1956

# The effect of plant location on manufacturing costs in the electronics industry

BOSTON UNIVERSITY

College of Business Administration

THESIS

# The Effect of Plant Location on Manufacturing Costs in the Electronics Industry

by

John F. Morten
(B.S. Management Engineering - Carnegie Tech, 1937)

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

1956

5-4-56
48278



TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF CHARTS

# INTRODUCTION

The constant evolution of our American industrial economy has been characterized by a nagging side-effect: manufacturers, for the most part, have had to remain competitive.

That this is good and desirable is not the subject of this thesis. All of us have witnessed the many benefits which a competitive economy has brought about. A higher standard of living, shorter work-weeks, more pleasurable leisure pursuits, greater conveniences in everything we do, and, lower and lower costs for the purchases we make.

These are the things which are natural results when two or more manufacturers compete with each other — or with manufacturers of other commodities vying for the same consumer dollars.

Large sums of money are spent on research and development to invent, improve, and push forward the frontiers of science and engineering. Still more funds are spent in the day-to-day engineering and design of products to make them better, cheaper, more durable, more serviceable and more desirable to the customer.

But once the product is released to production, the scramble to produce it at lower costs really takes over. It is here that the manufacturer must use all his ingenuity and hard-headed common sense to get the maximum production for the least cost.

## SCOPE OF THE STUDY

### I. Costs

This thesis deals with manufacturing costs in the electronics industry. More accurately, it deals with all costs -- including engineering, purchasing and distribution, as well as the costs of labor, material and occupancy charges. They are all interrelated. It is impossible to properly consider costs without looking at the total picture.

Further, since it examines costs in the electronics industry, the weight of importance of our set of cost factors is considerably different from those applying to another industry.

For example, the electronics industry is essentially a light manufacturing and light assembly industry. Most commercial electronics products of the type discussed here are characterized by a high labor content, a high value-to-weight ratio and a high degree of engineering and production skill.

This points up several things immediately. For one, a large labor supply of skilled or easily-trained workers are needed. And they are needed at as low a wage-rate structure as possible.

For another, nearness to markets is not as impelling a factor as is true of industries which have a large weight or bulk consideration.

Or that have a perishability factor. The food and beverage industries are typical of the group which have more of a geographical problem in locating their plants than does the electronics industry.

## II. Stage of the Art

The "stage of the art" is a vital consideration for the type of products we are examining. The electronics industry is one of America's most dynamic and rapidly growing industries. Its growth is two-fold.

First the greater and greater acceptance by the customer of things electronic. More and more units of electrical and electronic devices are being used by the consumer, the industrial plant, the communications field, professional people, institutions of all types, and virtually every industry.

But more important, new devices and radically improved devices are being developed constantly. Since they are new and at a relatively early "stage of the art", designs are fluid. Whole new concepts take over from established products and perform their same function in a new and totally different way. Usually they do it better, cheaper, faster or with greater reliability.

For example, witness the outstanding growth of the transistor. It is a very real threat to the vacuum tube. And yet the development of the vacuum tube has been characterized by a constant succession of improvements in design, versatility, reliability and additional functions.

How does the stage of the art affect the type of products we are considering here? In a very real way. Advancement of the art depends on a source of engineering talent and an atmosphere of scientific development.

## III. Importance of Suppliers

Not only from schools, colleges, and the research labs, from which flow the ideas and developments which lead to new design improvements, but also from the juxtaposition of electronics suppliers — that large group of small manufacturers who supply the components which are used in electronic equipments.*

This is a consideration which typifies the electronics industry. Earlier we said that the electronics industry was essentially a light manufacturing and assembly industry. Let's examine this.

The circuitry which makes up an electronic device calls for the interconnection of a number of standard components, each of which perform a specific function. Of course there are many other non-standard electronic components and elements.

* 31, p. 46

But the electronic part of the end-product usually contains a very high percentage of bits and pieces which can be selected as catalog items from a suppliers literature — or it can be readily made up as a print-item by a supplier who specializes in this type of custom work.

Firms of this type tend to cluster. There are certain geographical areas in the United States in which they are readily located. For example, New England; the New York City - upper New Jersey area; Chicagoland, parts of Texas and the area around Los Angeles.

To be sure electronics companies have moved into other areas. For example, North Carolina, some of the southern states, and others* But there have usually been specific projects which have attracted them to such areas or the lure of low cost labor for repetitive, production-line type of manufacturing has dictated such locational choices. By and large, the bulk of electronic "feeder-firms" have been concentrated in the well-defined areas mentioned above.

This has been a strong influence in the location of electronic equipment manufacturing plants. First the need for engineering, design and development talent; secondly the need to communicate, to consult and to confer with "feeder-firm" suppliers.

* 25, p. 2

## IV. Physical Resources

Other factors come into play too. The electronics industry, being a light industry, does not require certain physical resources essential to other industries. For example, cheap and abundant electrical power is not a critical need as it is in the aluminum reduction industry.

Large quantities of water for cooling, cleaning or process work is not required. Large amounts of ore, steel, iron, coal, gas, mica or other primary raw materials are of no consideration in the electronics industry.

## V. Inertial Effect

Still another important factor is the effect of tradition, inertia, resistance to change — or call it what you will. The electronics industry is affected by the same factors that have caused many another industry to remain in the same general area or areas in which it received its start.

Although many of the factors which caused some new industries to found in certain places have long since disappeared or have become non-important, large segments of those industries have continued to stay in the same confined areas.

For example, furniture manufacture in Grand Rapids, Michigan; automotive tire manufacture in Akron, Ohio; the automobile industry in

Detroit, and many others. This same inertial effect is at work to a degree in the electronics industry.

## VI. Definition of the Industry

Perhaps this is the time to define a little more accurately what is included in the electronics industry and which parts of it are being considered in this study. Typically, the industry is divided into four major segments. They include Government, Entertainment, Components and Commercial.*

### A. Government Electronics

Government electronics is that part which deals with the research, development and manufacture of electronic equipment which is used primarily in the defense effort. Typical examples of this are the guided missiles, radar search and warning, electronic equipment for aircraft, communications equipment and scores of other applications of electronics for military and defense purposes. Not excluded are the peacetime applications of electronic developments for government uses. An example is the electronic computer for large-scale data processing.

### B. Entertainment Electronics

Entertainment electronics includes that burgeoning new industry — Television. It also includes, radio, tape-recorders, record players,

* 25, p. 2

hi-fi, sound systems for theatres and a host of others. Generally included in this part of the electronics industry is not only the manufacture and distribution of the equipment (TV and radio receivers, transmitting equipment, etc.) but the programming, artists, technicians and others concerned with TV and Radio broadcasting.

C. Electronic Components

Electronic components covers that group of manufacturers referred to earlier as "feeder-firms". They are the people who make both catalog and custom items used by other electronic manufacturers and for the repair and replacement trade. They are generally specialists, making a line of coils, capacitors, tubes, transformers, knobs, dials, meters and a vast array of similar products.

D. Commercial Electronic Equipment

The fourth category is Commercial Electronic Equipment. This group covers a wide and diverse list of products used in virtually every industry in our economy. It includes products for communication, for industrial processes, for the medical profession, for office mechanization, for aircraft and marine navigation and control, for nuclear power. In fact the list of new applications is constantly growing and undergoing improvements. It is typical of the present stage of the art.

## VII. Area of Concentration

This report will bear most on the latter two segments of the electronics industry — commercial equipment and components. At present these two constitute about twenty-five percent of the industry. However, during the next decade they are expected to grow from a present annual rate of one-and-a-quarter billion dollars to four billion dollars. This is a rate of growth far in excess of the expected rate of growth of the Entertainment and Government segments of the electronics industry. See Chart I.

There are other reasons for excluding these two segments of the industry from this study. Entertainment electronics is a special case. Two or three important factors which are not so critical in the balance of this industry come into strong play here. Because of them we find that the manufacture of TV and radio receivers is most frequently found in the mid-west — importantly in and around Chicago.*

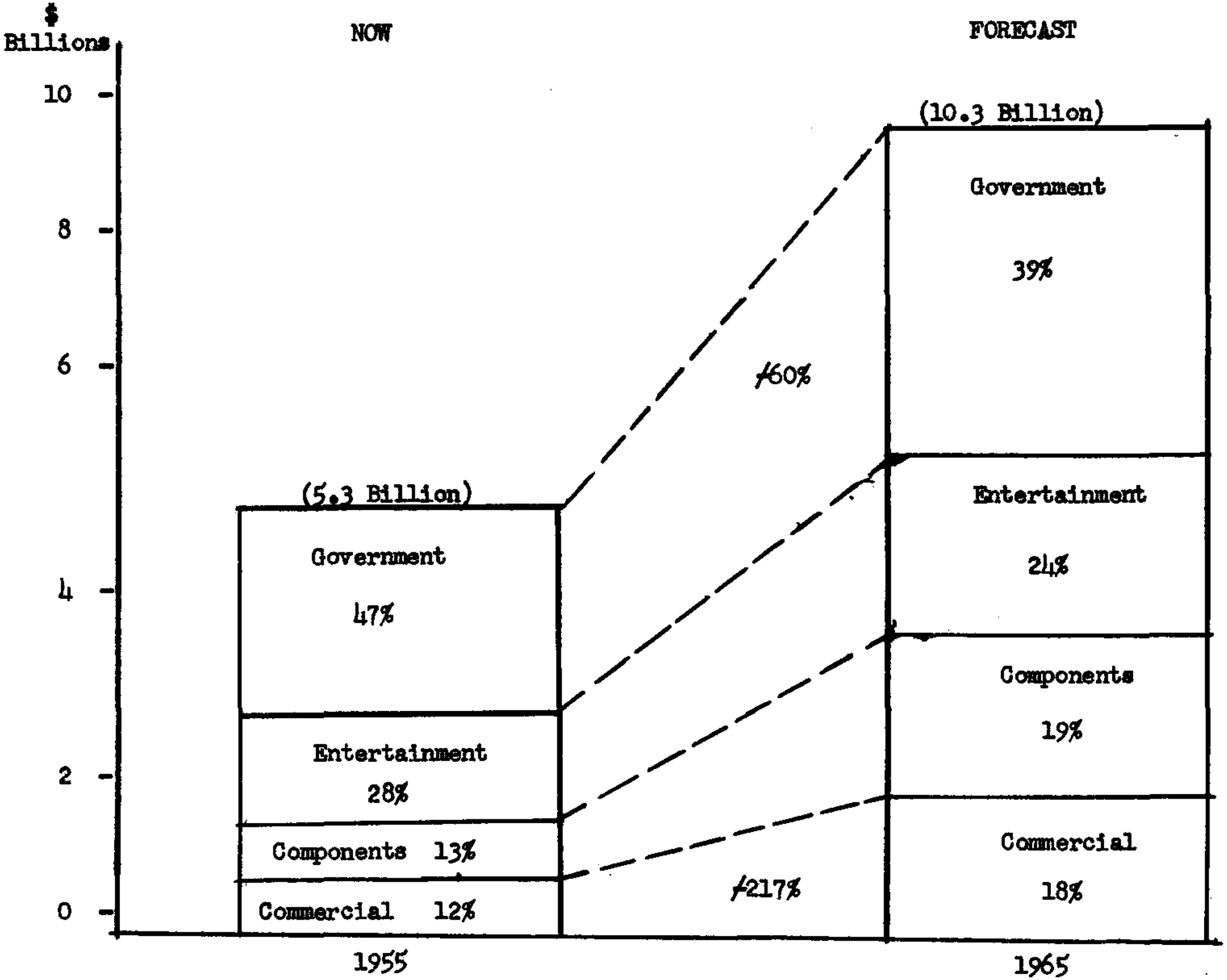
### A. Nearness to Markets

One of the reasons is the nearness-to-market factor. Since receivers are distributed and sold throughout the nation, it makes sense that they should be manufactured somewhere near the central part of our country rather than on one of the coastal areas or in the northeast corner which is usually considered to be the birthplace of electronics.

*22, p. 39

CHART I

ELECTRONICS MARKETS*




*Don G. Mitchell President of Sylvania Electric Corp. as reported in TV DIGEST, Dec., 1955

Transportation costs and the somewhat lower value-to-weight ratio also plays an important role. In addition, some effect is due to the mid-west location of the furniture industry from which the radio and TV receivers obtain their bulky cabinets.

### B. Effect of Costs

Government electronics is also a special case insofar as this study is concerned. This thesis is primarily concerned with the effect of plant location on manufacturing costs. Electronic gear produced for military and defense purposes general place other considerations ahead of cost. Some of these are research and development, engineering design, reliability, ruggedness, satisfactory service under extremes of environmental conditions, to mention a few.

It is highly important that plant location for development and production of government electronic equipment be such that these factors can be best assured -- even though cost of manufacture might be higher than elsewhere. And it does not make sense to too widely separate the research and design function and the production function in government electronics. Again, because of the extreme advanced stage of the art, it is essential that close liaison exist between drafting table, test bench, and production floor.

However, in the other segments of the electronics industry the cost factor is highly important. The radio and TV receiver portion is the most sensitive. These products are in a very competitive market. All the tools of merchandising, advertising and selling come into full play. And a price just a little below a competitor's price for comparable quality is one of prime keys to success in this field.

