

Express Bus Use in Honolulu: A Case Study

Bennett Mark, Hawaii Department of Transportation
Peter H. P. Ho and C. S. Papacostas, Department of Civil Engineering,
University of Hawaii

Selected results of a series of four on-board surveys taken to monitor the use of a peak-period bus system in Honolulu are presented and compared with results of an earlier door-to-door survey. The system offers express service to two general destination areas: the Honolulu CBD and the University of Hawaii. The surveys queried riders on basic socioeconomic information, characteristics of past and present travel modes, and user perceptions about service improvements. The study findings indicated that express bus patronage was significantly higher than that of the prior bus service. A significant portion of the morning riders, however, did not use the service for their return trips. The proportion of male and female riders was about even, and, among workers, the predominant occupations were professional and technical. Almost half of all riders came from households that owned two cars. About 60 percent of CBD riders and about 40 percent of riders on the university route were former automobile drivers. Increases in patronage over the survey period were in part due to gasoline shortages during the early months of 1974. The group most affected by gasoline shortages was students, who also showed a tendency over time to adjust their activity schedules to the schedule of the express bus service.

In 1972, the city and county of Honolulu and its consultants proposed a 35-km (22-mile) fixed-guideway system conforming to the linear development of the city in the east to west direction. In addition, a feeder bus system was planned to supplement the fixed route (1). At the same time, the city Traffic Department investigated the possibility of establishing an express bus service connecting the Hawaii Kai area, a rapidly growing suburb in the eastern extremity of the city, with the CBD and the University of Hawaii. The focus of attention was on one of the most critically congested corridors in Honolulu, the Kalaniana'ole Highway, which provides the only linkage between Hawaii Kai and major activity centers in Honolulu. The peak-hour traffic on the route during weekday mornings was about 4000 vehicles on three lanes moving toward the city.

The Traffic Department conducted a door-to-door survey in Hawaii Kai to determine the potential patronage of such a system, appropriate routes, bus stop locations, and initial bus schedule (2). A system

was implemented on a trial basis in August 1973 and has since become a permanent part of the overall bus system of Honolulu.

Several months after implementation of the express bus system, a series of on-board surveys was made to monitor its use and to compare the use with findings of the door-to-door survey.

PROGRAM DESCRIPTION

Hawaii Kai Population Profile

According to the U.S. census of 1970, Hawaii Kai had 3498 housing units and a population of 12 572. The median age of residents was 25 years, and the median household income was 17 896 (compared with 12 035 for the entire island of Oahu). More than 45 percent of the Hawaii Kai adult residents had attended college, and 28 percent had completed 4 or more years. The corresponding figures for Oahu are 29 and 16 percent respectively.

Employment of the residents was predominantly professional or technical (28.6 percent) and managerial or administrative (21.2 percent). The remaining work force consisted of clerical (17.4 percent), crafts and foremanship (8.1 percent), and sales (8.3 percent). Of this work force, 72.6 percent were employed by the private sector and 23.5 percent by the public sector. The census also reported 304 college students, but did not specify the proportion of enrollment at the University of Hawaii and the community colleges in Honolulu.

Of the 3131 housing units that reported owning automobiles, 27.8 percent had one car, 61.0 percent had two cars, and 11.1 percent had three or more cars. The census also indicated that, of the 5111 workers in 1970, 83 percent drove to work, 12 percent were automobile passengers, and 1 percent took the existing bus.

The 1972 door-to-door survey showed a socioeconomic profile that had remained essentially the same as in the 1970 census. The population and housing units had, however, undergone substantial change. A housing inventory taken in December 1973 from existing land use maps provided by the Honolulu City and County Department of General Planning placed the number of units at 5261. This represents an increase of 50 percent during the 3-year

period 1970-1973. On the assumption that the population of the area increased at a proportional rate, the 1973 population can be estimated to be 18 860 persons.

