AN ANALYSIS OF LABOR PRODUCTIVITY IN THE U.S. CONSTRUCTION INDUSTRY

By

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ABSTRACT

Labor productivity, or the output per hour-worked, is considered one of the best measures of production efficiency. The ultimate goal of every industrial sector in the nation, including construction, is to increase productivity. Macroeconomics data suggest that labor productivity declined significantly in the construction industry during the 1979-1998 period. However, microeconomic studies indicate the contrary. This dissertation critically examines the construction labor productivity macroeconomic data in the United States from 1979 to 1998 to determine its validity and reliability. Data collection, distribution, manipulation, analysis, and interpretation are reviewed and problems are identified. The dissertation presents a comparison of construction and manufacturing labor productivity during this period.

This dissertation describes a comprehensive research plan whose goal is to understand why labor productivity in the construction industry has followed a declining trend over the last couple of decades while other sectors have managed to create sustained increases. Special emphasis is given to the comparison between the construction industry and the manufacturing industry, in terms of labor force profiles, project environments, and production processes, among other characteristics. This dissertation also builds a profile of the construction labor force over the last 20 years and compares it to the manufacturing industry. Information about employment, education, age, and gender for both industries is presented. Projections for labor demand to the year 2008 are also examined.

This dissertation also presents the results of a survey instrument applied to determine the relative level of relevance of construction labor productivity drivers and opportunities. Owners, general contractors, electrical contractors, mechanical contractors, consultants and others participated in this survey. The results suggest that respondents consider the improvement of labor productivity within their reach and control rather than determined by external conditions.

To my dad (Vicharn Aramvareekul), and my mom (Jiraphan Aramvareekul)

for their love, and support.

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Chapter 1: Introduction

1.1 LABOR PRODUCTIVITY

Labor productivity, or the output per hour-worked, is considered one of the best measures of production efficiency. The ultimate goal of every industrial sector in the nation, including construction, is to increase productivity. The general increase in productivity is what generates economic progress because it creates non-inflationary wage increases. However, for the last couple of decades (1979-1998), it seems like construction productivity has been decreasing while other sectors have managed to generate a substantial increase. For example, when compared against the manufacturing sector, a reverse of roles is evident. Figure 1-1 and table 1-1 show that in 1979 the output per hour-worked in the construction sector was significantly higher than in the manufacturing sector. However, by 1998, the manufacturing sector exhibits a substantially higher output per hour-worked than construction. This is the result of a sustained increase in labor productivity over the last two decades for the manufacturing sector and an erratic behavior with a decreasing trend for productivity in the construction sector (Allmon et al 2000) over the same period of time.

This chapter will describe a comprehensive research plan whose goal is to understand why labor productivity in the construction industry has followed a declining trend over the last couple of decades while other sectors have managed to create sustained increases.

Special emphasis is given to the comparison between the construction industry and the manufacturing industry, in terms of labor force profiles, project environments, and production processes, among other characteristics.

The understanding of the possible causes of this consistent decline in productivity in the construction industry would allow the definition of mitigating strategies to reverse the trend and set new goals for productivity improvements over the next two decades.

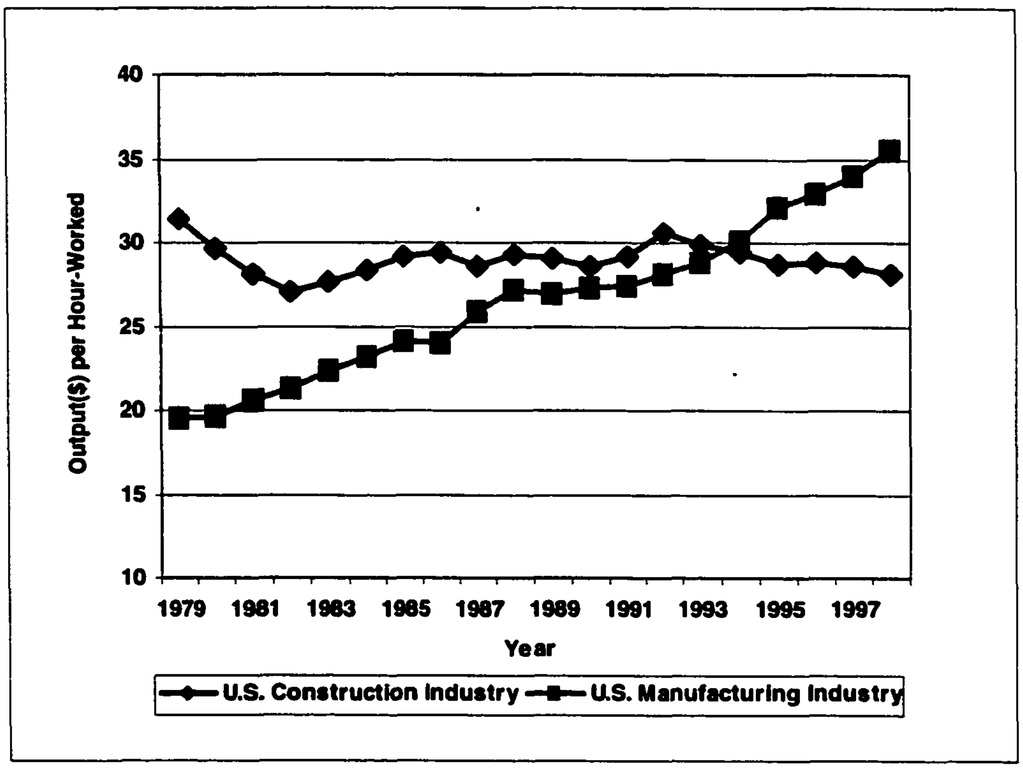


Figure 1-1: Labor Productivity Values in 1996-Chained Dollars for the US Construction and Manufacturing Industries from 1979 to 1998 (Sources: the Bureau of Labor Statistics and the Bureau of Economic Analysis)

Year	Construction Industry			Manufacturing Industry		
	Output ($ Billions)	Hour-Worked (Billions)	Productivity ($ / Hr)	Output ($ Billions)	Hour-Worked (Billions)	Productivity ($ / Hr)
1979	269.44	8.59	**31.38**	857.52	43.98	**19.50**
1980	247.76	8.36	**29.63**	822.48	41.88	**19.64**
1981	226.02	8.04	**28.13**	859.56	41.74	**20.59**
1982	201.80	7.45	**27.09**	809.45	37.99	**21.31**
1983	210.14	7.61	**27.60**	858.83	38.43	**22.35**
1984	243.82	8.61	**28.32**	950.48	41.00	**23.18**
1985	267.02	9.15	**29.18**	976.22	40.54	**24.08**
1986	275.03	9.35	**29.40**	961.75	40.10	**23.98**
1987	278.36	9.75	**28.56**	1046.30	40.51	**25.83**
1988	294.14	10.05	**29.28**	1120.20	41.28	**27.14**
1989	296.29	10.19	**29.07**	1111.60	41.34	**26.89**
1990	290.69	10.17	**28.58**	1102.30	40.47	**27.24**
1991	268.77	9.21	**29.17**	1066.30	38.95	**27.37**
1992	271.75	8.88	**30.62**	1085.00	38.60	**28.11**
1993	279.18	9.35	**29.87**	1122.90	38.91	**28.86**
1994	297.19	10.09	**29.47**	1206.00	40.01	**30.14**
1995	299.61	10.44	**28.70**	1284.70	40.07	**32.06**
1996	316.42	10.99	**28.80**	1316.00	40.01	**32.89**
1997	329.28	11.54	**28.53**	1385.50	40.79	**33.97**
1998	342.90	12.18	**28.16**	1448.70	40.78	**35.53**

Table 1-1: Productivity and Related Measures in 1996-Chained Dollars
(Sources: the Bureau of Labor Statistics and the Bureau of Economic Analysis)

The construction industry represents approximately about 4% of gross domestic product (GDP) in the United States and it employs more than 5.5 million people. Therefore, productivity increases in the sector would not only benefit those directly involved with the construction industry, but also the country as a whole. Furthermore, an increase in productivity would also represent an increase in competitiveness for the U.S. construction industry when competing internationally. The first step towards this goal is to determine why the industry seems to be incapable of achieving sustainable advances in labor productivity throughout the years.

The findings of the research study would also generate new avenues of research as the body of knowledge about labor productivity in construction is expanded.

Labor productivity is defined as the output generated per hour-worked. Therefore, in order to calculate productivity values for an industry, three pieces of information are required: the industry's output, the industry's employment data, and the average number of hour-worked. Mathematically, productivity is calculated as:

$$P_i = \frac{GPO_i}{\sum_{j=1}^{12} E_{ij} H_{ij}} \qquad \text{Equation 1}$$

Where:

P_i = Labor productivity for industry "i".

GPO_i = Gross Product Originating by Industry, for industry "i" in chained dollars.

E_{ij} = Average number of employees for industry "i" in month "j".

H_{ij} = Average number of hour-worked for industry "i" in month "j".

1.1.1 Gross Product Originating by Industry:

Gross product originating (GPO) by industry is the contribution of each private industry and government to the Nation's output, or gross domestic product (GDP). An industry's GPO is equal to its gross output minus its intermediate inputs. Current-dollar GPO by industry cannot be used to calculate and compare productivity values from different years because current-dollar GPO by industry must be adjusted for inflation. The adjusted GPO is known as real GPO by industry and it is referred, according to the based year, to convert the data from current dollars to real dollars. For example, if the base year is 1996, then a reference for 1996-chained dollars would be used. Most of the data available from the Bureau of Economic Analysis (BEA) of the Department of Commerce has been converted to real values by using 1996-chained dollars.

The definition of the term "chained dollars", given by The Energy Information Administration, Annual Energy Review 1999, is a measure used to express real prices. Real prices are those that have been adjusted to remove the effect of changes in the purchasing power of the dollar; they usually reflect buying power relative to a reference year. Prior to 1996, real prices were expressed in constant dollars, a measure based on the weights of goods and services in a single year, usually a recent year. In 1996, the U.S. Department of Commerce introduced the chained-dollar measure. The new measure is based on the average weights of goods and services in successive pairs of years. It is "chained" because the second year in each pair, with its weights, becomes the first year of the next pair. The advantage of using the chained-dollar measure is that it is more closely related to any given period covered and is therefore subject to less distortion over time. Therefore, chained-dollars are used to eliminate the effects of inflation and compare GDP and GPO in real terms.