Following closely behind this segment is the components segment of the industry in the need for low cost manufacturing and distribution. An important part of the reasons is that a major portion of the output of the components segment goes into radio and TV equipment. Therefore the same requirements for lower costs applies here. So much so that it is common to find hundreds and thousands of small firms operating out of lofts, old buildings and other low cost space to produce components cheaply.

Finally there is the commercial electronic segment which also has a very real need for low cost production and distribution. Our competitive economy is perhaps the most impelling factor to emphasize cost reduction requirements.

This part of the industry is emerging from a phase in which it was new, consumer acceptance was low, and its products, by and large, were untried and unproven. But it's a part of the industry which is growing rapidly.

With rapid growth and expanding consumer acceptance comes competition. And with competition comes need for lower and lower costs.

It is on these premises that this report is based.

## MAJOR FACTORS TO BE CONSIDERED

Before examining in detail how plant location can effect costs in a manufacturing and distributing activity, let's look at the various elements of cost and determine which are important in this consideration. Let's look first at Marketing Costs.

### I. Marketing Costs

Marketing is generally considered to be all the functions entailed in getting the right product in the right place at the right time and at the right price. Distribution, a term sometimes used synonymously with marketing, is considered to be the various functions concerned with moving a product from the shipping platform of the factory, through all the steps of selling, wholesaling, warehousing, retailing and delivering until it finally is in the customer's hands.

Marketing goes beyond distribution. Marketing first starts in the area of consumer research. Through marketing research, a marketing organization can do much to find out what is the right product, what is the right place, what is the right time, and what is the right price.

This has importance as we will see later in considering plant location. Importance because the cost and effectiveness of getting answers to these vital questions is directly related to the ease with which home office people such as marketing and engineering personnel can be placed in touch with the market.

Marketing performs other functions beyond the scope of things generally included in the term distribution. It has the responsibility for forecasting. Based on the considered judgement of marketing personnel, backed up by marketing research analyses of market potential and distribution studies, marketing determines optimum quantities and time schedules for production runs. Along with this goes accurate inventory control to maximize sales potential and minimize the tying up of the company's working capital.

## II. Labor Costs

As indicated earlier, the type of products with which we are concerned here, have a high value of labor content as contrasted with value of material content, overhead and other costs of doing business.

Of necessity, this is a generalization. It is perfectly easy to choose a group of products manufactured in the electronics industry in which components, pre-fabricated elsewhere, were assembled by a simple process, and marketed as a single package. In this case, the company's material content cost would be higher than its labor content cost.

However, this is the exception rather than the rule. In the first place, the components themselves have a high degree of labor content in them and if they are purchased at a satisfactory price, it is possible that they were made in a low-cost labor area.

But more important, if most of the components are being purchased on the outside and the plant is merely assembling them into a saleable package, chances are they are not realizing the profit they could obtain with a lower selling price. Generally, they would do well to examine their ability to produce more of their product within their own factory. In this way they could make greater use of their own overhead and cut out the profit being paid to the outside supplier.

## III. Taxes

Taxes, like labor and material, is an unavoidable expense of doing business. Percentage-wise it is considerably smaller than either of these first two major elements of costs.

But tax laws vary considerably from state to state and from community to community. Therefore if there is an equal choice in selecting one area over another for plant location, and the tax situation is quite different as it frequently is between adjacent states, this can be an important controllable element of expense.

### A. Federal, State and Local Taxes

Usually there is little or no difference between one plant location and another insofar as federal taxes are concerned. But differences in how one state or municipality raises its revenue can make a big difference. For example, one state may tax utilities, banks and service industries heavily; may obtain considerable revenue from race tracks, highway and gasoline use from visiting vacationists; and go fairly light on industry within its state. A manufacturer considering plant location would do well to look into such a situation.

Of course there's no assurance such a favorable situation would always remain. But tax laws currently in effect, and past tax history is an excellent guide to the political climate of the state and is representative of what treatment can be expected in the future.

B. Assessment Ratios

Along with tax rates it is essential for the manufacturer to examine assessment ratios and their historical record. Tax rates alone can be extremely misleading. And they generally are when one state or locality advertises low rates but fails to say that the assessment ratio is 100%, or close to it: A true comparison involves the two elements multiplied together.

The matter of tax comparisons causes some difficulty in the overall plant location study from a timing view point. Most firms approach such a study by examining broad areas first — and those may be many states apart. What appears to be a favorable tax picture so far as state taxes are concerned may be completely nullified or even reversed by the local tax situation. And yet the local tax picture can't be obtained until after the broader studies of labor, material availability, state taxes and other cost elements have been made and a general area determined.

### C. Personal Taxes

Personal taxes, apart from those which the company will have to pay, are of importance too. They can play a strong role in attracting and holding personnel — particularly administrative, marketing and professional personnel.

## IV. Raw Materials and Vendor's Items

As has been pointed out previously, the electronics industry is characterized by a combination of light manufacturing and assembly of components purchased from "feeder-firms".

### A. Catalog Items

The raw materials used in electronic manufacture are generally staple items, readily obtainable through standard channels of distribution. Sheet steel, fabricated or extruded metal shapes, wire, and other metal parts are widely used. Electrical and electronic parts such as tubes, coils, capacitors, resistors, transformers, stabilizers, knobs and a variety of other components are the sort of material which is generally found in practically every electronic equipment.

The above items are called catalog items. That is, they are usually available as standard supplies from firms who specialize in their manufacture. Such supplies are usually shelf items, immediately available.

B. Print Items

Another type of vendor supplies is the print-item supplies. These are non-standard, non-stock parts or components which are of a type which are not easily manufactured by the company but are available through firms who have the design know-how, the mechanical facilities or operational experience in the production of such special parts.

Usually the quantities needed of such items are relatively small. The supplier works from prints supplied by the purchaser and thus the term print-item. Examples of such items are gears, casings, linkages, forgings, castings and a wide variety of supplies.

Generally speaking catalog items are purchased from suppliers scattered over a broad geographical area. Because of the simplicity of dealing with them on standard items, the first considerations are frequently price and delivery, providing the component has the necessary performance characteristics, reliability and quality.

Print items, on the other hand, are most frequently purchased from suppliers who are located within a smaller circle. The reason is obvious. The nature of print-items usually calls for closer coordination between the vendor and the purchaser.

Frequently the purchaser visits the supplier's place of business (or vice versa) for the purpose of discussing the requirements of the purchase, checking the vendor's facilities, or for a variety of reasons. This suggests an area in which such vendors can be easily located and contacted.

## V. Transportation Costs

This is a natural follow-up to a discussion of raw materials. Cost of getting materials into a manufacturing plant is an important element of cost. Even more important, however, are two other types of transportation -- shipping of finished equipment and transportation of personnel.

Outbound transportation is more expensive because the class of merchandise that it represents is charged considerably more by the carriers than merchandise such as steel sheets, small parts, etc. It is also bulkier, and more likely to be fragile. It is also likely to be going longer distances than inbound shipments.

Travel of personnel is likewise expensive in the electronics industry. There are a number of requirements for home office personnel to travel in the electronics industry which tends to increase this expense over such travel for other industries. For one, the stage of the art demands that sales and engineering people keep in close contact with customers during the initial design and development of products to meet needs of customers.

Secondly, more application engineering is frequently needed to help solve customer's problems in the use of existing products of the company. Along with this is trouble-shooting after a product has been sold and installed. Still another need for travel is the frequent modification of products to new uses to help meet customers' new requirements.

And finally, a high degree of training of field salesmen, representatives, and customers calls for frequent travel of home office people.

## VI. Costs of Hiring and Training Personnel

A final element of expenses to be considered is the cost of hiring and training. This can be a sizeable factor. It should be broken down into several categories: factory workers; clerical and stenographic help; engineering personnel; and marketing, administrative and other supervisory people.

Availability and prior training of personnel from a given area will greatly influence these costs — particularly among the factory workers and office personnel. Engineering personnel are currently hard to find and expensive to attract. Recent periodicals have made quite a play on the high starting salaries which engineering college graduates are demanding and getting.

Marketing, administrative and other supervisory people are likewise receiving higher salaries as a result of the booming economy we have enjoyed for a number of years. The electronics industry is becoming more and more competitive and this is bringing about an increased demand for experienced and better qualified supervisory and management personnel. The cost of training and developing such people is taking an increasing share of operating expenses.

## A STUDY DEALING WITH SPECIFICS

The above discussions of the major cost factors to be considered are more or less generalized as to areas for plant location. They are provided so as to give a background to a more detailed and specific examination of such cost factors in a given area.

Proper presentation of a study of this nature requires the dealing in specifics. This means, in this case, the study of cost factors involved in locating a plant in a specific area — or the comparison of two areas to bring out the various considerations of controlling costs through plant location.

It presupposes several things. First that a plant is about to be located and that there are no limiting factors which would preclude a given area. For example, that there are no requirements such as being located near a single major market or group of key customers. Or that company policy, preferences of executives, number of present personnel which might be relocated, dependence on existing company plants, or other factors which would tend to limit the choice in selecting a new location.

### I. Pinpointing the Study

For the purpose of pinpointing this study and bringing out specific factors to consider in plant location, a comparison between two areas — Greater Boston and Southern New Hampshire — is being made.

The comparison could just as well have been between any other two parts of the country. And there are quite a few in which the electronics industry is already well intrenched. Or, the comparison might just as well have been made between Greater Boston and Maine or Vermont to the north; or Rhode Island or Connecticut to the south.

The purposes of this study however, are adequately served by comparing Greater Boston with only one other area. Southern New Hampshire — nearest in miles to Boston — has been chosen for this comparison.

## II. Dramatic Comparison

These two areas are nearby and first-hand data is readily obtained. Also they are not too far apart (a 50 mile circle contains them both) and they thus offer a more dramatic comparison — particularly where wide differences exist. And lastly, wide differences do exist. Differences in most of the cost elements discussed above will be well illustrated by a study of these two areas.

For these reasons this comparison is being made.

## DETAILED COST ANALYSIS — GREATER BOSTON VS SOUTHERN NEW HAMPSHIRE

The greater Boston area includes a semicircle around this port city which encompasses a number of contiguous communities with a total population of 801,444* (1950 census). The entire area is densely built-up and supports a well diversified industrial and commercial economy. It is one of the oldest centers of industrial activity in America.

Southern New Hampshire on the other hand is sparsely populated. In fact, the population of the entire state is less (533,242* in 1950 census) than that of Greater Boston. Southern New Hampshire economy is divided between forest and fishery products, agricultural products, mineral products and such industries as textiles, leather, lumber, machinery, electrical and electronic products.

* 7, p. 228, 238-239

## MARKETING COSTS

In choosing marketing costs as the first area to consider in analyzing the effect of plant location on costs we are assuming several things. First we are assuming that the products of the theoretical company which is about to choose a location are sold and distributed to a national market.

If the situation were otherwise, as pointed out above, the logical location would be somewhere which had the most convenient access to its confined market or major customers — other factors being relatively equal.

Serving a national market, it appears immediately that neither Greater Boston or Southern New Hampshire are suitable from a marketing viewpoint. It also appears quite readily that the Boston area is more desirable than a New Hampshire area considering only the aspects of marketing expenses. These will be detailed below.

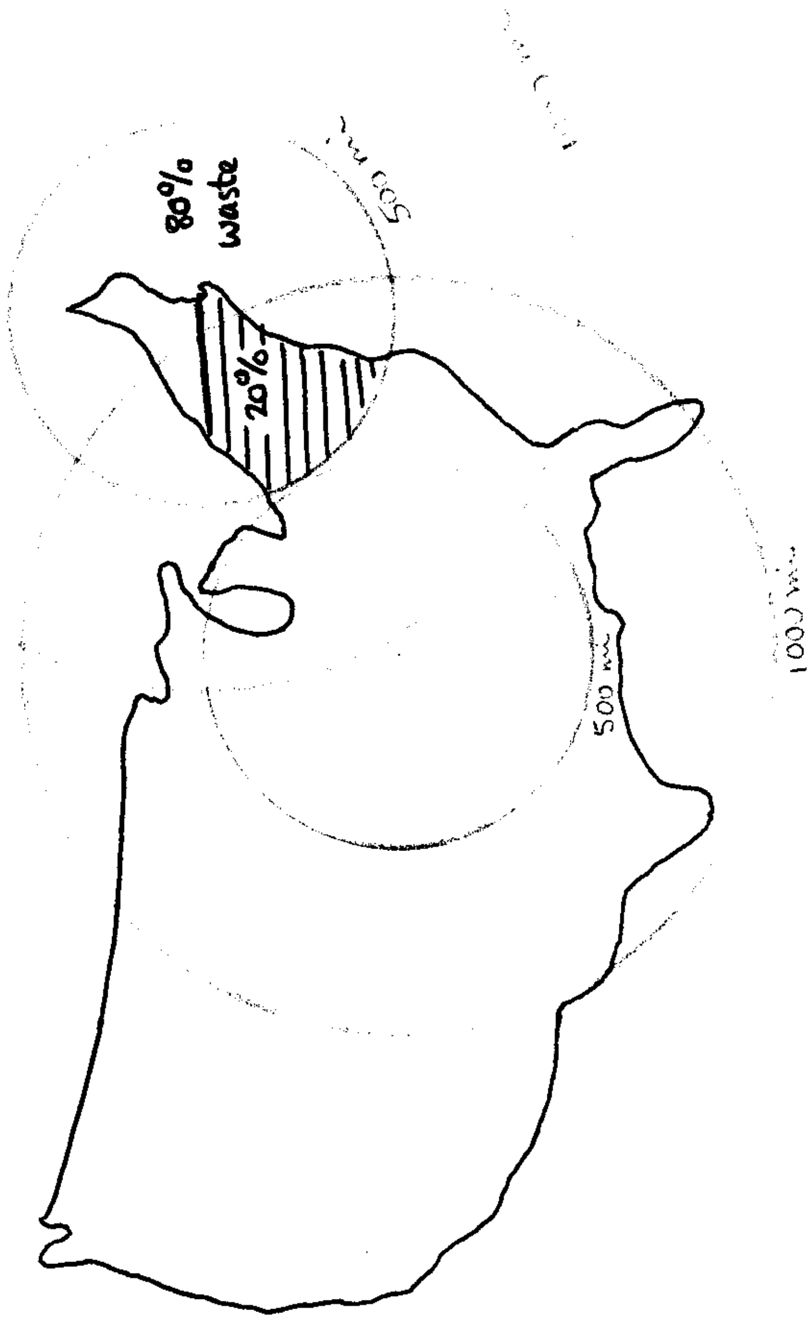
Chart No. II illustrates the marketing problem posed by a plant location any where in thé "northeast" pocket of our country.