Bus Service Prior to the Express System

Prior to implementation of the express bus system, the only CBD-bound transit service available to Hawaii Kai residents was provided by a bus service with two collection lines in Hawaii Kai. This bus could make as many as 74 stops along the route between Hawaii Kai and the Honolulu CBD, and as many as 53 stops before reaching the University of Hawaii area, where a transfer to another bus or a 1.2-km (0.75-mile) walk was necessary in order to reach the university. During the morning, the average headways were about 30 min for the first collection line and about 10 min for the second. The collection portion of the service varied from 7 to 12 min depending on the particular line. The line-haul portion was approximately 47 min to the CBD and about 33 min to the stop nearest to the university. This system attracted only 1 percent of the work trips to the CBD.

Door-to-Door Survey

Approximately 4570 workers were surveyed in the 1972 Hawaii Kai door-to-door survey; of these, 4222 valid survey responses were processed. Besides being asked to give basic socioeconomic information and destinations of work trips, respondents were asked to place 12 transit service characteristics into the following three groups: very important, important, and unimportant. Each respondent was asked whether he or she would consider using the express bus if those service characteristics classified very important were met. If the response was positive, the individual was considered to be a potential rider. The survey results indicated that 58 percent of all respondents were in this category (2).

Table 1 shows that the characteristics considered very important by all the respondents and by those identified as potential riders were essentially the same (2). These rankings were in agreement with findings elsewhere in the nation (5, 6, 7).

The number of potential riders derived from the door-to-door survey provided a rough estimate of the maximum patronage that the bus system could attract. However, since not all of the reported potential bus trips fell within the peak period, and since not all of the highly ranked improvements could be satisfactorily met for all potential riders, these patronage estimates were recognized as upper limits.

By identifying the origins, destinations, and work starting and finishing times of the potential riders, Beckwith and Arakaki (2) narrowed the number of candidate peak-period bus routes to eight alternatives. These were further reduced to three routes in order to satisfy the nonstop line-haul requirement of express operations. The adopted express bus system incorporated two of the remaining three routes.

Hawaii Kai Express Bus System

The city Traffic Department developed an express bus system having 18 express bus stops within Hawaii Kai and putting about two-thirds of the 5261 housing units within two blocks and about 80 percent of the housing units within three blocks of an express bus stop. Fourteen runs are made to the CBD and six to the university; the overall seat capacity is 980 passengers during the morning peak period. Bus fares are identical to regular bus service: 25 cents for adults, 10 cents for students, and free fares for the elderly who have bus passes.

During the morning peak, the line-haul portion of the express bus system, as depicted in Figure 1, uses an exclusive bus lane 4 km (2.5 miles) in length in the most congested portion of the Kalaniana'ole Highway. The first segment of the exclusive lane is a traffic lane coned off each morning from outbound traffic. Thus, for this 3-km (1.9 mile) segment, there are three lanes for inbound traffic—two for mixed traffic and one for express buses—and one lane for outbound traffic. The bus lane then crosses the median to a third inbound lane, 1 km (0.6 mile) long, which was completed just prior to the inception of the express bus service. The express bus then uses regular highway, freeway, and city streets for the remainder of the line-haul portion. There are no exclusive bus lanes for the afternoon return trip because traffic is spread out more evenly.

The distribution portion is relatively compact. The CBD route terminates at six bus stops on two adjacent one-way streets forming a couplet near the center of the CBD. The University of Hawaii (UH) route terminates at a single stop at the west edge of the campus. When the express bus service from Hawaii Kai to the CBD was started in August 1973, the line-haul and distribution portions of the trip took about 25 min [in contrast to the 50 min required by automobile to cover the same distance (3)]. The collection portion of the system includes three lines as shown in Figure 2. The first line covers 10 and the second line 13 bus stops. The third line, a combination of the first two, covers 18 bus stops. The CBD route uses the first two collection lines between 6:15 and 7:20 a.m. at an average headway of 10 min and the third line between 7:35 and 7:45 a.m. at 5-min headways. The university route operates between 6:10 and 8:40 a.m. and uses the third line at average headways of 30 min. The average collection time is 10 min for lines 1 and 2. For line 3, the CBD- and UH-bound buses are scheduled to make the collection circuit in 15 and 20 min, respectively (3).