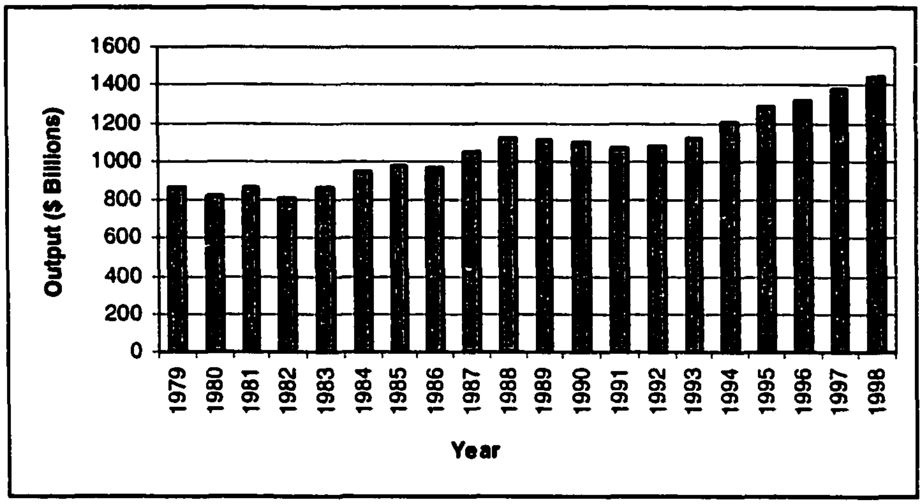


Figure 1-2: GPO in Manufacturing Industry in 1996-Chained Dollars (1979-1998)
(Source: the Bureau of Economic Analysis)

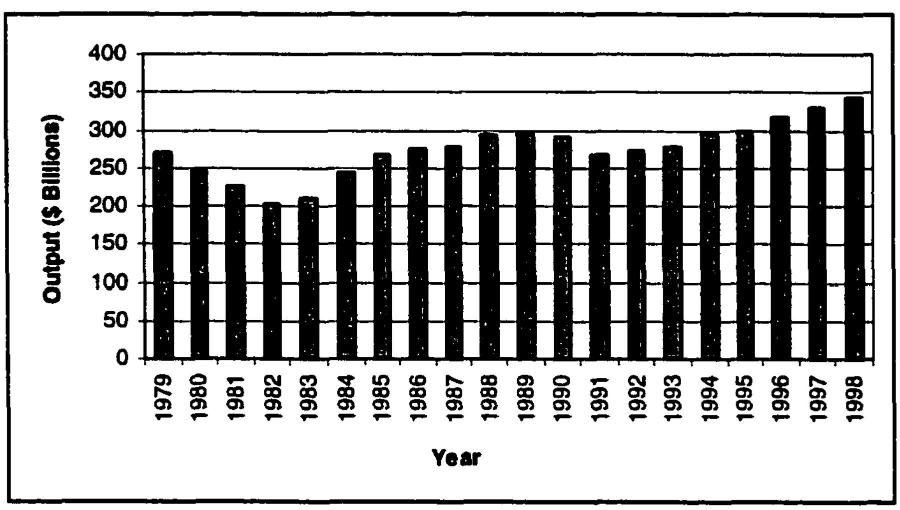


Figure 1-3: GPO in Construction Industry in 1996-Chained Dollars (1979-1998)
(Source: the Bureau of Economic Analysis)

Figures 1-2 and 1-3 show the GPO in 1996-chained dollars for the manufacturing and the construction industries from 1979 to 1998 respectively. Manufacturing output increased during this period, from $857.52 billion to $1448.70 billion, or by approximately 68.94%. In contrast, construction output increased from $269.44 billion to $342.90 billion within the same period, which represents only a 27.26% increase. Therefore, the manufacturing sector experienced a greater expansion than the construction sector over the last couple of decades.

1.1.2 Average Number of Employees:

The average number of employees by industrial sector is compiled by the Bureau of Labor Statistics (BLS) on a monthly basis. Average annual levels of employment for the manufacturing and the construction industries from 1979 to 1998 are depicted in figures 1-4 and 1-5 respectively. The average number of people employed by the manufacturing industry has actually declined from an annual average of 21.04 million of workers to an annual average of 18.805 million of workers, or by approximately 10.62% decrease. In contrast, the average number of people employed by the construction industry within the same period of time increased from 4.463 million of workers to 6.020 million of workers, which represents a 34.89% increase.

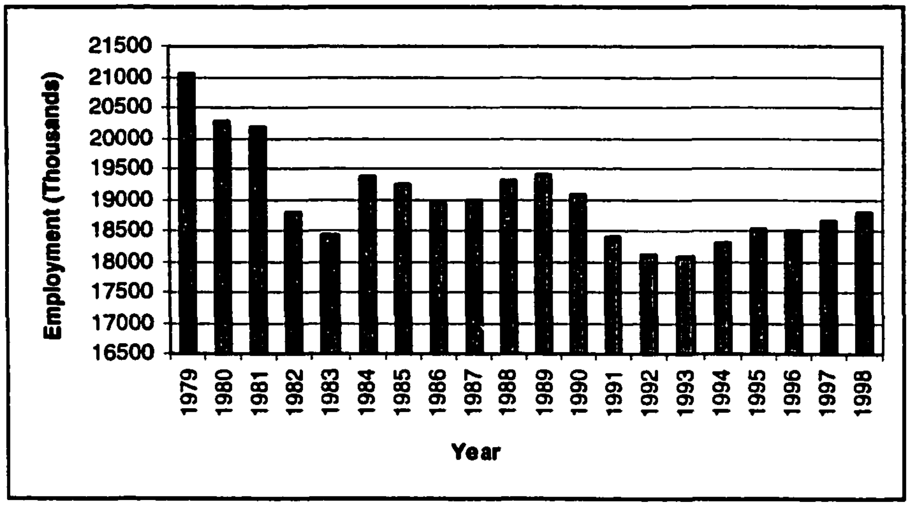


Figure 1-4: Employment in Manufacturing Industry (1979-1998)
(Source: the Bureau of Labor Statistics)

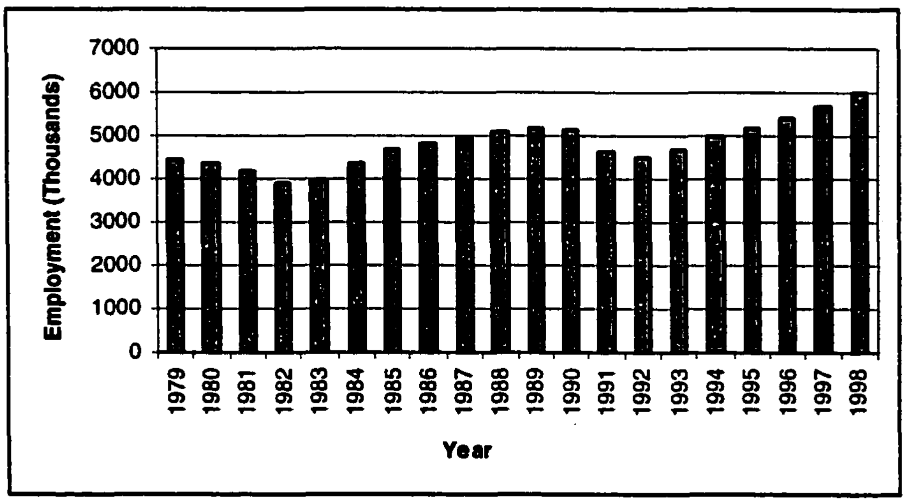


Figure 1-5: Employment in Construction Industry (1979-1998)
(Source: the Bureau of Labor Statistics)

1.1.3 Average Number of Hour-Worked:

The average number of hour-worked by the industrial sector is compiled by the Bureau of Labor Statistics on a weekly basis. Average annual levels of weekly hour-worked for the manufacturing and the construction industries from 1979 to 1998 are depicted in figures 1-6 and 1-7 respectively. The average number of weekly hour-worked in the manufacturing industry has increased from an average of 40.2 hours per week to an average of 41.7 hours per week, or by approximately a 3.73% increase. In contrast, the average number weekly hour-worked in the construction industry within the same period of time increased from 37.0 hours per week to 38.9 hours per week, which represents a 5.14% increase.

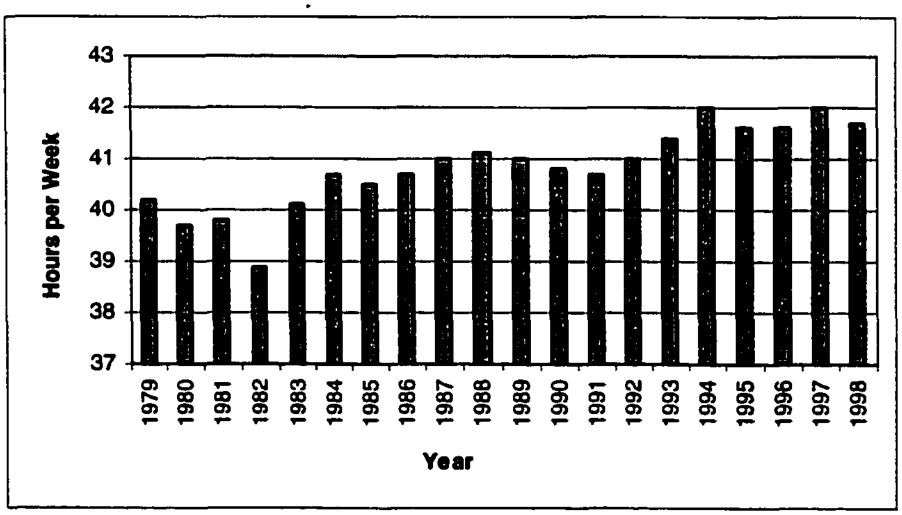


Figure 1-6: Average Weekly Hour-Worked in Manufacturing Industry (1979-1998)
(Source: the Bureau of Labor Statistics)

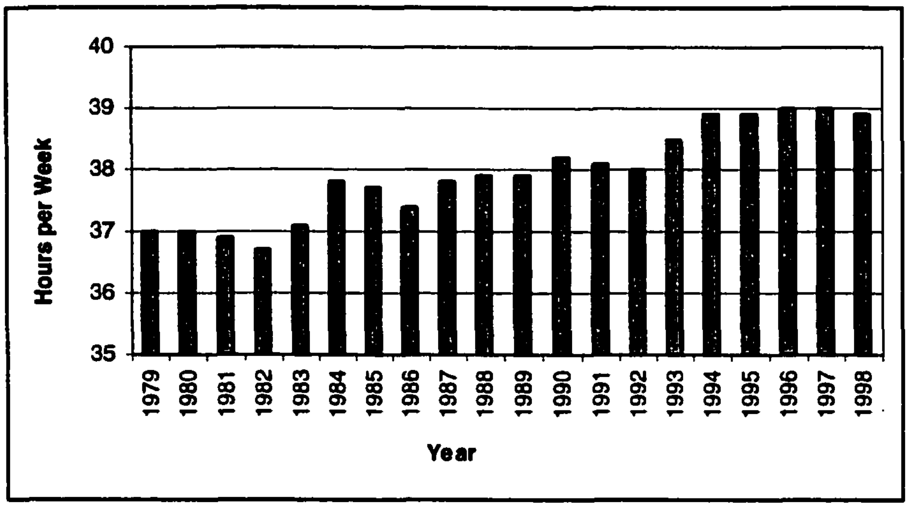


Figure 1-7: Average Weekly Hour-Worked in Construction Industry (1979-1998)
(Source: the Bureau of Labor Statistics)

1.1.4 Manufacturing versus Construction:

In summary, there were 34.89% more people employed in the construction industry in 1998 than in 1979, working 5.14% more time per week. The total output; however, only increased by 27.26%. On the other hand, in the manufacturing industry, there were 10.62% less people employed in 1998 than in 1979, working only 3.73% more time per week, but producing an increase in total output of 68.94%. Therefore, according to the shown data, it seems that the manufacturing industry has been doing better than the construction industry in term of labor productivity in the last two decades.

