

Industrial Development Survey on Massachusetts Route 128

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This paper summarizes the results of a survey of the industrial and commercial establishments which have been built along and near Route 128, a limited access 4- and 6-lane circumferential highway around metropolitan Boston. Among the subjects covered are role of highway in choice of plant locations, benefits expected and received from highway, volume of commercial and passenger car traffic contributed to Route 128, home origins of employees, home-to-work travel time and distance, and usage of Route 128.

● **THE PURPOSE** of the Route 128 Economic Impact Study, which is sponsored by the Massachusetts Department of Public Works and the U. S. Bureau of Public Roads, is to make an investigation of the basic factors underlying the changes that have taken place along the highway. The study will include a survey of the residential and industrial development which has taken place along the new sections of Route 128 and will attempt to evaluate the extent to which the highway has been responsible for it. The traffic generated by the development and its effect on traffic patterns in the metropolitan area will also be investigated.

In a broad sense the study has been undertaken to develop factual data which will demonstrate the ability of a modern limited access highway to create community benefits as well as provide superior traffic service.

Description of Route

Route 128 is a circumferential highway which is located about ten miles from the Boston central business district; however, the northeast section continues as a radial route to Gloucester (Figure 1). The present route replaces an earlier route composed of local roads connecting and passing through the business centers of most of the cities and towns surrounding Boston. The old route followed heavily traveled 2-lane roads of obsolete design. Although it appeared upon road maps as a bypass of Boston, it actually had little to offer in time savings or congestion relief.

Between 1936 and 1941, sections of 4-lane divided highway were built on new location in Peabody and Beverly, east of Route 1. Only partial access was obtained. Cloverleaves were constructed at all important cross roads, but several minor roads were allowed to cross at grade. Following World War II a 5-mile section of 4-lane divided highway was built westward from Route 1 to Wakefield, and the prewar section ending in Beverly was extended in stages as a 4-lane limited access highway to Gloucester.

The longest section to be built at one time was the 22.5-mile portion from Wakefield to Route 9 in Wellesley, a 4-lane, fully controlled access highway bypassing the congested business districts of Wakefield, Stoneham, Woburn, Lexington, Waltham and Newton. This link, opened in August 1951, provided for the first time an effective, high-speed circumferential highway around the most congested districts of the metropolitan area.

Subsequently the work was extended south of Route 9 as a 6-lane limited access divided highway, mostly on new location, and was opened as far as Route 138 in December 1956. Construction is continuing to a junction with Route 3 in Braintree. This will substantially complete the new Route 128 around Boston. The length of the route from Gloucester to Braintree is about 70 miles.

The old Route 128 carried traffic volumes ranging from 5,000 to 8,000 vehicles

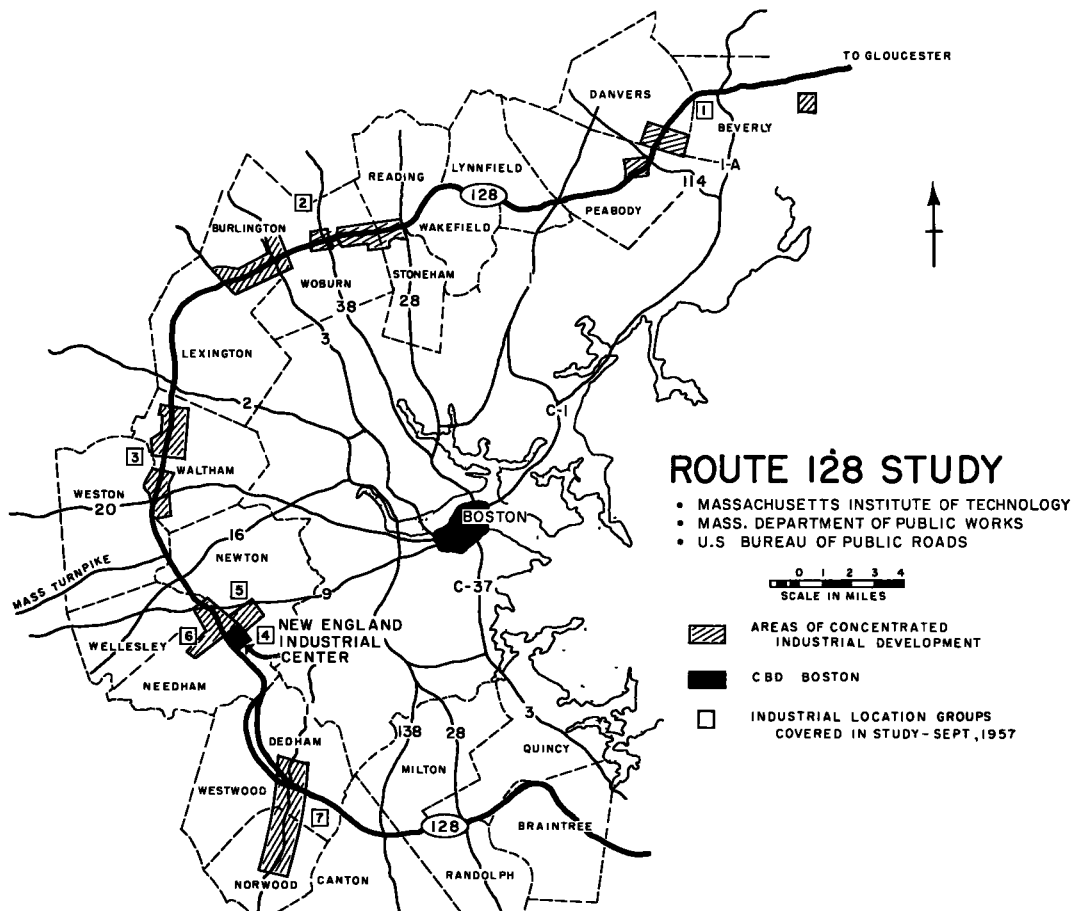


Figure 1.

per day. When the new section from Route 1 (north) to Route 9 was opened in 1951, traffic volumes of 12,000 to 15,000 vehicles per day were predicted with possibly 20,000 on Sundays. Actual traffic volumes have greatly exceeded these predictions, and are still rising. Figure 2 shows traffic volumes on a 4-lane divided section.

Program of Investigation

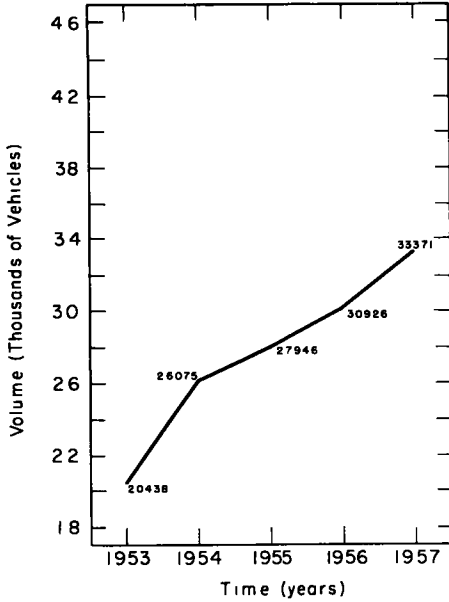
The first step in the investigation was to make a literature survey of all previous or current studies of a similar nature and to examine the methods and procedures used.

Next a search was made for available data pertaining to Route 128, such as aerial photographs, land use maps, zoning maps, and published statements regarding industrial and residential data. Planning boards and other governmental agencies were contacted to determine the availability of property assessments, sales data and evidences of building activity. Right-of-way, construction and engineering costs for each contract section of Route 128 were obtained from the Massachusetts Department of Public Works.

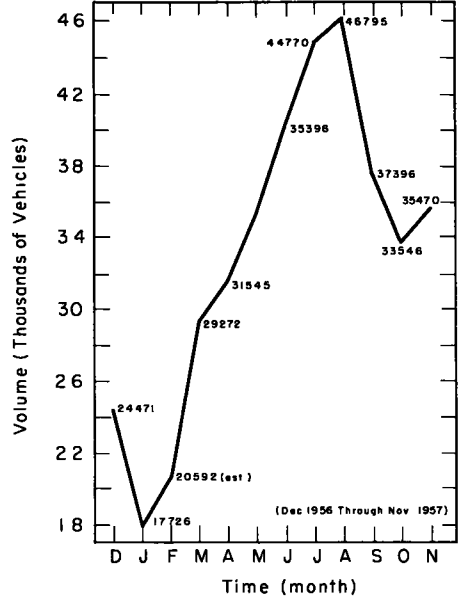
Three types of surveys were then initiated:

1. Survey of residential property values and sales before and after construction of the highway, both in the immediate vicinity and in areas removed from the location.
2. Survey of industrial and commercial developments along the highway and in nearby areas, and an investigation of employee travel patterns.
3. Traffic survey of Route 128 including trends in volumes over a period of years, and an origin-and-destination count as of 1957.

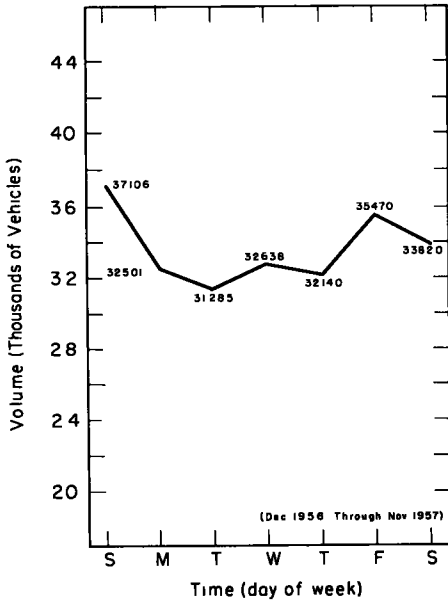
This paper deals with the survey of industrial and commercial developments and with the traffic characteristics and travel patterns of the employees at one industrial location group (the New England Industrial Center).



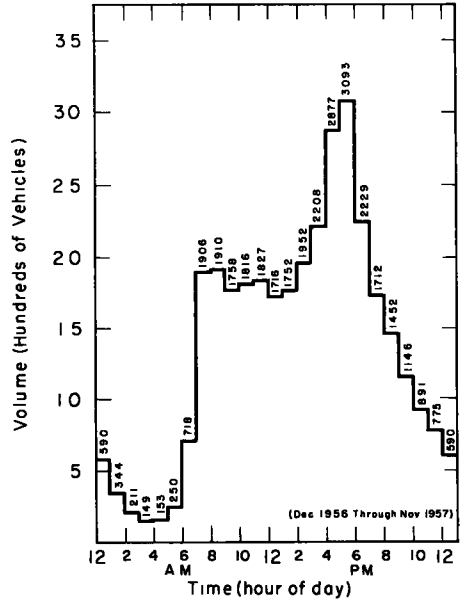
AVERAGE ANNUAL DAILY TRAFFIC VOLUMES
ROUTE 128 AT D.P.W. COUNTING STATION IN
BURLINGTON



AVERAGE DAILY TRAFFIC VOLUMES BY
MONTH—ROUTE 128 AT DPW COUNTING
STATION IN BURLINGTON.



