding in Indiana, due to the large mileage in our interstate system, that it appears likely that the future right angle traffic to this interstate system might develop a program practically as large as our present interstate system. Certainly, this feature of knowing what cross traffic is going to be like is vitally important.