1.2 OBJECTIVES AND SIGNIFICANCE OF THE RESEARCH

A. Evaluate Productivity Data for the Construction Industry and Compare it to the Manufacturing Industry.

Hypothesis:

In order to gather a clear understanding of the problem of declining productivity in the construction industry, it is vital to evaluate the validity of the data itself before reaching any conclusions.

Significance:

An in-depth review of the methodology followed to compute the values required to estimate productivity in the construction industry would validate the preliminary findings. Furthermore, a closer look at the data would also allow a better understanding of the magnitude of the problem.

B. Create Labor Force Profiles for the Manufacturing and the Construction Industries.

Hypothesis:

Labor force profiles for the manufacturing and the construction industries will reveal basic differences between the labor compositions in both industries.

Significance:

Differences in productivity values between the manufacturing and the construction industry might be partially attributed to differences in the backgrounds and technical capabilities of the labor force. A higher attainment of education and work experience of the labor force, adding a high degree of motivation and job satisfaction, is more likely to produce productivity improvements than a labor force with a lower attainment in education, work experience, and low motivation.

C. Evaluate Labor Productivity Drivers and Opportunities in the Construction Industries.

Hypothesis:

There are many factors that drive or determine labor productivity in the construction industry. To be able to improve productivity levels, studying the real factors, which affect construction productivity from people's opinions in the construction industry, such as general contractor, mechanical contractor, electrical contractor, consultant, and owner, will lead to practical solutions.

Significance:

Decreases in productivity values in the construction industry might be partially attributed to such factors as management systems and strategies, manpower, industry environment, and external conditions. In order to enhance the productivity level of the construction industry, it would be helpful to understand these factors. The results of a survey will introduce the concerns of stakeholders in the construction industry.

1.3 RESEARCH WORK PLAN

A. Evaluation of productivity data for the construction industry and comparing to the manufacturing industry.

Before looking for solutions, it is imperative to verify that a problem really exists. This is the reason why the phrase "it seems like construction productivity has been decreasing" was used before. The word "seems" was purposely used to signify that an independent verification of the information has not yet been performed.

First, productivity values are calculated based upon data from the Bureau of Economic Analysis (BEA) of the Department of Commerce. The BEA gathers data based on statistical approaches. These approaches might contain unintentional biases against particular industries due to intrinsic characteristics of the industries and the methodology employed (Allen 1985, Allen 1989, Pieper 1989). Therefore, this study performs an in-depth analysis of the survey instruments used to collect the data as well as at the data manipulation process that follows.

Second, changes in the output mix can generate changes in construction labor productivity values even when labor productivity for each sector remains constant. In other words, if the percentage of each sector in an industry changes during the period of study, labor productivity values for that industry as a whole could go down or go up even if each sector's productivity had remained constant. Therefore, this study performs an in-depth analysis of the output mix in the construction and manufacturing industries.

Activities performed in this phase include:

- Gathering raw data from the BEA and BLS.
- Review of methodological approaches followed by the BEA and BLS.
- Understanding of how to BLS and BEA get the data.
- Generation of time series data for labor productivity values for both construction and manufacturing industries.
- Study of state data.
- Generation of time series data for productivity by sectors in the manufacturing industry.
- Study of the output mix in the construction and manufacturing industries.

B. Create labor force profiles for the manufacturing and the construction industries.

One potential explanation for the differences in productivity between the construction and the manufacturing industries is the discrepancies in the labor force profiles of each industry.

This study creates labor profiles for both the construction and the manufacturing industries. These profiles include variables such as age distribution, gender distribution, education level, hour-worked related to experience level, real hourly wage, sectors in the industry, and so on.

Activities performed in this phase include:

- Definition of attributes to be included in the labor force profiles.
- Collecting the data that will be used to analyze the labor force.
- Generation of labor force profile of each relevant factor.
- Analysis of the labor force profile of each relevant factor.
- Projection of the labor force trend for the future.

C. Evaluate labor productivity drivers and opportunities in the construction industries.

This study reveals the real factors that affect the construction productivity through the use of survey instruments. These factors are evaluated to determine potential areas of improvement.

Activities performed in this phase include:

- Study factors that can affect the productivity.
- Generate the survey instrument to evaluate the level of importance of each factor.
- Generate the survey instrument to evaluate the level of the importance of the methods to enhance productivity.
- Collect the survey data.
- Analyze the data gathered through the surveys.

D. Compare labor force profile, project environments, and production processes and define goals for productivity improvements for the construction industry and introduce further research.

The construction and the manufacturing industries operate under very different project environments. Manufacturing usually deals with repetitive activities that occur in a controlled environment. Construction, on the other hand, works with unique projects in an environment that can only be partially controlled. These differences in project environments could account for some of the differences in productivity values. For example, weather-related events such as low or high temperatures, rain, and snow showers among others, usually have an adverse effect on construction productivity. However, the same events often have a negligible effect on manufacturing productivity. In fact, they only affect the manufacturing industry when they are so extremely severe that laborers and/or input materials cannot arrive at the production location.

Another major difference between the project environments in the manufacturing and construction industry is the number of disputes among project participants. Construction project managers are very often involved in dispute resolution between a variety of parties. Manufacturing, on the other hand, is an industry with a lower degree of conflicts because of the limited opportunity for interaction between subcontractors. In a manufacturing environment, different components can be produced independently from one another. However, in a construction project the production and assembly of the different components usually occurs simultaneously, generating a fertile environment for disputes among subcontractors who are constantly interacting.

Finally, the regulatory environment is also different in both industries. A significant percentage of the construction industry output is produced for public owners. In public projects, because funding comes from taxpayers, the production process is highly regulated and controlled by public entities. In manufacturing, only the quality of the final product rather than the production process itself is subject to a significant number of governmental regulations. Furthermore, in the construction industry even when projects are built for private owners, several governmental agencies still regulate the process in order to protect the general public. Production processes have considerably evolved in the manufacturing industry during the last two decades. The implementation of new technologies such as robotics and innovative managerial approaches such as just-in-time production are mainly responsible for this change.

Activities performed in this phase include:

- Review of major findings from previous phases.
- Determination of the reliability of the national data from BEA and BLS.
- Determination of the reliability of the productivity trend generated from the data collected by BEA and BLS.
- Analysis of the labor force profile analysis.
- Analysis of the labor productivity drivers and opportunities in the construction industries.

- **Definition of recommendation for improving construction productivity.**
- **Prioritization of recommendations and definition of further studies.**

Chapter 2:

Is Construction Labor Productivity Really Declining?

2.1 INTRODUCTION

Labor productivity, or the output per hour-worked, is considered one of the best indicators of production efficiency. Higher productivity levels usually translate into superior profitability. A sustainable improvement in labor productivity is also associated with economic progress as it generates non-inflationary increases in salaries and wages.

In general, according to macroeconomic data, most sectors of the US economy managed to generate substantial improvements in labor productivity during the eighties and the nineties, with a notable exception: the construction industry. Especially troublesome is the relationship between labor productivity in the construction and the manufacturing industries. Figure 1-1 shows labor productivity values, in 1996-chained dollars, for both industries from 1979 to 1998. In 1979 the output per hour-worked in construction was significantly higher than in manufacturing ($31 in construction vs. $19 in manufacturing). However, by 1998, manufacturing exhibited a higher output per hour-worked than construction ($28 in construction vs. $35 in manufacturing). As seen in figure 1-1, this is the result of a sustained increase in labor productivity for the manufacturing sector and an erratic behavior with a downward trend for labor productivity in the construction industry.

This downward trend in construction labor productivity exhibited by the industry in the 1979-1998 period has become common knowledge in both industrial (Civil Engineering 1983, Business Round Table 1988) and academic circles (Arditi 1985, Tucker 1986, Christian & Hachey 1995). Recent microeconomic studies, however, suggest that labor productivity in construction may have actually increased for the same period (Allmon at al 2000). This clearly contradicts the conclusions reached by macroeconomic data and calls for a close examination of their assumptions in order to reconcile both schools of taught.

2.2 CALCULATING LABOR PRODUCTIVITY DATA

Labor productivity is defined as the output generated per hour-worked. In order to calculate productivity values for an industry, three pieces of information are required: the industry's output, the industry's employment data, and the average number of hour-worked. Mathematically, productivity is calculated as:

$$Pi = \frac{GPOi}{\sum_{j=1}^{12} EijHij} \qquad \text{Equation 1}$$

Where:

P_i = Labor productivity for industry "i".

GPO_i = Gross Product Originating by Industry, for industry "i" in chained dollars.

E_{ij} = Average number of employees for industry "i" in month "j".

H_{ij} = Average number of hour-worked for industry "i" in month "j".

Gross Product Originating by Industry (GPO) is the contribution of each private industry and government to the nation's output, or Gross Domestic Product (GDP). An industry's GPO is equal to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other industries or imported) and it is often referred as its "value added". GPO is expressed in chained dollars to eliminate the effect of inflation when comparing data from different time periods. The Bureau of Economic Analysis (BEA) of the US Department of Commerce compiles GDP and GPO data.

The average number of employees by industrial sector is compiled by the Bureau of Labor Statistics (BLS) of the US Department of Labor on a monthly basis. The BLS also compiles the average number of hour-worked by industrial sector on a weekly basis. Figure 2-1 depicts the different processes involved for data collection, distribution, and computation of labor productivity values for the construction and manufacturing industries.

According to Equation 1, labor productivity is the ratio of total output vs. labor input in the production process. The following sections review how these output and input values are calculated for both the construction and the manufacturing industries.