Study Program and Design

On-board surveys were taken on October 25, 1973, December 6, 1973, February 21, 1974, and May 2, 1974 during the morning peak period to learn ridership information and preferences. Each of the dates was a Thursday. The survey period covered a span of 8 months to coincide with the 1973-1974 academic year.

The survey program was conducted to provide the city and county of Honolulu with information on (a) the morning ridership boarding at each bus stop in Hawaii Kai, (b) the number of passengers disembarking at each destination stop, and (c) general ridership profiles. The original program called for complete sampling for the first and third surveys and partial sampling for the second and fourth, i.e., surveying those riders who had not responded to any of the prior on-board surveys. However, because of a rapid increase in patronage and the possibility of assessing the impact of gasoline rationing on bus ridership, the fourth survey was also a full survey. Thus, only the survey taken on December 6, 1973, was a partial survey.

Survey Instrument and Procedure

The on-board survey instrument was divided into three sections. The first section sought basic socioeconomic information about each respondent. The second section sought information on the characteristics of the respondent's previous and present travel and access modes. It asked two open-ended questions, to determine the reason why the respondent switched to the express service and to determine the reason for not using the express service

Table 1. Door-to-door survey respondents ranking needed service characteristics very important.

Rank	Needed Service Characteristic	Respondents (%)	
		All Questionnaires	Potential Bus Riders
1	Direct home-to-work bus schedule, no en route transfers	66.3	77.2
2	Provision of service to within two blocks of job	61.4	71.0
3	Provision of bus service to within three blocks of home	58.2	67.3
4	Provision of more frequent service	57.9	66.7
5	Maintenance of bus travel time to equal automobile travel time	54.6	63.2
6	Provision of clear bus schedules and route maps	52.6	61.7
7	Maintenance of bus travel time significantly better than automobile travel time	46.1	52.8
8	Provision of free parking at express terminals in Hawaii Kai	44.6	49.1
9	Guarantee of a seat on the bus	42.3	50.1
10	Better identification of bus stops	25.5	31.0
11	Elimination of need to take children	24.9	25.9
12	Reduction of bus fare	20.5	23.5

Note: Number of valid responses was 4222 for all respondents and 2451 for potential bus riders.

Figure 1. Hawaii Kai express bus route.

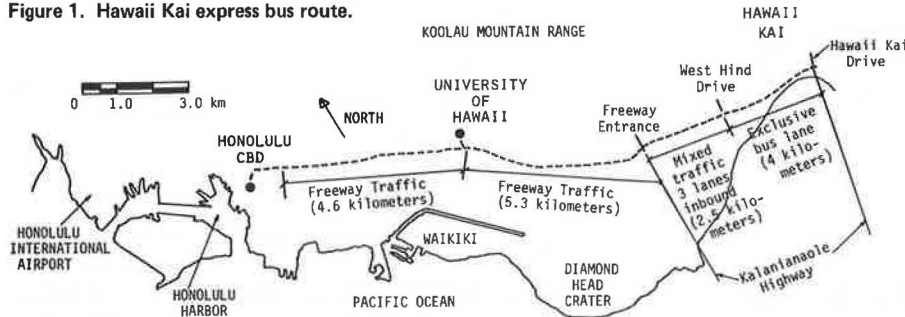


Figure 2. Express bus route coverage in Hawaii Kai.

