Productivity. (1949) NO GLADIS

BEFORE THE

Steel Board

APPOINTED BY THE PRESIDENT

CARROLL R. DAUGHERTY, *Chairman*
DAVID L. COLE, JUDGE SAMUEL I. ROSENMAN, *Members*

PRODUCTIVITY IN THE STEEL PRODUCING SUBSIDIARIES *of* UNITED STATES STEEL

R. CONRAD COOPER

August 22, 1949.

Pandick Press, Inc., 22 Thames St., New York 6, N. Y., U. S. A.

TABLE OF CONTENTS.

Exhibits.

I. INTRODUCTION AND SUMMARY OF CONCLUSIONS

In recent years organized labor leaned heavily upon increased "cost of living" in its successive campaigns for higher wages. Unsound wage increases, secured by one device or another, may satisfy expediencies of the moment, but they raise the "cost of living" to higher levels, and provide new grounds upon which union leaders can claim further wage increases ad infinitum.

The United Steelworkers of America—CIO rode far on its trusted horse, "Cost of Living". Now, however, because that horse is played-out and staggers on the downhill run, the Union becomes uneasy and attempts to stand up and ride Roman-style both this jaded nag and a new horse "Productivity", with still a third horse "Ability to Pay" in the middle. "Productivity", a term of great complexity and little common understanding, appears as the Union's favorite in the new "Public Purse Sweepstakes".

Were the stakes in this contest not of such serious importance to the people of this country, it would be diverting to observe the Union's attempt simultaneously to stand up on these two horses, "Cost of Living" and "Productivity", which normally should run in opposite directions. Cost of living increases ultimately narrow the distribution of products, whereas productivity gains do the opposite.

Productivity in its broad implications is of fundamental importance to all of our people. As applied to steel production it is the effective rate at which the combined forces of men, machines, and materials are utilized to convert raw materials of natural resource into articles of basic necessity as required by the consuming public. It is not a term to be used lightly or loosely.

Representatives of the United Steelworkers of America—CIO use the term both lightly and loosely, and for a purpose. They speak of the vast gains that have been made in productivity. They mention some of the factors involved therein. They engage in statistical gymnastics and produce erroneous figures which psychologically assign to the workers the credit for all of the improvements that increased demand, capital investment in more efficient facilities, and managerial skill and ingenuity have contributed. The United Steelworkers of America—CIO would have this Board and the public at large believe that productivity of the steel industry in 1949 is 50% higher than in 1939. The Union representatives infer that productivity of the steel industry and employee performance are the same thing; and consequently that employees of the steel industry are performing at a 50% higher level in 1949 than in 1939. They allege that the real wages of these employees have not kept pace with such increase in performance and therefore assert that the employees are entitled to an increase in compensation in return for such higher performance.

These conjectures of the Union representatives are not the facts. In the steel producing subsidiaries of United States Steel Corporation, the facts are that:

1. Current productivity in U. S. Steel, as measured by the results of 1948, is nowhere near 50% higher than in 1939, and is only slightly higher than the earliest prior year of comparable business volume.

2. Such productivity gains as have been realized in recent years in U. S. Steel result from increased demand for steel, large capital investment in new and improved facilities, and managerial skill and ingenuity.

3. Productivity of the enterprise and the average rate at which employees perform the available work are two entirely different, although related, subjects.

4. The current average employee performance rate, as measured by the results of 1948, is no higher in the steel producing subsidiaries of United States Steel Corporation than in 1941, the earliest prior year of comparable business volume.

5. The real wages of employees of U. S. Steel have increased, but the average employee performance rate has not increased during recent years.

6. The employees of U. S. Steel are not entitled to a further wage rate increase on the basis of alleged performance rate inprovements which in fact have never materialized.

7. The real need in the interest of the employees, the owners, and the consuming public is not a wage rate increase but is to achieve and thereafter maintain the highest level of employee performance that is consistent with safety, good health and sustained effort.

The foundations of fact and the analysis from which the foregoing conclusions emerge are set forth below for the assistance of the Board.

II. THE FACTORS OF PRODUCTIVITY

As previously noted, the term "productivity" when applied to steel production relates to the effective rate at which the combined forces of men, machines, and materials are utilized to convert raw materials of natural resource into articles of basic necessity as required by the consuming public.

It follows, of course, that the effectiveness with which each of the forces of men, machines, and materials is used has consequent bearing upon the overall effective rate of the several forces. Thus productivity in steel is the overall consequence of such principal factors as:

1. The rate at which the users of steel seek to satisfy their needs, called "demand".

2. The nature, condition, and amount of producing facilities, commonly called "tools of production" and made available by owner investments, called "capital investment".

3. The availability of suitable and sufficient quantities of raw materials.

4. The availability of: suitable goods and services to be purchased from others; qualified managing and technical personnel; and skilled, semi-skilled, and non-skilled work forces.

5. The degree to which raw materials are conserved in the conversion to steel products, called "yield".

6. The degree to which the available tools of production are utilized, commonly expressed in "per cent of rated capacity of operations".

7. The rate at which the employees perform the available work, called "employee performance rate".

8. The supervisory, directing, and technical skills with which the available men, machines, and materials are used to produce maximum product of suitable quality at minimum cost, called "management".

Appreciation of the magnitude of these factors in the steel producing subsidiaries of United States Steel Corporation (hereinafter referred to as the "Companies" and subsequently described in detail at page 31) can be acquired most readily by knowledge of the following principal facts relative to their operations in 1948.

The release of peak backlog demands for steel, following termination of World War II, produced abnormal requirements for steel in 1948. Consequently, the Companies' public shipments of steel products in 1948 amounted to 20.7 million tons, exceeding the prior peacetime record.

The tools of production in use in 1948 by the Companies, owned by their 228,000 different stockholders, represented almost two billion dollars of gross property capital investment.

Expenditures by the Companies in 1948 for improvement of the tools of production amounted to $187 million, the highest for this purpose in any of the last ten years.

The principal items of raw materials used in the production of steel are iron ore, iron and steel scrap, coal, limestone, and dolomite. 102.5 million tons of such raw materials were used by the Companies in 1948 to produce the 20.7 million tons of steel products shipped to the consuming public in that year. This represents a principal raw material yield of 20.1%. In round numbers, five tons of the principal raw materials were required for the production of one ton of steel product, which is about the condition that has prevailed during the last ten years.

As measured by the steel producing operations of the Companies, the available tools of production were operated in 1948 at an average of 93.8% of rated capacity.

181,855 employees of the Companies devoted 368.1 million man-hours of faithful, loyal service to the 1948 accomplishment, for which they were paid $623 million.

These are the significant factors, the effectiveness of each factor contributing to the overall productivity of the Companies and in one way or another depending upon the contribution of each other factor.

III. PRODUCTIVITY MEASUREMENTS

The ingenuity of mankind to date has not devised a measure or index of productivity in steel production which at one and the same time can express: (a) the overall effectiveness of the combined factors of productivity; and (b) the specific contributions of the individual factors of productivity.

The difficulties involved in such endeavors, relative to steel production, become readily apparent when one considers the simple fact that the several productivity factors do not lend themselves to measurement by one common term. Men, machines, and materials are different things. Their physical beings, their influences, and their respective contributions to productivity are not measurable by a common denominator.

A few illustrations will suffice to establish the point.

> 1. In steel production the raw materials and resulting steel products are generally expressed in terms of tons or other units of weight. The effectiveness with which the raw materials are used is commonly measured in terms of percentage yield, meaning the percentage relationship between the weight of finished product and the weight of raw materials. Yield figures themselves are not a full measure of the effectiveness as to the use of the raw materials, except as judged in relation to the quality of specific

raw materials used and the particular steel produced therefrom. Such matters alone are the subject of an entire field of metallurgical study.

2. The tools of production in steel constitute large acreages of land, expansive buildings, huge converting structures, massive pieces of equipment both stationary and movable, and almost every known kind of smaller tool and facility. The effectiveness with which such items are used relates to the proportion of their usable time that is employed in the production of steel and the rate of speed at which the facilities are operated by the employees.

3. The effective use of manpower involves two separate factors, namely: (a) the determination by management of the methods of operation to be employed, which in turn regulates the amount of work required in the production of a unit of product; and (b) the rate at which the employees perform the work. The former is measurable in terms of standards, which reflect the kinds and amounts of human effort and time required to perform each function in the production of a unit of product under stated conditions. The latter item, the rate at which the employees perform the work, is measurable as a percentage relationship between the standard amount of work performed and the actual man-hours expended in such accomplishment.

Obviously the effective uses of such widely divergent components do not lend themselves to single index measurements.

Efforts to develop sound yardsticks to measure productivity have involved extensive study and research by many people. The Chairman of this Board is fully conversant with such endeavors. There is no need to touch upon the results therefrom, except to note two points, namely that:

1. The system of productivity indexing most commonly encountered is that which reflects the relationship between output in units of product and input in units of man-hours.

2. The index reflecting product output per man-hour input discloses only a result and of itself sheds no light on the causes that produced such result.

The Bureau of Labor Statistics, United States Department of Labor, has the following to say with respect to the productivity index that reflects output, in physical units, per man-hour of work:

> "It is a measure of the relationship between the volume of goods produced and one factor of input—labor time. *Productivity data do not measure the specific contribution of labor or of capital or of any other factors of production.* Changes in the ratio between output and man-hours of work show the joint effect of a large number of separate, though inter-related, influences." [Monthly Labor Review, Volume 63, No. 6, Page 893, Paragraph 4] (Emphasis supplied)

We hold no brief for the system of productivity indices that expresses production per man-hour, nor do we quarrel with its use where applicable and when used intelligently. Such use however requires thorough understanding of its limitations. In some situations it may serve useful purposes. In other situations it may produce erroneous conclusions and resultant harm. This is particularly true in steel production which involves so many variable factors.

In the words of the U. S. Department of Labor, Bureau of Labor Statistics:

> "Changes in the ratio between output and labor input reflect the joint effect of a large number of separate, though inter-related, influences such as technical improvements, the rate of operations, the relative contributions to production of plants at different levels of efficiency, the flow of materials and components, the skill and effort of the work force, the efficiency of management, the state of labor relations and many other factors." [Major Sources of Productivity Information, June 1949, Page 1, Paragraph 2].

The significance of such matters in an appraisal of the product output per man-hour in the Companies is illustrated best by the examination of the actual effects of such matters as:

a. Volume and customer requirements

b. Capital improvements of facilities

c. Product variations as to grade of steel, size, shape, etc.

d. Improved methods and practices

e. Quality of raw materials

f. Purchased goods and services

g. Employee performance rates

Such illustrations are set forth below. Each illustration describes matters of established fact with respect to operations in and among the Companies.

a. The effects of volume and customer requirements upon product output per man-hour.

At any given time with a given complement of the tools of production, the total volume of production required to meet the public demand for steel becomes the most significant factor in the index of product output per man-hour. Two principal conditions account for this fact—one inherent in the nature of steel plant operations and the other inherent in the system of indexing.

Steel plant operation involves a high percentage of jobs that must be filled regardless of whether the plant is running at high or low rate. Also, it takes as many man-hours to start up furnaces and condition the equipment for one day of operation as for five or six days of operation.