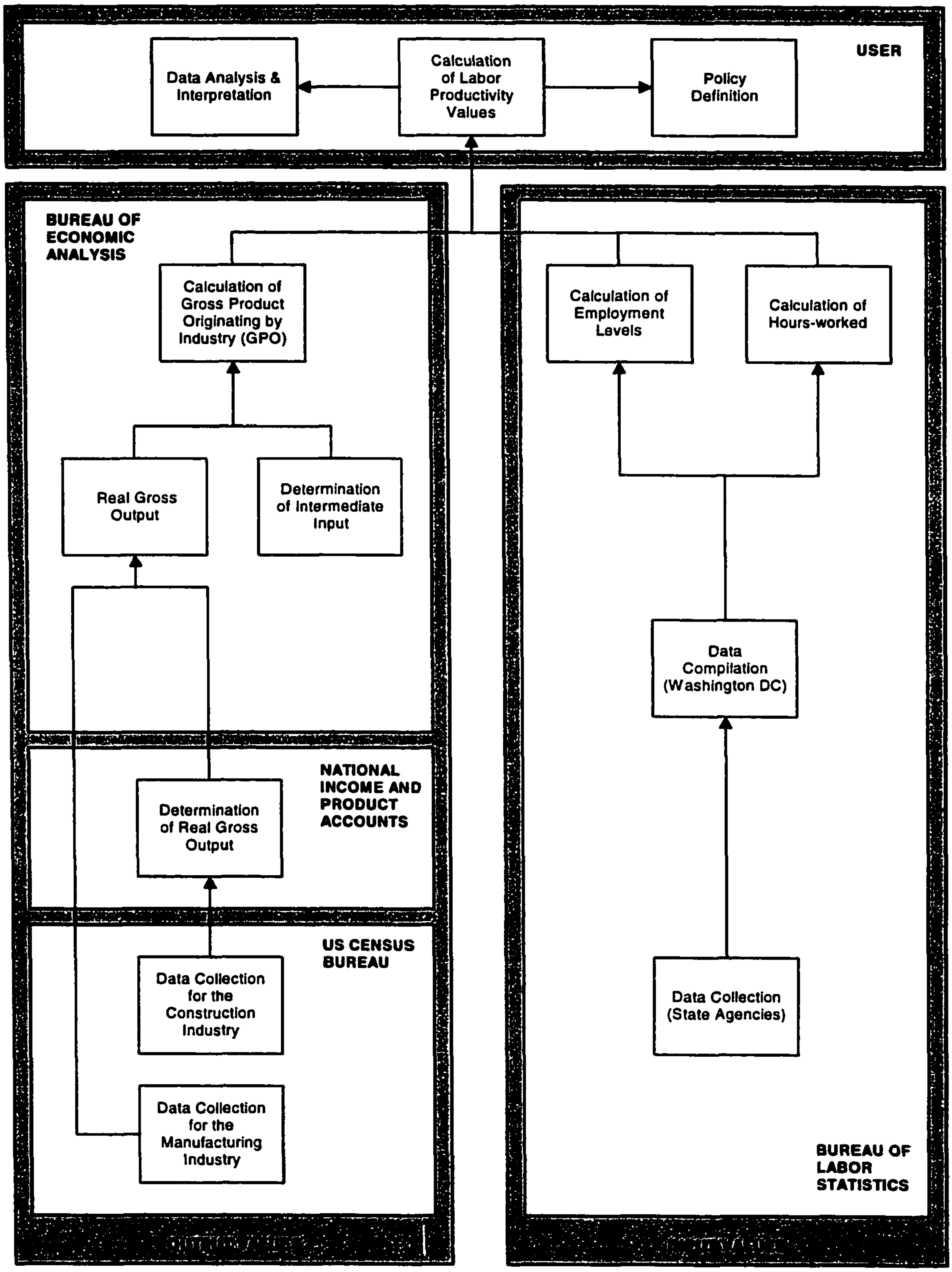


Figure 2-1: Processes Followed to Estimate Labor Productivity Values for the Construction and Manufacturing Industries

2.2.1 Output Values:

Output values are equal to the Gross Product Originating by Industry. As shown in figure 2-1, the process begins at the US Census Bureau with data collection. For the manufacturing industry, collected data consists of sales figures and other operating income that is compiled at the establishment level. For the construction industry, collected data consists of estimated values of construction put in place that is compiled, at the project level.

The difference in the degree of aggregation of the collected data between the manufacturing and the construction industries (establishment vs. projects) has the potential to generate different levels of accuracy. For example, the number of data collection units is higher in construction than in manufacturing. Consequently, the US Census Bureau only needs information from a few thousand manufacturing establishments to obtain a representative sample. However, there are hundreds of thousands of construction projects every year and in order to obtain a sample that would be as representative as that of the manufacturing industry, a major survey effort should be undertaken. Budgetary constraints at the US Census Bureau have precluded the performance of major surveys to achieve such level of accuracy. Therefore, even though surveys of the construction industry are still statistically significant, they are not as accurate as those from the manufacturing sector. In addition, it is easier to identify data collection units in the manufacturing industry than in the construction industry, as manufacturing establishments tend to operate in the industry for several years or decades.

Nevertheless, only a handful of construction projects span for more than a few years, and very short construction projects may never be included in the population from which a sample is selected for a survey.

The Value Put in Place Program (VIP) of the US Census Bureau has identified other problems and limitations in their data collection procedures such as the lack of good price indexes for non-residential construction, problems in the demarcation between structures and equipment, and the lack of a reliable independent annual measure in current dollars to serve as a benchmark for the monthly VIP estimates (US Census Bureau 2000). The lack of good price indexes is likely to be the biggest problem because it has forced VIP to use indexes produced, for the most part, by the private sector. These indexes are just weighted averages of the cost of materials and labor, which are inadequate for deflating GDP estimates to constant dollars because they do not reflect price changes due to changes in productivity and market conditions. As a result, when productivity is rising, these price indexes generate upward biases that produce overdeflation and, therefore, underestimation of GDP in constant dollars. If GDP is underestimated, productivity values are too. If, on the other hand, productivity is declining, the opposite is true and productivity values are overestimated. The magnitude of these possible biases is difficult to determine and was the source of much controversy in the late eighties (Allen 1985, Pieper 1989, Allen 1989). However, it is important to mention that the BLS is currently performing research into the development of construction price indexes, working together with the BEA and the US Census Bureau in these efforts (Dean 1999).

The data collected by the US Census Bureau for the manufacturing industry is sent directly to the Bureau of Economic Analysis. However, the data collected for the construction industry is first sent to the National Income and Product Accounts (NIPA). NIPA adjusts the values estimated by the US Census Bureau for the construction industry to include expenditures on new manufactured homes, expenditures for petroleum and natural gas drilling and exploration, expenditures for construction of mine shafts and mining exploration, brokers' commissions in the sale of new and existing structures, net value of purchases of used structures from the public sector by the private sector, and expenditures for federal government structures located outside the United States. All these items combined constitute the Structures component of GDP.

The Bureau of Economic Analysis (BEA) calculates the Gross Product Originating by Industry (GPO) by subtracting the intermediate input values from the real gross output values to obtain the "value added" by the industry. The intermediate input values are estimated by BEA using the input-output accounts. The input-output accounts show the production of commodities (goods and services) by each industry, the use of commodities by each industry, the commodity composition of GDP, and the industry distribution of value-added. The input-output accounts are based primarily on data collected from the economic censuses. For the construction industry, data are collected through the Census of Construction Industries. Both of these instruments are applied every 5 years. It is relevant to point out that a discrepancy exists between the Value Put in Place (VIP) estimates used to calculate gross output and the data obtained from the Census of Construction Industries (CCI). Only about two-thirds of construction activity as defined by VIP is included in the CCI. For example, architectural and engineering work, construction management, force-account construction, and secondary construction are not included in the CCI. Therefore, the BEA must make estimates and assumptions to take into account these differences when computing the GPO, which may diminish the reliability of the data.

2.2.2 Input Values:

Input values include both the average number of employees and the average number of hour-worked by industry. As shown in figure 2-1, these values are collected by the BLS (BLS 1997) at the state level and forward to Washington D.C. where all data are compiled. The same procedure is used for both the manufacturing and the construction industries. However, when state data were requested to the BLS, the authors were instructed to contact the individual BLS state agencies directly, as BLS in Washington D.C. does not archive state data after they are combined to generate the national figures. All 50 state agencies of the BLS and the District of Columbia office were contacted and their data were collected for the 1979-1998 period. However, most state agencies have incomplete data sets for employment and hour-worked for the construction industry. In fact, only 17 states have complete data. Out of the 34 agencies with incomplete data, 25 do not have any data at all for the 1979-1998 period. These agencies include Alabama, Arkansas, District of Columbia, Delaware, Florida, Kentucky, Louisiana, Maryland, Mississippi, South Carolina, Tennessee, Texas, Virginia, Maine, Massachusetts, New

Jersey, Pennsylvania, Rhode Island, Indiana, Kansas, Nebraska, North Dakota, Wisconsin, Utah, and Wyoming. Agencies with partial data sets include Georgia, North Carolina, Connecticut, New Hampshire, Vermont, Minnesota, Missouri, South Dakota, and California. The main reason for the lack of complete data sets for employment and hour-worked in the construction industry was budgetary constraints.

Figure 2-2 shows labor productivity data for the construction industry from 1979 to 1998 calculated following three different methodologies. First, non-adjusted data from weekly hour-worked were used to generate a productivity chart. The non-adjusted data plot includes only those states for which complete data sets exist for weekly hour-worked. Second, adjusted data from weekly hour-worked were used to generate another productivity chart. The adjusted data plot includes data from all 50 states. Data for those states with 1 or a few years missing were adjusted by substituting the data missing by the average values from the remaining years. Data for those states with no data sets were adjusted by using the national average instead. Finally, productivity values were also computed using the national data published by the BLS.

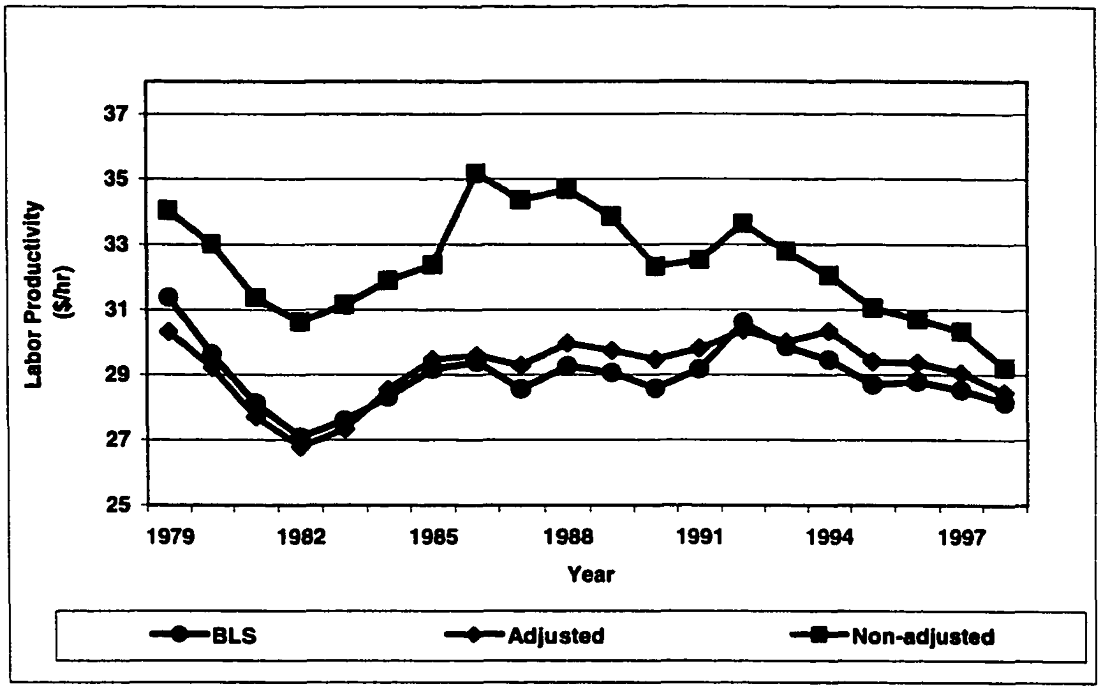


Figure 2-2: Labor Productivity Values for the US Construction Industry Calculated from Non-Adjusted, Adjusted, and BLS Data for the 1979-1998 Period.