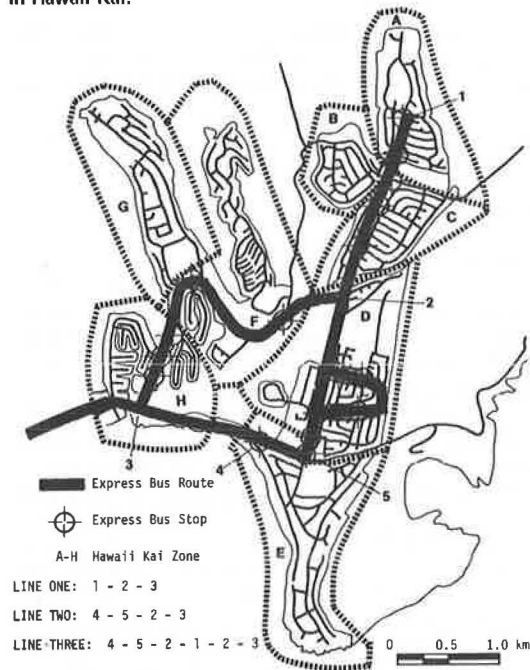


Figure 3. Questionnaire used in Hawaii Kai bus rider survey.

ABOUT YOU:

- Your occupation _____, age _____, sex _____.
- Your normal work or school hours _____ a.m. to _____ p.m.
- How many cars do you have in your household? _____

ABOUT YOUR TRIP:

- Number of blocks between your home and bus stop: _____ blocks
- How do you usually get to the bus stop in the morning? (check one)
 - Walk _____
 - Drive and Park _____
 - Get a Ride _____
- Where are you going? (check one)
 - Work _____
 - School _____
 - Shopping _____
 - Other _____
- What is the location of your destination?
 - Employer/School _____
 - Address _____
- How did you usually make this trip before express service? (check one)
 - Drive your car _____
 - Passenger in car _____
 - Local bus _____
- Why did you switch to the express bus? _____
- How do you reach your final destination after leaving the express bus?
 - Walk _____ How many blocks to final destination? _____
 - Transfer to another bus _____ Which route(s) _____
 - Automobile _____
- If you previously drove, did YOU pay for parking? _____ yes _____ no
If yes, how much? \$ _____ daily or \$ _____ monthly
- How much money do you think you save daily or monthly by using the bus?
\$ _____ daily or \$ _____ monthly
- Do you usually return home on the express bus? _____ yes _____ no
- If you do not return home on the express bus, why? _____

ABOUT THE BUS:

- How many days a week do you usually use the express bus? (circle one)
1 2 3 4 5
- If you work at a bank, would you use a late Friday express run?
_____ yes _____ no. If yes, what time? _____ P.M.
- What improvement would you suggest for this service? _____
- Your address (optional) so that we may send you current express bus information _____

in the afternoon if the respondent did not do so. The third section sought information about needed service improvements: It asked one open-ended question soliciting suggestions as to how the system could be improved. Figure 3 shows the survey instrument used by the study.

Two survey monitors were assigned to each of the 12 buses used in the express service. Separate survey booklets were kept for each of the 14 CBD and 6 university runs. Individual survey questionnaires were handed out in sequence so that the rider could be correlated with his or her boarding location. The total number of pas-

sengers boarding at each stop and the bus arrival time were recorded on a trip tally sheet contained in each booklet. As the riders completed the questionnaires during the course of the line-haul trip, the surveys were collected in no particular order. The number of passengers departing and the bus arrival time at each destination stop were also recorded on a trip tally sheet.

The survey procedure permitted direct correlation between the individual response and the time of boarding

and bus stop location. A similar correlation for departures was not possible. However, inspection of tally sheets showed that nearly all of the passengers disembarked at the first three stops in the CBD distribution loop. Apparently, because of the structure of the distribution loop, departing passengers found it more convenient to depart early and walk one extra block rather than to wait for the bus to bring them closer to their destinations.

The questionnaires for each survey were processed and coded for computer analysis. The following sections summarize the major findings of this study (3).