AVERAGE DAILY TRAFFIC VOLUMES — ROUTE
128 AT D.P.W. COUNTING STATION IN BURLINGTON



AVERAGE HOURLY TRAFFIC VOLUMES — ROUTE
128 AT D.P.W. COUNTING STATION IN BURLINGTON

Figure 2.

SURVEY OF INDUSTRIAL AND COMMERCIAL DEVELOPMENT

Methods and Procedures

The survey of industrial and commercial enterprises along Route 128 was conducted by direct interview with management. In this way it was hoped to obtain information on capital investment in plant, type of operation, factors considered in choosing a site on Route 128, other sites considered, and benefits (or disadvantages) expected and realized by virtue of location on Route 128. Also desired was information regarding employee commuting problems and any difficulties encountered in holding or procuring new employees.

Tentative questionnaire forms were prepared and then reviewed by the sponsors, by members of the city planning, marketing and economics staff at M. I. T., and by the Massachusetts Department of Commerce staff. A pilot study was made at one plant to test the questionnaires before reproducing them in quantity. In spite of these precautions, defects were found in the forms, which required several revisions.

In order to solicit maximum cooperation from industry two personal letters were mailed to top management of each industry prior to the interview. The first, from the Massachusetts Commissioner of Commerce, outlined the nature of the study and the interest of the Department of Commerce. This organization is concerned with state-wide planning and industrial development, and is therefore vitally interested in the study.

The second letter, by the supervisor of the study at M. I. T., explained more specifically the nature of the information desired, and stated that an interviewer would call for an appointment.

It is the opinion that these letters were to a considerable degree responsible for the fine cooperation received in all phases of the study. These also provided management with enough background to prepare for the interview and to produce the desired information with a minimum of time and effort.

In the planning stages of the study, it was feared that industry might be hesitant to release data regarding investment, number of employees, reasons for choosing location, etc., because of the competitive nature of some businesses. Therefore, considerable attention was given to convincing each industry of the serious intent of the study and of the fact that all data would be treated in a confidential manner, and that the results would be presented in such a way that no one company could be identified.

A listing of all industries near Route 128 was obtained from the Massachusetts Department of Commerce. Visits were also made to local chambers of commerce and local industrial development commissions to inform them of the study and to obtain any advice or information which they cared to offer. In addition, they were asked to review the listing of industries, and furnish the names of top management officials.

A schedule of interviewing was then set up and groups of plants assigned to each interviewer. At first it was thought advisable to interview in pairs in order to correlate and standardize techniques. Later, interviews were handled by a single interviewer. Most management interviews were pleasant and stimulating. A typical interview lasted about 20 to 30 minutes. However, considerable time and effort were required to make appointments.

Although the principal part of the industrial survey was concerned with industries that located in the Route 128 area after the highway was constructed, it was felt advisable to include two other types of industries in this survey for "control" purposes. One type of industry was that located in the Route 128 area before the new highway was constructed. The other type was one that had built its plant after the highway was constructed, but in an area definitely not influenced by the highway. Plants of the latter type were chosen in locations at least five miles within the periphery of the circumferential highway, i. e., closer to the center of the city. In interviewing these industries the main interest was to determine why they chose their location, whether or not they were satisfied with it, whether they had considered a location on Route 128 or at another suburban site; if so, why they discarded such locations, and whether or not they would choose a Route 128 location if they now were given another opportunity to select a site.

The purpose in investigating the older industries on Route 128 was to discover what benefits, if any, these companies have received as a result of the building of the new Route 128. Another objective was to compare travel patterns of workers in the older industries with those in the newer ones.

The Management Questionnaire (Appendix A)

The items in this questionnaire were arranged in two general groups. The first group concerning plant, products, transportation, employees and parking facilities, included direct questions calling for quantitative answers. The second group involved qualitative factors for which answers could be developed only by an interchange of questions with the interviewed party. It was not intended to present the questionnaire forms to the management official to fill out but rather to develop answers through verbal questioning. The qualitative parts of the questionnaire were filled out by the interviewer after the interview was over.

1. Plant. The first question in this group was designed to determine whether the plant represented new business or a transfer from another location. The address and disposition of the previous plant were desired to investigate what loss in taxes or rentals may have been suffered at the former location. The number of employees at the previous plant, when compared with employees at the present plant, indicates the shift in employment opportunities, and also the gain or loss of jobs resulting from relocation.

The question regarding the company's investment was very important. Most plants furnished complete figures; others were reluctant to give any answers. Still others held their property under lease and kept no record of its value. In cases where no values were given, an estimate was made based on sales prices of similar properties, assessments or appraisals.

2. Products. This question was useful in identifying type of business and its scope of operation. Only very generalized answers were obtained regarding the distribution of markets and source of raw materials.

3. Transportation. Changes in modes of transportation were generally affected by the availability of rail transportation. For the most part, few changes took place. In some cases there was a shift to rail where a convenient siding was made available, and in other cases the shift was to truck where industry moved away from rail facilities.

4. Employees. This information was desired to estimate times at which employee traffic was concentrated. The relation between total employees and number of forms returned gave a basis for expanding the sample obtained from employee questionnaires.

5. Parking Facilities. The parking questions were asked to determine ratios of employees to parking spaces for different types of industries. Such information should be useful for future planning purposes.

6. Qualitative Factors. This set of questions was of major importance since they were directed to the essence of the study: to determine reasons for the industrial growth along the highway, and to appraise the benefits (or detriments) derived from a location on or near the highway.

The question regarding trucking might better have been included in the section on transportation. It was intended to supplement passenger car travel information derived from employee questionnaires. Some information was obtained, although in most instances the companies could not give definite answers.

Processing Industrial Management Interviews

In the initial planning of the questionnaire, consideration was given to whether data would be tabulated by manual means or by machine. It was decided that the management survey data would be compiled manually since only about 100 industries were involved, and since many of the questions were of a general nature not adaptable to coding.

The data obtained from the management interviews was analyzed both quantitatively and qualitatively. A general summary of the replies to the factual questions was made including percentage distribution of replies to multiple choice questions. For more specific analyses, the industries were separated into 7 groups along different sections of Route 128. The grouping was also made according to concentration of industries

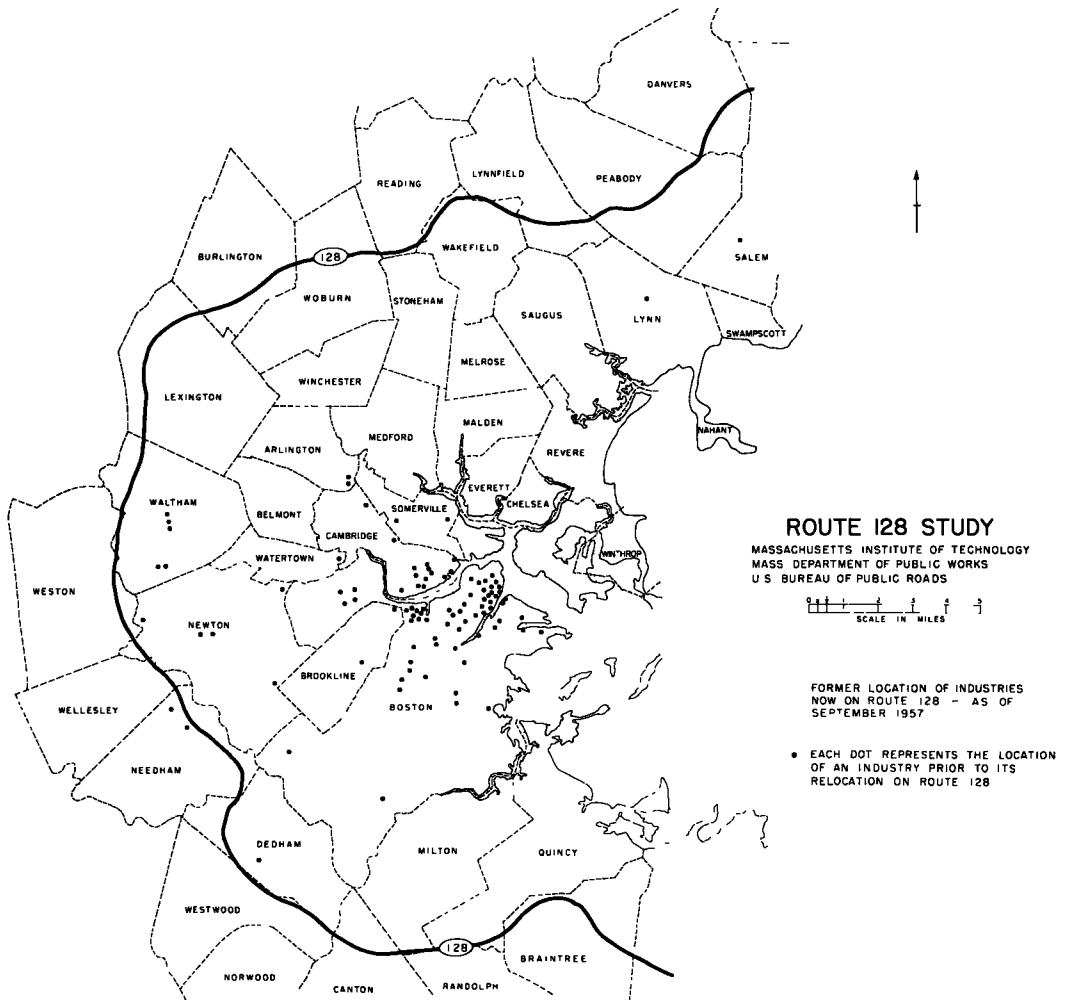


Figure 3.

(Figure 1). For each of these groups, and for each type of industry in the group, tabulations have been made showing investment in land and plant, site areas, building to land ratios, number of employees before and after locating on Route 128, ratio of parking spaces to employees, etc.

For all industries and for each of the 7 groups separately, tabulations were made of replies obtained from qualitative questions coordinated with type of business, percent of total investment and percent of total employees represented by the companies contributing to the replies.

Results and Analysis of Industrial Survey

1. General. This survey included 99 new industrial and commercial plants built along the new sections of Route 128, from just north of Route 1A (on the north) to Route 1 (on the south). The 7 industrial groups shown in Figure 1 fall within these limits, but are not uniformly distributed along the road; the groups are characterized by clusters of plants. In the Needham and Newton area, for example, 3 location groups of different identities are very close together; namely, the New England Industrial Center, the Newton Industrial Center and other individual plants in the vicinity outside of these centers.

2. Former Plant Locations. The former locations of plants which have located on Route 128 are shown by dots on a map of the greater Boston area (Figure 3). It will be noticed that most of these plants were formerly located near the heart of the city. Of the 99 industries interviewed, 59 percent were formerly located within a $2\frac{1}{4}$ -mile radius of the State House (city center), and 79 percent were within a $4\frac{1}{4}$ -mile radius.