The adjusted data and the BLS plots are almost identical, which suggests that BLS probably applies a similar adjustment as the one used by the author. However, the non-adjusted data are higher for all years in the period of study. In other words, if only data from those states with complete data sets were used while computing labor productivity for the construction industry, the results would be higher than those obtained while using the BLS published data. Therefore, the adjustment performed by the BLS creates a downward bias in labor productivity values in the construction industry. While the use of average values to complete data sets with a few data points missing may be deemed appropriate, the use of the national average to substitute for those states with significant data points missing may not be appropriate. It can also be argued that the data from those state agencies with incomplete data may be less reliable than from those with complete data sets, as data collection systems are likely to be better in state agencies with full data sets because a concerted effort is made year in and year out to collect the data. It is important to mention that the reason for incomplete data sets is budgetary constraints at the BLS state agencies.

2.3 ANALYSIS AND INTERPRETATION OF LABOR PRODUCTIVITY VALUES

The BLS regularly publishes productivity data for several industrial sectors. Construction is not included in this selected group of industries as BEA considers construction data to be too unreliable to be useful in the generation of productivity data. This, however, has not precluded others from attempting to calculate construction productivity values following the procedure shown in figure 2-1 and obtaining results similar to the ones depicted in figure 1-1. Notwithstanding problems with the raw data used, there is still a major misinterpretation of inter-temporal changes in productivity values due to the level of data aggregation.

Construction data include figures from residential, commercial, industrial, and heavy construction. Each one of these sectors could be classified as a separate industry on their own rights, not only because of the magnitude of their production levels, but also because of the intrinsic differences among them. Residential and commercial construction are labor intensive as compare to industrial and heavy construction, which tend to be capital intensive. Therefore, it is not surprising to learn that residential and commercial construction enjoy lower labor productivity than industrial and heavy construction. After all, it is the substitution of labor by capital that generates higher labor productivity values. Therefore, when labor productivity values are calculated for the entire construction industry, the result represents the weighted average of the labor productivity values for each one of its sectors. The weights are the percentages at which each sector participates in the industry. This is also known as the output mix. Changes in the output mix can generate changes in construction labor productivity values even when labor productivity for each sector remains constant. In other words, when residential and commercial construction increase their share of the construction industry at the expense of industrial and heavy construction, which happened in the period 1979-1998, labor productivity values for the industry as a whole could go down even if each sector's productivity had remained constant. Even worse, increases in labor productivity in all sectors might still be offset by a redistribution of the output mix, generating a decrease in labor productivity values when all data are aggregated. The magnitude of this problem for the period 1979-1998 is unknown, as the BEA does not maintain separate records for labor productivity for each sector of the construction industry due to budgetary constraints.

The absence of data for each one of the sectors that make up the construction industry does not preclude, however, the analysis of theoretical scenarios about the behavior of each sector in the overall economy from 1979 to 1998 and its possible effect in the aggregate productivity values. Table 2-1 shows such an analysis where the construction industry was broken down into two groups: residential and commercial construction (R&C) and industrial and heavy construction (I&H). The effect of different ratios of I&H to R&C productivity was studied under changes in the output mix. According to the annual values of construction put in place of the US Census Bureau, the output mix values changed from 67% for residential and commercial construction in 1979 to 76.2% in 1998. As shown in the table, a ratio of 1.3 would be sufficient to explain almost 25% of the decline in labor productivity in the construction industry. That is, if one accepts the hypothesis that labor productivity in industrial and heavy construction is 30% higher than in residential and commercial construction, then almost a quarter of the decline in construction labor productivity in the period of study would be explained by changes in the output mix rather than by actual decreases in labor productivity. For higher ratios, the percentage of the decline in labor productivity that is explained by changes in the output mix is even higher. At a ratio of 1.7 the percentage explained is above 50%. The actual ratio of labor productivity of I&H construction to R&C construction is debatable. However, it is expected to be somewhere between the values included in table 2-1.

Table 2-1: Theoretical Scenarios for Construction Productivity Ratios in a Changing Output Mix Environment for the 1979-1998 Period

	Output Mix (%)	Ratio of I&H to R&C Productivity										
		1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1979 Productivity Sectors:												
Residential & Commercial (R&C)	67.0	31.38	30.38	29.44	28.55	27.72	26.94	26.19	25.49	24.83	24.19	23.59
Industrial & Heavy Construction (I&H)	33.0	31.38	33.42	35.32	37.12	38.81	40.40	41.91	43.34	44.69	45.97	47.19
Aggregated Productivity	100.0	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38
1998 Productivity Sectors:												
Residential & Commercial (R&C)	76.8	28.16	27.52	26.91	26.33	25.77	25.23	24.72	24.23	23.75	23.30	22.86
Industrial & Heavy Construction (I&H)	23.2	28.16	30.27	32.29	34.23	36.08	37.85	39.55	41.18	42.75	44.26	45.71
Aggregated Productivity	100.0	28.16	28.16	28.16	28.16	28.16	28.16	28.16	28.16	28.16	28.16	28.16
1998 Productivity Sectors Applying 1979 Output Mix:												
Residential & Commercial (R&C)	67.0	28.16	27.52	26.91	26.33	25.77	25.23	24.72	24.23	23.75	23.30	22.86
Industrial & Heavy Construction (I&H)	33.0	28.16	30.27	32.29	34.23	36.08	37.85	39.55	41.18	42.75	44.26	45.71
Aggregated Productivity	100.0	28.16	28.43	28.69	28.93	29.17	29.40	29.61	29.82	30.02	30.21	30.40
Percentage of Productivity Decline Explained		0	8	16	24	31	38	45	52	58	64	70

Table 2-2: Output-Mix-Adjusted Labor Productivity for the Manufacturing Industry for the 1979-1998 Period

Manufacturing Sectors	Productivity Values for 1979			Productivity Values for 1998			Productivity Values for 1998 Applying 1979 Output Mix		
	Sector Productivity ($/hr)	Sector Output as a Percentage of Manufacturing Output	Contribution to Industry Productivity ($/hr)	Sector Productivity ($/hr)	Sector Output as a Percentage of Manufacturing Output	Contribution to Industry Productivity ($/hr)	Sector Productivity ($/hr)	Sector Output as a Percentage of Manufacturing Output	Contribution to Industry Productivity ($/hr)
	A	B	C = A x B	D	E	F = D x E	D	B	G = D x B
Lumber and Wood Products	16.93	3.54	0.60	23.92	2.87	0.69	23.92	3.54	0.85
Furniture and Fixtures	5.84	1.15	0.07	20.65	1.60	0.33	20.65	1.15	0.24
Stone, Clay, and Glass Products	16.20	2.91	0.47	30.81	2.70	0.83	30.81	2.91	0.90
Primary Metal Industries	18.66	6.82	1.27	33.42	3.79	1.27	33.42	6.82	2.28
Fabricated Metal Products	16.23	7.71	1.25	29.82	6.81	2.03	29.82	7.71	2.30
Industrial Machinery and Equipment	5.93	5.03	0.30	36.30	13.32	4.83	36.30	5.03	1.82
Electronic and Other Electric Equipment	6.35	2.85	0.18	49.98	15.29	7.64	49.98	2.85	1.43
Motor Vehicles and Equipment	25.13	9.66	2.43	42.28	7.19	3.04	42.28	9.66	4.08
Other Transportation Equipment	20.30	5.94	1.21	26.28	3.95	1.04	26.28	5.94	1.56
Instruments and Related Products	19.81	6.99	1.38	26.17	3.39	0.89	26.17	6.99	1.83
Miscellaneous Manufacturing Industries	10.70	1.22	0.13	30.23	1.71	0.52	30.23	1.22	0.37
Food and Kindred Products	21.06	8.83	1.86	30.92	7.79	2.41	30.92	8.83	2.73
Tobacco Products	24.36	5.72	1.39	26.51	0.76	0.20	26.51	5.72	1.52
Textile Mill Products	7.60	1.65	0.13	6.66	1.64	0.11	6.66	1.65	0.11
Apparel and Other Textile Products	7.90	2.21	0.17	16.25	1.67	0.27	16.25	2.21	0.36
Paper and Allied Products	25.81	4.65	1.20	35.85	3.78	1.36	35.85	4.65	1.67
Printing and Publishing	32.12	10.15	3.26	17.60	5.94	1.04	17.60	10.15	1.79
Chemicals and Allied Products	18.43	10.27	1.89	51.57	10.28	5.30	51.57	10.27	5.30
Petroleum and Coal Products	17.92	1.00	0.18	55.30	1.62	0.89	55.30	1.00	0.55
Rubber and Miscellaneous Plastics Products	7.94	1.60	0.13	21.34	3.66	0.78	21.34	1.60	0.34
Leather and Leather Products	2.01	0.11	0.00	21.83	0.25	0.05	21.83	0.11	0.02
Total		100.00	19.50		100.00	35.53		100.00	32.03

Changes in the output mix also affected labor productivity in the manufacturing industry. Data from the different sectors that make up the manufacturing industry are widely available and a similar analysis to the one explained above was also performed for this industry. The results are shown in table 2-2. Changes in output mix during the 1979-1998 period actually generated higher productivity values for the manufacturing industry that would have been generated have the output mix remained constant. In essence, manufacturing productivity in 1998 was $35.53 per hour, but this value would have only been $32.03 should the output mix remained constant. This difference, even though it seems small, represent about 50% of the difference observed in 1998 between construction and manufacturing productivity as presented in figure 1-1. Therefore, close to half of the gap shown in figure 1-1 for 1998 between construction and manufacturing productivity is due to changes in the output mix of the manufacturing industry rather than to actual improvements in manufacturing productivity.

2.4 SUMMARY AND RECOMMENDATIONS

This chapter has uncovered several problems with regard to the reliability and validity of construction labor productivity values calculated from macroeconomics data for the 1979-1998 period. These problems include deficiencies in data collection, data processing, and interpretation of results.

Gross Product Originating by Industry is calculated based on project rather than establishment data, generating less reliable data than that obtained for the manufacturing industry. The Value Put in Place Program (VIP) uses indexes produced by the private sector, which are inadequate for deflating GDP estimates to constant dollars because they do not reflect price changes due to changes in productivity and market conditions. A major discrepancy exists between the VIP estimates used to calculate gross output and the data obtained from the Census of Construction Industries (CCI), as only about two-thirds of construction activity as defined by VIP is included in the CCI. Weekly hour-worked and employment figures are generated from incomplete data sets, where averages are used to complete the missing pieces of information, incorporating downward biases in productivity values.

In addition to the problems stated above, misinterpretations of productivity values calculated based on the available data have also occurred. The inability to differentiate between the diverse sectors of the construction industry in a changing output mix environment may have created downward biases in labor productivity values, as sectors with low productivity have increased their share of the market. Manufacturing labor productivity has also been misinterpreted as changes in the output mix have caused an upward bias of the data.

Labor productivity values calculated based on macroeconomic data for the 1979-1998 period have fostered the idea that manufacturing is a more productive sector of the economy than construction, further damaging the image of the construction industry.