In an arithmetical problem of simple division, if the number to be divided fluctuates widely but the number used as the base of the division remains constant, the results of the divisions likewise fluctuate widely. For example, let us consider a hypothetical case of a railroad crossing watchman who sits at his station and pushes a lever to lower a grade crossing barrier when a train is approaching. Let us suppose that his production output is to be measured in terms of trains per man-hour. If one train passes during his 8-hour shift, his output is 1 train divided by 8 hours, which is .125 trains per man-hour. If 100 trains pass in another 8-hour shift, the watchman's output is 100 trains divided by 8 hours, equalling 12.5 trains per man-hour.

Thus the combination of large amounts of fixed man-hours in steel plant operation and the mathematical characteristic of the product output per man-hour index combine at any given time with a given complement of the tools of production to make volume of total steel output the most significant factor in figures showing the tons of product output per man-hour.

Exhibits I and II at pages 42 and 43 of this statement demonstrate this fact with respect to the Companies. They set forth the actual experience of the last 15 years, and are based on the total tons of product shipped to the public and total man-hours consumed.

First let us examine Exhibit I at page 42. The horizontal scale at the bottom of the chart indicates the year. The left hand vertical scale indicates the shipped tons of product per 1000 man-hours. The heavy solid line plots the actual tons per 1000 man-hours for each of the 15 years. The right hand vertical scale indicates the annual volume in millions of tons shipped. The broken line plots the total actual tons of product shipped to the public in each of the 15 years.

Without examining into the figures, which will be discussed in specific detail at a subsequent point in this statement, suffice it to note that this chart alone establishes the fact that tons per man-hour fluctuate with total volume of production. Note that the directional movements of tons per 1000 man-hours and total tons are the same in eleven of the fourteen annual periods after 1934. The exceptions represent special circumstances such as in 1942, the first war year in World War II, when total production was the all-important matter, steel operations were characterized by large influxes of untrained labor, and man-hours were of no consequence, and in 1946 when there was a steel strike.

We turn now to Exhibit II at page 43 which is another method of observing the effects of volume upon tons per man-hour. This chart is expressed in terms of man-hours per ton, which is the inverse figure of tons per man-hour. It is presented in this fashion to provide another form of graphic illustration. The horizontal scale at the bottom of the chart indicates quarterly volume in millions of tons shipped to the public. The left hand vertical scale indicates total man-hours per ton. The dots show the actual man-hours per ton respectively for the 60 quarterly periods of the 15 years. The solid line is the mathematically calculated line of "best fit" as among the 60 specific points. It shows the trend of actual experience as to man-hours per ton. Again, it is to be noted that tons per man-hour fluctuate with total volume of production.

This chart provides the basis by which to demonstrate the inaccuracy of one of the foundation points in the Union's presentation. Representatives of the United Steelworkers of America—CIO made this statement:

> "For the U. S. Steel Corporation . . . production at 30 per cent of capacity requires approximately 20 per cent more man-hours per ton than production at 95 per cent of capacity." [Economic Position of the Steel Industry, 1949, by Robert R. Nathan Associates, Inc.—Page 7, Paragraph 1.]

At 30% capacity operations, and the 1948 yield of 70.5% from ingots to shipped products, the quarterly shipments of steel products by the Companies would be 1,654,000 tons. At 95% capacity operations, and 70.5% yield, the quarterly shipments of steel products would be 5,237,000 tons. Based on average experience of the last 15 years as shown by the trend line of Exhibit II, the man-hours per ton respectively for those two levels of volume would be 31.8 for 30% capacity operations and 18.6 for 95% capacity operations. *The requirement of 31.8 man-hours per ton is 71% above the requirement of 18.6 man-hours per ton, not 20% as speculated by the Union.*

Beyond the matters of total volume, customer requirements of many kinds, such as size of order, specified shipment schedules, tolerance specifications and others too numerous to describe in the time at our disposal, have significant effects upon overall product output per man-hour.

Exhibit III at page 44 illustrates the matter of order size. It presents an extraction from the published and guaranteed performance standards for the measurement of employee performance and calculation of pay on the No. 1 and No. 2 Rod Mill at Joliet Works of one of the Companies, the American Steel and Wire Company. It displays a condition where the factor of one roll change per order causes a difference from .589 standard man-hours per ton on a 1,000 ton order to .913 standard man-hours per ton on a 100 ton order of the identical product, merely because the work required to change rolls is the same whether for large orders or small. At the same normal rate of employee performance in both cases, the tons per man-hour on the 1,000 ton order would be 1.70 and on the 100 ton order it would be 1.10. Thus if the order size is 1,000 tons the output per man-hour is 55% higher than on the 100 ton order.

On the other hand a 1,000 ton order might be attended with a customer's specified shipping schedule of let us say 100 tons per month, which could mean ten separate rollings on the order, each at 100 tons per rolling. If this were the case, of course, the net result would be that from the standpoint of tons per man-hour, the 1,000 ton order becomes ten 100-ton orders.

These are significant matters when judged in light of the following facts taken at random from actual records in the Companies.

Company	Works	Operation	Tons per Roll Change 1939	Tons per Roll Change 1948
National Tube	National	Seamless Rolls	280.3	447.7
Carnegie-Ill.	Homestead	52″ #2 CB	392.5	731.2
Carnegie-Ill.	Edgar Thomson	#2 Rail	1,510.0	2,777.0
Carnegie-Ill.	Clairton	#2 Light Str.	406.0	979.0
Carnegie-Ill.	Gary Steel	#1 Bar Mill	760.0	1,118.0

The foregoing figures also illustrate another aspect of the relationship of customer requirements to the overall figures of output per man-hour. As noted above, when steel was in heavy demand, as in 1948, the required roll change per ton was less than in 1939 when there was less demand for steel. Other important customer requirement factors have comparable results indicating the tendency of customers, in times of stringent steel supply, to adjust their requirements in such fashion as to facilitate maximum steel production. These tendencies have important bearing on the resulting overall output per man-hour in the steel producing operations, reflecting such matters as the item of roll change described above, product yields, etc. These practical matters of eased customer requirements in 1948 operated to offset Mr. Nathan's assumption that since 1939 a

> "... change in the character of production or product mix has had important effects . . . since these steels . . . require more man-hours . . . to produce . . . ." [Economic Position of the Steel Industry, 1949 by Robert R. Nathan Associates, Inc., Page 5, Paragraph 3.]

b. The effects of capital improvements of facilities upon product output per man-hour.

The effects of capital improvements of facilities upon the product output per man-hour in steel production cannot be over-emphasized. Speaking with respect to industry generally the U. S. Department of Labor, Bureau of Labor Statistics, states that:

> "The long-term upward trend of output per man-hour is due mainly to technical improvements in industry." [Monthly Labor Review, Volume 63—No. 6, Page 893, Paragraph 4.]

Such technical improvements in the Companies require the expenditure of tremendous sums of money, the specific extent of which will be mentioned at a later point in this statement. Suffice it for the moment and the purpose at hand to note that these capital improvements of facilities tend generally to: (1) increase productive capacity; (2) reduce the required man-hours per unit of product; (3) improve quality of product; and (4) make easier the jobs of operation.

Exhibit IV at page 45 presents the findings resulting from an impartial and exhaustive study of certain significant operations in one of the Companies. More detailed references will be made to this Exhibit at a later point in this statement, but for the moment I call your attention to one of the principal findings contained therein as follows:

> "The facts demonstrate that the gradual decline in man-hours per ton over the 25-year period was a result of constant replacement and improvement in plant and equipment. Further, this technological advance could not have taken place . . . without the expenditure of millions of dollars." [Dissertations, Volume XV, Fordham University, Productivity in the Blast Furnace and Open Hearth Segments of the Steel Industry, 1920 to 1946, Page 82, Paragraph 4.]

Illustration of a significant case in fact is set forth in Exhibit V at page 52 taken from official records of another of the Companies, the Carnegie-Illinois Steel Corporation. It shows that in a representative month the production of a given kind of tin plate utilized 34.8 man-hours per ton on the old style hot mill process at Shenango and only 12.4 man-hours per ton on the new continuous mills at Irvin. In the latter case the tons per man-hour were 180% higher than in the former. Anyone who has seen these two types of operation must be impressed with the magnitude of capital investment involved and will agree readily that the work required in the new process is not to be compared with the more difficult work of the old.

Another type of illustration is to be found in the case of blast furnaces. In the production of blast furnace iron, the two most important elements in the productive rate of the unit are the size of the furnace and auxiliary equipment, and the quality of raw materials used. For a specific set of conditions the output is directly associated with the size of the furnace and its auxiliaries, which normally is expressed in "tons per square foot of hearth area," the hearth area representing the inside diameter of the furnace at the elevation of the tuyeres. Thus, a 20-foot furnace has 314 sq. ft. hearth area and a 27 ft. furnace has 573 sq. ft.

In the Pittsburgh district both of these furnaces would be rated at and normally would produce 2.24 tons per square foot of hearth area. Accordingly, the 20 ft. furnace will produce 705 tons a day and the 27 ft. furnace will produce 1,283 tons per day with exactly the same crew. This is not mere theory. The following table sets forth the record of this kind of improvement in the Companies since 1929.

Year	Blast Furnaces Available	Rated Capacity—All Products: Tons per Furnace per day	Rated Capacity—All Products: Tons per Year (000 omitted)
1929	99	665	22,729
1939	85	783	22,957
1948	80	902	24,861

These figures are particularly significant from the standpoint of capital investment and its relationship to increased production, and product output per man-hour. Note that the number of furnaces decreased from 99 to 80 and the annual capacity increased by 2.1 million tons. This means that 9.4% more total product can be produced with 19.1% less man-hours, a total product output per man-hour increase of 22.9%.

The attention of the Board is called to Exhibit VI at page 53 which sets forth the case history of No. 6 Blast Furnace at Gary Works of Carnegie-Illinois Steel Corporation. It contrasts the situation of this furnace in 1910, following original construction at a cost of $613,843, to the situation existing after complete rebuilding in 1946, at a cost of $3,441,000.

The results in 1946 as compared to 1910 were that: (a) daily capacity increased 222%; (b) number of men per turn decreased 21%; (c) turns per day increased 50% (change from 12 to 8 hour shifts); (d) number of men per day increased 18%; (e) man-hours per day decreased 21%; (f) required man-hours per ton of capacity decreased 75%; (g) product output per man-hour at capacity increased 308%; (h) capital investment increased 460%; (i) total capacity to produce increased 203%; and (j) capital investment per ton of increased annual capacity increased 85%.

This is a shining example of the long-term benefits of improved tools of production. Jobs were added, working hours were shortened, leisure time was increased, yet greater capacity to produce was created and the product output per man-hour was more than quadrupled because managerial skill was applied and the owners' savings were risked to the extent of 460% added investment.

The foregoing are but illustrative cases. Improvements of a capital investment nature proceed constantly and in great magnitude in the Companies.

c. The effects of product variations as to grade of steel, size, shape, etc., upon product output per man-hour.

