MARKET POTENTIAL AND THE POSSIBLE LOCATION
FOR A NEW ENGLAND STEEL MILL

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CHAPTER I

INTRODUCTION

Objective

The purpose of this study is to demonstrate that a decision to establish an integrated iron and steel plant in New England would be well founded. In a general scheme of decentralization and in line with the abolishment of both the single and the multiple basing point systems of pricing,[1] New England would appear to be one of the logical places to establish a new integrated steel plant.[2]

In order to prove the hypothesis that a steel mill will be profitable in New England, the following subjects must necessarily be discussed in detail: the reasons for the present location of steel mills in the United States; new trends in steel mill location; a general description of the United State's steel industry; an analysis of the market demand in New England, metropolitan New York, and northern New Jersey; and finally a description of a possible mill site and its facilities. The last two subjects are extremely important in the final analysis for locating a mill in New England.

[1]System in which a certain city or cities, i.e. Pittsburgh and Chicago are set up as points of origin for transportation costs to be fixed on steel products produced anywhere in the United States. For example, steel produced in Birmingham and shipped to Florida will have transportation costs billed as if it were produced in Pittsburgh.

[2]An integrated steel mill is capable of producing steel from the basic raw materials of iron ore, coal, and limestone. A non-integrated mill does not have blast furnaces which are used to make the primary raw materials into pig iron. Thus, a non-integrated mill has to rely on some source of pig iron in order to keep its steel furnaces operating.

The paper focuses on New England as a region, although a similar situation may exist in other areas of the United States where a market-oriented mill could be feasible. New England has been singled out because government and industrial officials of the area have expressed the economic need for a steel mill in this region. Local officials feel that a mill would bolster the economy of the six state region.

There are over 3,000 concerns in New England that consume steel in some form or fashion. These businesses are plagued by a transportation disadvantage in regard to United States steel suppliers. Two paths have been taken by New England's merchants. One solution is to relocate near a source of steel and the other is to remain at their present locations and buy foreign steel. Foreign steel now controls over a third of New England's market. At any rate either of these alternatives weakens the economy of the region. If the merchants leave, the economic base of the area is lowered and those who choose to remain are at the mercy of distant producers, United States and foreign.

Problem

In the past the claim was made that New England would be a profitable location for a steel mill. In order to substantiate this claim, the New England Steel Corporation, in actuality an advisory board made up of a New England government and industrial officials, hired Jones and Laughlin Steel Corporation (1949), Coverdale and Colpitts Engineering Consultants (1951), and H. A. Brasser Engineering Consultants (1953) to survey the market and make feasibility reports for the proposed mill. These reports, which still remain classified, were apparently rejected. The results of the three surveys indicated that a mill would be of only marginal success.

Bethlehem Steel Corporation, which has a distinct transportation advantage in the New England area, sought to discredit the results of the surveys in hopes of discouraging other companies which may have had ideas of locating in New England.[3] Thus, "Bethlehem's rejection of the Coverdale Report (1951) caught this criticism at its height and crystalized on it; no matter what was said in further rebuttal, Bethlehem had little reason to fear that anybody else would soon start up the New England Mill."[4] The criticism was public in nature.

The New England Steel Corporation was determined and as a result hired H. A. Brasser and Company to complete a new feasibility study. The results of this study were positive and explained that due to a sharp rise in freight rates, steel consuming industries will locate near the mill. For example, before the ground was broken at the Fairless Works in Pennsylvania more than three hundred firms relocated along the Delaware River.

In order to solve New England's steel problems the study will attempt to answer the question: Should New England be served by a production point within the market, at a site near coal, one near ore, a site intermediate between the three or at a point served by cheap transport media (coastal), i.e. Sparrows Point and Morrisville? While other solutions are possible a recent study indicates that, "Current economic trends suggest that New England should be served by a New England producer."[5]

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[3]Editorial, "Bethlehem Steel and the Intruder," Fortune Magazine (March, 1953), p. 197.

[4]Ibid.

[5]Henry W. Broude, Steel Decisions and the National Economy, Yale University Press, New London, 1963, p. 115.

There are many positive factors that would be influential in attracting a steel mill to New England: "the metal fabricating industry is growing in Worcester, Hartford, Bridgeport,"[6] and New London; generous long-term, low-interest government loans can be obtained; the steel industry has changed from the basing point system to FOB pricing, under which steel manufacturers have to absorb some of the freight costs to New England; and adequate construction sites with level terrain, adequate water supplies, and waterfront facilities are available.

The study is also attempting to emphasize the problems of the New England metal fabricators. They are at a competitive disadvantage with other fabricators who are located closer to the producers of steel. New mills on the Middle Atlantic Coast are bolstering the market in their immediate vicinity, while New England's industries are slowly being suffocated. Periods of recession are critical because New England steel consumers cannot stock-pile enough steel at the current prices. This inability to maintain ready reserves of steel has discouraged many steel-using industries from locating in New England. It has also driven many fabricators out of New England in search of sites closer to the source of material inputs.

The locational factions which influenced the spatial arrangement of steel mills in the past, have tended to concentrate this activity in Pennsylvania and Ohio, near the source of coal. As a result of this locational orientation, a large market has developed in proximity to these facilities. Since World War II there have been certain developments that have proved of major importance for the production of steel and the

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[6]Editorial, Boston Herald Traveler, March 5, 1970, p. 10.

location of steel facilities: energy consumption has decreased, relegating the price of coal to a minor role in the decision making process; iron ore from the Mesabi Range is decreasing in quality; more scrap is being used in manufacture of steel; increased competition from foreign competitors; foreign ores are increasing in importance; and the impact of benification and pelletization of low grade ores. These factors have all interacted to alter the existing locational pattern of steel mills, i.e. United States Steel and Bethlehem Steel have new coastal mills to take advantage of the cheap foreign ores, and were designed to serve the expanding East Coast market.

Methodology

The paper is primarily geographic in organization and, as such is fundamentally concerned with the locational pattern of steel mills and the reasons for the spatial variations within the pattern. It will attempt to identify the major factor of location in the steel industry from its inception in eastern Pennsylvania. The description is significant nonthe-less, since the pattern suggests certain variables that may be causally associated with the distribution of steel mills. Those variables provide a basis for a more detailed analysis of the location problem in New England.

It must be noted that past studies have centered solely upon an investigation of transportation rates and steel prices, as in Walter Isard's article, "New England as a Location for an Integrated Iron and Steel Works."[7] This type of analysis was also done by Arthur Doerr in his articles, "Factors Influencing the Location of Non-Integrated and

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[7]Walter Isard, "New England as a Location for an Integrated Iron and Steel Works," Economic Geography, XXVI (October, 1950), pp. 245-259.

Integrated Iron and Steel Centers in Anglo-America,"[8] and "Quantitative Analysis of the Locational Factors in the Integrated and Semi-Integrated Steel Industry of the United States."[9] However, Doerr is correct in his analysis because he is dealing with international trends. Isard's article, the problem of locating a mill on a specific site, requires a much more detailed study than merely finding the cheapest transportation point. Isard cites the market as an important locational factor, but does not develop this idea to any great extent.

It will be demonstrated in this study that currently the market is the key locational variable. Statistical data on New England's steel consumption, compared with the national level, is presented in order to identify any regional trends in the consumption patterns of the various products. A survey of New England's consumers renders a percentage basis of the rates of participation in the patronizing of the proposed mill. Interviews were conducted with responsible officials from steel producers, consumers and warehouses in order to get a better idea of the problems facing the New England steel industry. It is unfortunate, however, the direct citations to some of these individuals are impossible, since the interviews were confidential.

This study will be of value to the following officials: present suppliers of steel to New England, metropolitan New York City and northern New Jersey; government officials who are interested in bolstering the

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[8]Arthur A. Doerr, "Factors Influencing the Location of Non-Integrated and Integrated Iron and Steel Centers in Anglo-America," Southwestern Social Science Quarterly, LIII (March, 1953), pp. 75-82.

[9]Arthur A. Doerr, "A Quantitative Analysis of the Locational Factors in the Integrated and Semi-Integrated Steel Industry of the United States," Journal of Geography, LIII (December, 1954), pp. 393-402.

economy of the region; and to the various metal fabricators in New England who are suffering from a lack of steel and consequently are trying to lure a steel producer to establish a mill in the region.

CHAPTER II

FACTORS INFLUENCING THE DISTRIBUTION OF THE UNITED STATES STEEL INDUSTRY

This chapter describes the locational patterns of the steel industry in the past and present, and the reasons for their development and evolution. Particular attention is paid to analyzing the locational patterns. Locational patterns are important in demonstrating the premise that a New England mill would be in the mainstream of future United States steel developments. The economic feasibility of the proposed mill would be aided by a favorable location in regard to growth potentials in the steel industry.

The Colonial and Post-Colonial Era - 1620 to 1850

The first settlers in America realized the importance of establishing iron smelters. Thus, "Within a dozen years of the establishment of the first permanent English Colony at Jamestown, iron ore was being smelted".[1] The first production site (1619) was located along Falling Creek, a small tributary of the James River. This early attempt at iron ore production was negated a year later when Indians destroyed the smelter. Another successful smelter was not to be established in America for twenty-six years.

The first successful ore furnace was built in 1646 on the Saugus River, using local bog ores from the meadows of Lynn, Massachusetts and

[1]Norman Pounds, The Geography of Iron and Steel, (London: Hutchinson University Library, 1966), p. 118.

charcoal made from the abundant timber resources. From this beginning the iron industry diffused throughout the hills and valleys of New England taking advantage of the more than adequate timber supplies and easily worked bog ores. The first foundries cast cannon and made nails, farm tools and equipment.

The iron industry spread gradually throughout the colonies and by the end of the seventeenth century New Jersey was producing appreciable amounts of iron. The industry spread northward from New Jersey into New York and west into Pennsylvania, where at the end of the seventeenth century the first permanent and successful iron works was established near Pottstown, on the Schuylkill River.

By the latter half of the eighteenth century the iron industry had worked its way up the Delaware, Schuylkill, Susquehanna and Juniata river valleys of Pennsylvania. Hematite bog ores in the valleys and hardwood trees on the hillsides were again the raw material resources. The smelted iron was floated down the rivers to the eastern coastal cities.

Pittsburgh marked the point of the farthest westward penetration (1750). Goods had to be transported from Pittsburgh overland to Philadelphia and New York City, thus an increased charge in transportation costs, almost to the point of being uneconomical, was encountered in supplying the east coast markets. However, the Pittsburgh iron industry developed primarily as a supplier of nails, plows, shovels, etc. to the pioneers leaving for the western territories. Thus the production of iron in Pittsburgh, which was begun in the 1760's was expanded during the remaining years of the eighteenth century and continued to develop during the first half of the nineteenth century.

In the pioneering era of iron production the dominant locational influence was access to fuel (charcoal). Consequently, the industry was relatively mobile in that it had to locate near a wood supply and then relocate when it had depleted local supplies of fuel. The Pittsburgh area, for example, had been producing iron since before the American Revolution but production facilities had never crystallized into a node. The iron industry continued to migrate up and down the Applachian valleys seeking plentiful supplies of wood. Pounds has noted, "Abundance of charcoal resources had permitted and the lack of developed means of transport had dictated a widely scattered geographical pattern of iron working."[2] This sporatic pattern may also be explained by the widely available bog ore and also the scattered, and largely local market.

Era of Industrial Concentration - 1850 to 1920

The period from 1850-1920 witnessed the crystallization of the locational pattern of the steel industry as it is today. The diffused pattern of iron production during the colonial era was replaced by a pattern of nodes dependent on large shipments of raw materials. The concentration of iron and steel production was a result of increased demand, the evolution of cities from mercantile orientations, changes in technology, and the increased substitution of coal for charcoal as a fuel in the iron industry. These nodes developed on the extensive network of railroads that had spread over the eastern half of the country by 1850.

During the 1830's coal was becoming a substitute for charcoal. The coal used in the initial phases was anthracite. For this reason steel production clustered in the northeastern section of Pennsylvania,

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[2]*Ibid.*, p. 119.

proximate to this type of coal. By the 1850's coal was firmly entrenched as a major locational factor in the iron and steel industry. As Isard has noted coal was the dominant locational force since, "the weight of coal required to smelt the ore and process the pig iron exceeded by a generous margin the sum of weights of the ore consumed and the finished output for a given unit of output."[3] It can be seen from this input-output relationship that the total tonnage involved in the shipment of ore to the coal deposits and the product to market was smaller than those necessary for carrying the coal to the ore and the product to the market. For example, in the early nineteenth century it took eight to ten tons of coal to make one ton of pig iron, by 1840, three tons of coal per ton of pig iron, and by 1850, the figure had fallen to two and one-half tons of coal consumed per ton of pig iron output. In spite of this increase in the efficiency of the use of coal, the weight of coal still exceeded the sum of the other weights. Hence, coal continued to be the prime locational factor. This level of coal consumption has dropped from 2.10 tons in 1879 to the figure of 1.28 tons in 1938, and in 1968, to the relatively insignificant figure of .67 ton.

There are many factors responsible for the decrease in the volume of coal consumption. The beehive technique of coke production was ideally suited for the steel industry as the coke did not become brittle when burning and it was able to support the heavy molten ore. Coke is made from bituminous coal (not anthracite) and the yield of coke per ton of coal is sixty to seventy per cent (1200 to 1400 pounds). The loss in weight is due to the burning off of volitile matter in the coal. Bitunimous coal fields

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[3]Walter Isard, "Some Locational Factors in the Iron and Steel Industry Since the Early Nineteenth Century," Journal of Political Economy, LVI (June, 1948), p. 203.

were not located in the immediate vicinity of the existing iron production sites, but since the weight reduction from coal to coke is thirty to forty per cent this correspondingly reduces the pull of coal as a locational factor.

TABLE I

TONS OF COAL PER TON OF PIG IRON

1879 - 2.10	1914 - 1.57
1889 - 1.85	1919 - 1.53
1899 - 1.72	1924 - 1.45
1904 - 1.70	1929 - 1.31
1909 - 1.62	1934 - 1.28

Source: Walter Isard, "Some Locational Factors in the Iron and Steel Industry Since the Early Nineteenth Century," Journal of Political Economy, LVI (June 1948) 205.

It is interesting to note that while coal consumption had dropped, the proportion of consumed iron ore remained relatively constant. However, "The amount of coal will vary with the proportion of iron in the ore and the chemical character of the ore."[4] Before the discovery of the Mesabi Range, the consumption of iron ore per ton of pig iron was two and one-half to three tons, but with the discovery of the rich Mesabi ore, this figure dropped below two tons. However, this has changed since World War II because of the depletion of high grade hematite iron ore deposits of the Mesabi Range. With the percentage of iron in the ore falling, more ore is being consumed. Nevertheless, this has had no noticeable impact on the present locational patterns of the iron and steel industry of the United States, since the patterns were strongly established before any depletion

[4]Richard Hartshorne, "Location Factors in the Iron and Steel Industry," Economic Geography, IV (July, 1928), p. 243.

in the reserves of the high grade iron ores. Prior to World War II, ore reserves were thought to be inexhaustible but this estimate was incorrect. The large consumption of two unforseeable world wars had drastically reduced the ore reserves.