However, the problems uncovered in this paper question the validity of such an assertion. The raw data used to calculate construction productivity values and its further manipulation and interpretation present so many problems that the results should be deemed unreliable. The uncertainty generated in the process of computing these values is such that it cannot be determined if labor productivity has actually increased, decreased, or remained constant in the construction industry for the 1979-1998 period.

A concerted effort is required to correct the problems uncovered in this paper and provide a reliable means of estimating construction labor productivity. Construction industry stakeholders should unite and lobby for an increase in the budgets of the government agencies in charge of collecting productivity-related data for the construction industry. Incomplete data sets for employment and weekly hour-worked are unacceptable. Furthermore, data should be collected in a manner that facilitates its analysis from multiple perspectives. For example, the authors were unable to calculate labor productivity values by region, company size, and construction sector, as data are either unavailable or incompatible between government agencies. Because of the changes in the output mix in the construction industry, labor productivity values should be calculated by sector rather than at the industry level. Finally, it is also important to differentiate between new construction and renovation/retrofitting work. Renovation/retrofitting, by its own nature, requires a higher labor/capital ratio than new construction. This difference should be factored in when calculating labor productivity values

Chapter 3: Labor Force Profiles

for the Construction and Manufacturing Industries

3.1 INTRODUCTION

Labor productivity, or the output per hour-worked, is considered one of the best indicators of production efficiency. Maloney (1983) has stated that in addition to the external factors affecting labor productivity in the construction industry, such as project design, management of the construction firm, job sequencing and layout, and government regulations, one should not forget that labor itself has a significant influence on construction productivity. In addition, Rowings et al. (1996) have emphasized that one of the many challenges that the construction industry faces today is the need to maintain a skilled and competitive craft workforce. Strategies such as the use of sub-journeymen (Business Round Table 1983) and the development of multi-skilled workers (Burleson et al. 1998) have been proposed to address the multifaceted labor problem in the construction industry. An understanding of the major characteristics of the construction labor force is the logical starting point for the development of long-term strategies to solve the many problems affecting it.

This chapter analyses demographic (Grigg 2000) and other characteristics of the construction labor force over the last 20 years and compares them to those of the manufacturing industry. This information facilitates the understanding of the nature and quality of the existing labor force in the construction industry as it compares to the manufacturing sector, and establishes the foundation for the development of long-term strategies to improve the productivity of workers.

The following sections present information about employment, education, age, and gender for the manufacturing and construction industries. Additionally, projections for labor demand to the year 2008 are also included. The historical data presented in this chapter has been collected by the Bureau of Labor Statistics of the US Department of Commerce (Bureau of Labor Statistics 2001).

3.2 EMPLOYMENT

A positive employment situation for the labor force in terms of the working environment, hour-worked, and real wages is fundamental in creating incentives for productivity improvements. The morale of the labor force has been proven to be positively correlated to the level of productivity achieved, as explained by Neely (1999):

"The issue of morale in the workforce is often dodged, excused or minimized, it is clear however, that progressive leaders in both public and private sectors are embracing it with open arms, and in the process reaping the benefits, (...) a workforce will produce a quality product if they are motivated to do so. Heavy-handed management may yield temporary results, but if the objective is long term and the concentration is on outcomes versus outputs, the wise manager will work to maximize the workforce through genuine measures that build morale."

The working environment for manufacturing and construction could not be more dissimilar. Most manufacturing workers perform their duties inside under the benefits of controlled environments. Construction workers, on the other hand, usually work outside and are exposed to the elements. The construction industry, however, has recognized this effort and construction workers receive 25% higher wages than those offered to manufacturing workers. Safety programs have also been implemented to increase the security of construction workers and close the safety gap between construction and manufacturing. These measures, without a doubt, should increase the morale of the construction worker. However, when one looks at absolute rather than relative compensations of real wages for the construction worker over the last two decades a different picture develops. Real hourly wages have continuously declined in the manufacturing and the construction industry from 1979 to 1999, as shown in figure 3-1. Construction wages have also declined at more than twice the rate of manufacturing wages. For the period of analysis, construction workers saw their real wages decline by 17%, while manufacturing workers experienced a 7% decline.

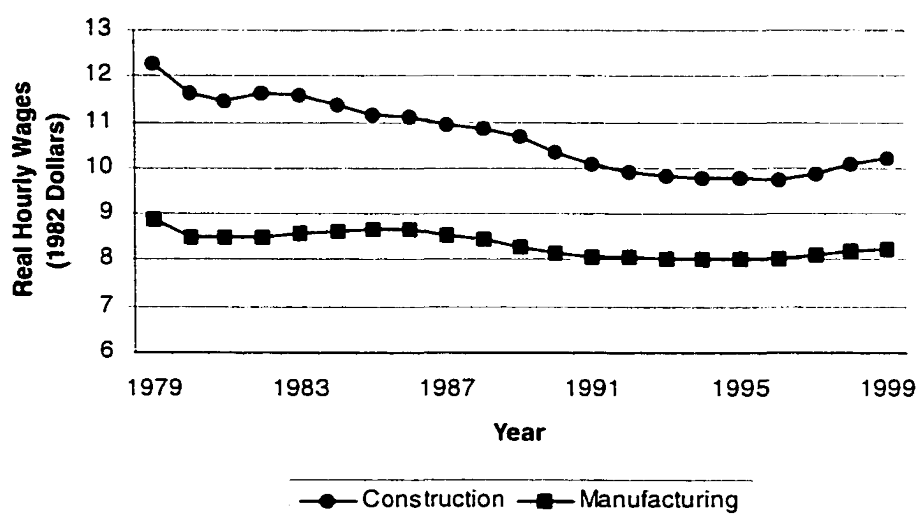


Figure 3-1: Real Hourly Wages for the Manufacturing and the Construction Industries for the 1979-1999 Period (Source: the Bureau of Labor Statistics)

The decline in real hourly wages seems to have been compensated by the workers with an increase in the average number of hour-worked per week in an effort to perhaps maintain their purchasing power. This behavior is evident in both the manufacturing and the construction industries from 1979 to 1999, as shown in figure 3-2. However, this increase in the average number of hour-worked over the long run may have some negative implications. Working longer hours over sustained periods of time may cause a decrease in productivity as workers are overextended. This situation may cause an increase occurrence of fatigue, stress, repetitive strain injury, and heart decease according to health studies (Cooper et al. 1997). These studies also point out that the effects are worse when workers feel that they are "obligated" to work longer hours.

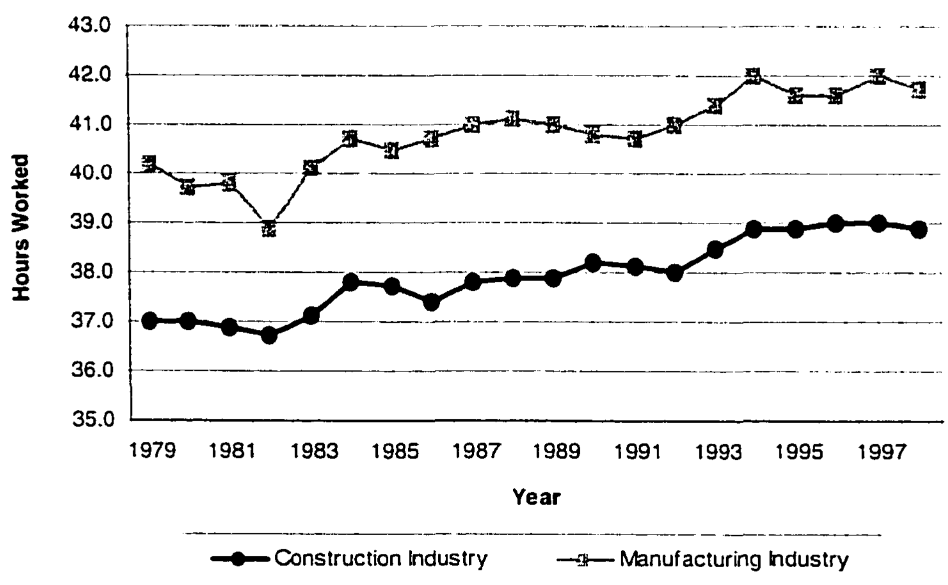
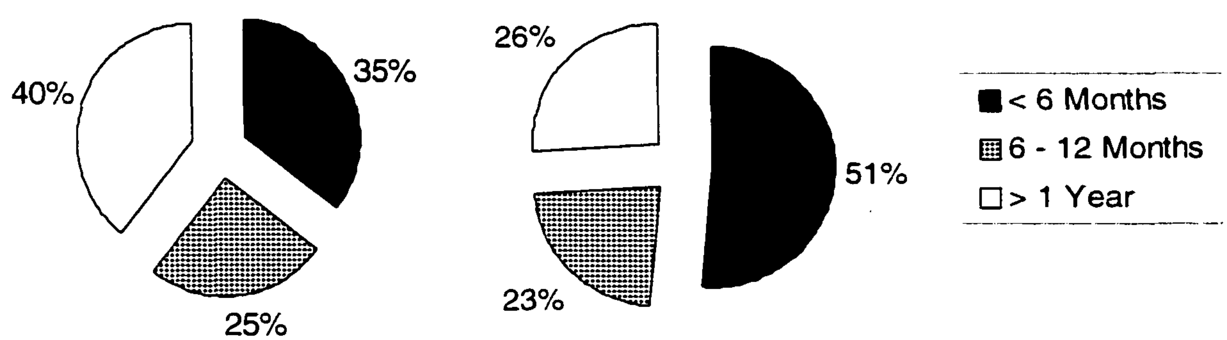


Figure 3-2: Average Number of Hour-Worked per Week for the Manufacturing and the Construction Industries for the 1979-1998 Period (Source: the Bureau of Labor Statistics)

Therefore, one could argue that since manufacturing and construction workers seem to be working longer hours to maintain their living standards, they are doing so while feeling "obligated". An environment of continuously decreasing real wages and increasing weekly hour-worked cannot be considered, by any means, a morale buster.

Low morale may be responsible, at least in part, for the "transient" nature of the construction labor force (Huang & Halpin 1995) because workers tend to stay with the same employer for only short periods of time. Figure 3-3 illustrates the seniority of the construction and the manufacturing labor force for 1998. As seen in the figure 3-3, more than 50% of construction workers employed in 1998 had been working for the same employer for less than 6 months and only about 25% had been with the same employer for more than 1 year. By contrast, 35% of manufacturing workers employed in 1998 had been with the same employer for less than 6 months, while close to 40% had been with the same employer for more than 1 year.



Manufacturing **Construction**

Figure 3-3: Seniority of Construction and Manufacturing Workers in 1998 (Source: the Bureau of Labor Statistics)

This should be a sign of concern for the construction industry. Employees with limited seniority are expected to be less productive than those who have been working for the same company for longer periods of time. Working procedures, production processes, enterprise culture, and other relevant knowledge about a company are only acquired by a worker through prolonged exposure to the working environment. In addition, a "transient" workforce makes it difficult for companies to provide significant and effective training, as management is not willing to train workers who may be working somewhere else in a few months.

