Abridgment

Evaluation of the Greenwood Drive Fringe Parking Facility

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Fringe parking (or park-and-ride) lots are designed to draw on the benefits of the private automobile and bus transit by using the automobile to collect passengers from low-density residential areas and then carry them along high-density transportation corridors by bus. Many fringe parking and express bus services have been successful; however, several lots, such as the Greenwood Drive lot in Portsmouth, Virginia, have not been fully utilized. One factor that may have contributed to the underutilization of such parking facilities is the lack of adequate planning procedures for use in preliminary feasibility studies and subsequent transit planning efforts for park-and-ride facilities and services.

To assist transit planners in developing park-and-ride facilities, Wester and Demetsky proposed a procedural method for express bus and fringe parking transit planning (1). This methodology is based on the analysis of population, service, and urban development characteristics of park-and-ride operations in Richmond and Virginia Beach (2, 3). In addition to determining the feasibility of the operation, the methodology also estimates the demand for the bus service.

This paper describes a study that was conducted to determine why the service from the Greenwood Drive lot failed to attract more riders than it did and to test the ability of the planning methodology to show why this fringe parking facility was not successful. In addition, the potential for more demand for the service is discussed.

HISTORY OF FACILITY

The Greenwood Drive park-and-ride lot was developed jointly by the Federal Highway Administration, the Virginia Department of Highways and Transportation, the Tidewater Transportation District Commission, and the city of Portsmouth. The lot, located at the interchange of I-264 and Greenwood Drive in southwest Portsmouth, was dedicated on May 17, 1976. Bus service connects the lot with downtown Norfolk, the central business district (CBD), and the naval bases at Sewell's Point. The lot provides 335 free parking spaces and includes a kiss-and-ride area, an enclosed passenger shelter, bicycle racks, lighting, landscaping, and easy access to both transit and private passenger vehicles.

The initial service consisted of six buses that departed from the lot during the morning and returned during the afternoon. Three buses traveled between the lot and the U. S. Naval Operations Base (NOB) and the U. S. Naval Air Station (NAS), and the others serviced the Norfolk CBD. Due to insufficient passenger demand, the service to the CBD was discontinued in April 1977. The remaining three buses also serve another free parking lot located at the Midcity Shopping Center and stop on demand at the Old Dominion University and Public Health Hospital and on Hampton Boulevard.

The use of the park-and-ride lot and the ridership on the bus service have been very low from the beginning—frequently only 15-20 vehicles are parked in the lot daily. Table 1 summarizes the bus patronage through October 1977. Approximately 30 persons trips/day were made in each direction between the Greenwood Drive lot and the NOB-NAS.

ANALYSIS

The procedural method for planning express bus and fringe parking transit was applied step-by-step to determine why demand for the bus service has been low.

An examination of the parking supply, roadway congestion, and travel costs revealed that conditions that have been shown to prevail where the majority of successful express bus and fringe parking services have been implemented do not exist in the Portsmouth-Norfolk area.

The area served by this service is made up of single-family houses and townhouses. The numbers of home-to-work trips to the Norfolk CBD and the NOB-NAS are given by census tract in Table 2.

Observations from an on-site survey and an analysis of the area around the Greenwood Drive lot revealed locational advantages that included proximity to an existing travel corridor at the interchange of an Interstate highway. Disadvantages of the lot site include a lack of signs to direct drivers to the site, low level of maintenance, and lack of security. Overall it was concluded that the status of the site could be improved, but no dominant negative characteristics were detected.

Demand Estimation

The demand for the Greenwood Drive fringe parking and express bus service was estimated by use of a model calibrated for a service that originated at the Princess Anne Plaza in neighboring Virginia Beach (2). This model was chosen because of the similarities between the two transit operations and the respective markets.

The traffic zones used in past studies of the area provided the basis for the demand analysis. A correspondence of the zones with the census tracts was established in order to apply the work-trip data given in Table 2 to the traffic zones.