3. Origins of Plants Located on Route 128. Some of the new plants on Route 128 are truly new industries. Others have relocated from another area, some are new branch plants, and still others are relocated branch plants. The distribution of these classes of plants among industrial location groups is shown in Table 1.

This distribution will ultimately be made on the basis of employees and of investment in plants. Such breakdowns will be significant in disclosing the employment opportunities and wealth created in the different industrial group locations.

The types of industry found in each of these classes are shown in Table 2.

4. Investment and Employment Represented by New Industries. The 99 plants on Route 128 where interviews were conducted represent a total investment of \$94,000,000 in buildings, land and equipment. In addition, new plants under construction will cost about \$34,500,000, and a few plants not yet interviewed account for an investment of \$5,000,000. The grand total of plants built or under construction as of December 1957 is about \$133,500,000. Other projects are in the planning or promotional stages. The plants in operation employ over 17,000 persons.

The distribution of investment, employment and number of plants among different

TABLE 1

Origin of Plant	Industrial Location Groups								Total %	Percent of Total
	1	2	3	4	5	6	7			
	Number of Plants									
New Industry	-	-	-	-	2	3	1	6	6.1	
Relocated Industry	1	13	9	9	6	11	10	59	59.6	
New Branch Plant	1	2	1	4	3	-	2	13	13.1	
Relocated Branch Plant	-	1	2	9	7	1	1	21	21.2	
Total Number of Plants	2	16	12	22	18	15	14	99	100.0	
Percent of Total Plants	2.0	16.2	12.1	22.2	18.2	15.1	14.2	100.0	100.0	

TABLE 2

Type of Plant by Origin	Type of Industry				
	Production	Research and Development	Service	Distribution	Total
New Industry	4	1	-	1	6
Relocated Industry	23	8	5	23	59
New Branch Plant	5	2	1	5	13
Relocated Branch Plant	1	1	-	19	21
Total Number of Plants	33	12	6	48	99
Percent of Total Plants	33.3	12.1	6.1	48.5	100.0

types of industry is shown in Table 3. Also shown are percent of total plant land area and percent of total plant building area occupied by each type of industry. Average total investment per sq ft of land is also given.

A further breakdown of this information by industrial location groups is provided in Table 4, and shown graphically in Figure 4.

The average investment in buildings and land by each type of industry is summarized in Table 5.

The unit investment in dollars per square foot of land is a convenient measure of the relative values of different types of plants. The values, however, are influenced by the size of the site. One of the service companies and two of the research and development companies owned large land areas around their plants. If these companies are eliminated from the averages, more representative results are obtained, as shown in Table 6.

The average employment at most types of plants has increased substantially since they moved to Route 128, as shown in Table 7.

Table 7 indicates that the new plants on Route 128 have created an enlarged labor market in the metropolitan area. Total employment data show an increase of 6,500 jobs in the Route 128 industries over those provided at their previous locations.

Of the above types of industry substantial gains were shown in employment for production, research and development, and service industries, but a decrease (-4.3 percent) appears for the distribution type. A possible explanation of the decrease may be found by examining the tabulation of origins of plants in section 3. It will be seen that 43 of the 46 new distribution industries (93 percent) are either relocated industries or

TABLE 3

Type of Industry	Percent of Total Investment	Percent of Total Employment	Percent of Total No. of Plants
All 128 Industry	100	100	100
Production	57.0	63.1	33.3
Research & Devel.	16.1	18.5	12.1
Service	4.1	3.2	6.1
Distribution	22.8	15.2	48.5

Type of Industry	Percent of Total Land Area	Percent of Total Building Area	Average Investment per sq ft. of Land
Production	66.6	54.5	1.70
Research & Devel.	10.0	11.7	3.21
Service	10.1	1.6	0.80
Distribution	13.3	32.2	3.46
All 128 Industry	100.0	100.0	1.99

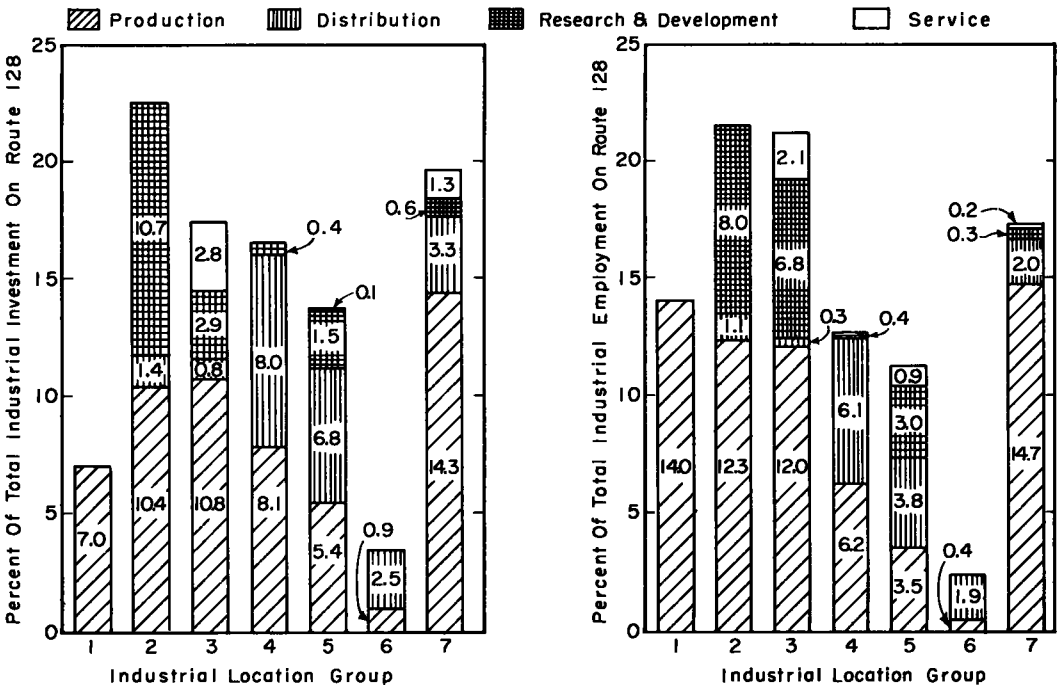


Figure 4. Percent of total employment and investment on Route 128 in each industrial location group--as of September 1957.

relocated branch plants. The drop in employment may, therefore, be traced to greater efficiency of operation in the modern facilities provided at the new location.

5. Site Locations Considered Before Building on Route 128. As an aid to establishing the effectiveness of Route 128 in attracting industries in preference to other locations, the industries were questioned regarding their consideration of other sites before choosing Route 128. The various sites considered, inside and outside of

TABLE 4
DISTRIBUTION OF INVESTMENT AND EMPLOYMENT, BY INDUSTRIAL
LOCATION AND TYPE OF INDUSTRY

Location	Type of Industry	% Total 128 Investment	% Total 128 Employment	% Location Investment	% Location Employment
Area No. 1	P	7.0	14.0	100.0	100.0
	R & D	-	-	-	-
	S	-	-	-	-
	D	-	-	-	-
	Total	7.0	14.0	100.0	100.0
Area No. 2	P	10.4	12.3	46.1	57.5
	R & D	10.7	8.0	47.8	37.5
	S	-	-	-	-
	D	1.4	1.1	6.1	5.0
	Total	22.5	21.4	100.0	100.0
Area No. 3	P	10.8	12.0	62.3	56.7
	R & D	2.9	6.8	17.0	32.1
	S	2.8	2.1	16.1	9.9
	D	0.8	0.3	4.6	1.3
	Total	17.3	21.2	100.0	100.0
Area No. 4	P	8.1	6.2	49.1	49.1
	R & D	0.4	0.4	2.5	3.0
	S	-	-	-	-
	D	8.0	6.1	48.4	47.9
	Total	16.5	12.7	100.0	100.0
Area No. 5	P	5.4	3.5	39.4	31.5
	R & D	1.5	3.0	10.8	27.2
	S	0.1	0.9	0.7	7.6
	D	6.8	3.8	49.1	33.7
	Total	13.8	11.2	100.0	100.0
Area No. 6	P	0.9	0.4	26.9	16.7
	R & D	-	-	-	-
	S	-	-	-	-
	D	2.5	1.9	73.1	83.3
	Total	3.4	2.3	100.0	100.0
Area No. 7	P	14.3	14.7	73.7	85.3
	R & D	0.6	0.3	3.2	1.4
	S	1.3	0.2	6.1	1.2
	D	3.3	2.0	17.0	12.1
	Total	19.5	17.2	100.0	100.0

P = Production
D = Distribution

R & D = Research and Development

S = Service

TABLE 5

Type of Industry	Average Investment in			Average Total Investment
	Land	Building	Equipment	
Production	\$167,000	\$837,000	\$619,000	\$1,623,000
Research & Devel.	62,400	794,000	412,600	1,269,000
Service	152,000	362,000	124,000	638,000
Distribution	121,000	248,000	78,000	447,000
All 128 Industry	131,000	509,000	310,000	950,000

Type of Industry	Percent of Total Investment		
	Land	Building	Equipment
	%	%	%
Production	10.3	51.6	38.1
Research & Devel.	4.9	62.6	32.5
Service	23.8	56.7	19.5
Distribution	27.1	55.5	17.4
All 128 Industry	13.8	53.6	32.6

TABLE 6

Type of Industry	Percent of Total Investment	Percent of Total Land Area	Average Investment per sq ft of land
	%	%	\$
Production	63.1	76.7	1.70
Research & Devel.	9.0	5.5	3.39
Service	2.6	2.6	2.00
Distribution	25.3	15.2	3.46
All 128 Industry	100.0	100.0	2.07

TABLE 7

Type of Industry	Average Employment (Present Site)	Percent Increase, Over Former Site
	persons	%
Production	334	+95.8
Research & Devel.	269	+55.2
Service	92	+38.9
Distribution	55	- 4.3
All 128 Industry	176	+60.5

Boston, by 89 of 99 industries in the study, are grouped in five categories in Table 8, and the number of plants that considered each category are entered under each heading. Since some industries considered more than one location, their plants will appear under more than one category and the numbers of plants will add to a total greater than 73. Since number of plants does not truly represent the weight to be given to the sites considered, the percentage of total Route 128 investment in each category is also given. A more detailed breakdown of site considerations is given in Table 9.

It will be seen that most consideration was given to sites in a Boston suburb or to another location on Route 128. Much less consideration was given to sites in downtown Boston or outside the metropolitan area.

TABLE 8

Number of Plants in Sample	No. of Plants that		Plants that Considered Plants in				
	Considered Other Sites	Did Not Consider Other Sites	Downtown Boston	Boston Suburb	Other Route 128 Sites	Other Mass. Cities	Outside Mass.
89	73	16	19	52	30	5	5
Percent of Sample Investment Represented by Above Numbers							
100	89.0	11.0	12.1	54.3	41.9	12.1	7.8

In terms of investment in those plants which considered other locations, 68 percent represents plants that considered only a Boston suburb, another location on Route 128, or both.