Finally, workers in the manufacturing industry tend to work almost exclusively for the private sector while construction workers constitute a more diverse group. According to data from 1999, 98% of those who work in the manufacturing industry are doing so in the private sector and self-employment accounts for only 2% of its labor force (figure 3-4). By contrast, 17% of the labor force in the construction industry is self-employed, 6% works for the government, and 77% does so for the private sector. These percentages have remained more or less constant during the last couple of decades. Therefore, almost 1 out of every 5 workers in the construction industry is self-employed. This is evidence of both the entrepreneurial spirit of the construction labor force and the low barriers for entry into the industry. On the one hand, an industry with a high entrepreneurial structure is desirable as it offers attractive opportunities for workers who may want to venture on their own in the future. This tends to attract better qualified, business-minded, and more assertive workers. On the other hand, the low barriers for entry into the construction industry, such as the low capital requirements and the lack of regulatory impediments, allow virtually anyone to become part of the self-employed labor force. This tends to attract marginally qualified, opportunistic, and less than ideal workers into the construction industry's labor force.

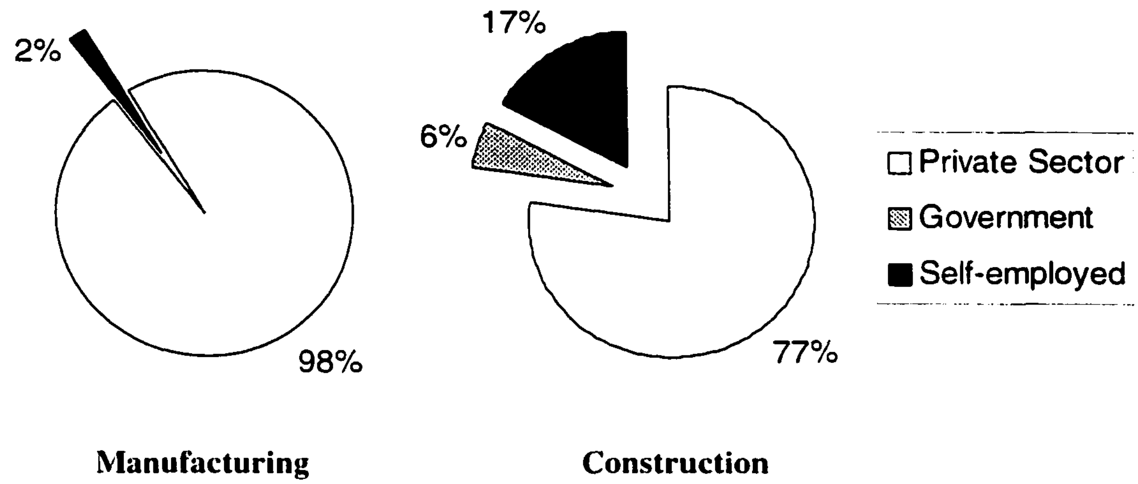


Figure 3-4: Distribution of the 1999 Labor Force Among Different Sectors for the Manufacturing and the Construction Industries (Source: the Bureau of Labor Statistics)

3.3 EDUCATION

A well-educated labor force that is continuously trained in the latest methods, techniques and technologies is essential in creating the right environment for productivity improvement. The level of educational attainment of the labor force has been found to be positively correlated to its level of performance and productivity (Uluatam 1992). As explained in the Education and the Economy Report of the National Center for Education Statistics (NCES 1997):

"Increases in educational attainment were responsible for an estimated 11 to 20 percent of growth in worker productivity in the United States in recent decades. (...) Education appears to play an important role in worker productivity in all industrialized countries. The industrialized countries with the highest productivity levels tend to have highly educated work forces, and the convergence in productivity among these countries generally parallels that in educational attainment."

The educational attainment level is different in the construction and manufacturing industries. Figure 3-5 shows the general educational level achieved by the labor force in both industries in the year 2000. According to the data, close to half of the manufacturing workforce has post high school education versus only one third in the construction industry. Additionally, almost a quarter of the workers in the construction industry have not finished high school, but less than 15% of their manufacturing peers are in this category.

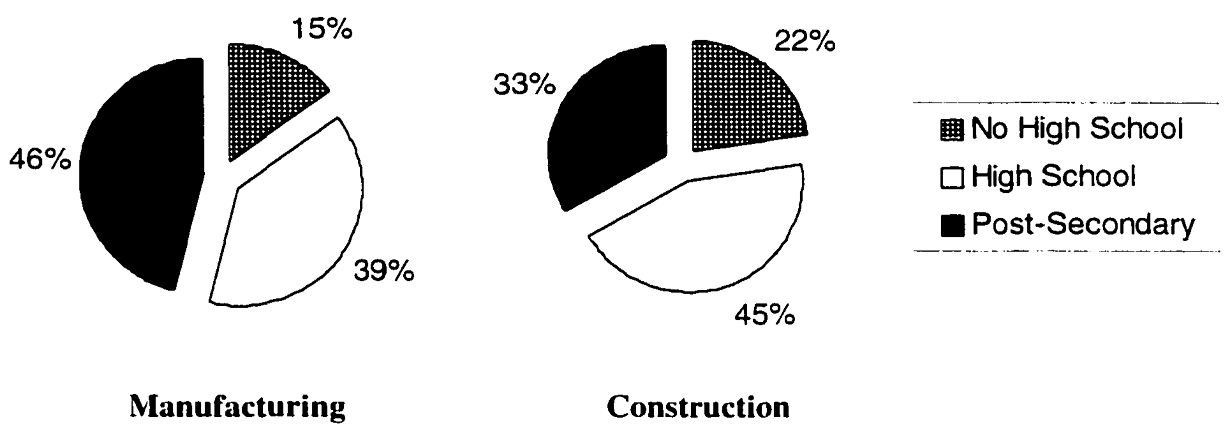


Figure 3-5: Educational Attainment for Construction and Manufacturing Workers in the Year 2000 (Source: the Bureau of Labor Statistics)

In addition to the educational attainment level achieved by the construction labor force as depicted in figure 3-5, which only considers formal education, one must also take into consideration on-the-job training, including apprenticeship programs, to obtain a holistic view of the educational situation in the construction industry. Chini at al. (1999) maintain that in the 80s when the construction industry began to shift from a unionized to an open shop environment, the non-union companies were unknowingly assuming the responsibility of craft training. However, in their opinion, even though some strides were made to provide open-shop training they were not very successful. In summary, the "transient" nature of the construction labor force and the lack of a formal trade based training or apprenticeship program in the open-shop market seem to have created a void that precludes construction workers from achieving their full potential.

3.4 AGE

The age profiles of the construction and manufacturing labor force have been steadily changing for the last couple of decades as the typical worker has become older. Figure 3-6 shows the percentage of workers ages 25 to 54 for both industries from 1979 to 1999. There is practically no difference between the construction and the manufacturing industries with respect to the overall trend depicted in the figure 3-6. This age group has increased its participation in the labor pool from about 65% to over 75% for the analysis period. Figure 3-7 represents a complimentary chart depicting the participation of workers ages 16 to 24 in the labor pool. This age group has experienced a decline in both construction and manufacturing. For the construction industry, its participation in the labor pool has decreased from over 25% to less than 15%, while a similar decline has been experienced in the manufacturing sector. These changes in the composition of the labor force have resulted in the increase of the average age of the construction and the manufacturing worker. Figure 3-8 shows the average age of workers in both industries for the analysis period. The average age of the construction workers has increased from about 37 to close to 39 years, while the average age of the manufacturing worker has increased from about 38.5 to close to 40 years.

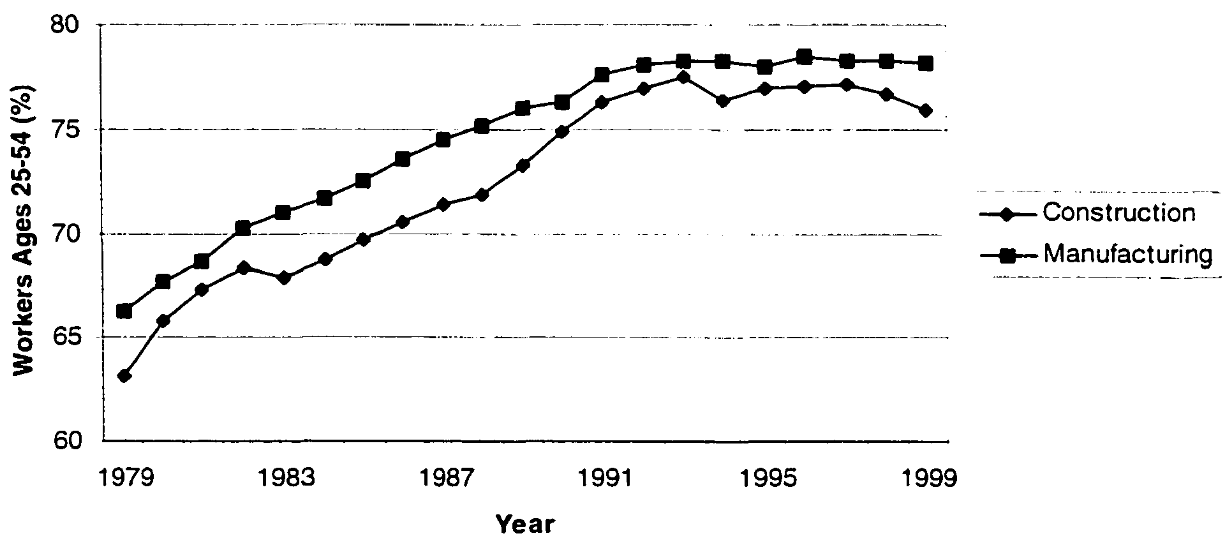


Figure 3-6: Workers Ages 25 to 54 in the Construction and Manufacturing Industries for the 1979-1999 Period (Source: the Bureau of Labor Statistics)

The changing age profile of the construction industry becomes even more troublesome when analyzed together with the typical seniority of construction workers shown in figure 3-4. The unavoidable conclusion is that an older labor force in the construction industry does not imply a more experience labor pool because of the high turnover. This situation reflects a systematic problem in the construction industry to attract younger workers.

New generations of workers entering the market do not appear to be interested in joining the industry.