An important point should be considered here. After the Civil War, the physical demands being put on iron were extraordinarily great. For example, iron bridges and railroad track were crumbling under the weight of heavier trains. The problem of making iron stronger was solved in England by Henry Bessemer. Bessemer invented an oven that burned the impurities out of pig iron, making it purer and consequently stronger. The integration of pig iron foundries with steel mills was introduced to cut the transportation costs and for fuel economies. Instead of being hardened and shipped to foundries where the pig iron would be later melted down and refined into steel, it was poured directly into the steel furnaces. The factors that enhanced this integration were: the elimination of shipping costs on semi-finished goods; less dependence on outside supplies; and better supervision of production stages.

The 1880's saw many advances in fuel-economies. As was previously mentioned, Henry Bessemer's furnace, which converted the crude material of the blast into malleable iron and steel without appreciable increases in fuel-consumption, was responsible for immense fuel-economies. Molten pig iron was poured directly from the blast furnace into a converter and there the desired amount of silica and carbon were burned off by powerful air blasts.

This period from 1850-1920 was definitely the most important in the development of the locational pattern of the United States' steel industry. The dependence on raw material inputs of coal and iron ore transformed the diffused pattern of steel production that had developed during the colonial era. A pattern was developed that manifested an increasing concentration of steel facilities at sites that possessed savings in transportation costs and were near the source of coal. It will be demonstrated in the next section how these concentrations created a problem in the farther evolution of the locational patterns of the iron and steel industry.

Decentralization of the United States Steel Industry - 1920 to 1954

The thirty-four year period from 1920 to 1954, experienced many changes influencing the pattern of steel production. Ore discoveries, fuel economies, and the growing Mid-West markets were of major consequence in the diffusion of the steel industry.

Chicago was the first major steel site to break away from the initial pattern that was established by the locational pull of coal. The development of Chicago (1904) as a major steel center was the result of the discovery (1890's) and the increased development of rich iron ore deposits in Minnesota's Mesabi Range. Chicago's location was optimal in relation to the cheap water transport of Pennsylvania coal and ore from the Lake Superior region. The shift away from the coal center was primarily due to fuel economies, which were a result of the bessemer and open-hearth processes.

Another example of this shift away from coal producing areas of Pennsylvania and Ohio, was the rise of Cleveland. The development of Cleveland (1931) as a steel center was to serve the growing Mid-Western market and demonstrates the increasing strength of markets on the location of steel mills. This was also the strategy behing the relocation of the Lackawanna Steel Company in 1901. The company moved to Buffalo from

Scranton, where it had developed on the basis of local bog ores and anthracite coal which were both available in the immediate vicinity. The new location was a strategic move to take advantage of cheap transportation of Mesabi ore on the Great Lakes and coking coal from Pennsylvania. At the same time, Buffalo steel producers could supply the eastern market at no extra cost and perhaps capture some of the Mid-West market by means of cheap water transportation.

In making a locational decision the businessman is less concerned with minimum ton-mile movement of raw materials and product than with minimizing the transport expenditures incurred by such movements. As a hypothetical example, if ore is twice as expensive to transport as coal, the locational pull of coal will be no greater than ore if it takes twice as much coal as ore to produce a ton of pig iron. Market locations are becoming more desirable since the price of transporting the finished product is becoming relatively larger than the costs on ore or coal. For this reason:

> The production of iron and steel even though a raw material-processing industry, exhibits the importance of the market factor. . . . The conspicuous growth of the steel industry has been near markets, as symbolized by the founding of Gary near Chicago half a century ago and the recent construction of the Fairless Works on the Delaware River convenient to New York City.[5]

And similarly Allan Rodgers points out that, "The weighted transportation costs indicate that the transportation of steel to fabricating centers should account for more than half of all transportation costs--in other words, the market should be the key locational force."[6]

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[5]Chauncy Harris, "The Market as a Factor in the Location of Industry in the United States," Association of American Geographers, XXXXIV (December, 1954), p. 318.

[6]Allan L. Rodgers, "Industrial Inertia: A Major Factor in the Location of the Steel Industry in the United States," Geographical Review, XXXXII (January, 1952), p. 57.

In the late 1920's a move to the east coast (major national market) was initiated. Bethlehem Steel Corporation located a plant at Sparrows Point, on the northwestern shore of the Chesapeake Bay to take advantage of foreign ores, domestic inland coal and the coastal and export markets. The plant was used for the dual interests of Bethlehem Steel Corporation--making steel and building ships.

Another point must be made here in respect to fuel economies. There was a growing use of scrap after the early 1900's to supplement ore in the blast furnace charge and to supplement pig iron in the bessemer converter and open-hearth furnace. Scrap is employed, to a considerably larger extent, with the open-hearth furnace. Less heat is required in the reduction and processing of scrap than in the processing of pig iron into a high quality semi-finished or finished steel product. Along with fuel consumption, ore consumption decreased by the use of scrap. Ore consumed per ton of semi-finished iron and steel fell from 1.83 tons in 1900 to 1.04 tons in 1938, while the use of scrap increased. Thus, since the turn of the century the locational pull of ore has almost been cut in half as the pull of the market has been correspondingly increased.

It can be seen from the history of the iron industry, and later with the development of steel industry, that the locational pull of raw materials, coupled with improvements in transportation, has resulted in the attractiveness of the market as a production site. The pattern of purchased scrap closely resembles the pattern of the market of the iron and steel industry. With scrap increasing as a material input in the steel process, there is a larger expense incurred by the movement of this scrap from its source to a distant site of production. Thus, the movement of scrap intensifies the locational pull of the market as measured by the sum of weights of finished product and purchased scrap, to the extent that the source of the latter is geographically concentrated at the market. Historically, regardless of where the production of steel has been localized, consumption of it has been at the market. Therefore, naturally, the market is the major supplier of scrap.

Small scale steel plants have located to take advantage of scrap. Through the use of scrap, many small producers of steel have located at or near market centers. The Pacific Coast is exemplary of this trend. In 1939, the Pacific Coast Region had no blast furnaces. This region had to rely on imported pig iron because raw materials were lacking. These plants were able to produce only a limited array of products in an attempt to minimize the disadvantages of their poor locations with respect to the raw materials, ore and coal. These plants have been able to maintain their competitive position (market on an economic basis) by the heavy consumption of scrap in the furnace, which at times has comprised as much as eighty-five per cent of the charge.

There are however, two important factors which tend to impede the accumulation of scrap supplies. One is the development of technologies in steel production which improves its ability to retard corrosion by better protective coatings. This lengthens the number of years a steel product will be useful. With the utility of steel being increased for longer periods of time, the large volume of marketable scrap will be greatly reduced in the short run. Another point strengthening this proposition is the diminishing percentage of bessemer product in the total stock of the United States' steel output. Open-hearth furnaces have increased in popularity. The increasingly widespread use of the open-hearth furnace may also retard the future potential of the scrap market, but federal air pollution laws may require open hearths to be shut down. The open-hearth product is more durable than the older bessemer steel which had made up the majority of the scrap supply during the last forty-five years. Other major factors foreshadowing a decline in the future for the consumption of scrap is the increasing use of steel for light gauge, flat rolled products, such as tin containers. Little of this tonnage returns to the mills as scrap. Also the high rate of export of ferrous materials and products by the United States can do nothing but drastically limit scrap supplies.

The steel industry has been accused of exhibiting a large degree of industrial inertia. This is true mainly because of the huge capital investments that have to be made for the construction of an integrated steel mill. Once the mill is a functioning unit, it is uneconomical to close it completely. This huge capitalization of mills also impedes rapid relocation of the industry as it is much more economical to enlarge present facilities than to relocate the mill. The mill fixtures cannot be moved and they must be abandoned because it is nearly economically impossible to tear down the huge superstructure of a steel mill, ship the parts, and reassemble them elsewhere. Even if it were economically feasible to move the mill could not be taken apart and put back together and function as efficiently as before.

Industrial inertia in the steel industry cannot be solely attributed to the large amounts of fixed capital. Another reason for such a static locational pattern in the steel industry (activity remaining in coal producing areas even when the pull of raw materials has decreased as the pull of the market has increased) is due to the coincidental occurences of coal districts and markets. Since its inception, the iron and steel industry has had only one period in which only one factor of location (coal) was the major reason for development at a site. Since the very early periods - 1830's - when coal was the only strategic factor, the occurence of any two of the main locational factors (coal, ore, market) has been sufficient to determine the site of production. This early period of coal dependence has, however, dominated the locational pattern of the iron and steel industry, both past and present. The reason for this is the convergence of other heavy industries and processing trades oriented to iron and steel on the mills. Over the years large markets have developed around coal districts. The reason for the developments of large markets near coal resources was not entirely by accident. Andrew Carnegie and other steel magnets derived a system of pricing that influenced consumers to locate as close as possible to the supplier. The majority of the steel suppliers were located in the Pittsburgh area and this pricing system was called the basing point system or 'Pittsburgh Plus'. Today there is little incentive for those plants located in coal districts to relocate outside of the coal producing areas. This will continue to be true until the coal is depleted or some major new motivating force develops. As has already been mentioned, huge investments and rigidity of equipment at these nodes have also deterred the development of a new locational pattern.

A proposed mill site must have access to or be able to serve a large market area, "The market or ore site is sometimes not economical for an integrated mill in that the consumptive capacity is not great enough to have economies of scale unless the new or old markets which these works are designed to serve are of sufficient size to absorb the output."[7] It

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[7]Walter Isard, "Some Locational Factors in the Iron and Steel Industry Since the Early Nineteenth Century," <u>Journal of Political Economy</u>, LVI (June, 1948), p. 217.

should be noted that the market as a factor of location will be the only factor that will be able to exert enough influence to alter the present distributional pattern of iron and steel production. Markets will grow in effective demand and will continue to provide a supply of scrap. A change in the world pattern of iron and steel production will probably occur when the market increases in its economic ability to produce steel at a cheaper cost than the antiquated, material-oriented mill sites.

One way the market will gain as an agglomerating force is with greater fuel economies, which will serve to diminish the attraction of raw materials. The steel industry is experimenting extensively with various techniques that will promote further fuel economies: pelletization and benefication to make ore more easily reduced in the furnace; the use of enriched air and oxygen in the blast, open-hearth, electrical furnace, and the bessemer converter; and also the use of high pressures, with or without enriched air in the blast furnace.

To somewhat offset the trend toward the consumption of larger amounts of iron ore, the production of pellets from beneficiated taconite ore was developed. Pelletization improves production efficiency by affording an increase in output of pig iron at a lower cost. Taconite ores contain twenty-five to thirty-five per cent iron. Through beneficiation the ore is refined and concentrated into pellets, and the end product contains over seventy-five per cent pure iron. Beneficiation processes utilizing this ore have been economically producing iron pellets since 1956. These pellets are concentrated ores that are thirteen per cent higher in procurement costs than regular ores, however pellets take less fuel to be reduced in the blast furnace and they are more easily and economically transported. Pellets offer greater locational flexibility with respect to sources of ore, consuming steel mills and transportation facilities. This locational flexibility is evident in the market location of small, one product mills (mini-mills) that exist on scrap, pellets and electrically run furnaces.

Fuel economies during steel production are very important to the industry. It has been reported by the Iron and Steel Institute that up to a thirteen per cent decrease in the consumption of coke occured when pressure was used in blast furnaces and similar results were experienced with the bessemer converter, open-hearth, and electrical furnaces. These economies will not be as great when lesser qualities of coal and coke are used, nevertheless the economies are still significant enough to defray the costs of locations more distant from coal sites. It must be realized, however, that these fuel economies will reach a "theoretical maximum" per ton of steel.

Market Oriented Period - 1954 to the Present

It can be seen from the foregoing that no matter what the stage of the steel industry, charcoal, coal or ore oriented, transportation is the key factor in location. Thus Isard and Capron have concluded that, "The iron and steel industry is an excellent example of a transport oriented industry."[8] Labor and other cost differentials are relatively small compared with those in the transportation of the raw materials and the finished products. Markets reflect transportation costs and today are as important as the location of coal and iron ore as a factor in establishing a new plant. Coastal and lake locations have been gaining in importance due to the savings from cheap bulk transport of water routes. Population has also been increasing along the fringe areas of highly concentrated

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[8] Walter Isard and Walter G. Capron, "The Future Locational Pattern of Iron and Steel Production in the United States," Journal of Political Economy, LVII (April,1949), p. 120.

regions of steel production, thereby increasing the market demand for iron and steel (Great Lakes, Atlantic, and Gulf Coasts, and also, although not analogous to the above example, the Pacific Coast). The spatial implications of these trends are summarized in the following manner by Isard and Capron, "In this sense then, a continuing relative decline of the old established inland steel centers east of the Mississippi, especially the Pittsburgh-Johnstown district, is foreshadowed."[9]

Transportation and the structure of freight rates have served as a major deterrent to the development of new locational patterns. In respect to the high costs of transporting raw materials, the growth of the Pacific Coast market has been retarded. It must also be recognized that the market was not considered large enough to warrant a fully integrated steel mill. These arguments were valid at the turn of the century, but today they are invalidated by the large amount of population and industrial growth in this area, as well as the previously mentioned reduction in raw material requirements per unit of the product.

The term market in the steel industry is not analagous to other industries. This term is misleading in that the market for steel is not concerned with a single product, but a diverse number of products, differing in specifications and purposes. There is no one real market but a multitude, each different in the consumption pattern of its particular steel commodity. These various markets do not coincide at one nodal point. Internal and external economies necessitate the production of standard steel products in a large integrated plant, to take advantage of technical efficiency. In order to maintain a continuous and balanced operation, steel

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[9]Walter Isard and Walter G. Capron, "The Future Locational Pattern of Iron and Steel Production in the United States," Journal of Political Economy, LVII (April, 1949), p. 126.

companies are obliged to produce a variety of products. It is very risky to supply only a few products to industries which may be located in close proximity to the plant. There are large risks involved because this leaves a large mill costing millions of dollars at the mercy of a few industries. The industries may decide to relocate or suffer severe seasonal and cyclical fluctuations of demand, which result in substantial diseconomies.

During the period 1948-1959, American steel mills experienced a steady increase in size. Nonetheless, some steel centers expanded more rapidly than others. This spatial differential in growth has had some influence on the locational pattern of the steel industry. One expert has evaluated the trend in the following manner, "Changes in the locational pattern of the Anglo-American steel industry were caused almost entirely by differences in the growth rate among existing steel centers and steel plants."[10] There are a few basic reasons why this would be so, even though it would appear more economical to decentralize.