Representatives of United States Steel in late 1946 were appointed as members of a subcommittee on Productivity Surveys under auspices of the Division of Statistical Standards of the U. S. Budget Bureau. Exhibit VII at page 54 is a copy of a memorandum prepared by the Budget Bureau describing background and pointing up subjects on which industry advice was desired. It states:

> "For several years the Bureau of Labor Statistics has been preparing measures of physical volume of output in relation to labor time expended. The method has generally involved securing aggregate production data for specific product from the Census or other sources and converting these data into index numbers. Manhours worked by production workers in the industry producing the specific product are estimated from Census or Bureau of Labor Statistics information and converted into index numbers. The index of production is then divided by the index of manhours worked to arrive at an index of 'labor productivity'.
>
> "This method of computing 'labor productivity' does not involve any additional questionnaires or burden on employers, but has certain definite limitations. The method generally can only be used to measure labor productivity in single product or very similar product industries for which production and employment data are available. Where products other than the specific product being measured are produced in an industry, the employment data can

> not usually be separated between the specific product and other production. *The method is not appropriate to multi-product industries.*
>
> "The BLS is now initiating a program to collect labor productivity information directly from plants. This program requires briefly (1) determination of what products are representative of a particular industry, (2) determination of what plants are representative, (3) approach to selected plants and trade associations to solicit cooperation in reporting, (4) preparation of a schedule showing quantity of physical production and manhours or labor cost charged to this production, and (5) the combining of plant and product reports to secure an index.
>
> "The Division of Statistical Standards is interested in securing the advice of industry on this project, particularly on item 4 above." (Emphasis supplied.)

Representatives of industry, including United States Steel, cooperated as requested, but to date no productivity survey of the type contemplated has developed in steel. This fact is understandable in light of the countless product variations involved in steel.

Let us consider the significance of the foregoing quotations as related to the facts in the Companies.

These Companies make a very large number of products when considered from a cost of production standpoint. For administrative purposes consolidated reports are compiled in various degree of breakdown ranging from 38 principal products on down. For cost purposes and other controls, however, we find it necessary to break down the production into hundreds of thousands of items. To show the degree to which the production must be broken down for cost purposes a few examples will be noted.

Product Classification	No. of Items
Hot Rolled Bars	153,000
Hot Rolled Strip	13,000
Sheets	139,000
Drawn Wire	370,000
Oil Country Goods	23,000

The above number of items is by certain size and gauge group and does not indicate the total number of sizes which we have to be prepared to furnish. The above number of items is also based only on size, treatments, etc. at the finishing mills. It does not comprehend the large number, over 350, of various steel analyses which we must be prepared to furnish in the above individual items and which have great range in cost in themselves.

Clearly any overall index of production per man-hour involving such a multiplicity of products and product variations has its limitations and must be used with care. It is equally clear that in two periods of time, if the man-hours are constant but production totals vary because of kind of product, the resulting product per man-hour will vary correspondingly.

The significance of such variation is illustrated by examination of two cases in fact.

Exhibit VIII at page 55 is an extraction from the published and guaranteed performance standards used for the measurement of employee performance and calculation of pay on the No. 1 and 2 Rod Mill at Joliet Works of American Steel and Wire Company. The two figures are the standard man-hours per ton for a given size of product made from two different grades of steel. For the given size, when carbon steel is being rolled the standard is .553 man-hours per ton and when alloy steel is being rolled the standard is .942 man-hours per ton. It follows that at the normal rate of performance in both cases the crew will produce 1.81 tons per man-hour if rolling carbon steel and 1.06 tons per man-hour if rolling alloy steel. In other words, with all other factors being identically the same in two periods of time, the output in tons per man-hour would be 70% higher in one period than in the other simply because of the grade of steel being rolled.

Exhibit IX at page 56 is taken from published and guaranteed performance standards used for the measurement of employee performance and calculation of pay on the No. 6—10″ Merchant Mill at Duquesne Works of Carnegie-Illinois Steel Corporation. The table sets forth the total standard man-hours for various sizes of product all of a given grade of steel. It is to be noted that the standard man-hours per ton of steel vary from 1.10 in the largest size to 4.44 in the smallest size. Thus at the same normal level of employee performance on both sizes, the tons per man-hour for the largest size would be .909 and for the smallest size, .226. In other words with all other conditions identically the same in two periods of time the output in tons per man-hour in one period would be roughly four times as much as in the other, simply because of the size of product being rolled.

d. The effects of improved methods and practices upon product output per man-hour.

It is the never-ending daily business of executive, engineering, metallurgical, technical and other management personnel in the Companies to search out and to perfect ways and means to improve operating methods and practices.

Exhibit X at page 57 illustrates one of thousands of such improvements that are in progress at all times. It presents a factual case selected at random from the affairs of Lorain Works of National Tube Company, another one of the Companies. It shows for example that the standard man-hours to taper bore and ream both ends of 3″ special line couplings is 1.10 per hundred pieces under the new method whereas the required standard was 2.034 per hundred pieces under the old method. The simple rearrangement of machines and reassignment of employee duties increased the product output per man-hour from 49 pieces to 91 pieces or 86%. No increase of employee performance is required to produce the greater number of pieces because the change in methods reduced the required amount of work per piece.

By way of illustrating another type of element we again refer to Exhibit IV at page 45 setting forth the findings of an impartial and exhaustive study, which records in part:

> "Another factor in the increase in production and productivity in the open hearth shop . . . was

the reduction in the amount of time required to rebuild and reline the furnaces. This is of definite importance since the life of an open hearth lining is relatively short, and must be replaced after every 150 heats. The chief factors in the reduction of this time have been the use of improved mechanical equipment and the proper scheduling of rebuilds so that no more than one furnace is out of production at any given time. This last item was one of the principal reasons for the record steel output at Plant A during the years of World War II, for by careful scheduling of rebuilds 15 of the shop's 16 furnaces were constantly in operation from 1941 to 1944.

"Another advantage of having no more than one furnace under repair at one time is that the number of charging and tapping delays is reduced. This is evident from the fact that some of the charging and tapping equipment, such as overhead cranes and locomotives, is also used in handling materials for furnace rebuilds. Thus if two or three furnaces were being rebuilt at one time the demand on this equipment would be sufficient to cause delays in the normal charging operations of the shop. Therefore, *it can readily be seen that organization and coordination of equipment play an important role in successful open hearth operations. Without the proper coordination furnace size alone could not account for the marked increase in productivity at Plant A.*" [Dissertations, Volume XV, Fordham University, Productivity in the Blast Furnaces and Open Hearth Segments of the Steel Industry, 1920 to 1946, Page 82, Paragraphs 1 and 2] (Emphasis supplied)

Naturally the burdens of organization, coordination and direction of the workings of steel plant operation fall upon management and the records of technological progress in steel stand as testimonials to the ingenuity of those engaged therein. Daily progress is made in the development of things which increase total product output per man-hour.

This is not to say, however, that the improvement of methods and practices is a field unto management alone. The employees generally, from those in the bottom to the highest class job, can and do contribute to these matters.

e. The effects of quality of raw materials upon product output per man-hour.

The character of raw materials is of vital importance in the productivity of a blast furnace. A superior coke permits a materially increased production from a given unit, with all other conditions being identical, this being illustrated in Exhibit XI at page 58. This presents a comprehensive test of washed and unwashed coals converted into coke, in which all variables were eliminated except the character of the coke consumed. The tests show that in the Pittsburgh District washed coal was responsible for 8.1% increase in production rate and 8.5% decrease in coke consumption on the same furnace with the same crew.

Similarly, the character of ore, its size and its chemical composition have substantial influence on blast furnace operations. Exhibit XII at page 59 illustrates this fact. It sets forth the results of comprehensive test and study of two identical furnaces, one provided with normal ores and the other with the normal ores screened over 3/8″ and the fines sintered. The superior burden resulting from this treatment yielded an increased production of 21.2% with a decreased coke consumption of 15.3% on one and the same furnace and with the same crew.

Open Hearth plants are generally designed for a specific percentage of pig iron and scrap and pronounced changes in these proportions can materially affect production rates. Confining the illustration to hot metal plants only, it can be stated that a plant can be well designed for a 40 per cent hot metal charge and the balance scrap and for a given size heat produce equally as well as a well designed plant using 70 per cent hot metal and 30 per cent scrap charge. While there is a certain amount of flexibility with respect to scrap and pig iron under all operating rates, the first plant cannot be expected to produce as much as the second if forced to operate with high pig iron charges at high operating rates, since in the design of such a plant the emphasis properly has been placed on equipment to permit expeditious assembly, preparation, and handling of the major raw material, which is scrap. Contrariwise, the second plant is seriously handicapped if forced to adopt a very high scrap percentage during high operating rates, since its facilities do not lend themselves advantageously to such practice. To illustrate this point, the experience of South Nos. 2 and 4 Open Hearth Shops during the period of April, May, and June of 1947 and 1948, are included in Exhibit XIII at page 60. It is to be noted that the productive rate of No. 2 Shop increased 7.3% and No. 4 Shop increased 11.2%.

Those are merely illustrative of the effects that variations in the quality and type of materials have upon the product output per man-hour. The numbers of such conditions are legion.

f. The effects of purchased goods and services upon product output per man-hour.

One paragraph will suffice to point out to the Board that at any given time if the management elects to purchase from other producers any of the goods or services that at other times are produced within the given company, the overall product output per man-hour will fluctuate, yet the productivity of the enterprise is unchanged. This is merely the consequence of the mathematical characteristics of the product output per man-hour index. For example, suppose in one year that a steel company contracts with outsiders for all of its furnace rebuild work, but in another year does not, and that the total product output is the same in both years. Because of the simple fact that no furnace rebuild man-hours appear on the payroll in the first year and do appear in the second year, the product output per man hour is higher in the first year but the real productivity is the same in both years.

g. The effects of employee performance rates upon product output per man-hour.

We come now to the all important matter of employee performance rates.

In one way or another the human equation is involved at the core of every operation in steel and that equation includes both those who direct and those who are directed.

The machines and processes do not operate themselves. They must be regulated by people.

The owners of the enterprise can supply the tools of production; the management can acquire the raw materials, employ the people, and plan the operations; but at that point, under the given circumstances at the given time, the product output per man-hour depends entirely upon the rate at which the employees perform the available work, in other words "the employee performance rate."

The constant improvements of the tools of production tend steadily to reduce the burdensome physical labors in the steel industry through the substitution of mechanical and electrical equipment. The tendency corollary to removal of the burdensome toils of physical labor is to place greater premiums upon the timeliness and coordination of the lighter exertions required to direct the actions of huge pieces of equipment through the actions of push button or lever controls.

With these ever-increasing amounts of the tools of production, made available and acquired by use of the investors' money, it becomes increasingly important that such tools be operated at their most productive rates. This can be accomplished only if the employees increase their performance rates to the highest attainable level consistent with safety, good health and sustained effort. The attainment of this objective is as much in the long term interest of the employees as of the owners. Only by the most effective use of the tools of production can investment in them be justified, and only by such justification can new tools and the related jobs of their operation be supplied.

With the ever changing conditions resulting from constant improvement of the tools of production, obviously the total product output per man-hour can and regularly does increase without involving any more, if as much, work per hour on the part of the employee. Thus it follows that product output per man-hour cannot be relied upon as a measure of the performance rate of the employee.

The United Steelworkers of America—CIO are fully aware of that fact, as is evidenced by the following labor agreement provision currently in effect:

> "The performance standards shall: be established for a specified set of conditions; reflect the performance requirements as related to a fair day's work for a fair day's pay; remain unchanged as long as all of the conditions under which the standards were established prevail; become null and void when and if conditions under which they were established are changed; and be replaced by new standards which as compared to such expired standards shall reflect only the change of conditions." [May 8, 1946 Agreement, Section 3, Paragraph (h) (2).]

Clearly, therefore, productivity of the enterprise, which reflects the combined contributions of men, machines, and materials, and the rate at which the employees perform the available work are two entirely different, although related, subjects.

