Abridgment

A Methodology for Forecasting Beltroute Corridor Land Use Impacts

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ABSTRACT

Forecasting land uses represents the first step toward ensuring compliance with land use plans and preventing inadequate transportation routes. This study was intended to develop a methodology for forecasting land use impacts within the corridor through which a beltroute is aligned. The methodology consists of assigning land uses to portions of the corridor, based on the potential those portions have for accommodating the requirements of the land uses. A planned requirements approach is used to assign land uses to tracts of land within the corridor. This approach of aggregating land uses at potential sites is advantageous in revealing the pressures that will bear on the goals and objectives of land use and transportation agencies. A computer aid based on the developed methodology has been implemented on a microcomputer and used in a real-world case. The methodology shows promise for assisting land use and transportation agencies in forecasting land uses in a beltroute corridor.

Beltroutes are limited access highways that completely or partly encircle an urban area. Such routes are particularly capable of altering, on a large scale, the attitude potential land users have for land within the region through which the route will be located, as well as for land within a reasonable distance of the beltroute. A tract of land that is considered undesirable because of a lack of accessibility may become very desirable for a number of different types of potential land users with the proposal to build a beltroute in the vicinity.

The land use-transportation relationship can be more concisely stated when considered in the context of beltroutes than if considered in the broader terms of transportation in urban areas. Three aspects of beltroutes contribute to the unique set of characteristics that affect adjacent land use developments. First, beltroutes tend to serve large amounts of local traffic. The type of traffic that a route serves consequently contributes to the land uses that locate within the corridor. Second, within the urban setting, uncongested beltroutes represent the ultimate in linking large sectors of the urban environment. Third, because a beltroute partly or completely encircles an urban area, a single beltroute could pass through as many types of land use as are existent in any one community. The implication this has for the land use-transportation relationship will depend on the particular urban area with its specific terrain, antecedent land uses, and goals.

Because a beltroute can facilitate and even precipitate new land uses within the urban area, it becomes incumbent on those responsible to anticipate and plan for the effects of the beltroute (1,2). Efforts can be made to capitalize on the changes wrought as a result of a beltroute. Further, problems of an inadequate or inappropriate design of the beltroute can result as a consequence of plans made without anticipation for future land uses. Because some types of land use projects will locate in anticipation of a beltroute, planning for the land use demands must be ongoing and must begin with conception of the particular project (3,4).

To date, a number of beltroutes have been completed or are being planned across the nation. Owing to the large impact such routes have, numerous studies have been undertaken to address the impacts these routes have had on land use. However, no universally applicable methodology has been developed to forecast likely land use within a beltroute corridor.

The objective of this study was to develop a methodology for forecasting land uses within a beltroute corridor. In order to demonstrate its usefulness and applicability, the developed methodology was then applied to the real-world case of I-215 located in the Salt Lake Metropolitan Area in Utah. However, the case study will not be presented in this paper due to space limitations. It is expected that the methodology will not only assist planners and decision makers in anticipating beltroute land use impacts, but it will also aid public and private sectors in capitalizing on the opportunities beltroutes offer.

DEVELOPMENT OF THE METHODOLOGY

The developed methodology has as its basis the planned requirements approach (5), which relies on locating sites within the corridor suitable to land uses projected to develop in the metropolitan area under study. There are 13 interrelated tasks involved in the methodology. Figure 1 shows the interrelationships of these tasks.

Task 1: Development of the Corridor Land Use Requirements Table

The history of land uses along representative beltroutes in the United States are examined to reveal the change or lack of change in land use under "before and after" conditions. A land use requirements table (LURT) for the beltroute corridor can be developed to show definite correlations between potential land uses and certain sets of original conditions.