(1) Expenses per ton capacity of a steel mill will be four times greater when the investment is made in a new plant on an undeveloped site when compared to an addition to present facilities.

(2) Since 1948, multi-plant corporations have rejected the old philosophy of product diversification and have begun to specialize in one product, thus a diversion of labor has resulted. This restricts a corporation's ability to expand and build a single new mill in the most favorable location.

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[10]Gunnar Alexandersson, "Changes in the Location Pattern of the Anglo-American Steel Industry," Economic Geography, XXXVII (April, 1961), p. 98.

(3) Another philosophy of the steel industrialist is the concentration of capital at one nodal point. In spite of the increasing dominance of the market as a locational factor, corporations are prevented from relocating because of the present concentrations of capital. Inertia is a strong force working on all industrial location patterns. A steel center with an obsolete location in respect to transport costs or raw materials will still operate on an economic basis because of compensating assets, such as experienced labor, and a favorable situation in relation to community schools, banks, and other service facilities geared to the steel industry. The machinery at these plants cannot be used in the manufacturing processes of other industries.

Since World War II, steel mills with water locations have had higher than average growth rates (Chicago, Detroit, Cleveland, Buffalo, Hamilton, and Baltimore). The causal elements of their growth are multi-factoral. The main factors are: low transportation costs for iron ore and in some cases limestone, scrap, and coal; and their favorable market situation. Chicago, Detroit, and Cleveland rank among the leading North American metal manufacturing centers. Buffalo has a strategic location between the Lower Lakes market and the East Coast, and especially New York City, which is the largest American steel market not possessing local steel producing capacity. Hamilton, Ontario has a central location in the Canadian portion of the Manufacturing Belt. United States Steel's Morrisville plant, located on the Delaware River between Philadelphia and New York, is one of the largest American mills. It was built in the 1950's to take advantage of the growing eastern market plus the cheap water transport potential. Chicago is the world's largest steel center with a capacity

(27.0 million tons) exceeding that of the United Kingdom (26.2 million tons) and France (17.9 million tons) and approaching that of West Germany (30.9 million tons). From 1948-1959 Chicago grew more than twice as fast as the second and third largest American steel centers, Pittsburgh and Youngstown.

In the United States more than half of the steel capacity (54.3 per cent) is located in the outskirts of urbanized areas of a million or more inhabitants (Chicago, Pittsburgh, Detroit, Cleveland, Buffalo, Baltimore, Philadelphia, St. Louis, Los Angeles, San Francisco, and Houston). Of the major American cities, only New York, Boston, Washington, and Minneapolis-St. Paul lack basic steel production industries.

The location of the steel industry was cumulative, in that other metal manufacturers were attracted to it, thus making Pittsburgh distinctive since it became a "million" city because of the steel industry. As mentioned earlier, Pittsburgh's prodigious development as a steel center is due to the basing-point pricing system. This system gave Pittsburgh a monopoly, in that any steel purchased from any producer in the United States would be charged the regular price per ton plus a shipping charge equivalent to the price shipped from Pittsburgh to that point, regardless of where the steel was actually produced.

Alexandersson has noted the localization of the United States steel industry and reports that, "Even the large American Steel corporations are solidly planted in a limited region - the district in which they originated."[11] The market of the four largest steel producers in analagous to the world's largest free trade area - the Manufacturing Belt of the Northeastern section of the United States. Alchian has done research pertaining to the success

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[11]Gunnar Alexandersson, "Changes in the Location Pattern of the Anglo-American Steel Industry," p. 102.

of industries and their site location and has concluded that, "There are only a few ventures that have been made outside of this region that have remained economically profitable by being adopted by their environment or adapting to it."[12] Alchian was referring to the Manufacturing Belt. Bethlehem Steel has almost all of its capacity at five steel centers within a small region along the eastern fringes of the Manufacturing Belt. United States Steel has fifty-nine per cent of its capacity at two centers, Chicago and Pittsburgh, and seventy-five per cent at and between these two cities.

When it was realized that expansion into new areas would be a profitable venture, large companies found it more economical to acquire already established companies in the new areas. However, this practice of the annexation of smaller plants has been impeded by federal anti-trust policies. A noteable example of this was the attempted merger between Bethlehem Steel and the Youngstown Sheet and Tube, which was prevented by governmental intervention. Thus, government policies can be an influential factor in the corporate locational pattern of the iron and steel industry. Defensive considerations also play a major role in governmental influence in the locational pattern of the iron and steel industry, i.e. the strategic location of Fontana and Geneva mills in the west during World War II.

Nevertheless, expansion is going on in the industry, with great differences in the rates of construction among the eight largest steel corporations. United States Steel, the world's largest steel company, has a low rate of increase, but six of the eight largest steel corporations in the United States expanded at a faster rate than the national average for

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[12]Armen A. Alchian, "Uncertainty Evolution and Economic Theory," _Journal of Political Economy_, LVIII (June, 1950), p. 214.

the steel industry. Corporation policies on expansion must be taken into account when various steel centers are evaluated. It is not enough to consider location only in regard to raw materials, markets, transportation, and government policies.

In 1959, 86.8 per cent of the national steel capacity was contained in the Manufacturing Belt. Manufacturing in this area of the United States had a somewhat lower industrial growth rate than the national average. However, there are regional differences in growth within the Manufacturing Belt. Thus, steel facilities located on the Atlantic Seaboard and the Southern Shores of the Great Lakes which are both growing market areas had considerably higher growth rates than the area as a whole. Steel capacity has been growing in the Great Lakes area since the end of the last century. Bethlehem has recently opened a new mill outside of Chicago to take advantage of the growing Mid-West market. Thus, "The steel producers on the lake shores now have more than one-third of the American steel capacity."[13] The Atlantic Seaboard with less than one-fourth of the Great Lakes region's capacity has grown rapidly in the post-war period due to an increasing American dependence on imported ores.

In contrast to the development of the old districts of western Pennsylvania and extreme eastern Ohio, which grew at low rates, the fastest growing steel area in the Manufacturing Belt and the only one to more than double its capacity was the inland area from eastern Ohio to western Illinois. This area grew rapidly, mainly as a result of increased contruction and manufacturing along the Ohio River and in the T. V. A. region. It can be seen that locations near ore and coal are becoming obsolete in the

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[13]Gunnar Alexandersson, "Changes in the Location Pattern of the Anglo-American Steel Industry," Economic Geography XXXVII (April, 1961), p. 98.

United States as indicated by lower growth rates for such centers as Pittsburgh and Youngstown. The inland centers of eastern Pennsylvania, an older steel area than western Pennsylvania and Ohio, have maintained their relative position with a growth rate close to that of the Manufacturing Belt as a whole.

The only major concentration of steel production in the South, Birmingham, has had a slower than average expansion rate due to the dominance of United States Steel in this area. United States Steel has maintained a philosophy of slow development here in order to have market consumption in excess of the output of the mills in Birmingham thereby necessitating a dependence upon its Pittsburgh mills for supplying the excess demand. United States Steel founded the Birmingham works in order to capture the southeastern market. Even though originally consumers had to pay the Pittsburgh price of steel plus transportation costs to the consuming point, it was still more convenient to buy from a nearby supplier. Today, United States Steel flourishes in the southeast as a result of the abolished 'Pittsburgh Plus' pricing system and because it was lucky enough to establish a mill and develop a nearby market for its products.

The medium-sized integrated mills of Houston and Lone Star, far outside the market areas of Alabama's production, have experienced the highest growth rates of any areas. Armco constructed the Houston plant with the help of a government loan. The source of iron is mainly from scrap. The Lone Star mill, based on local scrap iron and coal from Oklahoma, was built during the last two years of World War II as an emergency source of steel for the war effort. It did not become operational until it was purchased by a private company in 1948, and it became an integrated mill in the early 1950's.

The only integrated steel mill west of the Mississippi-Missouri Rivers before the Second World War was the plant at Pueblo, Colorado. The Geneva and Fontana mills were built during the war, the former by the government, the latter by Kaiser with a government loan. Both were built to supply the shipyards on the West Coast. They relieved the already overburdened transcontinental railroads and the Panama Canal, a route seriously hampered by enemy submarine operations. It is doubtful if a normal peace-time competitive market situation would have ever brought about the construction of these two plants, but they have both expanded rapidly in the post-war period. The reason for this expansion was due largely to the increased population of the West Coast and accordingly the development of steel markets to serve this population growth.

In summation, there are four factors that form the basis of the changes in the past and present locational patterns of iron and steel production: (1) there was a need for decentralization of the highly concentrated steel industry on the grounds of national security (Lone Star, Geneva, and Fontana were created during a national emergency, World War II, and shortly thereafter, the philosophy of decentralization was abandoned); (2) the Mesabi's high grade ores have been largely depleted which has provided an impetus for development of foreign ore deposits, more economically suitable for use in eastern plants; (3) fuel economies have increased; and (4) the changes in the pricing system from single-basing point and multi-base point system to FOB pricing has put the Pittsburgh-Youngstown production sites at a transportation disadvantage, relative to the rest of the country. The last three factors have made the market location of steel mills the more economical.

CHAPTER III

THE MARKET AS AN INFLUENCE ON A

POTENTIAL NEW ENGLAND STEEL MILL

The preceeding chapter described the locational forces in the steel industry and the patterns of steel production that have evolved from them. It was emphasized in Chapter II that the market is the key locational factor in today's steel industry. Pursuing this conclusion, Chapter III analyzes the steel production and consumption patterns of the United States and the patterns of consumption in New England, metropolitan New York, and northern New Jersey. This method of analysis should determine the feasibility of locating a mill in New England to serve the regional market of the Northeastern United States.

Steel Capacity in the United States

Steel capcity and consumption are studied on the national level in order to identify any trends that could be applied to the Northeastern United States. For example, if trends indicate a decrease in steel capacity or consumption it would be most difficult to convince people of the profitability of the establishment of a new mill. Trends in consumption will also be influential in isolating the products to be produced at the new mill.

The data for the consumption of steel in the United States and related statistics are published in the Statistical Handbook of the American Iron and Steel Institute. Table II, based on the American Iron and Steel Statistical Handbook, indicates that there has been a steady increase in the production of steel from 1958 to 1968.

AISI reports that at the beginning of 1958 ingot consumption was 85,255,000 tons and by the beginning of 1968 consumption had risen to 131,101,000 tons. The announced plans of the steel industry indicate that capacity will be about 165 million tons by January, 1975. The rise in capacity from 1958-1968 is due largely to the opening of Bethlehem's Gary, Indiana plant (Burns Harbor).

TABLE II

STEEL CONSUMPTION IN THE UNITED STATES

YEAR	THOUSAND NET TONS	YEAR	THOUSAND NET TONS
1958	85,255	1964	127,716
1959	93,446	1965	131,462
1960	99,282	1966	134,101
1961	98,014	1967	127,213
1962	98,328	1968	131,462
1963	109,261	1969	141,262

Source: Statistical Handbook, American Iron and Steel Institute, 1969, p. 69.

Steel Production

In order to understand the general terminology used in the steel business, and the problems and procedures involved in the proposed plant the making of steel will be discussed briefly. The first step in steel production is to smelt the ore into molten metal. Ore and limestone are placed on top of the coke in the blast furnace and heated to 3500 degrees

Fahrenheit. Once the blast is put into operation, it is a continuous process of adding raw materials, twenty-four hours a day, seven days a week.

During the melting process, silica and other liquid impurities are attracted to the limestone floating on top and are mixed, forming a fluid called slag. The furnace is tilted at intervals to pour off the impurity-ladden slag.

The melted pig-iron is channeled through a series of troughs into ladles which pour the hot metal into the furnaces (open hearth, electric, basic oxygen, and bessemer). Here the pig-iron is heated to 2600 degrees Fahrenheit and subjected to a series of air blasts. The blasts of air burn off impurities in the hot metal, manganese, aluminum and other alloys are added and the end result is steel. The steel is then poured into molds and hardened into ingots.

The various types of furnaces do the same tasks but in different manners. The open hearth furnace was the original steel-making furnace. The hearth is placed in such a position to cause a draft which thereby forces air over the hot metal. The bessemer converter uses air and pressure to burn off impurities. The above mentioned processes (open hearth, bessemer) take approximately eight hours to pour one heat (furnace capacity). The basic oxygen furnace is a refinement of the open hearth and bessemer furnaces because the basic oxygen furnace utilizes a steady stream of almost pure oxygen. The time needed to complete one heat is roughly forty-five minutes. The electric furnace is much the same as the basic oxygen furnace. It uses a stream of oxygen to burn the impurities from the pig-iron but also does this under controlled atmospheric conditions with a closed dome. The heat is produced from an arc made by electricity passing between positive and negative anodes at opposite ends of the furnace.

The steel ingots are heated and rolled into shapes at rolling mills. It is necessary to roll the ingots, since, "Steel in the form of an ingot is a relatively weak mass of non-uniform crystals. Rolling breaks these crystals down and elongates them so that the hot-rolled product approximates a closely packed bundle of fibers. In that form steel is strong."[1]

Ingots are rolled in blooms, billets or slabs. A bloom is a square or rectangular block containing more than thirty-six square inches. Billets are of the same shape but approximately half the size of blooms. Slabs are of the same size as a bloom but much wider and flatter. Blooms, billets, and slabs are semi-finished products. Blooms are pressed and rolled into plates. Billets are shaped into bars, wire, and structural products, while slabs are rolled into sheets and strip.

Hot-Rolling Capacity

In the following section the trends in consumption of hot-rolled products are discussed in order to form the basis for an analysis of New England's market and market potential. This section describes steel production, capacity to produce, and from these two factors the percentage of each major product consumed. Rates of consumption of the various steel products and the geographic locations of this consumption, i.e. flat rolled products in the northeast, will give an indication of what products would be most economically rolled on the proposed mill. The major products will be defined and discussed in some detail in order to acquaint the reader with the products of the steel industry.

The productive capacity of the hot-rolling mills of the United States has been given by AISI for twenty-two product classifications, which

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[1]The Making of Steel, American Iron and Steel Institute, 1964, p. 61.

may be grouped in the following classes:

Plates
Includes plates and skelp (steel to be made into pipe);

Sheets
Includes black sheets and black plate (steel to be coated with tin or chrome), and coils (narrow sheets rolled into coils);

Strip
Includes strip (sheets less than twelve inches wide), hoops, ties, and bands (these three items are used to hold coils of sheet and strip together);

Structurals
Includes structurals (beams, channels, and angles), rails, and rolled sheet piling (pipes used for construction of buildings);

Bars
Includes bars, blanks for seamless tubing, rolled sheet axles, rolled blooms and billets for forging, and tie plates and all other finished or hot-rolled products;

Wire
Includes wire rod, wire and wire products.

