RAILROAD PASSENGER SERVICE
ANALYSIS OF TRAIN SCHEDULING AND OPERATIONS

Prepared For The General Accounting Office As Part Of Its Review Of The Operations Of The National Railroad Passenger Corporation

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B-175155

Dear Mr. Chairman:

As part of our review of the operations of the National Railroad Passenger Corporation (AMTRAK) pursuant to your request dated January 28, 1972, we engaged the firm of Richard M. Michaels Transportation Consultants to study intercity passenger train scheduling and operations to determine how well passenger rail service matched user demands and desires. Two copies of the consulting firm's report are furnished.

Your office advised us that it would be helpful if we furnished you with information on segments of AMTRAK operations as work on each segment was completed. This report is the first of several reports we plan to furnish you on specific aspects of AMTRAK operations.

The consultants' study was based, in part, on a nationwide passenger survey made on various AMTRAK routes in June and July 1972 by our representatives with the assistance and cooperation of AMTRAK. The consultants found that:

1. Rail passengers generally differed from the population at large and from air travelers in that the proportion over 50 years of age (36 percent) was significantly greater than that of air travelers (24 percent) or of the population as a whole (20 percent). Also, rail passengers included significantly more women than men. Social or recreational travel accounted for more than 70 percent of train trips. The proportion of business train travel was significant only in the northeast (about 37 percent). Although complaints were raised about train service, passengers as a group were satisfied with the trains and only about one-third would use an alternative mode of transportation--bus, automobile, or airline--if they had free choice.

2. About one-quarter of the cities on any route contributed 75 percent or more of the traffic. Generally passengers were traveling from one metropolitan area to another--from a train's origin to its final destination. Passengers

used the trains largely for long trips, and train transfers were infrequent. Only about 14 percent of the passengers surveyed made transfers; 68 percent of these occurred in New York and Chicago. On the basis of existing traffic, there appeared to be little reason to modify scheduled departure times or to adjust train interconnections, but there did appear to be a need for AMTRAK to further consider the extent and frequency of stops at intermediate points.

3. Significant daily and seasonal fluctuations in demand for AMTRAK trains have presented difficulties in matching capacity to demand and in consistently obtaining high use of equipment and labor. However, it appeared that equipment choice and consists (train make-up) could be better matched to demand. On the basis of load factors determined for various selected routes, the average use of coach capacity ranged from about 14 to 67 percent, with a mean of only about 37 percent. The average use of sleeper cars ranged from 2 to 62 percent. Generally, and especially for AMTRAK's longer route trains, a 75-percent load factor would be necessary to bring revenues close to costs. AMTRAK was providing extensive first-class amenities on long-haul trains when the actual loads and passenger requirements in many cases might have been served by coach facilities. On shorter routes, it appeared that a substitution of self-propelled rail diesel cars for conventional equipment could be made at a very substantial cost savings.

The consultants' recommendations and AMTRAK's comments are presented below.

1. AMTRAK should better match train consists to traffic requirements to obtain better use of equipment.

AMTRAK said that improvements can and will be made. It commented that some idle capacity resulted from nonuse or noncancellation of reservations by potential passengers and that a planned new reservation system should permit improvement.

2. Because many passengers ride coaches only, use of coaches should be maximized and use of parlor cars, sleeper cars, and separate dining cars, which are costly to operate, should be minimized except where profitable.

AMTRAK concurred that the greatest potential for new business appears to be in coach travel and said it is planning to provide more coach capacity during the summer of 1973. AMTRAK said that it will continue to review all "premium cost" service to minimize excessive costs. AMTRAK expressed its belief, however, that a policy of offering only a spartan service is inconsistent with its legislative mandate and parallels too closely the practices of some railroads in the past.

3. Given the low loadings on many AMTRAK routes, particularly the shorter-haul routes, alternate equipment, especially the rail diesel car, should be considered.

AMTRAK agreed that greater use of self-propelled cars may be appropriate on certain routes and said that some rail diesel cars had recently been purchased for use on selected runs. Additional self-propelled cars are to be acquired and used if deemed appropriate.

4. To reduce variations in traffic, AMTRAK should experiment with differential fares. On days when traffic is light, lower fares could be charged with premium fares charged in peak periods.

> AMTRAK said that it has elected to simplify its present fare structure before embarking on radical new fare policies. AMTRAK explained that the great diversity of inherited fare policies and the requirements of the Price Board had delayed its efforts.

5. Because terminal costs are substantial and AMTRAK makes many train stops at low-revenue-producing cities, AMTRAK should study the location and frequency of its stops and the costs associated with them.

> AMTRAK said that some stops were made principally for operational reasons but that, with some changes, these requirements could be met by fewer or more appropriately located stops. AMTRAK said that steps were being taken to achieve this. Regarding other stops that might be uneconomical, AMTRAK said that it had instituted a program for collecting data that will give it a better basis for decisions regarding train stops.

6. Because passenger rail service is generally a leisure-time transportation mode, AMTRAK should study how it could tap the growing market of recreational travel.

> AMTRAK agreed that the recreation market offers great potential for train travel and stated that it was attempting to tap this market and planned further efforts in that regard.

7. AMTRAK should establish and finance an adequate program to collect and analyze market data as a basis for operational planning.

> AMTRAK concurred with this recommendation and said it had retained two private firms to help it determine what is required to attract people who are not presently using trains.

Overall, AMTRAK said that it recognized the validity of the general observations stated in the report but that, after 20 months of operation, it had found many institutional railroad practices which inhibited instant and dramatic change. AMTRAK said that it was striving to overcome these practices and expected continued improvement in the future.

The consultants' summary and recommendations begin on page 142 of the report. AMTRAK's comments begin on page 165.

A copy of this report is being sent today to the Chairman, House Committee on Interstate and Foreign Commerce. Also, in accordance with arrangements made with your office, copies will be sent to the Chairman, Subcommittee on Transportation, House Committee on Appropriations; the President of AMTRAK; the Secretary of Transportation; and the Director, Office of Management and Budget.

We shall not distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

The Honorable John Jarman, Chairman
Subcommittee on Transportation and
Aeronautics
Committee on Interstate and
Foreign Commerce
House of Representatives

C o n t e n t s

RAILROAD PASSENGER SERVICE --
ANALYSIS OF TRAIN SCHEDULING AND OPERATIONS

by

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Chapter I

BACKGROUND AND PROCEDURE

The purpose of this study is to determine how well-matched current passenger rail service is to user demand and user desires. Ideally, trains should be scheduled in some relation to the desired departure times of the users and should be routed to and from those cities among which sufficient users wish to travel. In addition, both the frequency and consist of the train should be matched to the demand. Clearly, if most traffic were to consist of trips of less than six hours, there is little need for first class cars--even if the train itself is traveling a longer time. Similarly, the type of train used, e.g., rail diesel car or diesel locomotive, depends upon the magnitude of demand and the services it requires.

At present, there is little data available on the rail passenger network as a whole to evaluate the efficiency of scheduling or train consist. Amtrak does have passenger loading data on various links of all routes. However, there is little information on the origins and destinations of travelers on the system. There is also little data on the characteristics of the users of the service. Without such basic information, it is not possible to evaluate the efficiency with which the service is provided nor whether it is serving its market in the most economical fashion possible. Finally, without some basic and continuing data collection and analysis of the existing and potential market, there is no way to design service that will attract traffic.

In this study, an attempt has been made to provide both a method for collecting data and also some means for analyzing such data for planning and evaluation purposes. The goal of the study was to answer four basic questions about passenger rail service. These are:

1. Who uses passenger rail service and why?
2. Where do passengers travel on the system?
3. Is the train schedule and consist optimal for the link demand?
4. Is the departure time of the train matched to the desired departure times of the users?

In order to answer these questions, a nationwide survey was undertaken, sampling all of Amtrak's routes except those between New York and Washington. The survey instrument was composed of three classes of items relating to the passengers and their travel: (1) trip origin-destination, mode of reaching the train, desired departure times, and travel frequency; (2) personal characteristics of the traveler--age, sex, and trip purpose; and (3) items relating to passenger satisfaction with the train service which included two questions: what mode would have been taken through free choice, and how satisfied were the passengers with the train service? The survey form is shown in the appendix.

In addition to the passenger survey, regular counts were made of train loadings. On any route, and generally concurrent with the survey, counts were made between major route stops. The counts were kept separate for coach and first class accommodations. Although they were not as detailed as Amtrak counts, they were sufficient to estimate passenger loads and, of course, were immediately accessible for analysis.

An initial sampling plan was developed, aimed at uniformly sampling each route on the system at least four times. The objective was to survey riders on the same train route in both of its directions. Where feasible, runs originating in a city both on weekdays and weekends were sampled. The total survey was designed to be completed in five weeks and was carried out beginning in June, 1972. It was completed by mid-July.

The survey and counts were conducted by GAO staff and Amtrak personnel. The basic sampling plan was fulfilled with certain deviations. Certain trains were surveyed that were not on the plan and more data were collected on certain lines than called for in the plan. In general, more trains were surveyed than originally called for and the rate of return was higher than expected. Approximately 32,000 survey forms were completed.

The forms were coded and the data placed on punch cards. The data were then processed using the SPSS tabulation program. This program produced, for every train, an origin and destination matrix which contained not only the frequencies by O&D pair, but also the marginal totals which provided the number of passengers originating or terminating their trips in any of the cities appearing in the matrix. In addition, appropriate percentages of each origin and destination to the total were provided, as were percentages within each cell both to the total sample and with respect to every other origin or destination with which it was related. This allowed rather complete analysis of origin and destination distributions. These matrices varied in size from four cells to nearly 1000.

The same program was used to summarize the passenger characteristics and satisfaction with the service. The program provided a print-out of the frequencies and the percentages of the total in each classification.

Analysis of passenger loadings was done using both the 1971 data published by Amtrak and that generated by this survey. The former was more detailed and allowed a more precise analysis of demand distribution. The survey data was used to scale the results from the previous year to the present.

The remainder of the report is organized around the four questions which the study sought to answer: Chapter II discusses the results relating to passenger characteristics and desired departure times; Chapter III discusses the results relative to train loadings; Chapter IV discusses the results of the analysis of the origin and destination data; Chapter V discusses the structure of train scheduling and consist; Chapter VI evaluates the functional and economic efficiency of Amtrak service; and Chapter VII is a summary and a series of recommendations on passenger train service.

Chapter II

PASSENGER CHARACTERISTICS

Certain basic information about the users of passenger rail service and the uses which they make of the service was obtained from the survey. The results may best be summarized in two ways--on an aggregate basis and by train and section of the country. It should be recognized that these analyses are based upon data collected during only two months. Although there is no reason to believe that differences at other times of the year would yield significantly different results, some changes might occur.

Aggregate Analysis

In the aggregate, two characteristics of the users of passenger rail service stand out: the sex of the train passenger and their age. Sixty-five percent were women and, of the total, the proportion over fifty years of age was 36%. These percentages may be compared with census data on the population as a whole. Here, one would expect approximately 20% of the adult population to be over fifty years of age. More specifically, they may be compared with airline passengers. Data from two studies indicated that the proportion of air travelers over fifty is approximately 24%. It seems reasonable to conclude that significantly more women use passenger rail service than would be expected and the users are significantly older than would be expected from the population at large or the traveling public.

Looking at trip purpose, four alternatives were possible: business, personal business, social, and recreation. It was found that 70% of all travel by train was for social and recreational travel. This, too, is higher than air transport. It would appear that train travel is a specialized form of transport adapted largely to discretionary travel.

The results are borne out by the frequency with which trips are made by train. Passengers were asked to indicate how frequently they made train trips. There were five alternatives: less than once a year; one to four times a year; five to eight times a year; nine to twelve times a year; and more than twelve times a year. Forty-seven percent of the respondents traveled less than once a year, and 33% only one to four times a year. Thus, 80% of the users may be categorized as occasional travelers, which is a characteristic of long-distance discretionary travel.

Given these characteristics of train users, the survey provided a means for evaluation of how passengers evaluated the service. Two questions on the survey approached this issue. The first asked, if they had free choice, which of four alternative modes would they have taken? The four modes were rail, bus, auto, and air. In the aggregate, the results showed a clear-cut preference for rail travel. Of the total, 68% would have chosen rail, 22% would have chosen air, 9% would have chosen auto, and 1% would have chosen bus. Clearly, users have a strong preference for rail travel.

It is obvious, however, that these travelers are willing to sacrifice time to take the train in preference to the airplane. A recent study by Moyer and Michaels (1) indicated that rail passengers have lower incomes than the population at large, are most comfortable on the train, and see it a most preferred mode. It would be well, in future studies, to explore the reasons for this preference.

The second item on the survey asked the respondents to rate their satisfaction with the train accommodations. A seven-point scale was used, ranging from completely satisfied to completely dissatisfied. To a first approximation, the rating scale may be considered as one having seven equal intervals. Thus, a numerical value may be assigned to each interval such that each number is subjectively equidistant from the next. On the basis of this interval assumption, the numerical values can be added or subtracted and averaged. If the category designated "completely satisfied" is given a rating of six, and the remaining categories given an appropriately smaller rating down to zero for "completely dissatisfied," then an average satisfaction score may be computed. Given that a score of three is neither satisfied nor dissatisfied, it was found that the respondents rated the accommodations at 4.4. Thus, it is reasonable to conclude that the passengers were quite positive in their attitudes toward the on-board service. Consequently, although many complaints may be raised about the train service (and many were expressed on the survey forms), the fact is that the users as a group consider the accommodations considerably more than satisfactory.

There are also significant differences among trains. The trains rated highest in rider satisfaction and significantly higher than the average are the #15 and #16 running between Chicago and Houston and #3 and #4 operating between Chicago and Los Angeles. Two trains were rated significantly less satisfying than the average. These were #78 between New York and Buffalo and #58 and #59 running between Chicago and New Orleans.

It should be noted that the single item used in this survey provides only indicative, rather than conclusive results. The study by Moyer and Michaels defines the appropriate techniques required for conclusive measures and their application in a rail passenger context. Sampling over time can provide a useful indicator for railroad management of the merit of their service and temporal trends of user satisfaction. Similar studies of non-users can also provide important information about the potential market for rail passenger service.

A final consideration in the aggregate analysis concerns the desired departure time of the passengers. On the survey, the users were asked to indicate the time at which they would have preferred the train to have departed from their city of origin. The results are shown in Figure II-1[1]. As may be seen, there is a preference for morning departure times. Over the whole day, passengers prefer to leave after 7 a.m. and before 8 p.m. More important, however, is the fact that between these hours, the differences are not very great. A simple regression of frequency of passengers desiring a departure time against time indicates a simple linear function of the form

$$y = 174.5 - 5.7t \qquad (1)$$

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[1] p. 9

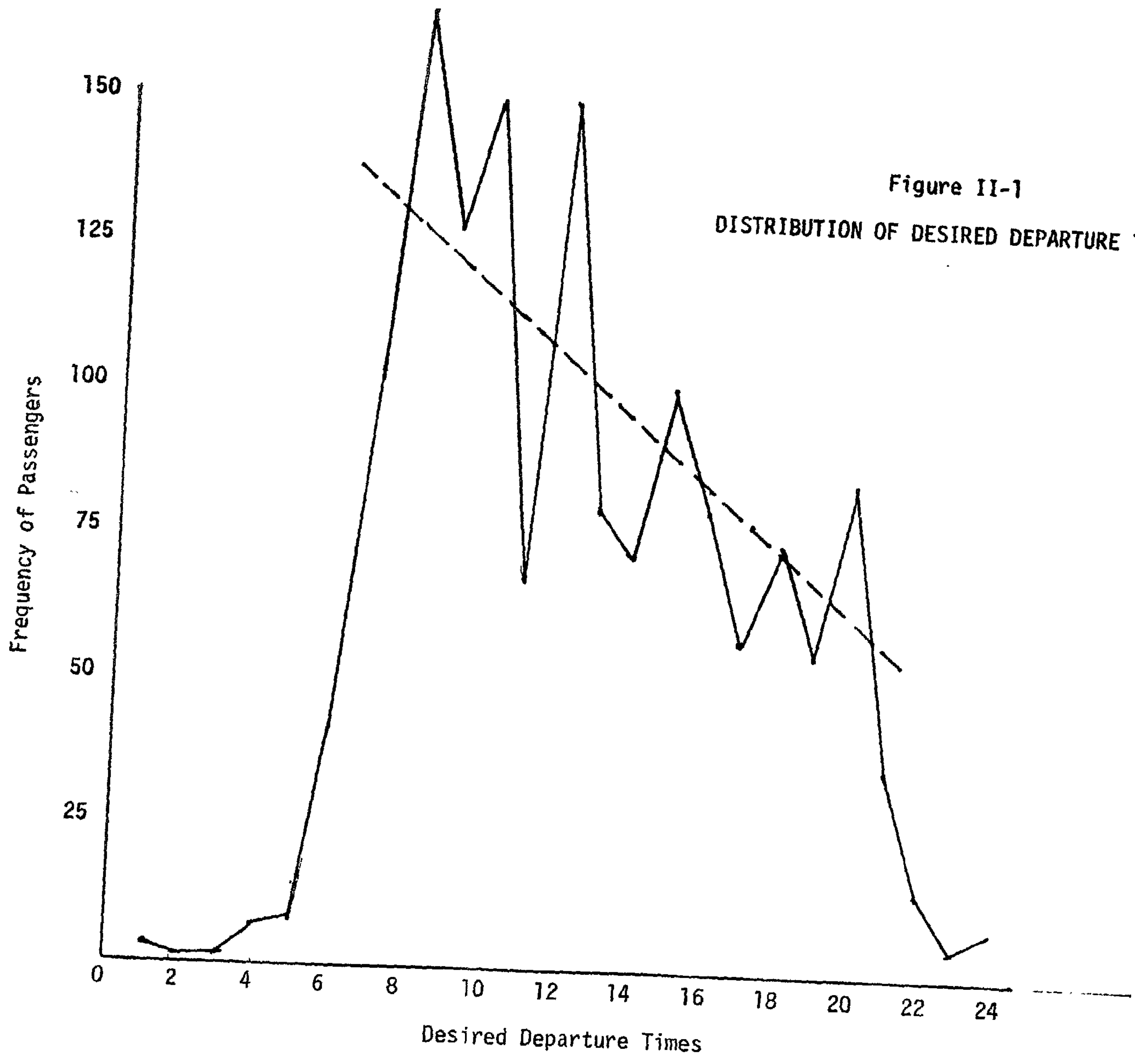

Figure II-1

DISTRIBUTION OF DESIRED DEPARTURE TIMES

Thus, the preference for departure time decreases over the period of 7 a.m. to 9 p.m., but only at a rate of 3% per hour. This suggests that although train travelers do have a preference for morning departures, they are quite flexible in adjusting their departure times. No significant differences were found for individual trains or for different regions of the country. Considering the fact that 70% of all travel by train is discretionary, the results of this analysis are not surprising. The users, because they are traveling for social and recreational purposes, can adapt their departure to schedules set by the train operator. Conversely, manipulation of train schedules is not likely to significantly affect train ridership--at least during the hours of 7 a.m. to 8 p.m. There is a question, for which no data is available, as to whether trains that depart between 10 p.m. and 6 a.m. are unacceptable to potential users. Certainly long-distance trains do make stops in major cities at these hours. It is reasonable to believe that some loss of riders occurs because of this, but their numbers or significance to Amtrak operations are not determinate from this study.

Analysis by Train and Region

For convenience, the data on individual trains were categorized by region of the country. One region was northeast and included trains running from Boston to Washington, as well as trains running from New York to Buffalo. A second region included all trains in the eastern half of the country running east and west. A third included all the trains in the east running north and south. A fourth included all trains in the western two-thirds of the country running east and west. A fifth included all trains in the west running north and south. Selected data for each is shown in Table II-1.[1] (All data on passenger characteristics are shown in the appendix). The variables selected for inclusion are the more discriminating dimensions discussed above.

It may be seen that the similarity among the regions are rather uniform. It is the northeast that differs most from other sections of the country. Here, the proportion of male travelers is significantly higher than on other routes throughout the country. In this region, 50.2% of all passengers are men. The reason for this is clear from the data. Over 37% of all travel on these trains is for business, while for those traveling east-west from the east, 24% are going for business travel. Those on the western routes are using the train for business in only 15% of the cases or less.

It is important to note that the age of the passengers on trains in the northeast is no different from other parts of the country. That is, older men are using these trains for business while on the rest of the system it is older women using the train for social and recreational purposes. An interesting question is whether these men are the remnant of a generation of businessmen for whom the only mode of intercity transport was the train. There is no evidence from the study save the fact that there is no correlation between trip purpose and mode of choice shown in the last two columns. Regardless of sex or trip purpose, all train travelers prefer the train over air two to one. The only difference in the northeast from the rest of the country is that auto as a free choice alternative is a higher proportion of preference. This would

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[1] p. 12

Table II-1

TRAVEL CHARACTERISTICS BY REGION
-Northeast-

D.O.W.	Train #	Origin/Destination	Trip Purpose*		Sex*		Satisfaction	Free Choice*	
			Business	Soc/Rec	F	M		Train	Air
Sunday	175	Boston/Washington	24.3	68.4	52.9	47.1	4.7	54.4	31.6
Thursday	175	Boston/Washington	22.4	69.3	58.2	41.8	4.3	61.2	26.5
Wednesday	174	Washington/Boston	36.4	48.5	56.1	43.9	4.2	62.1	19.7
Wednesday	151	Boston/Washington	55.9	38.3	48.9	51.1	4.0	75.6	20.0
Thursday	150	Washington/Boston	52.2	21.7	32.4	67.6	4.5	80.3	11.3
Sunday	182	Washington/Boston	11.2	82.7	51.9	48.1	5.0	50.8	40.3
Sunday	73	New York/Buffalo	22.0	71.1	67.8	32.2	4.2	54.2	23.7
Tuesday	74	Buffalo/New York	44.4	48.1	44.4	55.6	4.2	55.6	20.4
Monday	71	New York/Buffalo	33.8	59.2	40.0	60.0	4.2	63.4	19.7
Thursday	73	New York/Buffalo	30.4	59.0	48.4	51.6	4.1	70.0	20.0
Friday	74	Buffalo/New York	30.8	61.5	52.9	47.1	4.1	61.2	26.9
Wednesday	78	Buffalo/New York	23.7	68.5	43.2	56.8	3.2	65.7	14.3

*percentages

Table II-1

TRAVEL CHARACTERISTICS BY REGION

-East (East-West)-

D.O.W.	Train #	Origin/Destination	Trip Purpose*		Sex*		Satisfaction	Free Choice*	
			Business	Soc/Rec	F	M		Train	Air
Tuesday	41	New York/Chicago	57.8	32.6	44.8	55.2	4.6	80.2	12.7
Tuesday	40	Chicago/New York	18.5	74.0	48.1	51.9	4.6	77.8	18.5
Monday	41	New York/Chicago	19.5	74.6	70.7	29.3	4.9	63.4	24.4
Saturday	30	Kansas City/New York	36.9	53.5	51.7	48.3	4.0	81.6	14.9
Monday	31	New York/Kansas City	29.8	61.7	58.8	41.2	4.1	76.3	12.4
Thursday	50	Chicago/Washington	7.1	78.5	61.6	38.4	4.3	69.9	20.5
Thursday	51	Washington/Chicago	29.6	63.0	57.4	42.6	4.6	70.4	16.7
Tuesday	360	Chicago/Detroit	10.0	80.0	58.1	41.9	4.7	54.8	32.3
Monday	362	Chicago/Detroit	15.2	73.9	67.9	32.1	4.0	56.9	29.4
Monday	361 & 363	Detroit/Chicago	9.6	82.4	81.4	18.6	4.4	68.1	10.9

*percentages

Table II-1

TRAVEL CHARACTERISTICS BY REGION

-West (North-South)-

D.O.W.	Train #	Origin/Destination	Trip Purpose*		Sex*		Satisfaction	Free Choice*	
			Business	Soc/Rec	F	M		Train	Air
Monday	011	Seattle/San Diego	21.2	72.7	69.8	30.2	4.6	74.1	19.8
Saturday	015	Chicago/Houston	24.1	67.4	68.1	31.9	5.0	63.8	29.1
Tuesday	016	Houston/Chicago	17.0	79.6	67.0	33.0	5.1	75.0	15.9
Saturday	011	Seattle/San Diego	10.0	85.3	66.7	33.3	4.4	73.3	20.9
Friday	013	San Diego/Seattle	8.5	83.4	70.2	29.8	4.2	77.7	16.4
Saturday	015	Chicago/Houston	27.3	67.6	69.2	30.8	4.0	58.2	31.5
Thursday	302	St. Louis/Milwaukee	42.6	44.1	58.8	41.2	4.5	69.1	22.1
Wednesday	303	Milwaukee/St. Louis	40.0	56.9	60.0	40.0	4.3	67.7	20.0
Saturday	326	Milwaukee/St. Louis	30.0	62.0	72.0	28.0	4.1	54.0	28.0
Sunday	302	St. Louis/Milwaukee	19.3	75.5	65.8	34.2	4.6	61.4	21.9

*percentages

Table II-1

TRAVEL CHARACTERISTICS BY REGION

-West (East-West)-

D.O.W.	Train #	Origin/Destination	Trip Purpose*		Sex*		Satisfaction	Free Choice*	
			Business	Soc/Rec	F	M		Train	Air
Saturday	008	Seattle/Chicago	16.2	77.1	70.9	29.1	4.4	70.6	21.3
Wednesday	007	Chicago/Seattle	3.0	89.4	65.7	34.3	4.5	62.6	22.3
Monday	001	New Orleans/LA	4.3	87.1	85.9	14.1	4.7	75.9	17.7
Tuesday	002	LA/New Orleans	2.5	86.6	73.9	26.1	3.9	71.3	23.0
Tuesday	003	Chicago/LA	9.2	82.9	72.3	27.7	5.2	79.7	16.5
Tuesday	005	Chicago/San Fran.	20.8	71.9	61.3	38.7	4.2	71.5	21.5
Monday	006	San Fran./Chicago	2.9	91.2	64.1	35.9	4.5	73.4	19.0
Sunday	004	LA/Chicago	18.6	73.7	66.7	33.4	4.7	76.7	14.7

*percentages

indicate that in this region of the country, trip lengths are much shorter than in other areas. It is probably for this reason that the train is a relatively acceptable alternative to air and, consequently, this corridor is the most profitable for Amtrak.

However, there is another relation that may have a significant implication for the future of passenger rail. A correlation was carried out between the percentage of passengers using the train for business purposes and satisfaction with train service. (A Spearman rank correlation was used. In four out of five of the regions, rho was -0.41 to -0.59. This range of correlation is significant at the .05 level. The correlations are surprisingly high considering the very narrow range of satisfaction values.) The results reliably show that business travelers have more negative feelings about train service than those traveling for social and recreational purposes. It is reasonable to infer that, under pressure of business, the train as a mode is less satisfying to the traveler. In face of the fact that the sample is restricted to confirmed train users, such a correlation suggests that it may be extremely difficult for Amtrak to compete successfully for business travel. Again, detailed attitude studies of non-users are needed to determine the conditions, if any, that may make rail service attractive to significant portions of long-distance business travel.

In summary, the results of this study clearly indicate that, with the exception of the northeast, the rail users are older women traveling for social and recreational purposes. In general, these appear to be people under few time constraints for whom any alternatives to the train appear socially and psychologically unattractive. These users are very satisfied with the train service. Even in the northeast, where considerably more businessmen travel by train than elsewhere, as a group they seem to have similar characteristics to the users in other parts of the country. These appear, on the whole, to be a group significantly different from the larger population of travelers using air, bus, or automobile.

Chapter II

REFERENCES

1. Moyer, N. E. and Michaels, R. M. "User-Determined Priorities for Service Quality Control in a Passenger Railroad System." Transportation Center Research Report, Northwestern University, Evanston, Illinois, 1972.

Chapter III
PASSENGER TRAFFIC CHARACTERISTICS

Introduction

The purpose of this chapter is to present information on the quantity of traffic on the Amtrak system. Information is presented based upon two distinct data sets--one a sample survey of trains conducted in June and July of 1972 (the sample upon which the information in previous chapters is based) and the other being Amtrak statistics for the period May 1971 through February of 1972 (termed the 1971-2 data base for ease of reference). Both of these data sets are used in order to provide as complete a picture of traffic as possible. The 1972 sample provides the most recent data, and is compatible with the analysis of passenger characteristics and origin-destination patterns. Yet these data are for a particular period which is a peak traffic period on most Amtrak routes, and additional information on the seasonal fluctuations of traffic, the overall matching of train size to traffic, etc., is desirable to present a more complete picture of traffic patterns. Therefore, both data sets have been used in the analysis. The analysis and conclusions resulting from each data set are presented separately, so as to avoid confusion, the conclusions from each being integrated in the final section.

June and July 1972 Data

The source of these data--a survey sample of trains, was described in detail in the first chapter. The data on passenger loads on each train were made by actual counts of persons on board so that passengers who refused to complete the survey form or who had already filled one out were nevertheless included. Counts were made on a number of links of a train's route, generally between the major traffic generating stations, so that fluctuations in traffic were accounted for. These data are analyzed in terms of mean loads, geographic distribution, and variations in the loads.

Traffic Loads

Information on the traffic loads in the various routes was obtained in the survey of June and July, 1972. Passenger counts were made on each route between selected station stops In the eight weeks of the survey, every train route was sampled five to nine times. It was possible, therefore, to estimate the mean ridership and the variation in ridership during this period for all routes. For the system as a whole, the average number of passengers was 162.6. The lowest volume recorded was on train #363 from Detroit the Chicago which had an average of 37.7 passengers. The highest was the segment of train #58 from Memphis to Chicago, with an average of 388.3 passengers. In general, it is the trains in the eastern half of the country that have the lowest average loadings. The average loadings for each train by route segment is shown in Figure III-1.[1]

In order to place these data in perspective, these loads can be converted into an equivalent number of cars per train. For this purpose, a coach seating 60 persons is used, this being close to the mean capacity of Amtrak coaches 54.5 seats.*

*Coaches range in capacity from 44 to 89 seats (although on some runs it appears as though cars of greater capacity are used, but no record of such cars was found in the Amtrak lists), long distance luxury coaches ranging from 44 to 72 seats.

[1] p. 23

Fully 41.4% of the route segments have average traffic loads which are equivalent to two coaches or less, and 59.8% three coaches or less. All but one route segment corresponds to six coaches or less. Thus, the average traffic loads correspond to fairly short trains, although the fluctuations in traffic (to be discussed in a following section) are the actual determinants of train size.

Geographic Distribution of Traffic

Figure III-1[1] presents the geographic distribution of Amtrak traffic during the survey period. Although difficult to measure quantitatively, there appears to be no particular geographic bias in the traffic. However, the short distance routes appear to have somewhat less traffic than the longer routes, in general. (This is explored in detail in the section dealing with the 1971-2 traffic data.)

Variations in Traffic

Since every train and route segment was sampled an average of seven times, the variation in traffic may be estimated for the study period. The standard deviations in passenger loads was calculated. This statistic permits one to estimate the likelihood of passenger loads being at any particular level on any day. For planning purposes, a realistic criterion for this likelihood is the 85th percentile. This is used in planning needed highway capacity (1) among other systems. What the 85th percentile load means is simply that on the runs that a train makes, the number of passengers it will carry will be equal to or less than this value 85% of the time.

From the data obtained in the June and July, 1972 survey, it was found that the 85th percentile load on all Amtrak

1 p. 23

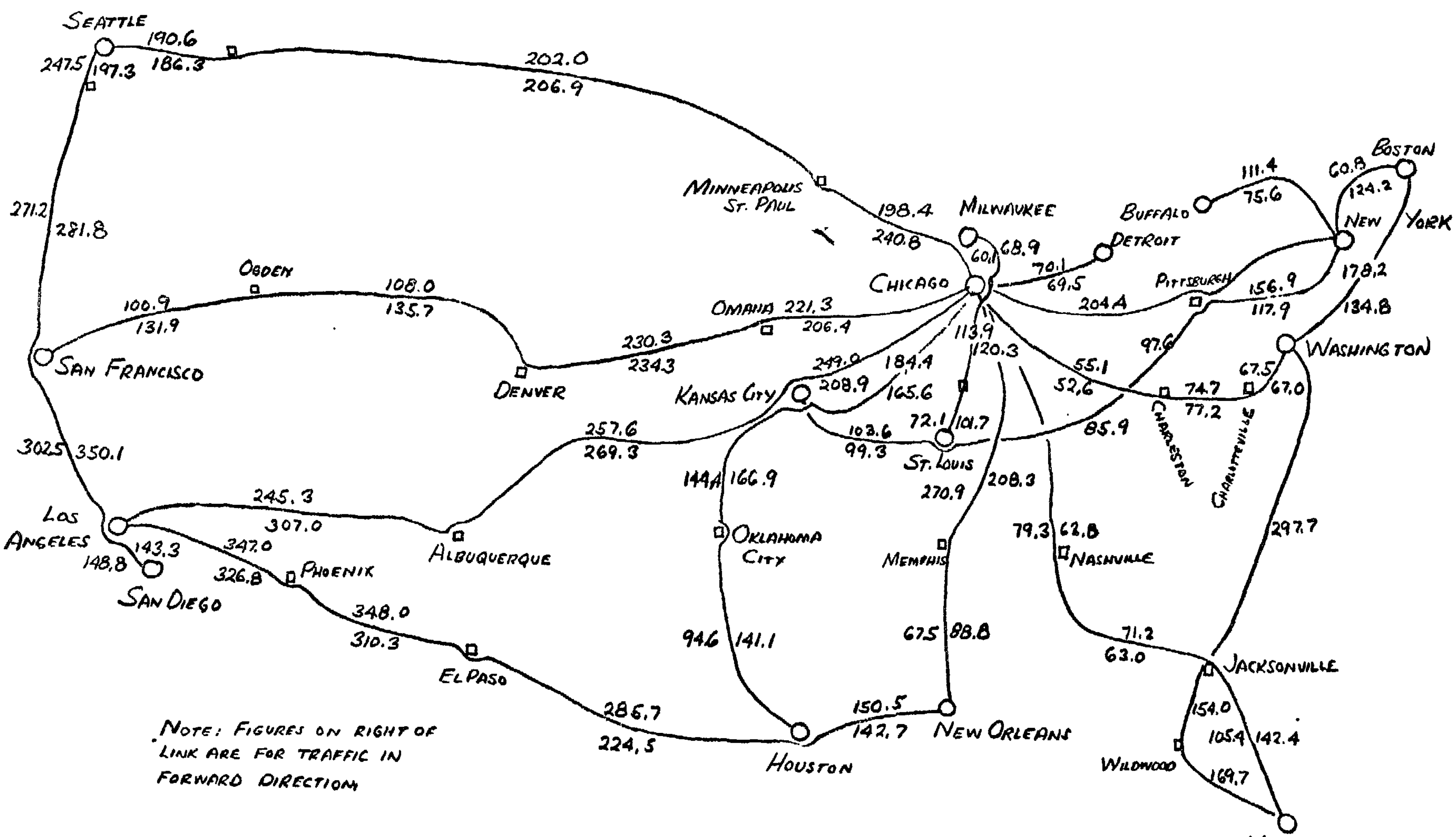

FIGURE III-1. AVERAGE TRAIN LOAD ON ROUTE SEGMENTS IN JUNE AND JULY 1972.

routes was approximately 1.31 times the average. The correlation between average train load and 85th percentile load is shown in Figure III-2[1] and III-3[2] in which the data are plotted for day trains (coach and parlor cars only) and overnight trains (coach and Pullman car) respectively. As may be seen, the deviations from the figure of 1.31 are quite small, hence this constant may be used on any route or route segment for estimating capacity requirements.