### I. The Travel Circle is Limited

For a company selling to national markets, the customers served and the field sales and service organization which must be supported reach across the entire country. Ability to maintain adequate contact with

CHART II

MARKETING PROBLEM - NEW ENGLAND FIRM SELLING
TO NATIONAL MARKETS



them from the home office is severely hampered by a location in New England.

This is graphically shown in Chart No. II. Note that the useful area of a 500 or 1000 mile travel circle lies in a sector which represents only 20% of the total. The other 80% lies in Canada and the Atlantic Ocean.

If the plant location were selected at a point 1000 miles in a southwestern direction, the entire 500 mile circle and most of the 1000 mile circle would cover useful sales territory.

II. Market Center is to the West

There are a number of ways to determine the theoretical center of the market for an electronics company. Market potential studies made by companies interested in knowing where they can sell their products and in what quantities frequently show weighted trading centers for their products.

A recent series of studies of sales potentials covering the markets for a variety of six different types of electronic equipments has been analyzed to determine where the geographical center of all such markets would be located. The product mix is such that the consolidation of these studies should result in a fairly representative picture of the market center for the commercial electronics equipment (excluding radio, TV and government) industry as a whole.

Chart No. III illustrates the geographical market center of the varous electronics products which were analyzed. Note that it falls in Western Pennsylvania -- about 500 miles southwest of the two areas we are considering.

Since from a marketing viewpoint it is better to be located so as to reach all parts of the market with a minimum of expense, this points up graphically why New England is poorly suited as an area for plant location for a company marketing nationally.

III. Population Center

Another consideration which has to do with marketing is the westward and southward movement of U. S. population. Chart No. IV* illustrates the population trends since 1930 of the Southern and Western states compared with the Northern and Eastern states. Note that the latter began to level off after 1940 while the former continued their same rate of increase.

The fact that there is a parallel between U. S. population shifts and location of industrial plants is further borne out by an examination of Chart No. V. This chart, prepared by the National Industrial Conference Board*, compares the percentages of total plant construction by states for those plants built prior to 1940 and those built in the period 1940 to 1947.

* 38, p. 10

# CHART III

## GEOGRAPHICAL MARKET CENTER

## -

## REPRESENTATIVE COMMERCIAL ELECTRONIC PRODUCTS

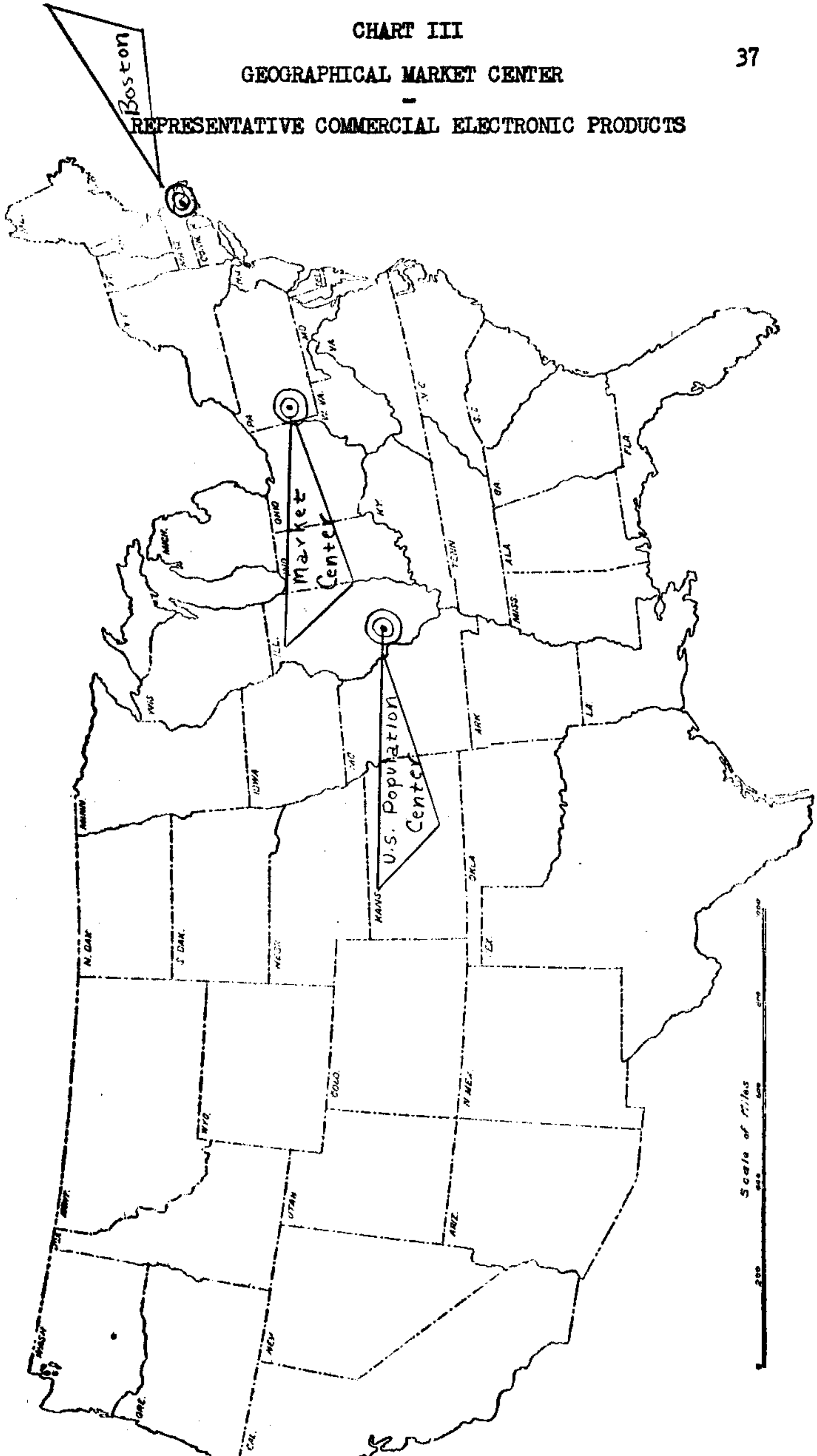
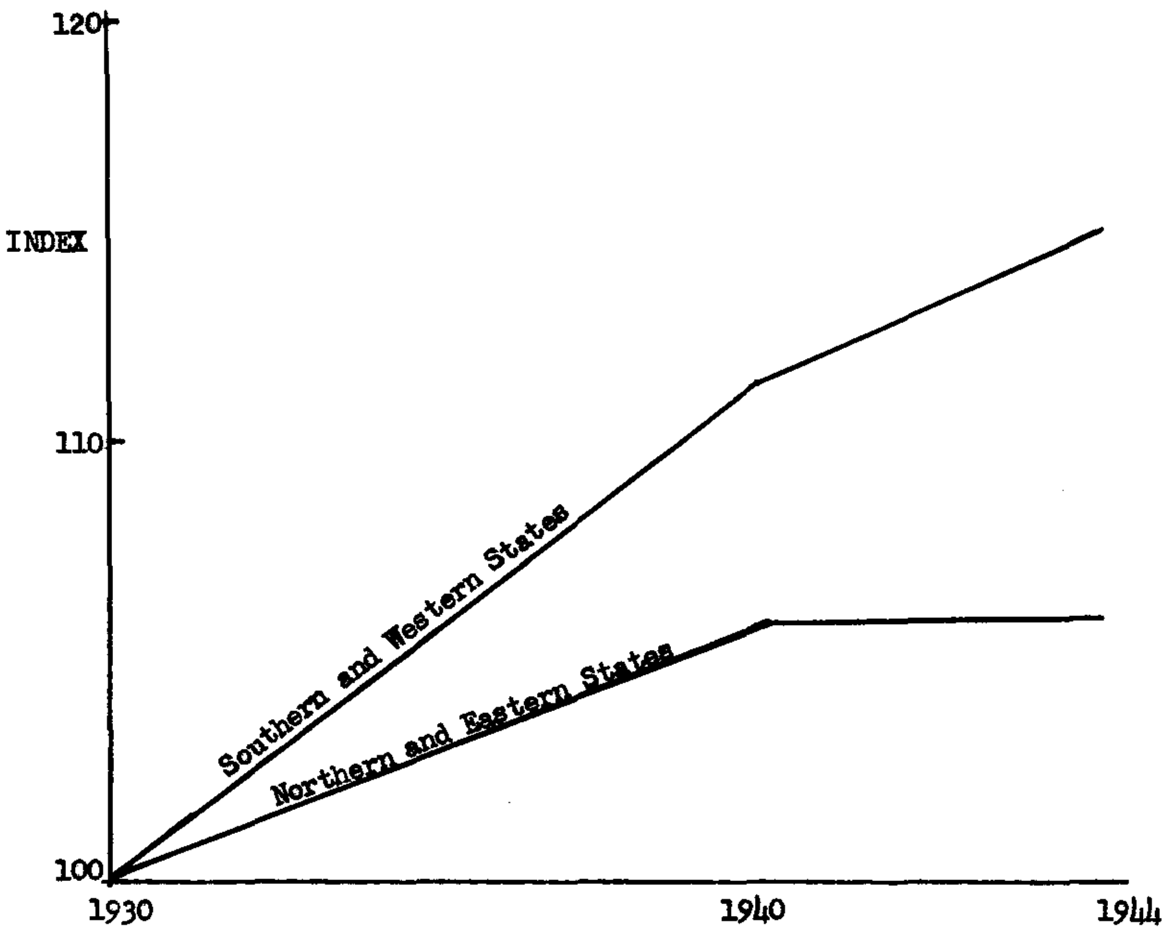


CHART IV

POPULATION TRENDS*

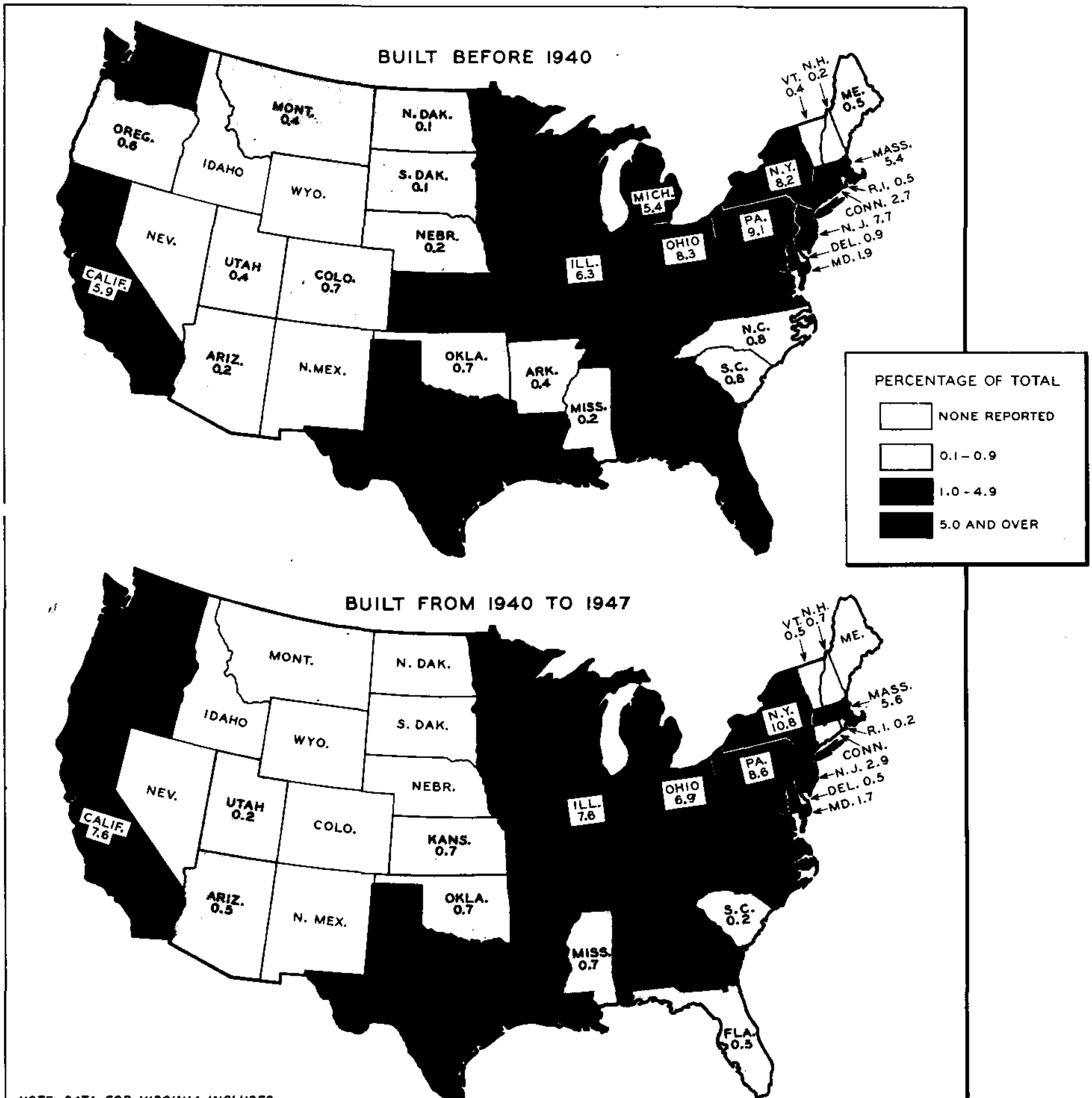
INDEX: 1930 - 100




* 13, p. 3

CHART V

# LOCATION OF INDUSTRIAL PLANTS
## UNITED STATES




*NOTE: DATA FOR VIRGINIA INCLUDES THE DISTRICT OF COLUMBIA*

The south and the Pacific coast received a greater share of the new industrial plants in the 1940-1947 period than in the years prior to 1940. The north central states held their own, while the northeastern states experienced a decline.