The first three types are known as flat-rolled products, and the last three as shaped products. The distinction between the three flat-rolled products depends upon the relationship between width and thickness. Briefly, a sheet is a thin, flat-rolled piece of steel twelve or more inches wide; strip is thin, flat-rolled steel twelve inches and narrower in width; a plate is flat-rolled steel one-fourth of an inch or more thick or larger in widths from six inches to forty-eight inches and five-sixteenths of an inch thick in widths over forty-eight inches.

The annual rolling output of the United States for these six types of products for the years 1958 and 1968 are presented in Table III. In 1958, the mills could roll about 65,105,000 tons of unfinished hot-rolled products based on available ingots. Of this capacity 64.2 per cent was for flat-rolled products; while 35.8 per cent was for shaped products.

The production of the mills increased to about 99,015,000 tons by 1968. Of this capacity, 65.4 per cent was for flat-rolled products, while 34.6 per cent was for shaped products. Of the increased capacity of 34,010,000 tons, 67.4 per cent was in flat-rolled products. The data on the table indicates an increase in demand for flat-rolled products. In addition, facilities for producing the flat-rolled products are operated at near capacity. When mill capacities are increased usually two-thirds of the increased tonnage is devoted to flat-rolled products.

TABLE III

COMPARISON OF STEEL PRODUCTION BY TYPE OF PRODUCT

	1958		1968	
PRODUCT	NET TONS	PERCENT	NET TONS	PERCENT
Plate	9,971	15.3	13,883	14.0
Sheet	30,097	46.2	49,129	49.6
Strip	1,760	2.7	1,733	1.8
Flat	41,828	64.2	64,647	65.4
Structural	5,135	7.9	7,164	7.2
Bars	13,800	21.1	22,093	22.3
Wire	4,342	6.7	4,111	5.1
Shaped	23,277	35.8	34,368	34.6
TOTAL	65,105	100.0	99,015	100.0

Source: Statistical Handbook, American Iron and Steel Institute, 1969, p. 53.

Consumption of Steel in New England

The preceeding section indicates that the tendency in steel consumption was for a slight increase in the flat-rolled categories. Employing the trends established in the preceeding section, New England's market is compared to the national market in order to identify any disparities and to estimate the probable product consumption for a proposed mill in New England. Classifying New England's steel consumption into the same categories as was done for the nation indicates a trend toward the consumption of flat-rolled products.

Since the New England market must provide the bulk of the demand for steel tonnage necessary to support a New England mill, careful analysis of steel consumption in New England is imperative. An analysis of such published materials as Iron Age, AISI, and Metals Handbook, indicates a close agreement on the total consumption of steel by New England's industries for the last ten years. The data shows that New England consumed between three to four per cent of the United States' total production of all steel products. Table IV lists the annual shipments of steel from all mills to their destinations for the eleven year period. Based on the average of the three sources (3.3%), New England's consumption would have been approximately 3,031,248 tons for 1968.

TABLE IV

SHIPMENTS OF STEEL PRODUCTS IN THE UNITED STATES

(in thousands of net tons)

1958	60,737	1964	84,945
1959	65,247	1965	92,666
1960	71,149	1966	89,995
1961	66,126	1967	83,897
1962	75,555	1968	91,856
1963	79,207		

Source: Statistical Handbook, American Iron and Steel Institute, 1968, p. 25.

The data in Table V indicates the volume of steel shipments into New England during the 1960's and was compiled from AISI shipping lists to the Boston and New York districts. These statistics are conservative, since not all of the companies report their shipments to the institute. It should be noted that the majority of the tonnage shipped to New England is of the flat-rolled classification. All the products listed are only those of major consequence in relation to the proposed plant.

The Market for Products of a New England Steel Mill

The market for any steel producer is defined by two main factors (1) the selling price of steel at the mill, and (2) the transporation charges for delivery to the consumer. It is assumed that the mill-base pricing system now in effect in the industry will be continued. In other words, under this pricing system the delivered price of steel products to the consumer, under most conditions, clearly defines the market area of a given producer. This delivered price is based on the mill-base price plus transportation charges from the mill to the consumer. Obviously, if a producer has a higher base price on his products than a competing producer, his normal market area is proportionately smaller than it would be with equal base prices. A higher base price (price per one hundred pounds of semi-finished steel) at a New England mill would be contrary to one of the announced reasons for establishing a New England mill--namely, to provide steel products to New England consumers at similar delivered prices (base price plus transportation costs) enjoyed by consumers in other steel producing areas. All production costs being equal, a lower base price would, of course, reduce the revenue and income of the proposed mill.

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TABLE V A

Shipments of Steel Products to New England (1960)

(In Tons)

	Sheets	Plates	Bars		Structural Shapes	Pipe*	Wire Rods	Drawn Wire	Tin Mill*	Total
Massachusetts										
Hot Rolled	61,073		Carbon	76,769		Standard				
Cold Rolled	91,456	82,756	Alloy	16,585	58,264	Line Over 16"	46,618	75,119		546,161
Galvanized	37,521			93,354		Line Under 16"				
	190,050									
Connecticut										
Hot Rolled	1,557	2,310	Carbon	11,423	3,496		193	5,427		26,773
Cold Rolled	1,867		Alloy	168						
Galvanized	332			11,591						
	3,756									
Rhode Island										
Hot Rolled	8,745	6,033	Carbon	6,893	9,858		-	4,771		47,487
Cold Rolled	7,146		Alloy	2,028						
Galvanized	2,013			8,921						
	17,904									
Maine										
Hot Rolled	1,718	10,276	Carbon	10,439	15,446		14	1,193		45,323
Cold Rolled	68		Alloy	551						
Galvanized	5,618			10,990						
	7,404									
New Hampshire										
Hot Rolled	2,922	3,795	Carbon	2,248	4,946		270	7,002		34,310
Cold Rolled	9,535		Alloy	734						
Galvanized	2,858			2,982						
	15,315									
Vermont										
Hot Rolled	640	929	Carbon	836	4,369		10	706		14,738
Cold Rolled	3,841		Alloy	304						
Galvanized	3,103			1,140						
	7,584					83,000			44,000	
Total	242,013	106,099		128,978	96,379	83,000*	47,105	94,218	44,000*	714,792
										83,000*
										44,000*
									Grand Total	841,792

Source: Geographical Shipments by District, American Iron and Steel Institute, January 1970.

*The above estimates given by the American Iron and Steel Institute's Division of Commercial Research, January 1970, Geographical Shipments by District

TABLE IV B

Shipments of Steel Products to New England (1965)

(In Tons)

	Sheets	Plates	Bars		Structural Shapes	Pipe*	Wire Rods	Drawn Wire	Tin Mill*	Total
Massachusetts										
Hot Rolled	56,773	118,294	Carbon	84,947	65,506	Standard	51,793	56,142		582,583
Cold Rolled	83,675		Alloy	26,766		Line Over 16"				
Galvanized	38,687			111,713		Line Under 16"				
	179,135									
Connecticut										
Hot Rolled	1,941	10,678	Carbon	19,901	12,009		232	1,154		47,966
Cold Rolled	1,135		Alloy	775						
Galvanized	141			20,676						
	3,217									
Rhode Island										
Hot Rolled	12,093	9,338	Carbon	10,146	9,586		-	3,321		60,445
Cold Rolled	11,025		Alloy	2,009						
Galvanized	2,927			12,155						
	26,045									
Maine										
Hot Rolled	2,992	14,204	Carbon	14,179	20,453		113	1,275		59,986
Cold Rolled	186		Alloy	1,344						
Galvanized	5,240			15,523						
	8,418									
New Hampshire										
Hot Rolled	12,404	6,803	Carbon	2,329	6,704		200	11,078		72,782
Cold Rolled	24,024		Alloy	2,077						
Galvanized	7,163			4,406						
	43,591									
Vermont										
Hot Rolled	457	1,095	Carbon	902	6,170		-	1,294		17,633
Cold Rolled	2,087		Alloy	721						
Galvanized	4,907			1,623						
	7,451					124,000			57,000	
Total	267,857	160,412		166,096	120,428	124,000*	52,338	74,264	57,000*	841,395

Source: Geographical Shipments by District, American Iron and Steel Institute, January 1970.

*The above estimates given by the American Iron and Steel Institute's Division of Commercial Research, January 1970, Geographical Shipments by District

TABLE V C
Shipments of Steel Products to New England (1968)
(In Tons)

	Sheets	Plates	Bars		Structural Shapes	Pipe		Wire Rods	Drawn Wire	Tin Mill*	Total
Massachusetts											
Hot Rolled	66,122	117,799	Carbon	55,710	74,040	Standard	32,368	54,917	36,926		595,151
Cold Rolled	79,063		Alloy	24,470		Line Over 16"	7,280				
Galvanized	32,217			80,180		Line Under 16"	14,239				
	177,402						53,887				
Connecticut											
Hot Rolled	158,956	76,329	Carbon	21,005	13,507	Standard	16,146	27,559	27,084		498,650
Cold Rolled	89,313		Alloy	29,587		Line Over 16"	312				
Galvanized	27,330			50,592		Line Under 16"	11,522				
	275,599						27,980				
Rhode Island											
Hot Rolled	14,255	11,775	Carbon	5,428	6,796	Standard	7,591	-	3,321		70,580
Cold Rolled	14,282		Alloy	1,601		Line Over 16"	365				
Galvanized	2,533			7,029		Line Under 16"	2,633				
	31,070						10,589				
Maine											
Hot Rolled	2,225	16,630	Carbon	12,678	16,861	Standard	6,633	-	880		61,558
Cold Rolled	334		Alloy	1,170		Line Over 16"	131				
Galvanized	3,589			13,848		Line Under 16"	427				
	6,148						7,191				
New Hampshire											
Hot Rolled	12,511	7,787	Carbon	4,860	12,277	Standard	2,290	355	8,242		77,627
Cold Rolled	19,914		Alloy	978		Line Over 16"	26				
Galvanized	7,001			5,838		Line Under 16"	1,386				
	39,426						3,702				
Vermont											
Hot Rolled	437	910	Carbon	613	5,088	Standard	2,007	-	963		17,188
Cold Rolled	1,874		Alloy	172			-				
Galvanized	4,658			785		Line Under 16"	466				
	6,969						2,473				
Total	536,614	231,230		158,272	128,569		105,822	82,831	77,416	59,000*	1,320,754
											59,000*
										Grand Total	1,379,754

Source: Geographical Shipments by District, American Iron and Steel Institute, January 1970.

*The above estimates given by the American Iron and Steel Institute's Division of Commercial Research, January 1970, Geographical Shipments by District

The surveys of the market are confined to the six New England states and the adjacent metropolitan area of New York City and northern New Jersey. In times of acute shortage of steel, steel from the New England mill might be sold in many other places in the United States. The possibility of water shipment to the South Atlantic, Gulf and Pacific coasts may be considered, but it is believed that the existing steel mills are more favorably situated and are able to meet the competition of a New England mill in such distant markets. Consequently, these distant regions cannot be considered within the normal market region of the projected New England steel mill.

It is believed that export markets for United States producers cannot be ruled out. There has been a general lack of American exports in the past, but this tendency has been reversed in recent years. Exports were up some one million tons in 1968 and the trend is the same for 1969. Iron Age says, "December exports accounted for nearly ten per cent of the tonnage shipped by domestic mills. . . exports are as strong as ever . . . best year since 1957".[2] Import tariffs are becoming more strict, and with the advent of voluntary export quotas on the part of foreign countries the export market cannot be dismissed, but it must be realized that the United States will have considerable tonnages of foreign steel in its markets at prices often lower than domestic prices. European prices are on the average six per cent lower than American prices while the Japanese prices are fourteen per cent lower.

Consumption of Steel in Metropolitan New York and New Jersey

The metropolitan New York and northern New Jersey area is a

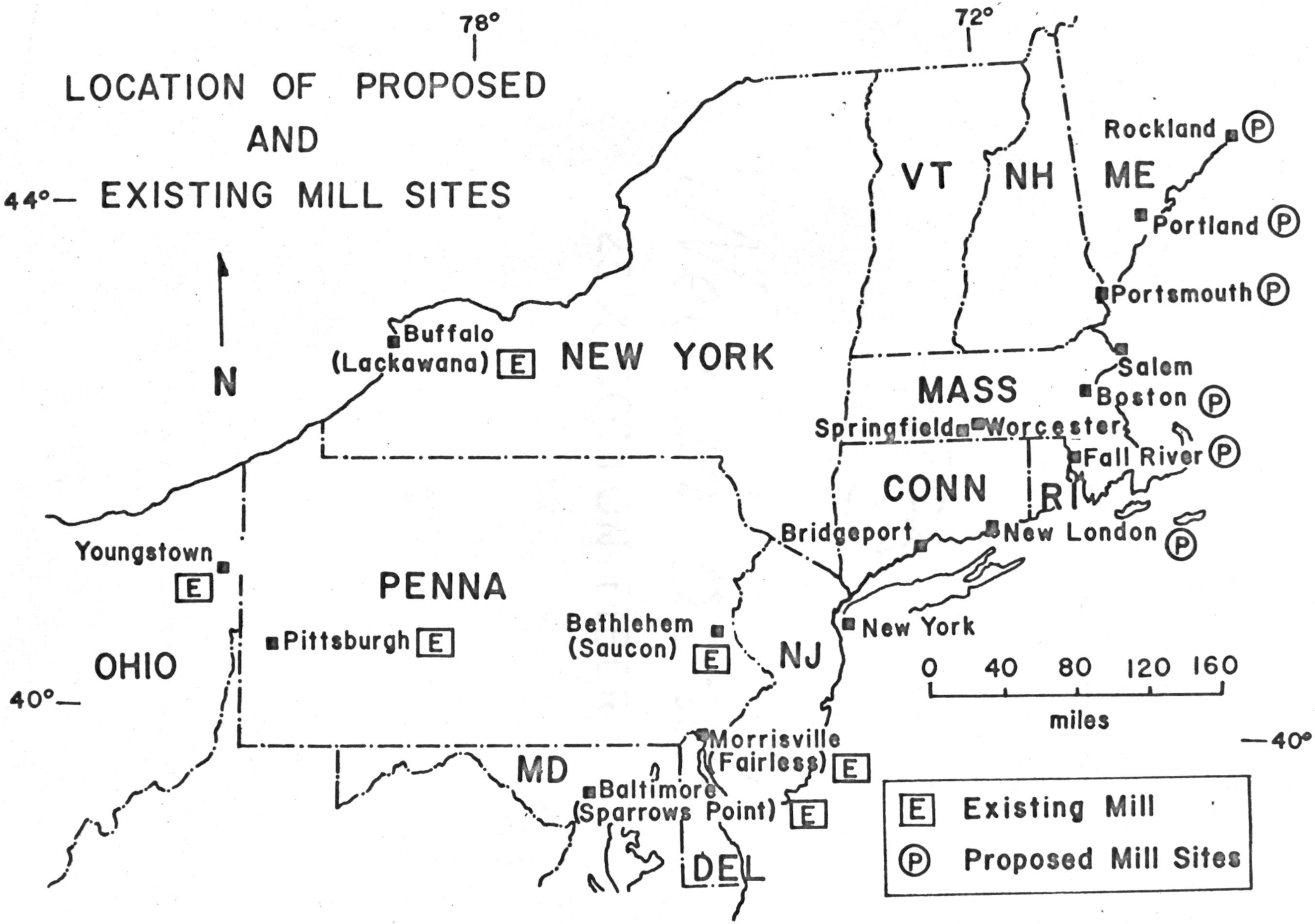
[2]"Steel Summary," Iron Age, Vol. 205 No. 12 (March 19, 1970), p. 89.

marginal market for any mill located in New England. It is ironic that this area is the largest consumer of steel in the country having no steel producing facilities of its own in the immediate vicinity. However, there is competition for this market from Morrisville, Sparrows Point, Pittsburgh, Youngstown, and Buffalo (see Fig. 1). The only plant having a locational advantage over a New England mill, based on transportation costs, would be United States Steel's Fairless Works, located outside of Morrisville, Pennsylvania. Their products are delivered to the metropolitan area with a rail freight charge lower than that of a potential New England mill. New England's mill would be a marginal supplier of steel in the New York metropolitan market with a transportation cost lower than Sparrows Point, Pittsburgh, and Youngstown. With the standardization of the quality of steel products, freight differentials in a normal market situation are difficult for any producer to overcome.