Table III-1[3] contains summary data on the size of train corresponding to average and 85th percentile loads on the various train segments sampled. Again, a car capacity of 60 persons was used. Half the train segments require trains of three cars or less, and 70% four cars or less, to accommodate the 85th percentile traffic. To accommodate this traffic, seven coaches of this capacity would be sufficient on all routes. Of course, with lower capacity pullman cars, actual trains would be larger, but this does serve to indicate the magnitude of traffic levels.

The implication of this variation in traffic for Amtrak is clear. If, for example, Amtrak were to decide to provide capacity for the 85th percentile traffic, then the fraction of seats and rooms occupied on average would not exceed 76% (1.00/1.31). Tending to increase this possible utilization would be the varying of train size to suit the traffic. On the other hand, tending to reduce it would be other variations in traffic (such as by direction on a route or seasonal variations) and the limitation of varying train capacity only in relatively large units (one car). Since the 1972 survey was conducted only in June and July, discussion of longer duration

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2 p. 26
3 p. 27

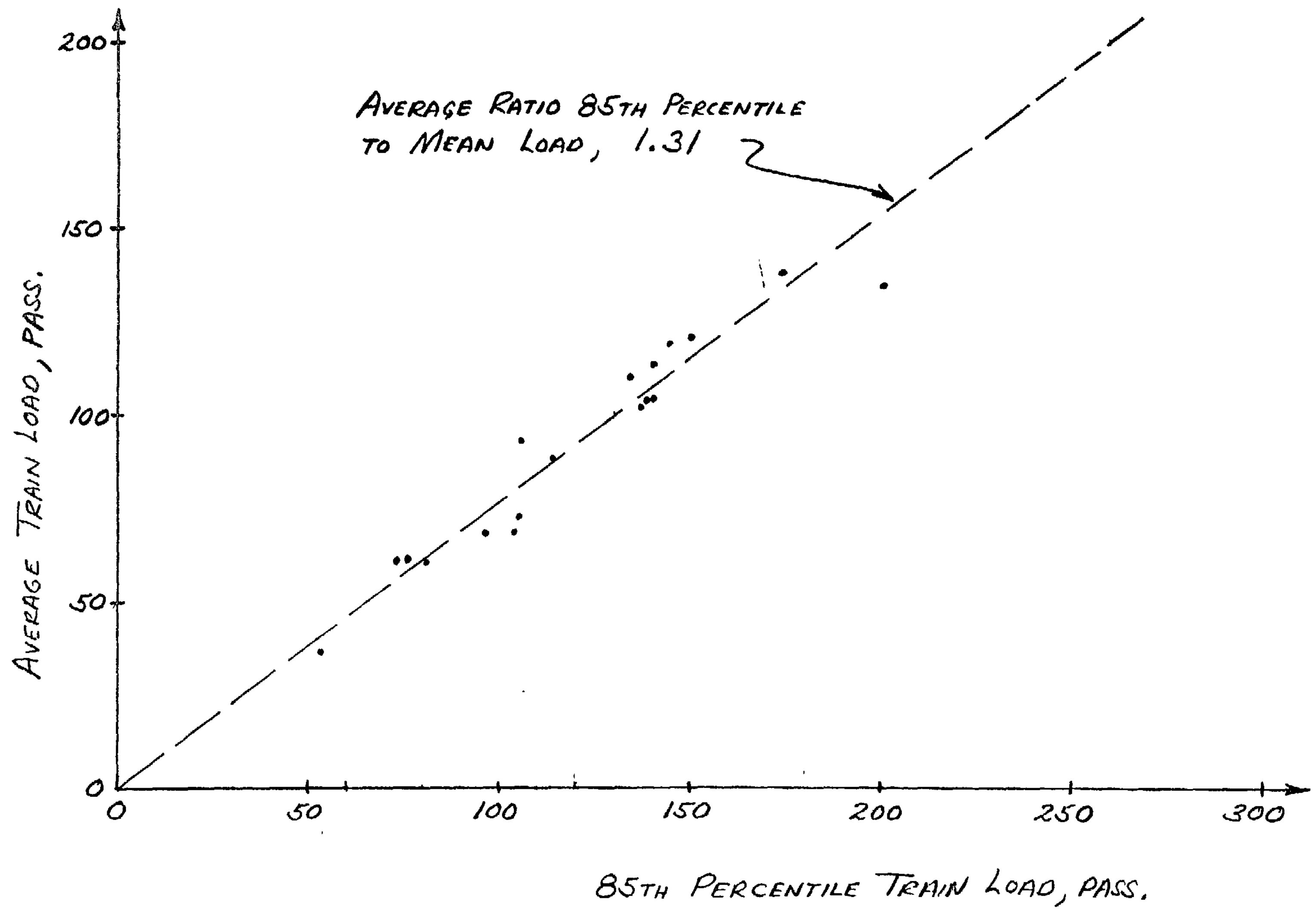

FIGURE III-2. AVERAGE AND 85TH PERCENTILE LOADS FOR COACH TRAINS IN JUNE AND JULY 1972 SURVEY.

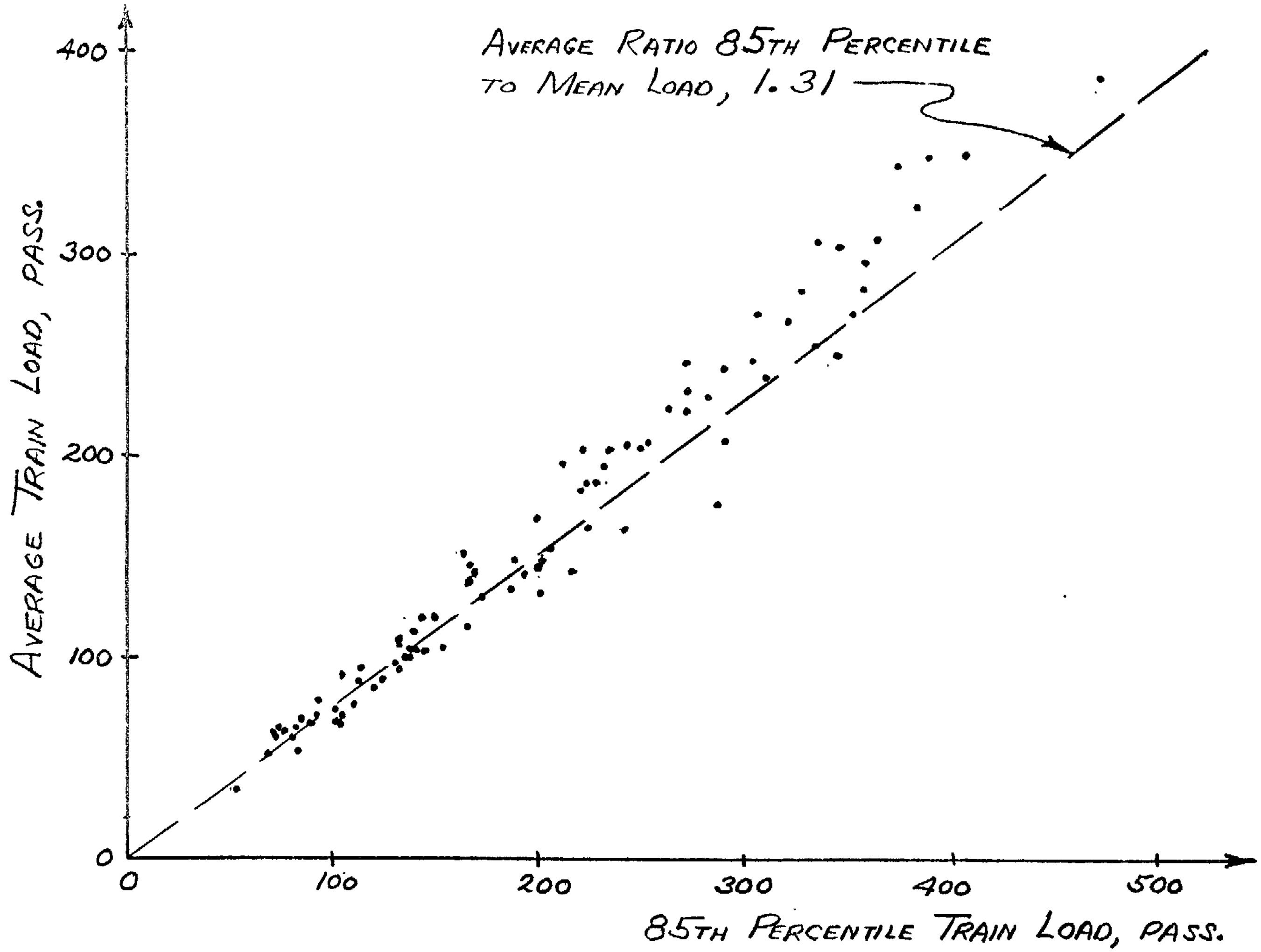

Figure III-3. Average and 85th Percentile Loads for Coach-Pullman Trains in June and July 1972 Survey.

Table III-1

TRAIN SIZE EQUIVALENTS OF AVERAGE AND 85TH PERCENTILE LOADS
IN JUNE AND JULY 1972 SAMPLES

Number Of Cars*	Average Loads		85th Percentile Loads	
	Number of Segments	Cummulative %	Number of Segments	Cummulative %
1	3	3%	1	1%
2	33	41%	20	24%
3	16	60%	22	50%
4	17	79%	18	70%
5	11	92%	10	82%
6	7	100%	11	94%
7	0	100%	5	100%

*Capacity of each car is 60 passengers

fluctuations must be made on the basis of the 1971-2 data in a following section.

Analysis of 1971-2 Data

Data Base

In order to analyze Amtrak traffic characteristics in addition to those discussed above, it was necessary to use data for the period of May 1971 through February 1972, summary route data for all of 1971, and detailed train data for July and August 1971. These data were very complete as to train loads and other characteristics, since the data were collected on every run of every train. They were not available for any period after February 1972 because of lags in the reporting and compilation process.

In using 1971 data, it is essential that the changes in traffic which have occurred between 1971 and 1972 be determined. In order to compare traffic levels, individual counts of passengers on board trains made in the sample survey conducted in late June and July of 1972 were compared with counts made in the same period of 1971. Each count made in 1972 was matched with a passenger count on the same train, between the same station stops, and on the same day of the week (two dates in advance) in 1971. In general, two days were matched for each train. The counts in each year for each train were then averaged and compared. These average loads are presented in Table III-2[1], along with the differences and ratio of 1972 to 1971 levels. Although the average number of passengers on board increased in 1972, Students 't' test performed on these data showed that the increase in average train loads was

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[1] p. 29

TABLE III-2

TRAFFIC

not significant from a statistical analysis standpoint. The significance of this for the ensuing analysis is that it is likely that the general pattern of traffic in 1971-2 is indicative of the present traffic pattern.

Penn Central Route Changes

As mentioned above, of necessity, much of the data used for this analysis is from 1971 and early 1972; the lag of reporting detailed information on operation and traffic levels precluding use of data from the past few months. The use of data for the period May, 1971 to February, 1972 poses few difficulties for analyses by routes except for routes on the Penn Central system. During the period of interest only on this railroad were substantial changes made in the route structure, resulting in a current route structure, introduced on November 14, 1971, which is substantially different from that for the preceding period. As the railroad stated in its annual operating statement, "effective November 14, 1971, extensive changes in train number, routes, scheduling, and destinations made comparability between periods meaningless. For this reason, year to date operating statements are shown for the period ending November 13, 1971, and for the period November 14 through December 31, 1971." In Table III-3[1] are presented the Penn Central routes operated during 1971. Of the eighteen routes defined for operations after November 14, only six were identical in terms of end points, number of trains operated, and approximate average train loads and average trip lengths before and after the change. The remaining routes are either entirely

[1]p. 31

Trip Length	
[illegible]	After
0	391.6
	355.5
[illegible].7	125.5
0.1	101.4
16.1	218.0
	162.2
103.9	112.8
128.5	135.0
	87.0
	50.9
122.9	136.1
	80.8
46.2	46.4
191.0	191.0
	129.3
	29.3

Table III-3

CHANGES IN PENN CENTRAL ROUTE STRUCTURE AND CHARACTERISTICS
ON NOVEMBER 14, 1971
(continued)

Status*	Route	No. of Trains Per Day		Average Train Load		Average Trip Length	
		Before	After	Before	After	Before	After
N	New Haven-Springfield		3 1/2		29.8		30.0
I	Harrisburg-Philadelphia	9 1/2	9 1/2	49.7	56.8	48.2	45.7
D	Philadelphia-Washington	1/2		56.5		56.1	
D	New Haven-New London	1		24.3		35.7	
D	Chicago-Cincinnati	1		19.2		132.3	
D	New York-Albany/Buffalo	8		41.8		172.5	
D	New York-Springfield	10 1/2		31.1		29.7	

*Notes: I = Route essentially identical before and after
D = Old route for which designation was dropped
N = New route
C = Route remained but characteristics changed

See text for more explanation.

new or their characteristics had changed markedly from one period to the next. Five of the routes operated before the change were discontinued.

This presents considerable difficulties for the analysis of traffic characteristics during this period. In order to make the data and analysis as current as possible, every effort was made to use data on the current Penn Central routes, although this introduces a bias in that these routes were only operated for one and one half months in 1971. Use of this data will tend to slightly bias traffic estimates upward although, as may be seen from Table III-3[1], the changes in traffic characteristics on those routes which remained in effect were minimal in most cases. Whenever information is required on characteristics of traffic prior to November 14, the data on the old route structure will be used, but this will be duly noted. For convenience, information on the current Penn Central routes will be designated "current Penn Central routes," and those on the earlier route structure will be designated "old Penn Central routes."

Average Traffic Loads

Average Annual Flows

Annual traffic loads on trains on the various Amtrak routes in 1971 are presented in Figure III-4[2]. These data are presented by route or, in the few instances of very long routes operated by more than one railroad, by major route segment. Current Penn Central data is used. The measure of passenger traffic load on each train is the total passenger miles traveled in that year on the route divided by the total train miles operated on that route. A passenger mile is

[1]p. 32
[2]p. 34

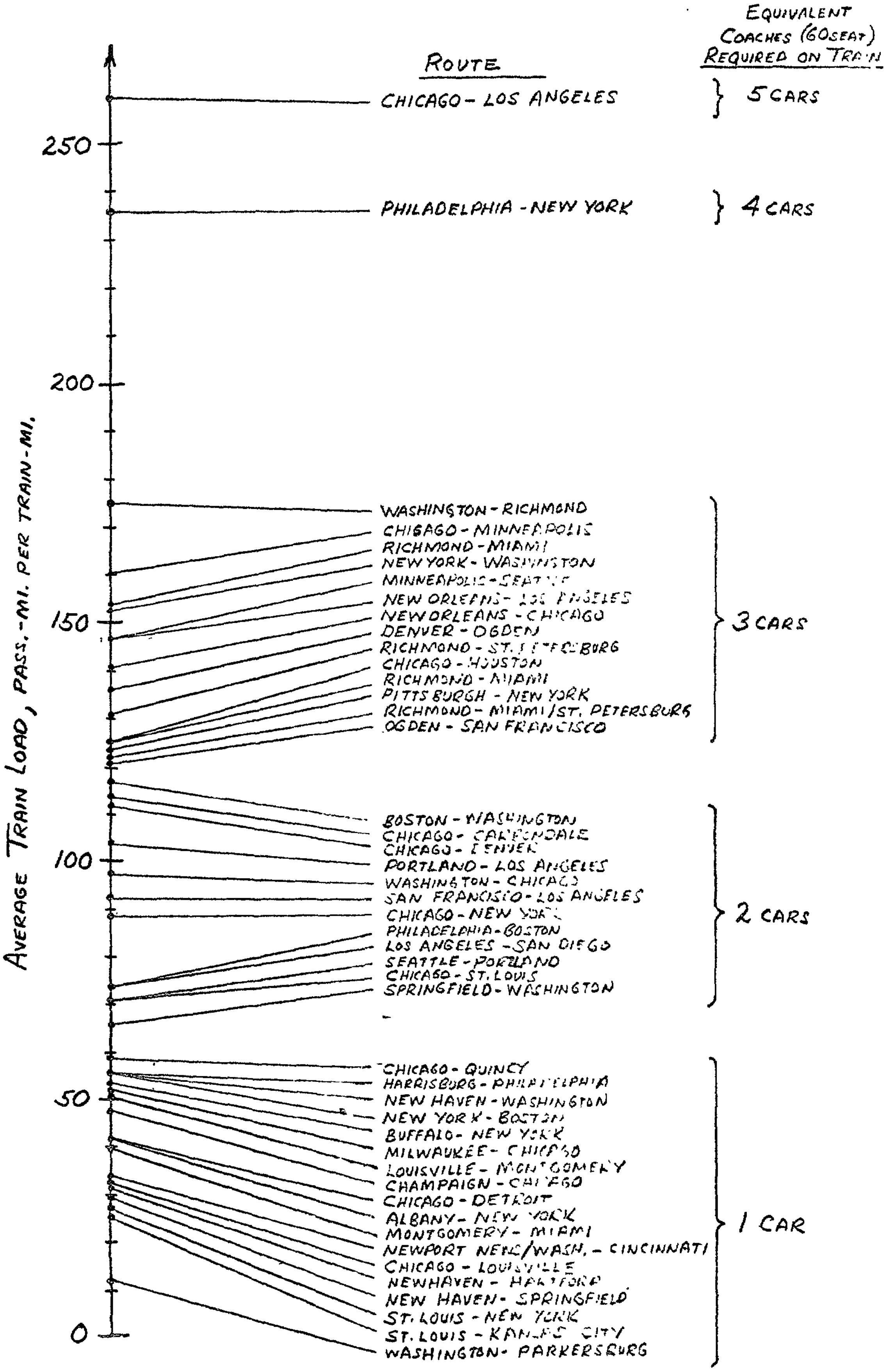

FIGURE III-4. AVERAGE TRAIN LOADS BY ROUTE IN 1971
(CURRENT PC ROUTES)

defined as a passenger traveling one mile, so that the total passenger miles for any particllar train is determined by simply adding the length of ride of each passenger on that train. These data for all trains on the route are then summed for the year, and this sum is divided by the total train miles operated. Thus, it is a measure of the average number of passengers one would expect to find on a train on that route.

As can be seen from this figure, there is a considerable range of average 1971 traffic levels, from a little more than ten passengers on a train to over 260, with most of the routes between 25 and 160 passengers. As expected, these are somewhat lower than the sample averages for 1972, since they were taken during a peak travel period (as will be discussed later). Again, these loads have been converted into an equivalent number of cars. Using coach seating of sixty passengers, these loads range from one coach being adequate to five coaches being required to accommodate the average traffic loads. More importantly, eighteen of the forty-six routes (or segments) or 39% of them require, on average, a one coach train. Fully thirty of these routes, approximately two-thirds of them, could be operated with trains of two coaches or less. All but two could be operated with trains of three coaches or less for the average load.

Geographic Distribution of Traffic

Figure III-5[1] presents the average 1971 train loads as they exist in terms of location throughout the Amtrak system, with the exception of the northeast area which, because of

[1]p. 36

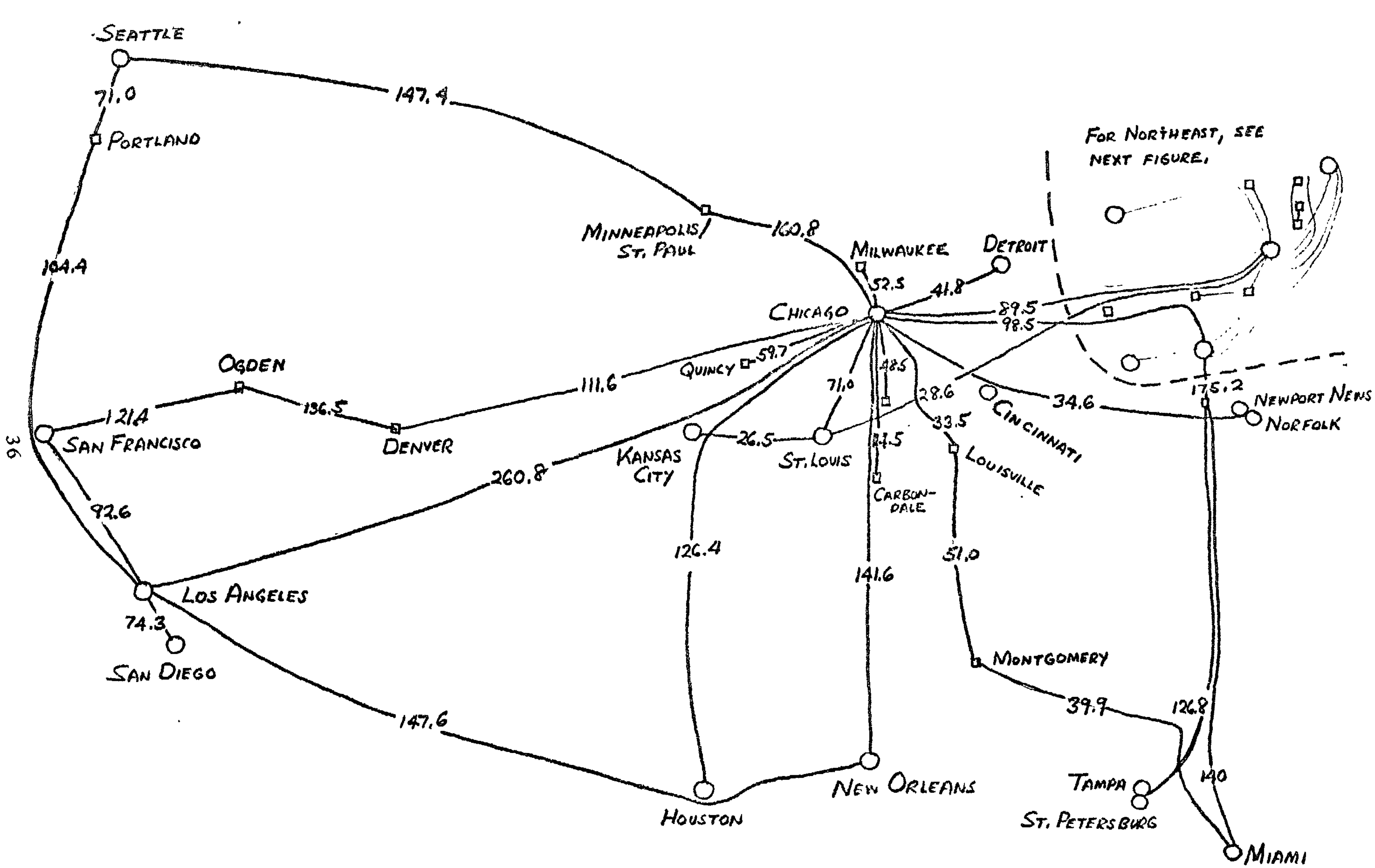

Figure III-5. Average 1971 Train Loads (outside Northeast).
(current RC Routes)

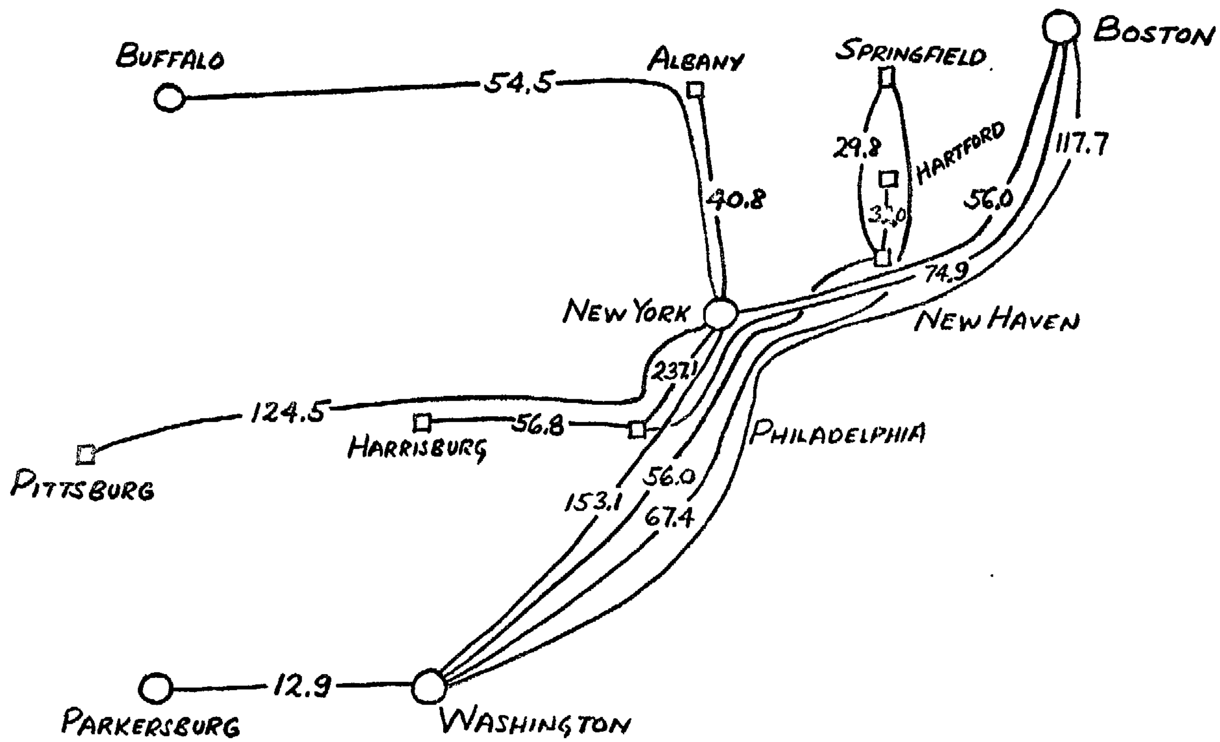

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FIGURE III-6. AVERAGE 1971 TRAIN LOADS IN NORTHEAST.
(CURRENT PC ROUTES)

the density of routes is shown on the following figure. Again, the current Penn Central route data is used. As revealed in the 1972 sample, there seems to be no particular spatial bias in terms of average load, high as well as low loads being experienced in the west, mid-west, and east. However, there seem to be concentrations of relatively low traffic routes in the vicinity of Chicago and Chicago to Miami, as well as in the northeast. Yet there are some very short routes with very high loads also. It should also be borne in mind that the shorter routes may be less costly per seat mile than longer routes, simply because passenger accommodations can be simpler, and there is no need for extensive dining, sleeping or lounge facilities.

Route length Distribution

The preceding figures for both 1971 and 1972 (Fig III-1,[1] III-5[2] and III-6[3]) seem to suggest that there may be an increase in average train load with increasing route length, suggesting that Amtrak may be currently more successful in attracting passengers to long distance routes than to short. However the relationship is weak, at best, as can be seen in Figure III-7.[4] It shows the relationship between average train load and average trip length. Average trip length, rather than route length, is used because a route may cover a long distance but may be used for short distance travel between major centers located on the route. The relationship appears especially weak considering the fact trip length is expressed logarithmically. And if the four lowest length routes were deleted, no relation at all would appear to exist.

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1 p. 23
2 p. 36
3 p. 37
4 p. 39

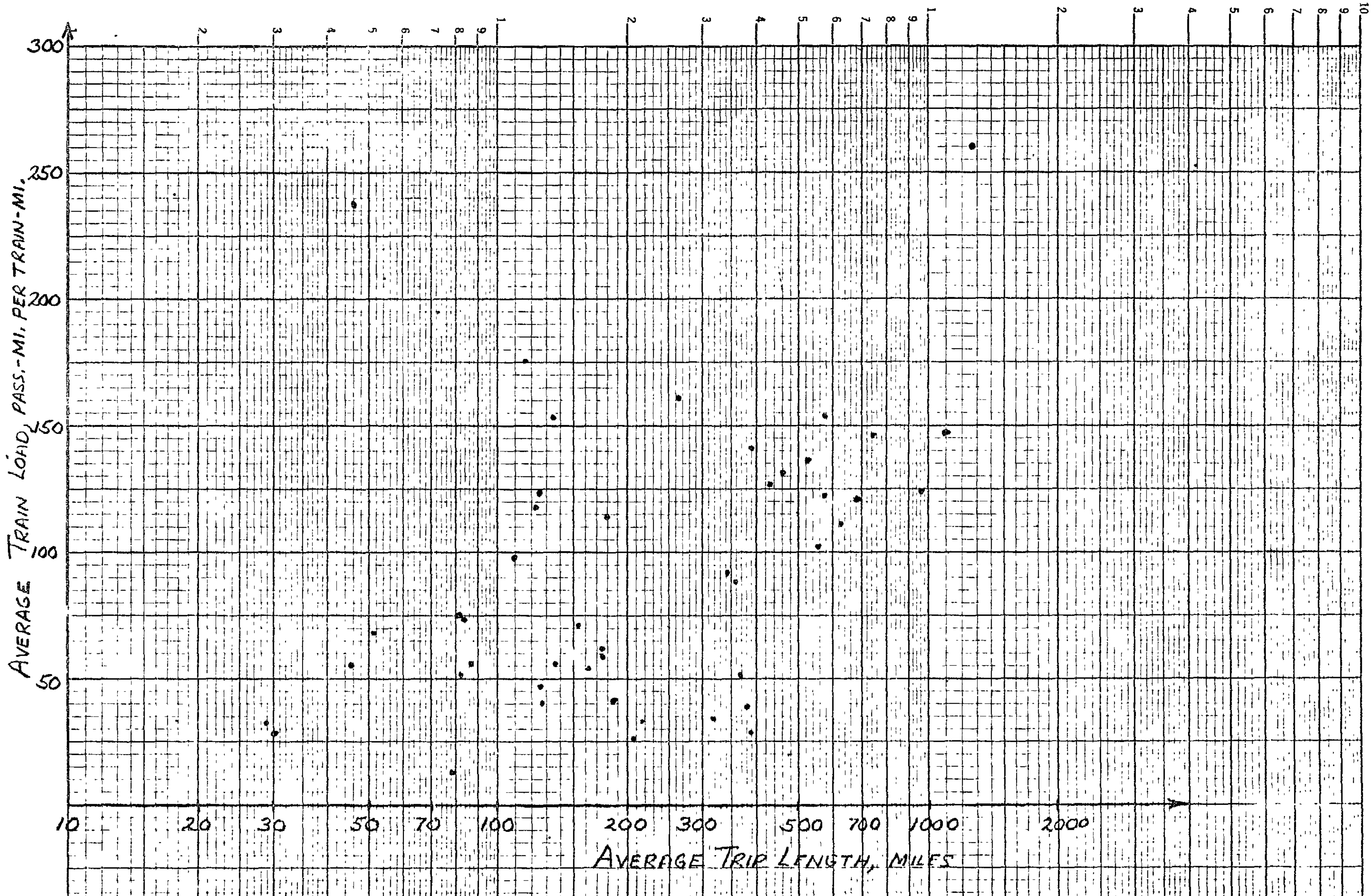

FIGURE III-7. RELATIONSHIP BETWEEN AVERAGE TRAIN LOAD AND AVERAGE PASSENGER TRIP LENGTH FOR EACH ROUTE (CURRENT PC ROUTES).

Traffic Variations

Seasonal Variations

As might be expected from the recreational nature of most Amtrak trips, there is a substantial seasonal variation in traffic on Amtrak routes. On a national or aggregate level, this is best seen by examination of Figure III-8[1], in which the revenue for the entire Amtrak system for each month in the period from May 1971 through February 1972 is presented. A substantial summer peak, reaching a maximum in July and a winter peak in December, can readily be seen. For the entire system, July is the peak month. The peak month revenue is approximately 50% greater than that for the lowest months--May, October, and November. This indicates that the traffic loads for the 1972 sample period--late June and July--should be interpreted as correct for that period but probably higher than those experienced in other portions of 1972, for the peaking observed in 1971 surely is characteristic of the predominately recreational traffic on Amtrak and would continue to occur in 1972.

Also presented in this figure, purely for information at this point, is data on train operating expenses and train operating plus facility expenses for the same period. These expenses seem to follow the same pattern as revenue, but the fluctuations are not nearly so great, indicating that added traffic was accommodated at relatively little added cost.

More specific information on the fluctuations in traffic by routes is presented in Table III-4[2]. For each route, the ratio of the July 1971 revenue (the peak month for the system) to the average 1971 monthly revenue is presented. This table

[1]p. 41
[2]p. 42

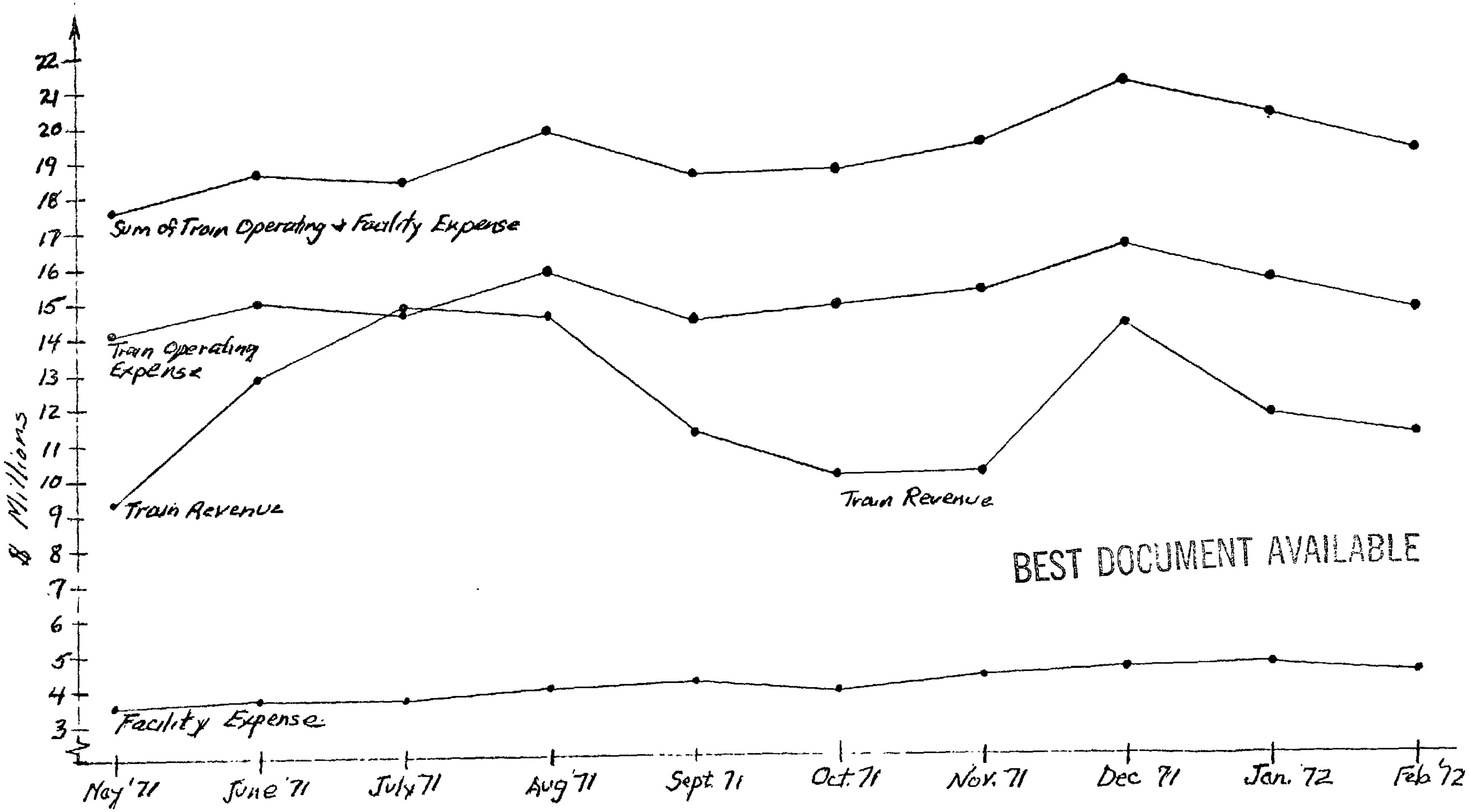

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Figure III-8 Monthly Revenue and Expense Pattern: May 1971-February 1972.