The latter subject, employee performance, takes us into a separate and distinct field of study in which the performance rates of employees must be measured by special devices other than mere product output per man-hour figures.

In the Companies the index of measurement now being employed for this all important subject is the percentage relationship between: (a) the standard amount of work accomplished in a given period of time, as measured by standards established in accordance with the labor agreement provision just quoted; and (b) the actual man-hours expended in such accomplishment.

h. Summary of variable factors that have significant effects upon product output per man-hour.

As we have seen in the foregoing examples of cases in fact, the figures on overall product output per man-hour input are affected significantly by: (a) volume and customer requirements; (b) capital improvements of facilities; (c) product variations as to grade of steel, size, shape, etc.; (d) improved methods and practices; (e) quality of raw materials; (f) purchased goods and services; and (g) employee performance rates. Such figures merely express a result reflecting the combined effects of the several factors as related to one factor of input, namely, labor time. They in no way disclose the specific contribution of labor or any other individual factor.

Ordinarily, for the reasons just stated, we find little use for total product output per man-hour figures. Our purposes are served better by use of the separate measures that are applicable to the individual factors of men, machines, and materials. Improvements are made by individual study of the individual influences which create the overall result, as contrasted to an after-the-fact study of the composite result of many complex factors.

However, the United Steelworkers of America—CIO elected to try for a free ride, partially on their new horse "Productivity", and chose to make declarations publicly and before this Board which inferentially assign credit for all recent progress to the single factor of input which they have the good fortune to represent, namely labor.

We conclude, therefore, that this Board is entitled: (a) to full knowledge of the facts regarding productivity as they exist in the Companies; and (b) to know which principal influences are accountable for such improvements as have been realized, so that credit therefor may be placed properly.

Only after having such knowledge of fact can the Board properly judge the Union declarations regarding productivity.

IV. THE UNION'S CASE ON PRODUCTIVITY

Representatives of the United Steelworkers of America—CIO appear to believe that if they make sufficient assertions of what they desire to be a fact, it may become a fact. Throughout their recent negotiations with representatives of the Companies they made constant declarations that productivity in steel has increased tremendously, but not once did they offer any basis in fact upon which to predicate such declarations.

Subsequent to such negotiations the Union representatives identified themselves with a document purporting to have been prepared at their request for the negotiations and entitled "Economic Position of the Steel Industry, 1949" by Robert R. Nathan Associates, Inc. This document sets forth alleged productivity facts.

In his opening presentation before this Board, Mr. Philip Murray, President of the United Steelworkers of America—CIO made this statement:

> "Before discussing the earnings figures of the steel industry, I want to say that these figures, and the others which I have used or shall use, are, except when otherwise indicated, taken from Mr. Nathan's two reports: one entitled 'A National Economic Policy for 1949' and the other 'Economic Position of the Steel Industry, 1949'. Both of these reports will be filed with this Board, and Mr. Nathan will be available to discuss the matters covered in these reports." [Statement of Philip Murray, President of United Steelworkers of America, Page 17, Paragraph 1.]

The report entitled "A National Economic Policy for 1949" contains nothing regarding productivity beyond generalities and assertions.

The report entitled "Economic Position of the Steel Industry, 1949" purports to deal with facts regarding productivity.

None of the other presentations made before this Board by representatives of the United Steelworkers of America—CIO contains anything regarding productivity other than assertion or repetition of the figures set forth in the report mentioned in the preceding paragraph.

The Union, therefore, saw fit to rest its entire productivity case on the Nathan report entitled "Economic Position of the Steel Industry, 1949". It follows that if the alleged factual case on productivity contained in such report falls, so do all other parts of the Union's case which are predicated on their claims regarding productivity.

Therefore we turn our attention to the "Economic Position of the Steel Industry, 1949" by Robert R. Nathan Associates, Inc.

In that document Mr. Nathan launches his productivity case with the following statements:

> "A significant change in the nature of steel production has taken place since 1939, which is not revealed by simple measures of ingot production. There has been a large increase in the production of quality steel products, such as alloy steels, electric steels, greater emphasis on cold rolled steels and the more expensive steel products generally. For example, alloy steel ingots in 1939 accounted for approximately 6 percent of total steel ingots produced. They now constitute 11 percent to 12 percent of total ingot production. This change in the character of production or product mix has had important effects on revenues, since these steels are higher priced; on costs, since they require more man hours, more materials and more skill to produce; and on profits, since expensive steels are more profitable per ton.
>
> "*To measure steel production in view of this change, a weighted index of output must be used . . .*" [Economic Position of the Steel Industry, 1949, by Robert R. Nathan Associates, Inc. Page 5, Paragraphs 3 and 4] (Emphasis supplied.)

Those statements obviously are made for a purpose. That purpose is to becloud the situation with confusion and, with a display of apparent knowledge of the industry, slip unnoticed from the controls of hard fact to the less confining restrictions of fancy.

Your attention is called to the second paragraph of the quotation. The generalities of the first paragraph are placed there to provide the ground for what follows in the second. Under the guise of the high sounding phrase "weighted index of output" what really eventuates is the equivalent of fictitious production figures. Conveniently for the Union's purposes, the fictitious results are of greater magnitude as related to production in 1948 and 1949 than as related to 1939 which the Union uses as the base of comparison. No doubt it is a slip of the tongue but the point is nicely confirmed in the very first sentence following the comparison that results from use of the so-called "weighted index of production". The sentence reads:

> "*As expected,* production has increased more rapidly since 1939 *when measured by the weighted index.*" [Economic Position of the Steel Industry, 1949, by Robert R. Nathan Associates, Inc., Page 5, Paragraph 5] (Emphasis supplied).

In other words, having selected the particular device by which to depart from the *actual* production figures, one should not be surprised if the result works out *as expected.*

The *expected* results unfold in the following manner. Tables 13 and 14 on pages 35 and 36 of the "Economic Position of the Steel Industry, 1949", submitted on behalf of the Union, allege for the steel industry: (a) ingot production of 52.8 million tons and 96.2 million tons in 1939 and 1949 respectively, bearing the relationship of 100 to 182.2 and reported as the "ingot production index"; and (b) finished steel shipments of 35.0 million tons and 70.4 million tons in 1939 and 1949 respectively, bearing the relationship of 100 to 201.1 and reported as the "finished steel shipments index". However, *instead of using either of those figures for the direct conversion to a product output per man-hour index of productivity,* Table 14 introduces a so-called "weighted index" of production bearing the relationship of 100 to 236.9 for the years of 1939 and 1949 respectively, thus reflecting an inflation of 30% above the reported actual increase of ingot tons and 18% above the reported actual increase in tons of finished steel shipments.

The particular device selected for conversion from the actual production figures to theoretical production figures is described as follows:

> "The weighted index used in this report was originally constructed by the Research Project of W. P. A., extended by the Bureau of Labor Statistics, through 1939, and by the O. P. A. through 1944.

> *This index has been carried through 1948 in this report.*" [Economic Position of the Steel Industry, 1949 by Robert R. Nathan Associates, Inc., Page 5 Footnote] (Emphasis supplied).

There is no need to discuss this so called "weighted index" beyond pointing out that:

1. It inflates the compared production figures of 1948 and 1949 more than it does the 1939 figures used as the base of comparison.

2. It expired upon the expiration of O. P. A.

3. It admittedly was resurrected and extended through 1948 by an agent of the United Steelworkers of America—CIO and therefore is entirely of a self serving nature.

4. The defects of Mr. Nathan's so-called "weighted index" have been demonstrated thoroughly by statements which others have submitted to this Board.

5. By this device Mr. Nathan purports to adjust for all of the changes that have taken place in the steel industry between 1939 and 1949 as among the variable factors described in the foregoing section of this statement, namely: (a) volume and customer requirements; (b) capital improvements of facilities; (c) product variations as to grade of steel, size, shape, etc.; (d) improved methods and practices; (e) quality of raw materials; (f) purchased goods and services; and (g) employee performance rates.

We observe that we who are engaged in the steel business are unable to arrive at one single "index" figure.

Let us turn now to "Table 14" on page 36 of the "Economic Position of the Steel Industry, 1949" by Robert R. Nathan Associates, Inc. That is the series of figures which result from this interesting device termed by Mr. Nathan as a "weighted index" and upon it rests the Union's entire case regarding productivity.

It is to be noted that this "Table 14" is captioned "Production, Manhours and Productivity". That caption, together with the listings of ingot production and man-hours and the references to the U. S. Department of Labor, Bureau of Labor Statistics as a source of data and participant in determination of the so-called "weighted index of production" implies that the resulting index of productivity reflects *actual production per man-hour* as conventionally used by the Bureau of Labor Statistics, United States Department of Labor. Such is not the case. Column 5 does not reflect relationships resulting from division of the tonnage figures in column 2 by the man-hour figures in column 3, as we shall demonstrate.

Furthermore, the man-hour figures set forth in the table are not the actual man-hours consumed. They are estimates based on plant samplings that reflect only part of the total man-hours.

But even assuming that the man-hour figures of Table 14 were correct, which we do not, the comparison of productivity reflecting tonnage output per man-hour as determined from the very source figures that the Union representatives rely upon in Table 14 will disprove their conclusions that productivity in 1949 is 50% higher than in 1939. Note the following as calculated from the source figures which the Union relies upon in Table 14:

Year	Ingot Production (Millions of net tons)	Man-Hours (Millions)	Tons per Man-Hour	Index of Productivity (1939-100)
1939	52.8	712.9	.0741	100.0
1940	67.0	867.5	.0772	104.1
1941	82.8	1,070.8	.0773	104.3
1942	86.0	1,124.8	.0765	103.2
1943	88.8	1,190.0	.0746	100.6
1944	89.6	1,162.6	.0771	104.0
1945	79.7	1,050.3	.0759	102.4
1946	66.6	857.1	.0777	104.8
1947	84.9	1,006.1	.0844	113.9
1948	88.5	1,078.1	.0821	110.7
1949*	96.2	1,130.0	.0851	114.8

* Annual rate based on 1st Quarter.

Thus we see that, based upon the source figures which the Union relies upon, the first quarter 1949 ingot production per man-hour productivity was 15% above 1939, not 50% as claimed. Furthermore, on the basis of those same figures, the ingot tons per man-hour of .0821 in 1948, the most recent full year that can be compared is only 6% above the ingot tons per man hour of .0773 in 1941, the earliest prior year of anywhere near comparable total business volume. It follows that the only proper conclusion that could be drawn from the Union's own figures is that current productivity, as measured by ingot tons per man hour is 6% above the earliest prior year of comparable business volume, and not the erroneous 50% reported by the Union representatives.

It is to be noted that had Mr. Nathan used from his report: (a) the man hours of 712.9 million and 35.0 million tons of finished steel shipments for 1939; and (b) the man hours of 1,130.0 million and 70.4 million tons of finished steel shipments for 1949; a conventional *unweighted* calculation of the gain in product output per man-hour, would have found for him a gain of 27% as between 1939 and 1949 instead of the erroneous 50%—a more plausible and defensible figure if one were to close his eyes to the factor of volume. Here again however, if account is made for the volume factor the only proper comparison is between 1941 and 1948. Mr. Nathan reports respectively 60.9 million and 66.1 million tons of finished steel shipments and 1,070.8 million and 1,078.1 million man-hours, which figures of course produce the more nearly proper but to the Union less attractive figure of 7% gain as compared to the 6% gain on the basis of ingot production per man-hour.