Table VI is included to provide the reader with an insight into the type of market and tonnage involved in the metropolitan New York and northern New Jersey market, since these areas will be important to the economic success of a New England mill. This table illustrates the significance of flat-rolled products. Three of the four largest products by tonnage shipped are flat-rolled products. It is not inconceivable that a New England mill could gain considerable tonnage from this large market.

Irrespective of freight differentials, a New England mill should expect to capture a certain portion of the steel market in the New York-New Jersey area. For this reason it is necessary to examine the volume and nature of consumption in this market and to estimate the extent of possible participation of the projected New England mill in the New York-New Jersey market. The metropolitan New York and northern New Jersey area consumed approximately four per cent of the total steel consumed in the

Figure I


LOCATION OF PROPOSED
AND
EXISTING MILL SITES
78°
72°
44°
40°
40°
N
NEW YORK
VT
NH
ME
MASS
CONN
RI
PENNA
OHIO
NJ
MD
DEL
Rockland P
Portland P
Portsmouth P
Salem
Boston P
Fall River P
New London P
Springfield
Worcester
Bridgeport
New York
Buffalo
(Lackawana) E
Youngstown
E
Pittsburgh E
Bethlehem
(Saucon) E
Morrisville
(Fairless) E
Baltimore
(Sparrows Point) E
0 40 80 120 160
miles
E Existing Mill
P Proposed Mill Sites

United States in 1968, or approximately 5,200,000 tons. Some of the largest consumers and warehouses in the United States are located in this area.

TABLE VI

STEEL CONSUMPTION IN

METROPOLITAN NEW YORK AND NEW JERSEY, 1968

(Thousand Net Tons)

Product	New York/New Jersey
Structural Shapes	312,188
Plates	200,132
Bars	191,244
Wire/Rods	138,604
Sheets and Strip	841,307
Tin Mill Products	440,000
Butt-Weld Pipe	117,000
All other	96,000
TOTAL	1,940,475

Source: Geographic Shipments by District, American Iron and Steel Institute, 1968.

Field Survey of the New England Market

The magnitude of the current New England market for steel products under existing conditions has been determined by the foregoing anlaysis, but the allocation of this total between the several steel mill products and the prospective market which a New England steel mill might enjoy can be determined only be field work.

The George D. Hall Company of Boston annually published a "Directory of New England Manufacturers". The 1969 edition of this directory indicates that there are more than 3,000 concerns in the six New England states which use steel products of all kinds and sizes. It was learned however, that there are many minor steel consumers in this region which are not listed in the New England directory.

In order to ascertain the character of the New England market, two representative metal-working centers were selected for intensive analysis. Worcester and Springfield were chosen as the most suitable areas for the concentrated study because they are diversified metal-working communities of medium size with well-defined metropolitan areas. The selections were made from the twelve largest metropolitan areas in New England, which are listed below.

TABLE VII

MAJOR METAL WORKING CITIES IN NEW ENGLAND

Twelve largest S.M.S.A.* in New England	City	Metropolitan Area
Boston	570,000	2,680,000
Providence	171,000	875,000
Worcester	175,000	342,000
Hartford	159,000	677,000
New Haven	139,000	476,000
Springfield	160,000	535,000
Bridgeport	151,000	375,000
Fall River	96,000	149,000
Cambridge	102,000	
New Bedford	97,000	148,000
Somerville	80,000	
Lowell	88,000	200,500

*Standard Metropolitan Statistical Areas

Source: 1970 Commercial Atlas and Marketing Guide, Rand McNally and Company, 143.

Worcester and Springfield Survey

A list was prepared from the locational section of the "Directory of New England Manufacturers" and the city directories of Worcester and Springfield of firms which were apparent steel consumers according to the description of the manufacturing processes given in these directories. This list included manufacturers, city and country government purchasing authorities, public utilities companies and construction companies. Contacts were also established with the Worcester and Springfield Chamber of Commerce and with the purchasing agent of Brown and Wales Company (a large warehouse dealer which has operated in the Cambridge-Worcester areas for more than one hundred years) for suggested changes in the list. Each of these organizations was extremely helpful.

Interviews were employed to supplement the steel statistics gathered from various sources in order to gain insight to New England's steel market. During the interviews with the executives of the steel consuming firms selected for sampling, information was gathered on the following subjects:

1. Quantity and kind of steel mill products consumed;
2. Present sources of supply;
3. Attitude toward the establishment of a New England mill;
4. Proportion of purchases that might be placed with a New England mill; and
5. Import problem.

In the course of the interviews it was rare to encounter a person who refused to discuss these matters. Seventy-five interviews were held in the Worcester area and forty in the Springfield area. Eighty-six per cent of the executives interviewed favored the establishment of a New England steel mill and indicated that the prospective participation would be about fifty per cent of the total sales. Fourteen per cent responded negatively, stating that their present suppliers were good enough and that they would not desire to make any changes in their present patronage.

The majority of steel tonnage, with which the consumers were concerned, was flat-rolled products (sheet, plate, tin-mill) and structurals. They were generally satisfied with the performance of their current suppliers but they were not overwhelmed. Generally the interviewees felt that they were out of the mainstream of the United States Steel industry. As a result they have had to turn to foreign producers in times of peak steel demand in the United States in order to be assured of deliveries. Having a steady supply of steel is essential. A New England mill could solve the problem. As mentioned previously a participation rate of fifty per cent from New England consumers would be expected. Contrary to the theory of supplier diversification buyers in the immediate vicinity of steel mills have been known to purchase as much as ninety to ninety-five per cent of the needs from the local producer.

New England Survey

On a nationwide basis, warehouses receive about eighteen per cent of the total steel shipments. It is believed, therefore, that the most feasible means of analyzing the New England market as a whole was to study the consumption patterns of the large users of steel and the purchases of the warehouses.

A list of large users of steel mill products in New England was prepared from Hall's Directory of New England Manufacturers. This list was based on the Worcester and Springfield experiences and was supplemented by consultation with qualified persons, such as warehouse salesmen, purchasing agents and vice-presidents of steel consuming companies. The warehouses were selected from the members of the American Steel Warehouse

Association, Inc. In all, calls were made to fifty large users and sixteen warehouses.

The New England survey of major consumers and warehouses substantiated the already established product trend (an increased tonnage of flat-rolled products over shaped products). The consumers relied on large inputs of sheet, strip, and plate. Some of these large consumers are: General Dynamics, Westinghouse, General Electric, and the Boston and Main and Central Vermont Railroads. These major consumers stated they would follow the purchasing rate of fifty per cent that was identified in Worcester and Springfield. It must be emphasized that the interviews were with purchasing agents and not the Board of Directors who control such decisions.

Imports

The importation of steel products from world sources to New England reached an all-time high in 1968 of 392,945 tons. However, this figure declined by twenty per cent in 1969 due to the increase in world-wide demand for steel.

During the course of the interviews, the question of imports was posed to the consumers. In all cases the reason for foreign steel consumption was the price, but there were underlying reasons. Many establishments felt they were overlooked by the United States steel companies. Production sites are quite distant from New England, orders are often late, and claims and service are rendered reluctantly were other reasons given by consumers for patronizing foreign steel producers.

A New England mill would hopefully solve many of the problems currently plaguing New England consumers. The following table (Table VIII), gives the tonnage by import district for New England. This table

TABLE VIII

FOREIGN IMPORTS OF IRON AND STEEL PRODUCTS BY CUSTOMS DISTRICT
(Net Tons)

	1965		1968	
	Boston	Providence Bridgeport	Boston	Providence Bridgeport
Sheets -				
Hot Rolled	3,690	14,018	12,467	39,962
Cold Rolled	14,727	17,423	20,260	99,810
Galvanized	2,955	261	13,868	4,183
	21,372	31,702	46,595	143,952
Plates	4,685	5,322	8,061	9,020
Structurals	21,757	21,145	17,739	49,124
Bars -				
Hot Rolled	9,549	4,588	7,726	6,958
Alloy	1,573	---	1,056	496
	11,122	4,588	8,782	7,454
Wire Rods	32,571	44,315	13,538	65,515
Drawn Wire	1,495	9	5,491	139
Pipe	8,891	---	13,977	3,558
TOTAL	101,893	107,081	114,183	278,762
Grand Total	208,974		392,945	

Source: C-14 Papers, American Iron and Steel Institute, 1968.

indicates foreign imported steel totals more than a third (392,945) of the domestic sources 1.4 million tons of steel in New England, or just under one-third of the consumption in New England. Of course not all of the imported tonnage remains in the New England area, but it is obvious from the above figures that imports are of a major importance in the New England area's market. Of course not all of this tonnage would be captured from foreign steel producers, but this is again a reason why the estimates given in Table XII, page 83, are a conservative estimate of the possible tonnage for the proposed mill. The estimated tonnage is conservative because it is likely that consumers will alot more than fifty per cent of their tonnage to a New England mill and there is no way to estimate how much tonnage could be taken from New England's foreign suppliers.

The main focus of this chapter has been on the steel industry of the United States and New England. The United States' steel production is presently in the area of 130,000,000 tons (1968). Of this tonnage, the finished steel products (plates, sheets, strip, structurals, bars, and wire products) shipped account for approximately 99,015,000 tons. The majority of this tonnage was of the flat-rolled category (sheet, strip, tin mill products, and butt-weld pipe).

Interviews were made with a large number of New England consumers and eighty-six per cent favored the proposed mill. The consumers stated that nearly fifty per cent of their purchases would be made from a supplier located in New England and that major consumers in metropolitan New York/ New Jersey would probably give fifteen to twenty per cent of their orders to the proposed mill.

Imports are a problem in New England. The field survey also revealed the consumers would rather purchase from a United States supplier but current problems in deliveries of orders and service of domestic plants forced them to turn to foreign suppliers. It is not inconceivable that a New England mill could capture some of the foreign steel tonnage.

The following chapter will present a detailed study of the proposed mill's location within the New England market region. Potential sources of raw materials for the New England steel mill will be evaluated.

CHAPTER IV

LOCATION INFLUENCES ON THE PROPOSED NEW ENGLAND STEEL MILL AND POSSIBLE STEEL-MAKING FACILITIES

In the preceeding chapter a product analysis was completed in order to establish trends in the consumption of steel products. There was an indication from this analysis that the consumption of flat-rolled products had increased over the years. As a region New England is no exception, also increasing in its consumption of flat-rolled tonnage.

The present chapter discusses a potential location for an integrated New England mill, its facilities and the raw materials needed for operation. At the present time there is one non-integrated mill producing specialty steel at Bridgeport, Connecticut. This mill is the only iron and steel mill of any kind in New England. The final decision for a mill site, the criteria desired in a mill site and the reasons for eliminating other proposed sites is also discussed.

The Potential Mill Site

The final decision by this study, for the location of the mill site was New London, Connecticut, after consideration had been given to several locations, principally along the New England seacoast. This location is one of the sites identified by Isard in his 1950 study, "New England as a Possible Location for an Integrated Iron and Steel Works". Isard concluded that, "The cost of shipping raw materials to New London and delivering the finished product to New York City is roughly two dollars cheaper than any of the proposed sites".[1] Other important cities which were given consideration were Portsmouth, New Hampshire; Portland and Rockland, Maine; and Worcester, Fall River, and Salem, Massachusetts. All of the above cities have developed port facilities except Worcester. Worcester was a potential site because of its developed metal industries. Portsmouth, Portland, and Rockland were ruled out because their locations were too far from the largest concentrations of consumers, i.e. Connecticut, Long Island, and New Jersey. Worcester is located some fifty miles from the nearest seaport (Boston). This location would necessitate a break-in-transportation from water to rail, making the movement of raw material inputs too expensive. Fall River and Salem have favorable seaboard locations, but there is no available shoreline upon which a mill could be constructed. New London was selected for the following reasons:

1. Location on the tidewater;
2. Several sources of fresh water;
3. Service by two railroads--Penn Central and Central Vermont;
4. Good roads for transportation by truck;
5. Forty per cent of all working man-hours in the New England states are consumed in the metal-working industry, fifty per cent of which are consumed in the state of Connecticut (proximity to the main New England market);
6. Desirability of locating the site as near to the New York market as possible without reducing its cost advantages in the New England states.

Raw Materials

In the analysis of production costs it is assumed that the principal raw materials for the proposed New England steel mill--iron

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[1]Walter Isard and John Cumberland, "New England as a Possible Location for an Integrated Iron and Steel Works," Economic Geography, XXVI, (October, 1950), p. 257.

ore, coal, limestone, and scrap--would all be purchased from suppliers in or outside of New England and would be subject to the prevailing price levels. However, certain favorable arrangements might be made for the acquisition of mining properties or participation may be undertaken with owners for their development. Note must be made of the fact that all of these materials would normally be purchased under long-term contracts, and because this mill is not now in the market, no firm prices or transportation charges could be assured or obtained. The bulk of the materials would be delivered by the cheapest mode, i.e., water.