Table III-4

SEASONAL VARIATIONS IN TRAFFIC BY ROUTE

Route and Segment	Ratio of Peak Month Revenue to Average 1971 Revenue
New York - Boston	2.04
New Haven - New London	2.22
New York - Springfield	1.90
New York - Albany/Buffalo	2.36
Boston - Washington	2.21
New York - Philadelphia	1.82
New York - Washington	1.86
Philadelphia - Washington	1.71
New York - Pittsburgh	2.13
Philadelphia - Harrisburg	1.65
New York - Florida	
Washington - Richmond	2.10
Montgomery - Miami	2.43
Richmond - Miami/St. Petersburg	2.55
Richmond - Miami	2.09
Richmond - St. Petersburg	2.07
Norfolk/Newport News - Cincinnati	1.79
Washington - Parkersburg	0.58
Chicago - Detroit	2.40
Chicago - Cincinnati	2.24
Chicago - St. Louis	1.28
Chicago - New Orleans	2.11
Chicago - Carbondale	1.43
Chicago - Champaign	

Table III -4

SEASONAL VARIATIONS IN TRAFFIC BY ROUTE
(continued)

Route and Segment	Ratio of Peak Month Revenue to Average 1971 Revenue
Chicago - Miami	
Chicago - Louisville	1.98
Louisville - Montgomery	2.14
Montgomery - Miami	2.43
Chicago - Los Angeles	2.21
Chicago - Houston	1.89
Chicago - San Francisco	
Chicago - Denver	2.21
Denver - Ogden	1.62
Ogden - San Francisco	1.69
Chicago - Quincy	
Chicago - Seattle	
Chicago - Milwaukee	1.55
Chicago - Minneapolis	2.16
Minneapolis - Seattle	2.33
St. Louis - Kansas City	1.93
Seattle - San Diego	
Seattle - Portland	1.75
Portland - Los Angeles	1.36
Los Angeles - San Diego	1.83
San Francisco - Los Angeles	1.49
New Orleans - Los Angeles	1.75

necessarily presents information on Penn Central routes using old route structure, as data for the 1972 season are not yet available. Substantial variations in this ratio, which increase with increasing peaking of traffic, is noticed among the routes. Exactly half of the routes had July revenues, indicating very substantial peaking of traffic. (Data on the Washington-Parkersburg route may contain reporting or transcription errors, it being unlikely that summer revenue was less than winter revenue, although other changes on the route such as the introduction of the experimental Turbotrain may have caused this.)

A cursory examination of the information in Table III-4[1] would appear to suggest that the longer routes tend to be more peaked, or experience greater fluctuations in traffic, than the shorter routes, but the data do not support this conclusion. Figure III-9[2] is a scatter diagram of this measure of peaking or fluctuation of traffic, the ratio of July revenue to 1971 average monthly revenue against average trip length. There is no discernable tendency for the ratio to vary consistently with average trip length, and the variation at any particular trip length is exceptionally great. Thus, these data suggest there is no relationship between peaking and average trip length by route.

Daily Variations

In addition to the seasonal fluctuations in travel which are consistently observed through the system to varying degrees, there is also a variation in traffic throughout the days of the week. On all the routes, an examination of train passen-

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[1] p. 42

[2] p. 45

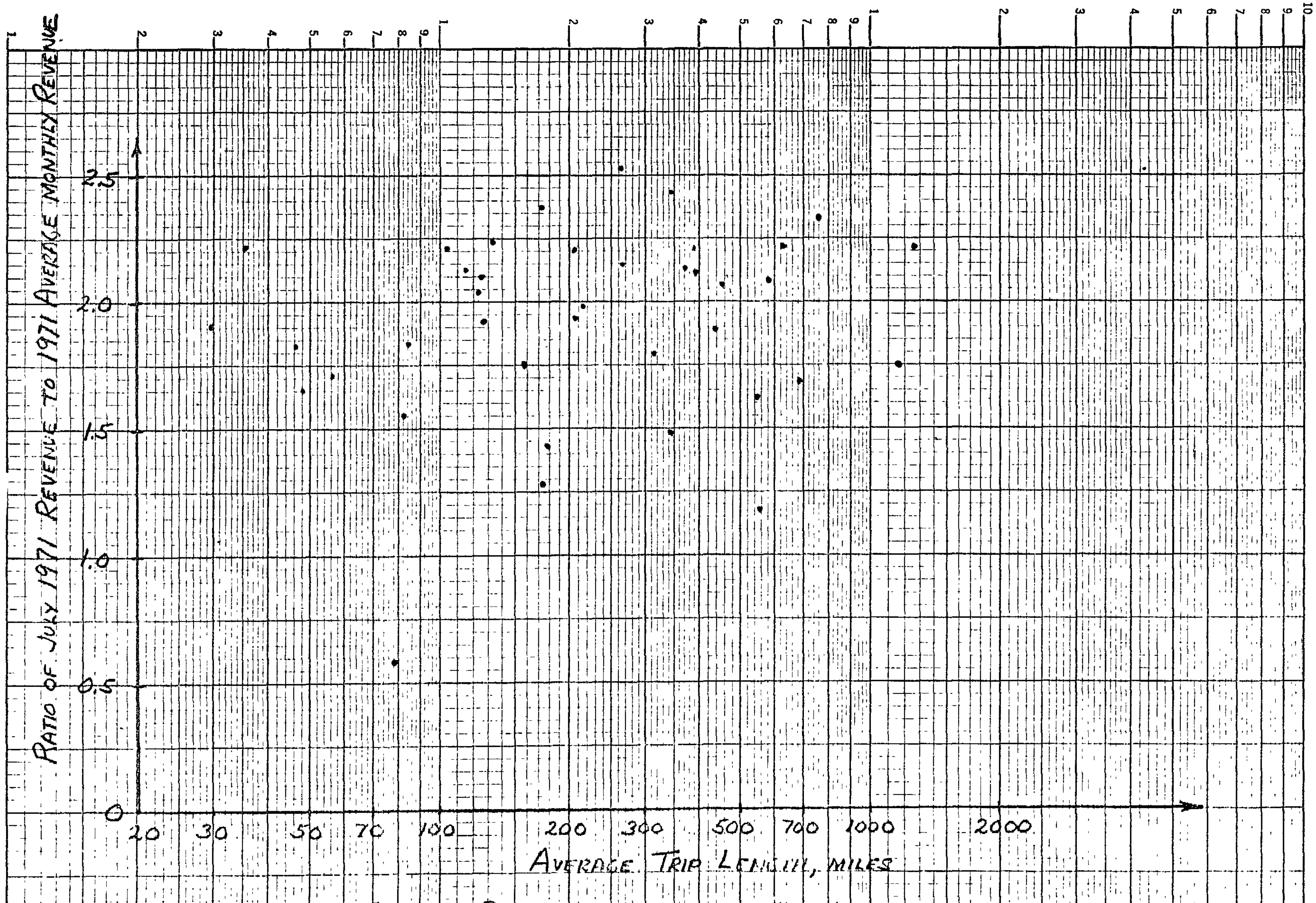

FIGURE III-9, PEAKING CHARACTERISTICS AND TRIP LENGTH
(OLD FC ROUTES)

ger count data indicated that traffic in the period from Friday evening through Monday morning seem to be substantially higher than the traffic typically found on weekdays. This is consistent with the preponderance of social and recreational trips in contrast to business trips being made on the rail system.

The conductors' counts of passengers on board their trains at various check points on each run every day were examined for the months of July and August, 1971 in order to identify the peak load on each train at each check point during each week of this period. For each route, the fraction of these peak loads which occurred on a Friday, Saturday, Sunday, or Monday were tabulated. These are presented in Table III-5[1] and it is very clear from that table that, on all routes, more than half the peak flow days are in the extended weekend period and, for most of the routes, the fraction is over two-thirds. Thus, there is a general pattern of daily variations in which a peak is acheived during the extended weekend period on all of the routes.

Capacity and Traffic Loads

Introduction

Against the background of the information presented above regarding average traffic loads and fluctuations in those loads by season and day of the week, it is appropriate to consider the extent to which the capacity provided throughout the Amtrak system is matched to those traffic loads. It is to be expected that the greater the fluctuation in traffic on a route, the greater the difficulty associated with matching capacity to traffic.

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[1] p. 47

Table III-5

FRACTION OF WEEKLY PEAK DAYS
OCCURRING ON WEEKENDS DURING TWO PEAK MONTHS OF 1971

Route and Segment	Fraction of Peak Days Which Were Friday-Monday
New York - Boston	93%
New Haven-Hartford-Springfield	64%
New Haven-New London	49%
New York - Buffalo - Cleveland - Chicago	--
New York-Albany	61%
New York-Cleveland-Chicago	89%
New York-Buffalo	65%
New York/Washington - Chicago/St. Louis	--
New York-Chicago/St. Louis	92%
Washington-Harrisburg	78%
New York - Pittsburgh	--
Harrisburg-Philadelphia	--
New York - Florida	--
Washington-Richmond	93%
Richmond-Florida	83%
Boston - New York - Washington	50%
Boston-Washington	--
New Haven-Washington	--
Springfield-Washington	--
Boston-Philadelphia	--
Norfolk/Newport News - Cincinnati	87%
Washington - Parkersburg	--
Chicago - Detroit	76%
Chicago - Cincinnati	78%
Chicago - St. Louis	81%
Chicago - New Orleans	100%
Chicago-Carbondale	94%
Chicago-Champaign	--

Table III-5

FRACTION OF WEEKLY PEAK DAYS
OCCURRING ON WEEKENDS DURING TWO PEAK MONTHS OF 1971
(continued)

Route and Segment	Fraction of Peak Days Which Were Friday-Monday
Chicago - Miami	--
Chicago-Louisville	92%
Louisville-Montgomery	100%
Montgomery-Miami	100%
Chicago - Los Angeles	63%
Chicago-Quincy	--
Chicago - Houston	74%
Chicago - San Francisco	--
Chicago-Denver	94%
Denver-Ogden	100%
Odgen-San Francisco	78%
Chicago - Seattle	--
Chicago-Milwaukee	71%
Chicago-Minneapolis	89%
Minneapolis-Seattle	79%
St. Louis - Kansas City	83%
Seattle - San Diego	--
Seattle-Portland	63%
Portland-Los Angeles	62%
Los Angeles-San Diego	55%
San Francisco-Los Angeles	66%
New Orleans - Los Angeles	81%

Annual and Peak Load Factors

A very useful measure of the utilization of capacity, or the matching of capacity to traffic loads, is the load factor. The load factor on a route is total passenger miles carried on that route in the period of concern, divided by the total seat miles (or passenger capacity miles) for the same period. It is usually expressed as a percentage and indicates the percentage of places for passengers which one would expect to find occupied on average.

Data on the coach and pullman load factors for the various Amtrak routes are presented in Table III-6.[1] Data presented here for the Penn Central system is for the current route structure. As can be seen, the range of utilization for coach capacity is from a low of 14.1% to a high of 66.7%, with an average of 36.9%. For the pullman, the range is from 1.8% to 59.7%. By comparison, in 1971 bus lines experienced a load factor of 49.7% (2) and in 1971 the intercity domestic air lines experienced one of 48.9% (3). On none of the routes is the utilization of capacity exceptionally high, although any evaluation of the adequacy of these load factors, or the adequacy of the matching of capacity to traffic, must await the economic analysis presented in Chapter VI.

For those routes which were operated during July of 1971, data are presented on the load factors achieved during that month. Perhaps the most striking feature of these data is that there is only a small difference between the peak month load factors and the average annual load factors for most of the routes, for both coach and pullman accommodations. On

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[1] p. 50

Table III-6

ANNUAL AND PEAK MONTH LOAD FACTORS
(UTILIZATION OF CAPACITY) BY ROUTE SEGMENT (CURRENT PC ROUTES)

Route and Segment	Coach Load Factors Average 1971	Coach Load Factors Peak Month 1971	Pullman Load Factors Average 1971	Pullman Load Factors Peak Month 1971
New York - Boston	25.5%		11.4%	
New Haven-Hartford	24.3%			
New Haven-Springfield	29.8%			
New York - Buffalo	33.3%			
New York-Albany	33.9%			
New York/Washington - Chicago/St. Louis	64.7%		33.0%	
New York-Chicago	30.8%		28.9%	
New York-St. Louis	14.1%		38.0%	
Washington-Chicago	47.5%		26.3%	
New York - Pittsburgh	50.5%			
Harrisburg-Philadelphia	29.0			
New York - Florida				
Washington-Richmond	63.0%	71.1%	28.0%	28.3%
Richmond-Miami/St. Petersburg	47.9%		40.2%	
Richmond-Miami	52.5%		25.2%	
Richmond-St. Petersburg	44.6%	51.3%	17.3%	16.6%
Richmond-Miami	56.1%	58.2%	32.3%	26.8%
Boston - New York - Washington				
Boston-Washington	33.1%		19.9%	
New Haven-Washington	28.9%		13.1%	
Springfield-Washington	25.2%		15.1%	
Boston-Philadelphia	19.6%		21.4%	

Table III-6

ANNUAL AND PEAK MONTH LOAD FACTORS
(UTILIZATION OF CAPACITY) BY ROUTE SEGMENT (CURRENT PC ROUTES)
(continued)

Route and Segment	Coach Load Factors Average 1971	Coach Load Factors Peak Month 1971	Pullman Load Factors Average 1971	Pullman Load Factors Peak Month 1971
Norfolk/Newport News - Cincinnati	26.9%	36.1%	33.4%	22.7%
Washington - Parkersburg	15.7%			
Chicago - Detroit	29.6%			
Chicago - Cincinnati				
Chicago - St. Louis	37.4%	40.1%	25.7%	20.1%
Chicago - New Orleans	32.1%	34.8%	33.4%	
Chicago-Carbondale	35.0%	32.6%	6.6%	4.0%
Chicago-Champaign	15.3%			
Chicago - Miami				
Chicago-Louisville	17.6%		16.4%	
Louisville-Montgomery	26.1%	41.7%	20.4%	19.8%
Montgomery-Miami	22.3%	34.7%	20.6%	15.4%
Chicago - Los Angeles	59.2%	70.6%	59.7%	75.3%
Chicago - Houston	43.8%	56.4%	44.5%	51.2%
Chicago - San Francisco				
Chicago-Denver	48.6%	60.5%	57.6%	78.0%
Denver-Ogden	60.1%	80.1%	61.7%	63.7%
Ogden-San Francisco	49.8%	57.0%	57.0%	59.8%
Chicago-Quincy	66.7%			

Table III- 6

ANNUAL AND PEAK MONTH LOAD FACTORS
(UTILIZATION OF CAPACITY) BY ROUTE SEGMENT (CURRENT PC ROUTES)
(continued)

Route and Segment	Coach Load Factors Average 1971	Coach Load Factors Peak Month 1971	Pullman Load Factors Average 1971	Pullman Load Factors Peak Month 1971
Chicago - Seattle				
Chicago-Milwaukee	25.4%	29.2%	1.8%	
Chicago-Minneapolis	46.2%	45.1%	28.4%	48.1%
Minneapolis-Seattle	52.5%	62.2%	59.6%	77.6%
St. Louis - Kansas City	21.4%	26.2%	9.6%	10.9%
Seattle - San Diego				
Seattle-Portland	34.1%	36.8%	38.9%	54.7%
Portland-Los Angeles	32.3%	32.8%	42.3%	50.3%
Los Angeles-San Diego	39.5%	41.1%	21.6%	27.4%
San Francisco-Los Angeles	42.8%	47.2%	29.7%	29.9%
New Orleans - Los Angeles	53.3%	64.0%	45.7%	53.3%

Note: No data are available for individual month train loads anywhere on the Penn Central system; hence the omissions.

all but two of the coach routes for which data are available, the load factors increased. Probably the explanation for the decrease for some load factors is that, with the addition of a few passengers to trains operating with a relatively low total load, the addition of a new coach and/or pullman car was required, and the added capacity more than outweighed the added traffic. In general, the data seem to indicate a consistent utilization of capacity that never approaches 100% for any extended period.

Route Length Variations

In Figure III-10[1] are presented data on the relationship between average annual load factor and average trip length by route. Data are differentiated between pullman and coach-type accommodations. It might be expected that, with increasing trip length, the carrier's ability to match capacity to demand would be greater, because it is more likely that passengers would obtain reservations in advance and, hence, the lead time necessary to change train length would be provided. This tendency is very weakly indicated by these data, although the deviations are very large for any trip length. Probably the reason for this is that the Amtrak system has many routes on which traffic is quite low relative to the capacity of an individual car--the basic unit by which capacity can be varied--and, hence, there is only a limited ability to match the capacity actually provided with the precise number of passengers traveling. Also, of course, there are variations in the traffic load along a train's route, and it may not be possible to vary the size of the train as the traffic varies. However, as discussed in

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1 p. 54

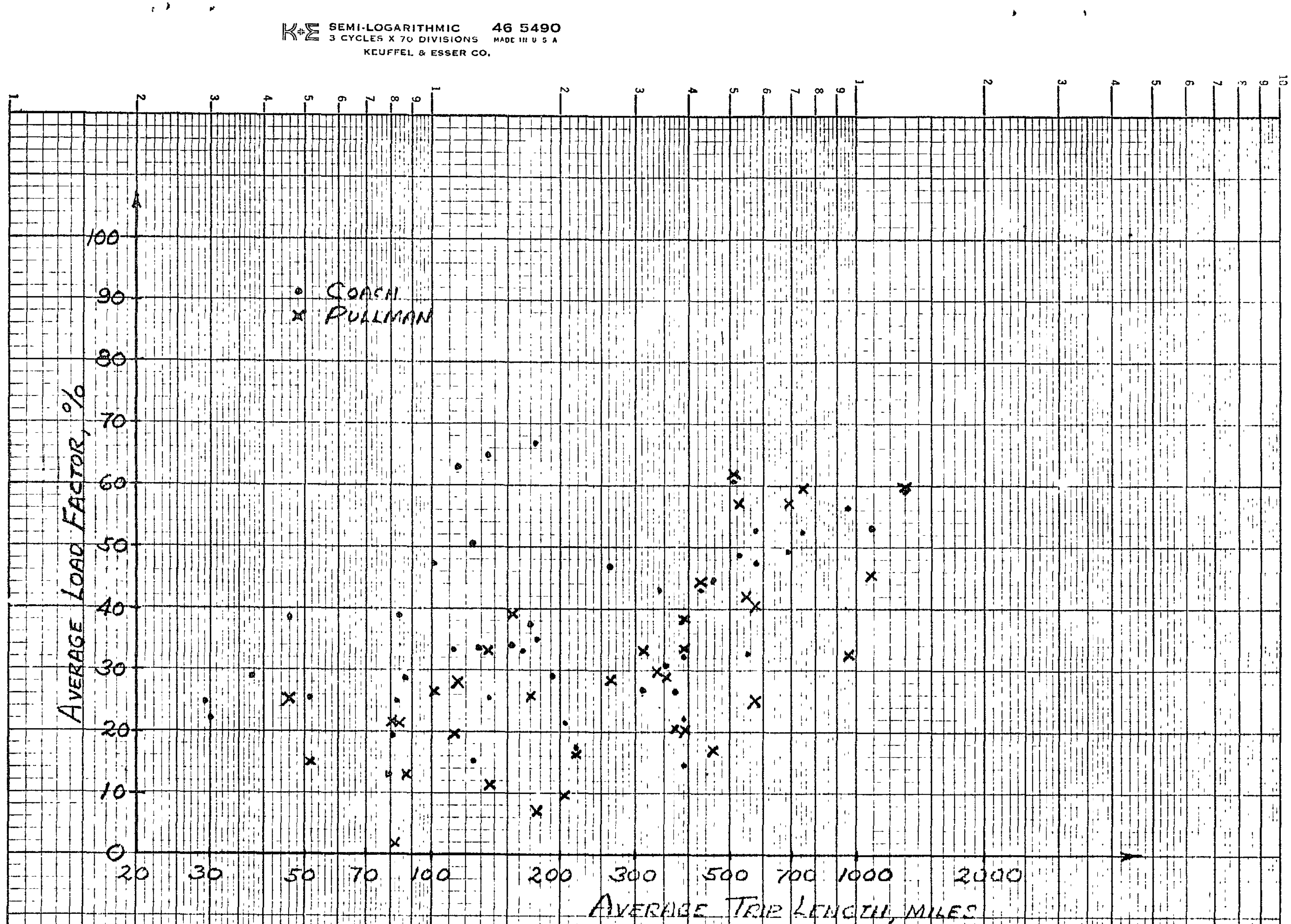

FIGURE III-16 LOAD FACTORS AND TRIP LENGTH BY ROUTE,
(CURRENT PC ROUTES)

BEST DOCUMENT AVAILABLE

Chapter IV, the patterns of origins and destinations used by travelers on most Amtrak routes would suggest that Amtrak could do a more efficient job of train sizing than these data indicate they actually do.

Conclusion

The basic conclusions from this chapter are that Amtrak traffic does not require long trains, either on average or to accommodate 85% of all loads experienced. Eighty-five percent of the demand during essentially the peak travel period of 1972 could be accommodated by coach trains of three cars or less on half the route segments, and all could be accommodated with seven cars. Average loads are, of course, lower. Also, Amtrak traffic is subject to considerable seasonal and daily variation, the peak month (July) having about 50% more traffic than the average month. Within a month, traffic is typically peaked on weekends, and 85% of all demands are less than approximately 1.3 times the average demand in a period of a month. This naturally makes for some difficulty in matching capacity to demand and in consistently obtaining high utilization of equipment and labor. This is borne out by the load factors which, even during peak months, are typically less than 60% and are often much lower, somewhat lower than would be expected in comparison to air and bus carriers who do not have the option of easily varying aircraft or bus capacity.

Chapter III

REFERENCES

1. American Association of State Highway Officials, A Policy on Geometric Design of Rural Highways (Washington: A.A.S.H.O., 1965), pp. 54-46.

2. National Association of Motor Bus Owners, Bus Facts, 38th edition (Washington: N.A.M.B.O., 1972), p. 27 The average load factor was calculated assuming a 39 seat bus--the most typical in industry. No data was given for average bus size in 1971 but, in 1970, the average load factor was given in ref. 3, p. 15, as 46.0%.

3. Air Transport Association, Transportation Facts and Trends, 9th edition (Washington: A.T.A., 1972), p. 15.

Chapter IV
ORIGIN AND DESTINATION ANALYSIS

For each train, a series of analyses were done on the patterns of passenger origins and destinations. All the data upon which these were based were obtained in train surveys made in June and July, 1972. The survey asked the riders both where they got on the train and what their destination was. Approximately 99% of all destinations were on the rail system. From data on mode of transport used to reach the train on which they were surveyed, information was provided as to whether or not the passengers were involved in multiple train trips.

Mode of Reaching the Train

In the aggregate, 13.7% of the passengers used a train to connect to the one on which they were surveyed. The range for individual trains was from 0 to 64%. The distribution is highly positively skewed with the median percent train transfer being 10%. The cities having the largest numbers of passengers involved in transfers are New York and Chicago.

The main mode of transport used to reach the train was the automobile. It was used by 67% of the passengers. Since 87% of all trips originate within the area encompassed by the city of origin, it is not surprising that auto is the overwhelming mode of transportation to reach the train.

These results indicate that only a small proportion of train travel involves connecting trains. Scheduling of trains to make transfer more efficient does not seem to be a significant problem. It would appear more important to schedule departures at times most convenient to the 80-90% of the passengers who are originating in the city where their train trip begins. Of course, there is no evidence from this study whether greater coordination of connecting trains would increase ridership. Only studies of non-users could answer such a question.

Origin and Destination of Travelers

The survey asked each respondent to indicate the city at which they boarded the train and the city to which they were destined. The results provided a matrix of origins and destinations for each train. Two major analyses were done on these data. One concerned the cities that were major attractors and generators of rail travel. The second concerned the density of traffic among all pairs of origin and destination on any route.

One would expect that train usage would be for relatively short trips. At least, on the basis of trip length theory, one would expect some exponential decrease in numbers of passengers from an originating city to the terminus of the train. For example, if 100 people in Chicago board a train bound for Houston, we might expect fifty to be destined for Kansas City or north; seventy-five to be destined for Oklahoma City or north; ninety to be destined for Fort Worth or north; and 100 for Houston or north. Obviously, if such a model held, train travel within a region, e.g., Milwaukee-St. Louis, might then be profitable. However, what emerges from the analysis is that utilization of train service does not follow such a model. Rather, the train generally seems to be used for trips going from the train origin to the city where it terminates.

Specifically, we can examine a series of trains to demonstrate the trip length distribution of train travel in most of the country. (Again, the northeast is a partial exception.) Taking train #1, which originates in New Orleans and terminates in Los Angeles, one finds that 70% of all passengers originate in three cities: 29% in New Orleans; 25% in Houston; and 17% in San Antonio. Of the passengers originating in New Orleans, 50% were destined for Los Angeles, 20% for Houston, 11% for San Antonio, 4.3% for Lake Charles, Louisiana, and 4.3% for Indio, California. Of the passengers originating in Houston, 72% were bound for Los Angeles and 8% for Tucson. Of the passengers originating in San Antonio, 77% are destined for Los Angeles--8% for Pomona, California. Fully 67% of all passengers who board this train are bound for Los Angeles and this concentration of destination applies to any origin city on the route. In effect, 88% of the passengers boarding this train are traveling thirty hours or more to reach Los Angeles.

Examining train #2, originating in Los Angeles and terminating in New Orleans, fully 76% of all passengers originate in either Los Angeles or Pomona, California. Of these, 12% are destined for El Paso, 20% for San Antonio, 9% for Houston, 12% for Beaumont, Texas, and 25% for New Orleans. Again, the long trip predominates with only a few cities contributing the majority of either origins or destinations. Of the 75% of all passengers who board on the West Coast, fully 70% are traveling for thirty hours or more.

Another western train that may be examined is the Chicago to San Francisco route, train #5. Fully 68% of all passengers originated in Illinois--60% in Chicago, 4% in Aurora, and 4% in Galesburg. Of these, 85% were destined for Denver or San Francisco. In general, people boarding this train are traveling for twenty-four hours or more.

On the eastbound run of this train, 37% of the passengers are boarding in California and 32% are boarding in Denver. Of those boarding on the west coast, 55% are bound for Illinois and 18% are bound for Denver. Of those boarding in Denver, 56% are bound for Illinois. Again, the trip time exceeds twenty-four hours for 80% of all passengers boarding the train.

This basic pattern of long-distance travel is quite consistent on all Amtrak routes. There are relatively few cities that generate most of the traffic on any route and these generally are the furthest apart. This would suggest that travelers perceive the train for long-distance travel, more than for short or medium length trips. This would appear to place Amtrak in direct competition with air travel. When, of course, travel time is important to users--as it is in business travel--passenger rail service cannot compete very well and, hence, its potential business market is a limited one.

In the northeast, the pattern is somewhat different. The service from New York to Buffalo indicates that for train #71, 100% of all travel originates in the New York City area. Of these, 14.3% are destined for Hudson, 27.4% for Albany, 9% for Utica, 12% for Syracuse, 10% to Rochester, and 7% for Buffalo. In the other direction, the pattern is reversed. The interesting aspect of flows is not the fact that New York City is the dominant generator or attractor of traffic. Rather it is that there is a rather uniform split among the smaller cities as origins and destinations to and from the New York City area. This indicates that regular use is made of the major stops to the route. This ought to provide for more economic operation of the train facility. Finally, it would appear that although travel to New York is somewhat faster by air and about the same by automobile relative to the train, the differences are relatively small, hence convenience factors plus past history may make train use attractive in the New York area.

From New York to Boston, the pattern of usage is more typical of the rest of the country. A total of 86% of all travelers originate in New York. Of this total, 77% are destined for Boston or the Route 128 station and 15% are destined for Providence. Again, this indicates the use of the train for travel between the termini of the train.

In the midwest, a similar pattern emerges for the relatively short-haul train. For the train from St. Louis to Milwaukee, 43% originate in St. Louis, 30% in Springfield, and 21% in Alton, Illinois. Of the destinations, 66% of all trips terminate in Chicago and 11% in Joliet. Approximately 52% originating in Alton are bound for Chicago, 68% of the St. Louis passengers are bound for Chicago, as are 70% of Springfield passengers. Over 29% of the total sample are making the complete trip from St. Louis to Chicago. Interestingly enough, this train terminates in Milwaukee, but only 10% of all passengers are bound for that city. Fully 37% of those originated in St. Louis.

In the southbound direction, the picture is even simpler. Over 81% of the passengers originate in Chicago and 51% of them are destined for St. Louis or East St. Louis. Only 4% originated in Milwaukee.

Finally, the Chicago-Detroit train is even more clearly a terminal service. Over 79% of all passengers originate in Chicago and 65% are destined for Detroit. Westbound, 58% originate in Detroit and 79% are destined for Chicago.

In sum, this analysis of the origin and destination pattern gives a useful picture of passenger usage of the rail system. It is used mainly for origin to train terminus travel. Generally, these are long-haul trips. There are relatively few short or even medium length trips taken using the train outside of the Northeast Corridor. It is estimated that the median travel time per passenger per trip over the whole Amtrak network is approximately six hours. In the northeast, it is nearly four hours, while in the west, it is nearly twelve hours. It would appear reasonable to conclude that train travel is largely an excursion--a leisure-time activity.

Node Usage

The pattern of usage of train service has significant implications for the operation of the system. The origin and destination data provides a further means for evaluation.

One way to estimate how well service is matched to the demand and the travel desires of users is to examine the usage of stops on the route. For example, if 100% of all passengers originate at City A and 100% are destined for City B and no passengers wish to get on at any intermediate stop, then the service should be non-stop from A to B. In fact, if the train stops at any intermediate city, it adds an increment of cost to the operator due to reduced average travel speed, train operating costs, and terminal costs. It also adds an indirect cost to passengers already on board because it increases their travel time and perhaps discomfort.

Conversely, if 100% of the passengers originate at one city and their destinations are to a number of cities on the route, the unloading would, ideally, be distributed such that the number of passengers disembarking is sufficient to cover the cost of stopping and maintaining the station. What the railroad does not want is to make many stops for unloading small numbers of passengers for the costs of stopping may be greater than the fare charged to bring the passenger to that station. For example, let's suppose that it costs $50 to stop the train at a station. Now suppose the actual cost of carrying a passenger is three cents a mile while he is charged five cents a mile. The passenger must be traveling 2500 miles if the net cost of his travel plus the station stop is to equal the revenue he produces. Obviously, as the number of passengers disembarking at a station goes up, the average trip length per passenger for break-even operation will decrease proportionately.

The third case of economic operation is the one where, from origin to termination, passengers are added at stops sufficient to equal those leaving at those stops. In effect, the train, by stopping, adds sufficient revenue to cover the terminal costs for stopping. This was actually the situation that existed in the United States--for the first 75 years of railroading, at least. When the population was largely distributed in rural places, the train efficiently collected and distributed people among many relatively small population centers where most travel was concentrated. This travel was for relatively short distances, but sufficient numbers of people boarded at most stops to make such stops economically as well as socially attractive. The shift in the last quarter century to an 80% urban population makes such a model no longer a realistic one for this country except perhaps for very high density urban corridors.

In theory, it is possible to determine the economic tradeoffs for the first two cases. Some of the basic methods are developed in Meyer, Kain, & Wohl (1). The detailed operating cost data are not available to carry out such an analysis here. However, it is possible to examine the distribution of origins and destinations on the various routes to provide an indication of how well matched the train routing is to the O&D pattern. In order to do this, the cumulative percent of origins and destinations for each train was plotted against the number of cities by rank. That is, the origin cities were ranked by percentage of total passengers boarding and those were cummulated. The same was done for destinations. The results, in effect, show the increment in passengers (normalized) obtained by stopping at the cities on the route[1] of the train. The results are shown in Figures IV-1 thru 15 which contain data on all routes on the Amtrak system and up to ten cities.

Clearly, if the first model of O&D pattern described above held for any route, then the figures would show simply two points located at 100% and one city. There would be one for the origin and one for the destination. Case two would be defined by the destination function being a straight line with a slope, b = 100/n where n = number of cities and the origin distribution a point. Alternatively, it would be one in which the origin function would be a straight line and the destination function would be a point.