Individual plants, as shown on the chart, are not weighted to reflect differences in size as measured by employment or cost of construction. There may be some duplication of plants which have changed hands; for example, a plant acquired by one company in the 1940-1947 period may have been built and reported by another company in the period before 1940.

Data used in the chart were drawn from a survey made by The Conference Board in connection with its report on "Decentralization of Industry," to be mailed to Associates shortly. Returns were received from 148 manufacturing companies with 1,256 plants and 1,309,671 employees.

SOURCE: The Conference Board

Note that the shift has been toward the south and west here too. This is summarized in Table I which groups the 48 states into four geographical areas with the following significant changes:

TABLE I

DISTRIBUTION OF INDUSTRIAL PLANTS*

| Geographical Area | Percent Before 1940 | Percent 1940 - 1947 | Percent Change |
|---|---|---|---|
| North East | 34.6 | 24.4 | 29.5 loss |
| North Central | 33.2 | 33.8 | 1.8 gain |
| South | 22.6 | 24.8 | 9.7 gain |
| West | 9.6 | 12.0 | 25.0 gain |

Note also, on Chart No. III the present (1950 census) location of the U. S. population center. Review of past census figures will show that the population center has had a steady and uninterrupted movement westward ever since the first national census was taken in 1790**

IV. Bulk of Business Comes From Nearby

Still another normal phenomenon typical of the commerical electronics industry — again excluding the radio, TV and government parts of electronics — is the fact that practically every company studied (a list of 201 electronics companies) does most of its business in the first 500 mile travel circle from its main plant.

* 36, p. 15
** 7, p. 238

This is natural. As described earlier, the marketing of electronics products is characterized by the need for close contact with the market and with the customer. To travel home office personnel great distances results in excessive costs which may not be justified.

The marketing pattern of a typical company in this group located in New England is shown in Chart No. VI. Note that nearly three-fourths of their total sales come from within the first 500 mile travel circle.

V. Location of Existing Plants

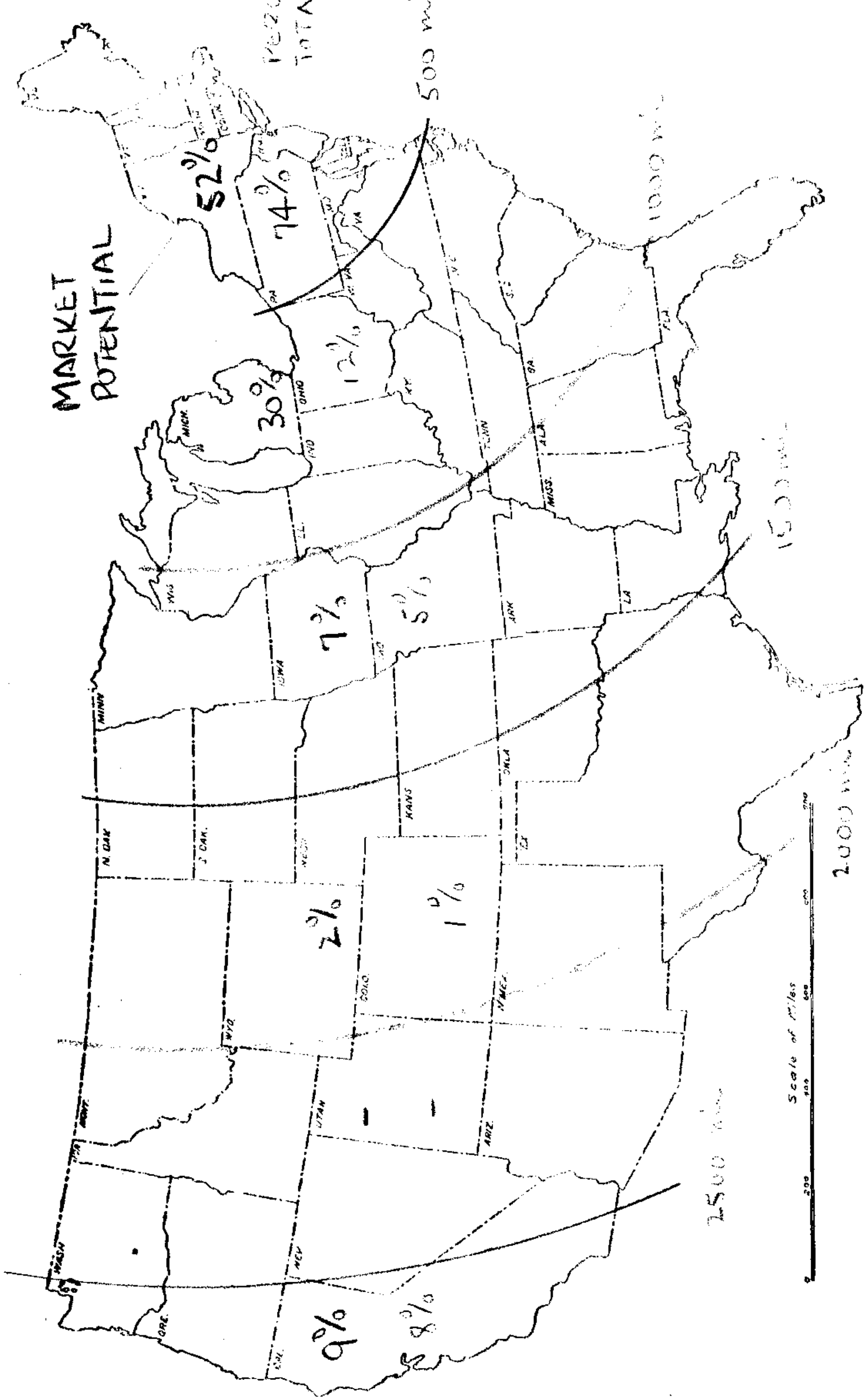
Still another close correlation can be noted by an examination of existing plant locations of the 201 electronics companies studied. See Chart No. VII.

Note that 157 of the 201 plants, or 78%, are situated in three of the nine U. S. Regions. Comparison of market potential studies for the commercial electronics industry shows that 80% of the market for these types of products is located in the same three regions.

In our comparison of Greater Boston with Southern New Hampshire as plant location possibilities, it will be readily seen from the foregoing that neither one is well-suited from a marketing viewpoint. This is on the premise that efficient marketing demands close and easy contact with the customer and the field sales organization.

CHART VI

MARKETING PATTERN
TYPICAL ELECTRONICS
COMPANY

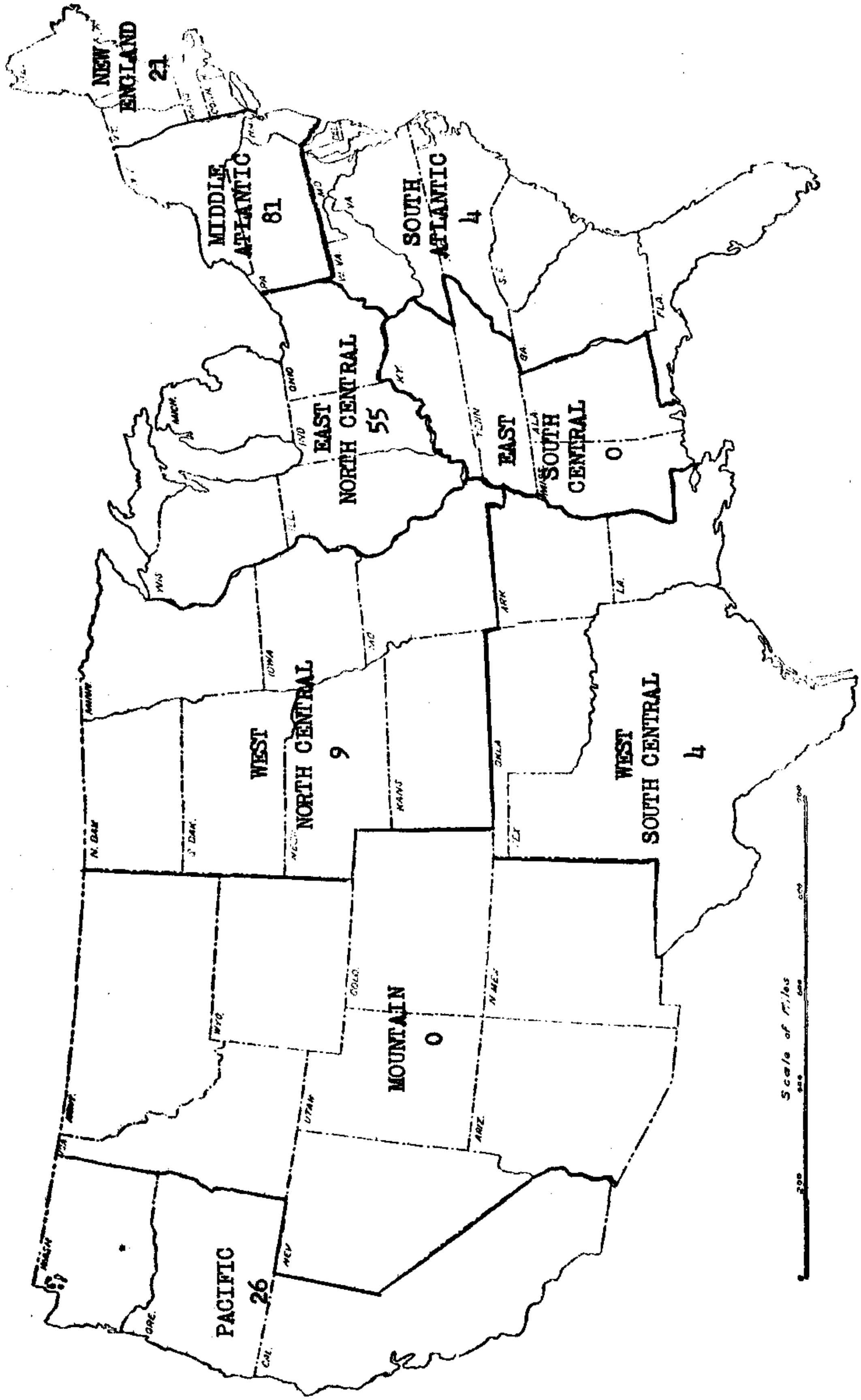


# CHART VII

## PLANT LOCATIONS

-

## 201 ELECTRONICS COMPANIES



Such contact as is made with national markets out of a plant in New England is a direct function of ease of travel. Boston has long been known as the "Hub" — a term relating to travel by land, sea and air. Boston therefore has definite advantages over Southern New Hampshire in this respect. These will be further explored under the section Transportation Costs.

# LABOR COSTS

As discussed earlier, the labor content cost of electronic products is generally high. Therefore this area of cost analysis is an important one.

The examination of labor costs has several facets which will be reviewed in detail as we compare the two areas under consideration. The first facet concerns availability of labor.

## I. Labor Availability

The question of whether factory and office workers will be available in the necessary quantities and with the necessary skills is of paramount importance in selecting an area for plant location.

### A. Semi-Skilled and Unskilled Labor

A high percentage of workers in the electronics industry are of the semi-skilled and unskilled categories. Many of these are women workers. The ratio frequently runs from 2, 3 or 4 women to 1 man. The higher the degree of complexity the lower the ratio; the more repetitive the type of work or the greater the need for manual dexterity, the higher the ratio.

Despite the above, the requirement for very highly skilled and trained technicians is a factor which must be balanced in. Many industries do not have a parallel to this situation. These highly skilled technicians are required for the delicate jobs and those requiring a high degree of ingenuity, inventiveness and resourcefulness.

### B. Skilled Labor

Let's examine our two locations in view of the above types of labor requirements. Skilled workers and technicians are far more readily available in the Greater Boston area than in New Hampshire.