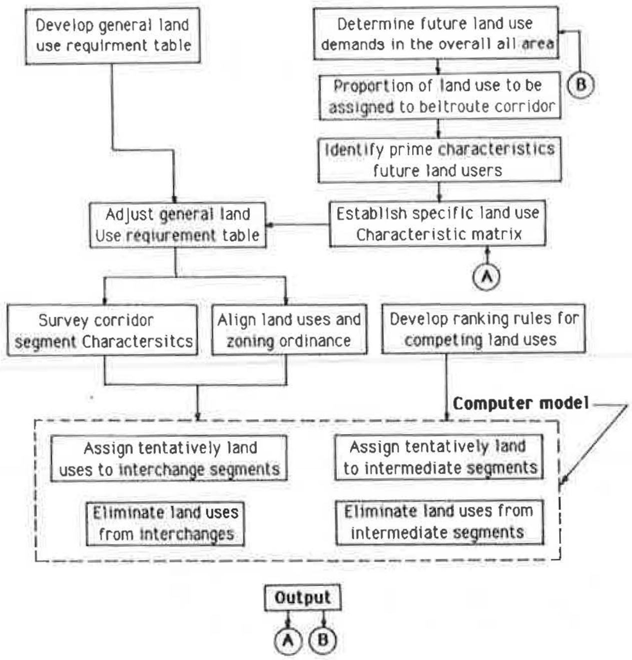

FIGURE 1 Methodological procedures for forecasting land use impacts in beltroute corridor.

Task 2: Identification of Future Regional Land Uses

The likely future land uses that will seek sites within the entire urban area where a beltroute is located are identified. It cannot blindly be assumed that the demands for types of land uses in one urban area will be the same as in another. This is obvious by noting the differences in industries and, hence, land uses when considering two grossly different regions.

Task 3: Forecasts of Future Land Use Demands within the Corridor

This task is to estimate the future growth of the urban area and the proportion of that growth that will be located within the corridor. Typically, a future point in time must be chosen for which projections are calculated. Supporting data such as population projections, housing demand, industrial growth, income level, and land costs and availability can be used to forecast the growth of various land uses within the urban area or the beltroute corridor. One way to allocate growth to the corridor would be by examining those land uses for which there is a projected growth. Attendant with each land use would be the prime characteristics required of a potential site. A survey of the corridor would then reveal how much land is available within the corridor that would be acceptable to the individual land uses.

Task 4: Identification of Prime Considerations Sought by Land Users

Characteristics that the industries or other land users will seek when selecting a site for development are identified by this task. Each land use identified will have one or more characteristics that are considered vital for a potential site. That a particular land use will contribute one characteristic, whereas another may contribute five or six is of no consequence.

Task 5: Formulation of Characteristics Versus Land Use Matrix

This task is to form an m by n matrix, where n is the number of characteristics from Task 4 and m is the number of land uses identified in Task 2. If a desired characteristic holds for a particular land use, assign the digit one to the intersection of that row and column, otherwise assign a zero. This matrix is called the characteristics matrix (CM) for a particular beltroute corridor.

Task 6: Adjustment of the Land Use Requirements Table

It is possible that the LURT and the CM may have a different set of land use characteristics listed vertically and each may have a different set of land uses listed horizontally. This task will adjust the LURT based on the CM so that the resulting LURT reflects the characteristics future locators of land use activities will consider as being of prime importance when considering sites within the particular beltroute corridor.

Task 7: Survey of Beltroute Corridor Characteristics by Segment

Homogeneous portions within a beltroute corridor are called segments. Each segment of the beltroute corridor is surveyed for the characteristics listed in the original LURT. If the LURT has been adjusted, then the revised version is used.

Task 8: Alignment of Land Uses and Zoning Ordinances

The set of zones from the local zoning ordinances should be aligned, as nearly as possible, into a group having the same description as the list of land uses from the LURT. The purpose of this task is to condense a number of different zones into the broad land uses of the LURT based on

1. What currently is in existence within the zone; that is, is it already developed to some extent or zoned?
2. The latitude that is allowed in development by what has already been constructed and what the zone is currently.

Task 9: Rankings for Assigning Competing Land Uses

This task will establish one or more ranks by which individual land uses are considered for final assignment to segments within the corridor. The ranking system is established on the basis of special considerations of the study beltroute corridor. There are basic components of the ranking that will be fairly constant. Other considerations being equal, if two activities seek to locate at a given site, the one with the higher ranking will be allowed to locate at the site and others may be forced to locate elsewhere. Also included in this task is the formulation of a land use compatibility table (LUCT). Such a table would indicate which combinations of land uses are not to share a segment or are to occupy adjacent segments.