As may be seen, most of the routes fit none of the three models, although system operation most nearly approaches the first. Ten or less cities account for 85% or more of the origins or destinations on all routes. In half the routes, only four

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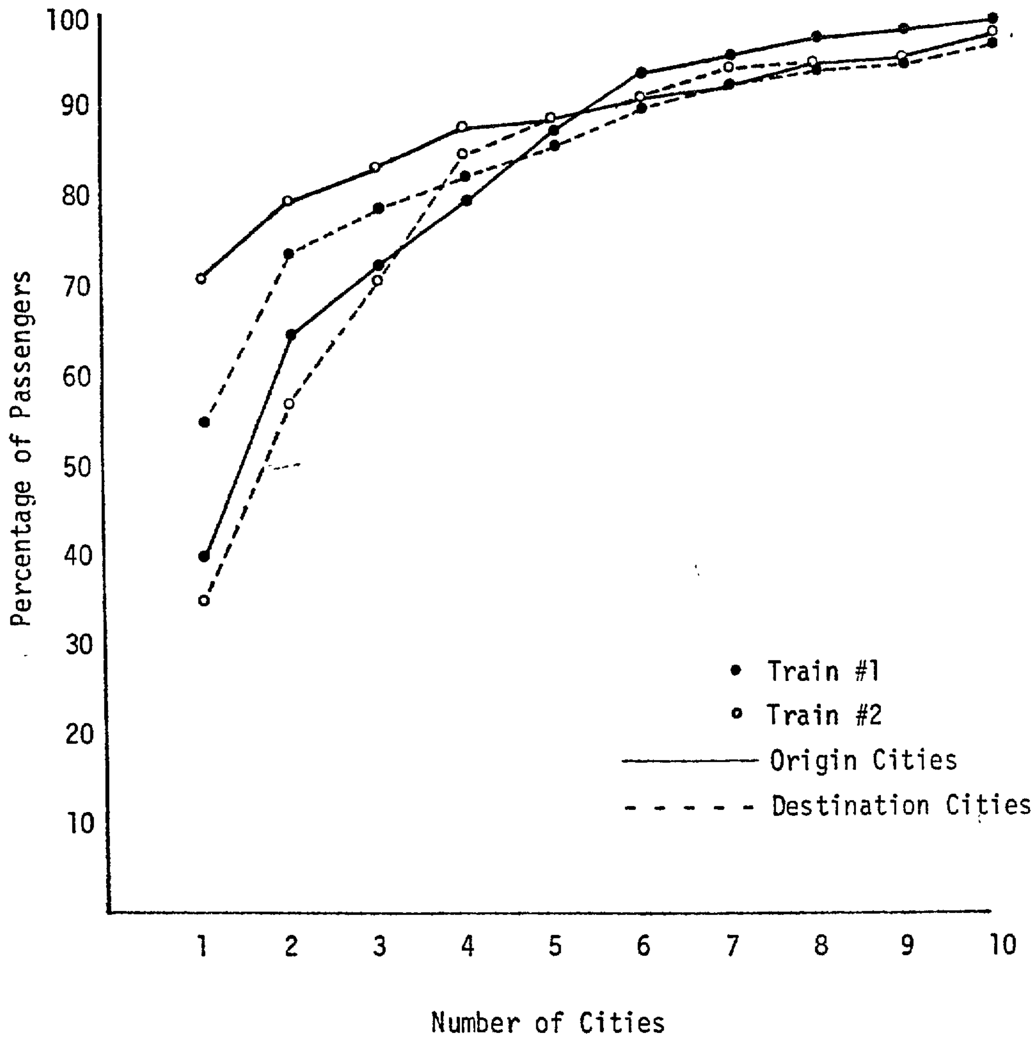
[1] pp. 65-79