The probability (P_b) of choosing the express bus was determined by the logistic model

$$P_b = e^{G(x)}/[1 + e^{G(x)}] \quad (1)$$

where $G(x)$ = a linear function of explanatory variables and is given by $G(x) = 1.2444 - 3.2961X_1 + 2.8541X_2 + 2.0156X_3$;

X_1 = number of household automobiles ÷ number of licensed drivers (2)

$$X_2 = (T_a - T_b)/[(T_a + T_b)/2] \quad (3)$$

Table 1. Ridership of Greenwood Drive park-and-ride bus service.

Week Beginning	Destination	
	NOB-NAS	CBD
May 17, 1976	18	8
June 14, 1976	33	17
July 19, 1976	63	24
August 16, 1976	63	31
September 13, 1976	58	31
October 18, 1976	61	29
November 15, 1976	69	29
December 13, 1976	77	19
January 17, 1977	57	21
February 14, 1977	63	19
March 14, 1977	65	18
April 11, 1977	58	Service terminated
May 16, 1977	63	
June 13, 1977	62	
July 18, 1977	61	
August 15, 1977	52	
September 12, 1977	66	
October 17, 1977	58	

Table 2. Greenwood Drive corridor market-area home-to-work trips.

Census Tract	Population	Home-to-Work Trips[a]	
		CBD	NOB-NAS
127.01	4568	29	228
127.02	5893	29	249
128.0	7541	46	126
213.01	1887	16	26
214.04	2531	39	64
215.01	3396	6	57

[a]The figures in this table were estimated from the 1970 census by assuming that all nonlocal government workers employed in Norfolk work at the NOB-NAS.

$$X_3 = (C_a - C_b)/[(C_a + C_b)/2] \quad (4)$$

where

T_a = travel time via automobile,
T_b = travel time via bus,
C_a = cost of using automobile, and
C_b = cost of using bus.

In order to estimate the demand for the express bus service the number of captive riders was subtracted from the zonal NOB-NAS and Norfolk CBD work trips. The rate of captive automobile riders was assumed to be the same as that for the area where the models were calibrated—47.7 percent. A summary of the ridership estimates by zone for the express bus service from the market area is given below.

Traffic Zone	Destination	
	CBD	NOB-NAS
389	1	1
390	3	4
391	1	1
393	1	5
398	1	4
400	0	1
406	0	1
407	1	2
408	0	0
487	8	59
495	7	16
505	8	63
Total	31	157

Demand Analysis

The NOB-NAS is unique in that a bus service that closely resembles that provided by the Greenwood Drive operation was available prior to the institution of the new service. Buses are privately owned and operated by employees of the NOB-NAS. Personnel interested in using this service contact an owner and arrange a pick-up point. A current directory shows that nine 65-passenger buses operate in the same market area as the Greenwood Drive parking lot. The cost of this bus service ranges from 60 to 75 cents/trip. Therefore, the express bus service faces direct competition from the established subscription bus service. In order to determine the expected patronage for the Greenwood Drive lot service, the submodal split between the subscription buses and the Greenwood Drive express bus was estimated.

Since the travel time and cost of the established subscription bus service are similar to those of the new Greenwood Drive express bus service and the new service requires an additional access mode but the subscription bus provides door-to-door pickup, it was assumed that the majority (80 percent) of the current subscription bus passengers would continue to use that service.

These passengers were then subtracted from the total estimated demand in the market area for express bus service to get an accurate estimate of the number of people who would use the express bus service. The table below gives the final estimates of ridership for the Greenwood Drive express bus service.

Traffic Zone	Destination	
	CBD	NOB-NAS
389	1	1
390	3	3
391	1	1
393	1	1
398	1	1
400	0	0
406	0	0
407	1	1
408	0	0
487	8	23
495	7	9
505	8	17
Total	31	57

The final step of the procedure for planning fringe parking and express bus transit is to determine the number of automobiles that will be parked at the fringe parking lot. This was accomplished by using a submodal split model for each zone in the market area:

$$P_b = e^{G(x)}/[1 + e^{G(x)}] \quad (5)$$

$$G(x) = -5.7146X_1 + 3.4796 \quad (6)$$

The estimate of the number of automobiles parked was found by multiplying the probability of parking by the estimate of the express bus ridership. These results are given below.