Other points of detail will be enumerated, but clearly the productivity case made by the representatives of the United Steelworkers of America—CIO falls on the simple counts just enumerated herein and with it fall all other parts of their representations that relate to their claims based on productivity.

* * *

V. THE FACTS REGARDING PRODUCT OUTPUT PER MAN-HOUR IN THE COMPANIES

Comprehensive judgment of productivity in its full sense would require appraisal as to the effectiveness with which each of the forces of men, materials, and machines are used. However, the United Steelworkers of America—CIO saw fit to base its claims on the single product output per man-hour aspect of productivity. Accordingly we likewise will address ourselves to the single subject of product output per man-hour.

Before turning to a reporting of the facts as they exist in the Companies, we desire to note for the record that:

1. The figures contained herein relate to the total manufacturing operations of The American Steel and Wire Company of New Jersey, Carnegie-Illinois Steel Corporation, Columbia Steel Company, Geneva Steel Company, National Tube Company, and Tennessee Coal, Iron & Railroad Company, excluding raw materials operations, and Cyclone Fence, Donora Zinc, and Electric Cable Works of America Steel and Wire Company.

2. The man-hour and payroll figures are the total figures applicable to the operations described in No. 1 above and are as reported to and included in published reports of the American Iron and Steel Institute.

3. The product output figures are the total tons of public shipments of steel products as reported in the Annual Report of the United States Steel Corporation.

4. All other figures attributed to the Companies are taken from the official accounts, and records of the Companies.

5. The tonnage figures are in terms of net tons of 2,000 pounds each.

Our analysis of the facts will deal with the results obtained in 1948, which is the most recent full year of operations that can be judged, as compared with the results obtained: (1) in 1939, the year selected by the Union as the basis for its comparisons; and (2) in 1941, the earliest prior year of reasonably comparable total volume of product output. In the interest of simplifying the comparisons, the product output rates will be expressed in terms of tons per thousand man hours. The facts with respect to operations in the Companies during the last fifteen years, 1934 through 1948, are as follows:

Year	Public Shipments in Tons (000 omitted)	Total Man-Hours (000 omitted)	Tons per 1000 Man-Hours
1934	6,501	198,006	32.8
1935	8,086	228,920	35.3
1936	11,905	309,823	38.4
1937	14,098	340,613	41.4
1938	7,316	195,820	37.4
1939	11,707	262,830	44.5
1940	15,014	306,650	49.0
1941	20,417	378,763	53.9
1942	20,615	398,383	51.7
1943	20,148	416,727	48.3
1944	21,052	408,432	51.5
1945	18,410	366,382	50.2
1946	15,182	290,741	52.2
1947	20,242	353,778	57.2
1948	20.655	368.148	56.1

The foregoing figures show that the actual result in 1948 was a product output of 56.1 tons per thousand man-hours of input which:

(1) As compared to 44.5 tons per thousand man-hours in the year 1939, represents an increase of 26.1 per cent; and

(2) As compared to 53.9 tons per thousand man-hours in the year 1941, a year of comparable shipments, represents an increase of 4.1%.

It is clear therefore that current product output per man-hour in the Companies, as measured by results of 1948, is nowhere near 50% higher than in 1939 as indicated by the United Steelworkers of America—CIO, and is only slightly higher than the earliest prior year of comparable business volume.

VI. ANALYSIS OF THE PRINCIPAL INFLUENCES ACCOUNTABLE FOR PRODUCTIVITY GAINS IN RECENT YEARS

The United Steelworkers of America—CIO make the following statements to the public generally and to this Board in their "Economic Position of the Steel Industry, 1949" by Robert R. Nathan Associates, Inc.:

> ". . . between 1939 and 1949 . . . productivity per man-hour rose by 50 per cent. . . ." [Page 1, Paragraph 4 (a)]
>
> "Was the worker's effort, as measured in terms of the real output produced for each hour of work, as skimpy as the dollars the worker received for his effort?" [Page 14, Paragraph 4]
>
> "At no time since 1939 have changes in the real earnings of the steel worker matched changes in his real output." [Page 14, Paragraph 4]

Those statements must be answered. They contain implications far beyond the bare printed or spoken word. The manner in which they are phrased and the surrounding circumstances of presentation, publicly and to the Board, psychologically assign to the employees represented by the Union, all of the credit for such productivity gains as have been realized in recent years. They openly charge that management has withheld from such employees just compensation for their contributions to the increase of productivity.

The issue is between the Union and the management, not between the employees and the management of the Companies.

In the interest of 228,000 owners, a substantial proportion of whom are also employees, and all of the employees, including those represented by the Union, it is the responsibility of management to protect the long-term welfare of the enterprise.

The Union now makes untrue allegations on behalf of part of the employees, which allegations operate to the discredit and disinterest of other employees and the owners.

Therefore, it is the obligation of management to refute such allegations in the common interest of both the owners and all of the employees. Consequently, we submit the following analysis as to the principal influences accountable for such productivity gains as have been realized in recent years.

The foregoing sections of this statement establish the facts that:

1. Product output per man-hour measurements standing alone disclose nothing as to the relative contributions made by the several inter-related factors.

2. At any given time with a given complement of the tools of production, the total volume of production required to meet the public demands for steel is the most significant factor in the output per man-hour figure.

3. The ever-changing conditions as to kind and size of product, methods and practices, raw materials, etc., have a bearing on the product output per man-hour but their related effects are inseparable. In general they tend toward the production of better product with less effort and less expenditure of materials and equipment time. At best the most that can be learned from overall figures of product output per man-hour is the long term trend, possibly with some degree of information as to the principal factors of influence, namely volume, tools of production, and employee performance, if there are sufficient cross comparisons of significant nature.

4. The 1948 output per man-hour was 26.1% higher than in 1939 and 4.1% higher than in 1941 (hereinafter referred to in round numbers of 26% and 4%).

In matters of internal administration the Companies make extensive use of basic standards as to the amounts of men, machines, and materials required to produce a given unit of product under specified conditions. These basic standards serve such major management functions as the planning, scheduling, and control of operations, the determination of costs through a standard cost system of accounting, etc. An exhaustive application of such basic standards to the 1939 and 1948 production shows that had the 1948 production been composed of the 1939 product mix, the average required standard man-hours per ton of product would have been substantially unchanged. In other words the difference in product mix as between 1939 and 1948 had no effect upon the relative product output per man-hour figures of the two years.

Let us now examine the product output per man-hour gain since 1939 in light of that fact.

In the short span from 1939 through 1941 the product output per thousand man-hours rose from 44.5 tons to 53.9 tons, an increase of about 21%, attributable clearly to the principal influence of total volume of production, which rose from 11.7 million tons to 20.4 million tons within a period of two years when the tools of production necessarily were substantially the same.

At the end of the seven-year span from 1941 through 1948, the total volume of production was higher by slightly more than 1% and the product output per man-hour was higher by only 4%.

It follows that, because the total volume of production in 1941 and 1948 were substantially the same, the increased product output per man-hour of 4% necessarily was attributable to the principal influences of: (a) improved tools of production and managerial skill; (b) improved average employee performance rate; or (c) various combinations thereof.

No precise measurement of the contributions made by these respective influences can be made from the overall figures.

However:

1. If the tools of production and managerial skill were the same in the two periods, then the improved

output per man-hour of 4% reflects a corresponding 4% increase in the average employee performance rate.

2. If the tools of production were improved and used with greater managerial skill to any extent whatever, then the improvement in the average employee performance rate was less than 4%.

3. If the influences of improved tools of production and managerial skill contributed as much as 4%, then the average employee performance rate was unimproved.

4. If the influences of improved tools of production and managerial skill contributed more than 4%, then the average employee performance rate was correspondingly less than in 1941.

If no further facts were available one could do no more than speculate as to which of the foregoing propositions is applicable. However, additional facts are available.

Let us, therefore, inquire into such further facts.

The attention of the Board is called to Exhibit XIV at page 61. It discloses that in the seven-year period, the tools of production were improved in the amount of $623 million, by far the most extensive rate of facility improvement in the history of the Companies.

No one can doubt that an expenditure of $623 million in the period from 1941 through 1948 in the Companies contributed to the improved product output per man-hour. As previously noted herein:

> "The long-term upward trend of output per man-hour is due mainly to technical improvements in industry." [U. S. Department of Labor, Bureau of Labor Statistics, "Monthly Labor Review," Volume 63—No. 6, Page 893, paragraph 4].

Clearly, then, the improved tools of production and the related managerial skill of 1948 contributed to the 4% increase in product output per man-hour.

The attention of the Board is now called to Exhibit XV at page 62. This exhibit serves the inquiry now before us. It sets forth the facts regarding product output per man-hour in 1941 and 1948 in two coke plants, three blast furnaces, and four steel works where the tools of production and volume were substantially the same in both years. Thus, with the factors of volume and tools of production being substantially the same in both years, the resulting change in product output per man-hour necessarily is attributable to the principal factor of employee performance. The results are most revealing. You will note that in eight of the nine cases the output per man-hour in 1948 was less than in 1941 and the average of all nine units was lower by about 6%.

That is a record of fact regarding the overall results in the nine substantial plants involving 29.3 million man-hours in 1948, where the facilities were maintained but no substantial capital improvements beyond replacement in kind took place, where the total volume of production was substantially the same, and where there were no significant changes in the kinds of product.

Now, on the basis of the evidence before us, it appears that:

> 1. The average employee performance rate, as judged on the total of plants where change of product output per man-hour reflects only this principal factor, was about 6% lower in 1948 than in 1941.
>
> 2. In 1948, without the benefits of improved tools of production and managerial skill the product output per man-hour in the plants of the Companies as a whole would have been 6% lower than in 1941.
>
> 3. In 1948 the benefits of improved tools of production and managerial skill in the plants of the Companies as a whole were sufficient to offset the retrogression in average employee performance rate and to produce a net gain of 4%.

We do not hold that those are precise calculations. On the contrary we have pointed out that the output per man-hour system of figures is limited to narrow uses. But since the question has been raised by the Union we can do no less than answer with the facts at our disposal.

We have no quarrel with the employees of the Companies and intend for them no discredit. Equally, however, no credit should be placed except as earned, particularly if the misplacement operates to the disadvantage of others. In the interest of proper credit where credit is due, but to give to the employees the benefit of any doubt that might exist due to limitations of the figures, we conclude on the facts before us that:

> 1. Such productivity gains as have been realized in recent years in the Companies result from increased demand for steel, large capital investment in new and improved facilities, and managerial skill and ingenuity.
>
> 2. The current average employee performance rate, as measured by the results of 1948, is no higher in the Companies than in 1941, the earliest prior year of comparable business volume.

We turn now to the Union allegation that "At no time since 1939 have changes in the real earnings of the steel worker matched changes in his real output." [Economic Position of the Steel Industry, 1949, by Robert R. Nathan Associates, Inc., Page 14, Paragraph 4.]

The attention of the Board is called to the following Union statement:

> "Using 1939 as an index of 100, both for productivity for each hour of work and for real average hourly earnings—the index figure for productivity is 149.5 while *earnings for the first quarter of 1949 are only 114.3.*" [Statement of Philip Murray, President of United Steelworkers of America, Page 21, Paragraph 5.] (Emphasis supplied.)

It is not our purpose to go into the matter of real wages beyond pointing out to the Board the Union declaration that current real earnings are 14.3% above 1939. Consider that declaration in light of the facts in the Companies.