6. Factors Influencing Route 128 Site Selection. In choosing a site on Route 128 each company was influenced by one or more factors, such as cost of site development, accessibility, space for expansion, labor market, taxes, and environment. One company might consider a given factor more important than another company. In the industrial survey it was hoped to bring out the major factors considered, particularly those relating to a location on Route 128.

When the management questionnaire was being prepared, consideration was given to attaching "weights" to the different replies, such as by asking the management to attach a weight to each of the site selection factors which led them to locate on Route 128, or to list factors in the order of their importance. These methods were discarded as unnecessarily complicated and not likely to develop a reliable degree of distinction between one factor and another. Instead, it was decided to ask for only major factors, which, if more than one were given, could be considered of nearly equal weight. The major factors were solicited directly from management. A list of factors was not suggested, as it might have served to bias the replies.

7. Explanation of Major Factor Groups. Each company stated their major site selection factors in different words, so that quite a number of major factors were obtained. After analyzing the interview replies, however, it was found that they could be grouped under 11 headings, as follows:

- a. **Business Accessibility**—refers to ease of access for business purposes, such as truck pick-up and delivery, salesmen and business calls, and customers' visits.
- b. **Employee Accessibility**—refers to ease of access by employees involving savings in time or distance from home to work.
- c. **Labor Procurement and Retention**—refers to labor market supply on Route 128 and ability of industry to acquire and hold labor force.

TABLE 9
OTHER SITE LOCATIONS CONSIDERED BY INDUSTRIES THAT LOCATED ON ROUTE 128

Location Group No.	No. of Plants	Other Feasible Sites Considered ^a				Category of Other Sites Considered									
		Yes		No		Downtown Boston		Suburban Boston		Elsewhere on 128		Other Cities in Mass.		Outside of Mass.	
		(a) ^b	(b) ^c	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
1	2	2	100.0	0	0	0	0	1	17.9	0	0	1	82.1	0	0
2	15	14	98.2	1	1.8	2	6.9	7	44.7	8	50.4	2	11.4	0	0
3	12	12	100.0	0	0	2	9.9	9	70.5	8	80.3	1	13.2	2	17.0
4	20	15	34.5	5	42.5	11	22.4	11	26.1	3	2.8	1	1.4	0	0
5	16	14	66.0	2	3.8	2	12.2	12	53.7	4	28.7	0	0	1	4.1
6	13	6	35.4	7	52.0	1	5.2	5	30.2	2	25.4	0	0	0	0
7	11	10	87.1	1	0.4	1	9.9	7	62.4	5	40.5	0	0	2	18.0
All 128	89	73	89.0	16	11.0	19	12.1	52	54.3	30	41.9	5	12.1	5	7.8

^a The sum of the (b) columns in Yes and No in some cases do not add up to 100.0 percent because information is missing from 10 plants.

^b Column (a) in each case lists the number of plants.

^c Column (b) in each case shows percent of investment represented by the plants in column (a).

d. **Space for Expansion and Improved Operational Efficiency**—includes availability of enough land for both present and future space requirements. This space may be needed for enlarged production, more efficient operation in 1-story buildings versus multiple story buildings, enlargement of parking facilities, or a combination of these factors.

e. **Advertising**—includes expected benefit or increase in prestige to be derived from frequent viewing of signs and attractive grounds by passing motorists and potential customers.

f. **Aesthetics**—indicates a desire to locate in a good-looking site, both with respect to buildings and landscaping.

g. **Land Cost**—implies land cost was low, or lower than at other sites considered.

h. **Railroad Facilities**—includes the necessity or desirability of having a rail siding available.

i. **"Package Deal"**—refers to the availability of a promoter who will provide a plant as a "package," including land, preparation of site, erection of buildings to owner's specifications and aid in the financing of the project. Such plants may be acquired in different ways: some are bought outright, others are taken on lease, and others on lease with option to buy. The purchaser is relieved of the burden of site selection, and of dealing with many contractors. The developer is in a position to acquire desirable tracts of land at low price on a "wholesale" basis, and to gain economies from "volume" production of sites and buildings.

j. **Site Potential**—This classification indicates that the industry interviewed expressed satisfaction with the site selected without pointing to specific site factors considered. They also indicated that they expected their site to increase in value with time.

k. **Lower Taxes**—refers to taxes being lower than at former site or at other sites considered, and also the prospect that taxes would not rise excessively in the future.

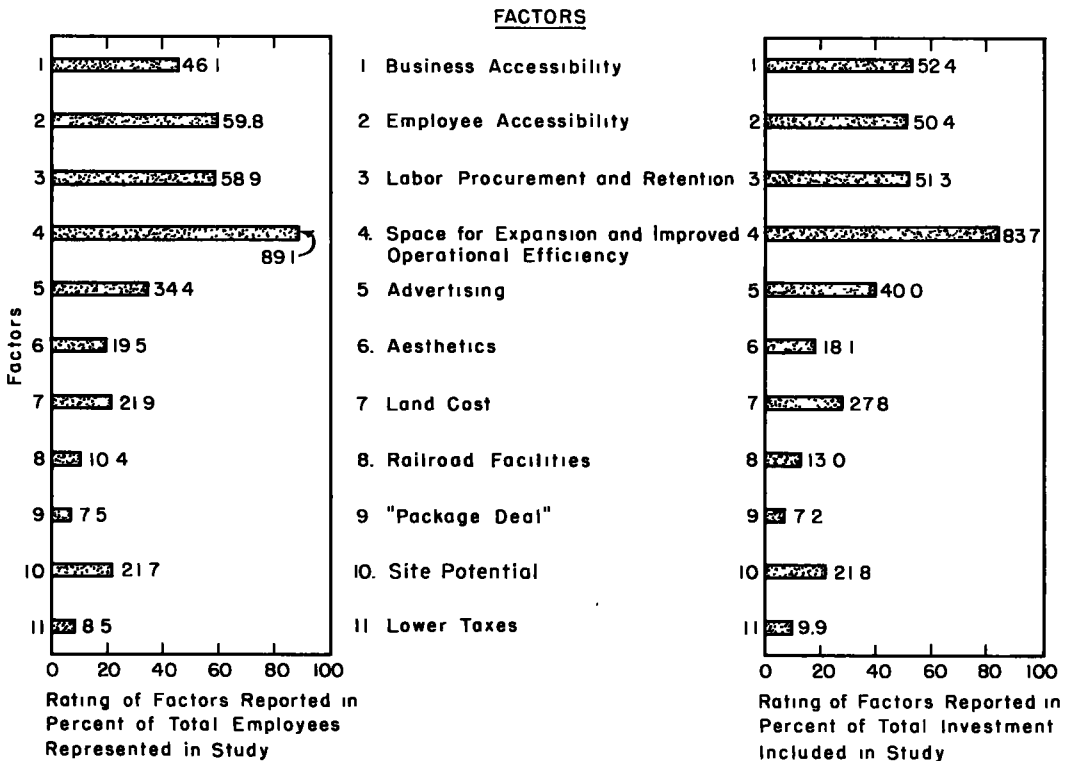


Figure 5. Rating of major factors considered in site selection by all new industries interviewed on Route 128--as of September 1957.

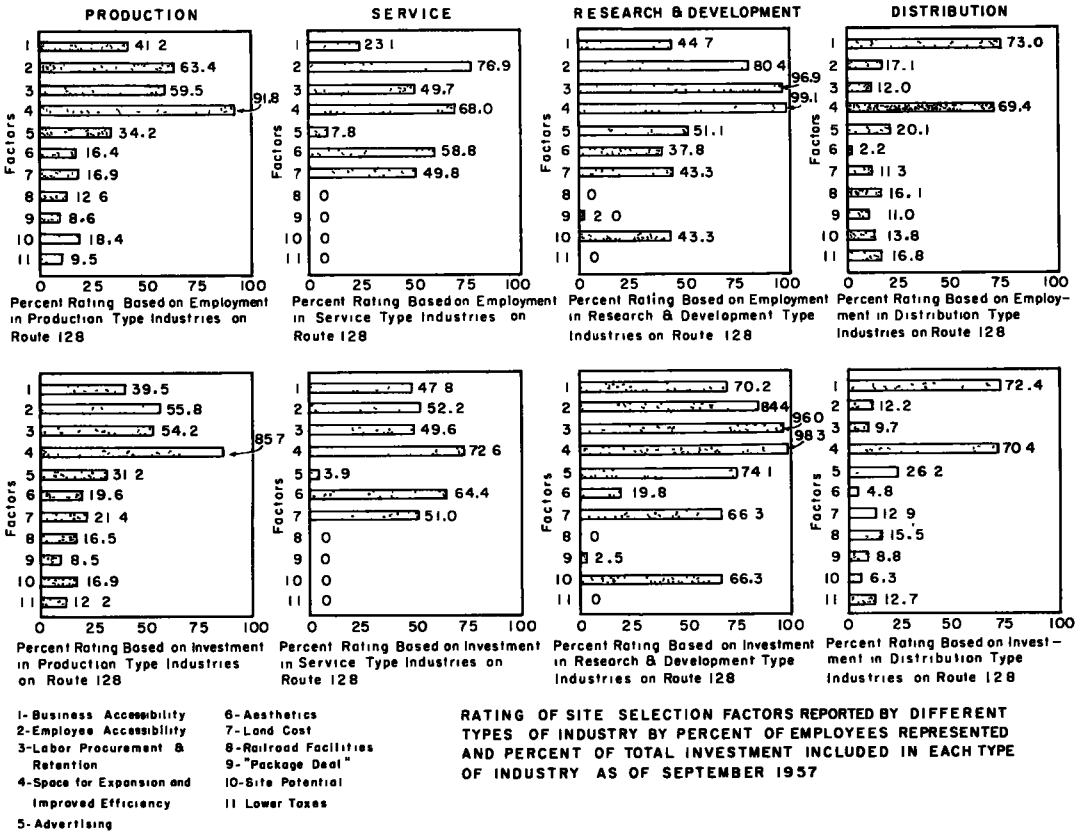


Figure 6.

8. Evaluation of Major Route 128 Site Selection Factors. The industries indicating a given factor were grouped under that particular factor heading. If an industry gave only one primary site selection factor, it would be recorded only once. If it gave three factors, it would be recorded under each of those three factors. For comparison purposes the number of industries in each factor group are expressed in percent of investment, and in percent of employees represented. The results of this analysis for all industries on Route 128 is shown in Figure 5. Similar results for each type of industry are shown in Figure 6.

The graphs are presented to show the relative importance attached to each of the 11 site selection factors.

Referring to Figure 5, it will be seen that for all Route 128 industries, space for expansion and improved efficiency of operation is the most important factor in site selection, followed by labor procurement and retention, employee accessibility and business accessibility.

An inspection of Figure 6 shows that although the space and efficiency factor is high for all types of industry there is more variation in the other highly rated factors. Business accessibility rates high for distribution type industries, but employee accessibility and labor procurement rate low. Aesthetics and land cost rate high for service types (insurance companies, etc.) and for research and development types, but low for production and distribution types.