Traffic Zone	Owner's Destination	
	CBD	NOB-NAS
389	1	1
390	2	2
391	1	1
393	1	1
398	1	1
400	0	0
406	0	0
407	0	0
408	0	0
487	5	15
495	2	2
505	5	12
Total	18	35

The estimated ridership for the express bus service (as given above) is approximately double that actually realized (Table 1). Much of the discrepancy between the actual and predicted values is attributed to the numerous assumptions required in order to account for the subscription bus service and the error to be expected by borrowing models. The demand analysis did indicate, however, that the service would experience levels of patronage much lower than those for which the lot and service were designed.

CONCLUSIONS

The application of the methodology to the planning of express bus and fringe parking transit to the Greenwood Drive service reveals that the low levels of patronage that have been experienced could have been expected. When the Greenwood Drive service was planned, the competing subscription bus service was not properly considered. Although the planning methodology was not designed to deal directly with such unique issues as competing bus service, we have shown that the comprehensive study approach could be adapted to special local problems, such as this competition. Accordingly, we conclude that the methodology improves the general capability for developing successful park-and-ride transit operations.

The following observations were made regarding the future potential of the Greenwood Drive lot service to attract riders:

1. The competing subscription bus service clearly dominates the market for transit to the NOB-NAS,
2. The site is somewhat isolated from the local neighborhoods,
3. The service should have been advertised continually and more directional signs should have been provided on local roads, and
4. The lot design is adequate, but better maintenance and security are desirable.

In view of the above findings plus other factors considered, it does not appear that demand for the service will grow in the near future. Only when the area to the south of the lot (Chesapeake and Suffolk) is developed will it be possible for the lot and service to be anywhere near successful.

REFERENCES

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Bus Route Analysis Model (BRAM) Summary Report

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This describes the bus route analysis model (BRAM), a computer system that was developed to design bus routes. The computer program uses an iterative process to test various route configurations and to minimize the number of routes, the distance traveled, and the total travel time within constraints established by the parameters of maximum riding time and average speed of the bus. In the active mode BRAM designs bus routes by first dividing the district into a number of pie-shaped sectors, which are preselected by the planner, and then designing a route within each sector. Bus stops are first assigned to a sector by location and are then assigned to a route. A theoretical loop curve that represents an ideal route is used to form the routes. Bus stops are assigned to the route based on distance from the ideal curve and other constraints (such as bus capacity and student travel time). In order to test feasibility the routes are then subjected to a modeling procedure to determine travel time and travel distance. Through an iterative process various configurations of routes are tested until the best configuration is determined. BRAM is user oriented. A user's procedure manual describes the procedures for data collection and completion of coding forms, which are then keypunched. Support personnel input the data to the computer program and also establish the various parameters and constraints used. The printout is then sent back to the school district, where the routes are plotted and analyzed. The computer program also includes a management information system that can summarize daily statistics and print out monthly reports on the bus system. These reports provide information on the buses, routes, employees, and related costs. BRAM provides a design tool that can quickly investigate route alternatives for school buses or other fixed-route transit systems.

During the past several years research has been conducted at the Upper Great Plains Transportation Institute to develop a computer model to route school buses. The need for the conservation of energy is urgent in this age of increasing energy costs and dwindling resources. One area where costs can be reduced is in the transporting of students to and from school. The costs of transporting students are a particularly acute problem in North Dakota, where those school districts that responded to a questionnaire on usage of the computer indicated that there was an average of 1 student/7.8 km^2 (1 student/3 $mile^2$). After an extensive review of the literature (1-4) we decided that contemporary network analysis models would be too complicated for school district personnel to use. Structuring of the networks would be too expensive because many of the school bus routes in rural North Dakota are very long. Due to the severe weather and expected absences, routes change continually. The road system is everywhere—a road is available on most section and quarter-section lines.

DESCRIPTION OF THE RESEARCH

The objectives of the research were