The inescapable conclusion is that real wages of employees increased (the Union says 14.3%) during a seven-year period when the average employee performance rate did not increase. It follows therefore that the employees are not entitled to a further wage rate increase on the basis of alleged performance rate improvements which in fact have never materialized.

VII. THE REAL NEED

Undoubtedly this Board is well aware that the task before it is one of sobering consequence. It requires careful examination of fundamentals.

You have before you a strong labor union, the United Steelworkers of America—CIO, endeavoring to perform the impossible, a "Roman Horse Race" ride on two incompatible and opposite-running chargers with still another animal, "Ability to Pay", in the middle. The Union representatives lament the "cost of living" plight of their constituents, created largely by their own prior actions, and strive mightily to make it worse. They claim, on behalf of their constituents, large contributions to increased "productivity", which contributions are non-existent.

The record speaks for itself. Consider the following figures in the Companies:

Year	Public Shipments in Tons (000 omitted)	Total Payroll (000 omitted)	Payroll Cost Per Ton
1939	11,707	$240,056	$20.51
1940	15,014	279,679	18.63
1941	20,417	383,364	18.78
1942	20,615	442,852	21.47
1943	20,148	489,183	24.28
1944	21,052	530,848	25.22
1945	18,410	486,887	26.45
1946	15,182	425,490	28.03
1947	20,242	562,518	27.79
1948	20,655	623,474	30.19

The foregoing figures show that the actual result in 1948 was a payroll cost per ton of $30.19 which:

(1) As compared to $20.51 per ton in the year 1939, represents an increase of 47%; and

(2) As compared to $18.78 per ton in the year 1941, represents an increase of 61%.

As previously noted, the product output per man-hour in 1941 was 21% higher than in 1939, an increase due to the principal influence of total volume of production which rose from 11.7 million tons in 1939 to 20.4 million tons in 1941. This increase in product output per man-hour was attended by a payroll cost decrease from $20.51 per ton in 1939 to $18.78 per ton in 1941, a decrease of about 8%. These are the expected benefits of increased productivity accompanying increases in business volume.

The comparison between 1948 and 1941, however, is another story. In 1948 the total production was slightly more than 1% above 1941, the product output per man-hour was 4% higher, *but the payroll cost per ton was 61% higher.* This is not the normal result of increased productivity. It is the opposite. It represents inflation contributing to "high cost of living."

The normal expectancy of increased productivity is that unit product costs will decrease, thereby enabling more widespread distribution of goods and services. But, as we have just noted, such was not the case in the Companies in the last seven years. The Companies spent large sums of money to improve the tools of production and turned out record peacetime production. Yet the net productivity benefits of those actions were absorbed and on top of that the payroll cost per ton of product went up 61%.

Clearly, since the end of World War II, the need has been and is now to reduce unit costs. The most effective way to reduce unit costs is to make maximum use of the available tools of production. Such maximum use of the tools of production in steel can result only when the employees attain the highest level of performance consistent with safety, good health and sustained effort. The Union and the Companies recognized these facts on February 15, 1946 when they agreed that:

> "It is the intent of the parties to secure and sustain maximum productivity per employee during the term of the March 13, 1945 agreement as amended and supplemented by this Supplemental Agreement. *In return to the Company for the wage increase herein provided and consistent with the principle of a fair day's work for a fair day's pay, the Union re-emphasizes its agreement with the objective of achieving the highest level of employee performance and efficiency consistent with safety, good health and sustained effort . . .*" [Supplemental Agreement dated February 15, 1946, Paragraph 1.] (Emphasis supplied.)

This employee performance obligation of the United Steelworkers of America—CIO and the employees of the Companies has continued through each labor agreement since February 15, 1946 and is in effect currently. To date it has not been discharged, and during the pendency thereof the employees of the Companies have received three rounds of wage rate increases. The Union now seeks a fourth. Instead of placing its members in the position of supporting unwarranted demands based on ill-founded claims, the Union should be urging the employees of the Companies to discharge their performance obligations, thus providing greater protection to the jobs now held by the employees and to the high standard of wage rates currently enjoyed by them.

Clearly, therefore, the real need, in the interest of the employees, the owners, and the consuming public, is not a wage rate increase but is to achieve and thereafter maintain the highest level of employee performance consistent with safety, good health, and sustained effort.

This is the road to increased productivity with more jobs and more of the desirable things in life for all.

Respectfully submitted,

R. Conrad Cooper,
Vice President, Industrial Engineering,
United States Steel Corporation of Delaware.

EXHIBIT I

RELATIONSHIP OF SHIPPED TONS PER 1000 MAN HOURS AND VOLUME OF SHIPMENTS TO THE PUBLIC FOR THE YEARS 1934 THROUGH 1948

YEAR	PUBLIC SHIPMENTS TONS 000 OMITTED	TONS PER 1000 MAN HOURS
1934	6,501	32.8
1935	8,086	35.3
1936	11,905	38.4
1937	14,098	41.4
1938	7,316	37.4
1939	11,707	44.5
1940	15,014	49.0
1941	20,417	53.9
1942	20,615	51.7
1943	20,148	48.3
1944	21,052	51.5
1945	18,410	50.2
1946	15,182	52.2
1947	20,242	57.2
1948	20,655	56.1

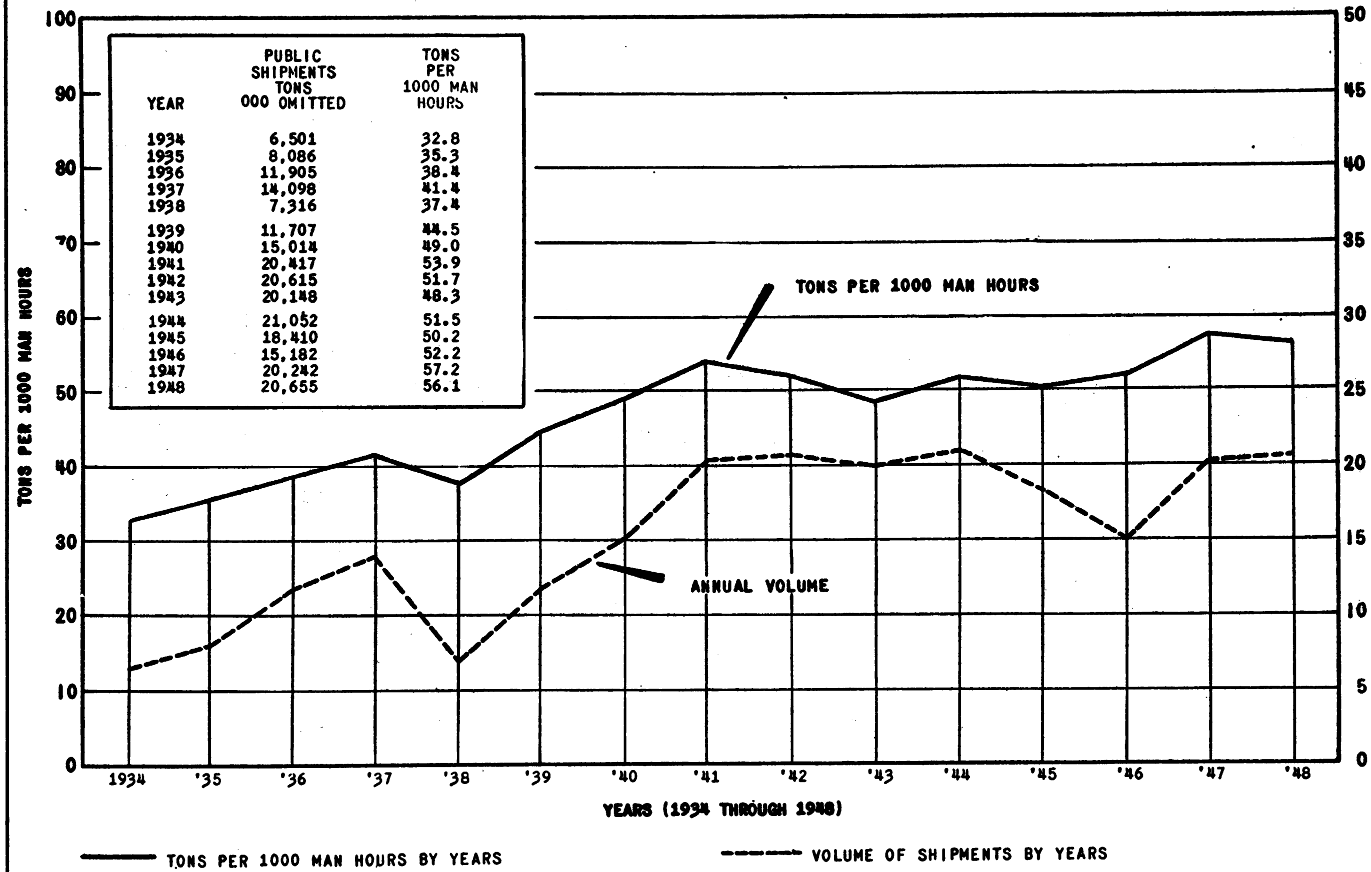

EXHIBIT II

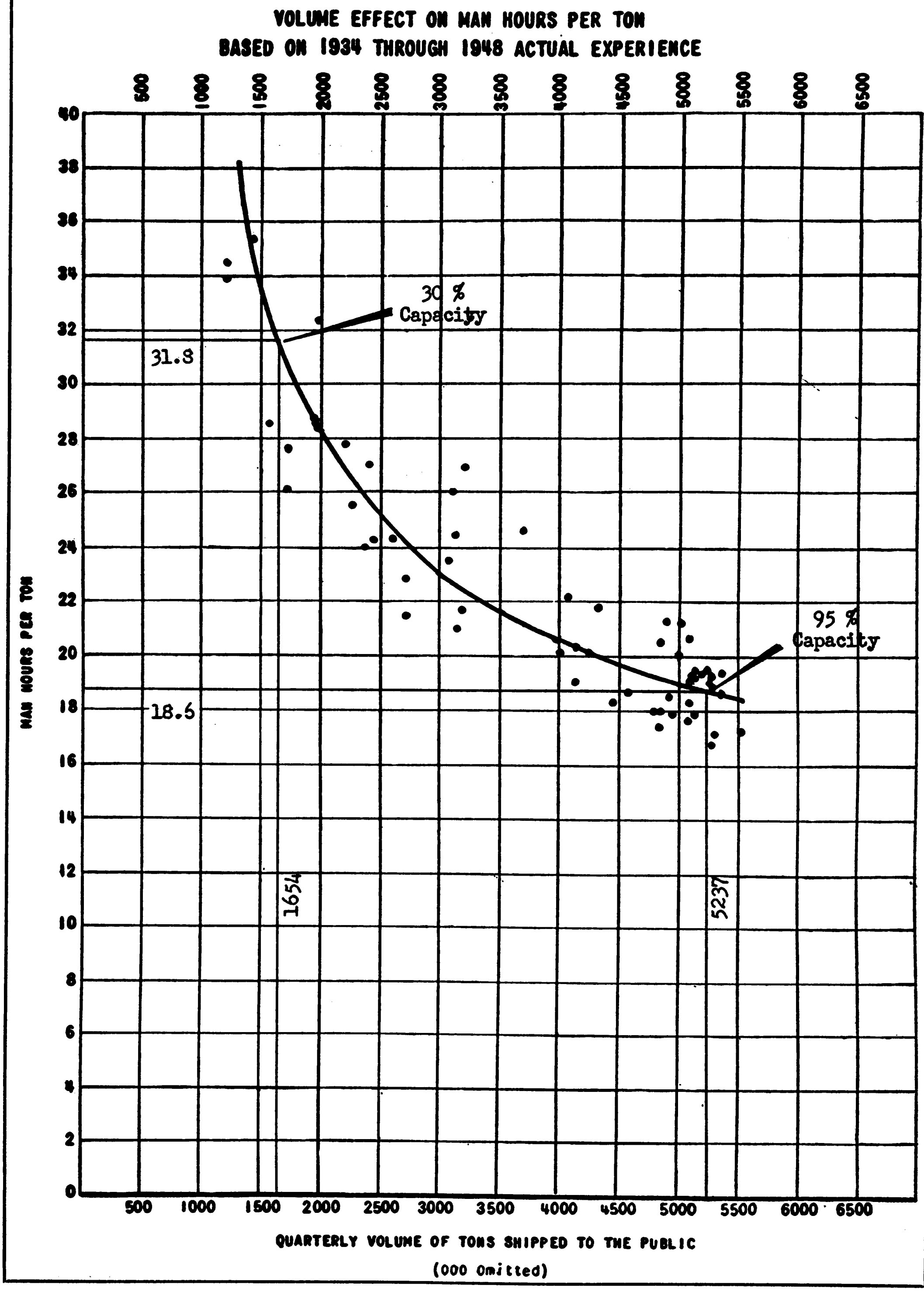
VOLUME EFFECT ON MAN HOURS PER TON
BASED ON 1934 THROUGH 1948 ACTUAL EXPERIENCE
30 %
Capacity
95 %
Capacity
31.8
18.6
1654
5237
MAN HOURS PER TON
QUARTERLY VOLUME OF TONS SHIPPED TO THE PUBLIC
(000 Omitted)