In order to further bring out the influence of the major factors on the choice of a location on Route 128, Table 10 has been prepared. The 5 highest rated factors (in terms of percent investment) have been arranged in order of decreasing magnitude for all Route 128 industries and for each type of industry separately. The investment percentages are taken from Figures 5 and 6. To simplify the comparison, an index has

TABLE 10

ROUTE 128 SITE LOCATION FACTORS ARRANGED IN ORDER OF DECREASING INVESTMENT REPRESENTED

	Factor % Invest. Index	No. 4	No. 3	No. 1	No. 5	No. 7	Others	Total
All Route 128 Industries		83.7 26	51.3 16	52.4 16	40.0 12	27.8 8	70.0 22	325.2 100
Production		85.7 27	55.8 17	54.2 17	31.2 9	21.4 7	73.7 23	322.0 100
Service		72.6 21	64.4 19	52.2 15	51.0 15	49.6 15	51.7 15	341.5 100
Research and Develop.		98.3 17	96.0 17	84.4 14	74.1 13	70.2 12	154.9 27	577.9 100
Distribution		72.4 29	70.4 28	23.8 10	15.5 6	12.9 5	54.5 22	249.5 100

TABLE 11

PARKING SPACE AVAILABILITY ON ROUTE 128

Type of Industry	Average Employment per Plant	Parking Space to Employee Ratio
All Route 128	176 persons	0.75
Production	334	0.69
Distribution	55	0.93
Service	92	0.94
Research & Development	269	0.78
Range of Employees	No. of Plants	Parking Space to Employee Ratio
0 - 50	48	1.52
51 - 100	16	1.03
101 - 150	4	0.69
151 - 200	3	0.90
201 - 500	12	0.70
501 - 1000	5	0.66
1001 Up	3	0.54

been derived for each type of industry. It is obtained by adding the percentage investments assigned to each of the 11 factors in each industry group and calling this total 100. The individual indices are then made proportional to the individual percentages.

The one factor entering most prominently into the choice of a Route 128 location is space for expansion and improved operational efficiency (No. 4). It is followed by employee accessibility (No. 2), labor procurement and retention (No. 3), advertising (No. 5), business accessibility (No. 1), and land cost (No. 7).

These factors can be closely tied to the effect of Route 128. This highway opened up large areas of low-valued land where expansion was possible. The high-speed, limited access character of the highway extended practical home to work distances and enlarged the labor market. The absence of congestion and availability of ample parking space increased accessibility for both business purposes and employees.

9. Availability of Automobile Parking Space. From the management survey, data were obtained concerning parking spaces available and their relation to number of employees during the shift of greatest employment. The ratios of parking space to employees at different types of industries are shown in Table 11. A further separation of ratios is made up of ranges in number of employees in plants of different sizes.

10. Control Industries. The companies located on old Route 128 before the new route was built in substantially the same location expressed the view that the new highway had favorably influenced their business. Better access had contributed to a larger volume of business. In some cases this was brought about by the new advertising medium provided by the new route. The owners felt that their property had increased in market value. One disadvantage mentioned by a number of companies was a more than normal increase in wages of employees, apparently due to increased competition from new industries along Route 128.

The opinions of industries located 5 miles or more inside the periphery of Route 128 varied. One large industry with international markets saw no special advantage in locating on Route 128, but was more concerned with the possibility of sites in other parts of the country. Another company engaged in research under government contract preferred to use older, low-rent buildings on a temporary basis, so that they would not be left with a large fixed investment if government contracts should be canceled. However, this same company does have plans for an administration building to be constructed on Route 128.

Still another company felt that their particular type of skilled labor requirements could not be met as well in a suburban highway location as in town. Another company decided against building on Route 128, and located elsewhere. However, they would now prefer a Route 128 location.

11. Influence of Zoning on Plant Locations. One factor which significantly influences industrial growth on Route 128 is the zoning restrictions of individual towns and cities. Some towns, such as Needham, were reluctant to zone for industry. About two years of promotion and education were necessary to persuade this town that the New England Industrial Center was a good thing for the town. Now that it is built they are quite proud of it. Lexington, on the other hand, has resisted efforts to change the semi-rural, suburban atmosphere of this historic, residential town. An inspection of Figure 1 shows concentration of industry on either side of Lexington, but none within the town boundaries. The only industrial establishment on Route 128 in the town is a restaurant and gasoline station, operating as state-controlled concessions.

12. Benefits or Disadvantages, Expected and Realized. In addition to being questioned on their decision to locate on Route 128, the management of each firm was asked what benefits (or disadvantages) they expected because of the plant's proximity to Route 128, and what labor procurement and commuting problems they anticipated. Further, they were asked if these benefits were realized, or if they received other unanticipated advantages because of their particular relationship to the highway.

In nearly every case, management stated that the expected benefits were closely related to the major factors in their decision to locate at their Route 128 site. In other words, if they chose their particular site because of the necessity for business accessibility, they felt that the route would provide this advantage.

In general, management felt the highway not only provided access for business purposes and employees, but also, by virtue of the additional access, made heretofore undeveloped land available and feasible for development and expansion. Most of the industries did not anticipate labor procurement or retention problems as they normally chose their particular site with regard to known labor markets and necessary access requirements. Generally they expected a higher quality of labor at the new site. However, those companies who located without regard to the employees homes or who employed principally unskilled and part-time help sometimes found difficulty in obtaining it at the new Route 128 location. For example, some of the industries are having this problem at the N. E. I. C., which is not surprising when it is considered that 47 percent of the old employees at the center had to change from public transportation and walking to automobile (Table 14).

For the most part, industries found their labor procurement problems much less

difficult than anticipated. Quite often passing motorists voluntarily enter a Route 128 industry office seeking employment. On the other hand, those industries hiring engineers are finding some difficulty in holding them as these people can easily visit similar industries along the road during lunch hour and shop around for better job opportunities.

Some plants hiring principally secretarial personnel were hesitant in locating on the circumferential highway, as they felt it might be hard to retain this help due to the lack of car ownership and nearby shopping conveniences. However, most of these companies reported less turnover of secretarial help at the Route 128 location than in town.

Some complaint has been registered because of the lack of public transportation to and from the different locations on Route 128. However, in those cases where this service was offered after the company's move to Route 128, it was not used by more than a handful of employees, even in areas where more than 2,000 persons were employed, and therefore was discontinued. Some companies set up their own bus service to nearby towns, but almost all have since found even this service unnecessary.

Many of the new establishments wanted to be located in a good looking industrial park; some expressed the opinion that their personnel considered this quite important. Most companies are satisfied if not exceedingly proud of being part of a good looking industrial community.

Though few of the industries actually anticipated advertising or prestige value from the highway, a number pointed out that they had received considerable unexpected benefit from this medium.

Route 128, as built, had few frontage-type roads. In many cases the industries had to build their own access roads and maintain them. At an intown location, the municipality would have provided and maintained these facilities.

Another objection was made to the lack of good eating places on the road or in the vicinity of the industrial parks. At present more restaurants are being planned by private operators, and this problem should be abated in the near future.

TRAVEL PATTERNS OF EMPLOYEES AT THE NEW ENGLAND INDUSTRIAL CENTER

Methods and Procedures

An employee travel pattern survey was conducted to determine the amount of traffic generated by the industries along Route 128, when and where this traffic was concentrated and its influence on local travel patterns. Answers were desired to such questions as: Are distances to work becoming longer or shorter? Are travel times becoming longer or shorter? Are modes of travel changing? Are car pools becoming more common? Does the availability of Route 128 permit longer distances to work in less time? Are people tending to move closer to their place of work?

A questionnaire was designed to yield the desired information in the fewest number of questions, with the least effort on the part of the employee and with the least possibility of ambiguity. The first form of the questionnaire (Appendix B) was tried out at one of the companies in the New England Industrial Center. As a result certain changes were made resulting in the form shown in Appendix C which was used for most of the survey.

At the conclusion of each management interview, the company was requested to distribute questionnaires to their employees. Excellent cooperation was obtained. Most industries preferred to circulate the employee questionnaire in their own way and at their own convenience. Some prepared their own directives urging their employees to cooperate, and distributed them with pay checks; others merely placed them in a convenient place, such as near the lunch room door, and left it to the initiative of the employee to fill it out. Some decentralized the responsibility for distribution by routing the forms to department heads and sub-department heads. The latter method proved most effective in obtaining a high percentage of returns.

To verify the reliability of the sample obtained from the questionnaires regarding vehicles and people at each plant and their use of Route 128, "gate" counts were made

TABLE 12

**DISTRIBUTION OF INDUSTRIES IN NEW ENGLAND INDUSTRIAL CENTER
COMPARED WITH THAT OF ALL INDUSTRIES CONTACTED ALONG ROUTE 128**

Type of Industry	Percent of Total Investment		Percent of Total Employees		Percent of Total Number of Plants	
	N. E. I. C.	All Rt. 128	N. E. I. C.	All Rt. 128	N. E. I. C.	All Rt. 128
	%	%	%	%	%	%
Production	49	58	49	63	9	33
Service	0	4	0	3	0	6
Research and Devel.	2	16	3	19	9	12
Distribution	49	22	48	15	82	49
All Types	100	100	100	100	100	100

at several individual industries and at the New England Industrial Center. The counts were made at the end (or beginning) of the day shift. Usually the factory or shop workers had different hours than office workers, so a separation often could be made between data for these two classes of workers.

Processing Employee Questionnaires

In planning this survey estimates indicated a total of about 5,000 employees in the industries located on Route 128. If a maximum of 60 percent returns were realized, only 3,000 forms would need processing. Therefore, it was felt that data could be processed manually and the questionnaire was designed with this method in mind.

As the survey progressed, it was found that considerably more employee questionnaires would need processing than anticipated. To date about 7,500 forms have been returned from industries located on Route 128. Manual processing proved too slow and cumbersome, so a shift was made to machine methods.

At this writing, machine processing is still in progress, and data are available for only one industrial location group, the New England Industrial Center (N. E. I. C.) located in Needham (Location Group 4). The results which follow relate to that center. They are not necessarily typical of those that will be obtained for other location groups or for the route as a whole. The center does, however, represent the most concentrated group of establishments currently located along Route 128.

TABLE 13

**EMPLOYEE QUESTIONNAIRES DISTRIBUTED AND RETURNED BY TYPE OF
INDUSTRY IN THE NEW ENGLAND INDUSTRIAL CENTER**

Type of Industry	Number of Employees	Forms Distributed		Forms Returned		
		Number	Percent of Total Employees	Number	Percent of Forms Distributed	Percent of Total Employees
Production	1,085	875	81	211	24	19
Service	0	0	0	0	0	0
Research and Devel.	66	30	45	22	73	33
Distribution	1,054	617	59	379	61	36
All Types	2,205	1,522	69	612	40	28

Characteristics of the New England Industrial Center

Table 12 shows a comparison of the distribution of types of industries in the N. E. I. C. with that of all industries contacted along Route 128. Since the size of the individual industries varies considerably (from 4 to 875 employees), a comparison based on number of plants alone would not be significant. Therefore, additional comparisons have been made on the basis of plant investment and number of employees in each type of industry. It will be seen that the N. E. I. C. contains primarily production and distribution types of activity.