STUDY FINDINGS

Ridership

The total morning and afternoon patronage of the express bus system is shown in Figure 4. Express bus patronage was significantly higher than that attracted by the prior bus system. The ridership reached its peak in January 1974 coinciding with the height of the gasoline shortage. During this time, the state of Hawaii had adopted an odd-even rationing scheme with restricted hours of gas station operation. Figure 3 also shows that, even though there was a subsequent reduction in ridership, bus patronage after abatement of the gasoline shortage was higher than before it.

During the initial 2½ months of operation, morning trips comprised about 60 percent of the total daily patronage. This proportion decreased with time, reaching the 50 percent level after 7½ months of operation. According to the on-board surveys, the percentage of morning riders who did not ride in the afternoon fluctuated between 30 and 18 for the CBD and between 26 and 21 for the UH route (Table 2). The most common reasons given for this were schedule conflicts (finishing earlier or later than the scheduled bus) and the availability of an automobile ride home.

Age and Sex

As expected, the CBD route ridership age profile was quite different from that of the UH route. These profiles remained unchanged over the survey period. The split between male and female riders remained about even throughout the 4 surveys, although slight deviations were observed.

Occupational Profile

A comparison between the population make of Hawaii Kai reported by the 1970 census and the ridership makeup reported by the CBD on-board survey showed a substantially larger proportion of professional and technical workers in the latter. To a lesser degree, this was also true for clerical and secretarial workers. The remaining occupational groups were underrepresented among the bus ridership. The split between public and private sector employees in the CBD remained approximately the same for all surveys and matched the 1970 census findings. Thus, private and governmental sector workers exhibited the same propensity for using the express bus system.

Car Ownership

The household car ownership pattern reported by bus users is shown in Table 3. Chi-square tests on the weighted averages of both the CBD and the UH proportions indicated that the car ownership distributions were statistically the same at the 95 percent level. Almost

half of all express bus riders came from households owning two cars, more than a third owned one car, approximately one out of seven had three or more cars, and only one out of fifty reported owning no cars at all. This distribution is the same as that found in the 1970 census at the 0.95 level of significance.

Previous Mode of Travel

When the travel modes used by express bus users before the initiation of that system were compared with the modes used by persons identified as potential riders in the door-to-door survey, the two were found to be statistically different at the 0.95 level of significance (Table 4). The express bus system did not succeed in attracting as many automobile drivers as the door-to-door study had anticipated. Whereas three-fourths of the potential riders identified in the door-to-door survey were automobile drivers, less than 60 percent of the actual CBD-directed and only about 40 percent of the UH-directed riders were former drivers.

The percentage of riders who formerly used the regular bus service was much higher than had been predicted by the door-to-door survey. Although about 1 out of 15 passengers was expected to have been a former city bus rider, nearly a fifth of the CBD and more than a fourth of the UH riders were diverted from the regular bus service. Former automobile passengers also constituted a higher percentage of the total patronage than had been anticipated by the door-to-door survey, which had predicted that about 17 percent of the users would be former automobile passengers. By contrast, nearly 22 percent of the CBD riders and about 27 percent of the UH riders belonged to that group. In total, about 40 percent of the CBD and about 55 percent of the UH riders were either former automobile passengers or regular bus patrons. The door-to-door survey study had anticipated that this group would account for 23 percent of the total patronage.

Access-Egress

By the use of city land use maps, an estimate was made of the number of housing units within one, two, three, four, and over four blocks from each of the nearest bus stops on the express bus line. An average block was estimated to be approximately 213 m (700 ft) long. Sixty-six percent of the housing units were within two blocks of an express bus stop; 80 percent were within three blocks, and 90 percent were within four blocks.