There are many reasons for this. The Boston area being an industrial center of long-standing, skills of the type desired have been taught and learned for many generations. Boston has continued to remain as an industrialized community so the skills have advanced with the progression of industry and with manufacturers training programs.

There are numerous trade and technical schools in the Boston area. They have enjoyed a surge of activity since World War II — partly because learning a trade has taken on greater significance to men in the service — and because of the free schooling afforded to veterans through the G.I. Bill.

The above factors which encourage a high degree of technical training are considerably lessened in Southern New Hampshire. There isn't the same opportunity for men to acquire such training there. There are some technical schools there; for example, the New Hampshire Technical

Institute located in Manchester and Rochester which offers training in the various mechanical trades such as welding, metal fabrication, etc. and in addition offers a course in electronics.

## C. Labor Mobility

Despite the relative shortage of skilled labor in the particular skills required by electronics technicians, there is an important counter-factor to consider. Highly skilled technicians are extremely mobile compared to lesser skilled workers. Not only are they willing to travel from twenty to fifty miles each way to work when the occassion demands; they also frequently uproot themselves from their communities and relocate near a plant in which they can find the kind of work at the wages they want.

As for the unskilled and semi-skilled workers, the situation appears to favor New Hampshire. In the Boston area during this period of near full employment, practically every worker -- man or woman -- or potential worker can get a job if he wants one. As a result the wages demanded are higher and the quality of the worker is lower.

This situation is not the case in most parts of Southern New Hampshire. In the first place the level of employment is not so high in the Nashua and Manchester areas. There is more of a ready labor force available from which to draw.*

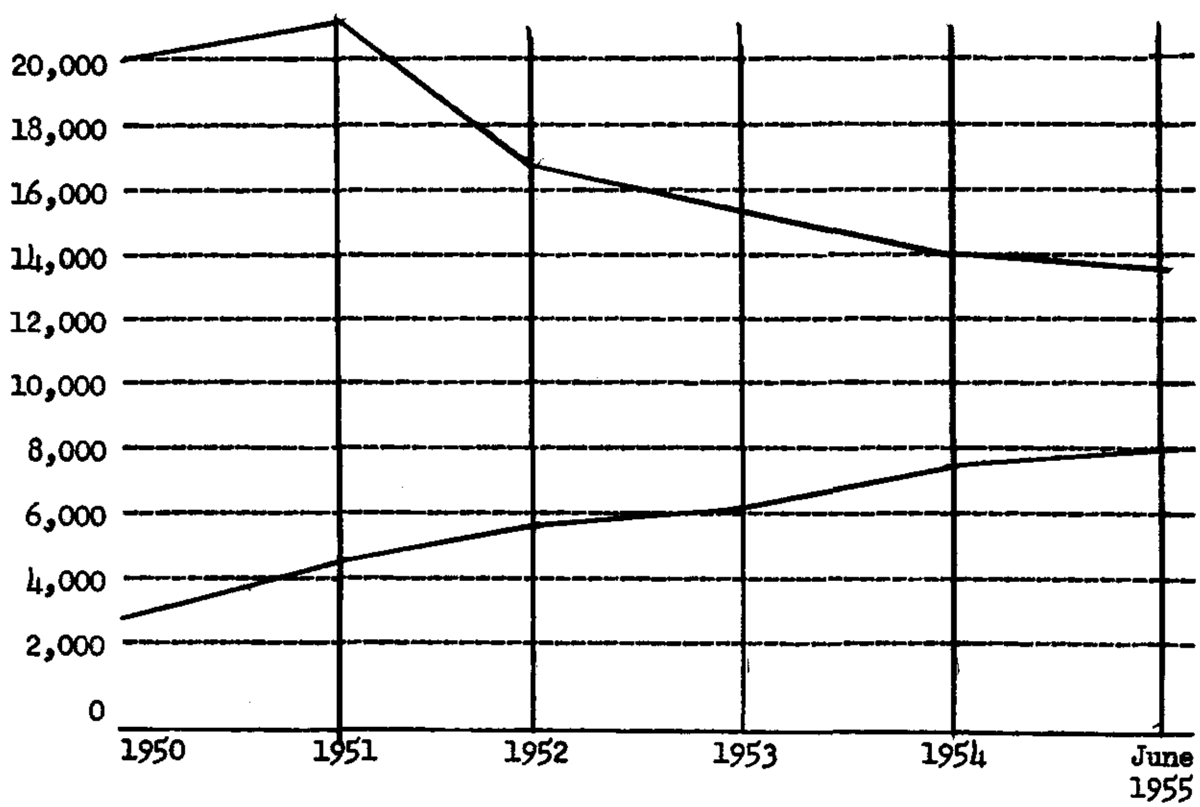
* 40, p. 16

## D. Women Workers

Equally important is the fact that there are many women in the homes of surrounding communities who are ready, able and willing to work — but do not have job opportunities. In addition, the textile industry which formerly employed many women has sharply declined* causing these workers who already have trained manual dexterity to revert to becoming housewives. To some extent employment has already shifted from textile products to electrical and electronic products. Chart VIII illustrates this graphically.

CHART NO. VIII

SHIFT OF EMPLOYMENT**




* 40, p. 18
** 40, p. 16

## II. Labor Productivity

Another important consideration is the effectiveness of the individual worker -- usually termed labor productivity.

Productivity and availability are generally closely related in any labor market. In an area where availability is low because of competition of other sources of employment, the productivity generally is lower. Where jobs are scarcer, worker output is generally higher.

This situation seems to apply in the comparison we are making between the Boston area and Southern New Hampshire. According to several personnel managers who have had labor employment experience in both areas, the New Hampshire workers were said to be considerably more productive.

There are other factors which affect productivity, to be sure. For example, the quality of supervision, the degree of training, the facilities available, the type of work, the working conditions, and many others. However, in comparing a given situation in two different localities these factors would normally wash out and the ethnic background of the local population would have considerable effect on their labor productivity.

## III. Labor Cost

Let's look now at one of the most important differences between the two areas insofar as manufacturing costs are concerned -- labor costs.

### A. Wage Rate Comparison by Industry

Considerable savings in labor costs appear to be possible for most industries generally -- and including electrical manufacturing*. Below (Table II) are the average hourly rates for all manufacturing and for electrical manufacturing in the Boston area as compared with two labor centers in New Hampshire.

TABLE II

AVERAGE HOURLY RATES -- 1955**

| Area | Average Hourly Rate All Manufacturing 1955 | Average Hourly Rate Electrical Manufacturing 1955 |
|---|---|---|
| Boston | 1.73 | 1.67 |
| Nashua | 1.46 | 1.39 |
| Manchester | 1.40 | 1.27 |

From the above table it is shown that for electrical manufacturing the Boston area is 20% higher than Nashua and 31% higher than Manchester in average hourly rates.

Since in electronics, the labor cost content is high, savings of this magnitude can be of extreme importance in selecting a plant location.

### B. Average Rates for Specific Skills

Let's look at specific skills to see how this variation in wage rate structure affects different categories of workers.

* 40, p. 20-21
** 40, p. 30

Table III lists the average rates paid in September, 1955 to office and hourly workers of the types generally used in electronics industries.

## C. Employment

Another consideration in evaluating a job area is the number of experienced civilian workers available and the number employed. Table IV, published from the 1950 United States Census, shows the percentage of available male and female workers who are employed.

Unemployment of normally able workers is also worth examining. Table V* shows the unemployment index for Boston and Manchester during September, 1955 and also the percentage of women workers.

* 40, p. 18

TABLE III

AVERAGE RATES BY JOBS - SEPTEMBER, 1955

| Job Title | Average Rate Boston September, 1955 | Average Rate Nashua September, 1955 | Percent Boston is Higher than Nashua |
|---|---|---|---|
| Hourly Workers | | | |
| Tool and Die Maker | $2.46 | $2.10 | 17 |
| Machinist | 2.14 | 1.70 | 26 |
| Electrician | 2.48 | 2.15 | 15 |
| Plumber | 2.28 | 2.13 | 7 |
| Carpenter | 2.14 | 2.13 | 1 |
| Engine Lathe SU & Opr. | 2.08 | 1.55 | 34 |
| Turret Lathe SU & Opr. | 2.08 | 1.55 | 34 |
| Milling Machine SU & Opr. | 2.08 | 1.55 | 34 |
| Janitor | 1.45 | 1.20 | 21 |
| Material Handler | 1.55 | 1.40 | 11 |
| Highly Skilled Female Assembler | 1.45 | 1.25 | 16 |
| Semi-Skilled Female Assembler | 1.39 | 1.15 | 21 |
| Entry Rate - Female Worker | 1.22 | 1.00 | 22 |
| Office Workers | | | |
| Typist A | $51.00 | $40.00 | 28 |
| Stenographer A | 59.05 | 50.00 | 18 |
| Secretary A | 71.70 | 60.00 | 19 |

TABLE IV

EMPLOYMENT - SELECTED CITIES

| Area | MALE<br>Total Exp. Civilian Labor Force | Total No. Employed | % Employed | FEMALE<br>Total Exp. Civilian Labor Force | Total No. Employed | % Employed | NO. AVAILABLE<br>Male | Female |
|---|---|---|---|---|---|---|---|---|
| Boston | 653,548 | 611,647 | 93.6 | 315,333 | 303,306 | 96.2 | 41,901 | 12,027 |
| Manchester | 24,129 | 22,353 | 92.6 | 14,434 | 13,666 | 94.7 | 1,776 | 768 |
| Nashua | Total civilian labor force (male and female) - 18,825 | | | | | | 790 | 502 |

TABLE V

UNEMPLOYMENT - SELECTED CITIES

| Area | Unemployment Code | Women as a % of Total Non-agricultural Employed | No. of Quits per 100 Employees |
|---|---|---|---|
| Boston | C | 36.0 | 1.4 |
| Manchester | C | 42.4 | 2.1 |

Description of Unemployment Coding

A - Critical labor shortage (1.5% of total labor force unemployed)

B - Opportunities slightly greater than seekers (1.5-2.9% unemployed)

C - Seekers in excess of opportunities (3.0-5.9% unemployed)

D - Seekers in excess of opportunities (6.0-8.9% unemployed)

E & F - Represent more critical unemployment situations

# TAXES

There are a number of different types of taxes which affect a business and tax systems vary considerably from state to state and community to community. Only the more important taxes will be discussed here. They will include state, local, payroll and personal taxes.

Federal income taxes are omitted since plant location has little effect on these except as reflected in state taxes. For example, some states permit payment of federal income taxes to be taken as a deduction in computing state income taxes. Others do not.

## I. State Taxes

State corporate income taxes are high in Massachusetts* Only one other state (Oregon) has a higher corporate tax rate than Massachusetts. In New Hampshire state corporation taxes are non-existent.

Tax systems of these two states show that a greater percent of the tax yield in Massachusetts comes from state taxes of the type which would affect a company and its people then is the case with New Hampshire. The balance of the tax yield comes from other types of taxation. For example, utilities, banks, recreational industry, and other sources.

The table below shows the percentage of tax revenue which comes from taxation of manufacturing companies and the personal taxes which

* 35, p. 85

comes from taxation of manufacturing companies and the personal taxes which affect their employees, as contrasted to other sources of revenue.

TABLE VI

TAX SOURCE — MASSACHUSETTS VS NEW HAMPSHIRE *

| State | Share of Tax Yield from Mfg. Companies and their Employees | Share of Tax Yield from Utilities, Banks Recreational Industry, etc. |
|---|---|---|
| Massachusetts | 73% | 27% |
| New Hampshire | 43% | 57% |

Breaking out the various types of taxes levied by the two states we can examine them to see where their tax yield comes from. Note in the table below that one-third of the Massachusetts tax revenue comes from corporate income tax, while there is no such tax in New Hampshire.

Note also that another 22% comes from personal income taxes on income from all sources while in New Hampshire only intangible imcome (interest and dividends from stocks, bonds, notes, etc.) is taxable.

An additional interesting observation is that the total taxes per capita is nearly 50% higher in Massachusetts than in New Hampshire. This and other state tax comparison is brought out in Table VIII.