Task 10: Assignment of Potential Land Uses to Interchanges

Within this task and Task 11, a planned requirements approach becomes apparent. The assignment is accomplished by examining each segment in turn, and on a tentative basis assigning as many land uses to the interchange segment as will have their prime consideration factors satisfied there. The prime consideration factors for a particular land use are recorded in the LURT. Whether or not a land use qualifies for a segment is determined by referring to the column below that land use in the LURT. Each interchange will have a list of characteristics. These characteristics are previously gathered in Task 7.

Task 11: Elimination of Land Uses from Interchanges

Each interchange segment is individually considered in combination with adjacent interchanges that are not separated by an intermediate zone. As many land uses as possible should be eliminated from each interchange segment based on land use compatibility, zoning considerations, and region versus local serving priority. The elimination process is conducted by considering the rankings established in Task 9. The recommended order for applying the rankings is application of the LUCT followed by those aspects of the zoning ordinances with which a unanimity of opinion exists.

Task 12: Assignment of Potential Land Uses to Noninterchange Segments

One method is to begin by attempting to assign all qualifying land uses to unfilled segments closest to the interchanges. Each interchange is taken in turn. This is continued until the supply of assignable land uses is exhausted. The second possibility is to assign all segments between an adjacent interchange pair before moving to the next noninterchange segment. Which method is used will depend on the policies in a particular reach of the beltroute. Where a policy of filling in of vacant land before allowing development elsewhere exists, the second method should be used. If the policy is not to constrain development with an infill policy, then the first method should be used.

Task 13: Elimination of Land Uses from Noninterchange Segments

After each segment between the interchanges is assigned a set of tentative land uses, attempts are made to eliminate land uses from the assigned sets based on compatible zones, ranking criteria, and land use compatibility.

COMPUTER AID

The developed methodology is partly computerized for facilitating its use. The dashed rectangle around Tasks 10 through 13 in Figure 1 encloses the computerized portion of the methodology. It is the computer model that maintains accounting information on land use characteristics resulting from changes in policy, prompts the analyst for input data, and displays warning information about land use conflicts and overly restrictive policy.

Aside from the relative interactions shown in Figure 1, other important aspects are the feedback loops from the computer model. These loops are designated A and B. The loops imply input or a decision from the decision makers who are questioned as to the desire to alter land use policy. Policy is defined as those actions a governing body can take to direct land use.

The developed methodology requires a considerable amount of manipulation of the small amount of data that it uses. For a beltroute corridor that has a large number of segments, as well as many characteristics and land uses, the methodology is prohibitively tedious. To assist users of the methodology, an interactive computer program has been developed. Through the interactive framework, the analyst is confronted with options to alter the data sets used by the program.

DATA PREPARATION

The data preparation process for the methodology can begin only after the land uses that will likely locate within the corridor have been determined. Once the land uses are known, they subsequently define one dimension of the LURT. The list of characteristics that describe the land uses dictate the second dimension of the LURT and the data that are to be collected from the corridor.

The first stage in data preparation, after all possible land uses have been determined, is that of characterizing the land use. If the LURT can be accepted as it appears, no further preparations are needed before starting stage two. Altering the LURT is possible by adding a row for each new characteristic and a column for each new land use. Next, a one is placed in the columns considered to be of prime importance to the added land use. By similar reasoning a land use could be removed. As a final step in the first stage, a zero is placed in boxes of the LURT not having a one. The LURT is now ready to enter into the computerized process.

The second stage of data preparation involves describing the beltroute corridor in the same terms as those used to characterize the various land uses. More specifically, the beltroute corridor segments should be described in the same terms as the list of characteristics in the original LURT.

CONCLUSIONS

Beltroutes encircling urban areas have definite effects on adjacent land use and urban development patterns. Both transportation and land use planners should realize these consequences of the beltroute and plan accordingly. Through coordinated transportation and land use planning, the beltroute can become a positive form-giving element in the metropolitan area.