About 80 percent of the CBD riders and 86 percent of the UH riders walked to reach the express line. The rest either rode or drove. The 80-20 split between walkers and nonwalkers destined for the CBD was identical with the split between housing units within and beyond three blocks from a bus stop. For the university route, the 86-14 split between walkers and nonwalkers was similar to an 89-11 split between housing units within and beyond four blocks from a bus stop. This correspondence suggests that the decision as to access mode is dependent on distance from a bus stop, the approximate maximum walking distance being three blocks for the CBD riders and four blocks for the UH riders.

Table 5 shows that about three-fourths of the CBD route riders walked to their final destinations after alighting the express bus, while about one-fourth of the riders transferred to another bus. Slightly more than four-fifths of the UH riders walked to their final destinations, and the rest transferred to another bus. During the survey period, between 78 and 88 percent of those who walked from the bus to their downtown destinations traveled a distance of less than two blocks. The correspond-

ing percentages for the UH route were 54 and 72,

Departure Times

The departure times of riders on the CBD route remained unchanged during the survey period. However, the departure times for UH route patrons exhibited a tendency to spread out during the survey period. This occurred after December 1973 and coincided with the end of one academic semester and the beginning of the next and suggests that students, having more scheduling flexibility than downtown employees, responded to the availability

Figure 4. Thursday ridership counts on express bus system.

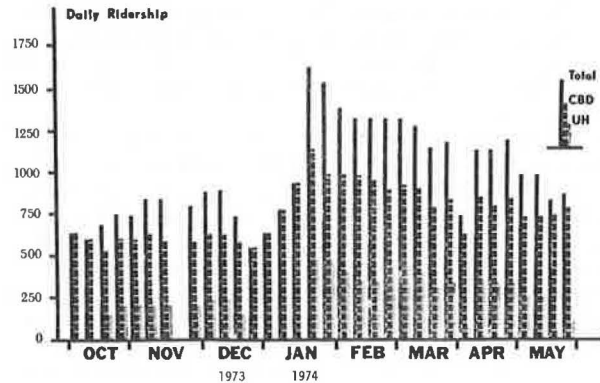


Table 2. Percentage of morning express bus riders who ride home on express bus.

Route	Survey	Morning Riders (%)			No. of Valid Responses
		Do Ride	Do Not Ride	Occasionally Ride	
CBD	Oct. 25, 1973	75.6	23.1	1.3	320
	Dec. 6, 1973	69.0	29.6	1.5	209
	Feb. 21, 1974	81.0	18.0	1.0	406
	May 2, 1974	79.3	18.9	1.9	482
University	Oct. 25, 1973	71.7	25.5	2.8	106
	Dec. 6, 1973	79.1	20.9	0.0	67
	Feb. 21, 1974	72.0	23.3	4.7	193
	May 2, 1974	72.1	25.5	2.4	165

Note: Percentages do not add to 100 because of rounding.

Table 3. Automobile ownership of express bus riders and general population.

Automobiles Owned	Riders on CBD Route ^a (%)	Riders on UH Route ^a (%)	Riders on Both Routes ^a (%)	General Population ^b (%)
0	2.0	2.3	2.1	—
1	36.6	29.5	34.6	27.8
2	48.0	52.3	49.1	61.0
3 or more	13.5	16.0	14.2	11.1

Note: Percentages do not add to 100 because of rounding. Percentages of bus riders are weighted averages of four surveys. Percentage of general population is from 1970 census.
^aComputed chi-square value between CBD and university distributions is 0.818. Theoretical chi-square value at $\alpha = 0.05$ and d.f. = 3 is 7.8.
^bComputed chi-square value comparing two distributions with first cell suppressed is 4.8. Theoretical chi-square value at $\alpha = 0.05$ and d.f. = 2 is 6.0.

Table 4. Travel mode of express bus riders before initiation of express bus service.