Figure IV-1

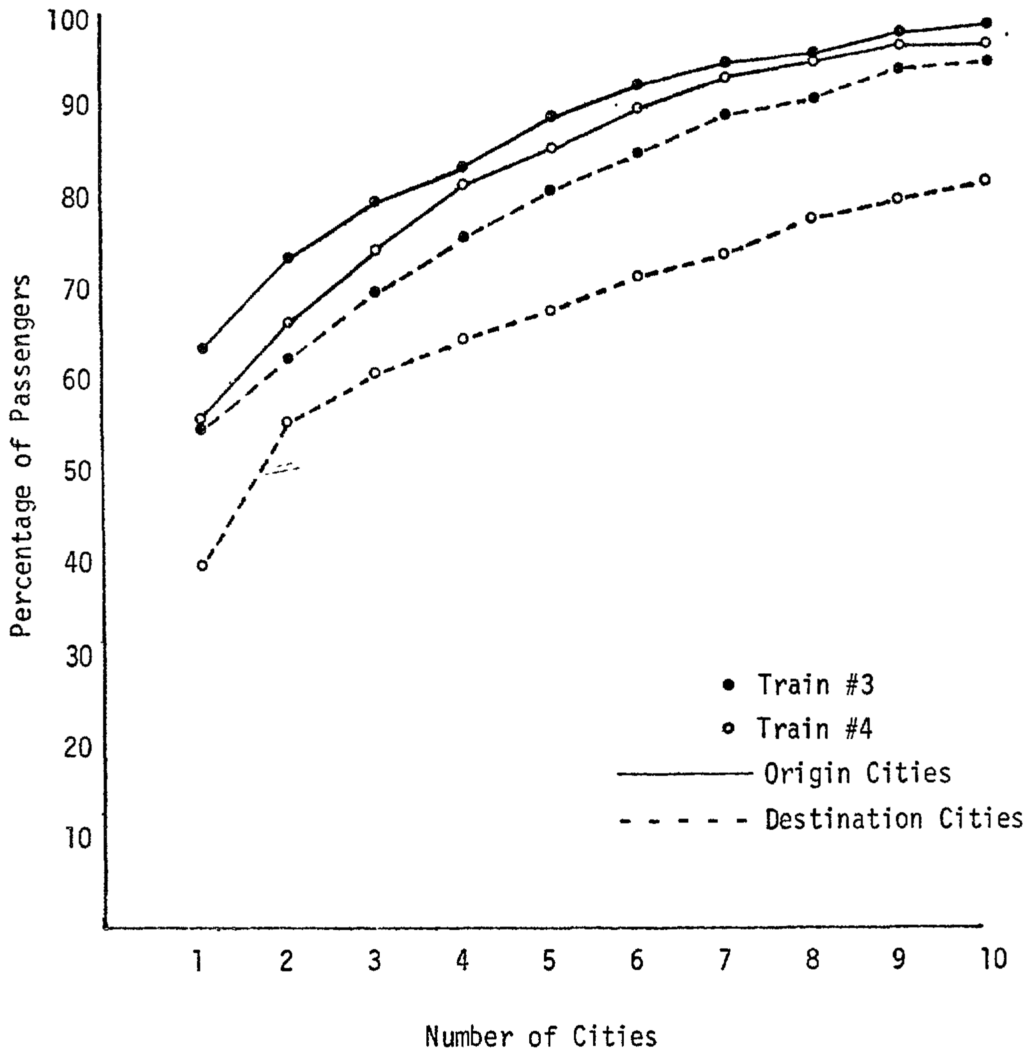
NEW ORLEANS/LOS ANGELES/NEW ORLEANS



Train #	Orig/Poss	Dest/Poss
1	12/19	10/19
2	9/19	13/19

Figure IV-2

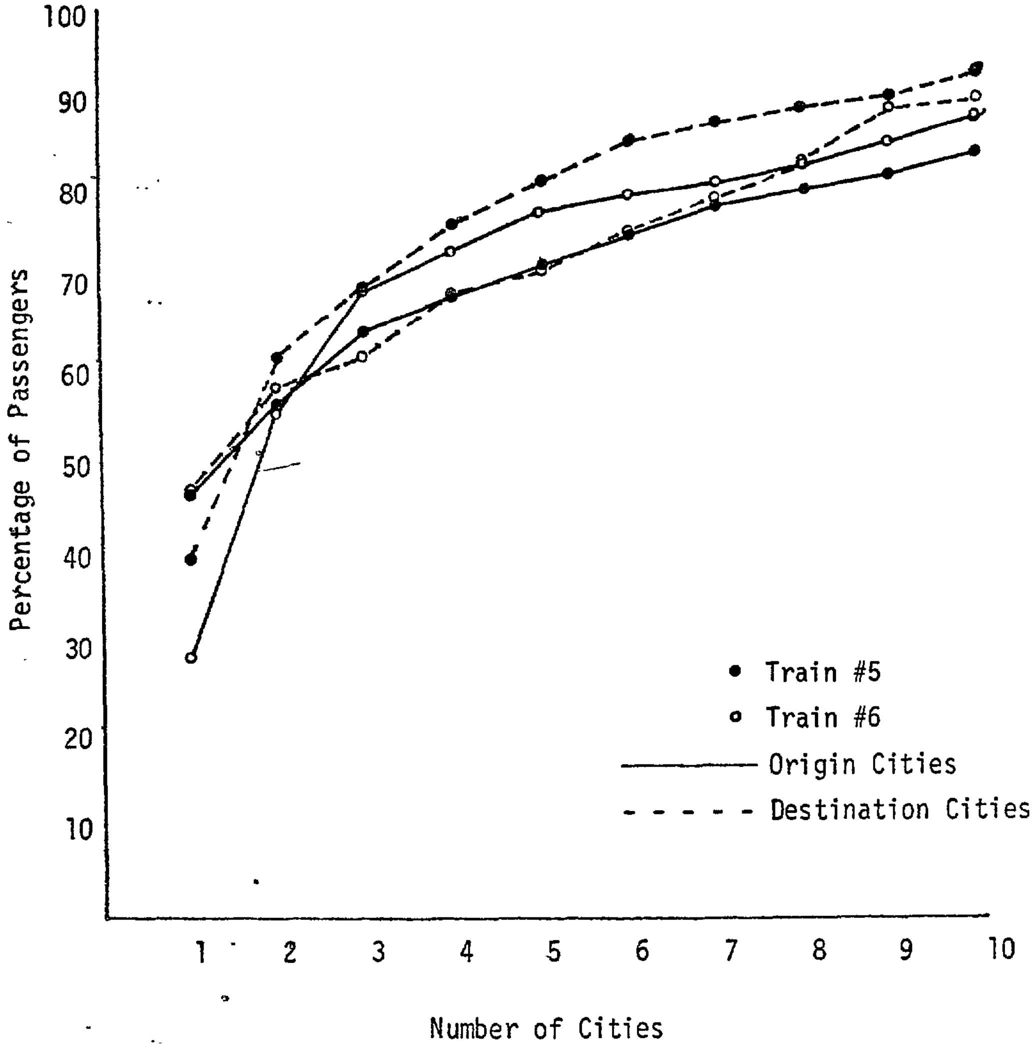
CHICAGO/LOS ANGELES/CHICAGO



Train #	Orig/Poss	Dest/Poss
3	11/27	14/27
4	13/27	23/27

Figure IV-3

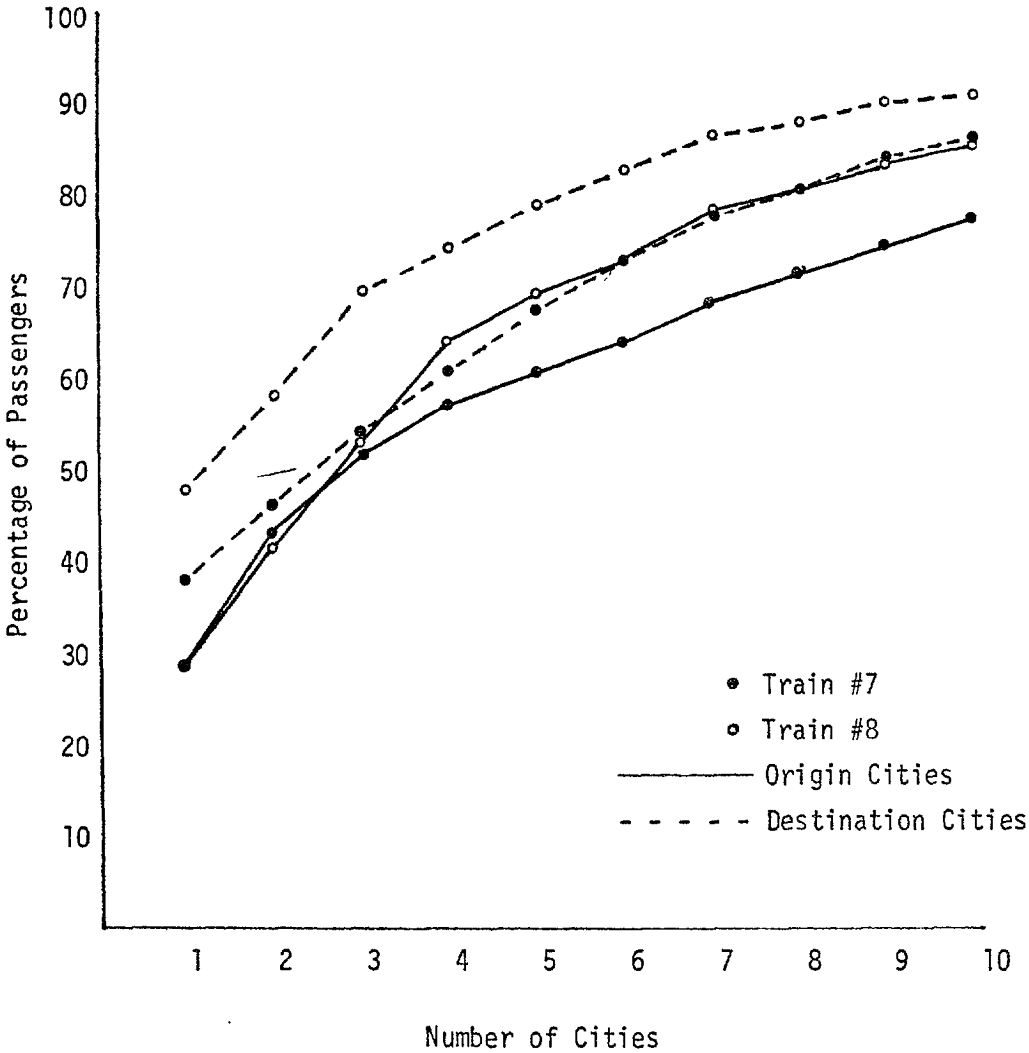
CHICAGO/SAN FRANCISCO/CHICAGO



Train #	Orig/Poss	Dest/Poss
5	18/34	17/34
6	29/34	25/34

Figure IV-4

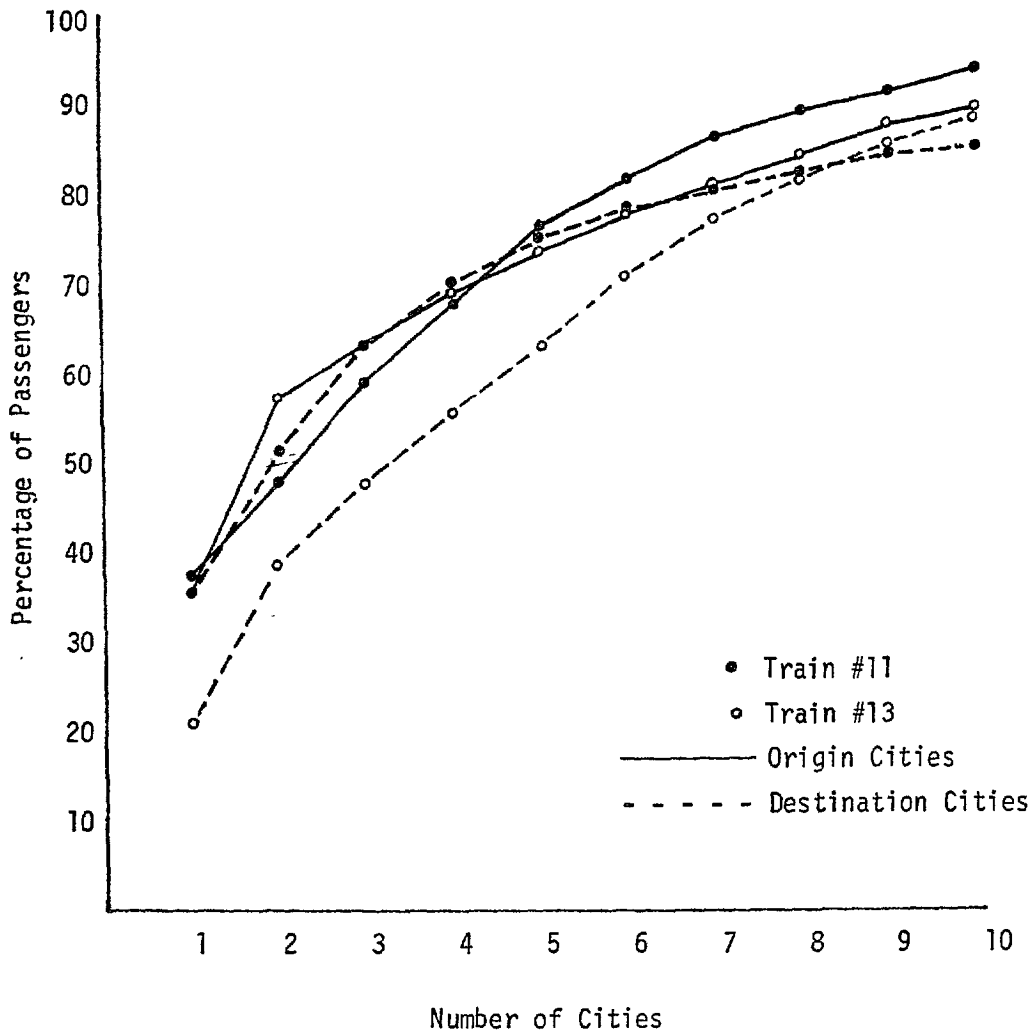
CHICAGO/SEATTLE/CHICAGO



Train #	Orig/Poss	Dest/Poss
7	31/31	31/31
8	31/31	30/31

Figure IV-5

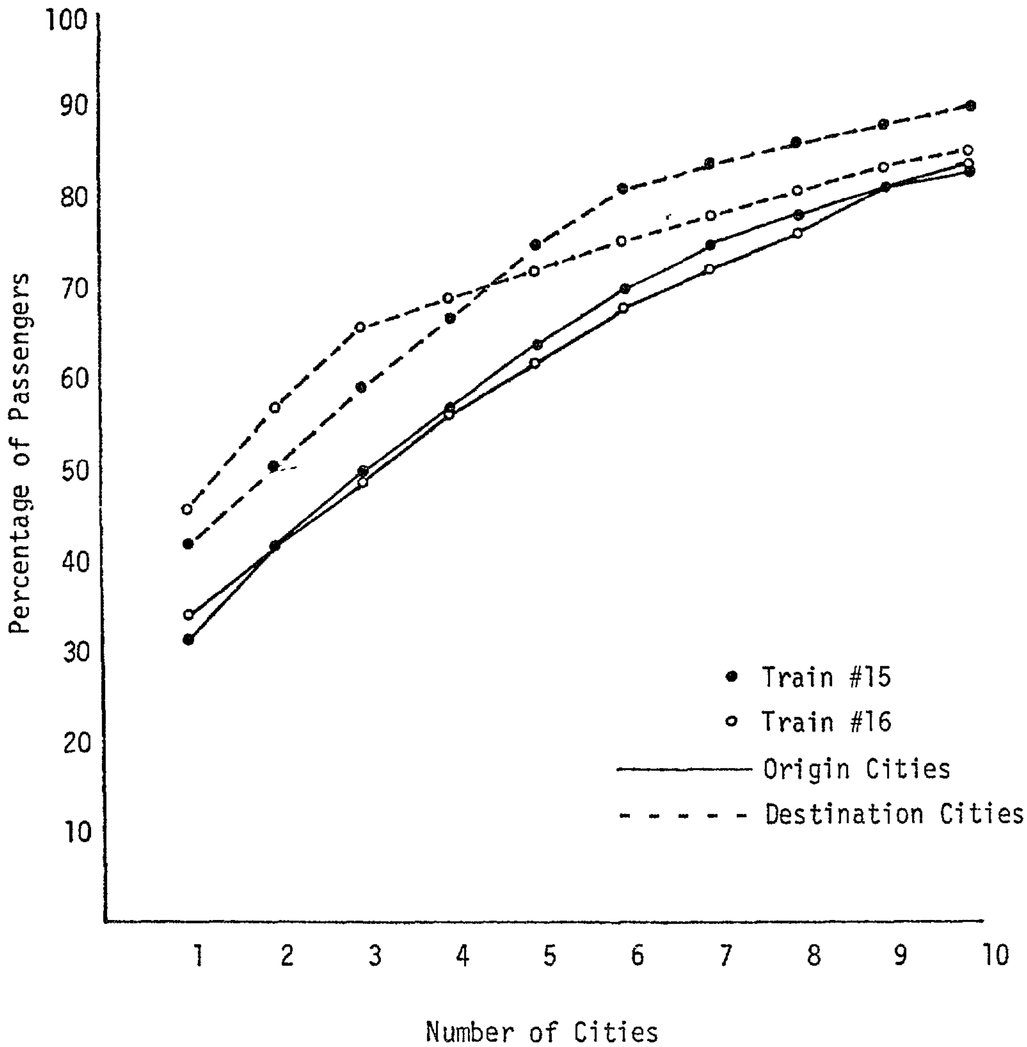
SEATTLE/LOS ANGELES/SEATTLE



Train #	Orig/Poss	Dest/Poss
11	17/27	23/27
13	21/27	23/27

Figure IV-6

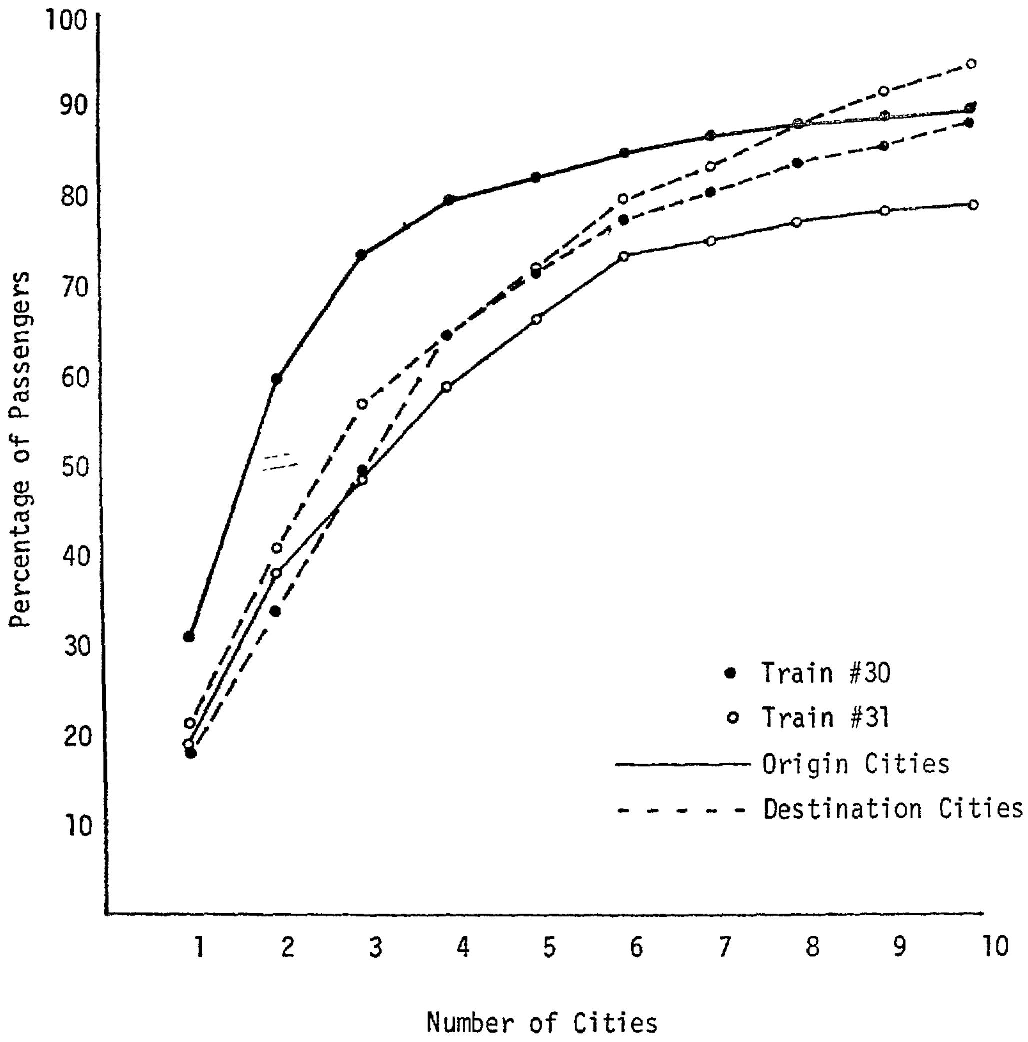
CHICAGO/HOUSTON/CHICAGO



Train #	Orig/Poss	Dest/Poss
15	30/30	30/30
16	28/30	26/30

Figure IV-7

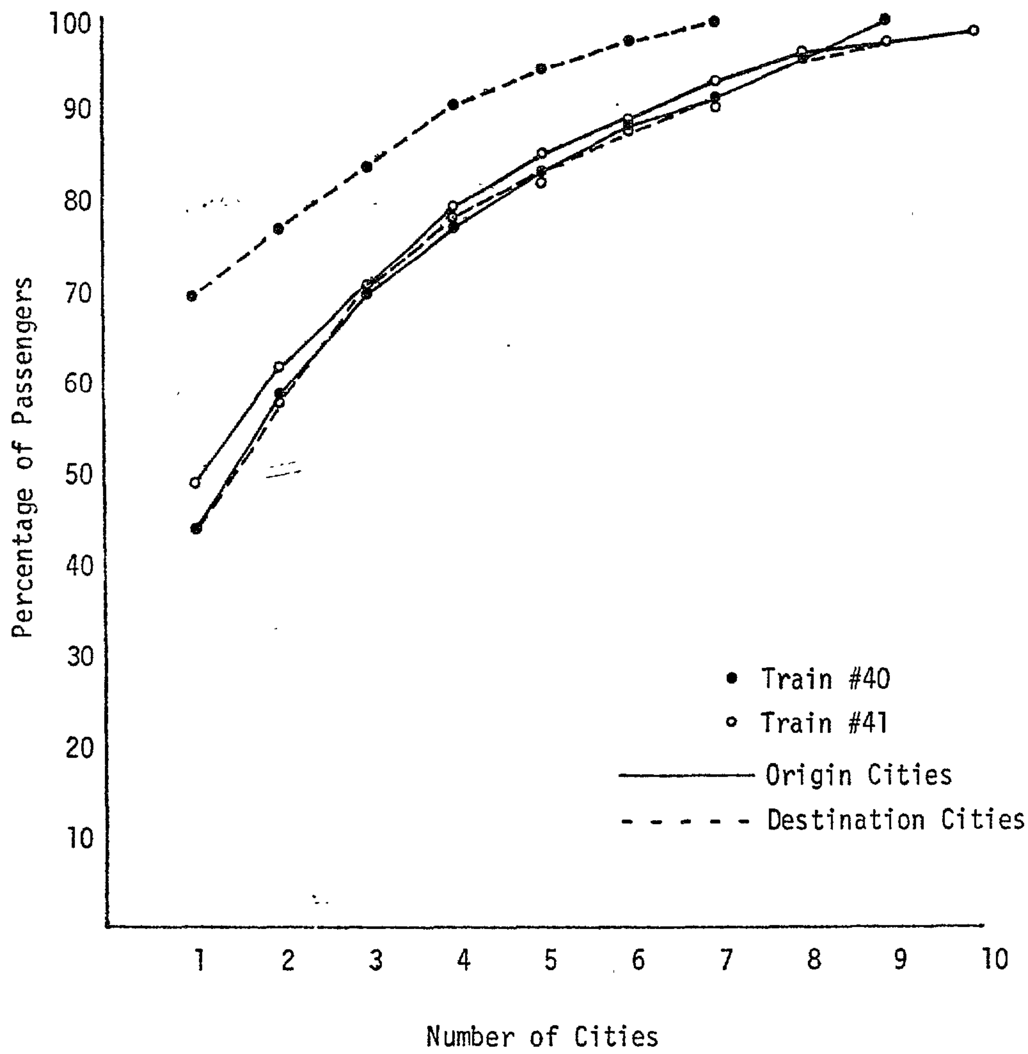
NEW YORK/KANSAS CITY/NEW YORK



Train #	Orig/Poss	Dest/Poss
30	25/29	23/29
31	21/29	25/29

Figure IV-8

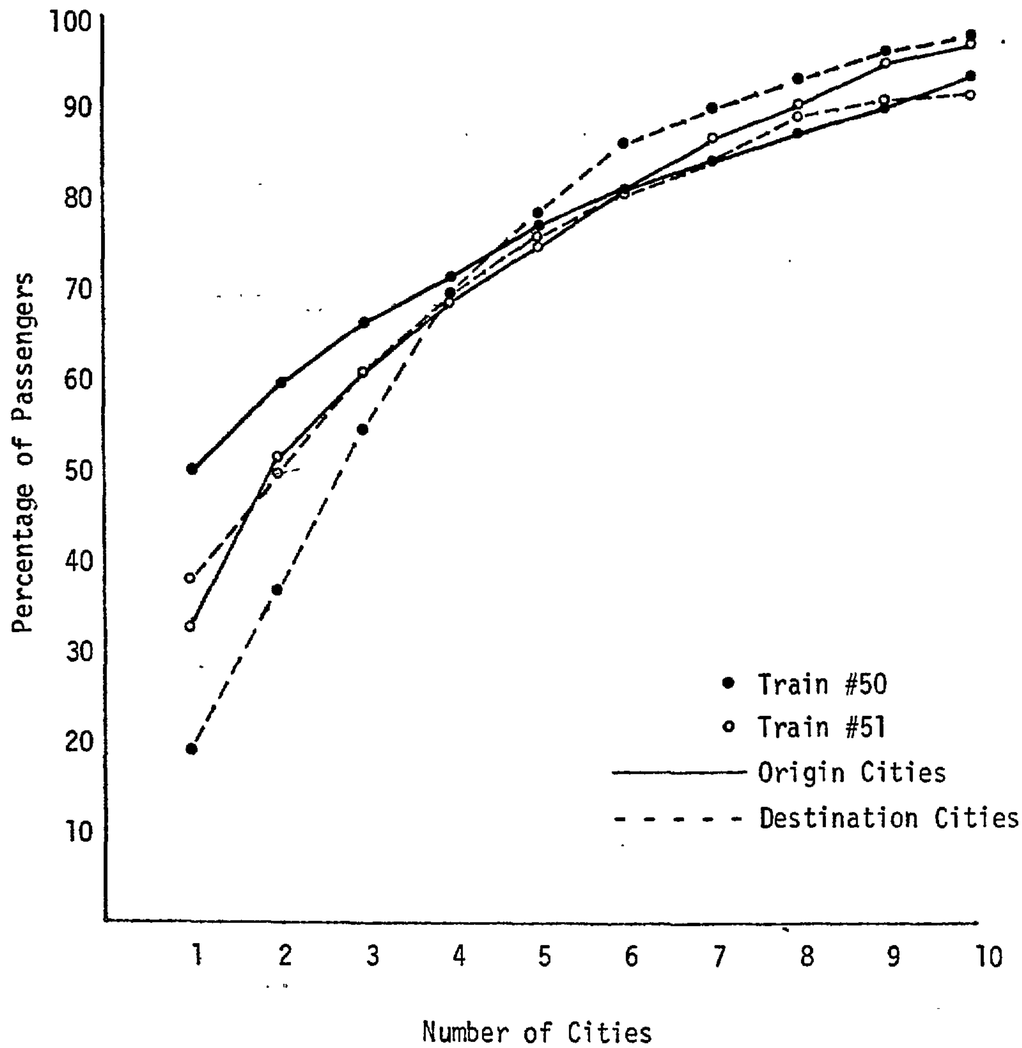
CHICAGO/NEW YORK/CHICAGO



Train #	Orig/Poss	Dest/Poss
40	7/16	5/16
41	5/16	5/16

Figure IV-9

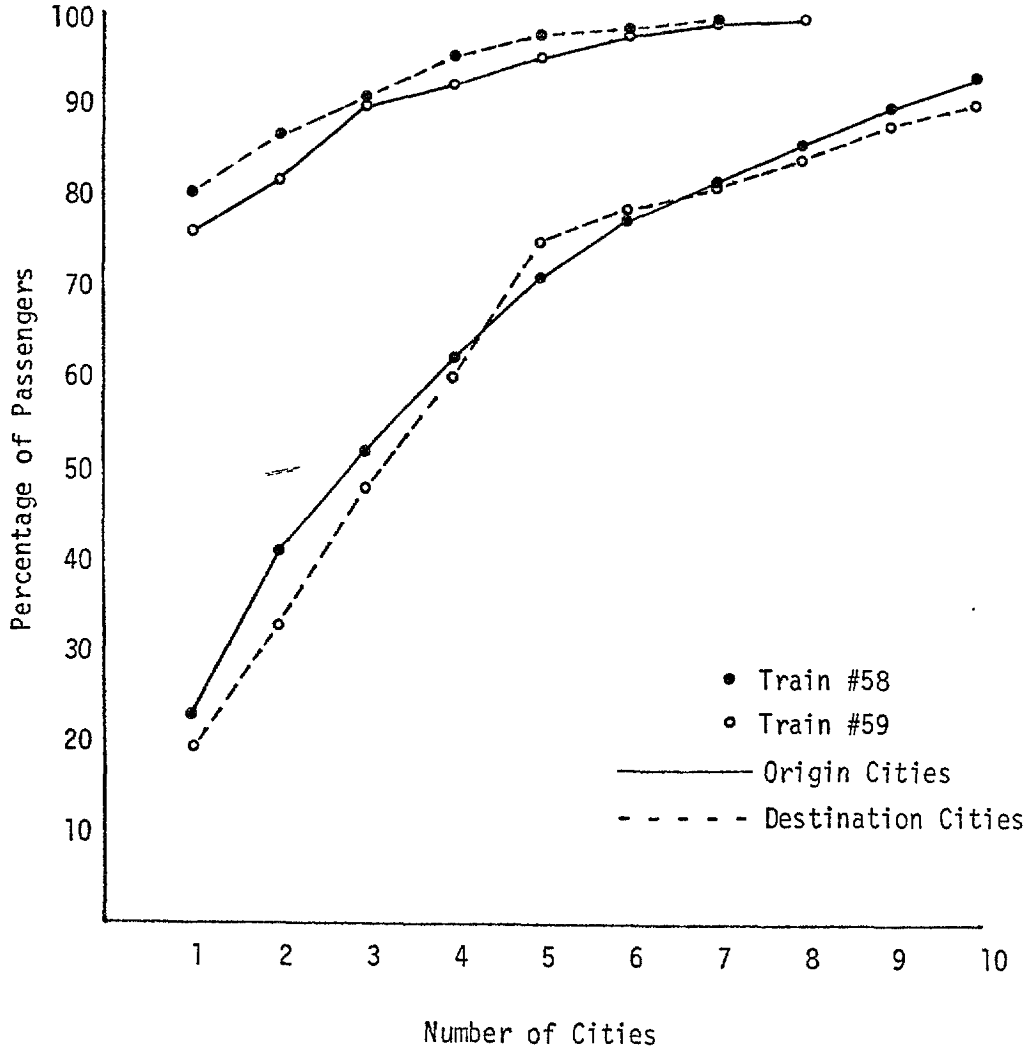
CHICAGO/WASHINGTON D.C./CHICAGO



Train #	Orig/Poss	Dest/Poss
50	16/18	16/18
51	18/18	15/18

Figure IV-10

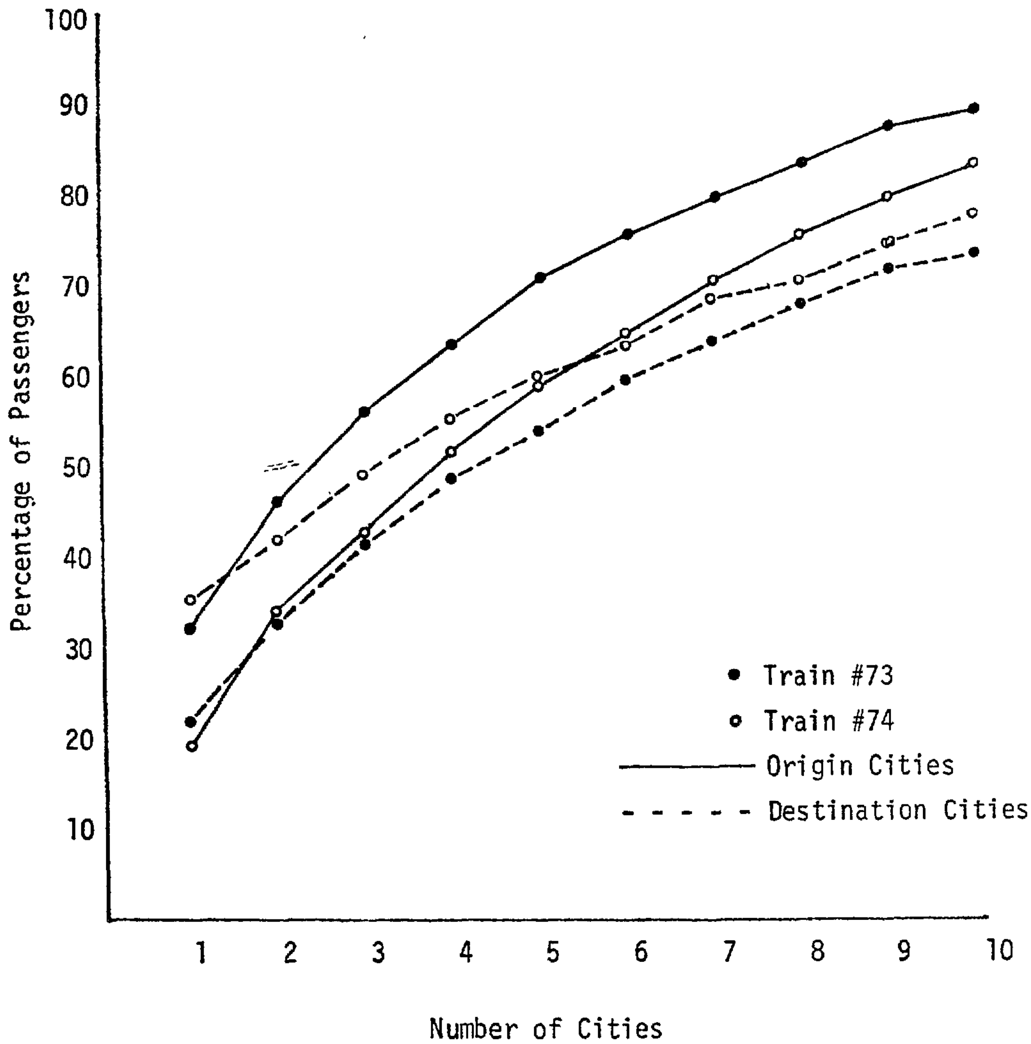
CHICAGO/NEW ORLEANS/CHICAGO



Train #	Orig/Poss	Dest/Poss
58	13/23	8/23
59	8/23	20/23

Figure IV-11

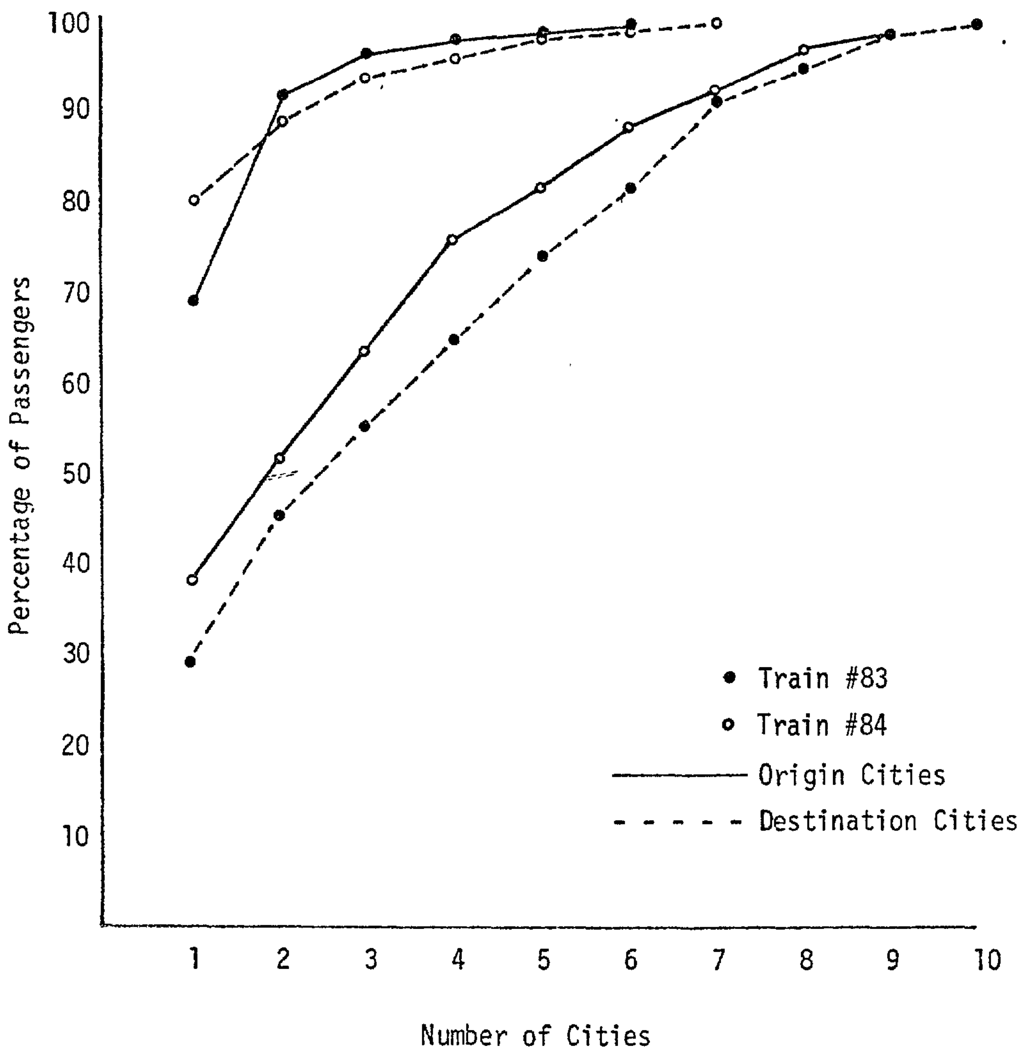
NEW YORK/BUFFALO/NEW YORK



Train #	Orig/Poss	Dest/Poss
73	9/12	11/12
74	9/12	10/12

Figure IV-12

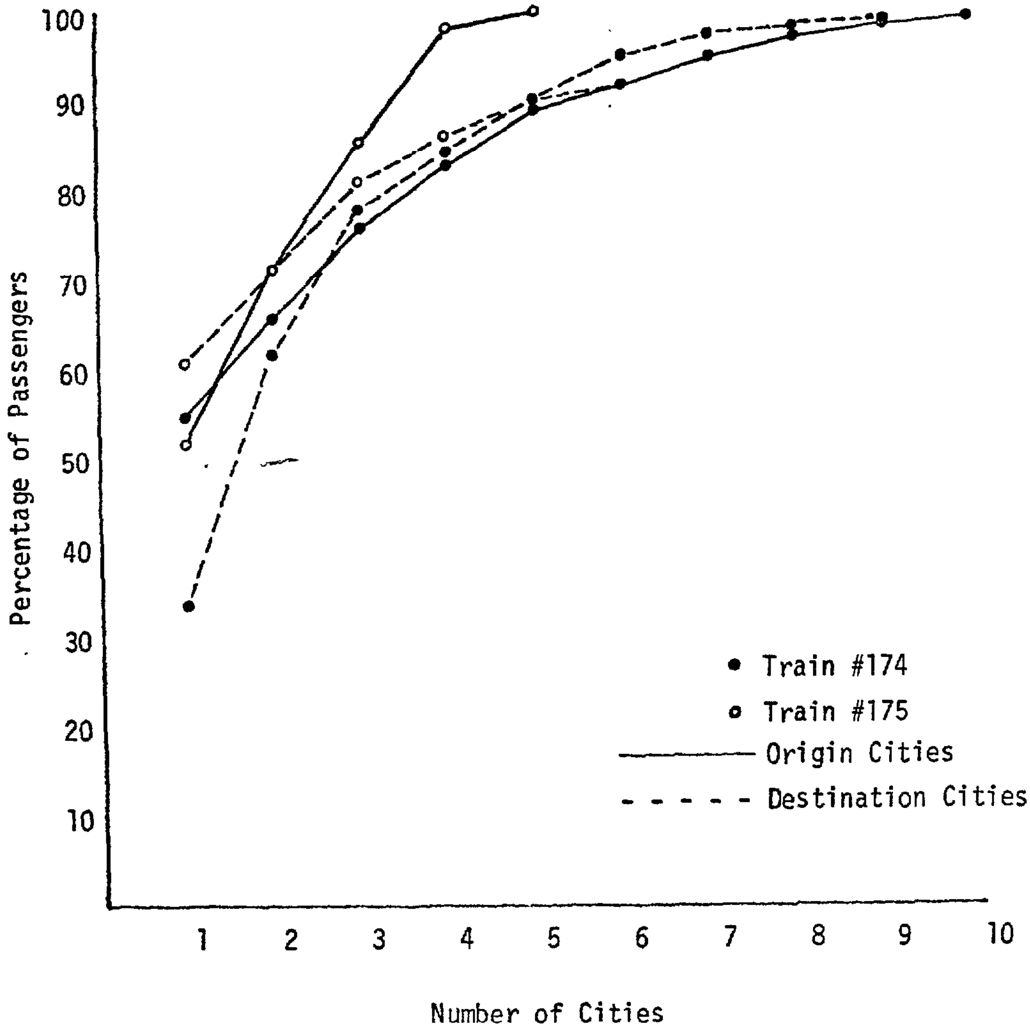
NEW YORK/MIAMI/NEW YORK



Train #	Orig/Poss	Dest/Poss
83	19/30	29/30
84	25/30	28/30

Figure IV-13

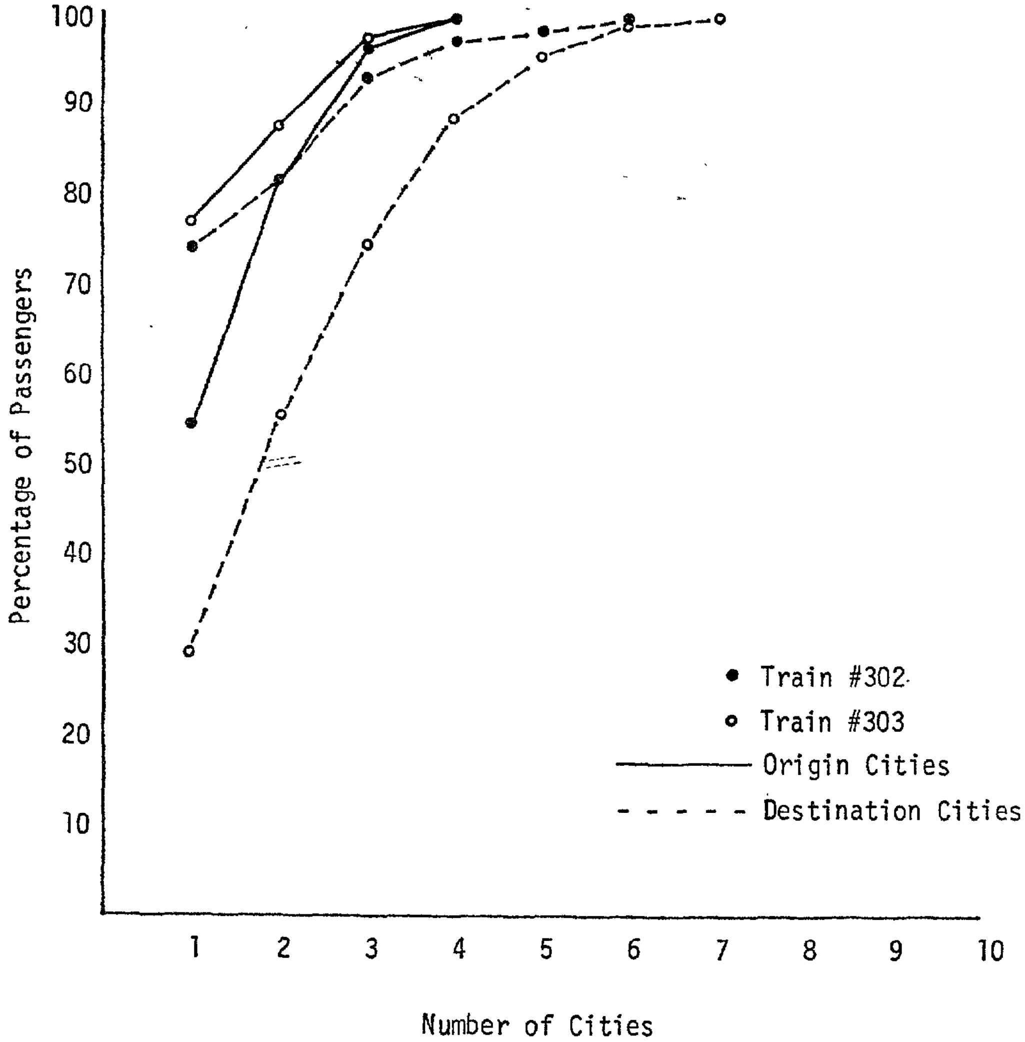
BOSTON/NEW YORK/BOSTON



Train #	Orig/Poss	Dest/Poss
174	18/18	12/18
175	8/17	15/17

Figure IV-14

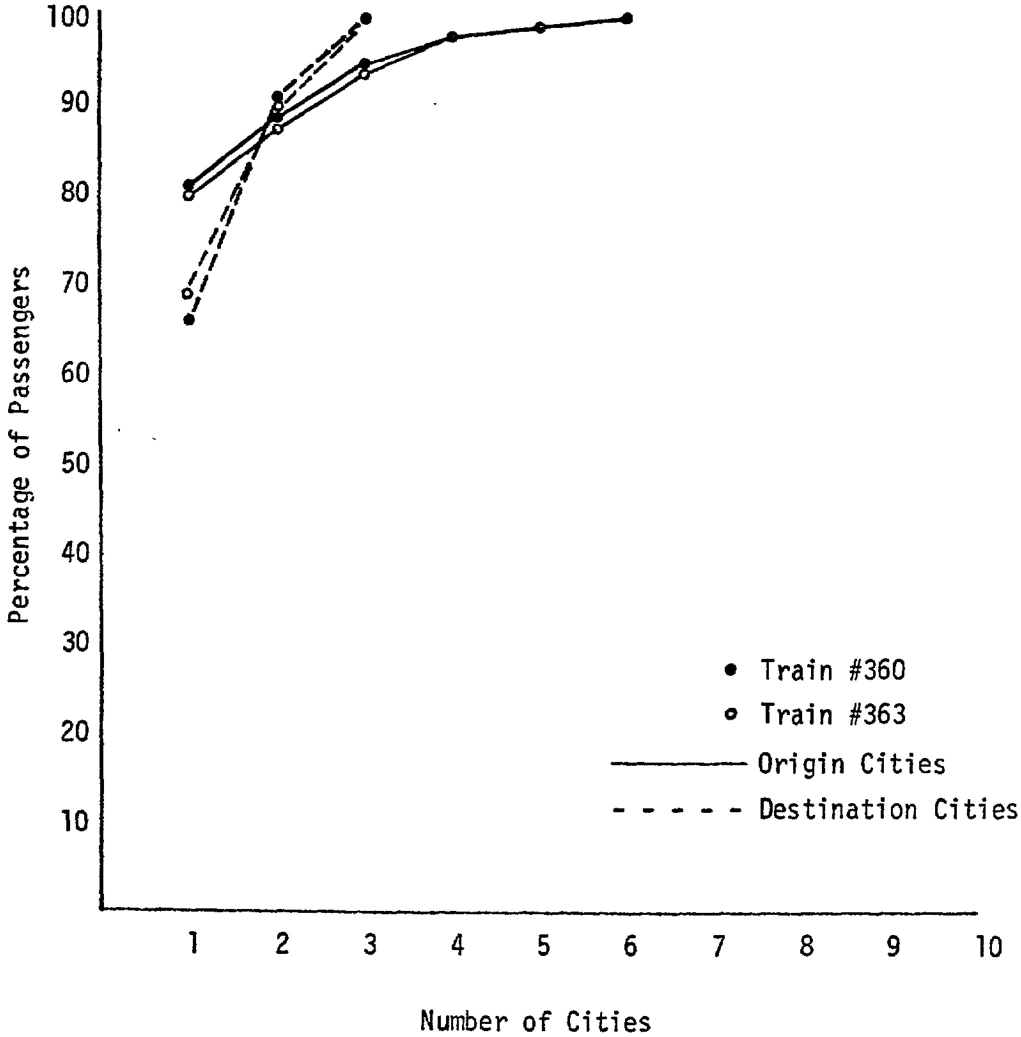
ST. LOUIS/MILWAUKEE/ST. LOUIS



Train #	Orig/Poss	Dest/Poss
302	5/10	9/10
303	3/10	6/10

Figure IV-15

CHICAGO/DETROIT/CHICAGO



Train #	Orig/Poss	Dest/Poss
360	6/7	3/7
363	6/7	3/7

cities account for 75% of the origins or destinations. It should be kept in mind, however, that the destination cities are largely at the ends of the route.

These figures are significant in relation to the total number of station stops on the route. In each figure is a table that contains the ratio of stations boarding or discharging passengers to the total number of stops the train makes. For example, on train #1, there are nineteen stops, but only twelve of them are used to board 100% of the passengers, and only ten of them are used as destinations. Although the ratios shown in Figures IV 1-15[1] vary considerably, over the whole system, the average number of station stops used per train as origins was 72%. The average used as destinations was 79%. The range for both cases was from 23% to 100%. It should be noted that these figures do not indicate the actual numbers of passengers boarding or leaving the train at any of the stops actually used. What can be said, however, is that 25 $\pm$ 10% of all the stops on all the routes account for 75% or more of passenger boarding or discharging. Whether or not this frequency of station usage is sufficient to cover the direct and indirect costs over the route depends upon the passenger loads. From the data presented in Chapter III, such loadings do not appear adequate to support train operations--economically, at least.

From the origin and destination matrices for any train, it is also possible to determine the utilization of any city on the route as both an origin and a destination. This can be explained most easily by referring to one such O&D matrix. The one for the Detroit-Chicago train (#363) is shown in Table IV-1.[2]

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[1] pp. 65-79

[2] p. 81

Table IV-1

PATTERN OF PASSENGER FLOW ON TRAIN #363

Origins	Destinations 1	2	3	4	5	6	7	8	Totals	
1 Detroit		0	0	0	2	1	97	0	100	(1
		0.000	0.000	0.000	.020	.010	.970	0.000	1.000	(2
		0.000	0.000	0.000	.667	.500	.571	0.000	.571	(3
		0.000	0.000	0.000	.011	.006	.554	0.000	.571	(4
2 Ann Arbor			0	0	1	1	24	0	26	
			0.000	0.000	.038	.038	.923	0.000	1.000	
			0.000	0.000	.333	.500	.141	0.000	.149	
			0.000	0.000	.006	.006	.137	0.000	.149	
3 Keckson				0	0	0	7	0	7	
				0.000	0.000	0.000	1.000	0.000	1.000	
				0.000	0.000	0.000	.041	0.000	.040	
				0.000	0.000	0.000	.040	0.000	.040	
4 Battle Creek					0	0	14	0	14	
					0.000	0.000	1.000	0.000	1.000	
					0.000	0.000	.082	0.000	.080	
					0.000	0.000	.080	0.000	.080	
5 Kalamazoo						0	17	0	17	
						0.000	1.000	0.000	1.000	
						0.000	.100	0.000	.097	
						0.000	.097	0.000	.097	
6 Niles							8	0	8	
							1.000	0.000	1.000	
							.047	0.000	.046	
							.046	0.000	.046	

Table IV-1 (continued)

PATTERN OF PASSENGER FLOW ON TRAIN #363

Origins	Destinations 1	2	3	4	5	6	7		8	Totals
7 Chicago									0	3
									0.000	1.000
									0.000	.017
									0.000	.017
8 Other Cities	0	0	0	0	0	0	0		0	0
	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000
Totals	0	0	0	0	3	2	170	(5	0	175
	0.000	0.000	0.000	0.000	.017	.011	.971	(6	0.000	1.000
	0.000	0.000	0.000	0.000	1.000	1.000	1.000	(7	0.000	1.000
	0.000	0.000	0.000	0.000	.017	.011	.971	(8	0.000	1.000

(1) number of passengers surveyed originating in city
(2) % of passengers surveyed originating in city
(3) % of passengers surveyed originating in a city with a destination at another city
(4) % of all passengers surveyed originating in a city destined for another city
(5) number of passengers surveyed destined for city
(6) % of passengers surveyed destined for city
(7) % of all passengers surveyed destined for city
(8) % of all passenger destinations to a city

This matrix is arranged with the cities listed as origins from the beginning of the route to the end and similarly for the destinations. Each cell defines the number (or percentage) of passengers who boarded at a particular city who left the train at each of the possible destinations. For example, no passengers who boarded in Detroit got off the train at Ann Arbor (destination 2). As a matter of fact, of the 100 people surveyed on the train who boarded in Detroit, all but three were destined for Chicago. Only three of the six possible destinations for these Detroit passengers were actually used as destinations. In the whole matrix of possible origins and destinations, only eleven out of the twenty-two were actually used. In sum, the train stops at six cities to board or discharge passengers, but in only half of those cities do some passengers get off as well as on. In this particular case, the train is a collector of people going to Chicago.

The proportion of route cities used as both origins and destinations is another measure of how the rail system functions. It defines how the train serves as a collector-distributor system. If the percentage of possible origins and destinations actually used is low, then the train is serving as a collector or as a distributor, but not as an interchange system. Ideally, one would like to see as many stops as possible used both to embark and discharge passengers, in sufficient quantities, to make stopping reasonably economical. These percentages are shown in Table IV-2[1] for all routes surveyed. As may be seen, the percentage of possible city pairs actually used ranged from 7% to 67%, with a median of only 25%. Generally, it is only the shorter routes that show any high frequency of use of station stops as both origins and destinations.

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[1] p. 84

Table IV-2

PROPORTION OF POSSIBLE ORIGIN-DESTINATION CITIES
TO THOSE ACTUALLY USED ON AMTRAK ROUTES

Train No.	No. of O&D Pairs Used	Possible No. of O&D Pairs	Percentage*
1	38	171	22
2	26	171	15
3	52	351	15
4	70	351	20
5	41	561	7
6	82	561	15
7	112	465	24
8	90	465	19
11	69	351	19
13	86	351	24
15	146	335	43
16	107	335	32
30	74	306	24
31	97	306	31
50	57	120	47
51	74	120	62
53	46	276	17
58	48	276	17
71	18	66	27
73	29	66	44
74	36	66	55
78	21	66	32
151	4	55	7
174	70	105	67
175	44	105	43
182	12	153	8
302	23	45	51
303	11	45	25
360	8	15	52
363	10	15	67

*median = 25%

These results indicate quite clearly that passenger rail service is a collector or distributor system. When station stops are used, they are used either as origin or destination stops, but not both. If they are used as origins, it is to take a trip to the train route end. If it is a destination, it is largely a trip that began at the train originating point. It is interesting to note that, for almost all of the Amtrak routes, this holds whether or not the train origin and termination is 300 or 2000 miles apart.

In general, the results of the analysis of the origin and destination patterns of usage of the passenger rail system indicate two consistent points: (1) about one quarter of the cities on any route are contributing more than 75% of all passengers, and (2) passengers are largely traveling from the beginning of a train route to its termination. These two results raise a question about the criteria for maintaining station stops intermediate to the very few major generators and attractors of traffic. On purely economic grounds, it would not appear justified to maintain these stations. Though there may be significant social reasons for maintaining these stops, they have never been made explicit, and they are certainly not obvious. However, it should be clear that maintaining a station stop implies that a benefit is produced to either the carrier or the community or both, which is sufficient to justify the cost over some time period at least.

The data shown in the O&D matrices for each train surveyed are shown in a separate appendix. From these, it is possible to examine each station stop on any of Amtrak's routes and evaluate on any criteria that is desired its reason for being retained on the route. It does not appear, on the basis of the data collected in this study, that there is much relation between the retention of station stops and travel demand. Clearly, Amtrak needs to reevaluate the stations on its system to determine the need to retain all those stops.

Chapter IV

REFERENCES

1. Meyer, J. R., Kain, J. F. and Wohl, M. The Urban Transportation Problem, Cambridge, Mass., The Harvard University Press.

Chapter V

AMTRAK SCHEDULE ANALYSIS

The question to which this section is addressed is: are Amtrak train schedules optimal from the passenger's standpoint? In order to provide optimal scheduling from the passenger's standpoint, two criteria should be met. First, the train should leave at the most convenient or desired departure time of the passengers and, second, if the trip requires use of more than one train, then lay-over times at the points of transfer should be minimized. These two aspects are addressed separately.

Transfers

The transfer issue was approached by first determining the number of passengers involved in a change of train. Then the cities where these transfers occurred were identified. Finally, the schedule connections in those cities were evaluated where there were a significant number of transfers.

These data were obtained from the passenger survey. An item was included in which respondents indicated whether "another train" was the method of transportation which brought them to the train on which they were interviewed. In addition, for each train, the number of transferees who boarded at each station was determined. The results showed that 13.7% of all passengers surveyed were transferees. A great majority of these transfers occurred at only a few cities. The survey did not identify the train from which the transfer was made or whether that train was an Amtrak train or other train (most likely a suburban train). Table V-1[1] shows the cities at which

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[1] p. 89

Table V-1

IMPORTANCE OF TRAIN-TO-TRAIN TRANSFERS BY ROUTE

Route	Train No.	Total Transfers		Largest Single Transfer	
		Number	% of All Pass.	Station	Number
New York - Boston	150	13	17 %	New York	13
Boston - New York	151	2	7	--	--
New York - Boston	182	29	22	New York	29
New York - Buffalo	71	8	7	New York	8
New York - Buffalo	73	16	18	New York	10
Buffalo - New York	78	6	13	Buffalo	6
Chicago - New York	40	6	22	Chicago	5
New York - Chicago	41	4	10	New York	4
Washington - Boston	174	18	16	New York	9
Boston - Washington, D.C.	175	11	11	Boston	9
		9	7	New London	4
New York - Kansas City	31	14	13	Philadelphia/ New York	5/3
Kansas City - New York	30	12	16	Kansas City	7
Chicago - Washington, D.C.	50	13	14	Chicago	10

Table V-1

IMPORTANCE OF TRAIN-TO-TRAIN TRANSFERS BY ROUTE
(continued)

Route	Train No.	Total Transfers		Largest Single Transfer	
		Number	% of All Pass.	Station	Number
Washington, D.C. - Chicago	51	5	7	Washington, D.C.	4
New York - Miami	83	19	14	New York	17
Chicago - Miami	52	12	15	Chicago	6
Miami - Chicago	53	1	1.5	Miami	1
Chicago - Detroit	360	8	25	Chicago	7
Detroit - Chicago	361	7	22	Detroit	5
Chicago - Detroit	362	32	64	Chicago	32
Detroit - Chicago	363	3	18	--	--
Chicago - Seattle	7	16	11.5	Chicago	11
Seattle - Chicago	8	12	9	Seattle	9
		13	40	Chicago	13
St. Louis - Milwaukee	302	4	5	St. Louis	4
Milwaukee - St. Louis	303	15	25	Chicago	14
New Orleans - Chicago	58	3	2.6	--	--
Chicago - New Orleans	59	15	14	Chicago	14

Table V-1

IMPORTANCE OF TRAIN-TO-TRAIN TRANSFERS BY ROUTE
(continued)

Route	Train No.	Total Transfers		Largest Single Transfer	
		Number	% of All Pass.	Station	Number
Chicago - Houston	15	24	17	Chicago	21
Houston - Chicago	16	3	4	Houston	3
Chicago - Oakland	5	41	25	Chicago	36
Los Angeles - Chicago	4	11	--	Los Angeles	10
Seattle - San Diego	13	34	16	Los Angeles	28
Seattle - San Diego	11	19	11	Seattle	8
New Orleans - Los Angeles	1	9	11.5	New Orleans	8

most of the transfers occurred and to which (but not from which) train transfer occurred. The columns are the number of the train to which the transfer was made, number of persons transferring to that train throughout its journey, percentage of all persons boarding that train (over entire route) who are transferees, and the number and city at which the largest number of transfers occurred. The fraction of transfers is never really large relative to the train load. In three cases, it exceeds 25%, but the maximum is still only 32%. The larger fractions occur at Chicago and New York where extensive non-Amtrak rail service is provided. Therefore, no case can be made on the basis of these data to alter Amtrak schedules to benefit connecting travelers.

An indication of the overall importance of a few cities as train-to-train transfer points is given in Table V-2.[1] Chicago accounts for almost half of the transfers of surveyed passengers and New York for almost one-quarter of them.

All Passengers

To determine the desired train departure time for all passengers on each train, respondents were asked, "What time of day would you have liked this train to have departed?" All answers were converted to a desired change in the schedule for each train by calculating the difference between the actual scheduled departure time and the desired time. For each train, a histogram was developed of the desired changes using time increments of one hour. The results for each train (and route) are shown in Table V-3,[2] in the form of sample sizes, means, standard deviations, and the fraction of passengers who are satisfied with the existing departure times.

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[1] p. 93

[2] p. 94

Table V-2

IMPORTANCE OF CITIES AS TRANSFER POINTS

City	Fraction of Total Transferees Actual	Cummulative
Chicago	43%	43%
New York	25	68
Los Angeles	10	78
Seattle	5	83
Boston	2	85
New Orleans	2	87
Kansas City	2	89
Buffalo	2	91
Detroit	1	92
Other Cities	8	100

Table V-3

DESIRED CHANGES IN SCHEDULES

Route	Train #	Passengers	Desired Shift, Hours		% Pass. Satisfied
			Mean+	Std. Dev.	
New York-Boston	150	59	.034	1.80	53
	151	30	.967	1.033**	40
	182	84	.429	1.996**	57
New York-Kansas City	30	103	- .049	3.943	64
		65	.077	1.279	80
		50	.400	3.301	50
	31	101	- .020	2.534	70
		104	1.125	4.048**	65
		62	- .855	3.529*	53
New York-Miami	84	130	.277	2.326	77
New York-Chicago	40	25	- .280	.980	92
	41	41	- .317	2.018	83
		96	- .260	2.881	71
	71	54	- .278	.787**	74
New York-Buffalo	73	40	- .150	1.642	43
		59	- .119	1.219	67
	74	46	- .413	1.292*	54
		56	- .429	1.386*	59
	78	19	- .692	1.499*	84
Chicago-Detroit	360	30	- .667	1.470**	70
		29	- .069	.371	97
		23	- .043	2.184	70

Table V-3 (continued)

DESIRED CHANGES IN SCHEDULES

Route	Train #	Passengers	Desired Shift, Hours: Mean+	Desired Shift, Hours: Std. Dev.	% Pass. Satisfied
	361	49	.163	.943	86
		32	.156	1.081	94
		36	.028	.845	78
	362	22	- .409	2.062	59
		49	- .468	1.733*	61
	363	10	- .200	1.549	70
		16	- .500	1.549	75
Chicago-St. Louis	302	113	.912	2.064**	74
		67	.448	1.417**	73
	303	62	- .548	1.434**	74
Chicago-Houston	15	138	- .949	3.577**	60
		122	-1.230	3.340**	33
	16	70	1.186	3.009**	60
Chicago-Los Angeles	4	110	- .185	2.062	87
Chicago-Milwaukee	326	50	- .680	1.634**	72
Chicago-Seattle	8	76	.368	2.874	58
Seattle-San Diego	11	207	- .575	1.772**	78
		202	- .069	2.089	69
	13	156	.038	2.252	66
Washington-Boston	174	63	.016	.684	87
	175	131	.912	2.064**	78
		94	- .106	1.000	84

Table V-3 (continued)

DESIRED CHANGES IN SCHEDULES

Route	Train #	Passengers	Desired Shift, Hours Mean+	Std. Dev.	% Pass. Satisfied
Washington/Newport News-Chicago	51	53	.264	2.962	68

*Significant at the .01 level
**Significant at the .05 level
+The minus sign indicates mean desired shift earlier, e.g., -.429 indicates the mean desired departure time is .429 hours or approximately 26 minutes earlier than the existing departure time. No sign indicates a shift to a later departure than the existing time.

Although almost all the means are less than one hour, approximately 40% of these means are statistically significantly different from zero. Also, the standard deviations on many are fairly large, indicating considerable changes are desired by some travelers. For most trains, much more than half the travelers desired no change in the scheduled departure times. However, this was not the case for a few, and it is appropriate to examine the desired shifts in more detail.

Histograms of the desired departure time changes were developed for those trains on which the fraction of passengers who were satisfied with the existing departure times was less than 60%. These are trains on the New York-Boston, New York-Buffalo, Chicago-Houston, and Chicago-Seattle routes.

The histograms for the New York-Boston route are given in Figure V-1[1]. Trains numbered 150 and 151 are the Turbo-trains, new experimental trains which operate on slightly faster schedules than conventional trains between these cities. The passengers on #151 departing Boston at 6:15 a.m. and arriving in New York at 10:00 a.m., generally desire a later departure--almost one hour later in terms of a mean. There is a train departing one hour and ten minutes later, but this train arrives in New York almost two hours later, so this is probably not an acceptable substitute in terms of arrival time, and the newer accommodations of the Turbo-train may be strongly desired also. Thus, Amtrak should consider rescheduling train #151 to a later departure.

Train #150, which departs New York at 4:10 p.m., arriving in Boston at 8:00 p.m., presents a different situation in

[1] p. 98

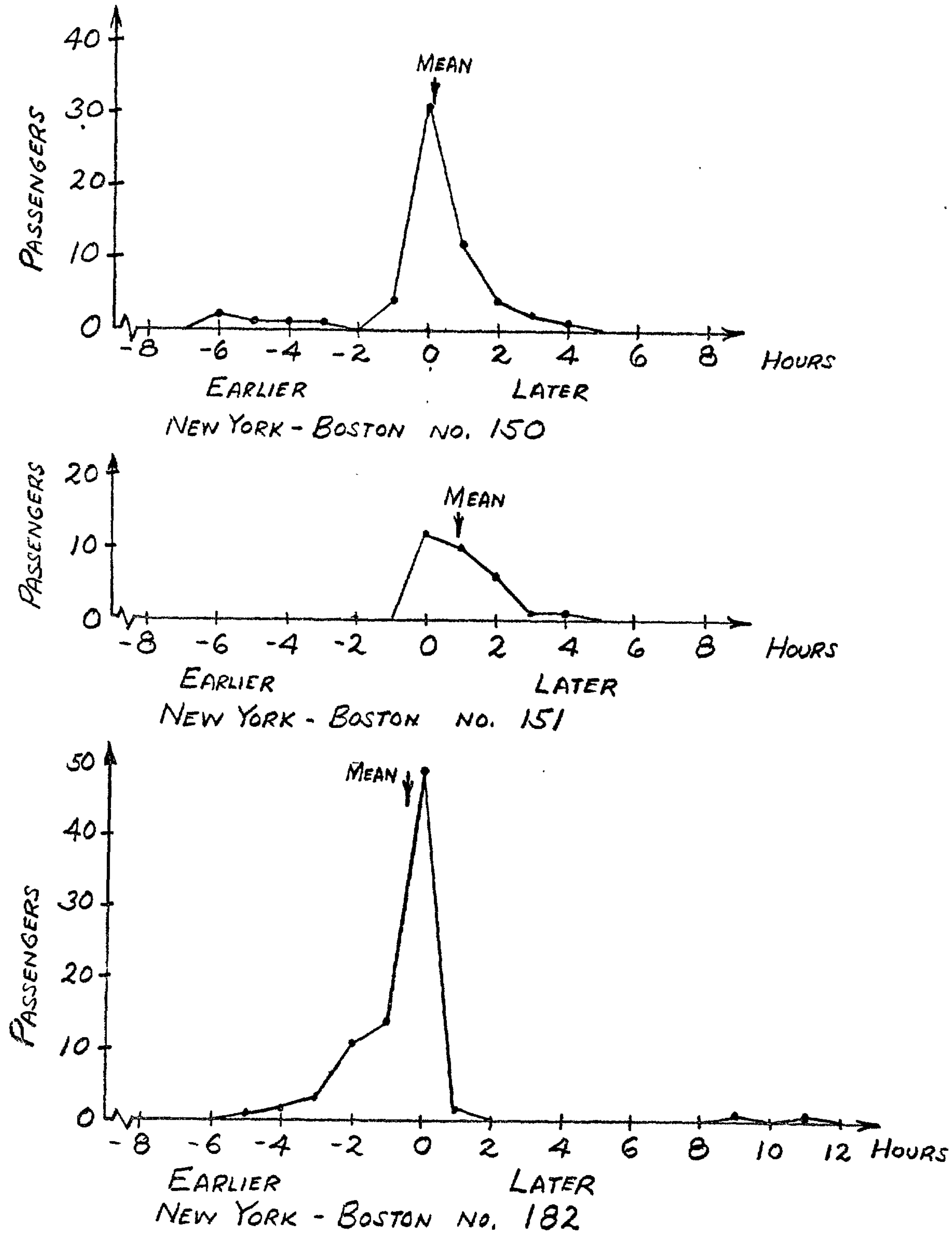

FIGURE V-1. DESIRED SHIFTS IN SCHEDULES ON SPECIFIC ROUTES that the desires for earlier departures are almost equally balanced by desires for later departures. Also, there are trains departing New York exactly one hour before and after #150, and there is frequent service throughout the day. Thus, no more satisfactory schedule can be identified for this train. Train #182 departs New York at 5:10 p.m., one hour after #150. The previous train, with similar accommodations and servicing the same (actually more) stations, leaves at 3:10 p.m., so it is odd that anyone on #182 desired an earlier departure by two hours or more. Those desiring about a one hour earlier departure could use the Turbo-train any day but Saturday, at an increase in price, and those desiring later departures could take the trains operating one and two hours later which serve all the places served by #182. Thus, no major change can be supported for this train.