Iron Ore

At capacity operation it is estimated that approximately 1,500,000 net tons of iron ore per year would be required for an integrated steel mill at the New London site, serving the anticipated New England market. Under present conditions there is a world wide shortage of iron ore. Any additional production must come principally from the further expansion and development of exisitng mines or the opening of new ones. The following review of the principal sources of iron ore is made for the purpose of indicating the nature of the problem of obtaining an adequate supply of iron ore for the proposed New England mill. It should be noted that currently, "It takes approximately 1.6 tons of iron ore to make a ton of pig iron".[2]

Newfoundland

The Wabana mines on Bell Island, in Conception Bay, owned and operated by Dominion Steel and Coal Corporation, have been seriously considered as a source of supply for a New England mill (Fig. II). Present

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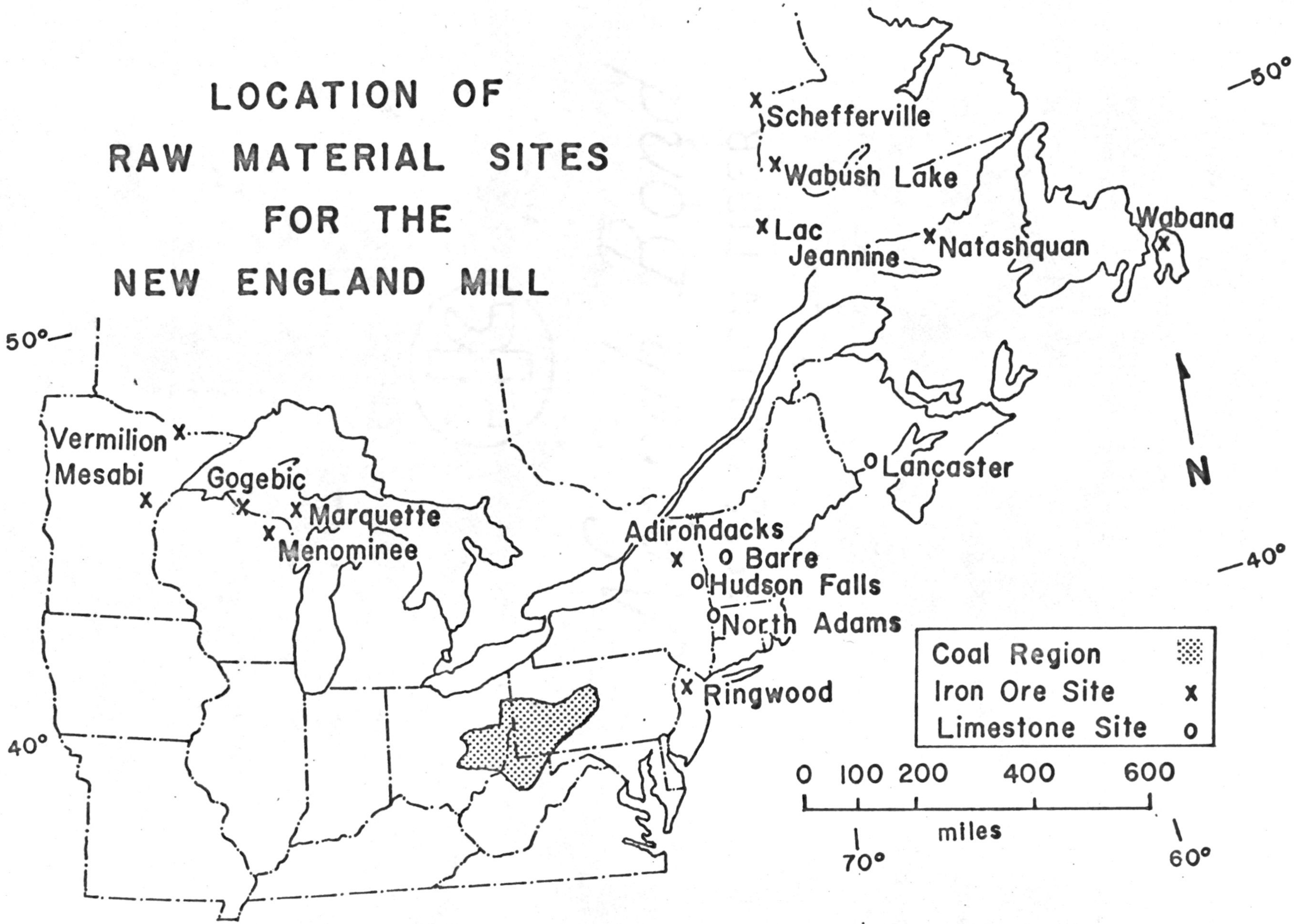
[2]The Making of Steel, American Iron and Steel Institute, 1964, p. 61.

Figure II


LOCATION OF
RAW MATERIAL SITES
FOR THE
NEW ENGLAND MILL
Schefferville
Wabush Lake
Lac
Jeannine
Natashquan
Wabana
Lancaster
Adirondacks
Barre
Hudson Falls
North Adams
Ringwood
Vermilion
Mesabi
Gogebic
Marquette
Menominee
Coal Region
Iron Ore Site x
Limestone Site o
0 100 200 400 600
miles
50°
40°
50°
40°
70°
60°
N

production, and that to be developed in the near future, is predominantly consumed by the Dominion's steel mill in Sydney, and by British and German interests. Additional production could be developed if the purchaser of such ore would be willing to make the necessary capital investments. The American Iron Ore Association has described the iron reserves here in the following manner, "Although it is impossible to determine ore reserves in submarine mining (all Wabana mining is conducted under the sea), such exploration that has been possible indicated probable reserves of over 300,000,000 tons."[3] The A.I.O.A. has further described the ore as a, "refractory hematite with an iron content of about fifty-two per cent and has a high phosphorous and silica content and is very low in manganese".[4] The silica is chemically combined in the ore and cannot be removed by washing. The use of this ore presents a metallurgical problem in comparison with Lake Superior ore. There is no doubt, however, that good steel can be made with this ore, but other sources are probably more attractive from the standpoing of production and capital costs.

Venezuela

The most extensive iron ore developments in South America are under way in Venezuela. United States Steel Corporation is developing a concession containing upwards of one billion tons of high-grade ore at Cerro Bolivar and a second deposit, about one hundred million tons, thirty miles south of San Feliz on the Orinoco. Isard evaluated Venezuela ore for a New England mill in the following manner, "However, it is not

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[3] World Iron Ore Reserves, American Iron Ore Association, 1969, p. 61.

[4] Ibid.

inconceivable that a New England mill could obtain ore from this country".[5] This statement is not outdated. In 1961 Bethlehem Steel Corporation acquired ore deposits here and there are still ample reserves left.

Labrador

The Iron Ore Company of Canada, formed by Hollinger-Hanna Limited and five American steel companies--Republic, Armoc, National, Wheeling, and Youngstown Sheet and Tube Company--is developing large deposits of high grade iron ore in Quebec and Labrador near Knob Lake about 350 miles north of the St. Lawrence River at Seven Islands. Because of the climatic conditions, it is planned to operate mines and railroads six months per year and the ore terminal at Seven Islands seven to eight months per year. This ore is the most promising for a New England steel mill because of its quality and possibility of transportation by water.

Domestic Sources

All sources of present production of iron ore are taxed heavily (state real estate), none more so than those in the United States. The most serious difficulty is a result of the shortage of transportation facilities, both water and rail. Although additional vessels are being built, it is doubtful if the increase in shipping capacity can meet the added demand. Railroads are finding it increasingly hard to raise capital for the building of new railroad cars. The purchase of any Lake ore during the next few years appears to be dependent upon the availability of transportation. Two non-Great Lake sources have also been considered, the Ringwood Mine in northern New Jersey and also the Jasper ores located

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[5]Isard and Cumberland, "New England as a Possible Location for an Integrated Iron and Steel Works," p. 259.

in the Continental Shelf off the New England coast (Fig. II). The latter may be a future possibility, but little research has been done on the topic.

Ringwood

Deposits amounting to several million tons of a combination of magnetite and hematite iron ore with a content of fifty-three per cent iron were mined for a few years prior to 1931, in northern New Jersey. During World War II the United States government financed the construction of a preparation plant and other improvements, but no appreciable production resulted before the end of the war when operations were suspended. A detailed survey of this property would be required to determine whether it would be a suitable source of ore for a New England mill.

Natashquan

There are several deposits of iron-bearing sands (15-25%) along the north shore of the St. Lawrence River and St. Lawrence Gulf between the Seven Islands and Gethsemani (Fig. II). The American Iron Ore Association locates and evaluates these deposits as, "The most important of these is at Natashquan, at the mouth of the Great Natashquan River, about 530 miles east of Quebec City and due north of the eastern end of Anticosti Island".[6] The property is in the form of a beach with sand dunes; the sands are practically in a free state and can be concentrated by means of washing and magnetic separation. A detailed study of these deposits would be required to determine their extent and the cost of mining and preparation.

Coal

Each ton of pig iron produced requires a blast furnace charge of

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[6] World Iron Ore Reserves, American Iron Ore Association, 1969, p. 72.

1300 pounds of coking coal. The importance of coal to ferrous metallurgy is indicated by the fact that, "Coal supplies more than eighty per cent of the iron and steel industry's total heat and energy requirements".[7] During the coking process, the coke furnace will yield 1,200 to 1,600 pounds of coke for every ton of coal, depending on the quality of the coal.

West Virginia, Pennsylvania, Kentucky, and Alabama supply more than ninety per cent of the bituminous coal used in the steel industry, but coal of coking quality is mined in twenty-four states, including Ohio, Illinois, Indiana, Utah, and Virginia. Some of these coals present certain problems for the steel industry since they contain excessive amounts of sulfur.

There are great demands for the high quality coking coals, especially those mined in Kentucky and West Virginia, the states which would be the most acceptable suppliers for a New England mill on the basis of the minimization of transportation costs (Fig. II). A New England steel mill would have the same problems of purchasing suitable coking coal from the West Virginia fields as many public utilities and blast furnaces now experience. Approximately 937,250 net tons of coke are required for full capcity operation of the projected New England steel mill. It is believed that such tonnage can be purchased from existing mines, with the possibility that part or total ownership of the necessary mining properties would provide a more reliable source of coal.

Limestone

Limestone is a fluxing element. A flux neutralizes or forms slag

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[7] Making of Steel, American Iron and Steel Institute, 1964, p. 16.

with unwanted impure materials. When the heat (furnace load) is melted the iron is separated from the extraneous material by being attracted to the flux. One expert feels that, "At capacity operation it is estimated that approximately 200,000 net tons of limestone per year will be required".[8] For steel to be manufactured properly, "a ton of pig iron needs .2 of a ton of limestone".[9] Adequate supplies of limestone are not available in the New London area. Possible sources are located in Vermont, southwestern New Brunswick, and in the Hudson Valley in New York (Fig. II). A large deposit of high-calcium content limestone is located in New Brunswick, about five miles south of St. George, near the Maine border. The deposit is on the tidewater in L'Etang Harbor on the Bay of Fundy. The sea distance is about 425 miles from New London. A quarry operated by the Callanan Road Improvement Company at South Bethlehem, twelve miles southwest of Albany, is presently supplying limestone to the Troy Furnace of Republic Steel Corporation. Some information is available on quarries on the Vermont Marble Company at Proctor, Vermont, and another quarry at Adams, Massachusetts, but the rail freight rates are so high as to make these sources unattractive in comparison with the New Brunswick and Hudson Valley deposits.

Steel Scrap

Scrap is very important in the manufacturing of steel. As has been noted, "The use of scrap as a raw material has grown to such an extent that nearly as much scrap as pig iron is used".[10] In fact,

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[8]Walter Toner, Senior Sales Engineer, Bethlehem Steel Corporation, interview held prior to Annual Sales Meeting of the Bethlehem Steel Corp., Boston, Mass., February 10, 1970.

[9]Making of Steel, American Iron and Steel Institute, 1964, p. 16.

[10]Making of Steel, American Iron and Steel Institute, 1964, p. 16.

"Approximately .05 tons or more may be used in the manufacturing of a ton of pig iron".[11] Naturally, steel mills are the best generators of scrap since approximately thirty per cent of all scrap originates from the original melting of the heat into ingots, billets, and other products. Open hearth and electric furnaces consumed approximately eighty-five per cent of the scrap tonnage in 1968.

The New England states consume about three to four per cent of the steel products used in the United States and create about ten per cent of the steel scrap which amounts to approximately 915,830 tons per year. The apparent excess can be explained by the number of automobiles scrapped and corresponding use of steel mill products in the region.

Steel scrap is consumed in New England by the steel-making industry and by metal foundries in localities where scrap is cheaper than iron. An excess of scrap over and above local demands appears to have been a dominant theme in New England, and this excess has found its way to the steel-making centers. Historically the price of scrap in New England is as much as ten dollars per ton below the Pittsburgh price since New England scrap has to be competitive after delivery to the steel-making centers. A steel executive has concluded that, "At capacity operation of the proposed steel mill, it will require about 74,000 tons of purchased scrap per year".[12] This is widely available in the New England region.

The above raw material figures were based on a total steel tonnage capacity of 865,150 tons for the projected New England mill. The reason for this amount of tonnage is due to a twenty to thirty per cent

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[11] Ibid.

[12] Walter Toner, Senior Sales Engineer, Bethlehem Steel Corporation interview held prior to Annual Sales Meeting of the Bethlehem Steel Corp., Boston, Mass., February 10, 1970.