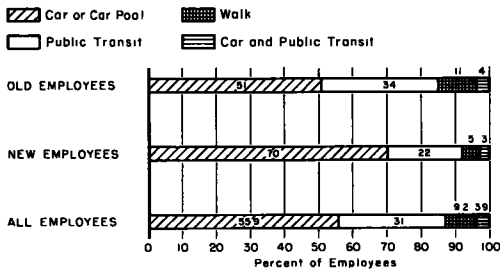
The number of employees in each type of industry, number of forms distributed and forms returned in the N. E. I. C. are shown in Table 13. It was hoped that questionnaires would be distributed to all employees, and that as large a percentage as possible would be returned. As the questionnaires were distributed voluntarily by the companies, it did not seem appropriate to impose on them a systematic sampling process that would cause them substantial inconvenience and expense. Certain companies considered it inadvisable to distribute forms, consequently only 69 percent of all employees in the center received forms. Of these, 40 percent were returned, representing 28 percent of all employees in the center. The percent of returns was significantly lower (19 percent) for the production companies than for the research and development (33 percent) and distribution (36 percent) types. Since no control was possible over the distribution of returns, the extent of their randomness is not known.

TABLE 14

TRAVEL PATTERNS OF EMPLOYEES AT NEW ENGLAND INDUSTRIAL CENTER^a

Employment Status—1957	Old Employees	New Employees	Both Categories
Percent Distribution	%	%	%
	69.4	30.6	100.0
Home to Work Trip			
a. Percent using Rt 128	43.2	46.5	44.2
b. Percent not using Rt 128	56.8	53.5	55.8
Average Distance to Work	miles	miles	miles
a. Rt 128 users	15.7	12.9	14.7
On Rt 128	8.5	7.2	8.0
Off Rt 128	7.2	5.7	6.7
b. Non-Rt 128 users	9.9	5.9	7.8
c. All workers	12.4	9.1	11.0
Average Time to Work			min
a. Rt 128 users			27.9
b. Non-Rt 128 users			21.2
c. All workers			24.1
Mode of Travel to Work	%	%	%
a. Before working on Rt 128			
Auto and car pool	51.0	70.0	55.9
Public transit	34.0	22.0	31.0
Auto and public transit	4.0	3.0	3.9
Walk	11.0	5.0	9.2
b. After working on Rt 128			
Auto—1 person	63.2	79.6	67.7
Car pool	35.2	19.0	30.7
Public transit	1.6	1.4	1.6
Walk	0	0	0

^a Based on analysis of questionnaires returned by 612 of the 2,205 persons employed at New England Industrial Center.



MODE OF TRANSPORTATION USED BY NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES, SEPTEMBER 1957

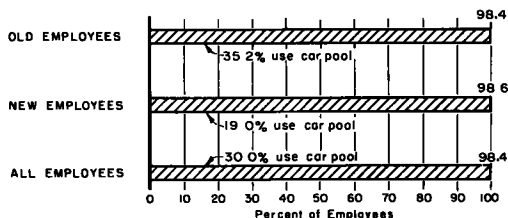


Figure 7. Mode of transportation used by New England Industrial Center employees prior to working at a Route 128 industry.

Results and Analysis of Travel Pattern Survey at N. E. I. C.

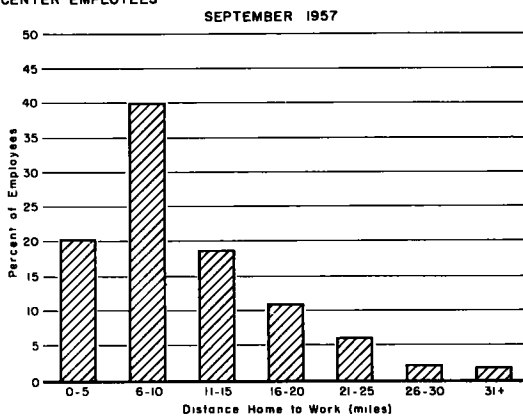
General. The employee travel patterns found at the New England Industrial Center are summarized in Table 14. They are illustrated in more detail in Figures 7 to 11, inclusive. The changes that have taken place in employees' place of residence since working in the N. E. I. C. are shown graphically in Figure 12, and their home areas, as surveyed in 1957, are shown in Figure 13.

Two major classifications are made of all employees: (1) Those employed by the company before it moved to Route 128 ("old" employees) and those who have joined the company since it moved to Route 128 ("new" employees); (2) Those who travel on some portion of Route 128 in their trip to work (Route 128 users), and those who do not use Route 128 (non-users). The traffic characteristics of these groups were found to be sufficiently different to warrant a separation. Also, the influence of the highway will become evident in its effect on employees time and distance to work and on their change of residence.

As of 1957, old employees comprise 69 percent, and new employees 31 percent; 44 percent of all employees use Route 128 and 56 percent do not. Route 128 users average 14.7 miles and 28 minutes to work, whereas non-users average 7.8 miles and 21 minutes. The average for all employees are 11.0 miles and 24 minutes.

Mode of Travel. Modes of travel of N. E. I. C. employees before and after working on Route 128 are shown in Table 14 and in Figure 7. The shift from use of public transit or walking to automobile after the plant moved to Route 128 is evident. Considering all employees, 56 percent reached their plant by automobile before the move to Route 128 and 98 percent used this mode after the move. The change to automobiles was greater for old employees than for new ones. This change was inevitable, since walking

DISTANCE HOME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES



DISTANCE HOME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES, ROUTE 128 USERS vs NON-USERS, SEPTEMBER 1957

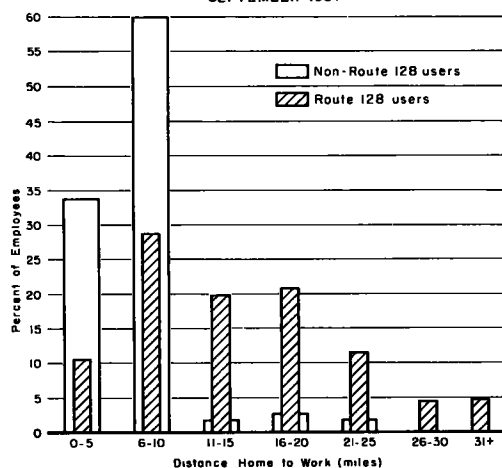


Figure 8.

to work was no longer possible. Also, the transit trip to Route 128 from intown is very time-consuming and requires two fares. Some companies with a large number of employees living in the central city were much concerned about how their people would get to work, and made arrangements for special public transportation. However, when the move was made, nearly all the employees managed to reach the plant by automobile. Arrangements for public transportation usually were abandoned. The change to automobile transportation was accomplished by some employees purchasing cars for commuting purposes, and by the formation of car pools. Old employees increased their home-to-work travel in automobiles from 51 to 95 percent.

Car pool data prior to plant location on Route 128 is not available. After the move, however, 35 percent of trips were in car pools.

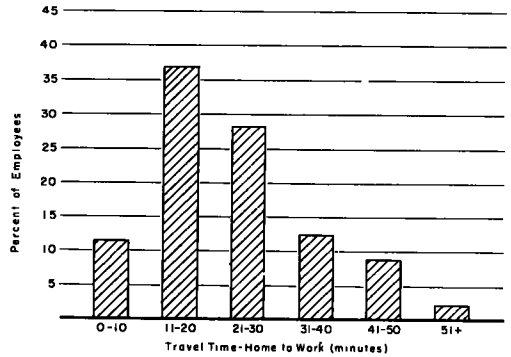
Travel Times and Distances. The percentage distribution of home-to-work distances for N. E. I. C. employees is shown in Figure 8 by 5 mile ranges for all employees, and for Route 128 users and non-users. Most trips (60 percent) of all employees are 10 miles or less, but a few (2 percent) exceed 31 miles. The non-users trips are even more concentrated in the 0 to 10 mile range, whereas the Route 128 users trips are fairly well distributed up to 25 miles. For example, 94 percent of the non-users travel 10 miles or less to work whereas only 39 percent of the users of Route 128 travel in this range.

The percentage distribution of home-to-work travel times of N. E. I. C. employees is shown by 10-minute ranges in Figure 9. Most (75 percent) of the trips of all employees take 30 minutes or less. Only a small fraction (2 percent) take over 51 minutes. The non-users of Route 128 account for most of the shorter trips. For example, 57 percent of non-users make the trip in 20 minutes or less, compared to 37 percent of Route 128 users.

The advantages in travel time gained by Route 128 users compared to non-users is brought out in comparison of average distances, travel times and speeds of users and non-users of Route 128 shown in Table 15.

The time versus distance advantage gained by the use of Route 128 is further emphasized in Figure 10, which is a plot of travel distance against travel time for different percentage ranges of Route 128 use. The curves shown in Figure 10 were obtained

TRAVEL TIME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES SEPTEMBER 1957



TRAVEL TIME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES, ROUTE 128 USERS vs NON-USERS SEPTEMBER 1957

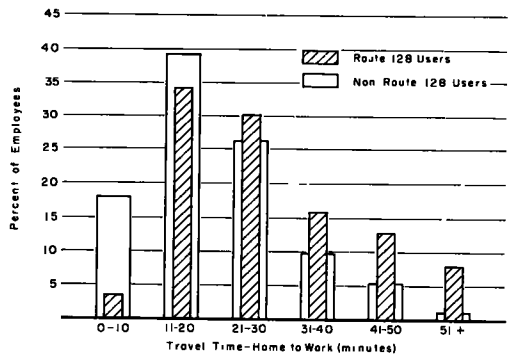


Figure 9.

TABLE 15

Home-to-Work Trip	Average Distance miles	Average Travel Time min	Average Speed mph
Route 128 Users	14.7	27.9	31.3
Non-Users	7.8	21.2	22.1
All N. E. I. C. Employees	11.0	24.1	27.4

TABLE 16

Home-to-Work Time—40 minutes			
Percent of Trip on Route 128	Home-to-Work Distance miles	Ratio of Increase in Distance	Average Speed of Total Trip
%			
0	14.7	1.00	22.0
1 - 20	18.0	1.23	27.0
21 - 40	19.0	1.30	28.5
41 - 60	21.2	1.45	31.8
61 - 80	22.4	1.53	33.6
81+	28.8	1.96	43.2

from separate plots for each percentage range. On these graphs all available trips were plotted as points and an average curve drawn through them.

Since travel times are influenced by many factors, the curves did not always follow a regular pattern. The 41 - 60 percent curve, for example, might logically be expected to rise uniformly instead of bulging at 30 minutes and then flattening out. The origins of the trips for which this curve was plotted were investigated and it was found that most of the trips longer than 20 miles originated in congested city areas or in some cases were on slow-speed secondary roads. When more data are processed from other locations a more consistent relation may be obtained.