Travel Mode	Potential Riders ^a (%)	Current Riders ^b (%)	
		CBD Route ^c	University Route ^c
Automobile driver	75.5	57.1	39.3
Automobile rider	16.9	21.6	27.4
City bus rider	6.5	18.0	27.4
Other	1.1	3.3	6.0

Note: Percentages do not add to 100 because of rounding.
^aIdentified in door-to-door survey.
^bWeighted averages from on-board surveys.
^cComputed chi-square values for CBD and university distributions as compared with potential rider distribution are 30.54 and 112.91 respectively. Theoretical chi-square value for $\alpha = 0.05$ and d.f. = 3 is 7.8.

of the express service when arranging their schedules for the spring semester.

Comparison of Ridership Predictions With Observed Results

Beckwith and Arakaki (2) had identified 2451 potential express bus riders of which 473 were bound for the CBD and 220 were destined for the UH area. The door-to-door study recognized that these values were maximum estimates that were based on the assumption that the desired service characteristics of the new system could be met to the satisfaction of all potential riders.

Table 6 gives comparison of actual express bus ridership by residential zone (Figure 2) and predicted ridership. There was no comparative agreement at the 95 percent confidence level for the distribution of university ridership by zone (Table 7). The CBD route, however, showed good agreement with the predicted distribution by zone, and the predicted ridership level on the CBD route was approximated in the February and May 1974 surveys.

Impact of the Energy Shortage

The height of the energy shortage occurred in January 1974. The state of Hawaii responded to the crisis by initiating a gasoline allocation program, which provided for the sale of gasoline on odd and even days according to license plate numbers (4). Gas stations were required to remain open during specified periods of the day.

The impact of the shortage on the use of the express bus system is worth noting. Although a significant increase in total patronage took place (Figure 3), the socioeconomic makeup of the users remained largely unaffected. The only other discernible reaction to the shortage occurred in relation to access distances to the university route. According to the October and December surveys about 70 percent of the university riders traveled a maximum of two blocks and about 80 percent traveled a maximum of three blocks to reach the bus line. The February and May surveys, on the other hand, showed a shift to 70 percent accessing the system from within three blocks and 80 percent from within four blocks of a bus stop. Thus, the tributary area expanded during the critical period and remained at the new level thereafter. This phenomenon did not occur in the case of the CBD route.

The ranking by riders in each of the four surveys of fuel shortage as a reason for switching from another mode is listed below.

Survey	Ranking by CBD Riders	Ranking by UH Riders
Oct. 25, 1973	—	18
Dec. 6, 1973	11	5
Feb. 21, 1973	4	1
May 2, 1974	5	3

Table 5. Modes used by express bus riders to reach final destinations.

Route	Survey	Walked (%)	Transferred to Another Bus (%)		No. of Valid Responses
			Other (%)	Other (%)	
CBD	Oct. 25, 1973	74.9	24.1	0.9	323
	Dec. 6, 1973	74.3	25.7	0	206
	Feb. 21, 1974	72.6	26.6	0.8	482
	May 2, 1974	75.8	22.9	1.2	410
UH	Oct. 25, 1973	82.2	17.8	0	107
	Dec. 6, 1973	81.8	16.7	1.5	66
	Feb. 21, 1974	80.9	18.6	0.5	194
	May 2, 1974	81.0	19.0	0	168

Note: Percentages do not add to 100 because of rounding.

Table 6. Comparison of potential with actual patronage.

Zone	Potential Riders		Actual Riders							
			Oct. 1973 Survey		Dec. 1973 Survey		Feb. 1974 Survey		May 1974 Survey	
	CBD	UH	CBD	UH	CBD	UH	CBD	UH	CBD	UH
A	48	23	57	10	52	12	67	20	64	21
B	36	11	28	19	25	23	39	27	46	16
C	91	25	39	10	45	13	67	22	53	27
D	128	68	93	26	116	29	149	40	138	35
E	28	19	25	6	37	6	27	16	34	21
F	45	22	6	0	5	1	15	2	12	1
G	31	22	40	14	51	22	64	23	47	17
H	66	30	59	26	57	26	69	59	68	37
Total	473	220	347	111	388	132	497	209	462	175

Table 7. Statistical analysis of comparison of potential and actual patronage.