The New York-Buffalo train data are presented in Figure V-2.[1] Train #73, which departs from New York at 1:00 p.m. and arrives in Buffalo at 9:20 p.m., is preceded by a 9:00 a.m. departure. Thus, even though there is a skewness in the desired shift toward an earlier departure, more than a minimal shift is not warranted. The closeness of the mean to zero, plus the fact that 58% of the passengers are satisfied, further reinforces this. Train #74 departs Buffalo at 8:35 a.m., arriving in New York at 4:55 p.m. While the mean desired shift is about one-half hour earlier, the distribution indicates that many would be disadvantaged by any shift.

Train #15, from Chicago to Houston, departed during the survey period at 3:00 p.m., arriving at 6:45 p.m. the next day,

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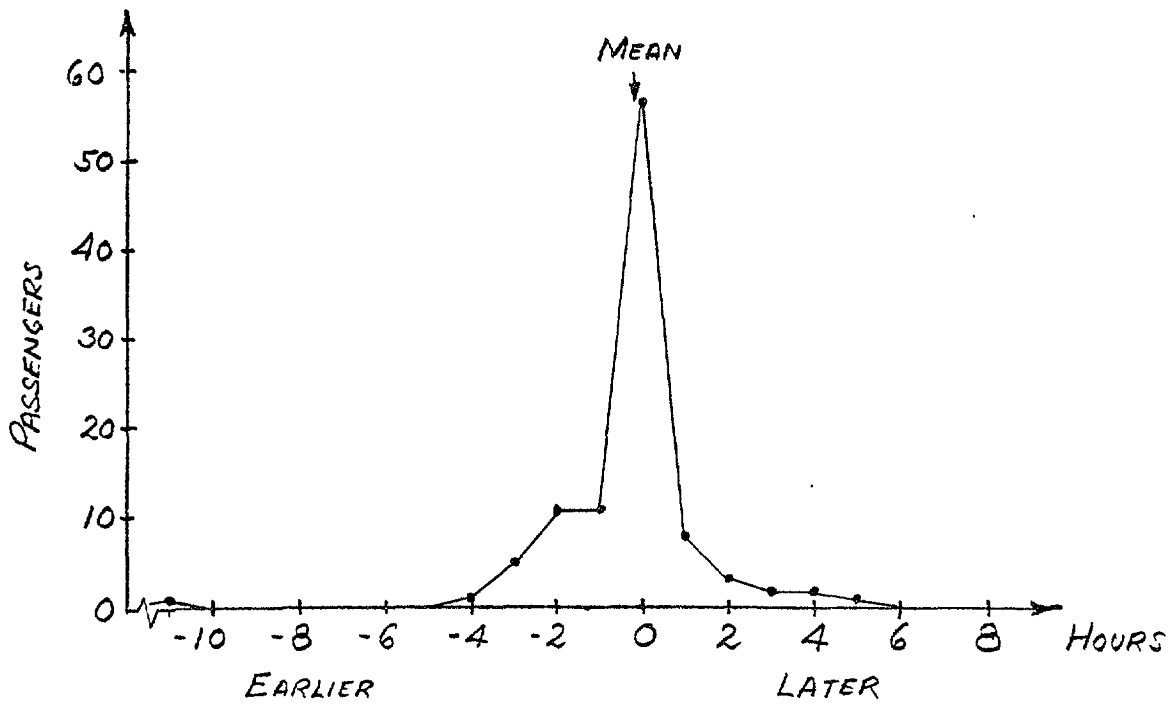
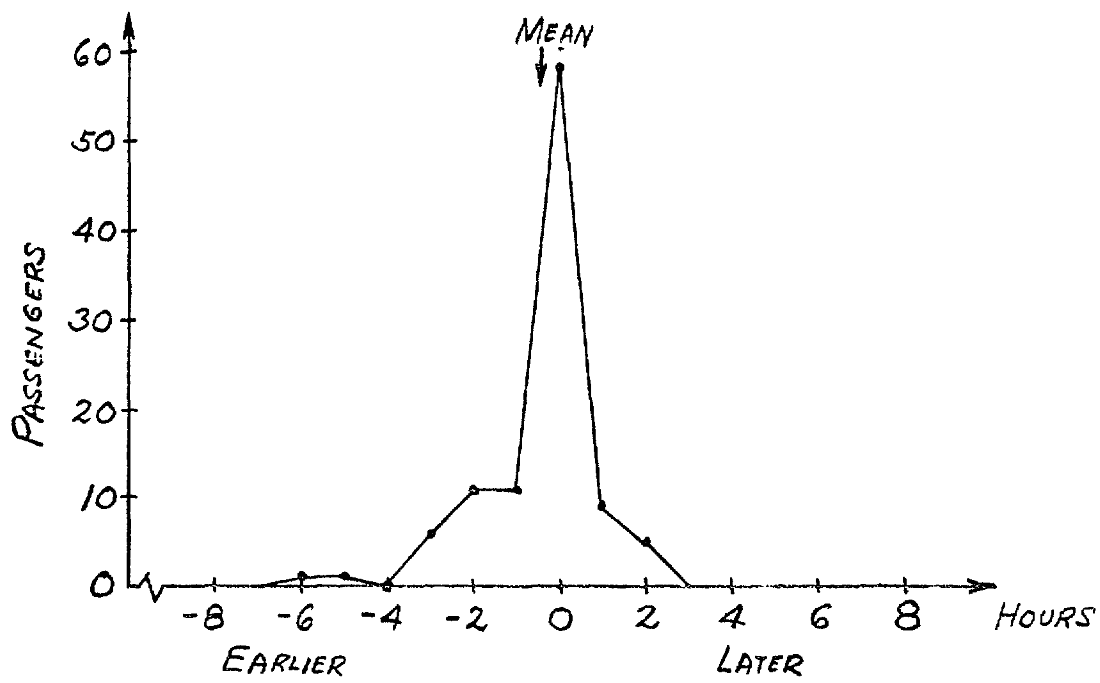
[1] p. 100

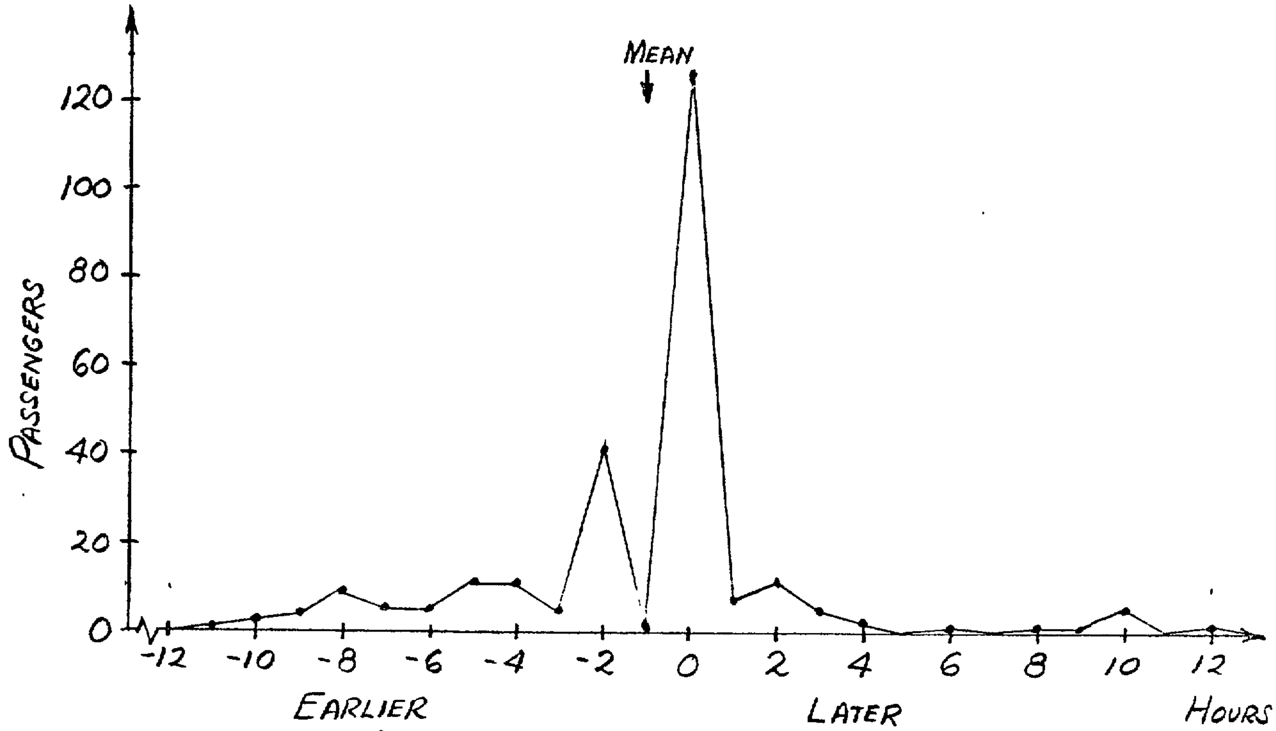


NEW YORK - BUFFALO NO. 73

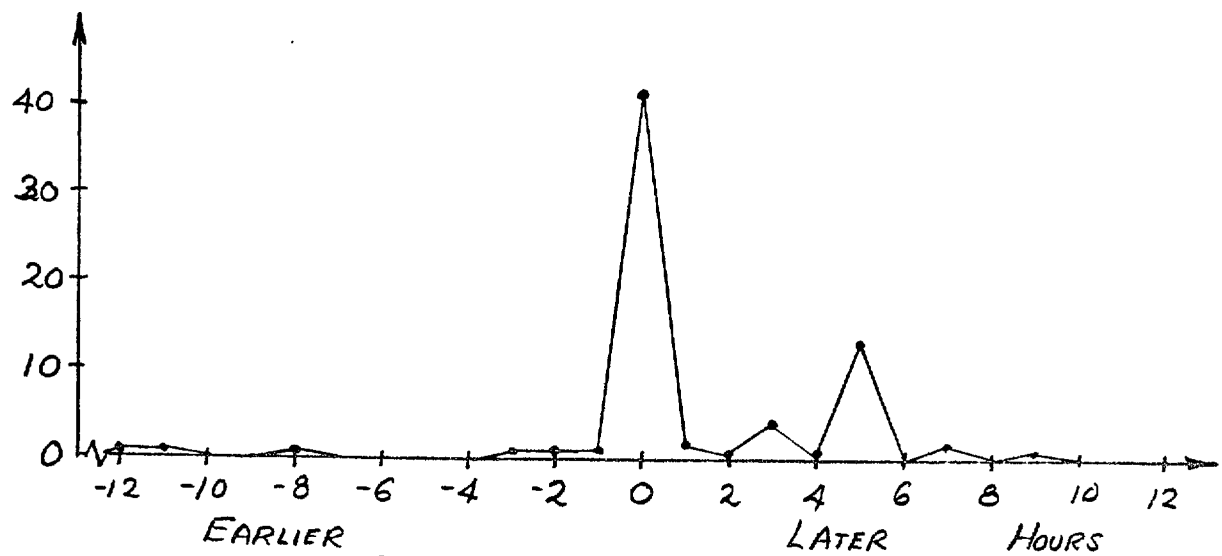


BUFFALO - NEW YORK NO. 74

FIGURE V-2. DESIRED SHIFTS IN SCHEDULES ON SPECIFIC ROUTES.



CHICAGO - HOUSTON TRAIN NO. 15



HOUSTON - CHICAGO TRAIN NO. 16

FIGURE V-3. DESIRED SHIFTS IN SCHEDULES ON SPECIFIC ROUTES.

has a satisfactory schedule for only 49% of its passengers. It is the only train on the route, except for train #3, which leaves Chicago at 6:30 p.m. and covers the same route as far as Kansas City. The mean desired shift in the departure time is approximately one hour earlier, and there are relatively few who desire a later departure time. Although the range of desired shifts is too great to satisfy all travelers and still operate only one train, these data suggest that an earlier departure would be more satisfactory. Amtrak altered the schedule of #15 on June 17, just prior to our survey, to depart at 3:00 p.m. instead of 5:00 p.m. A further advance of one hour seems justified.

Also at that time train #16, which had departed Houston for Chicago at 7:20 a.m., was changed to depart at 12:20 p.m. Our data for this train, also presented in Figure V-4, indicate that most travelers (60%) are satisfied with the new schedule, although many desire an even later departure. Thus, the new schedule is more satisfactory to the passengers as a whole. The mean desired shift is still for about a 71 minute later departure, but the high satisfaction with the present schedule makes it difficult to recommend any change.

The remaining train with less than 60% satisfied with the departure time is #8, from Chicago (2:30 p.m.) to Seattle (1:45 p.m. on the third day of travel). As shown in Figure V-4,[1] the desires for a later departure (21) were almost twice as numerous as for an earlier departure (11), with a mean desired shift of 22 minutes later. This is hardly sufficient to warrant any more than a shift adjustment, if any. Amtrak added a second train on this route which operates tri-weekly,

[1] p. 103

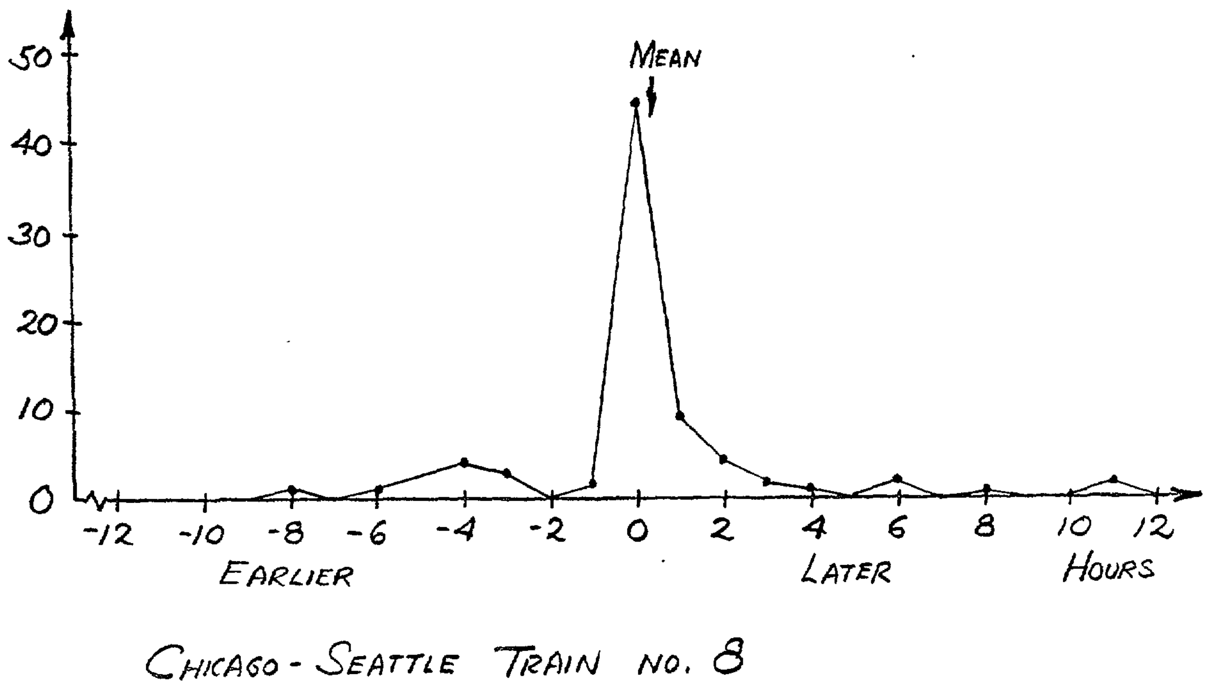


FIGURE V-4. DESIRED SHIFTS IN SCHEDULES ON SPECIFIC ROUTES.

departing at 10:30 a.m. on June 11, 1972, which could be taken by any one strongly desiring the earlier departure.

Thus, on the basis of our sample, very little in the way of substantial shifts in schedule can be justified. While there clearly are patrons who are dissatisfied with the current schedules, in most cases, any changes would benefit some and cause others to be less satisfied. Furthermore, since those who desire another departure time are now riders, their need for their desired departure time is not so great as to preclude their using Amtrak. On the other hand, those satisfied with the present schedule might not use Amtrak if the schedule were changed, although given the characteristics of the travelers and their trip purpose, this is not very likely. In any event, caution should be used in revising schedules.

As a summary indication of desired schedule changes for the entire system, an aggregate histogram was developed. This is shown in Figure V-5.[1] About 69% of the surveyed passengers desired no change in the present schedule. The remainder were about equally divided among preferences for earlier and later departures, resulting in a mean desired change of 0.131 hour earlier departure. Again, the mean was significantly different from zero. However, as to interpretation, it still indicates that unless more trains were added, it would not be possible to significantly increase the satisfaction of travelers.

Conclusion

Given the small amount of train-to-train transfers on the system and the preference of 69% of all passengers surveyed for the present schedule of the train they rode, no schedule

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[1] p. 105

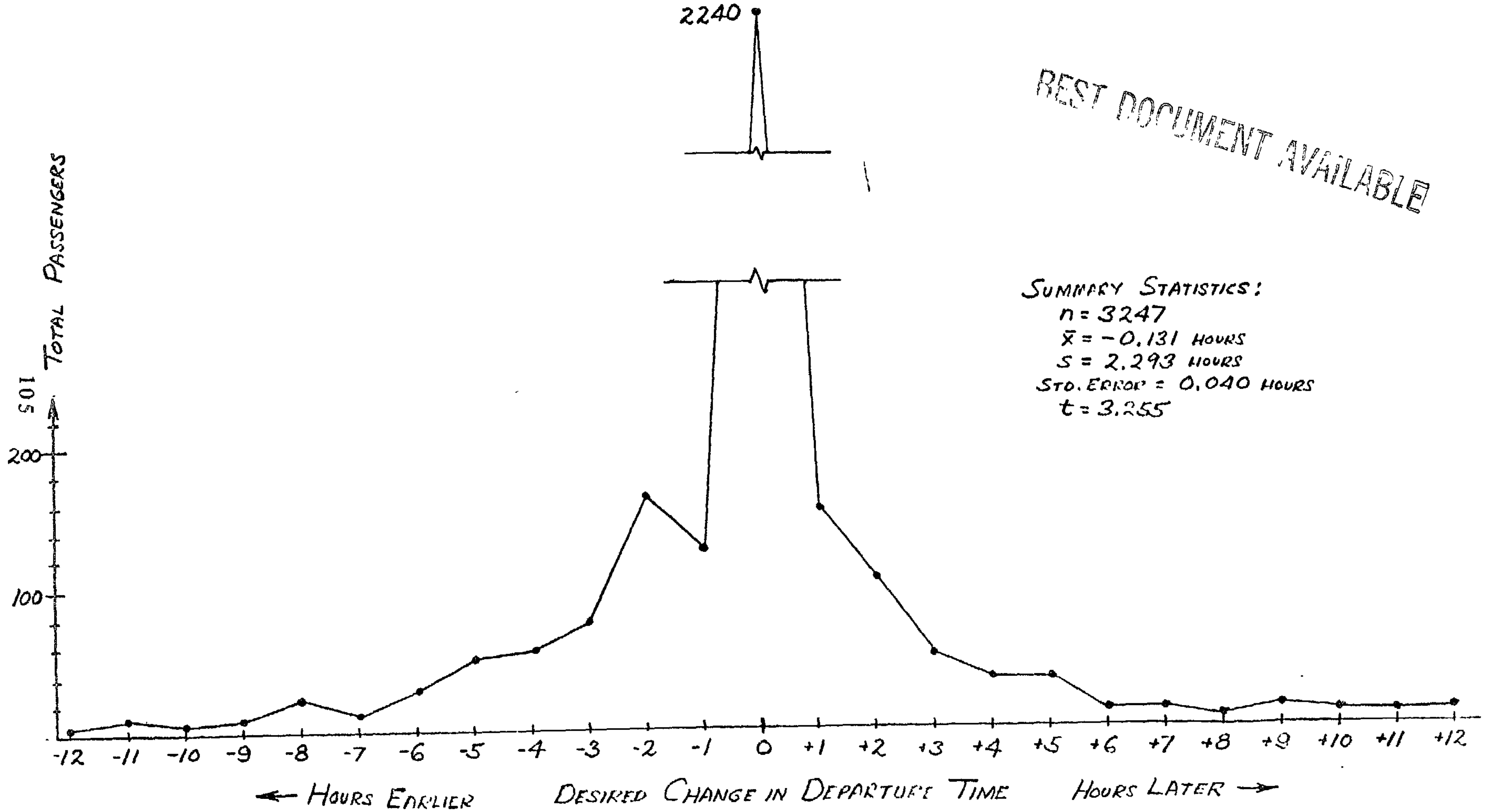

FIGURE V-5 AGGREGATE HISTOGRAM OF DESIRED CHANGE IN DEPARTURE TIMES.

change recommendations can be made, except as indicated for trains #15 and #151. It should be borne in mind, however, that this conclusion is valid for only present Amtrak riders and may not be true for potential riders who might be drawn from other modes.

Chapter VI

EVALUATION OF AMTRAK PASSENGER SERVICE: TRAIN SIZE AND EQUIPMENT CHOICE

Introduction

The purpose of this chapter is to evaluate Amtrak's operation of their service with respect to the matching of train size to traffic and the choice of type of equipment to operate. To do this, it is necessary to present background information on the economics of intercity railroad passenger service operating in markets such as those found in the United States. The focus of this chapter will be upon the identification of those factors which are important in achieving a reasonable balance between revenues and costs. Since this study is concerned with the efficiency with which Amtrak is providing existing service rather than a concern with the development of new markets and additional revenues, the emphasis will be upon those factors which are important in determining the costs of providing a given service.

As discussed in Chapter III, the railroad passenger routes of the United States are typically ones of very low traffic levels. All routes but a few are operated by diesel or diesel-electric propulsion, pure electric operating being limited to the New Haven-New York-Philadelphia-Washington route, Philadelphia-Harrisburg route, and the Grand Central Terminal in New York. As discussed earlier, our concern is with those routes other than the New York-Philadelphia-Washington route, because that route is characterized by a very heavy volume of passenger traffic, very frequent train service (hourly between New York and Washington, and more than half hourly between New York and Philadelphia in each direction), and is apparently profitable--all factors making it unique in the Amtrak system. While the discussion of cost characteristics of railroad passenger service below is limited to diesel and diesel-electric operation, the basic principles should apply to the two segments and one terminal which are operated electrically and which are within the scope of our study.

The basic cost data and cost model which were used for our analyses were taken from Amtrak reports. Therefore, our conclusions and recommendations should be compatible with the views of Amtrak. If not, the disagreement should not be over the basic information upon which our conclusions are based, but rather upon the interpretation of the quantitative results.

Current Traffic and Profitability

Historical data exists on the traffic carried, revenue, and expenses on the various Amtrak routes and some route segments since the inception of Amtrak passenger service. Figure VI-1[1] presents information on the ratio of revenue to cost in 1971 for Amtrak routes (for route segments in some cases), along with the average traffic on each such route or segment.*

The revenue included in the ratio is the total revenue on the trains of that route and the costs are the billings by the railroads providing the service. Therefore, the costs must be considered only an approximation to true costs, deviations above and below true social costs being possible. The measure of average traffic is the passenger miles per train

*Separate revenue and cost information is presented in the appendix to this chapter, pages VI-34-35.

[1] p. 109

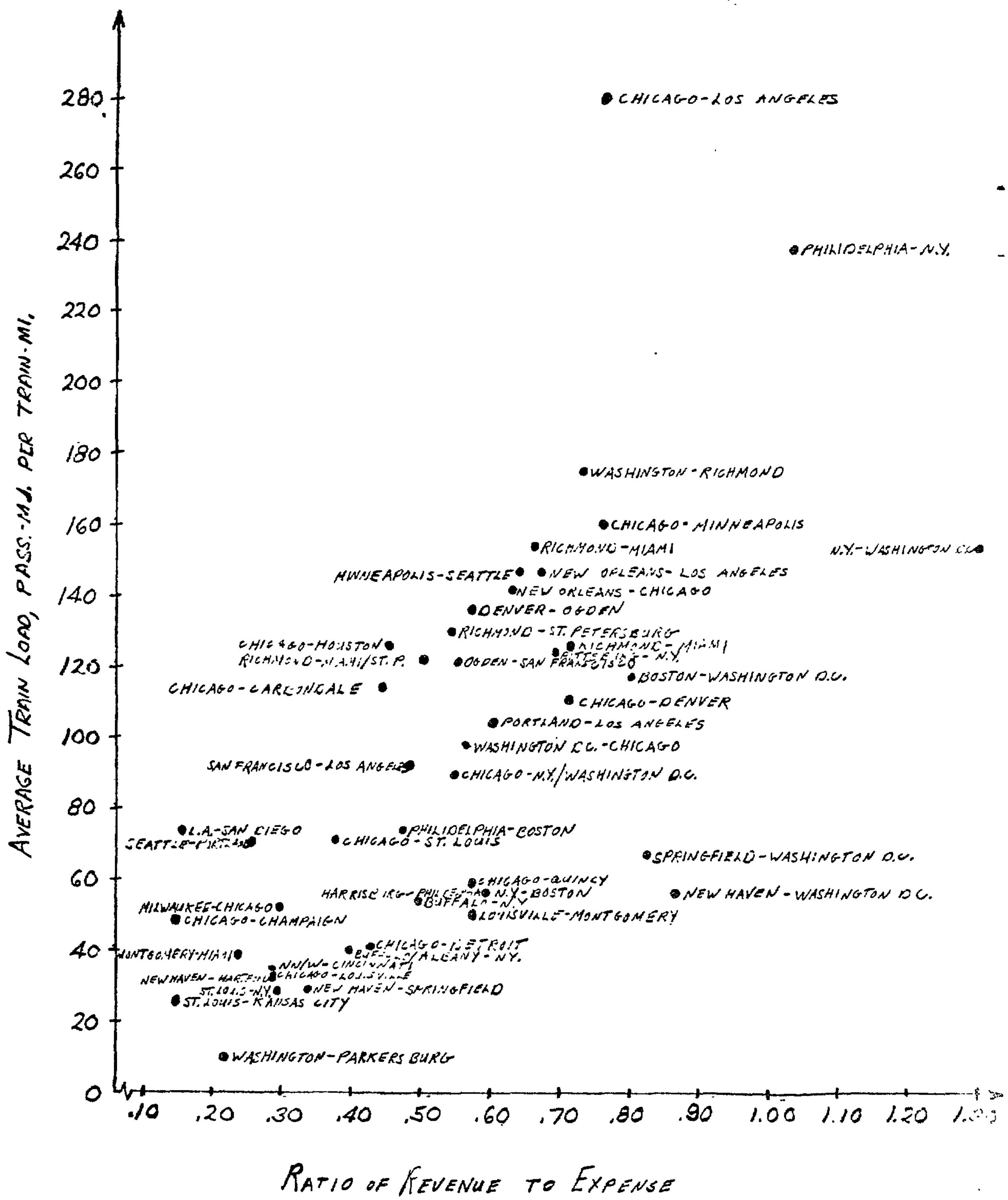

FIGURE VI-1. TRAIN LOADS AND REVENUE TO EXPENSE RATIO.

mile. The total passenger miles on a route are calculated by adding up the miles traveled by each and every passenger on that route. The train miles are the sum of the miles operated by each train on the route. The average traffic measure, passenger miles per train mile, is derived by simply dividing these. Thus, it is a measure, in effect, of the average number of passengers one could expect to find on a train on that route. It should be borne in mind that the actual number of passengers on each train could vary among the trains, as it could vary on each train as it traversed its route. However, it is a useful measure of traffic on each train.

As can be clearly seen from this figure, most of the routes have very low ratios of revenue to cost, indicating the source of Amtrak's large deficit. It is rather surprising that there is no consistent relationship between average traffic per train on a route and the ratio of revenue to cost, for one would expect that, as the traffic increased, the revenue would increase approximately in proportion while the cost would remain relatively constant, leading toward a higher ratio of revenue to cost and, ultimately, to profitability. It is significant that, of the forty-six routes or segments, twenty (44%) cover less than half their cost by revenues and only seven (15%) have revenues sufficient to cover three-quarters of the expenses. Only two--New York to Philadelphia and to Washington--are profitable.

It should be borne in mind that these data are for 1971, and that the situation on specific routes may have changed during 1972. First, the fare structure has changed, low per-mile fares being raised and the higher fare being lowered in many instances. Also, fares on some routes were reduced experimentally to ascertain riding and revenue reactions. Also, in the course of gaining experience with the system, Amtrak may have made changes in the manner of provision of service which would reduce costs. Yet the overall picture of revenues not being sufficient to cover costs is undoubtedly still true.

To gain a clearer picture of the traffic on Amtrak routes, table VI-1[1] was developed to indicate the size of the train required to accommodate the traffic loads on Amtrak routes. This table indicates the size of train, in coaches only, necessary to accommodate the 85th percentile traffic on the 46 routes. As was discussed in Chapter III, the 85th percentile traffic is that traffic level below which the traffic is 85% of the time. These 85% loads were calculated for the routes by multipying the average 1971 loads by 1.30, this being the ratio of 85th percentile loads to average loads found in the survey. The reason for using 1971 load data instead of the survey data is simply that the 1971 data applies to all routes, while the survey does not. The seating capacity of a coach for this analysis is 60 passengers*

As can be seen from perusal of the table, more than half (57%) of the Amtrak routes can be operated--accommodating the 85th percentile load--with trains of two coaches or less. Eighty-one percent can be accommodated with three coach trains and the maximum length required would be five coaches. Thus, our concern is with relatively short trains, although to the

*Actual Amtrak coaches range from 44 to 89 seats, with many long distance coaches seating 44 and 68-72 passengers, and medium distance coaches typically seating 56 to 70.

1 p. 112

Table VI-1

TRAIN SIZE REQUIRED ON ROUTES TO ACCOMMODATE 85TH PERCENTILE TRAFFIC LOADS

Train Size (60 Seat Coaches)	Number of Routes Which Can Be Accommodated		
	Actual	Cummulative	Percent
1	10	10	22%
2	16	26	57%
3	11	37	81%
4	7	44	96%
5	2	46	100%

Source: Derived from Table III-2[1]; see text for explanation of method

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[1] p. 29

extent Pullman accommodations are used the trains are, of course, longer since these cars accommodate fewer passengers than coaches.

Another important aspect of Amtrak traffic is its variability. As discussed in detail in Chapter III, there is, based upon the limited experience of the past year and one half, a seasonal variation in traffic leading to a substantial peaking of traffic in the summer months and around the Christmas holidays. Also, on most routes, there is considerable variation in the traffic within each week, there being relatively little weekday traffic and considerable weekend (Friday night to Monday morning) traffic. The traffic flow during these peaks is often many times the traffic flow during the low period. If Amtrak chooses to maintain sufficient cars, locomotives, train crews, and station capacity to adequately accommodate these weekly and seasonal peaks, then much of the equipment is essentially unused during the low periods which are most of the year. Even if this equipment and these crews are operated during these low periods, their operation in addition to the minimum train unit is clearly not required and these items are necessarily underutilized. This clearly involves a managerial policy decision as to the proper trade-off between service to more travelers and increased costs. In the provision of highway capacity, it has become standard practice to design for the thirtieth highest hourly flow in a year, this corresponding to the 85th percentile traffic load.

With this brief review of the findings of the study with respect to Amtrak traffic, it is appropriate to turn to the economies of train operation.

Cost Characteristics

An understanding of the cost characteristics of railroad passenger service is necessary in order to define those management practices which will lead to efficiency in the operation of the service. Our concern in this study is with the matching of train characteristics to the existing traffic characteristics of Amtrak routes, in particular, with the type and size of trains operated. This seems appropriate for a study with a relatively short time horizon, because the train operations represent the major decision variables to management in the short run, changes in the track and terminal facilities obviously representing major investments beyond the scope of current Amtrak finances. Also, an understanding of the short run cost characteristics of Amtrak-type services is likely to yield an understanding of characteristics of traffic, such as variation in traffic with season and minimum levels of traffic, which might lead to difficulties in controlling costs. If such problems are identified, then attention can be directed to changing these traffic characteristics.

There are many options with respect to the trains operated on Amtrak routes which are not electrified--the routes of primary concern to us. One option is with respect to the type of propulsion of the train, which can be either (1) a locomotive (consisting of one or more units) pulling or pushing a train of cars or (2) a self-propelled passenger car which requires no locomotive at all. Another major option is, of course, the number of cars on the train, which can vary from one up to at least twenty to twenty-five cars, although the technical characteristics of particular pieces of passenger equipment, as well as the track capacities at stations and yards, will also influence the maximum length of train which can be operated. However, given the existing Amtrak traffic, situations in which track capacity is a problem are relatively few in number. A third option is with respect to the types of accommodations offered in the train in which the basic types are coach seats, parlor car seats, sleeping rooms (of various types), and dining service (which might be offered in a special car at tables or in coach cars with a snack bar for light meals). As will be shown below, decisions with respect to the types and length of trains operated can dramatically affect the costs of providing service and, therefore, these choices must be made very carefully. A particular concern of this inquiry into costs is the identification of the characteristics of trains which can provide any given capacity and types of accommodation at minimum cost.

The cost estimating relationships used in this investigation are those developed for and used by Amtrak in its own studies. The reason for the choice of these relationships rather than others which have been developed in the literature is two-fold. First, the costs borne by Amtrak in providing its passenger service do not necessarily correspond to the full costs of providing that service as it might have been provided by railroads, because railroads bill Amtrak for certain types of costs incurred, and these costs in any particular situation, might be greater than or less than the actual cost to the railroad of providing the service. Therefore, there could be some difference between Amtrak costs and costs based upon prior railroad experience. Second, the use of Amtrak's relationships insures that our conclusions are based upon relationships which Amtrak accepts. Therefore, if there are any disagreements regarding our conclusions, these are presumably based upon disagreements on interpretation rather than over the underlying cost relationships. This should greatly facilitate any discussion of our conclusions.

The cost model is presented in reference (2). The model estimates the cost of operating various types of trains per mile of operation. It takes into account variations in the type of accommodation in those cars. Although there are certainly some regional and carrier differences in costs, these are probably quite small relative to the total costs developed by these relationships. The cost of terminal operations and the costs of general Amtrak administration is included as a fixed fraction of all other costs. The cost model is presented in detail in the appendix to this chapter.