II. Local Taxes

Because of the wide variations between tax systems in one community versus another, it is impossible to generalize in a report

* 8, p. 68-70, 91-92

TABLE VII

STATE TAXES - 1951*

| Tax | Massachusetts Amount | Massachusetts Percent of Total | New Hampshire Amount | New Hampshire Percent of Total |
|---|---|---|---|---|
| Corporation Income | $97,499,466 | 33.3% | ---- | ---- |
| Personal Income | 65,774,231 | 22.4% | $2,547,148 | 11.3% |
| Gasoline | 28,079,497 | 9.6% | 5,497,884 | 24.3% |
| Tobacco Products | 26,589,654 | 9.1% | 2,691,975 | 11.9% |
| Alcoholic Beverages | 23,821,568 | 8.1% | 1,270,025 | 5.6% |
| Motor Vehicle | 11,192,686 | 3.8% | 4,414,487 | 19.5% |
| Insurance Companies | 10,581,546 | 3.6% | 1,066,406 | 4.7% |
| Inheritance and Estate | 10,452,843 | 3.6% | 869,986 | 3.9% |
| Race Tracks | 9,208,473 | 3.1% | 1,768,978 | 7.9% |
| Excise on Meals | 5,147,422 | 1.8% | ---- | ---- |
| Banks | 3,228,875 | 1.1% | ---- | ---- |
| Public Utilities | ---- | ---- | 1,269,268 | 5.6% |
| Licenses, fish, game, etc. | ---- | ---- | 792,452 | 3.5% |
| All other | 1,512,217 | 0.5% | 416,082 | 1.8% |
| TOTAL | $293,088,478 | 100.0% | $22,604,691 | 100.0% |

* 8, p. 68-70, 91-92

## TABLE VIII

### COMPARISON OF STATE TAXES — MASSACHUSETTS AND NEW HAMPSHIRE *
(based on 1951)

| Tax | Massachusetts | New Hampshire |
|---|---|---|
| Total taxes per capita | $78.39 (U.S. rank 17) | $53.56 (U.S. rank 40) |
| Corporation Income | No other state derives as high a share of their total tax yield (33%) from this one source as Massachusetts | No tax |
| Personal Income | Only 3 other states (Delaware, New York, Oregon) derive a larger share of their total tax yield from this source. Taxed on all personal income. | No tax on salary or wages. Taxed only on interest on bonds, notes, money, debts, except interest from savings deposits; and dividends from stock; first $600 exempt. |
| Gasoline | 5 cents per gallon. Talk in Massachusetts legislature of raising to 6 cents. | 5 cents per gallon |
| Motor Vehicle | | |
| Driver's license | $5.00 every other year | $4.00 every other year except first year $5.00. |
| State Registration | $6.50 - 1953 Dodge<br>$6.50 - 1948 Pontiac | $12.50 - 1953 Dodge<br>$12.50 - 1948 Pontiac |
| Local Excise | $50.70 - 1953 Dodge<br>$8.01 - 1948 Pontiac<br>Local excise formula based on an increasing rate:<br>1952 - $48.25<br>1953 - $50.42<br>1954 - $51.86<br>1955 - $53.37 | $19.80 - 1953 Dodge<br>$4.50 - 1948 Pontiac<br>Local excise formula based on a constant rate: |

| Tax | Massachusetts | New Hampshire |
|---|---|---|
| Tobacco Products | 5 cents per pack | 3 cents per pack |
| Public Utilities | Average domestic electric bills are 22% higher on Boston Edison systems than in Manchester. | Average industrial power rates are 10% lower. |
| Unemployment Compensation | Average rate 2.0. | Average rate 1.7. |
| All Other | Corporation franchise fees, licenses, stock transfer, etc. | Banks, domestic corporations, property tax on railroads and utilities. |
| Total | 134% increase over 1945. | 75% increase over 1945. Total New Hampshire tax is only 8% of total Massachusetts tax. |

* 8, p. 68-70, 91-92

such as this. There are a number of variations which make it impossible to compare one area with another until actual sites are selected for consideration.

At such time, the variables which must be analyzed are: local tax rates, assessment ratios and the assets which are subject to local taxes. Also to be considered are tax concessions, if any, offered by the community to attract industry.

## III. Payroll Taxes

Payroll taxes, or unemployment insurance, is levied on companies as a percentage of their total payroll. This goes into a fund, out of which is paid unemployment compensation to workers who are laid-off.

All companies start at the rate of 2.7% which they generally must pay for a minimum of three years. After establishing a merit rating based on their employment experience, their rate may be reduced from 2.7 to some lower rate down to the legal minimum.

In both Massachusetts and New Hampshire the legal minimum is 0.5. Based on actual experience of all employers, the records show that the average company pays a higher rate in Massachusetts (2.0%) than in New Hampshire (1.7%).

## IV. Personal Taxes

The amount of personal taxes paid by individual employees has a bearing on a company's ability to attract and hold key employees. As pointed out under State Taxes, Massachusetts has fairly heavy personal taxes. 22% of the state's tax yield comes from personal income taxes; other taxes such as automobile excise taxes and the so-called hidden taxes exact a sizeable sum from the individual's personal income.

New Hampshire, on the other hand, has no tax on salary or wages. It does tax certain intangible income such as interest on bonds, notes and debts, and stock dividends — after a $600 exemption. Usually this intangible income is a very small part of the total income of the average employee of a manufacturing company. As such, it has little effect on present or prospective employees.

Considering only the differences between the two states in personal income taxes and auto excise taxes, the increase in disposable income to the average employee would be the equivalent of a three percent raise -- New Hampshire versus Massachusetts.

# RAW MATERIALS AND VENDOR'S ITEMS

It was pointed out that there are two general classes of material purchased for use in the manufacturing of electronic equipment; catalog items and print items.

## I. Catalog Items

Catalog items are generally less of a problem than the other category of purchases. Since these are usually off-the-shelf items which can be selected from a catalog or with a moderate amount of shopping around, the main problem is adequately forecasting requirements so as to permit adequate lead time to assure favorable prices for securing them.

Thus the effect on manufacturing costs of plant location for this class of purchase is affected least. There is some increment of added cost in transportation from more distant suppliers of catalog items, but this is covered under the next section. To the extent that catalog items are modified or become non-standard, the costs of dealing with a more distant supplier becomes more of a factor.

## II. Raw Materials

Sheet steel, wire and other unprocessed supplies are usually another form of catalog items. A distinction is made here between such raw materials and components such as coils, capacitors, transformers, meters, knobs, dials, panels, etc. These components are generally manufactured by "feeder-firms" who specialize in such products.

They can be located most anywhere, but they appear to concentrate in four of five localities, nationally. These areas include New England; New York City - Upper New Jersey; Chicagoland; Texas and Southern California.

Raw materials suppliers of the types described above are not as localized as the components manufacturers. Since other industries also purchase large quantities of their total volume, these suppliers are more widely scattered.

## III. Print Items

The other general category of purchased material is print items. And it is in this area that greatest consideration must be given to the effect of plant location on this element of manufacturing costs.

Since there is a requirement for relatively close coordination between the buyer and the seller in this case, it is evident that cost rises with distance in dealing with these suppliers.

There are two main categories of print items to be considered. The first is the requirement for special parts used in the design and development of new products or improvements to existing products. The other is the requirement for quantity supplies of such print items that have been selected for production runs.

Although the cost of the special parts used in design and development (prototype parts) represents a much smaller dollar amount than the cost of quantity supplies used in production runs, the need for closer contact between the buyer and the seller is far greater in the case of the prototype parts. Often the production run requirements can be stated in terms of quantity amounts of approved prototypes.

IV. Boston VS New Hampshire

From the above, we can generalize that the requirement for catalog items is affected to only a very limited degree by plant locations in either of the two areas under study. The same applies generally to raw materials of the type described.

In the case of print items there is somewhat more of a cost difference. Additional costs of travel and telephoning would be added in the negotiation of these items.

This is partly offset by several factors. First, the distance involved in this particular comparison is small. Boston and Southern New Hampshire areas are within a 50 mile travel or telephone circle.

Second, because of general wage structure differences between the two area, print items — where they can be supplied by New Hampshire firms — would be less costly than similar items purchased from Boston suppliers.

It has been reliably estimated that such New Hampshire supplies would be about 10% less expensive.

Thirdly, for the average equipments manufactured by electronic companies, the share of purchases represented by catalog and raw material items is considerably higher than that represented by print items.

## TRANSPORTATION COSTS

Transporation costs break down into three major categories: inbound and outbound shipping; and transportation of personnel. There are significant differences between the first two:

### I. Inbound Shipments

Raw materials, components, print items and such inbound supplies represent a considerably smaller investment in transportation cost than outbound shipments of finished goods. Several reasons were mentioned in an earlier part of this report. Let's examine each of them in detail.

The classification of the commodity has a considerable bearing on the cost of transportation. Raw materials of the types used in the electronics industry enjoy a fairly low rate. This, coupled with the fact that shipments of sheet steel, wire, and metal shapes are moved in bulk at even lower rates to centralized distributing points means fairly economical transportation for this type of inbound shipments.

Partly processed materials such as coils, capacitors, tubes and the wide variety of electronics parts used in this industry also enjoy a fair inbound shipping cost rate. Although the classification of this type of material calls for a higher freight rate than the raw materials described above, generally this class of components is readily available within New England, or little further than the New York area.

Still another reason for inbound shipments being less of an expense than the other categories of transportation costs that we are examining is the element of time. With normal production planning processes and adequate lead time being allowed, it is usually possible to schedule inbound shipments in a fairly leisurely manner. This makes possible the choice of the "cheapest way" for transportation.

## II. Outbound Shipments

Outbound shipments, on the other hand, are frequently required at their destination at such a time as to call for more rapid shipments -- and hence at premium rates. An extreme example of this is the situation where a particular function such as an automated production line, a communications system, a TV broadcast studio, etc. is down because of an equipment failure.

It is not economical to stock all types of spare equipments or replacement parts against such an emergency. Nor is it likely that such equipments would be readily available at points closer than the factory where they were manufactured. The result is generally a frantic phone call to the plant, an expedited trip to the airport, and an air express shipment to the waiting customer.

To be sure, this is an extreme example, but it serves to dramatically point up one of the major differences between some outbound shipments and most inbound shipments. Of course, the practice of the trade is generally to charge the customer for transportation of his purchase.

So outbound transportation could be logically argued as not being a cost to the manufacturer. But in the final analysis, it has a very direct effect on his business — particularly in the commercial electronics field with which this report deals.

All things being equal, or nearly so — availability, quality, performance, price, service policies, etc. — the customer is frequently prone to choose the product which costs less. And to him, the transportation cost he must pay must be met with the same kind of dollars with which he pays the price of the equipment.

Another important distinction between inbound and outbound shipping costs is fragility and bulk. Take one element, for example the sheet steel which will be fabricated into a cabinet to house delicate assemblies of tubes, wiring and other components.

The sheet steel shipped in stacks in an open gondola car did not take up much space — nor did it require much protection from the weather, from bumps and jars, from unauthorized tampering or any other element that might damage it.

That was on the way into our manufacturing plant. The finished product on its way to the customer is an entirely different story. That flat piece of steel has now been wrapped into the shape of a cabinet of some sort. Inside it are all kinds of electronic equipment which could readily be thrown out of adjustment by improper handling.

For these reasons, the classification rates for finished electronic gear is considerably higher than inbound costs of raw materials and components. Add to this the fact that outbound shipments frequently span the country and it points up the need for carefully considering outbound shipping costs as a factor in plant selection.

## III. Transportation of Personnel

The final area for study under transportation costs concerns movement of personnel. Generally the people who travel are home-office marketing personnel, administrative personnel, some purchasing personnel and some engineering people.

In addition to these home office people, others who must be considered are field sales supervisors, field sales and service personnel visiting the plant, and, less frequently, manufacturers agents, dealers, and customers who may visit the plant.

The most used forms of transportation for personnel are rail and air. In our comparison of the Boston area with Southern New Hampshire we must compare the adequacy of these two modes of transportation.

It is not sufficient to compare merely flight-time or train schedule time between starting point and city of destination. Total elapsed time from plant to destination must be figured. This is important in and around a city such as Boston where traffic conditions could actually take longer than flight time from Boston to New York.

## A. Air Travel

One of the advantages of a plant location in a less populated area such as Southern New Hampshire is the fact that it is frequently possible to be on the open road just outside the plant gates. A site not too far from an airport served by Northeast Airlines such as Keene, Manchester, Concord or Laconia could provide transportation service little, if any, longer in total elapsed time, than a trip starting from applant in the Greater Boston area.

As for the cost, a trip to New York, Philadelphia, Chicago, etc. would cost only a little more than a dollar more starting from Southern New Hampshire than from Greater Boston.

Let's examine time schedules for travel facilities available to personnel. First the airlines. Boston lives up to its reputation as the "hub" of transportation routes. Fully 123 daily flights are available out of Boston for points in all directions.

Nashua has no airport; Manchester has a good airport and a large field. Four flights daily depart for Boston, New York, and other cities and the line serves as a feeder with a wide selection of flight times and destinations avilable out of Boston. Since business trips are generally planned in advance, the timing to take one of the four daily flights can be such as to permit nearly the same amount of flexibility as is offered through Boston.

However, as distance of plant site from this, or any other airport in Southern New Hampshire increases, the time and convenience factors change. Since these can usually be measured in cost to the company, they take on meaningful proportions in a cost analysis of plant locations.

B. Use of Company Planes

In connection with a discussion of air travel we should also consider the use of company planes. The growing trend of American industry to own and use private planes is an important development. This has significance in plant location considerations when non-congested areas such as Southern New Hampshire are examined.

Community airports, where available, are generally adequate for light planes of this type. In other cases companies have included landing strips adjacent to their plants.

The economic evaluation of the use of company-owned planes is an entire study in itself. It is usually feasible if 400 to 600 hours can be logged for company transportation.* Over and above savings at and beyond these hours, there are savings in executive time, convenience, prestige and customer service aspects.

In Table IX there is presented a time and money comparison between plane and car on a typical business trip. These are based on actual figures supplied by a company using a company plane.

* 34, p. 10

TABLE IX

TIME AND MONEY COMPARISON*

| | Plane | Car |
|---|---|---|
| Mileage | 278 miles | 310 miles |
| Travel Time | 3:09 hours | 9:24 hours |
| Trip Cost - 1 passenger | $82.30 | $110.59 |
| 2 passenger | 104.60 | 170.89 |
| 4 passenger | 149.20 | 314.99 |
| Total Trip Time | 1 day - no meals, no hotel expense | 2 days and 1 night |

On the following page, Table X shows the cost to operate a typical two-passenger plane.