Regardless of the irregularities of the individual curves, one trend is evident; as Route 128 usage increases, employees can travel a greater distance in a given time. Table 16 illustrates this point.

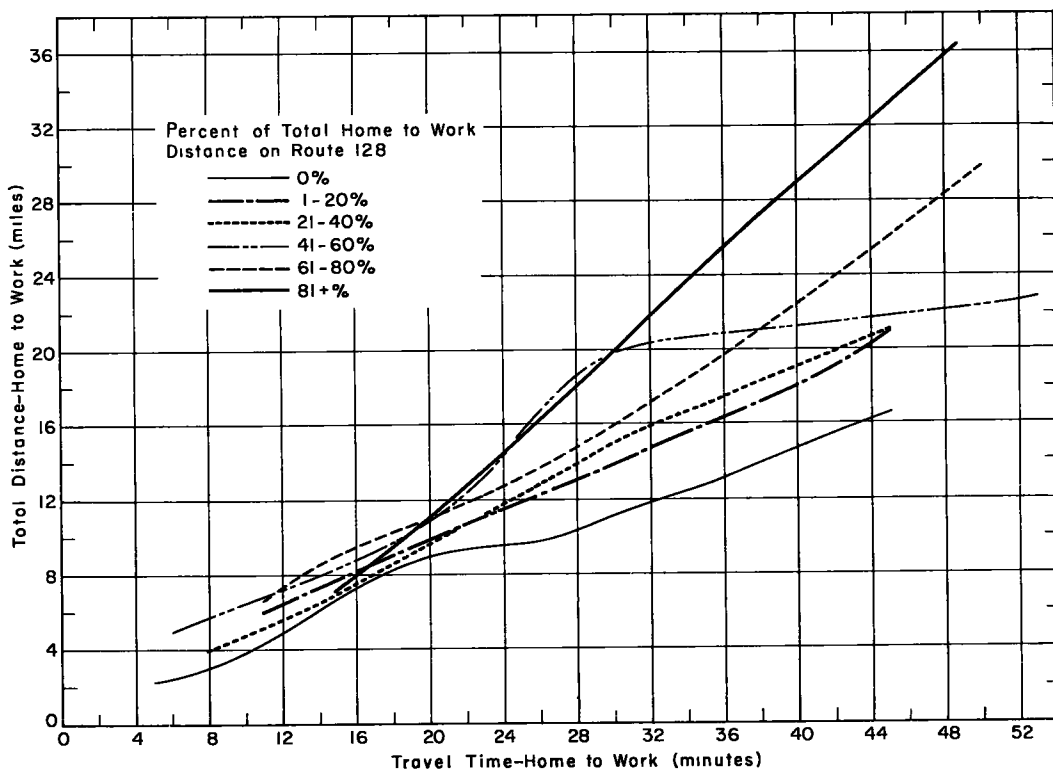
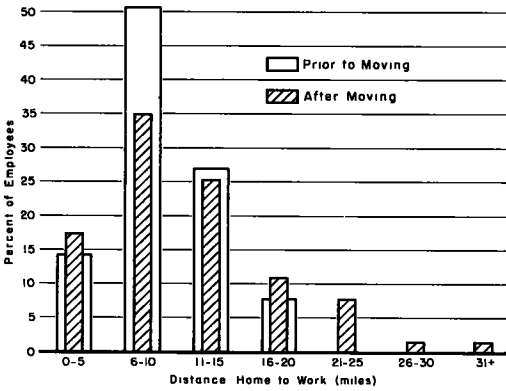


Figure 10. Time-distance relationship for home-to-work travel of New England Industrial Center employees for various percent Route 128 usage.

DISTANCE HOME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES WHO HAVE CHANGED THEIR RESIDENCE SINCE STARTING TO WORK AT A ROUTE 128 INDUSTRY SEPTEMBER 1957



DISTANCE HOME TO WORK FOR ALL NEW ENGLAND INDUSTRIAL CENTER EMPLOYEES WHO HAVE CHANGED THEIR RESIDENCE SINCE STARTING TO WORK AT A ROUTE 128 INDUSTRY, COMPARING ROUTE 128 USERS WITH NON-ROUTE 128 USERS SEPTEMBER 1957

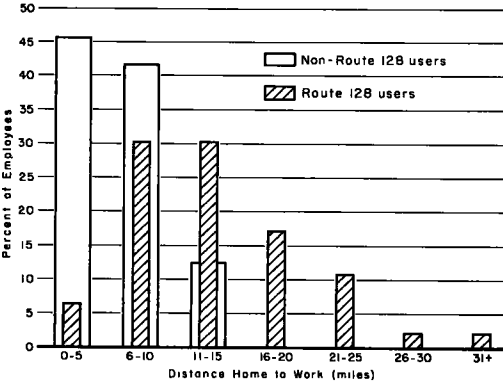


Figure 11.

have moved since starting to work at a Route 128 industry. Of the 72 reporting, 19 percent were old employees who worked for their company before it moved, and 81 percent were new employees.

Figure 11 shows (in 5-mile ranges) the percentage distribution of the distance traveled to N. E. I. C. before and after change of residence. The chart shows the trend of distance to work to be longer after a move, particularly in the 6 - 10 mile range which included 51 percent of trips before moving and only 35 percent after moving. In the group that moved, Route 128 users travel considerably farther than non-users.

The old and new home locations of employees who moved and the direction of the move are shown in Figure 12. The general movement out of the central city is evident, but a movement toward the N. E. I. C. is less evident. Of the old employees who moved only 40 percent moved nearer to work; of the Route 128 users 55 percent moved nearer to Route 128. The pertinent facts regarding employees who moved are summarized in Table 17.

There are many factors that influence people to change their residence aside from its proximity to work, such as price, community environment and suitability to the buyer's (or renter's) needs. The time to work is usually more important than distance. Unfortunately the questionnaire did not include a question regarding time to work before employment on Route 128. However, those employees questioned directly about their use of Route 128 said time saving was its principal advantage.

Another finding indicated by Figure 10 is that as the length of trip increases the average speed of the non-users of the route tends to decrease while that of the Route 128 users increases with the amount of use of that route. For example, for trips taking 20 minutes or less the average speed represented by the slope of all the curves is about 30 mph. For a 40 minute trip, the non-users average speed is about 23 mph, while the 81+ percent Route 128 users average about 44 mph. If the average travel-time speed is considered as a measure of trip efficiency, the 81+ percent group users of Route 128 have gained a 91 percent advantage over non-users in the case of a 40 minute trip.

While it would be expected that the 81+ percent users of Route 128 would gain in average speed as the trip is lengthened, it is not obvious why the non-users should show a loss in average speed. The explanation appears to lie in the nature of the trips. The shorter trips are made in the outer suburbs where there is little if any traffic congestion, whereas the longer trips start in the downtown areas where considerable congestion is encountered before the drivers reach the suburbs. The home locations of workers in the N. E. I. C. (Figure 13) indicate that a large number live in congested areas south and southwest of the Boston central business district where travel time would be slow.

Travel Patterns of Employees Who Have Moved Since Starting to Work on Route 128. Of the 612 N. E. I. C. employees who returned forms, 72 or 12 percent

TABLE 17
SUMMARY OF EMPLOYEES WHO CHANGED THEIR RESIDENCE SINCE STARTING TO WORK ON ROUTE 128

12 Percent of All the N. E. I. C. Employees Moved

- Of the 12% Who Moved:
- a. 19% Are Old Employees
 - 81% Are New Employees
 - b. 75% Are Route 128 Users
 - 25% Are Non-Users

- Of the Old Employees Who Moved:
- 40% Moved Closer to Work
 - 44% Moved Further from Work
 - 16% Had the Same Distance to Work

- Of the Route 128 Users:
- 55% Moved Closer to Route 128
 - 34% Moved Further from Route 128
 - 11% Had the Same Distance to Route 128

Gate Counts. Vehicle and passenger "gate" counts were made at 9 separate industries and at the New England Industrial Center. In some cases counts were conducted at such points that the vehicles entering or leaving Route 128 could be separated from those not using Route 128. The purpose was two-fold: one, to obtain a 100 percent count of the number of vehicles and their occupants entering and leaving at a peak hour,

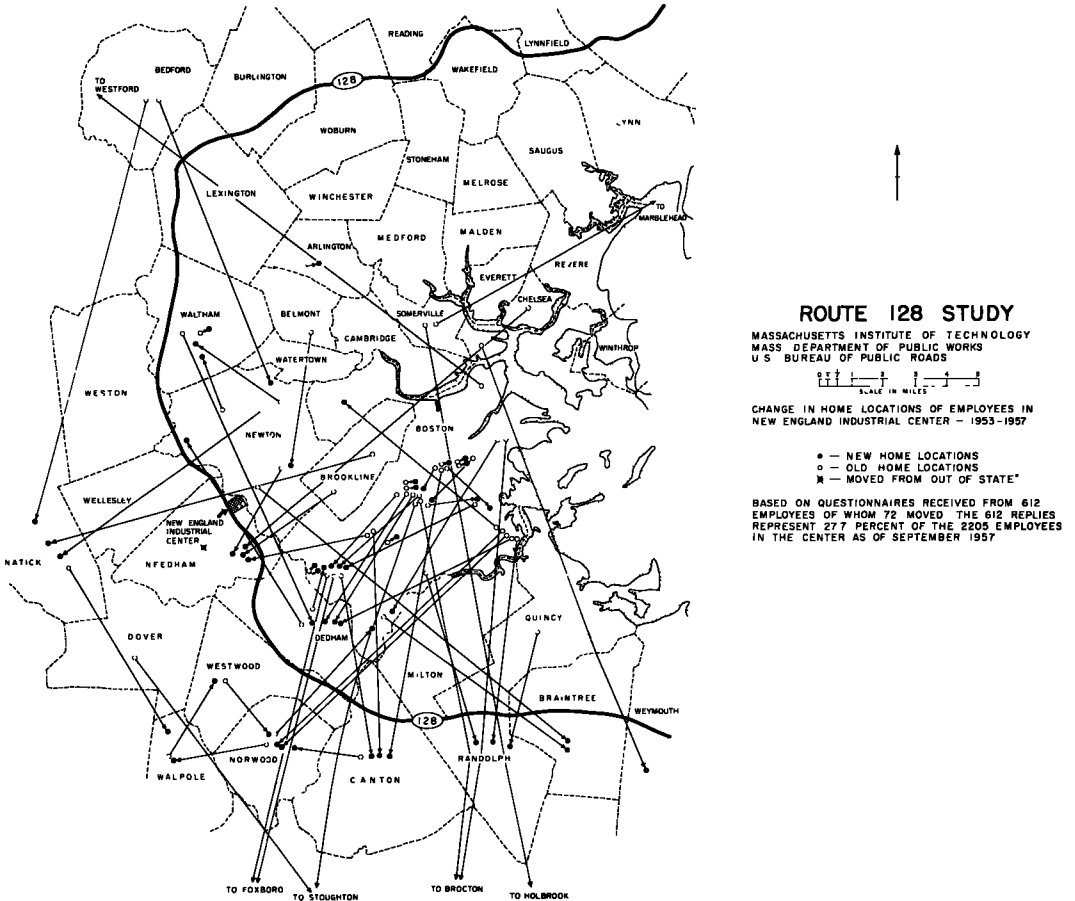


Figure 12.