Coach Train Costs

The basic options with respect to operating coach trains are: type of propulsion; number of cars; seating capacity of the cars used; and the provision of dining service, if any, which might be provided in a special dining car or in snack bars in coaches (such as in the Metroliner service). It is difficult, in this analysis, to deal with the question of whether or not a standard dining car should be included on the train, because no information is available on the utilization of diners by coach passengers or their preferences between diners and snack bars, although a 1965 railroad study indicates they prefer snack bars (4). Amtrak may have decided in favor of snack bars, since most Amtrak coach and coach-parlor cars have snack bars rather than diners, and all the new Metroliner trains have snack bars in every other car.

Train Types

Before presenting the cost results, it is appropriate to specify the nature of the trains used in this analysis, because the characteristics of Amtrak coaches vary widely (seating capacities varying from forty-four to eighty-nine and possibly more), and the few self-propelled diesel cars which Amtrak uses on one of their local lines probably are not fitted with seats appropriate for longer distance services. The coaches assumed for this analysis are coaches which will accommodate sixty passengers, this being an approximate average seating capacity of current Amtrak coaches. Unfortunately, it is not possible to determine the exact seating capacity of coaches assigned to short and medium distance routes for which an all-coach train would be appropriate, but train reports indicate train seating capacities which imply individual coach capacities of approximately fifty to sixty persons (3). There seems to be very extensive lounge space available in coaches with this number of seats, so that the snack bar can be fitted without loss of passenger revenue seats (as was done by the Penn Central).

The rail diesel car envisioned for comparison purposes is the rail diesel car which was produced by the Budd Company in large numbers in the post-war period, but one in which the seating capacity is reduced to correspond to a seat spacing identical to that of the new Metroliner coaches in the Northeast Corridor. As these trains are operated, every other coach contains a snack bar. Applying the snack bar to the interior of a rail diesel car and using the same seat spacing as in the Metroliner cars, the seating capacity of a rail diesel car with a snack bar is seventy-two passengers and the capacity without a snack bar is eighty-eight. It should perhaps be noted at this point that rail diesel cars have slightly better acceleration and deceleration properties than conventional locomotive drawn trains and a maximum speed of eighty-five miles per hour--higher than the speed limit on most railroads. Thus, one would expect slight running time reductions if rail diesel cars were substituted for locomotive-drawn trains, but these would not be as dramatic as those achieved with Metroliners in the Northeast Corridor.

Costs

The costs of operating these two types of trains per mile are presented in Figure VI-2,[1] these costs including operation costs and an allocation of the Amtrak purchase price and refurbishing cost. These costs are shown as they would vary with the number of seats available for passenger use on the train. The points at which the costs sharply increase represent points at which the number of cars on the train must be increased in order to accommodate an additional passenger. Also shown, in dashed lines, are revenues from various fare levels, which will be discussed shortly. As can be clearly seen, the costs of operating a rail diesel car train are considerably less than those for operating a locomotive-drawn

[1] p. 119

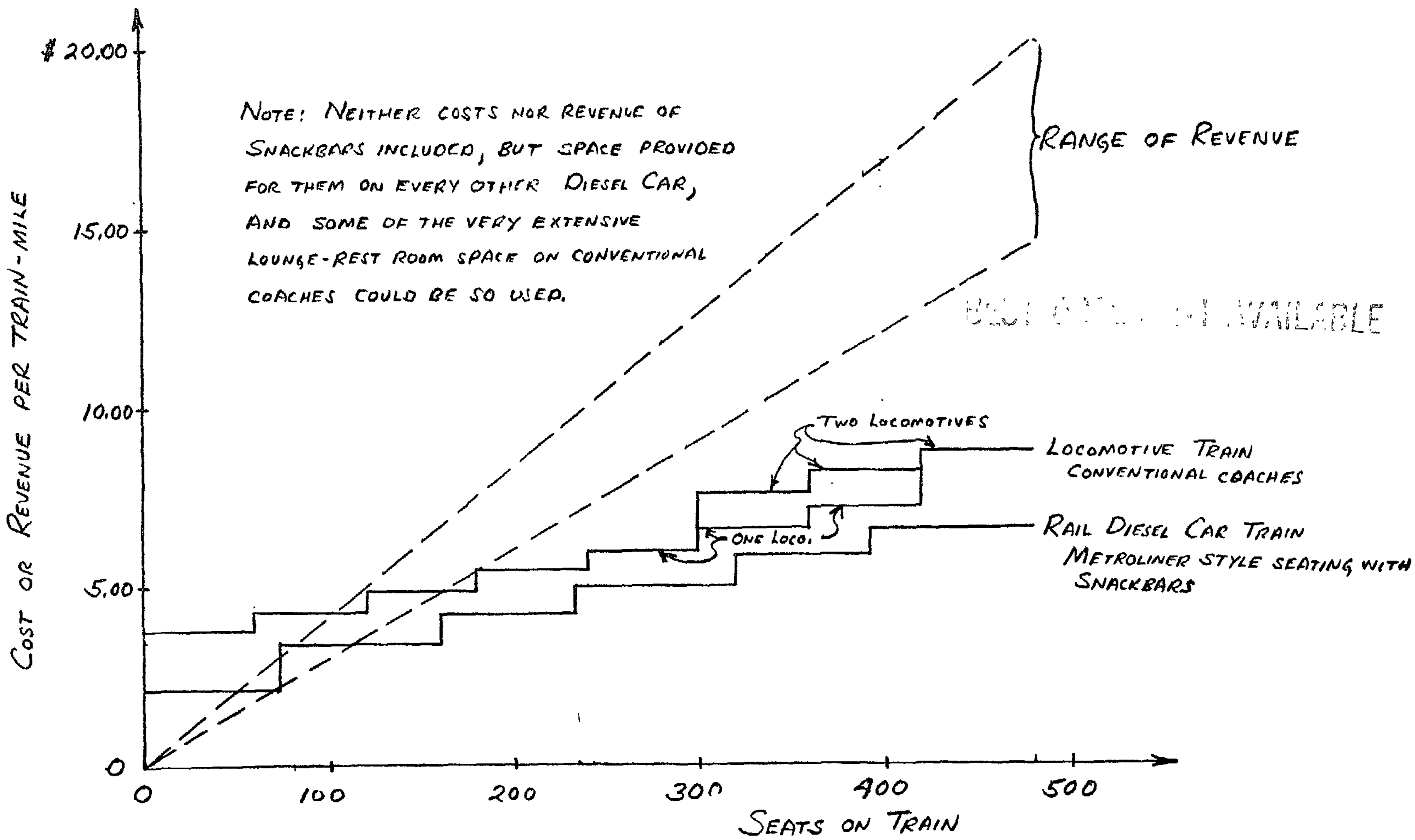

FIGURE VI-2. COSTS AND REVENUE OF VARIOUS COACH TRAIN TYPES.

train regardless of the number of passengers on board the train. Therefore, for coach only trains and coach trains with a snack bar-type dining service, Amtrak should definitely study the feasibility of using rail diesel cars instead of conventional locomotive-drawn trains. In the relatively low-volume ranges most typical of Amtrak's services, the cost savings from substitution of rail diesel cars for conventional trains should be on the order of twenty-five to fifty percent. Such cost reductions would probably convert some currently money-losing Amtrak services into slightly profitable ones. Factors such as passenger comfort, feasibility of operating such cars on specific railroads and tracks (e.g., suitability of signals for these cars), and the availability of used cars or the ability to purchase new ones, and the precise costs on particular routes, must all be considered before any actual substitution or purchase.

Although a cost comparison between locomotive trains and rail diesel car trains indicates an advantage to operating rail diesel cars, the advantage is not fully appreciated until this is interpreted in terms of typical Amtrak traffic levels. Also shown in Figure VI-2[1] is the range of revenue obtained for typical Amtrak fares, which range from 3.0 cents per mile to approximately 4.2 cents per mile. It is seen that, with the higher fare level, a one unit rail diesel car train will cover its full expenses with fifty-one passengers, corresponding to a load factor of 71%, while the locomotive drawn train requires 117 passengers to cover its costs, with a load factor of 65%. (Load factor is defined as the ratio of passengers on the train, or seats occupied,

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[1] p. 119

to the total seats available, expressed in the form of a percentage.) With over half the Amtrak routes having 85th percentile train loads of less than 117 passengers, the advantage of the rail diesel car in operating services profitably is very important. Even at the lower fare level, the rail diesel car requires only 115 passengers to operate profitably, while the conventional train requires 168.

In using these figures, it must be borne in mind that at some higher volumes of traffic the costs of operating the required train may not be covered by the revenue. For example, with the number of passengers more than 72, two RDC's cars are required, but the revenue is insufficient to cover costs until there are 82 passengers on board (a 51% load factor). It might be concluded that on any route with, say, an average train load of 80 persons, that even with RDC's, the service would be unprofitable. In fact, this is actually unlikely. First, train traffic would in reality vary, so that some runs would be made with one car, others two cars, etc., tending to reduce the costs. Also, the frequency of service might be increased, replacing, for example, two two-car trains per day with these one-car trains, yielding a cost reduction of 8%. Or, more likely, the timing of the trains might be altered to yield loads requiring two cars on one train and one car on the other, yielding a 19% cost reduction. Because of these options, minor instances of unprofitability occurring with traffic greater than that required to first push revenues over costs will be ignored in the following analyses. Thus, we will consider any service to be potentially profitable once the traffic has exceeded the

the minimum for revenue to cover costs at an acceptable load factor.

The fluctuations in Amtrak traffic, both as variations with season, day, etc., and along a route, make it virtually impossible to achieve high load factors unless traffic peaks are smoothed in some manner. As discussed in Chapter III, the maximum load factor typically achieved on Amtrak routes is somewhat less than 75%, and 50% is a more representative load factor. The comparison between locomotive trains and rail diesel car trains can be made with the restriction that load factors not exceed these limits. (Of course, it is not possible to restrict the load factor to a particular value and then calculate the break-even load because train capacity cannot be varied by increments of one passenger, but must be varied by increments of the capacity of a car.) Table VI-2[1] presents information on the minimum break-even load required on these two types of trains in order to cover costs for the two levels of maximum load factor (75% and 50%) and for the maximum and minimum typical fares. It is very apparent that the rail diesel car requires considerably less traffic in order to turn a profit than the locomotive drawn trains under any condition. Thus, it appears that the substitution of rail diesel cars for conventional locomotive drawn trains on many Amtrak routes would substantially improve Amtrak's financial position.

Coach and Pullman Trains

Because of the long distances involved on many Amtrak routes, the trains operate during the night time periods and sleeping services are provided. Based upon the traffic counts

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[1] p. 123

Table VI-2

BREAKEVEN LOADS AND LOAD FACTORS
FOR VARIOUS TYPES OF COACH TRAINS

Maximum Typical Fare Levels (4.2 ¢/mi.)

	Locomotive Train	Rail Diesel Car Train
Load Factor ≤ 75%		
Minimum Breakeven Load	117 pass.	51 pass.
Load Factor	65 %	71 %
Load Factor ≤ 50%		
Minimum Breakeven Load	144 pass.	101 pass.
Load Factor	48 %	44 %

Minimum Typical Fare Levels (3.0 ¢/mi.)

	Locomotive Train	Rail Diesel Car Train
Load Factor ≤ 75%		
Minimum Breakeven Load	168 pass.	115 pass.
Load Factor	70 %	72 %
Load Factor ≤ 50%		
Minimum Breakeven Load	293 pass.	193 pass.
Load Factor	49 %	49 %

discussed in previous chapters on overnight routes, it is typical to find approximately one fifth of the travelers on the train using pullman accommodations. Because a typical pullman accommodates sixteen people (although this varies greatly among car designs and also depends somewhat on the occupants), and a typical long distance coach seats fifty-six passengers, such a mix of pullman and coach passengers requires approximately one coach for each pullman car. In addition, such trains typically have full dining car service. Therefore, the train used in this analysis will be one with an appropriate number of locomotives, an equal number of coaches and pullmans, and one diner. For purposes of this calculation, Amtrak costs will again be used.

The variation in the cost of operating such a train with the number of spaces provided for passengers is shown in Figure VI-3.[1] The costs of operating such a service definitely increase with the increasing number of cars per train, again indicating that a concern with matching the size of the train to the number of passengers is quite important.

Also shown in this figure is the revenue which would be obtained from this train, as this would vary with the number of passengers on this train. In the range of typical fares, it is necessary to have from approximately 97 to 182 passengers on the train before revenues would begin to exceed expenses, and this occurs with a train which will accommodate a maximum of 216 passengers. Table VI-3[2] presents more detailed information on the loads required to support a train of this type and the corresponding load factor.

Typical load factors for such trains on the more heavily

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[1] p. 125
[2] p. 126

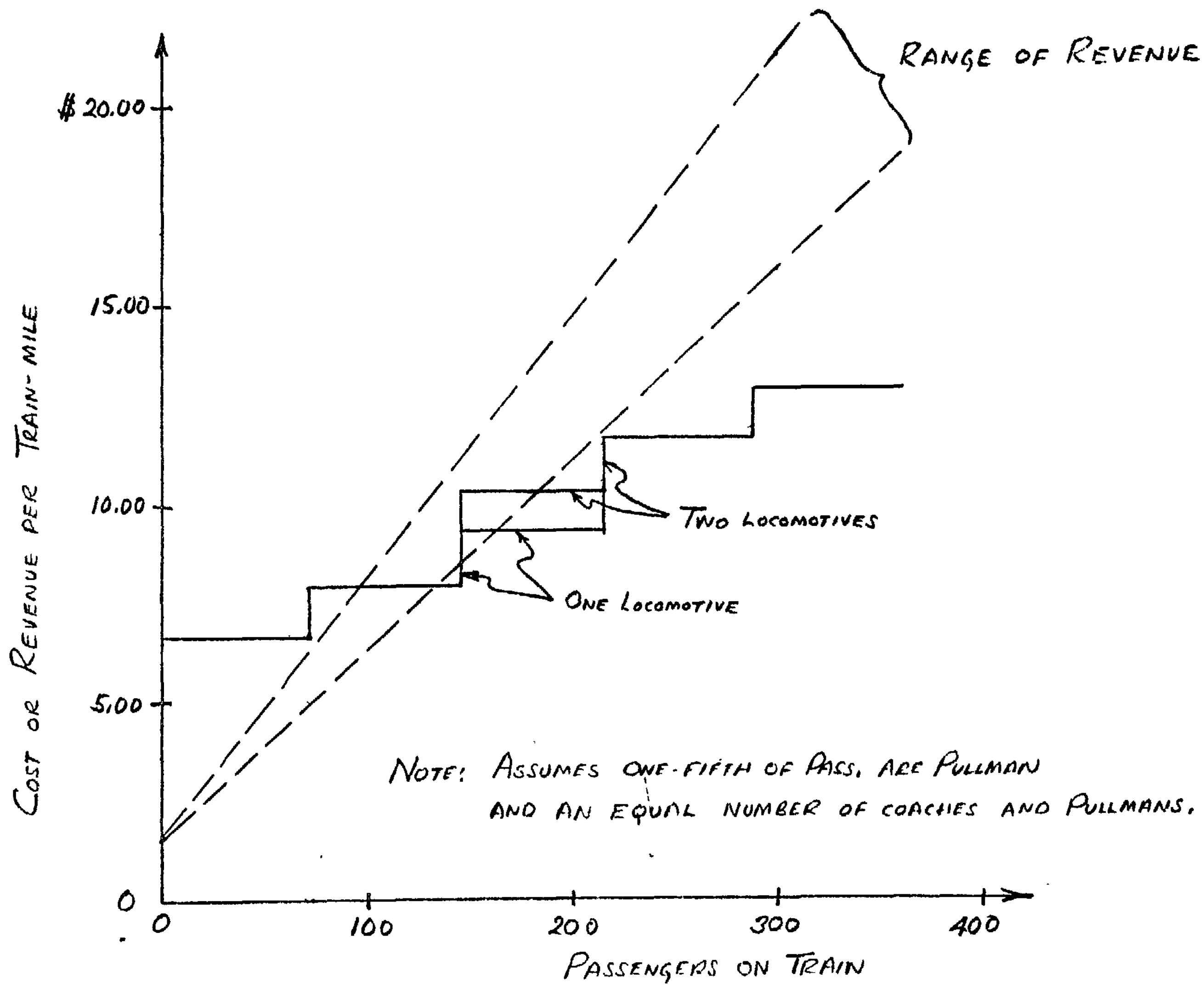

FIGURE VI-3. COST AND REVENUE OF A COACH-PULLMAN-DINER TRAIN.

Table VI-3

BREAKEVEN LOADS AND LOAD FACTORS
FOR COACH-PULLMAN-DINER TRAINS

	Typical Fare Levels	
	Maximum*	Minimum**
Open Load Factor		
Minimum Breakeven Load	97 pass.	134-182 pass.
Load Factor	67 %	98-84 %
Load Factor ≤ 75%		
Minimum Breakeven Load	97 pass.	210 pass.
Load Factor	67 %	73 %
Load Factor ≤ 50%		
Minimum Breakeven Load	174 pass.	(beyond reasonable train length)
Load Factor	48 %	

* Coach @ 4.2 ¢/mi., pullman @ 11.2 ¢/mi.
** Coach @ 3.0 ¢/mi., pullman @ 15.0 ¢/mi.

traveled routes range from 60 to 75%. Requiring a load factor not exceeding 75%, it is necessary, with the maximum fare level, to have at least 97 passengers on board the train in order to cover costs and 210 passengers at the minimum fare level. These correspond to 67% and 73% load factors, respectively. If the maximum attainable load factor were somewhat less than 50%, then it is only possible to cover expesses with the higher fare levels, and this begins with 174 passengers and a load factor of 48%.

Coach and Parlor Car Trains

The provision of parlor car services is limited to only a few Amtrak routes and is not required on any routes by the enabling legislation. Thus, parlor cars can reasonably be considered as a marginal type of service, in which the provision of parlor car services would only be considered as an addition to an existing coach train. Therefore, it is appropriate to consider solely the additional costs of providing parlor car service in comparison to the additional revenue derived from providing the service. A typical parlor car seats thirty so, if it is added to a train and fully occupied by former coach passengers, coach revenue drops by about $ .90 to $1.25 and parlor revenue increases by $1.70 to $2.40, for a marginal revenue at 100% occupancy of $ .80 to $1.15. Marginal cost is $ .84, requiring a break-even load factor of 73% to 105%. On no parlor car portion of a train, during 1971, was the average load factor greater than 50%, and most monthly values were less than 40%. On the basis of this simple analysis, it is unlikely that any parlor car service would be economically justified on existing Amtrak routes, except possibly New York-Washington Metroliner routes about which we can made no statements since they were not included in our analysis.

Current Amtrak Traffic and Profitability

Introduction

The above discussion of costs has shown clearly the benefits from selecting proper equipment and tailoring trains to their traffic loads. It is imperative that these results be interpreted in terms of their profitability implications for Amtrak routes given their current traffic levels. The traffic levels used will be those from the survey of June and July 1972-the most recent data available.

Coach Trains

In the preceding section the minimum traffic levels required in order for revenue to cover costs on a route were identified, in terms of average fare levels and load factors. Since Amtrak's 85th percentile traffic is about 1.30 times the average load, if this percentile traffic is to be accommodated without varying train length, the load factor must be less than 77%.[1] From Table VI-2 it is possible to determine break-even costs. For a locomotive drawn train, an average of 117 passengers must be carried at a fare level of 4.2¢. This corresponds to an average load factor of 65%. For a rail diesel car train, 51 passengers must be carried on the average. This corresponds to a load factor of 71%.

Table VI-4[2] presents the average loads by route for those trains with day (coach and parlor) accomodations only, and an indication of whether or not the route would be profitable with each train type. Using conventional trains, five of the nineteen routes (or segments of a route, in the

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1 p.123

2 p.129

Table VI-4

POTENTIAL PROFITABILITY OF COACH TRAINS

Route & Train #[1]	Average Load[2]	Profitable[3] Using: Locomotive Train	Rail Diesel Car
Boston-New York			
151	60.8		x
150	110.0		x
Boston-Washington			
175	134.8	x	x
174	178.2	x	x
182	138.3	x	x
Buffalo-New York			
74	92.2		x
78	69.1		x
71	104.3		x
73	119.7	x	x
Chicago-Detroit			
360	61.0		x
362	88.1		x
361	104.3		x
363	37.7		
Milwaukee-St. Louis			
302			
Milwaukee-Chicago	101.7		x
Chicago-Springfld	120.3	x	x
Springfld-St. L.	68.9		x
303			
St. L.-Springfld	60.1		x
Springfld-Chicago	113.9		x
Chicago-Milwaukee	72.1		x

[1]The first train listed for any route operates from the first city mentioned to the other; if this number is odd (even), then all odd (even) numbered trains operate in the same direction, even (odd) ones in the opposite direction.

[2]Averages are based on the survey sample conducted in June and July of 1972.

[3]Profitability is based upon the cost model described in the text, and is based upon the traffic requirements stated in Table VI-2 (p. 123)

with a 4.2¢ per mile fare and approximately (but less than) 75% load factor. See accompanying text for full description and discussion.

case of the Milwaukee-St Louis route) have traffic sufficient to cover costs. Using rail diesel cars, 18 of the 19 routes could cover costs. Thus, the rail diesel car seems very attractive in its potential to improve Amtrak's financial position. The same analysis could be performed with other fare levels, with similar trends noted. For example, with a 3¢ per mile fare, one route covers costs with locomotive trains, five with the rail diesel car. (This also underscores the need to bring fares up to the higher levels.)

Pullman Trains

An analysis similar to that for coach trains has been done for sleeper trains. Again, in order to accomodate the 85th percentile traffic, load factors were restricted to 75% or less. Since fare levels seem to vary considerably, the analysis was performed for the low and high fare levels, identified in Table VI-3[1]. The lower fare level requires 210 passengers on average to cover the costs of a train composed of an equal number of coaches and pullmans plus one diner. At the higher fare level 97 passengers would be required. The split between coach and pullman passengers is assumed to be 20% pullman. This split is typical but will vary.

Table VI-5[2] presents the average traffic by route segment and an indication of the profitability. With the higher fare level, 55 of the 68 segments (81%) would be profitable. Thus the importance of fares is again underscored. This clearly indicates that with fares similar to those assumed in the analysis and a control on load factors so as to yield ones of the order of 70%, the minimum traffic required is an average of around 100 passengers per train. For higher volume routes the minimum required load factor would be a bit less, dropping to about 50% for the highest traffic levels at the higher fare

1 p. 126
2 p. 132

Table VI-5

POTENTIAL PROFITABILITY OF COACH/PULLMAN ROUTES

Route & Train #[1]		Average Load on Route Segment[2]	Profitable[3] with Fare Level High	Low
Florida-Washington (New York)	84	169.7	x	x
		154.0	x	
		297.7	x	
Chicago-New Orleans	59	270.9	x	x
		67.5		
	58	251.3/ 88.8	x	x
		388.3/208.3	x	x
Chicago-Miami	52	79.3		
		63.0		
		105.4	x	
	53	142.4	x	
		71.2		
		63.8		
Chicago-Los Angeles	3	249.0	x	x
		257.6	x	x
		245.3	x	x
	4	307.0	x	x
		269.3	x	x
		208.9	x	
Chicago-Houston	15	184.4	x	
		144.4	x	
		94.6		
	16	141.1	x	
		166.9	x	
		165.6	x	
Chicago-San Francisco	5	221.3	x	x
		230.3	x	x
		108.0	x	
		100.9	x	
	6	131.9	x	
		135.7	x	
		234.3	x	x
		206.4	x	

Table VI-5 (continued)

POTENTIAL PROFITABILITY OF COACH/PULLMAN ROUTES

Route & Train #[1]		Average Load on Route Segment[2]	Profitable[3] with Fare Level High	Low
Chicago-Seattle	7	198.4	x	
		202.0	x	
		190.6	x	
	8	186.3	x	
		206.9	x	
		240.8	x	x
New York-Chicago	41	204.4	x	
New York-Kansas City	31	156.9	x	
		97.6	x	
		103.6	x	
	30	99.3	x	
		85.9		
		117.9	x	
Chicago-Washington	50	52.6		
		77.2		
		67.0		
	51	67.5		
		74.7		
		55.1		
Seattle-San Diego	11	247.5	x	x
		271.2	x	x
		302.5	x	x
		148.8	x	
	13	143.3	x	
		350.1	x	x
		281.8	x	x
		197.3	x	
New Orleans-Los Angeles	1	150.5	x	
		285.7	x	x
		348.0	x	x
		347.0	x	x

Table VI-5 (continued)

POTENTIAL PROFITABILITY OF COACH/PULLMAN ROUTES

Route & Train #[1]		Average Load on Route Segment	Profitable[3] with Fare Level High	Low
New Orleans- Los Angeles	2	326.8	x	x
		310.3	x	x
		224.5	x	x
		142.7	x	

[1]The first train listed after each route travels from the first named city to the second, the other train travels in the opposite direction

[2]Average loads are based upon the special survey conducted in June and July 1972

[3]Profitability is based upon the cost analysis of the preceding section, as described in the text and Table VI-3. (p. 126)

level. It should be borne in mind that the costs used are for a rather spartan train, with no extras such as dome and lounge cars. Yet the analysis does indicate that these Amtrak services might be operated at a profit.

Chapter VI

REFERENCES

1. National Railroad Passenger Corporation, Financial Report, December 1971.
2. L. T. Klauder and Associates, Preliminary Unit Cost Data for Approximating the Cost of Train Operation (in letter form), June 14, 1971.
3. L. T. Klauder and Associates, Passenger Cars and Locomotives Unit Maintenance Costs, undated.
4. David A. Watts, Jr., "Rail Passenger Transportation," S. C. Hollander, editor, Passenger Transportation (East Lansing: Michigan State University Press, 1968), pp. 325-348.
5. "What Happened to RDC's in 1956," Railway Age, December 24, 1956, pp. 20-22.
6. Data on the interior configuration of the rail diesel car and the Metroliner cars are from the following sources: RDC, Car Builders Cyclopedia, 21st edition (New York: Simmons-Boardmen, 1961), pp. 536-537; and Metroliner: Amtrak, Traveling by Train (brochure) (Washington: National Railroad Passenger Corporation, 1972), and Railway Age, vol. 167, no. 23 (December 15, 1969), p. 33.

Chapter VI
APPENDIX

The cost models used in this chapter were taken from Reference 1. These were not modified except in the case of a minor modification for rail diesel cars, as explained below. These models include so-called "above-the-rail" costs--those of train purchase, operation, and maintenance--and an estimate of other costs and 50% of these "above-the-rail" costs. This other cost category includes expenses of Amtrak and those reimbursable to railroads. Thus, the costs approximate total Amtrak costs, with the exception of car rennovations.

The costs per train mile (T) of a conventional locomotive-drawn, all coach train as a function of the number of cars are as follows, based upon information in (1, p. 2):

T = \$3.210 + \$0.555C, with 1 loco., up to 5 or 6 cars

T = \$4.230 + \$0.555C, with 2 loco., up to 11 or 12 cars

Typical Amtrak coaches have 60 revenue seats (ranging from 44 to 89 or more), with sufficient room in them for a snack bar. No costs for snack bars are included, either installation or operation.

Similar costs for a rail diesel car train are based upon data in (1, p. 2) also. The only change in costs was for the purely fixed cost, estimated at 35¢ per car mile in (1, p. 2). This is a fixed annual cost divided by the expected car-miles to be operated per car (1, pp. 2-3). This cost was based upon an average car mileage of 60,000 miles, since these are now used in only local service, (2, Exhibit Va), while such a car in intercity service can be used as much--and probably more--as a regular coach, for which the average mileage is 174,420. Therefore, a mileage of 180,000 miles per year is assumed for RDC's in intercity service, resulting in a fixed cost of 11.67¢ per car mile. This results in the costs:

$T = \$2.13, \ C = 1$

$T = \$1.875 + \$0.780C$, 2 or more cars

With reclining seats and the usual lavatories and water cooler, these cars seat 88; and with a snack bar like those on the Metroliner, they seat 72.

The typical long-distance train considered was one with a diner and an equal number of coaches and pullmans. The costs for this train, based upon (1, p. 2) are:

$T = \$5.31 + \$0.66C$, with 2, 4, or 6 cars (1 loco.)

$T = \$6.33 + \$0.66C$, with 6, 8, 10, or 12 cars (2 loco.)

Typical long distance coaches seat 56 (although some seat fewer) and typical pullmans accommodate 16 (typical in the sense that these appeared frequently in the conductors' reports). It should be noted that this train is somewhat spartan, in that it includes no dome or lounge cars, and hence the costs are somewhat understated.

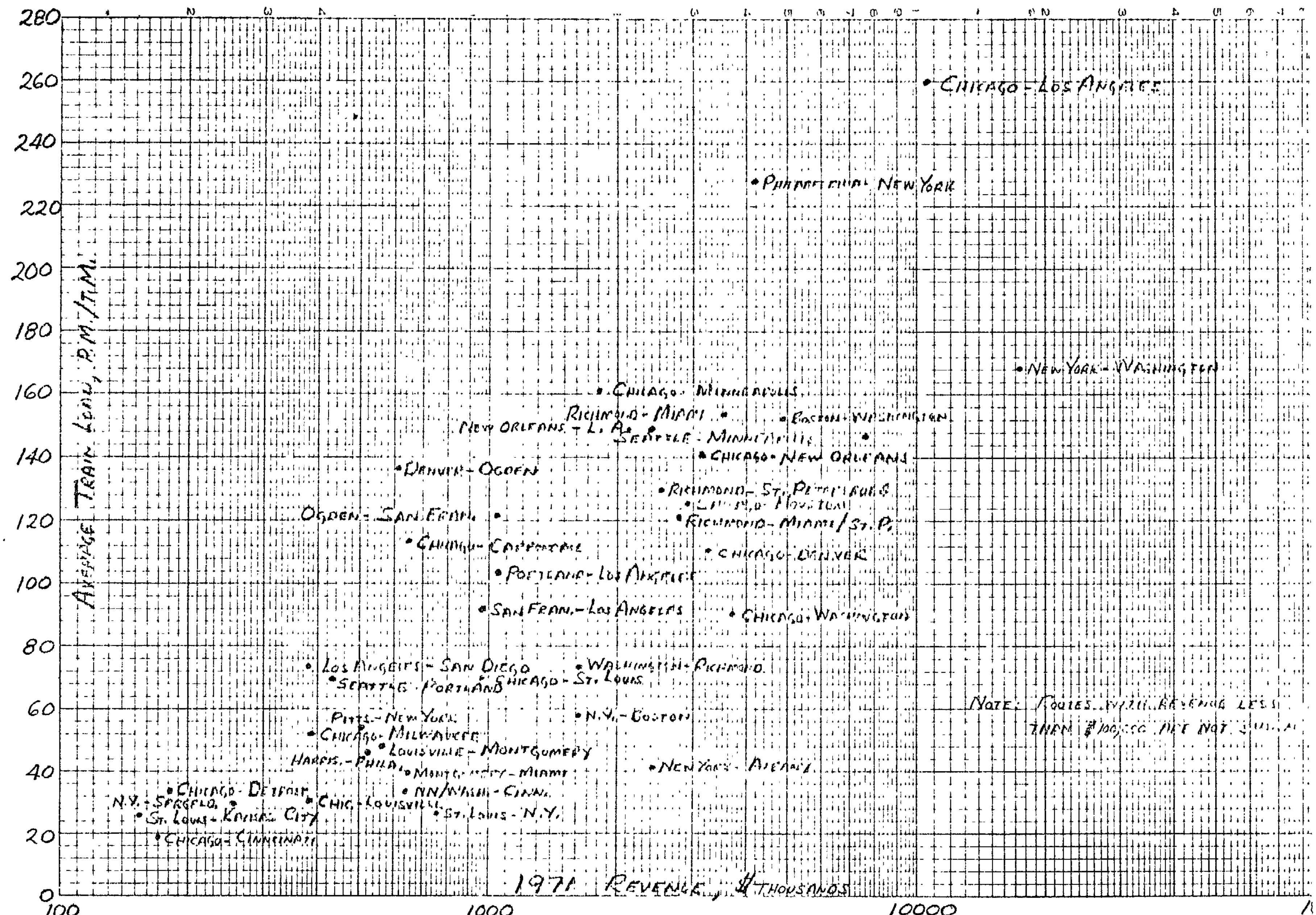
Revenue is based upon the range of fares observed on the system. Most coach fares seem to lie between 3.0¢ and 4.2¢ per mile. These values correspond to the range suggested in (1, p. 3), also. Diner revenue is estimated at $1.50 per car mile.

The costs of parlor cars and fare levels are taken directly from (1, pp. 2-3). Costs are 84¢ per car mile and revenues at full-load range from $1.70 to $2.40.

References

1. L. T. Klauder and Associates, Preliminary Unit Cost Data for Approximating the Cost of Train Operation, June 14, 1971.

2. L. T. Klauder and Associates, Passenger Cars and Locomotive Unit Maintenance Costs, undated (1971?)



Revenue and Train Load by Route, 1971

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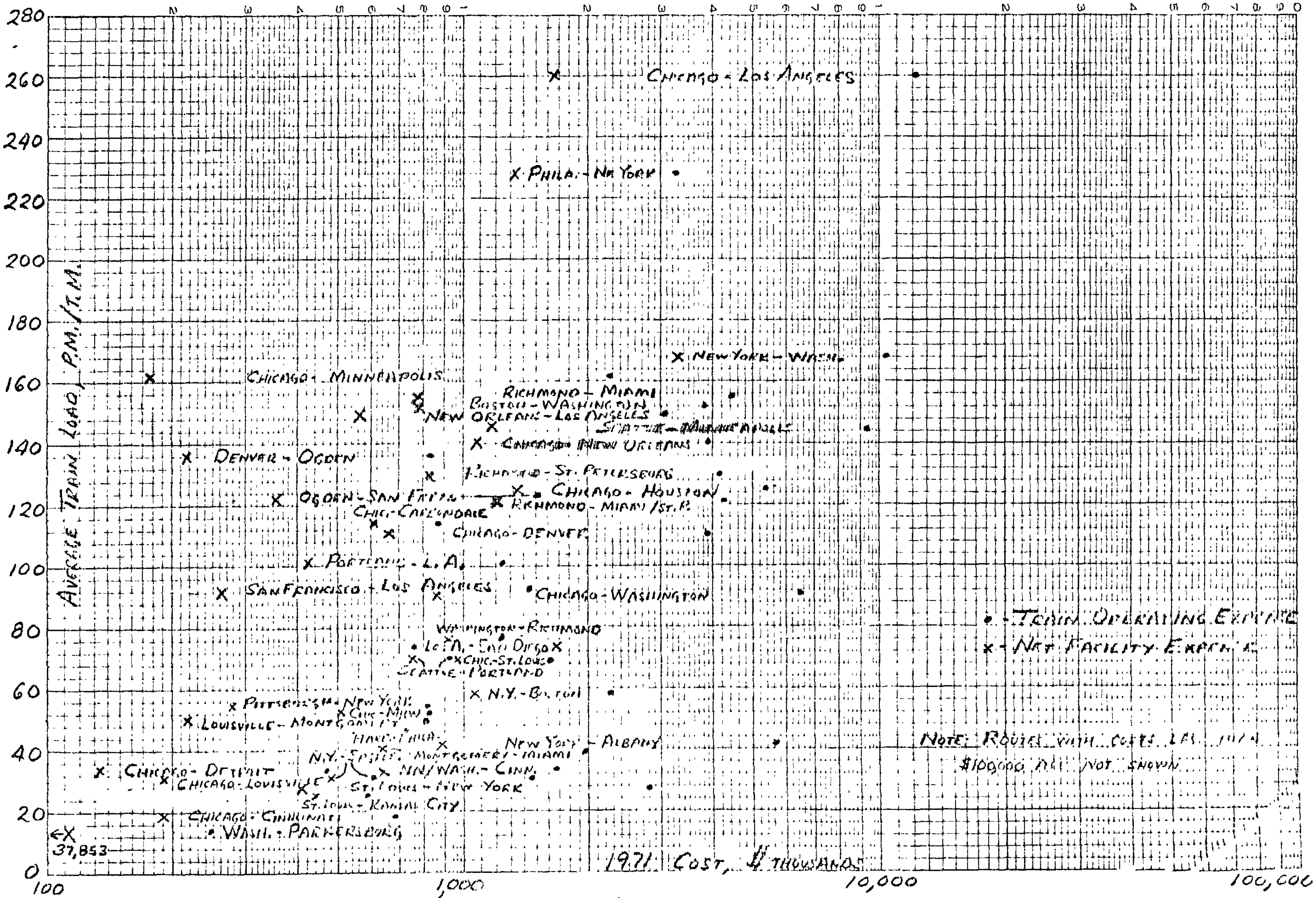

COSTS AND TRAIN LOADS BY ROUTE IN 1971.