Survey	Deviation From Estimate of Potential Riders (%)		Chi-Square Value for Goodness-of-Fit Test*	
	CBD	UH	CBD	UH
Oct. 25, 1973	-27	-50	8.7	42.8
Dec. 6, 1973	-18	-40	7.0	38.8
Feb. 21, 1974	+5	-5	3.2	36.1
May 2, 1974	-2	-20	6.2	19.1

*Theoretical chi-square value for $\alpha = 0.05$ and d.f. = 6 is 12.6.

This incentive never attained first ranking among the CBD riders, even at its highest position in February 1974. At that time the UH riders ranked the fuel shortage as the top item on their list.

SUMMARY AND CONCLUSIONS

The on-board surveys conducted for the Hawaii Kai express bus routes showed that the substantial majority of riders were white-collar workers and students. General ridership profiles remained constant over the span of the surveys.

Increases in patronage occurred over the survey period. This was in part due to energy shortages experienced in Honolulu during the early part of 1974. No firm number can be ascribed to this factor alone, since the drop in patronage after the gasoline crisis did not result in return to preshortage ridership levels. The group most affected by the gasoline shortages was that of students on the university route who were willing to travel increasing distances to reach a bus stop. There was no corresponding increase for CBD riders.

The door-to-door survey had indicated that 75.8 percent of the potential riders in Hawaii Kai were automobile drivers prior to the initiation of the express bus system. The on-board surveys, on the other hand, showed that only 57.1 percent of the CBD riders and 39.3 percent of the university riders were former automobile drivers.

Comparison of ridership distributions by origin zone for the two surveys indicated a good fit for the CBD route; on-board survey counts for the latter portion of the study approximated the potential volume predicted by the door-to-door survey. Results for the UH route, however, did not fit well with predicted levels.

Even though the door-to-door survey study did not attempt to develop or use a parametric modal-split model, it provided information that was useful in identifying potential express bus routes as well as access and distribution configurations. Moreover, since the door-to-door survey was conducted 2 years after the latest census, well-timed information was made available that could not have been found elsewhere. The availability of such timely information is especially valuable in rapidly growing suburban areas such as Hawaii Kai.

ACKNOWLEDGMENTS

This paper is a result of research undertaken through the cooperation of the Honolulu Department of Transportation Services, and the Civil Engineering Department, University of Hawaii. During the period of research, Bennett Mark was a graduate intern in the Minorities in Planning and the Urban Professions Program, administered by the Hawaii Department of Planning and Economic Development and financed in part through the Comprehensive Planning Assistance Grant from the U.S. Department of Housing and Urban Development.

REFERENCES

1. Honolulu Rapid Transit System: Preliminary Engineering Evaluation Program. Daniel, Mann, Johnson and Mendenhall, Dec. 1972; Honolulu Department of Transportation Services.
2. J. A. Beckwith and H. Arakaki. Report on the Hawaii Kai Express Bus Service Study. Mass Transit Division, Honolulu Department of Traffic, Nov. 1972.
3. B. W. Mark. A Ridership Study of the Hawaii Kai Express System. MS thesis, Department of Civil Engineering, Univ. of Hawaii, 1975.
4. Energy Policies Plan. General Plan Revision Program, Hawaii Department of Planning and Economic Development, 1974.
5. A. N. Nash and S. J. Hille. Public Attitudes Toward Transit Modes: A Summary of Two Pilot Studies. HRB, Highway Research Record 233, 1968.
6. Public Attitudes Toward Transit. Simpson and Curtin, Interim Rept. 4, 1969; Twin Cities Area Metropolitan Transit Commission, St. Paul.
7. E. Horton, J. Louvierre, and D. R. Reynolds. Mass Transit Utilization: Individual Response Data Inputs. Economic Geography, Vol. 49, No. 2, 1973.