A methodology for forecasting land use impacts within the beltroute corridor has been presented in this paper. Strengths of this methodology are the speed with which alternative land use policies can be examined and the minimal amount of data required. In the application of the methodology and computer aid to a real-world case (I-215 in Utah), it is apparent that the methodology is very useful for forecasting and monitoring land use development within a beltroute corridor. Of equal significance is the potential this methodology has for being useful in the design phases of a beltroute by affording an integrated design involving both the physical aspects of the route and the policies that affect land uses within the beltroute corridor.

REFERENCES

1. S. Khasnabis and W.F. Babcock. Impact of a Beltway on a Medium-Sized Urban Area in North Carolina: A Case Study. In Transportation Research Record 583, TRB, National Research Council, Washington, D.C., 1975, pp. 71-77.

2. F. Mills. Effects of Beltways on the Location of Residence and Selected Work-Places. In Transportation Research Record 812, TRB, National Research Council, Washington, D.C., 1981, pp. 26-33.
3. Payne-Maxie Consultants. The Land Use and Urban Development Impacts of Beltways, Guidebook. U.S. Government Printing Office, Washington, D.C., June 1980.
4. Payne-Maxie Consultants. The Land Use and Urban Development Impacts of Beltways, Case Studies. U.S. Government Printing Office, Washington, D.C., June 1980.
5. F.S. Chapin and E.J. Kaiser. Urban Land Use Planning. University of Illinois Press, Urbana, 1979.

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Effects of Freeway Stage Construction on Nearby Land Uses and Vehicle User Costs

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ABSTRACT

Because of the huge costs involved, most freeways are commonly constructed in lateral or longitudinal stages. In the case of lateral stage construction, service roads are constructed and opened to traffic before the main lanes. In the case of longitudinal stage construction, the service roads or main lanes are constructed on a freeway section-by-section. Impacts of stage construction include adjacent area land use development, user travel time costs, vehicle running and speed change costs, and accident costs. This paper contains the findings of a study of stage construction impacts on two freeways located in Houston, Texas: (a) one completely stage constructed and (b) the other partly stage constructed. Although authorization was given to purchase right-of-way for both freeways within 2 years of each other, the second freeway to receive authorization was completed at least 6 years before the first. During the "before" construction period, the socioeconomic characteristics of the areas adjacent to the two freeways are shown to be generally similar. During the construction and "after" periods these characteristics are shown to be dissimilar, partly because of differences in the construction schedules of the two freeways. A regression analysis of historical land use changes reveals that certain land uses are sensitive to nonstaged freeway construction. Other variables such as abutting and nonabutting, freeway location differences, capacity changes, and average daily traffic volumes are included in the analysis. A user analysis reveals that staging a freeway costs more in vehicle user costs than benefits gained from delaying construction expenditures.

It is recognized that a major thoroughfare, such as a freeway, attracts not only traffic but also affects nearby land uses. The presence of a major thoroughfare can obviously set off a chain reaction among land uses with one land use affecting other land uses. Accessibility resulting from the existence of the thoroughfare is a major contributing factor. People are more willing to live farther from the city or farther from other currently well-developed areas if they can count on a quicker way to get to and from work. Industries are less reluctant to rule out the possibility of locating their firms in rural areas if they are certain of good accessibility for their workers and for their goods and supplies.

Besides the mere presence of a freeway, it is believed that the method of constructing a freeway can influence how land is used. Because of the huge costs involved, most freeways are commonly built in longitudinal or lateral stages. In longitudinal staging, one segment of the freeway is built and opened before the next segment is started. In lateral staging, the service roads, if any, or part of the main lanes are built first. Later, all of the remaining main lanes are constructed.

It is also believed that staging of freeways affects user costs. A freeway does not reach maximum efficiency in carrying traffic until all the main lanes and service roads are constructed and opened for use. Until this is accomplished, part of the traffic that would normally use the freeway will have to choose an alternate route in the corridor that may require more travel time, incur higher