C. Rail Transportation

Looking next at rail transportation for personnel travel, two things must be considered. First the added cost and lesser convenience of a plant site roughly 50 miles further from market areas. As in the case of airline travel, the cost is negligible -- particularly when auto transportation from plant to railroad station is added in, as it must logically be.

The train times out of rail stations in Southern New Hampshire are quite frequent. Nine trains run daily and take a total elapsed time from Nashua to Boston of only 47 minutes. An equal number of trips are made in the reverse direction. Train fare, Nashua to Boston is $1.32.

* 34, p. 19

TABLE X

COST TO OPERATE A TWO-PASSENGER PLANE *

Below are representative figures, on the high side, on the cost of operating a typical $3,000 2-passenger airplane with 100 mph cruising speed.

| Annual Use | 200 Hours 20,000 Miles | 400 Hours 40,000 Miles | 600 Hours 60,000 Miles |
|---|---|---|---|
| Gasoline and oil - 5 gals. @ 30¢ plus 1/2 pint of oil per hour | $1.70 | $1.70 | $1.70 |
| Inspection and Maintenance on Aircraft - 100 hour checks @ $35 - 25 hour checks @ $5 plus parts, cleaning, etc. | .60 | .60 | .60 |
| Engine Overhaul - $350 @ 600 hr. | .46 | .46 | .46 |
| Total Direct Operating Cost per hour | 2.76 | 2.76 | 2.76 |
| Depreciation (5 yr. amortization) $600 per year | 3.00 | 1.50 | 1.00 |
| Storage @ average of $20 per month | 1.20 | .60 | .40 |
| Total Cost per hour | 6.96 | 4.86 | 4.16 |
| Total Cost per Passenger Mile | 3.5¢ | 2.4¢ | 2.1¢ |

Insurance Costs. Because of the wide range of insurance coverage available no specific figures on insurance have been included in the table above. The following approximate figures can be used to calculate insurance costs:

| | |
|---|---|
| All-risk hull insurance per year* | $375.00 |
| Public liability $25/50,000 limits | $ 20.00 |
| Property damage $50,000 limit | $ 30.00 |
| Passenger liability, 1 seat $10,000 limit | $ 47.50 |

*Hull insurance for wind, fire, and other ground accidents alone is only $100.00

* 34, p. 21

D. Automobile Travel

Automobile travel should also be examined since it would probably come in for considerable use for several reasons. First, the excellent road system which exists between Southern New Hampshire and Boston. Second, the frequency of trips to the large metropolitan center of Boston for both business and personal reasons.

There are three new limited access highways in the road system connecting these two areas. They include the Circumferential Highway — Route 128 — around Greater Boston with its many new arteries leading into the city itself.

Connecting Route 128 with the southern border of New Hampshire are several new highways, recently opened (new Route 3) and being constructed (new Route 28). These are, or will be, limited access highways with fairly high speed limits.

A new highway system is now under construction, extending from the southern border of New Hampshire, up through the center of the state. It is known as the Frederick C. Everett Highway.

The first section has recently been opened, extending as far as Manchester; the second section is due to open next fall, extending the highway as far as Concord.

This is a limited access divided four-lane, high speed artery. It has one toll house at present at Thornton's Ferry Interchange. A second will be placed at Hooksett. The toll is twenty-five cents per passenger car. Tokens can be purchased for fifteen cents each (good for one passenger car trip) when bought in quantities of twenty at a time.

An interesting feature of this highway is the automatic toll collection system. All except one lane each way is equipped with electronic coin collectors which require no attendant. The driver drops his quarter (or token) into a slot, the light changes, and he may proceed. The single lane not so equipped is for trucks, trailers, special vehicles, or drivers without correct change.

A similar highway exists along the eastern part of New Hampshire. This is known as the Spaulding Turnpike. It connects the express highway No. 1 which runs along the coast from Massachusetts, through New Hampshire and into Maine, with Rochester and other inland cities.

# COSTS OF HIRING AND TRAINING PEOPLE

## I. Personnel Requirements

The size of the company, the products it makes, the labor content of these products, the engineering and professional requirements of the company — all these things help determine the personnel requirements.

As discussed in an earlier section, these labor, professional, administrative and secretarial requirements would have to be cataloged and an audit of the labor and personnel pool made of the areas under consideration.

Once this is done, recruiting, selecting, hiring and training can begin. Here is an area in which added time and expense can repay handsome dividends. One firm stated that they interviewed 1200 job applicants to build a labor force of 400.

But when they had finished, they had an organization of which they could be proud. Not only did they have an excellent morale with attendance records of low turnover and low absenteeism, they also had an extremely high productivity rate and outstanding product quality control.

## II. Costs of Hiring

Costs of recruiting and training professional people are high. Fortunately, the numbers of these employees is small compared to the requirements for factory workers.

Available figures from a survey of 137 companies* which estimate their costs of hiring and training salesmen, are probably similar also to the costs of hiring and training other types of professional people. Here are the figures they show:

TABLE XI

COSTS OF HIRING AND TRAINING**

| | |
|---|---|
| Recruiting - - - - - - - - - | $100.00 |
| Interviewing - - - - - - - - | 450.00 |
| Training - - - - - - - - - - | 2,000.00 |
| | $2,550.00 |

These figures appear to check out with estimates made by several members of the American Training Directors Association who were contacted on this point.

Costs of training factory workers is a little difficult to estimate. Conflicting estimates by the same members of the American Training Directors Association place the training cost anywhere between five hundred and one thousand, five hundred dollars. Obviously the complexity of the job function and the degree of starting skill and desired skill exert considerable influence in arriving at such a cost estimate.

## III. Costs of Transferring People

In the event that personnel must be transferred in connection with a move to a plant site selected as a result of such a study, it is important to consider the costs involved.

* 5, p. 6
** 5, p. 8

Company practices vary widely in this regard. It is normal for most companies to pay all usual costs of moving household fuѕniture and families. Some companies lend further assistance in the way of financial loans, real estate departments, baby-sitting services, and many other ways.

IV. Company Policies on Transferring People

The following comments were made at a recent American Management Association Workshop Seminar by participants when the discussion got around to company practices in moving personnel:

> Company A: "We cover the man's moving expenses and in addition give him a flat sum equal to 12% of his base salary. This is to cover unusual and intangible things such as the uprooting of the family from the community; the purchase of new draperies, new wall-to-wall carpeting, etc., etc., If the man owned a boat, for example, we wouldn't pay for moving that, but would expect the extra 12% to cover it."

> Company B: "We give the man an extra month's salary -- and of course pay all his moving expenses."

> Company C: "We give him 5% of his base salary and make any additional adjustments that may seem desirable depending on the individual's personal circumstances and his value to the company."

Company D: "We pay all moving expense of the family and furnishings. In addition, we recognize that an employee may have difficulty in relocating. So we will also pay for storage of his furnishings up to a maximum of 3 months and will permit him to include on his expense report unusual living costs for himself and his family for a period up to a maximum of two months. This covers extra expenses of eating in restaurants and living in hotels or motels. The only limit on this is 25% of his base salary for the two months."

USE OF OUTSIDE SERVICES IN PLANT SITE SELECTION

There are many agencies avilable to the manufacturer to help him in the selection of a plant site. Also there is a wealth of published material available, including a bi-monthly periodical, Industrial Development Magazine, Conway Publications, Brookhaven, Georgia.

This section is not meant to be an exhaustive report on such services. It is, instead, merely an indication of where the executive interested in the subject can turn for help.

I. Professional Factory Locating Services

There are a number of such agencies throughout the country. Each major metropolitan center has its share. They vary in size, experience and competency.

One of the best, and the country's largest, is Fantus Factory Locating Service, New York and Chicago.* They have an impressive list of "blue chip" companies and medium-sized companies among their clients.

The key benefits they offer are:

Specialization: Depth of experience (35 years) in concentrating exclusively on the science of plant location . . . extensive files . . . trained personnel.

* 12, p. 1-12

<u>Objectivity</u>: Loyalty to the interests of the client . . . impartiality not usually available from Chambers of Commerce, state agencies, utilities and real estate brokers.

<u>Anonymity</u>: Secrecy of company plans to prevent troublesome labor or competitive reprocussions.

<u>Techniques</u>: Development of methods of scientifically approaching the problem of cost analysis. Their Standards of Industrial Analysis are reproduced on the following pages. See Table XII.

<u>Economy</u>: Fantus claims that their fee would be substantially less than the time and expenses of company personnel who might undertake such an assignment.

The comments above are not meant to be an endoresement for this particular firm. They are, instead provided to orient the reader as to the type of service avilable through firms such as Fantus Factory Locating Service.

## II. Industrial Park Promotors

The growth of industrial parks has been spectacular over the past decade. <u>Industrial Development</u> magazine in its July - August, 1955 issue carries an index of Organized Industrial Districts in the U. S.

Briefly, planned industrial districts are tracts set aside for industrial use, zoned for protection against residential encroachment, supplied with basic utilities and services, under coordinated management, and available to a variety of firms*.

The above mentioned article lists 324 such industrial districts. Dramatic examples of the growth and acceptance of such industrial parks can be seen by a drive around the Boston Circumferential Highway.

The firm of Cabot, Cabot and Forbes has done an outstanding job in developing approximately ten such parks in the Greater Boston and environs area.**

## III. State and Local Development Agencies

The past few years has seen a rapid growth in interest on the part of agencies who wish to attract industry into their state or community.

The following extract from a report in the Journal of Commerce, Tuesday, March 6, 1956 under the heading "Development Agencies Credited for New England Revitalization" typifies the important work groups such as these are doing in helping to develop local economy:

> Credit for the revitalization of New England industry since the late 1930's is due to the region's numerous private and public development agencies, the Federal Reserve Bank declares in its annual report.

* 22, p. 51
** 11, p. 1-50

These range from the development credit corporations at the State level, assisted by State Departments of Commerce, to industrial development committees, industrial foundations and management assistance bureaus at local levels. At the regional level are such agencies as the New England Governors' Conference, the New England Senators' Conference and the New England Council.

Contrasting the progress made by the region since 1939 with earlier developments, the Reserve Bank says:

> "Between 1919 and 1939 the number of New England manufacturing firms decreased by 18 percent and the number of workers by 26 percent. Between 1939 and 1953 the number of firms increased by 48 percent and the number of workers by 35 percent."

Much remains to be done, but never before have so many individuals and organizations joined together to do it.

## IV. Railroads and Utilities

Even a casual perusal of our newspapers and magazines will impress most readers with the high degree of interest and activity that railroads, power and light companies, natural gas transmission companies take in promoting areas they serve.

This is natural. These firms stand to gain through increased revenue when new customers are added to their lines. It is economically justifiable for them to spend the large sums of money such as advertising costs.

They also can afford to make surveys at their own expense for interested prospects. This can entail considerable expense on their part but it obviously is well worth the cost.

## CONCLUSIONS

This report has attempted to point out the many areas of consideration in examining the effect plant site location can have on manufacturing and marketing costs. Only the major factors which apply to most companies interest in this subject have been presented in detail.

Each company has its own set of considerations to analyze -- and its own set of standards against which it must measure the importance of its findings. What might be impelling reasons for some companies to move into a given locality might be completely negated in the considerations which must apply to another company.

The table which follows* lists 34 factors which were developed through interviews with more than 500 manufacturers who located in the southwest following World War II. These are the reasons, in their order of importance, which these firms said were significant in their making the decision to locate in this area.

* Table XIII, p. 94

In summation, the factors which are important to any given firm in reaching a decision concerning plant site location are unique with that firm. Also the factors are many, and are intricately interrelated.

Careful, non-partial consideration of all the facets of such a problem can be rewarding to the company who seriously analyzes it. Due weight should be given to the long-range, continuing benefits which might accrue as well as the immediate, short-range benefits.

In this report, specific considerations have been analyzed, merely to bring into sharper focus the advantages and disadvantages. These specific considerations have been the study of such a problem as it relates to a commercial electronics manufacturing company of medium size.

To further focus attention on detailed considerations, a comparison between costs relating to manufacturing and marketing operations for a plant located in the Greater Boston area versus a plant located in Southern New Hampshire, has been made.

In this way specifics — such as the effect of labor rates; labor productivity, taxes, shipping, and marketing costs — could be pinpointed. This is not to say that either of the two areas used in this example is better than the other for a given company.

As pointed out above, each company has its own problems and its own considerations. There is no panacea available to the manufacturer by the simple choice of any given set of factors and the measurement of these factors against a set of norms.

Plant site selection is an involved study. The companies who have approached the problem with careful, unhurried analysis have proven to be the ones who have remained in their new locations longest and who have shown the greatest growth.*

* 27, p.3

**TABLE XII**

PART I - ANALYSIS OF CLIENT'S PRESENT FACILITIES

A. GENERAL HISTORICAL OUTLINE

1. When founded
2. Mergers or business changes
3. Affiliations or subsidiaries
4. General growth of company

B. MARKETS (including information on finished products)

1. Annual volume in dollars of finished products
2. Total tonnage of finished products
3. Location of principal markets, and percentage of tonnage shipped to major market areas
   a. Rail (LCL - Carload)
   b. Truck (LTL - Truckload)
   c. Carloading Companies
   d. Waterway (LCL - Carload)
   e. Others
4. Freight classification description of finished products, and how packed for shipment
5. Location of warehousing facilities, including public warehouses
6. Terms of sale: FOB, FAS, CIF, prepaid, etc.
   a. Equalization
   b. Freight allowances
7. Total annual freight costs on outgoing products
8. Location of principal competitors
9. Is time in transit an important factor in reaching your market?