EXHIBIT III

Illustration of Standard Man-hour Variation
Due to Change in *Ordered Quantity*

Company: American Steel and Wire Company
Plant: Joliet
Department: #1 and #2 Rod Mill
Crew Size: 17
Steel Grade: Carbon
Products: #5 Rod
Roll change conditioned assumed: Complete change of 3 pairs of roughing rolls and 4 finishing stands removed and replaced.

Ordered—Single Lot Quantity	100 Ton	500 Ton	1,000 Ton
Standard Man-hours—Processing	55.30	276.50	553.00
Standard Man-hours per Roll Change	36.00	36.00	36.00
Total Standard Man-hours/order	91.30	312.50	589.00
Standard Man-hours/ton ordered	.913	.625	.589

EXHIBIT IV

Productivity in the Blast Furnace and Open Hearth Segments of the Steel Industry, 1920 to 1946
by William T. Hogan

Published in Dissertations Vol. XV,
Fordham University

During the past two decades the question of productivity, or the ratio between input and output in production, has been of prime importance to the economy of the nation. The increase in productivity since the end of World War I has contributed much to raising the American standard of living, while vastly increased productivity in certain lines contributed substantially to our success in turning out the equipment necessary to wage World War II. Again, the importance of increased productivity can be seen in the conservation of natural resources, since improved machinery and techniques in production have enabled us, in many cases, to obtain a greater yield from our raw materials.

Fluctuations in productivity are considered to be more significant as a norm of the economy's health than fluctuations in physical output, because as long as there is full employment an increase in productivity means an increase in national wealth in the truest sense. Thus, more goods and services are being produced by an expenditure of the same or less energy and materials. On the other hand, an increase in total output does not necessarily mean an increase in national wealth, for it may have been accomplished by a greater expenditure of labor and resources.

This study strives to investigate the trend in this vital factor, productivity, in steel. The steel industry was chosen because of the focal position it holds in the American economy. It is one of the nation's largest employers, while its use as a raw material in other products provides 40% of factory jobs. Further, the steel industry is one of our largest consumers of raw materials as well as a leading customer of the railroads. Thus, its welfare is closely tied to that of the national economy, and any change in its productivity would affect the entire country.

The steel industry embraces a great number and variety of operations from mining iron ore, coal and limestone to the manufacture of structural shapes, tubing, wire and tin plate. Consequently, a productivity measurement on the industry level, based on manhours per ton of output and including all of the industry's operations in a single figure, would contain too many heterogeneous items to be of significance. This study breaks the industry down into operations and considers each operation separately and on a plant level. Thus, a significant manhour per ton figure based on a relatively homogeneous product can be obtained.

Two of the most basic operations of the steel industry, viz., the manufacture of pig iron by the blast furnace and the production of steel by the open hearth furnace, are dealt with. Productivity for both of these processes is measured on the plant level over the 1920-1946 period. The resulting trend is then analyzed in order to discover the causes responsible for the changes which have taken place.

The plant chosen for the productivity study operates both blast furnaces and open hearth furnaces and is representative of the larger and more modern plants of the steel industry. The plant, designated as Plant A for purposes of the study, has an annual capacity for producing 2.5 million tons of pig iron and 1.7 million tons of open hearth steel and is a particularly apt subject for a productivity study. Evidence of this can be found in the fact that the blast furnace department of the plant has employed, with few exceptions, every type of technological improvement that has been introduced in blast furnace practice during the past 25 years. The open hearth shop, on the other hand, was built shortly before the opening date of the study and was considered one of the most modern in the country at that time. Thus the study gives complete coverage to the developments and improvements that have affected productivity in the shop.

From 1920 to 1946 the blast furnace department of Plant A showed a considerable increase in productivity. The number of manhours required to produce a ton of pig iron in 1946 was substantially less than the number needed in 1920. This downward trend in manhours per ton was a gradual development marked by interruptions in years when production was cut substantially. The trend reached its low point in 1942 when the figure was 67% below that of 1923. However, since 1942 it has turned upward and in 1946 the figure was 50% below that of 1923.

Fundamentally, the explanation behind much of this increase in productivity can be traced to improved and enlarged blast furnace plant and equipment. In 1920 the plant had eleven blast furnaces with an average production of 550 tons per furnace day. The number of furnaces was gradually reduced over the years while the individual furnaces were enlarged, so that in 1946 there were eight furnaces with an average output of about 1100 tons per furnace per day. The increase in furnace size was accomplished by enlarging the hearth when the furnace was taken out of operation for relining. In one instance the furnace was torn down and rebuilt completely, and in 1942 two of the most modern furnaces of the day were erected at the plant. Each of these, complete with the latest auxiliary equipment, was capable of producing over 1300 tons of pig iron per day.

Along with the development of the plant's furnaces there was a corresponding improvement in the auxiliary equipment required to run the furnaces. The large stoves used to preheat the air blast were increased in size so that some of them had 250,000 square feet of heating surface in 1946 as compared to 50,000 square feet in 1920. Air blowing equipment was improved by the installation of the turboblower, which made it possible to deliver 70 to 80 thousand cubic feet of air per minute as contrasted with 40,000 in 1920. The use of improved refractory brick developed for furnace linings permitted the operator to produce two million tons on a lining in 1946, as compared with about 700,000 in 1920. Equipment used in stocking raw materials and charging them into the furnace was enlarged and coordinated in order to keep a constant flow of materials going into the furnace. The need for this can be seen from the fact that a furnace producing 1300 tons of iron per day consumes 4,000 tons of solid raw materials in addition to 4500 tons of preheated air per day. Among the improvements in stocking equipment was the replacement of a car dumper capable of picking up and emptying 50-ton railroad cars with one capable of handling 90-ton cars.

These improvements required the investment of many millions of dollars over the 25-year period and resulted in the concentration of the plant's production capacity in fewer, larger and more efficient furnaces. Consequently, considerably fewer manhours were required to operate the eight large furnaces than were required for the eleven smaller furnaces, and, since total production increased somewhat, the manhour per ton figure decreased.

The open hearth department at Plant A likewise showed a very favorable trend in productivity during the 1920 to 1946 period. The manhour per ton figure declined 49% between 1923 and 1946. Again, as in the case of the blast furnaces the decline was a gradual one. However, it contained a few violent fluctuations in the years 1932, 1933, 1938 and 1939, when there were correspondingly violent fluctuations in production. The low point in manhours per ton was reached in 1942 when the figure dropped to a point 62% below that of 1923. After 1942 the trend turned upward and climbed to a point 49% below the 1923 level. The increase in productivity, or the decrease in manhours per ton in the open hearth, was accomplished by doubling output while total manhours remained relatively stable. This differs from the blast furnace department performance, where there was a relatively small variation in output during the period, while total manhours were cut in half.

The increase in open hearth output from 903,000 net tons in 1920 to a record of 1,708,000 in 1943 was accomplished by adding two new furnaces in 1925 and by a gradual increase in the size of the furnaces enabling them to turn out larger quantities of steel. The size of the heat of steel, i. e., the amount made at one time in a furnace, increased from 114 net tons in 1920 to 176 net tons in 1946. This was achieved by gradually increasing the size of the furnaces through a series of rebuilds. However, the larger furnaces, in turn, were made possible by improved design, enlarged and improved charging and tapping equipment, instrumentation and improved refractory linings.

In the matter of design, one of the most fundamental changes was the installation of sloping walls which prolonged the life of the furnace lining and cut down on maintenance. New and improved equipment included a dolomite machine, installed in 1927, which contributed materially to the possibility of larger furnaces since it spread the dolomite, a kind of limestone, over the bottom of the furnace between heats. Formerly this was done by shovel and it was a practical impossibility to cover a large hearth adequately. Other equipment, such as charging machines, overhead cranes and hot metal ladles, was improved and enlarged to handle the greater mass of material required for the increased output. A number of instruments were put in during the 25-year period which did much to insure regularity of operation and uniformity of steel quality. The more important instruments provided for fuel and air volume control, furnace pressure control, automatic furnace reversal and roof temperature control. In addition to these the carbometer was developed and put in use in 1937. It enabled the furnace operator to tell the percentage of carbon in the heat within two minutes after the sample was taken. Thus exact specifications could be met with much less difficulty than previously.

Another factor in the increase in production and productivity in the open hearth shop at Plant A was the reduction in the amount of time required to rebuild and reline the furnaces. This is of definite importance since the life of an open hearth lining is relatively short, and must be replaced after every 150 heats. The chief factors in the reduction of this time have been the use of improved mechanical equipment and the proper scheduling of rebuilds so that not more than one furnace is out of production at any given time. This last item was one of the principal reasons for the record steel output at Plant A during the years of World War II, for by careful scheduling of rebuilds 15 of the shop's 16 furnaces were constantly in operation from 1941 to 1944.

Another advantage of having no more than one furnace under repair at one time is that the number of charging and tapping delays is reduced. This is evident from the fact that some of the charging and tapping equipment, such as overhead cranes and locomotives, is also used in handling materials for furnace rebuilds. Thus if two or three furnaces were being rebuilt at one time the demand on this equipment would be sufficient to cause delays in the normal charging operations of the shop. Therefore, it can readily be seen that organization and coordination of equipment play an important role in successful open hearth operations. Without the proper coordination furnace size alone could not account for the marked increase in productivity at Plant A.

From the plant-process-productivity measurement and analysis it is evident that sizeable productivity increases were made at both the blast furnace and open hearth departments of Plant A. A detailed analysis of the productivity trend of each process, which can be made accurately on the plant level, reveals the facts behind the productivity figures.