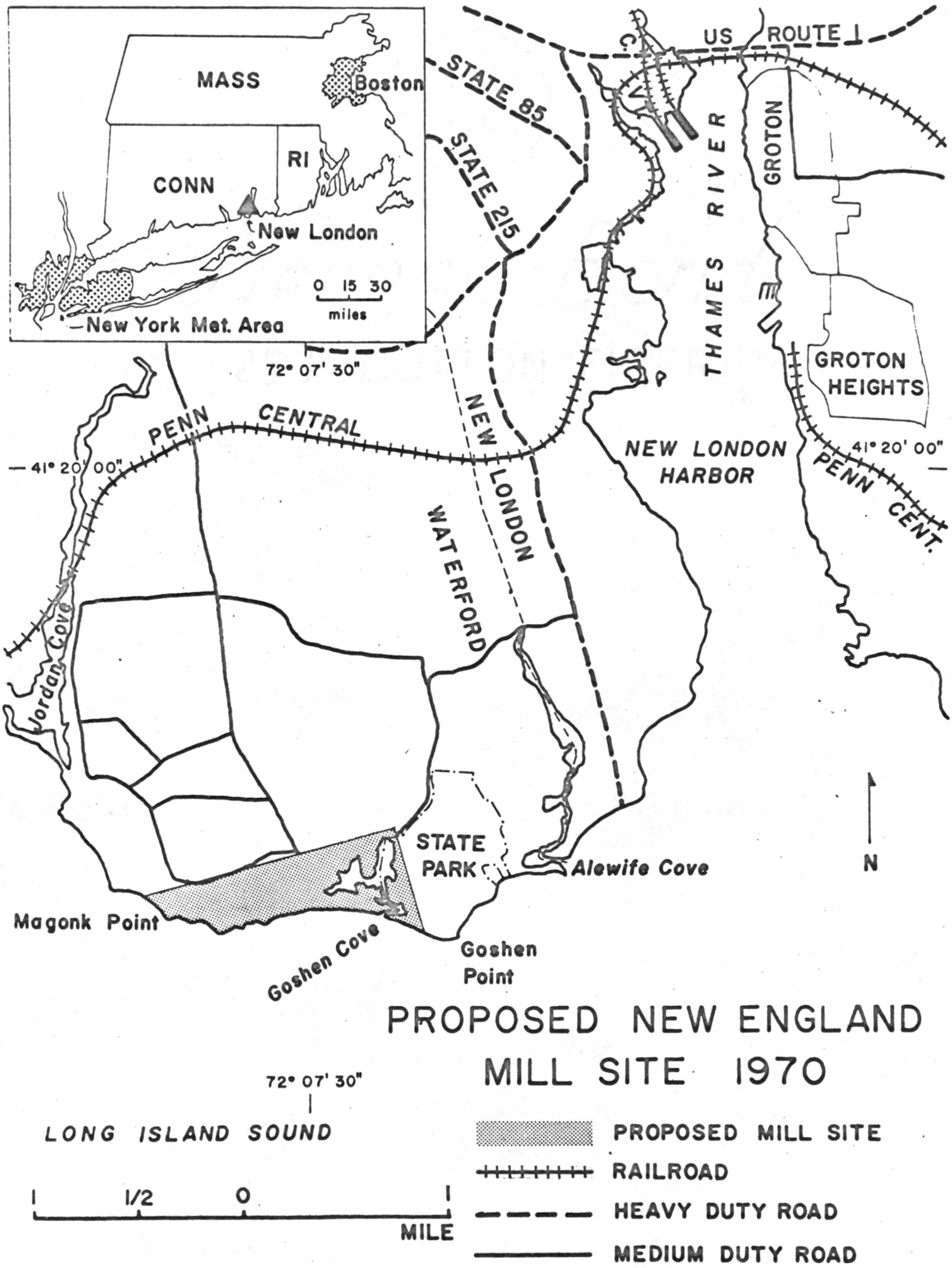
MASS
Boston
CONN
RI
New London
0 15 30
miles
New York Met. Area
US ROUTE 1
STATE 85
STATE 215
THAMES RIVER
GROTON
GROTON HEIGHTS
72° 07' 30"
PENN CENTRAL
41° 20' 00"
NEW LONDON HARBOR
PENN CENT.
NEW LONDON
WATERFORD
Jordan Cove
STATE PARK
Alewife Cove
N
Magonk Point
Goshen Cove
Goshen Point
PROPOSED NEW ENGLAND MILL SITE 1970
LONG ISLAND SOUND
1 1/2 0 1
MILE
PROPOSED MILL SITE
RAILROAD
HEAVY DUTY ROAD
MEDIUM DUTY ROAD

Figure III

loss in steel tonnage through rolling and cutting. Therefore, based on an estimated New England market of 605,585 tons (Table XIII), 865,150 tons of crude steel would be required, assuming a thirty per cent loss in processing.

Description of the Steel Mill Site

The site proposed in this study, is located on Long Island Sound on a peninsula between Jordon Cove on the west and New London Harbor on the east (Fig. III). It is situated in the town of Waterford, Connecticut. For the construction of an integrated steel mill more than 1,000 acres would be required. The topography and transportation conditions of the immediate vicinity are clearly visable on Fig. III. The main line of the Penn Central Railroad between New York and Boston passes within one mile of the site, and a connection can be made with the Central Vermont Railway which passes through New Haven. Deepwater navigation is possible along the southwestern portion of the site, and the dock and anchorage facilities could be protected by suitable breakwaters.

Water Supply

There are several possible sources of water for the proposed mill. Salt water can be used for cooling at the blast furnace, open hearth, and the power plant. Fresh water could be obtained from neighboring streams with the construction of storage dams, pipelines and pumping stations. Jordan Brook, emptying into Jordan Cove on the west side of the site, could easily be dammed at the mouth of the cove. Several dams could be constructed along Latimers Brook, which flows into the Niantic River at Golden Spur, about five miles northwest of the site. Hunts Brook, flowing into Millers Pond, about seven miles north of the site could be impounded by a dam in the narrow part of the valley.

One expert maintains that, "The estimated requirement for fresh water is about 15,000,000 gallons per day",[13] at a mill of the size projected for Waterford, Connecticut. Much less than this amount is necessary if the bulk of the water is reclaimed by recirculation through a cooling and purifying system where the make-up requirements are only about three per cent of total circulation. There are also means of purifying salt water, such as those that are being used at the Sparrows Point and Fairless Works. Thus, indications are that, "Between the fresh water streams and salt water purification it would appear that an adequate water supply is available or could be developed with little difficulty".[14]

It should be noted that some public criticism might arise in regard to environmental quality. The proposed site is in proximity to Harkness Memorial State Park but by modern standards and governmental restrictions steel mills do not desecrate the immediate environs.

Other Facilities

The existing Connecticut State Tuberculosis Sanatorium buildings located on the proposed site could be used advantageously for office space and other purposes, such as a hospital, fire and police quarters, etc. Several structures would be required for machine, electrical, carpenter, pattern, blacksmith, and maintenance shops and for a warehouse. The sanatorium was closed in the fifties.

This report is based on the assumption that the proposed New England mill would be an independent operation, it would secure its own raw materials and have its own administrative, operating and sales organization. It should be pointed out that the prospects of such a mill

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[14] Ibid.

are considerably less favorable, at least in the first few years of its existence, than if it were built and operated as a part of an existing large steel company. The problems of design, construction and initial operation would be reduced, if implemented by an existing firm. Acquisition of raw materials would be much easier. The most important factor favoring development by an established corporation would be a more rapid expansion of the market than would be available to an independent mill. Economies in management and other general expenses accruing to a mill owned by an existing firm should be realized. It is not possible to estimate exactly what the total advantage of outside ownership would be, but the difference might be as much as twenty-five per cent of the operating profit.

Competition

The proposed mill at New London would be competitive with the following mills: Bethlehem's Saucon Valley mill at Bethlehem, Pennsylvania; Bethlehem's Lackawanna mill at Buffalo, New York; Bethlehem's Sparrows Point mill at Baltimore, Maryland; and United States Steel's Fairless Works at Morrisville, Pennsylvania (Fig. II).

It would seem that the eastern market is already saturated with steel mills. However, an analysis of Table IX, indicates that although a mill is fully integrated, it does not necessarily produce a complete line of products. Therefore, a New England mill could be more competitive in the New York market than it would at first appear from observing mill locations only. The New England mill could produce tin mill and sheet products which the Fairless Works plant does not.

The proposed mill has a distinct transportation advantage to all the major consumption areas in New England. As was alluded to in previous chapter a tin mill would be part of the proposed mill facilities. It is obvious from Table IX, that New London's mill would be the sole producer of tin mill products in the entire northeastern market. This would be a very enviable position for any mill.

TABLE IX

THE PRODUCT MIX AT COMPETITIVE MILLS

Saucon Valley

- Structurals
- Tool Steel
- Forgings --Specialty Product
- Castings -- " "

Lackawanna

- Bars
- Sheets
- Shapes
- Plates

Sparrows Point

- Sheets
- Plates
- Rods and Wire
- Pipe
- Wire Strand
- Reinforcing Bars
- Tin Mill Products

Fairless

- Sheets (Galvanized Only)
- Bars
- Bar Sized Angles
- Rods and Wire
- Pipe

Tables X and XI illustrate the different freight rates to various important steel centers from the existing and the proposed mill. The rates are those published for the public and are based on competitive pricing. The mill at New London does not have any rail rates published. Of course, in New England it would be just as cheap to ship by truck due to the short length of the hauls. A distinct possibility exists for obtaining discount rates from truckers. In this case the published truck rates versus actual rates can differ as much as five cents per hundred pounds when x number of truck loads per week are guaranteed to a trucker.

On a product basis (flat-rolled products), it is apparent that New London would only be competitive with Fairless in the metropolitan New York-northern New Jersey area. There is, of course, a large difference

TABLE X

TRUCK RATES TO NEW ENGLAND MARKET FROM STEEL CENTERS (1969)

	Bethlehem	Lackawanna	Sparrows Point	Fairless	New London
Bridgeport (Conn.)	$.42	$.71	$.52	$.35	$.27
New London (Conn.)	$.48	$.79	$.67	$.44	
Worcester (Mass.)	$.66	$.84	$.76	$.57	$.52
Springfield (Mass.)	$.62	$.79	$.74	$.57	$.52
Boston (Mass.)	$.72	$.92	$.85	$.64	$.52
Newark (N. Jersey)	$.25	$.68	$.43	$.20	$.61
Portland (Maine)					$.72

Source: Interstate Commerce Commission Public Rates, Interstate Commerce Commission, Washington D.C., 1969

TABLE XI

RAIL RATES PER 100 POUNDS FOR STEEL PRODUCTS (1969)

	Bethlehem	Lackawanna	Sparrows Point	Fairless	New London
Bridgeport (Conn.)					
80,000 car	$.42	$.68	$.52	$.39	
60,000 car	$.46	$.71	$.55	$.42	
40,000 car	$.49	$.74	$.59	$.46	
New London (Conn.)					
80,000 car	$.49	$.76	$.57	$.47	
60,000 car	$.52	$.81	$.60	$.50	
40,000 car	$.55	$.85	$.65	$.53	
Newark (N. Jersey)					
80,000 car	$.27	$.65	$.43	$.23	$.51
60,000 car	$.29	$.69	$.47	$.23	$.54
40,000 car	$.31	$.72	$.50	$.24	$.57
Boston (Mass.)					
80,000 car	$.57	$.76	$.73	$.56	
60,000 car	$.60	$.81	$.76	$.59	
40,000 car	$.65	$.85	$.80	$.64	
Worcester (Mass.)					
80,000 car	$.55	$.73	$.65	$.51	
60,000 car	$.53	$.69	$.63	$.51	
40,000 car	$.63	$.80	$.72	$.57	
Springfield (Mass.)					
80,000 car	$.50	$.65	$.59	$.48	
60,000 car	$.53	$.69	$.63	$.51	
40,000 car	$.56	$.72	$.66	$.54	
Portland (Mass.)					
80,000 car	$.73	$.87	$.87	$.68	
60,000 car	$.76	$.90	$.90	$.71	
40,000 car	$.80	$.94	$.94	$.74	

Source: Interstate Commerce Commission Public Rates, Interstate Commerce Commission, Washington D.C., 1969 in transportation costs, but with the size of the market and the desire on the part of consumers to divide their inputs from different sources, so as not te be entirely dependent upon one supplier, considerable business should be developed in this area.

Types of Steel Plant Facilities

The product distribution of the tonnage in the New England plant's market area has been studied in order to dtermine what type of facilities would most economically serve the market.

The flat-rolled product mill would be set up as follows:

> "A semi-continuous strip mill can be designed in such a manner that it could produce plates of any desired width out of the roughing stand (shapes plates from the ingots) of the strip mill, and with appropriate finishing facilities, hot-rolled coils and cut lengths of sheet out of the finishing stands after processing through suitable cutting. With the addition of other processing equipment, pipe, tin-plate, zinc and terne coat (steel coated with a solution, 85 per cent lead and 15 per cent tin) could be produced. This arrangement could produce a considerable portion of the steel products in any flat-rolled category."[15]

An arrangement of bar-structural mills can also be designed to make a considerable portion of the steel products in the shaped category, i.e., items that are bent and molded into form. Steel executives believe, "This could be accomplished with four finishing mills, such as a forty-eight inch wide flange mill to roll large structurals, rail products and sheet piling sections as well as billets for the smaller mills".[16] A fourteen inch mill could be installed to produce small structural sections and large bars and a ten inch mill for

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[15]Walter Toner, Senior Sales Engineer, Bethlehem Steel Corporation, interview held prior to Annual Sales Meeting of the Bethlehem Steel Corp., Boston, Mass., February 10, 1970.

[16]Ibid.

small bars and rods. Mills are designated by the width of the material they can roll. Wide flange is simply a designation for structural I-beams of heavier weight per foot than the average.

Coke ovens, blast furnaces, steel-making furnaces and a break down mill would be essential pieces of equipment in the forward ends of the strip and bar-structural plants; while similar in arrangement they would not be identical.

The steel-making furnaces for a flat-rolling plant could be predominantly open-hearth furnaces tapping two hundred tons or more per heat. The furnaces serving a bar plant should be electric furnaces, at least in part, and considering the quantity in which some of the bar grades are ordered, a few of the furnaces should tap one hundred tons or less per heat. Basic oxygen furnaces could be used in place of the large open-hearth furnaces in order to economize on capital investments and space.

The breakdown mill (shapes the ingots) for the flat-rolling arrangement would probably be a slabbing mill capable of spreading and edging the ingots to the appropriate width for the roughing mill and strip mill to finish.

The corresponding breakdown mill for the shaped rolling plant would be a blooming mill to produce square or nearly square sections efficiently. The rolls in such a mill would probably be grooved or shaped to handle specific sections.

It is apparent from this brief description that a compromise mill arrangement capable of producing some flat and some shaped products would result in a sacrifice of ability to serve any one of these purposes to the fullest extent. This is important because, "This may have some economic bearing on the success of the mill, but it is hard to determine to what extent until the mill is in operation".[17]

The steel ingots supplied to the shaped mills would be more expensive than those going to a flat mill because of the small furnaces that would be necessary for its share of the business. The breakdown mill would probably not be able to roll a given tonnage of blooms as fast as a similar mill would roll slabs. Bloom material intended for the smaller mills would require further conversion on a billet mill or on one of the larger mills acting in the place of a billet mill. It is believed the four shaped mills would be asked to roll more than 1,900 different sections in a month. Bar-structurals are not economically produced because, "The setting time for these sections would mean delays and require a minimum of thirty per cent of the available operation hours. When normal mechanical and electrical delays are added, the series of mills would actually roll no more than sixty per cent of their scheduled hours".[18]

It seems that the most suitable mill for consideration is one that rolls flat products. Indications suggest a shortage of these products at the present time. In addition the proportion of flat-rolled products in the total steel rolled has been increasing steadily. The tin plate portion of the business is more stable than any other single steel mill product. In addition, the margin of profit in these products is generally higher than in shaped products. Flat milled products are rolled steadily without making changes in specifications, which necessitate

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[17]Walter Toner, Senior Sales Engineer, Bethlehem Steel Corporation, interview held prior to Annual Sales Meeting of the Bethlehem Steel Corp., Boston, Mass., February 10, 1970.

[18]Ibid.

changes in the mechanics of the mill. Therefore, the profit per ton is greater because of the larger volume.

Due to the limitations on the minimum size of the steel facilities necessary to manufacture products economically, certain products can be eliminated from consideration at the present time. These are shaped products (structural, bars, and wire products) and plate.