C. RAW MATERIALS

1. Primary (Source..........Quantity and..........Total freight charges..........

2. Secondary (Source..........Quantity and..........Total freight charges..........

D. LABOR

1. General summary of labor needs, skills required, training time, etc.

2. Direct production labor

a. Male

| Job Classifications | Quantity | Hours | Wage Scale Minimum | Maximum | Average |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

b. Female

| Job Classifications | Quantity | Hours | Wage Scales Minimum | Maximum | Average |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

3. Non-productive labor

a. Male (chart as above)

b. Female (chart as above)

4. Total annual factory payroll

5. Present fringe benefits now in effect

6. Shift differentials

7. Hours worked in average week, overtime provisions, etc.

8. Labor turnover

a. Discharges

b. Voluntary quits

D. LABOR (cont'd)

c. Percentage of labor turnover to average number of payroll

d. Seasonal fluctuations, if any

9. Union setup

10. General summary of labor conditions in area

11. Personnel to be transferred if branch plant is established

a. Executive
   1. Number
   2. Housing requirements
   3. Social and recreational hobbies
   4. School and church preferences

b. Superintendent and Foreman
   1. Number
   2. Housing requirements
   3. Social and recreational hobbies
   4. School and church preferences

c. Key Workers
   1. Number
   2. Housing requirements
   3. Social and recreational hobbies
   4. School and church preferences

E. POWER, GAS, WATER

1. Electrical power

a. Present power rate per K.W.H. including demand, energy and load factor charges. (A sample of your monthly power bill is desirable).

b. Total number of K.W.H. used annually.

c. Is consumption of power steady or are there seasonal peaks?

d. Motor equipment A.C. or D.C.

e. Motor equipment is..................volt .............phase.............cycle.

E. POWER, GAS, WATER (cont'd)

2. Coal (or oil)

   a. Total quantity consumed for processing only

   b. Type and quality used

   c. Delivered price per carload.

3. Gas

   a. Natural or artificial

   b. Annual consumption

   c. Cost per 100 cubic feet

   d. B.T.U. per cubic foot

4. Water

   a. Annual consumption

   b. Cost per 1,000 gallons

   c. Characteristics

   d. Disposal of effluent

F. WORKMEN'S COMPENSATION INSURANCE

1. Classification

2. $............per $100 of Payroll

3. Total annual cost of Workmen's Compensation Insurance

G. STATE TAXES, ETC.

1. Corporation income, excise, franchise, and personal property taxes

2. Are State labor laws, unemployment compensation provisions or other regulations prohibitive or restrictive?

H. PRESENT PLANT(S)

1. Total floor space currently occupied

H. PRESENT PLANT(S) (cont'd)

2. Does present layout of plant(s) restrict free flow of production

3. Rent or total annual carrying costs (excluding taxes)

4. Estimated additional annual costs due to poor layout, lack of siding, etc.

5. Total local real estate taxes (real property only)

6. Personal property and other locally assessed taxes.

7. Heat by coal or oil - total cost.

I. IN THE EVENT THAT A BUILDING ALREADY CONSTRUCTED CAN BE UTILIZED IN THE AREA FINALLY CHOSEN THE FOLLOWING INFORMATION SHOULD BE SUPPLIED

1. Total floor area required

2. Type of building .

   a. Materials

   b. Dimensions

   c. Floor materials and floor load

   d. Ceiling heights

   e. Sprinkler

   f. Siding and loading facilities

   g. High or low pressure boilers (coal or oil)

   h. Bays

   i. Type of roof (monitor, sawtooth, etc.)

J. CONSTRUCTION OF NEW PLANT (if suitable building is not available)

1. Give brief description of type of building to be constructed

2. Preferred elevation of land

3. Size of plot required

J. CONSTRUCTION OF NEW PLANT (if suitable building is not available) (cont'd)

4. Is proximity to railroad siding essential?

5. Size of water mains, gas line, and power line necessary

6. Sewerage and disposal requirements

7. Will tank for sprinkler system be installed, or will fire protection depend entirely on local water pressure?

8. Do operations give off any offensive odor?

9. Is employee convenience a factor?

K. LOCATION PREFERENCE

1. Geographical boundaries

2. Size of community

3. Type of community

4. Community cooperation required

L. COMPUTATION OF PRESENT COSTS

In order to arrive at a correct valuation of the various factors involved, it is advisable to formulate a chart somewhat along the following lines:

Total Transportation Costs

| | | |
|---|---|---|
| | Inbound materials . . . . . . | $ |
| | Outbound products . . . . . . | $.................. |
| | TOTAL | $ |

Labor

| | | |
|---|---|---|
| | Direct production . . . . . . | $ |
| | Non-productive. . . . . . . . | $.................. |
| | TOTAL | $ |

L. COMPUTATION OF PRESENT COSTS (cont'd)

Plant Overhead

| | | |
|---|---|---|
| Rent or carrying costs, excluding taxes . . . . . . . | | $ |
| Additional costs due to inefficient layout, lack of siding, etc. . . . . . . . . | | $ |
| Real Estate taxes . . . . . . . | | $ |
| Personal property and other locally assessed taxes. . . . | | $ |
| Fuel for heating purposes only. . . . . . . . . . . . . . | | $.................. |
| | TOTAL | $ |

Utilities

| | | |
|---|---|---|
| Power . . . . . . . . . . . . . . | | $ |
| Gas . . . . . . . . . . . . . . . | | $ |
| Water . . . . . . . . . . . . . . | | $.................. |
| | TOTAL | $ |

State Factors

| | | |
|---|---|---|
| State taxes . . . . . . . . . . | | $ |
| Workmen's Compensation Insurance . . . . . . . . . . . | | $.................. |
| | TOTAL | $ |

Miscellaneous

| | | |
|---|---|---|
| Other cost factors inherent or peculiar to your present location(s) . . . . . . . . . . | | $.................. |
| | TOTAL | $ |
| | GRAND TOTAL | $.................. |

TABLE XIII

COMPARISON OF IMPORTANCE ATTACHED
TO PLANT LOCATION FACTORS *

| Plant Location Factors | Importance Attached to Per Cent |
|---|---|
| Availability of product markets | 82 |
| Wages and salaries | 81 |
| Abundance of general labor supply | 79 |
| Availability and cost of raw materials | 78 |
| Labor's will tp put out a full day's work | 78 |
| Workers' happiness and well-being | 78 |
| Cost of transportation of products to principal markets | 76 |
| Cost of transportation of raw materials | 75 |
| Abundance of skilled supervisory and professional labor | 75 |
| Cost of living | 75 |
| Time required for delivery of products to principal markets | 75 |
| Cooperativeness of other business people | 74 |
| Availability of building sites | 75 |
| Climatic conditions | 73 |
| Hospital, sanitation, education, and welfare facilities | 73 |
| Time required for delivery of raw materials | 72 |
| Availability and cost of utilities | 72 |
| Plant rental or construction costs | 72 |
| General living conditions for key personnel | 71 |
| Insurance rates | 71 |
| Availability of business credit | 70 |
| Availability of business information | 69 |
| Labor Laws | 69 |
| Taxes | 69 |
| Recreational facilities | 68 |
| Availability of risk capital | 67 |
| Labor unions | 65 |
| Time required for delivery of machinery, equipment & supplies | 62 |
| Cost of transportation of machinery, equipment and supplies | 61 |
| Competence and stability of state and local government | 61 |
| Availability of prime contractors | 58 |
| Editorial policy, news coverage, circulation of newspapers | 57 |
| Availability of subcontractors | 55 |
| Subsidies or other incentives by state or local groups | 45 |

*Study by University of Oklahoma Business Research Center — reprinted by FORTUNE Magazine, April 1956.

# BIBLIOGRAPHY


## I. BOOKS

1. Brown, Lyndon O., Marketing and Distribution Research, New York, Ronald Press Company, 1949.

2. Folts, Franklin E., Introduction to Industrial Management, New York, McGraw Hill Book Company, Inc., 1954.

3. Lasser, J. K., Business Management Handbook, New York, McGraw Hill Book Company, Inc., 1952.

4. Lester, Bernard, Marketing Industrial Equipment, New York McGraw Hill Book Company, Inc., 1935

5. Mandell, Milton M., A Company Guide to the Selection of Salesmen, New York, American Management Association, 1955.

6. Owens, Richard N., Management of Industrial Enterprises, Homewood, Illinois, Richard D. Irwin, Inc., 1953.

7. Standard World Atlas, New York, Rand McNally and Company, 1953

8. Tax Systems, Thirteenth Edition, New York, Commerce Clearing House, 1952.

9. Tead, Ordway and Metcalf, Henry C., Personnel Administration, New York, McGraw Hill Book Company, Inc., 1933

10. Tosdal, Harry R., Introduction to Sales Management, Third Edition, New York, McGraw Hill Book Company, Inc., 1950

## II. BOOKLETS AND PAMPHLETS

11. Prepared Site Package Plan -- Garden-type Industrial Development, Boston, Cabot, Cabot and Forbes, 1955.

12. Management's Most Important Decision, New York, Fantus Factory Locating Service, 1955.

13. New Facts on Locating Regional Plants, New York, Ford, Bacon and Davis, 1946.

14. Research Based Industries in New England, Boston, Arthur D. Little, Inc., June 22, 1955.

## III. NEWSPAPERS AND PERIODICALS


15. <u>Dun's Review and Modern Industry</u>, April 1956 "Location Analysis", p. 30.

16. <u>Harvard Business Review</u>, March - April, 1954, "Fact and Fiction About Southern Labor", Robock, S. H. and Peterson, J. M., p. 79

17. <u>Harvard Business Review</u>, March - April, 1955, "Plant Location — 1965", Fulton, Maurice, p. 40.

18. <u>Harvard Business Review</u>, March, 1951, "Plant Location", Gilmore, Frank F., p. 15.

19. <u>Industrial Development</u>, September - October, 1955, "Consultant Reviews Location Factors", p. 12.

20. <u>Industrial Development</u>, January - February, 1955, "How Do Regions Compare?", p. 22.

21. <u>Industrial Development</u>, May - June, 1955, "Labs Lure Industry to New England", p. 29.

22. <u>Industrial Development</u>, July - August, 1955, "National Index of Organized Industrial Districts", p. 51.

23. <u>Industrial Development</u>, March - April, 1955, "Should Expansion be Secret?", p. 6.

24. <u>Industrial Development</u>, November - December, 1955, "When Are Taxes Reasonable?", p. 4.

25. <u>Monthly Review</u>, Federal Reserve Bank of Boston, September, 1955, "New Manufacturers Experiences in New England", p. 1.

26. <u>Monthly Review</u>, Federal Reserve Bank of Boston, November, 1955, "Executive Attitudes Toward Locating Plants in Massachusetts and New England", p. 1.

27. <u>Monthly Review</u>, Federal Reserve Bank of Boston, October, 1953, "A Survey of New England's Electronics Industry", p. 1.

28. <u>The New Englander</u>, December, 1954, "The Go Get 'Em' City", p. 12.

29. <u>Sales Management</u>, August 15, 1951, "What Firms Do When They Transfer Their Men", p. 92.

30. <u>Saturday Evening Post</u>, September 10, 1955, "I Never Miss Chicago", Wm. E. L. Bunn, p. 38.

31. _Steel_, November 23, 1953, "Electronics, New Englands Rising Potential, p. 46.

32. _Western Industry_, January, 1954, "Electronics", p. 82

IV. PUBLICATIONS OF GOVERNMENT AGENCIES, ASSOCIATIONS, ETC.

33. American Management Association, _Company Practices In Employee Transfers and Relocation_.

34. Aviation Distributors and Manufacturers Association, _For the Most Out of Living, You'll Fly_, Philadelphia, Pa., 1955.

35. Business Reports, Inc., _Plant Location_, Yaseen, Leonard C., Roslynn, New York, 1952.

36. National Industrial Conference Board, _Decentralization in Industry_, New York, 1948.

37. National Industrial Conference Board, _Techniques of Plant Location_, New York, 1953.

38. National Industrail Conference Board, _Trends in Industrial Location_, New York, 1952.

39. New Hampshire Division of Employment Security, _Employment and Labor Supply in the Nashua Job Center Area_, Concord, N. H., March, 1955.

40. New Hampshire Division of Employment Security, _New Hampshire Non-Agricultural Employment and Other Labor Force Data_, Concord, N. H., October, 1955.

41. Research Institute of America, _Is your Location Balanced?_, New York, May 19, 1953.

42. The Tax Foundation, _Facts and Figures on Government Finance_, New York, 1954.

43. Tax Institute, Inc., _Tax Policy, Part II, Industrial Location Impacts_, Princeton, New Jersey, February, 1956.

44. U. S. Department of Labor, _Employment Security Review_, Washington, D. C., February, 1955.

45. U. S. Department of Labor, _Labor Market Developments in Major Areas_, Washington, D. C., September, 1955.

## V. PERSONAL SOURCES OF INFORMATION

### Persons Interviewed

46. Director of State Planning and Development Committee, Concord, N. H.

47. Division Engineer, Massachusetts Department of Commerce, Boston, Mass.

48. Personnel Director, American Optical Company

49. Vice President, Cabot, Cabot & Forbes, Boston, Mass.

50. Vice President, Fantus Factory Locating Service