The facts demonstrate that the gradual decline in man-hours per ton over the 25-year period was a result of constant replacement and improvement in plant and equipment. Further, this technological advance could not have taken place at Plant A without the expenditure of millions of dollars. In addition to capital equipment, much engineering skill, industrial planning and coordination were necessary to increase productivity. For as the analysis indicates it was through a combination of these factors that the increase was accomplished.

After measuring and analyzing the increase in productivity, observations were made on the trend in a factor closely related to productivity, viz., the cost of manufacturing over and above the cost of raw materials. It was observed that this trend was generally downward, with but few interruptions, in both the blast furnace and open hearth departments of the plant until the inflationary period of World War II caused it to rise abruptly. In 1944 cost above in the blast furnace department of Plant A was more than 16% higher than it was in 1923, and in 1946, cost above in the open hearth department of the plant was 21% above the 1923 figure. A substantial element of these costs was wages. They constituted about one-third of the blast furnace cost above and about one-fourth of the open hearth cost above. During the period under observation, the trend in hourly wages was steadily upward though it suffered reversals in 1932, 1933 and 1939. The money wage, measured on the basis of the hourly wage rate, increased 76% from 1923 to 1941, while the grand total of manhours for all those employed declined 57% in the blast furnace department of the plant and 11% in the open hearth department from 1923 to 1945. There was, however, no causal connection between productivity and wages on the plant level, for wages were determined on a corporation wide basis, while productivity was a result of plant improvements and their efficient operation.

EXHIBIT V

Product Output per Man-hour Comparison
Reflecting
Capital Improvement of Tin Plate Manufacturing Facilities
Carnegie-Illinois Steel Corporation
Shenango — Irvin
March 1942

Operation	Shenango Man-hours Per Ton	Irvin Man-hours Per Ton
Rolling	24.910	5.225
Tinning	9.332	6.672
Packaging—Warehousing & Shipping	.535	.502
Total Man-hours Per Ton	34.777	12.399
Total—Tons Per Man-hour	.0288	.0805

Increase in Production Per Man-hour—Irvin vs. Shenango = 180%.

EXHIBIT VI

Comparison of Crews, Productive Capacity
and Cost of Construction for
Blast Furnace No. 6, Gary Works
Carnegie-Illinois Steel Corporation
in 1910 and 1946

Items	Built in 1910	Rebuilt in 1946	Percent + increase — decrease
Furnace Size—Hearth Diameter	21′ 3″	28′ 0″	+ 32
Daily Capacity—Tons	470	1509	+222
Crew—Men per Turn	9.5	7.5	— 21
Turns per Day	2	3	+ 50
Men per Day	19	22.5	+ 18
Man-Hours per Day	228	180	— 21
Man-Hours per Ton Capacity	.485	.119	— 75
Capacity Tons per Man-Hour	2.06	8.39	+308
Total Cost of Furnace	$613,843	$3,441,000	+460
Tons Capacity per Year	171,600	520,500	+203
Investment per Ton—Annual Capacity	$3.57	$6.61	+ 85

EXHIBIT VII

November 26, 1946

Subject: Memorandum on Productivity Surveys

To: Russell Schneider, Executive Secretary Advisory Committee on Government Questionnaires

From: Tom Mills, U. S. Bureau of the Budget

For several years the Bureau of Labor Statistics has been preparing measures of physical volume of output in relation to labor time expended. The method has generally involved securing aggregate production data for specific product from the Census or other sources and converting these data into index numbers. Manhours worked by production workers in the industry producing the specific product are estimated from Census or Bureau of Labor Statistics information and converted into index numbers. The index of production is then divided by the index of manhours worked to arrive at an index of "labor productivity".

This method of computing "labor productivity" does not involve any additional questionnaires or burden on employers, but has certain definite limitations. The method generally can only be used to measure labor productivity in single product or very similar product industries for which production and employment data are available. Where products other than the specific product being measured are produced in an industry, the employment data can not usually be separated between the specific product and other production. The method is not appropriate to multi-product industries.

The BLS is now initiating a program to collect labor productivity information directly from plants. This program requires briefly (1) determination of what products are representative of a particular industry, (2) determination of what plants are representative, (3) approach to selected plants and trade associations to solicit cooperation in reporting, (4) preparation of a schedule showing quantity of physical production and manhours or labor cost charged to this production, and (5) the combining of plant and product reports to secure an index.

The Division of Statistical Standards is interested in securing the advice of industry on this project, particularly on item 4 above.

EXHIBIT VIII

Illustration of Standard Man-hour
Variation Due to *Steel Grade*

Company:	American Steel and Wire Company
Plant:	Joliet
Department:	#1 and #2 Rod Mill
Crew Size:	17

Standard Man-hours Per Ton of Product For #5 Rod Carbon Steel Based on One Mill Operating	.553
Standard Man-hours Per Ton for #5 Rod Alloy Steel Based on One Mill Operating	.942

EXHIBIT IX

Illustration of Standard Man-hour Variations Due to *Size* of Product

Company: Carnegie-Illinois Steel Corporation

Plant: Duquesne

Department: #6—10″ Merchant Mill

	Round Size Diameter in Inches	Standard Man-hours Per Ton of Plain Rounds—Carbon Steel
	23/64	4.44
	24/64	4.10
	25/64	3.81
Note: 23-man crew from 23/64 to 30/64 inc.	26/64	3.55
	27/64	3.33
	28/64	3.12
	29/64	2.44
	30/64	2.10
	31/64	2.08
	32/64	2.00
	33/64	1.94
Note: 21-man crew for sizes over 30/64	34/64	1.87
	35/64	1.82
	36/64	1.75
	37/64	1.70
	38/64	1.64
	39/64	1.40
	40/64	1.36
	41/64	1.35
	42/64	1.33
	43/64	1.28
	44/64	1.26
	45/64	1.22
	46/64	1.18
	47/64 to 53/64	1.16
	54/64 to 71/64	1.03
	72/64	1.04
	73/64	1.05
	74/64	1.08
	75/64	1.08
	76/64 to 88/64	1.10

EXHIBIT X

Illustration of Standard Man-hour Variation Due to Change in *Method* of Processing

Company: National Tube Company

Plant: Lorain Works

Department: Coupling Shop

Operation: Taper Bore and Ream Both Ends of Couplings

Crew Size: Old Method—1 Man Per Machine
New Method—1 Man Per 2 Machines

Method Change: Rearrangement of Equipment Permitting More Effective Utilization of Labor

	Standard Man-hours Per 100 Pieces (H40 Grade)	
Product Size	**Old Method**	**New Method**
3″ Standard	1.623	1.02
3½″ Standard	2.012	1.06
4″ Standard	2.196	1.17
3″ English Gas or Steam	1.623	1.02
3½″ English Gas or Steam	2.012	1.06
4″ English Gas or Steam	2.196	1.17
3″ Special Line	2.034	1.10

EXHIBIT XI

RESULTS OF TEST ON COKE MADE FROM WASHED VS. UNWASHED COALS—CARRIE FURNACES—JULY, AUGUST, OCTOBER AND NOVEMBER, 1940

	Coke Made From		Difference	
	Unwashed Coals	Washed Coals	Amount	Per Cent
Iron Production, N.T./Day	781	844	+63	+8.1
Gross Coke Consumption, Lb./N.T. Iron	1,966	1,799	—167	—8.5

Details published in PROCEEDINGS of the Blast Furnace, Coke Oven and Raw Materials Committee, AIME, Vol. 3, Page 19, 1943.

EXHIBIT XII

RESULTS OF TEST ON SIZED AND SINTERED MESABI IRON ORES VS. REGULAR MESABI ORES—EDGAR THOMSON WORKS FEBRUARY, MARCH AND APRIL, 1947

	Regular Ores	Prepared Ores	Difference	
			Amount	Per Cent
Iron Production, N.T./Day	1,324	1,605	+281	+21.2
Coke Consumption, Lb./N.T. Iron	1,859	1,574	—285	—15.3

Details published in PROCEEDINGS of the Blast Furnace, Coke Oven and Raw Materials Committee, AIME, Vol. 7, Page 55, 1948.

EXHIBIT XIII

EFFECT OF HOT METAL PROPORTIONS IN TOTAL CHARGE OF IRON AND SCRAP ON THE PRODUCTIVITY OF OPEN HEARTH FURNACES

Period	South Works No. 2 Open Hearth: Heat Size Net Tons	Per Cent Hot Metal	Net Tons per Fce. Oper. Hr.	South Works No. 4 Open Hearth: Heat Size Net Tons	Per Cent Hot Metal	Net Tons per Fce. Oper. Hr.
1948						
April	119.9	43.8	9.53	191.8	45.0	14.15
May	122.1	50.0	9.89	190.7	50.4	14.66
June	122.4	47.9	9.62	186.9	48.3	13.48
Average	121.5	47.2	9.68	189.8	47.9	14.10
1949						
April	121.8	54.5	10.48	189.1	54.6	15.75
May	121.7	53.6	10.42	189.0	51.5	15.87
June	120.0	58.7	10.28	186.8	58.1	15.43
Average	121.2	55.6	10.39	188.3	54.7	15.68
Per Cent Increased Output			7.3			11.2

EXHIBIT XIV

EXPENDITURES TO PROPERTY ACCOUNTS BY YEARS

Year	Investment
1939	$ 15,466,100
1940	35,299,672
1941	65,924,187
1942	69,276,528
1943	47,724,602
1944	23,946,549
1945	21,507,888
1946	129,725,785
1947	143,476,011
1948	187,417,897
Total	$739,765,219
Total (1942-1948)	$623,075,260

EXHIBIT XV

TONS PER MAN HOUR COMPARISONS IN REPRESENTATIVE PLANTS

Plant	1941 Tons (000 omitted)	1941 Man Hours (000 omitted)	1941 Tons Per Man Hour	1948 Tons (000 omitted)	1948 Man Hours (000 omitted)	1948 Tons Per Man Hour	% Inc. or Dec.
Isabella	133	851	.156	154	932	.165	5.8
Central Fces.	506	899	.563	518	1,040	.498	—11.6
Gary Coke	4,697	2,752	1.707	5,099	3,337	1.528	—10.5
Joliet Coke	1,142	1,026	1.113	1,063	1,009	1.054	— 5.4
Cleveland Coke	1,007	789	1.276	797	783	1.018	—20.2
Clairton Steel	658	7,148	.092	583	6,621	.088	— 4.4
Ohio Works	1,747	10,295	.170	1,774	11,414	.155	— 8.8
Torrance Works	168	3,012	.056	143	2,945	.049	—12.5
Rankin Works	87	1,188	.073	83	1,208	.069	— 5.5
TOTAL		27,960			29,289		
Total Blast Fce.	639	1,750	.365	672	1,972	.341	— 6.6
Total Coke	6,846	4,567	1.499	6,959	5,129	1.357	— 9.5
Total Steel Works	2,660	21,643	.123	2,583	22,188	.116	— 5.7
TOTAL		27,960			29,289		

Combined net effectiveness in units of production per man hour for blast furnaces, coke plants and steel works in 1948 as compared to 1941 = —6.2%.

This result is obtained as follows:

1948 tons (000 omitted)		1941 Tons/Man Hour	1948 Required Man Hours at 1941 Output Rate (000 omitted)
672	+	.365	1,841
6,959	+	1.499	4,642
2,583	+	.123	21,000
Total			27,483

$$1948 \text{ Effectiveness} = \frac{1948 \text{ Required}}{1948 \text{ Actual}} = \frac{27{,}483}{29{,}289} = 93.8\%$$