Structural products make up a large part of the New York-New Jersey market. At the present time there are five operational mills located in Bethlehem, Pennsylvania, turning our structural products covering the entire range of sections with a rolling capacity of 3,559,000 tons per year. These mills are closer to the New York-New Jersey area than a New England mill. A definite amount of engineering service is required in connection with the sale of this commodity. Competition in this field would be quite risky and of marginal profitability.

New England rod and wire consumers now receive an estimated seventy-five per cent of their requirements from local wire drawers. A New England mill producing wire rods, wire or wire products would be competitive only with existing producers in New England and would not particularly benefit the area.

While the total bar market appears attractive, closer analysis indicates that it would be a difficult market to serve. The total bar tonnage includes hot-rolled carbon, reinforcing, tool steel, and stainless steel. Bars represent about twenty-five per cent of total tonnage consumed in New England. Electric furnaces are required in order to produce the full range of these products, and extremely rigid production and inspection procedures are required. It appears that these products should not be considered for a New England mill. The remaining seventy-five per cent of the

New England market for bar products, is made up of carbon and reinforcing bars. A large part of the reinforcing bar market is served through a New England producer and through warehouses and mill depots affiliated with integrated producers. Similarly, a substantial carbon bar tonnage is handled through a New England cold drawer which is a subsidiary of an integrated steel company. It is the opinion of one steel executive that, "At least two bar mills would be required to serve the New England market adequately".[19] On carbon bars alone there are some sixty-nine standard analysis steel classifications, any one of which may be required as flats, rounds, squares, and other standard or special sections. As steel is competitive on delivery dates it would be extremely difficult in the limited market available to a New England mill to accumulate sufficient tonnage for economical rollings. It is, therefore, recommended that bars should not be considered as a product for a New England mill.

Plate is a flat-rolled product that varies in grade, width, thickness, and length. The slabs for a conventional plate mill are tailored to individual requirements. The repetitive portion of this business that will fit the slab heating furnaces of a strip mill is of limited tonnage. Perhaps ten per cent of the total plate tonnage is of standard size (96" x 240") and this amount will not justify the installation of specialized plate finishing equipment, but it could be added as the operation develops and as demand requires this expansion.

In summation, an integrated New England mill would be the most profitably run if flat-rolled products were produced. Sheets, hot, cold,

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[19]Thomas Gates, Carbon and Alloy Bar Salesman, Bethlehem Steel Corporation, Interview held February 17, 1970.

and galvanized and tin mill products could all be produced from the same mill. Pipe could also be made from the same mill as sheets but different finishing equipment would have to be installed. The sheet mill could be made in such a manner to produce plate if the future market dictated it to be economically sound.

Estimate of the Market for a New England Plant and Probable Participation

In the preceeding section the production of the various steel products was discussed in their relation to the mill's market. It was decided that the mill should produce flat-rolled products (sheet, strip, tin mill products, plate and pipe) except plate, although the mill could be expanded at a later date to produce plate and other shaped products (bars, structurals, wire). The following table (Table XII) indicates the probable participation of the proposed mill's consumers based on the average of fifty per cent participation of primary consumers (New England) and twenty per cent on the part of the marginal consumers (metropolitan New York-New Jersey).

TABLE XII

TONNAGE OF FLAT-ROLLED PRODUCTS

SHIPPED TO THE PROPOSED MILL'S MARKET AREA (1968)

	Primary Market	Marginal Market	Total Estimated Participation
Hot-rolled sheets and cold strips	254,826	227,340	172,881
Cold-rolled sheets	283,282	490,814	239,804
Tin Mill products	59,000	440,000	117,000
Butt-weld products	104,000	117,000	75,400
TOTAL	701,108	1,275,154	605,585

Source: Geographical Shipments by District, American Iron and Steel Institute, 1969 (Mimeographed).

Participation estimates are difficult to make, and the figures may be somewhat conservative, as explained in the previous chapter. This is particularly true at a time when steel is in short supply. However, it is expected that participation in New England would be about fifty per cent and about twenty per cent in the marginal market for sheets, strip, and pipe. Marketing practices are very competitive in the northeastern market area. The existing steel companies have been selling here for years. The problem is further complicated in the New England market by the construction of a large, integrated mill in the Philadelphia area (Fairless Works), which has a lower freight cost than a New England mill on products delivered to the northern New Jersey and metropolitan New York areas.

The participation figures for New England are based on the results of interviews with the largest steel consumers and warehouses in New England. It must be realized that many consumers particularly the larger ones, insist on more than one source of supply in order to be independent from suppliers of steel incase of mill shut downs and price changes. Other consumers have traditional sources of supply, and their value added in manufacture is such that the extra cost of their steel from a more distant producer is not of prime importance. This is particularly true in the New England market. There are many other factors, such as the desire to purchase steel from a producer capable of supplying a full range of steel products, special quality requirements, and the like which narrows down the potential participation of a New England mill in the regional market.

It is felt that the participation figures cited above represent a realistic potential for a New England mill at the 1968 level of business and with anticipated competition. It must be realized that this participation will not be immediately attained in a normal steel market. Purchasers are reluctant to change sources of supply unless there are compelling reasons for them to do so. However, current estimates indicate that the tonnages shown should provide an accurate basis for the purpose of projecting capital and operating costs and evaluating the soundness of constructing an integrated steel mill in New England.

In summation, the final decision by this study for the mill site based on location with regard to the market, raw materials, harbor facilities, transportation media and available land for the mill site was New London. Raw materials would be supplied by Labrador, Newfoundland, and Venezuela (iron ore); New Brunswick and New York (limestone); West Virginia and Kentucky (coal); and New England (scrap). The mill could produce a full range of flat-rolled products with the minor exception of plate.

The proposed New England mill would produce an estimated 605,585 tons of flat-rolled products yearly. This figure was based on the total tonnage of steel shipped to New England and metropolitan New York-New Jersey which was adjusted by the estimated rate of demand by consumers from the proposed mill. Field interviews with company officials indicated that New England and metropolitan New York-New Jersey would give fifty per cent and twenty per cent of their purchases respectively, to the proposed mill at New London.

CHAPTER V

SUMMARY

The present study has sought to determine if the desire of government and industry officials in New England to establish an integrated iron and steel plant in New England is economically well founded. In the general framework of decentralization, and in line with the abolishment of the "Pittsburgh-Plus" basis of pricing, New England appears as one of the logical places to establish an integrated steel plant. The increase in the price, the decline in quality of Lake Superior ores since World War II, and the new supplies of foreign ore all favor an East Coast location for the manufacture of iron and steel.

The New England location is well situated to serve a portion of the New York-New Jersey metropolitan market. It offers great opportunity for relatively inexpensive water shipment of raw materials and finished products. The cost of operating a mill in New England should be very low. Competition from other mills located at a greater distance from the market should be readily met. Professor Hogan, an economist at Fordham University, states that, "The development of an integrated steel industry on the New England coast, whether as an independent operation, or consolidated with an existing large steel company, would appear to be inevitable".[1] The proposed mill has many factors in its favor with the basic shift in the raw material situation, the position of the scrap market, the advantage of a

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[1]Rev. William T. Hogan, "Steel Facts", Industry Week, April 6, 1970, p. 59.

tidewater location on the Long Island Sound, and a market advantage in the New England-metropolitan New York-New Jersey area.

Of course with the expansion of steel production currently taking place generally, through the "rounding out" process of existing mills, and with the high capital cost as related to earnings of new integrated mills elsewhere, some hesitation on the part of existing companies to locate their facilities in New England is understandable. Capturing a large enough portion of the market in order to make a mill profitable is basically a competitive situation. But, the present study indicates that the first mill to be established in New England would capture a most enviable market and would reap substantial profits.

The idea of a New England mill was advanced in 1947, when a survey made of Pittsburgh concluded that it had reached its peak as a steel producer. This information, together with the expansion of metal working industries in New England, led local businessmen to explore the economic feasibility of constructing a steel mill in the region. Discoveries of iron ore deposits in Labrador, Quebec, and in Venezuela gave the project added impetus. The movement was further advanced by the Research Department of the Federal Reserve Bank of Boston, prominent New England businessmen, the New York, New Haven, and Hartford Railroad (Penn Central) and the Boston and Maine Railroad.

The steel committee, made up of representatives of the state governments from the six state region, made the final decision for the location of the mill site at New London, Connecticut. The present study has substantiated the validity of this location after the consideration of several alternative sites principally along the New England coast. Other important sites under consideration were Portsmouth, New Hampshire; Portland

and Rockland, Maine; and Worcester, Fall River, and Salem, Massachusetts.

New London was selected as the proposed mill site for a number of reasons. The projected location for the mill has the following advantages: location on tidewater with access to cheap ocean transportation; service by two railroads - New Haven (Penn Central) and Central of Vermont; and the greater New London area has good roads for transporation by truck. Other locational advantages include several sources of fresh water and proximity to a major steel market. Forty per cent of all working man hours in the New England states are consumed in the metal-working industry, fifty per cent of which are consumed in the state of Connecticut. Consequently New London is located near the major areas of steel consumption in New England. It is also desirable to locate as near as possible to the New York market without hindering its advantage in relation to the rest of the market in New England. This location would protect over half of its market with a transportation cost advantage which should be beneficial in periods of diminished demand for steel and steel products.

The survey of the market was confined to the six New England states and the adjacent metropolitan area of New York City and northern New Jersey. During a period of acute steel shortage, steel from a New England mill could be sold in many other places in the United States. The possibility of water shipment to the markets in the Southeast and along the Gulf and Pacific coasts could be considered. However, existing steel mills are situated in a competitively favorable pattern and as a consequence such distant markets generally are located outside of a New England mill's profitable market area.

Market analysis indicates that an export market is not without promise to the United States producers. A general lack of American steel exports in the past has resulted in the expansion of European steel capacity above European demands for this product. The lower production costs in the European countries permit foreign steel and steel products to compete with the United States steel not only in the foreign market, but also in the protected domestic markets of the United States. In order to cut imports, the current trend in the United States tariffs is an increase in the level of duties on iron and steel and steel products. There has been also an increased demand on the world steel market. United States steel exports were up a million tons last year. It is, therefore, expected that American producers, particularly along the Atlantic seaboard, will be able to take advantage of a growing export market. This would provide an additional market for a steel mill in New England.

Since the New England market must provide the bulk of the purchases necessary to support a New England mill, steel consumption in New England was carefully analyzed. A review of the literature indicates that there is a very close agreement on New England's share of steel consumption in the United States. This consumption could provide a market large enough to support a steel mill. However, before any analysis of the type and size of the steel facilities necessary to supply this demand could be implemented, a much more detailed analysis of the tonnage and characteristics of the products compromising the demand the New England market was required.

Consequently, the Worcester, Massachusetts and Springfield, Massachusetts areas were chosen for a detailed field survey in which a total of seventy-five and forty interviews, respectively, were made in order to determine the quantities and types of steel purchased in the above areas. Interviews were then held with two of the larger consumers and warehouses in New England, to determine the production sites of steel, their prices and their levels of consumption.

The metropolitan New York and northern New Jersey area is a marginal market for a New England mill. Sparrows Point, Pittsburgh, Youngstown, and Buffalo all are at a freight charge of two dollars per ton below that of a New England mill located at New London. Thus, New England would be a marginal supplier with a transportation cost disadvantage. With the quality of steel products being on parity with each other, freight differentials in a normal market are difficult for a producer to overcome.

A New England mill should expect to obtain a certain proportion of the tonnage purchased by consumers in this area. For that reason it is necessary to examine the quantity and nature of consumption there and to establish the extent of possible participation by a New England mill in this market.

The study reveals a steady increase in the steel making capacity of the United States. At the beginning of 1968, the volume of production of steel in the country was approximately 146 million tons of ingots per year. This is expected to rise to 165 million tons during the next two years.

The rolling capacity of the mills has been kept in balance with the steel-making capacity. The share of this rolling capacity between flat and shaped products had been increasing more rapidly for flat products than for shaped products. Similar demand trends are discernable in New England and in the New York-New Jersey metropolitan area.

An analysis of these market areas indicates that the most promising products for a New England mill would be hot-rolled sheet and strip, cold-rolled sheets, tin mill products and butt-weld pipes (electrically welded). The demand for these products is of sufficient volume to warrant a careful consideration of the economies of installing facilities to produce them.

The annual total market for these products in the primary New England area is estimated to be 605,585 tons. The annual total market for these products in the marginal metropolitan New York and northern New Jersey area is 1,275,154 tons.

This study has indicated that a New England mill, under normal conditions, would expect to command about fifty per cent of the market in the New England area and fifteen to twenty per cent in the marginal area. Because firms prefer to purchase from several sources in order to remain independent from their suppliers, the proposed mill could not control the New England market. At the 1968 level, such a share would result in a total finished product tonnage of 605,585 tons of hot-rolled sheets and strip, cold rolled sheets, tin mill products and butt-weld pipe. It is apparent that primary consideration should be given to a mill capable of rolling 865,150 tons per year of flat-rolled products.

It has been assumed that this mill would be an independent operation responsible for obtaining its own raw materials and maintaining its own administrative, operating and sales organization. This independent status presents the mill with a personnel problem. It would be forced to lure production and sales people from other steel organizations in order to operate efficiently from the construction of the mill. Walter Toner contends that this problem is not unsurmountable and that, "It is estimated that the organization will reach full operating efficiency in its fourth year of operation".[2] A mill unit laid out on the proposed site at New London would have the following facilities:

Coke ovens
Open hearth furnaces or BOF and electric furnaces
Blast furnace
Blooming mill
Hot-strip mill
Cold-strip mill

The most likely sources of raw materials are as follows: ore from the Great Lakes and Labrador; coal from West Virginia; limestone from New Brunswick; scrap from New England dealers; water from nearby sources; and power from fuel generated within the plant supplemented by purchases from nearby sources. The procurement of iron ore presents the greatest difficulty, since the Great Lakes transportation facilities are limited. Labrador, Newfoundland and Venezuela appear to be the best alternatives for obtaining ore. Albert Carlson reached similar conclusions about the procurement for a New England mill:

> "Iron from Labrador, coal from West Virginia, limestone from New England, or New Brunswick deposits, a supply of cheap scrap, electricity from steam from the steel process, a modern plant on suitable tidewater site and satisfactory water supply will combine to produce steel at a cost low enough to assure profitable operation."[3]

The present study is not an answer to New England's steel problems. It is however, a starting point from which further studies on the topic can be made. The construction of a steel mill requires geological, sociological, economic and engineering studies. This study has sought to aid the formation of the above by giving a general analysis of the trends in steel mill location, the probable market for the mill, and a description of the mill site and its facilities.

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[2]Toner, interview, Boston, Mass., February 10, 1970.

[3]Albert S. Carlson, "Steel for New England," Annals of the Association of American Geographers, Vol XL, (June, 1950), pp. 166-167.

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