In the final report both the industrial development and travel pattern data will be assembled and analyzed in three major groupings: (1) Route 128 as a whole, (2) functional types of industry, and (3) industrial location groups.

Within each industrial location group a further separation will be made by type of industry.

The assessed valuations of new industries and their tax contribution to the towns in which they are located will be obtained.

Employee travel data will be obtained for each industrial location group, and vehicle-miles contributed to different sections of Route 128 will be computed. Traffic generation statistics will be compiled for different types of industry.

A study will be made of rate of growth of industry on Route 128 since its construction, including number of jobs brought into area and traffic generated each year.

The data obtained from the origin-and-destination survey of Route 128 will be analyzed and traffic studies made of the influence of that highway on the over-all traffic patterns of metropolitan area, particularly with reference to traffic generated by activities on Route 128.

SUMMARY OF FINDINGS

This paper is a preliminary report of the principal findings of a survey of 99 industrial establishments along Massachusetts Route 128, the Boston Circumferential Highway. The industrial survey findings are based upon interviews with management of these plants. Employee travel patterns at the New England Industrial Center were obtained from questionnaires distributed to employees; this data was verified and supplemented by field counts at certain plants.

Industrial Survey

Of the 99 new Route 128 industries interviewed, 59 percent were formerly located within a $2\frac{1}{4}$ -mile radius of the city center, and 79 percent within $4\frac{1}{4}$ miles. New industries comprised 6 percent, relocated plants 60 percent, new branch plants 13 percent, and relocated branch plants 21 percent.

These plants represent an investment in land, buildings and equipment of about \$94,000,000. Plants under construction as of December 1957 will bring the total to about \$134,000,000.

The types of industries represented are: production 33 percent, research and development 12 percent, service 6 percent, and distribution 49 percent. Although production-type industries comprise only one-third of the number of plants, they account for most of the investment (57 percent) and employment (63 percent).

Average investments in buildings and land were found to be \$1,004,000 for production, \$856,000 for research and development, \$514,000 for service and \$369,000 for distribution-type industries.

As of September 1957 about 17,000 persons were employed by Route 128 industries. This number is 6,500 more than employed by these companies at their former locations. The gain was 96 percent for production types, 55 percent for research and development, 39 percent for service, minus 4 percent for distribution, and 60 percent for all types.

When asked why they located on Route 128, most industries gave space for expansion and improved efficiency of operation as a major factor. Production types also particularly stressed employee access, labor procurement, and business access; service types, aesthetics and employee accessibility; research and development types, employee accessibility, labor procurement and retention; distribution types, business accessibility.

Parking space ratios for all industries averaged 0.75 spaces per employee. Some variations occur among different types of industry, but the principal influence is number of employees. At companies employing less than 50 people the average ratio is 1.52; for companies employing over 1,000 people it is 0.54.

Travel Patterns at New England Industrial Center

The industries in the New England Industrial Center (located on Route 128 in Needham) employ 2,205 persons of whom 1,522 (69 percent) received travel pattern ques-

tionnaires, of which 612 (40 percent) were returned, representing 28 percent of the total employment.

"Old" employees who worked for a company before it moved to Route 128 comprise 69 percent of the total employees. The remaining 31 percent are "new" employees who joined a company after it moved.

Of the old employees, 43 percent make use of Route 128 in traveling to work. The average trip length of Route 128 users is 8.5 miles on Route 128 and 7.2 miles on other highways, a total of 15.7 miles. Non-users of Route 128 average 9.9 miles to work.

Of the new employees, 47 percent make use of Route 128 in traveling to work. The average trip length of Route 128 users is 7.2 miles on Route 128 and 5.7 miles on other roads, a total of 12.9 miles. Non-users of Route 128 average 5.9 miles to work.

For all workers, the average home to work distance for Route 128 users is 14.7 miles which is covered in 27.9 minutes at an average speed of 31.6 mph. For non-Route 128 users, the averages are 7.8 miles, 21.2 minutes and 22.1 mph, respectively.

The distance that can be traveled to the N. E. I. C. in a given time increases substantially as the percentage use of Route 128 increases. Users of Route 128 for 81 percent or more of their trip average 28.8 miles in 40 minutes (43.2 mph); in the same time non-users average only 14.7 miles (22.0 mph).

Before working on Route 128, employees used automobile transportation (56 percent), public transit (31 percent), combination of automobile and transit (4 percent) and walked (9 percent). After working on Route 128 they used automobiles and car pools (98 percent) and public transit (2 percent). A negligible number walked. The shift from public transit and walking to automobiles was greater for old employees than new ones.

Of all N. E. I. C. employees, 12 percent have moved since starting to work on Route 128. Of these 19 percent are old employees and 81 percent new employees; 75 percent are Route 128 users and 25 percent are non-users.

Of the old employees who moved, 40 percent moved closer to work, 44 percent moved farther away and 16 percent made no change in distance to work.

Of the Route 128 users who moved, 55 percent moved closer to Route 128, 34 percent moved farther away and 11 percent made no change in distance.

The major advantage given by workers for use of Route 128 was savings in time. Principal objections raised were strain and discomfort of driving in heavy, fast moving traffic and frequency of accidents, even though the accident rate is low based upon fatalities (2.0) or accidents (121) per 100,000,000 vehicle-miles (year of 1955).

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Appendix A

MANAGEMENT QUESTIONNAIRE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge 39, Massachusetts

ECONOMIC STUDY OF THE INFLUENCE OF ROUTE 128
sponsored by
Massachusetts Department of Public Works
and
U.S. Bureau of Public Roads

PLANT

1. Is this plant a
 new branch plant? relocated plant?
 relocated branch plant?
 new industry without a previous plant?
2. What was the disposition of your previous plant? _____

3. What was the address of your previous plant? _____

4. What was the number of employees at your previous plant?
5. What is the company's approximate investment in
land? (_____ sq. ft. x _____ cost/sq.ft. = _____ total cost)
buildings? _____
equipment? _____
sq. ft. of buildings _____

PRODUCTS

1. What products does this company produce and/or distribute? _____

2. Where is the market located for your products?

_____ %	_____ %	_____ %	_____ %
Metropolitan Boston	Other Parts of Mass.	Other parts of New England	Other parts of the United States

QUALITATIVE FACTORS

1. Were there other feasible sites considered for your plant location?

YES

NO

a. If yes, were one or more of these sites located in

downtown Boston?

suburban Boston?

elsewhere on Route 128?

other cities in Massachusetts?

outside Massachusetts?

2. What would you consider to be the major factors in your decision to move to Route 128? _____

3. At the time you decided to locate at this site, what were the benefits that the company hoped to derive because of its proximity to Route 128? (or disadvantages?) _____

a. If not explained above, ask "What did you consider the effects would be from locating on Route 128 on employee procurement in so far as (1) Commuting problems of employees? _____

(2) The change in the potential labor market with respect to quantity and quality"? _____

(3) Better employee facilities available"? _____

4. Do you believe that your company is receiving the above benefits from being located on Route 128 and are there other benefits that you are now receiving that were not anticipated? (or disadvantages?) _____

5. How many truck loads of material do you estimate are arriving and departing from this plant each day? _____

a. What would you estimate as the average number of miles per truck that these trucks utilize Route 128 each day? _____

b. Are there any hours in which this trucking is concentrated? _____

Appendix B

EMPLOYEE QUESTIONNAIRE—PILOT STUDY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Cambridge 39, Massachusetts

ECONOMIC STUDY OF THE INFLUENCE OF ROUTE 128

sponsored by

Massachusetts Department of Public Works

and

U.S. Bureau of Public Roads

A STUDY IS BEING MADE IN ORDER TO BETTER UNDERSTAND THE EXTENT TO WHICH ROUTE 128 HAS BEEN RESPONSIBLE FOR THE INDUSTRIAL AND RESIDENTIAL DEVELOPMENT IN THIS AREA. THE INFORMATION REQUESTED IN THE FOLLOWING QUESTIONS IS A VITAL PART OF THIS STUDY. YOUR ASSISTANCE IN SUPPLYING THIS INFORMATION WILL BE APPRECIATED.

1. Your present home _____
postal address is? _____

2. Did you work for this company prior to
the company's location on Route 128? YES NO

3. Have you moved since starting to work
for a company on Route 128? YES NO
If yes, what was your previous
home postal address? _____

4. What method of transportation did
you use prior to working for a
company on Route 128? Walk Car Public
Transportation

5. When traveling to work, how far
do you drive on Route 128? _____ miles

6. How many minutes does it take you
to drive from home to work? _____ minutes

7. Do you belong to a car pool? YES NO
 - a. If yes, how many share this
pool with you? _____ persons
 - b. If you do not use your car pool
every day, how many days per
month do you drive alone? _____ days per month

Appendix C

REVISED EMPLOYEE QUESTIONNAIRE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge 39, Massachusetts

RESEARCH STUDY
Sponsored by

Massachusetts Department of Public Works and
U.S. Bureau of Public Roads

TO AID IN THE DESIGN OF THE 41,000 MILE FEDERAL HIGHWAY PROGRAM, M.I.T. IS MAKING A STUDY OF THE TRAVEL HABITS OF PERSONS EMPLOYED IN INDUSTRIES LOCATED ON ROUTE 128. THIS INFORMATION WILL BE USED TO BETTER DESIGN THE HIGHWAYS TO ACCOMMODATE THE ADDITIONAL TRAFFIC RESULTING FROM EMPLOYEES COMMUTING TO WORK. THE INFORMATION FURNISHED BY YOU WILL BE HELD CONFIDENTIAL.

1. Where do you live?

Street

City or town Zone State

2. Did you work for this company prior to the company's location on Route 128? YES NO

3. Have you moved since starting to work for this or another company located on Rte. 128? YES NO

a. If yes, where did you live?

Street

City or town Zone State

4. What method of transportation did you use prior to working for a company on Rte. 128? Walk Car Public Transportation

5. What method of transportation do you now use to travel to work? Walk Car Public Transportation

6. How far do you travel from home to work? _____ miles

7. In traveling from home to work, how far do you drive on Route 128? _____ miles

a. What entrance to Route 128 do you use?

(Entrance number, street, or highway route number)

8. How many minutes does it take you to drive from home to work? _____ minutes

9. Do you belong to a car pool? YES NO

a. If yes, how many share this car pool with you? _____ persons

b. If you belong to a car pool, but do not use your car pool every day, what is the average number of days per month that you

1. drive alone? _____ days per month

2. walk? _____ days per month

3. use public transportation _____ days per month