Chapter VII
SUMMARY AND RECOMMENDATIONS

Four questions were addressed in this study relating to the structure and function of railroad passenger service. These related to who uses the rail service; how it is used; are the train equipment and consist matched to demand; and is the schedule matched to user time desires? The data by which these questions were answered was collected in a nationwide survey of passengers and link demand as well as by data available from Amtrak on consist and passenger loadings. The information employed was gathered in June and July, 1972 and July and August, 1971. The results will be summarized under four headings.

1. Users of Amtrak

The key finding was that the users of rail service are both different from the population at large and air travelers. Rail passengers are a significantly older segment of the population and include significantly more women than men. The users of the service, in addition, are very satisfied with the train they are riding, and less than one-third of them would use an alternative mode if they had free choice.

2. Uses of Rail Service

Over 70% of all trips by train are for social and recreational travel. Only in the northeast does the proportion of travel for business become significant and, even here, only 37% of the travelers are riding the train for business purposes. In addition, and consistent with these findings, the frequency of use of the train is quite low:

80% use it less than quarterly.

Analysis of the origins and destinations of travelers indicated that they used the train largely for long trips. The median train trip travel time was twelve hours in the west and four hours in the east. The reasons for this are simply that passengers are traveling from one metropolitan area to another, and these, largely, are those at which the train originates and its final destination. On all routes of the system, ten cities or less will account for more than 80% of the traffic. The proportion of all stops the train makes on a route to those at which a passenger boards or leaves is 73%. Of all possible pairs of cities which may be used as origins and destinations, only 25% are actually employed. The density of demand on the rail passenger system is, thus, very low. Further, there are no obvious criteria that Amtrak is using to determine what station stops should be maintained or the type of service that should be provided.

3. Train Size and Equipment Choice

Analysis of link demand for both 1971 and 1972 indicates that the equipment choice and consist can be better matched to demand. Assuming a coach capacity of sixty passengers, 39% of Amtrak routes have average traffic levels of one coach per train. Two-thirds of the routes require trains of no more than two coaches. Sleeper facilities are operating where offered at load factors of 20% to 40%. In general, and especially for longer route trains, a 75% load factor is necessary to bring revenues close to costs.

There is considerable fluctuation in demand both weekly and seasonally. Traffic is higher on weekends than on weekdays and in summer months than during the rest of the year. These variations make efficient utilization of equipment very difficult, especially since Amtrak is trying to be completely responsive to demand whenever it may arise.

It is clearly the long-distance trains that are the most uneconomical to operate with present consists. It is sleepers and dining car facilities, plus the added labor required to operate these trains that add significantly to costs. In essence, these long-haul trains are providing first class amenities when the actual loads and passenger requirements in many cases might be served by coach facilities.

4. Schedule Adequacy

Because of the nature of the users and the types of trips for which rail passenger service is used, there are few scheduling problems apparent. Only 13.7% of all passengers are engaged in a train transfer over the whole network with 68% of these occurring in New York and Chicago. Furthermore, although passengers prefer somewhat earlier departure times, the nature of their travel does not make departure time of very great significance to them. Any departure time between 7 a.m. and 9 p.m. is acceptable, with 8 a.m. to 11 a.m. most preferred. On this basis, there would appear to be little reason to modify scheduled departure times or adjust train interconnections.

Recommendations

The results of this study indicate that, on a national basis, rail travel serves a limited portion of the travel market. The ultimate questions revolve around how to provide service to the existing market with maximum economy and how to expand the utilization of rail service by a wider segment of the population. The following recommendations are aimed at suggesting certain steps that Amtrak may take to meet these two issues. Four recommendations are offered having both long and short-term implications.

1. <u>Train Consist and Scheduling</u>

Amtrak needs to better adjust the size and consist of the train to the traffic. Accepting the fact that there may be substantial costs associated with switching operations to make these adjustments and with maintenance of cars used only part of the time, the problem needs to be carefully analyzed to determine the balance that may be struck among these options.

Given the low loadings on many Amtrak routes, particularly the shorter haul routes, alternative equipment should be considered, especially the rail diesel car. On many routes, the average loads are of the order of one or two cars per train and, at this level of traffic, the savings from such a substitution would be very substantial.

On the face of it, parlor cars, sleeper cars, and separate dining facilities are extremely costly for the railroads to provide. Many passengers are not using any accommodations other than coach. Amtrak ought to try to minimize provision of these luxury services except where profitable.

In order to reduce weekly variations in traffic, it is recommended that Amtrak experiment with differential fares throughout the week. On days where traffic is light, low fares could be charged with premium fares charged in peak periods. This is done on some airlines and on Canadian railroads, and it appears to be successful. Furthermore, there are benefits from this for travelers who are very much concerned with the dollar cost of travel. Careful study needs to be given to differential fares, both in terms of its feasibility, structure, and marketing.

2. Station Usage

Terminal costs are a significant cost to Amtrak and maintenance of stations should be minimized. Amtrak needs to look very carefully at where and how frequently it makes stops and the costs associated with them. It seems obvious that Amtrak should not be required to maintain and pay for operations in low revenue producing terminal cities. Further, if Amtrak can make use of equipment like rail diesel cars, it can begin to consider skip stop service, demand actuated stops, and more frequent use of bus connections. On short and medium length routes, such practices could provide better equipment utilization and higher travel speeds.

3. Recreational Travel

The results of this study clearly indicate that passenger rail service is a leisure-time transportation mode. For all but a very few corridors, the railroad cannot be competitive with air transport for business travel. It would appear, however, that there may be a market for train-based recreational travel. In many respects, the railroad is in the same position that maritime passenger service was in with the advent of jet aircraft. Most of their transoceanic market disappeared. However, the cruise ship market, especially in the Caribbean, has been developed and is a quite profitable, though limited, market. More interesting are the ways in which this kind of transport has been linked to air travel in recent years. This linkage has spurred its growth.

The parallel with passenger rail service is not exact, but the opportunities would appear to exist. There are whole regions of the continental United States that are accessible primarily by rail and yet have few amenities to attract travelers. The train could serve both functions and, if interchanges were made with airlines, it would appear feasible to open a potentially profitable rail market. It is not the purpose here to suggest such a service, but rather to recommend the careful study of the market potential. This is an area where the railroad may tap a travel market that is growing faster than any other.

4. Planning and Marketing Research

It seems clear that the nature of passenger rail service is a narrow and specialized one. To make effective use of equipment; to plan most efficient operating policies and procedures; and to analyze potential markets will require sophisticated analysis and adequate data. A well-organized effort to provide the data collection, analysis, and marketing capability appears essential. It is strongly recommended that Amtrak establish and allocate sufficient funds to staff and support such a program on a continuing basis.

APPENDIX

AMTRAK PASSENGER SURVEY   Train #_____   Time _____   Link _____

- -

Please answer the following questions and return the form

1. Where is your home? ______________________________

2. What is your final destination? ______________________________

3. In what city did your train trip start? ______________________________

4. In what city will your train trip end? ______________________________

5. In what city did you board this particular train? ______________________________

6. In what city will you get off this particular train? ______________________________

7. What method of transportation brought you to this train?
   a bus___ another train___ an automobile___ other___

8. How long did you have to wait for this train? ______________________________

9. What time of day would you have liked this train to have departed?________

10. Do you travel by train: less than once a year___ 1-4 times a year___
    5-8 times a year___ 9-12 times a year___ more than 12 times a year___?

11. How satisfied are you with the accommodations on this train?
    completely satisfied___ very satisfied___ satisfied___
    neither satisfied nor dissatisfied___ dissatisfied___
    very dissatisfied___ completely dissatisfied___

12. If you had a free choice, would you have taken this trip by: train___
    bus___ automobile___ airplane___?

13. Is the purpose of this trip: business___ family business___ visiting
    family or friends___ recreation___?

14. Sex of respondent: female___ male___

15. Age of respondent: Under 21___ 21-35___ 35-50___ 50-65___

MODE OF TRANSPORTATION USED TO REACH THE TRAIN*

Train #	Bus	Train	Auto	Other
1	7.6	11.4	75.9	5.1
2	8.9	16.3	69.9	4.9
3	4.8	30.1	61.4	3.6
4	7.8	12.4	79.1	.8
5	5.0	25.5	59.0	10.6
6	24.4	6.4	64.1	5.1
7	12.0	9.9	67.6	10.6
8	7.2	10.9	74.6	7.2
11	22.6	10.4	64.6	2.4
11	7.7	8.7	75.6	8.0
13	5.8	9.9	77.1	7.2
15	13.5	17.0	61.0	8.5
15	1.1	8.6	87.0	3.2
16	1.1	3.4	90.9	4.5
30	7.6	11.4	73.3	7.6
30	4.5	14.8	72.7	8.0
30	10.8	16.2	63.5	9.5
31	6.9	12.7	64.7	15.7
31	6.2	15.5	68.0	10.3
31	16.2	12.6	58.6	12.6
40	11.1	22.2	51.9	14.8
41	4.9	21.7	53.8	19.6
41	7.3	9.8	63.4	19.5
50	4.0	21.3	66.7	8.0
51	13.0	20.4	61.1	5.6
52	7.0	11.3	64.8	16.9
53	4.3	2.9	82.6	10.1
58	4.1	3.1	81.6	11.2
59	7.0	14.8	73.2	4.9
71	8.1	32.4	29.7	29.7
73	5.1	18.6	54.2	22.0

*percentages

MODE OF TRANSPORTATION USED TO REACH THE TRAIN*
(continued)

Train #	Bus	Train	Auto	Other
73	3.2	23.8	34.9	38.1
74	9.3	5.6	75.9	9.3
74	4.5	6.1	75.8	13.6
78	0.0	30.6	61.1	8.3
83	6.1	14.4	72.0	7.6
84	3.9	2.8	82.2	11.1
150	4.1	14.9	48.6	32.4
151	0.0	2.2	87.0	10.9
174	10.6	12.1	48.5	28.8
175	3.7	1.5	74.3	20.6
175	10.2	11.2	55.1	23.5
182	2.3	22.7	43.8	31.3
302	7.0	4.4	76.3	12.3
302	14.7	7.4	63.2	14.7
303	9.2	13.8	63.1	13.8
326	4.0	14.0	70.0	12.0
360	16.1	12.9	61.3	9.7
360	9.4	25.0	56.3	9.4
360	6.7	26.7	50.0	16.7
361	22.2	5.6	68.5	3.7
361	9.4	21.9	65.6	3.1
361	5.3	5.3	78.9	10.5
362	1.9	50.9	45.3	1.9
362	8.3	41.7	41.7	8.3
362	6.0	64.0	24.0	5.0
363	0.0	0.0	75.0	25.0
363	0.0	10.0	80.0	10.0
363	0.0	17.6	52.9	29.4

*percentages

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AVERAGE AGE OF RAIL PASSENGERS*

Train #	Under 21	21-35	35-50	Over 50
1	9.2	28.9	25.0	36.8
2	10.5	24.2	18.5	46.8
3	6.3	23.8	25.0	45.0
4	10.9	23.3	21.7	44.2
5	12.7	24.2	18.8	44.2
6	5.1	25.6	29.5	39.7
7	14.2	22.0	18.4	45.4
8	16.1	25.5	16.8	41.6
11	16.5	33.0	17.9	32.5
11	15.6	34.2	16.6	33.6
13	18.3	31.7	15.6	34.4
15	18.4	23.4	21.3	36.9
15	13.3	34.8	16.0	35.9
16	17.0	25.0	14.8	43.2
30	8.1	17.6	17.6	56.8
30	14.3	18.1	24.8	42.9
30	5.7	26.1	25.0	43.2
31	17.6	13.7	23.5	45.1
31	13.3	15.3	27.6	43.9
31	14.4	27.9	31.5	26.1
40	7.4	29.6	11.1	51.9
41	7.3	31.7	17.1	43.9
41	2.8	31.9	25.7	39.6
50	33.3	17.3	22.7	26.7
51	11.1	25.9	22.2	40.7
52	7.1	28.6	34.3	30.0
53	14.1	22.5	15.5	47.9
58	18.4	30.1	21.4	30.1
59	14.9	47.5	19.9	17.7
71	9.3	36.0	12.0	42.7
73	27.1	32.2	18.6	22.0

*percentages

AVERAGE AGE OF RAIL PASSENGERS*
(continued)

Train #	Under 21	21-35	35-50	Over 50
73	12.9	29.0	27.4	30.6
74	11.1	31.5	25.9	31.5
74	8.8	35.3	26.5	29.4
78	10.8	35.1	13.5	40.5
83	11.9	23.0	18.5	46.7
84	24.4	21.7	16.7	37.2
150	1.3	32.0	28.0	38.7
151	8.5	42.6	29.8	19.1
174	6.1	43.9	13.6	36.4
175	22.4	33.7	11.2	32.7
175	22.1	32.4	15.4	30.1
182	23.8	52.3	10.0	13.8
302	24.6	17.5	18.4	39.5
302	16.2	25.0	17.6	41.2
303	13.8	33.8	33.8	18.5
326	12.0	44.0	14.0	30.0
360	23.3	26.7	16.7	33.3
360	10.0	30.0	23.3	36.7
360	12.5	12.5	15.6	59.4
361	16.4	21.8	32.7	29.1
361	12.3	28.1	14.0	45.6
361	15.6	18.7	21.9	43.8
362	12.0	18.0	32.0	38.0
362	11.3	37.7	18.9	32.1
362	12.5	45.8	29.2	12.5
363	9.1	63.6	0.0	27.3
363	10.0	50.0	10.0	30.0
363	17.6	41.2	23.5	17.6

*percentages

MODE OF TRANSPORTATION PREFERRED
GIVEN FREE CHOICE*

Train #	Train	Bus	Auto	Other
1	75.9	1.3	5.1	17.7
2	71.3	.8	4.9	23.0
3	79.7	0.0	3.8	16.5
4	76.7	1.6	7.0	14.7
5	71.5	0.0	7.0	21.5
6	73.4	0.0	7.6	19.0
7	62.6	.7	14.4	22.3
8	70.6	0.0	8.1	21.3
11	73.3	1.0	4.8	20.9
11	74.1	0.0	6.1	19.8
13	77.7	0.0	5.9	16.4
15	63.8	.7	6.4	29.1
15	58.2	1.1	9.2	31.5
16	75.0	0.0	9.1	15.9
30	59.0	0.0	13.3	27.6
30	81.6	0.0	3.4	1 .9
30	82.4	1.4	9.5	6.8
31	72.5	2.9	5.9	18.6
31	76.3	2.1	9.3	12.4
31	74.8	0.0	11.7	13.5
40	77.8	3.7	0.0	18.5
41	63.4	0.0	12.2	24.4
41	80.3	0.0	7.0	12.7
50	69.9	0.0	9.6	20.5
51	70.4	1.9	11.1	16.7
52	68.6	2.9	7.1	21.4
53	75.0	0.0	2.9	22.1
58	58.3	2.1	14.6	25.0
59	46.8	1.4	20.9	30.9
71	63.4	4.2	12.7	19.7
73	54.2	3.4	18.6	23.7

*percentages

MODE OF TRANSPORTATION PREFERRED
GIVEN FREE CHOICE*

(continued)

Train #	Train	Bus	Auto	Other
73	70.1	1.7	8.3	20.0
74	55.6	0.0	24.1	20.4
74	61.2	1.5	10.4	26.9
78	65.7	0.0	20.0	14.3
83	66.4	0.0	6.9	26.7
84	66.7	0.0	6.1	27.2
150	80.3	0.0	8.5	11.3
151	75.6	0.0	4.4	20.0
174	62.1	6.1	12.1	19.7
175	54.4	0.0	14.0	31.6
175	61.2	0.0	12.2	26.5
182	50.8	.8	8.1	40.3
302	61.4	1.8	14.9	21.9
302	69.1	0.0	8.8	22.1
303	67.7	0.0	12.3	20.0
326	54.0	0.0	18.0	28.0
360	54.8	6.5	6.5	32.3
360	84.4	0.0	0.0	15.6
360	86.7	0.0	0.0	13.3
361	83.3	0.0	7.4	9.3
361	64.9	0.0	8.8	26.3
361	81.3	0.0	6.3	12.5
362	56.9	0.0	13.7	29.4
362	78.0	2.0	2.0	18.0
362	62.5	0.0	8.3	29.2
363	81.8	0.0	0.0	18.2
363	80.0	0.0	0.0	20.0
363	64.7	0.0	11.8	23.5

*percentages

TRIP PURPOSE*

Train #	Business	Family Business	Visiting Family/Friends	Recreation
1	4.3	8.6	71.4	15.7
2	2.5	9.9	76.0	11.6
3	9.2	7.9	72.4	10.5
4	18.6	7.8	59.7	14.0
5	20.8	7.4	59.1	12.8
6	2.9	5.9	58.8	32.4
7	3.0	7.6	64.4	25.0
8	16.2	7.7	69.2	6.9
11	21.2	6.1	59.0	13.7
11	10.0	4.6	60.6	24.7
13	8.5	8.1	56.4	27.0
15	24.1	8.5	60.3	7.1
15	27.3	5.1	59.1	8.5
16	17.0	3.4	70.5	9.1
30	42.9	2.9	44.8	9.5
30	36.9	9.5	46.4	7.1
30	23.0	10.8	60.8	5.4
31	18.0	9.9	55.0	17.1
31	27.5	10.8	52.9	8.8
31	29.8	8.5	53.2	8.5
40	18.5	7.4	33.3	40.7
41	19.5	4.9	43.9	31.7
41	57.8	9.6	25.9	6.7
50	7.1	14.3	67.1	11.4
51	29.6	7.4	59.3	3.7
52	7.5	16.4	58.2	17.9
53	10.4	11.9	58.2	19.4
58	31.9	21.3	37.2	9.6
59	33.6	18.7	38.3	9.4
71	33.8	7.0	33.8	25.4
73	22.0	6.8	54.2	16.9

*percentages

TRIP PURPOSE*
(continued)

Train #	Business	Family Business	Visiting Family/Friends	Recreation
73	30.4	10.7	30.4	28.6
74	44.4	7.4	37.0	11.1
74	30.8	7.7	52.3	9.2
78	23.7	7.9	47.4	21.1
83	10.8	12.3	63.8	13.1
84	17.2	10.6	55.0	17.2
150	55.9	5.9	22.1	16.2
151	52.2	26.1	6.5	15.2
174	36.4	15.2	45.5	3.0
175	22.4	8.2	46.9	22.4
175	24.3	7.4	51.5	16.9
182	11.2	6.0	49.1	33.6
302	19.3	5.3	62.3	13.2
302	42.6	13.2	35.3	8.8
303	40.0	3.1	49.2	7.7
326	30.0	8.0	48.0	14.0
360	10.0	10.0	70.0	10.0
360	20.0	13.3	63.3	3.3
360	37.5	6.3	50.0	6.3
361	25.0	6.3	62.5	6.3
361	10.0	8.0	48.0	34.0
361	24.6	1.8	61.4	12.3
362	15.2	10.9	67.4	6.5
362	25.0	12.5	54.2	8.3
362	44.0	10.0	32.0	14.0
363	8.3	8.3	75.0	8.3
363	20.0	0.0	50.0	30.0
363	47.1	17.6	29.4	5.9

*percentages

TRAVEL FREQUENCY*

Train #	Less Than Once a Year	1-4 Times a Year	5-8 Times a Year	9-12 Times a Year	More Than 12 Times a Year
1	64.9	27.3	2.6	0.0	5.2
2	66.1	28.8	2.5	1.7	.8
3	63.0	29.6	1.2	0.0	6.2
4	63.6	25.6	3.1	3.1	4.7
5	54.3	35.2	5.6	1.9	3.1
6	66.3	27.5	2.5	3.8	0.0
7	60.4	36.1	1.4	1.4	.7
8	60.9	31.9	5.1	.7	1.4
11	59.4	30.7	4.2	1.4	4.2
11	59.8	28.5	5.5	1.0	5.2
13	60.5	31.8	4.1	1.4	2.3
15	55.3	31.9	4.3	.7	7.8
15	42.5	41.4	5.0	3.9	7.2
16	45.5	43.2	6.8	1.1	3.4
30	47.6	26.7	10.5	4.8	10.5
30	41.4	28.7	6.9	4.6	18.4
30	41.9	36.5	12.2	2.7	6.8
31	45.0	35.1	8.1	.9	10.8
31	45.1	28.4	9.8	3.9	12.7
31	38.8	30.6	6.1	6.1	18.4
40	44.4	37.0	7.4	3.7	7.4
41	41.5	31.7	7.3	9.8	9.8
41	30.0	21.4	15.7	3.6	29.3
50	52.1	28.8	6.8	4.1	8.2
51	38.9	48.1	7.4	1.9	3.7
52	53.6	37.7	2.9	1.4	4.3
53	60.9	29.7	1.6	3.1	4.7
58	23.8	44.6	16.8	5.0	9.9
59	34.0	37.6	16.3	5.7	6.4
71	32.4	33.8	9.5	4.1	20.3
73	35.6	32.2	10.2	5.1	16.9

*percentages

TRAVEL FREQUENCY*
(continued)

Train #	Less Than Once a Year	1-4 Times a Year	5-8 Times a Year	9-12 Times a Year	More Than 12 Times a Year
73	21.0	24.2	16.1	6.5	32.3
74	16.7	27.8	18.5	11.1	25.9
74	17.9	38.8	70.4	4.5	28.4
78	30.6	22.2	16.7	0.0	30.6
83	49.2	35.4	10.8	2.3	2.3
84	50.6	37.8	7.8	.6	3.3
150	13.9	31.9	12.5	9.7	31.9
151	33.3	33.3	9.5	7.1	16.7
174	27.3	30.3	12.1	9.1	21.2
175	25.5	31.6	15.3	12.2	15.3
175	28.7	27.2	14.0	4.4	25.7
182	31.3	31.3	14.1	7.8	15.6
302	42.1	42.1	7.0	6.1	2.6
302	45.6	23.5	11.8	4.4	14.7
303	27.7	50.8	9.2	7.7	4.6
326	32.0	42.0	12.0	8.0	6.0
360	54.8	35.5	6.5	3.2	0.0
360	46.9	40.6	3.1	0.0	9.4
360	53.3	30.0	3.3	3.3	10.0
361	51.9	38.9	3.7	1.9	3.7
361	50.0	31.3	3.1	3.1	12.5
361	52.6	28.1	10.5	0.0	8.8
362	46.0	46.0	0.0	2.0	6.0
362	40.0	44.0	8.0	2.0	6.0
362	58.3	25.0	4.2	8.3	4.2
363	54.5	18.2	9.1	0.0	18.2
363	40.0	20.0	20.0	10.0	10.0
363	58.8	29.4	5.9	0.0	5.9

*percentages

TRAIN LOADS DURING SURVEY

IN JUNE AND JULY 1972

Route Segment	Train Number	Traffic Load, passengers Mean	Std. Deviation	85 Percentile
Boston-New York	151	60.8	12.09	73.4
New York-Boston	150	110.0	23.12	134.0
New York-Boston	182	138.3	35.08	174.8
Boston-Washington	175	134.8	63.73	201.1
Washington-Boston	174	178.2	107.5	290.0
Buffalo-New York	74	92.2	14.47	107.2
Buffalo-New York	78	69.1	33.92	104.4
New York-Buffalo	71	104.3	34.30	140.0
New York-Buffalo	73	119.7	23.40	144.0
Florida-New York	84			
Miami-Wildwood		169.7	30.6	200.9
Wildwood-Jacksonville		154.0	10.44	164.9
Jacksonville-Washington		297.7	59.01	359.1
New York-Kansas City	31			
New York-Pittsburgh		156.9	50.1	208.
Pittsburgh-St. Louis		97.6	34.74	133.7
St. Louis-Kansas City		103.6	39.48	144.7
Kansas City-New York	30			
Kansas City-St. Louis		99.3	33.18	133.8
St. Louis-Pittsburgh		85.9	33.01	120.2
Pittsburgh - New York		117.9	46.10	165.8
Chicago-Detroit	360	61.0	14.43	76.0
Chicago-Detroit	362	88.1	24.86	114.0
Detroit-Chicago	361	104.3	34.09	139.8
Detroit-Chicago	363	37.7	15.27	53.6
New York-Chicago	41	204.4	17.10	222.2
Chicago-Washington	50			
Chicago-Charleston		52.6	14.57	67.8
Charleston-Charlottesville		77.2	32.84	111.4
Charlottesville-Washington		67.0	34.98	103.4
Washington-Chicago	51			
Washington-Charlottesville		67.5	21.75	90.1
Charlottesville-Charleston		74.7	26.04	101.8
Charleston-Chicago		55.1	27.07	83.3

Route Segment	Train Number	Traffic Load, passengers Mean	Std. Deviation	85 Percentile
Chicago-Miami	52			
Chicago-Nashville		79.3	14.64	94.5
Nashville-Jacksonville		63.0	13.36	76.9
Jacksonville-Miami		105.4	48.54	155.9
Miami-Chicago	53			
Miami-Jacksonville		142.4	71.27	216.5
Jacksonville-Nashville		71.2	21.02	93.1
Nashville-Chicago		63.8	18.98	83.5
Chicago-Houston	15			
Chicago-Kansas City		184.4	35.30	221.1
Kansas City-Oklahoma City		144.4	21.90	167.2
Oklahoma City-Houston		94.6	20.98	116.4
Houston-Chicago	16			
Houston-Oklahoma City		141.1	50.91	194.0
Oklahoma City-Kansas City		166.9	55.95	224.8
Kansas City-Chicago		165.6	74.42	243.0
Chicago-San Francisco	5			
Chicago-Omaho		221.3	49.32	272.5
Omaha-Denver		230.3	50.47	282.8
Denver-Ogden		108.0	23.34	132.3
Ogden-San Francisco		100.9	36.11	138.4
San Francisco-Chicago	6			
San Francisco-Ogen		131.9	40.77	174.3
Ogden-Denver		135.7	49.95	187.6
Denver-Omaha		234.3	31.04	266.6
Omaha-Chicago		206.4	35.66	243.5
Chicago-Seattle	7			
Chicago-Minn./St. Paul		198.4	32.78	232.5
Minn./St. Paul-Spokane		202.0	34.01	237.4
Spokane-Seattle		190.6	32.17	224.1
Seattle-Chicago	8			
Seattle-Spokane		186.3	40.75	228.7
Spokane-Minn./St. Paul		206.9	41.81	250.4
Minn./St. Paul-Chicago		240.8	66.62	310.1
St. Louis-Milwaukee	302			
St. Louis-Springfield		101.7	35.53	138.7
Springfield-Chicago		120.3	28.97	150.4
Chicago-Milwaukee		68.9	27.16	97.1
Milwaukee-St. Louis	303			
Milwaukee-Chicago		60.1	19.87	80.4
Chicago-Springfield		113.9	26.01	140.8
Springfield-St. Louis		72.1	32.35	106.4
Chicago-New Orleans	59			
Chicago-Memphis		270.9	80.50	354.6
Memphis-New Orleans		67.5	24.80	93.3
New Orleans-Chicago*	58			
New Orleans-Memphis		251.3	90.14	126.9
		88.8	36.64	
Memphis-Chicago		388.3	82.18	292.1
		208.3	80.60	

Route Segment	Train Number	Traffic Load, passengers Mean	Std. Deviation	85 Percentile
Chicago-Los Angeles	3			
Chicago-Kansas City		249.0	53.28	304.4
Kansas City-Albuquerque		257.6	76.61	337.3
Albuquerque-Los Angeles		245.3	48.81	296.1
Los Angeles-Chicago	4			
Los Angeles-Albuquerque		307.0	29.74	338.0
Albuquerque-Kansas City		269.3	50.33	321.6
Kansas City-Chicago		208.9	45.83	256.6
Seattle-San Diego	11			
Seattle-Portland		247.5	25.61	274.1
Portland-San Francisco		271.2	34.88	307.5
San Francisco-Los Angeles		302.5	42.09	346.3
Los Angeles-San Diego		148.8	52.17	203.7
San Diego-Seattle	13			
San Diego-Los Angeles		143.3	58.98	204.6
Los Angeles-San Francisco		350.1	38.89	390.5
San Francisco-Portland		281.8	45.10	328.7
Portland-Seattle		197.3	15.02	212.9
New Orleans-Los Angeles	1			
New Orleans-Houston		150.5	37.81	189.8
Houston-El Paso		285.7	69.67	358.2
El Paso-Phoenix		348.0	58.30	408.6
Phoenix-Los Angeles		347.0	38.11	386.6
Los Angeles-New Orleans	2			
Los Angeles-Phoenix		326.8	53.84	382.8
Phoenix-El Paso		310.3	53.84	366.3
El Paso-Houston		224.5	38.25	264.3
Houston-New Orleans		142.7	24.50	168.2

* The first numbers listed in each row and column are probably erroneous counts, but there was no means to check this, so they are presented.

COMMENTS OF

NATIONAL RAILROAD PASSENGER CORPORATION

ON RECOMMENDATIONS IN REPORT PREPARED BY

RICHARD M. MICHAELS TRANSPORTATION CONSULTANTS

National Railroad Passenger Corporation, 955 L'Enfant Plaza North, S.W., Washington, D.C. 20024 Telephone (202) 484-7100

Amtrak

December 19, 1972

Mr. Richard W. Kelley
Assistant Director
Resources and Economic Development Division
The United States General Accounting Office
Washington, D.C.

ATTN: Mr. Stanley Sargol

Dear Mr. Kelley:

This will acknowledge your letter of November 27, transmitting draft copies of the report prepared for you by Richard M. Michaels, Transportation Consultants, covering passenger train scheduling and operations in connection with your review of Amtrak operations.

We met with your representatives and with the consultants on December 6 for a general discussion of their report and our comments thereon. Subsequently, on December 8, we received a revised draft which included minor revisions of certain aspects of the report modified as the result of our conference.

At the request of your staff, we are listing below the principal general findings of the consultants and our views, as presented in the foregoing meeting. The major recommendations of the study group are:

1. Amtrak should better adjust train consists to traffic requirements to obtain better utilization of equipment.

> We agree that improvements can and will be made in matching seat availability with requirements. It should be pointed out that a certain amount of idle capacity observed by the consultants was due to potential riders who made reservations but did not use them and failed to release them for sale to other parties. The new reservation policy and system should provide improvement.

Further, the problem of matching consists with requirements is compounded by the need to balance equipment moves in both directions against wide variation in use (e.g., morning and evening peak travel on weekdays, weekend peaks, even seasonal variation, such as New York to Florida in December and Florida to New York in the spring.)

Amtrak does not make widespread use of adding or dropping cars at stations along the route because the practice is often quite expensive and causes considerable train delay. More importantly, the cars we acquired at a cost of about $60,000, including heavy overhaul, are relatively inexpensive to operate and the incremental cost of operating an extra car can be covered with only a few riders.

2. Many passengers are not using any accommodations other than coach and use of these should be maximized. Since parlor cars, sleeper cars and separate dining cars are extremely costly for Amtrak to provide, Amtrak ought to try to minimize provision of these luxury services except where profitable.

We concur that the greatest potential for new business appears to be in coach travel and, accordingly, are planning more coach capacity during the summer of 1973 than was available during 1971-72. It should be pointed out, however, that the Act creating Amtrak <u>requires</u> operation of sleeping and food service cars under certain circumstances. The apparent losses in food service must be compared with the loss in revenue that would occur if food service was not available. This should be compared with the airline cost of providing free meals to most passengers. We will continue to review all "premium cost" service to minimize excessive costs. However, we believe that a policy of offering only a spartan service is inconsistent with our legislative mandate and parallels too closely the practices followed by some railroads in the past.

3. Given the low loadings on many Amtrak routes, particularly the shorter haul routes, alternate equipment should be considered, especially the rail diesel car.

> We agree that greater use of self-propelled cars may be appropriate on certain routes. We have recently purchased some rail diesel cars and plan to use them on selected runs. Additional self-propelled cars will be acquired and used if deemed appropriate.

4. To reduce weekly variations in traffic, Amtrak should experiment with differential fares.

> Varying the cost of travel during different periods has many apparent advantages and the principle is used now with regard to group, excursion and other discount fares. However, a differential fare policy would pose a major customer relations task if applied nationally to the present fare structure. Accordingly, we have elected to simplify the diverse price structure we inherited from the railroads before embarking on radical new pricing policies. The great diversity of the previous railroad policy, together with the requirements of the Price Board, has delayed our efforts to rationalize the price structure.

5. Station costs are substantial and many stops are now made by Amtrak at low revenue producing cities. Amtrak should carefully study where and how frequently its trains make stops and the costs associated with them.

> The need for train stops is a matter under continuing review. Some stops are currently being made principally for operational reasons. We believe that with some changes (e.g., labor contracts), our operational requirements can be met by fewer or more appropriately located stops and we are taking steps to achieve this. It is possible that other stops may be uneconomical. We have instituted a program for collecting origin and destination data, and the information from this program will give us a better basis for decisions regarding the elimination of unneeded stops and explanations to the local communities involved.

6. Because passenger rail service is generally a leisure-time transportation mode, Amtrak should make a study of how it could tap the growing market of recreational travel.

> We agree that the recreation market offers great potential for rail travel and are attempting to tap this market through use of travel agents, tour sales, etc. We plan to make further efforts in this regard, including "auto ferry" on the West Coast, coordinating local auto rental with intercity rail travel, and more amenities of service (e.g., entertainment cars) that make train travel recreation in itself rather than simply a method of transportation.

7. Amtrak should staff and support an adequate program to collect and analyze market data as a basis for operational planning.

> We concur in this recommendation and have retained Harris and Associates to advise us how the public perceives Amtrak and what it expects from train travel. We have retained McKinsey & Company, Inc., to quantify that potential market. We are now using different approaches to determine what is required to attract people who are not now using trains. Unfortunately, the accepted techniques in this regard depend too heavily on present users or on surveys of users of other public transportation. The results may, or may not, be applicable to users of the private automobile--our largest potential market.

In general, we recognize the validity of the general observations set forth in the report. However, after 20 months of operation, we have found many institutional practices which inhibit instant and dramatic change. We are striving to overcome them and expect continued improvement in the future.

Respectfully submitted,

Roger Lewis
President