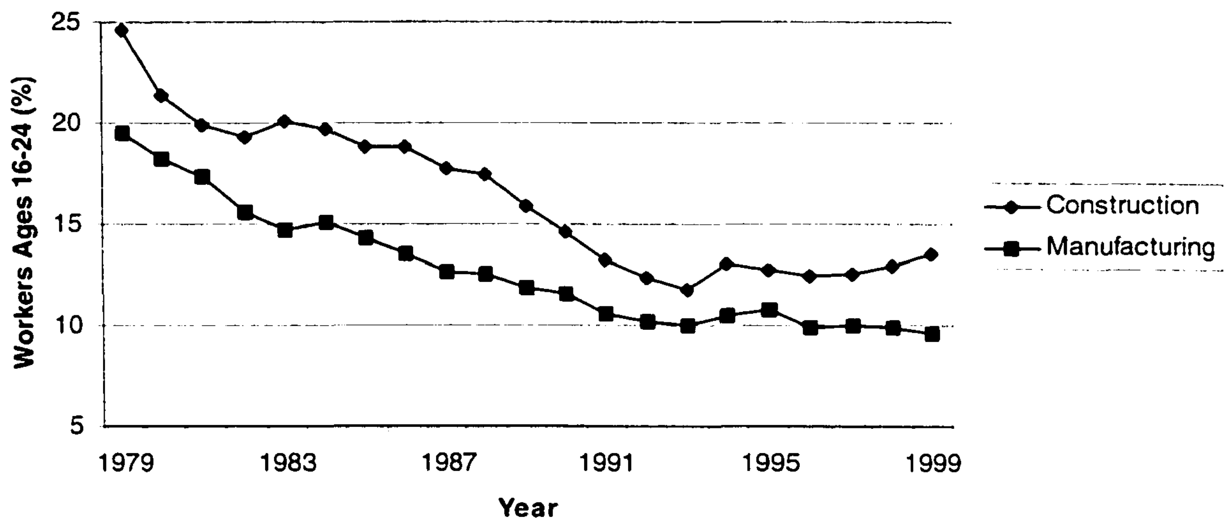


Figure 3-7: Workers Ages 16 to 24 in the Construction and Manufacturing Industries for the 1979-1999 Period (Source: the Bureau of Labor Statistics)

The increase in the average age of the labor force is a more critical issue in the construction than in the manufacturing industry. Construction work is usually more strenuous than manufacturing labor. Prolonged standing, climbing, bending, and kneeling are often necessary. Construction workers also risk injury (Abdelhamid & Everett 2000) working with sharp or rough materials, using sharp tools and power equipment, and from slips or falls. Additionally, many construction workers work outdoors, which is more uncomfortable than working in a factory with a control environment. Therefore, even though it is expected that an older labor force would be a less productive one for both construction and manufacturing, the effect is likely to be more pronounced for the construction industry.

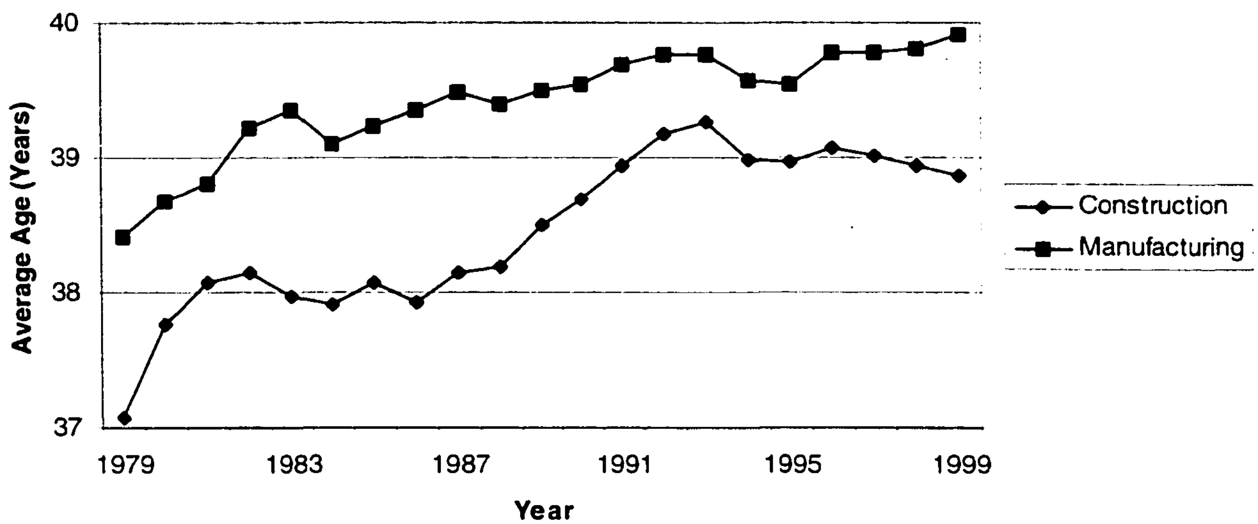


Figure 3-8: Average Age of Workers in the Construction and Manufacturing Industries for the 1979-1999 Period (Source: the Bureau of Labor Statistics)

3.5 GENDER

Historically, the participation of women in the construction labor force has been minimal. Figure 3-9 shows data from 1999 about the gender distribution of the labor force for both the construction and the manufacturing industries. In manufacturing, almost one third of the labor force is made up of women, while in the construction industry only 10% of the labor pool is comprised of women. This relative participation of women in the labor pool for both industries has remained more or less constant over the last couple of decades.

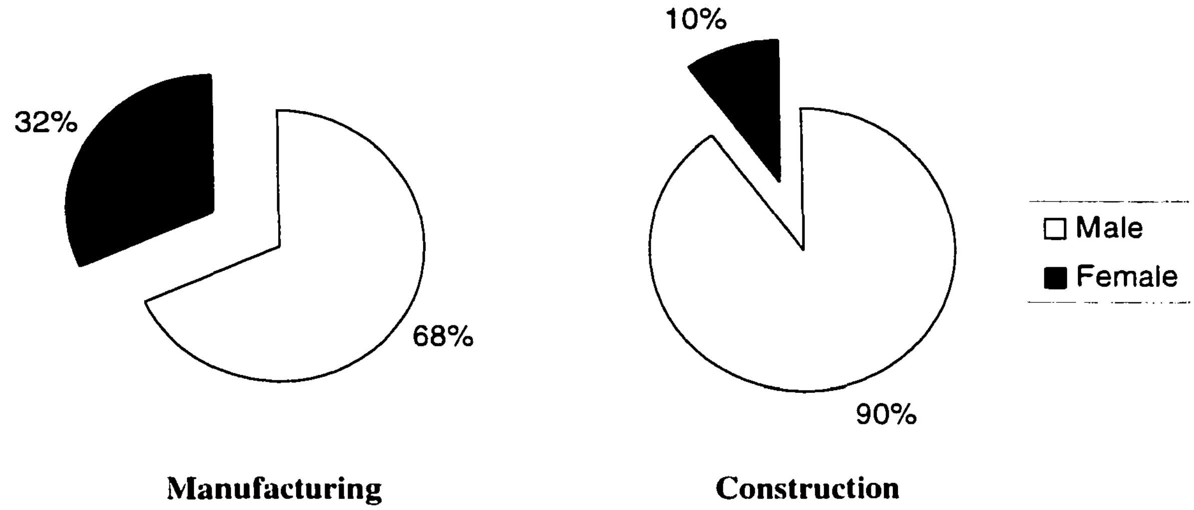


Figure 3-9: Distribution of the Labor Force by Gender for the Manufacturing and the Construction Industries in 1999 (Source: the Bureau of Labor Statistics)

3.6 LOOKING AHEAD: LABOR DEMAND PROJECTIONS TO 2008

The Office of Employment Projections at the Bureau of Labor Statistics of the US Department of Commerce generates projections based on labor force data to determine future trends. Some of the trends and projections generated for the year 2008 shed some light into how the construction and manufacturing labor force will change in the years to come.

It is expected that the demand for workers in the construction industry will increase at an average rate of about 1% per year until 2008. while no demand for new manufacturing workers is forecasted (Thomson 1999). In fact, construction is the only goods producing sector of the economy that is expected to increase its demand for workers. Therefore. by

2008 the construction industry should not only replace those workers who will leave the labor pool because of retirement and other reasons, but also increase its total labor force by over half a million workers. Manufacturing, on the other hand, should only need to replace those workers who leave the labor pool. This situation will only exacerbate the labor shortage in the construction industry and some needs may go unmet unless workers work longer hours, older workers can be retained, or other sources of workers can be found. However, construction workers are already working longer hours with a likely adverse effect on productivity. Retaining older workers would only increase the average age of the construction labor force further decreasing productivity. The only viable alternative seems to be the recruitment of younger workers from non-traditional labor pools such as women and minorities. This, in turn, will require a transformation of the management structure in the industry to train employees in diversity, gender sensitivity, and even the English language. For example, Asians and Hispanics are projected to continue to grow much faster than white non-Hispanics, as an important portion of the population growth to 2008 will come from migration to the US (Fullerton 1998).

The sectors of the construction industry that are expected to experience the highest growth until 2008 are multifamily, apartment, and assisted living housing as well as health care facilities and hospitals as more adults enter the 55-and-older group. In addition, highway infrastructure, bridges, schools, and modernized manufacturing facilities are also expected to contribute to non-residential investment growth. These sectors are the most likely to be affected by labor problems.

3.7 STRATEGIES

Several problems have been uncovered in the previous sections with regard to the construction industry's labor profile. The creative thinking of the industry stakeholders should be tapped to develop long-term strategies to improve the labor situation. Some potential strategies that deserver further discussion and research include:

- A plan to maintain and even foster the entrepreneurial spirit of the construction labor force. This would be desirable as long as some selectivity is implemented to ensure that quality would not be sacrificed. Such a strategy could actually represent a comparative advantage for the industry when competing with the manufacturing sector for the best-qualified workers.

- A strategy to stabilize or even decrease the number of hour-worked in the construction industry by maintaining or increasing real wages. This would probably result in higher productivity values throughout the industry. It is also important to consider that an environment of decreasing real wages tends to demoralize the labor force. However, an environment of raising real wages is difficult to achieve, as there must be sound economic reasons supporting it. Improving the technical capabilities of workers through better training is probably the only feasible alternative. The construction industry should also be more aggressive marketing the fact that real wages in the industry are 25% higher than in the manufacturing sector. This should also represent a comparative advantage for the industry when competing with the manufacturing sector for the best-qualified workers.

- A proposal focused on increasing the seniority of construction workers. This would benefit the industry through organizational learning while providing construction companies with an incentive to train their workers.

- Improve the educational level of the construction labor force. The educational profile of the construction worker presents serious challenges for the construction industry. How can the construction industry take advantage of the "information age" or implement quality improvement programs when almost a quarter of its workforce has not even finished high school? The shortage of qualified workers in the construction industry, already evident in several sectors, had forced the industry to incorporate into its labor force people with non-traditional educational backgrounds. Therefore, increasing the minimum educational requirements for workers who wish to join the construction labor force is not a feasible solution, as it would just exacerbate the labor shortage problem, not to mention experience indicates that the most likely scenario is that the industry would not be able to enforce such a requirement. The only feasible solution seems to be on the job training. A strategy that provides industry-wide on the job training for workers joining the construction labor force will likely increase the long-term productivity of the industry. An industry-wide training strategy is required as individual companies may be reluctant to initiate such programs by themselves due to the transient nature of the labor force.

- Women and minority groups, including immigrants, could be the best source for new workers in the construction industry. However, the industry was unable to attract more women into the labor force during the eighties and the nineties. A long-term strategy to steadily increase the participation of women and minority groups in the construction industry would likely alleviate the labor shortage problem, reduce the need for longer working hours, and ultimately increase productivity.

3.8 SUMMARY AND RECOMMENDATIONS

The typical construction worker works longer hours today than two decades ago, receives real hourly wages that are 17% lower than in 1979, is getting older, has only a 30% chance of having a post-secondary education but a 25% change of not having completed high school, has a 50% chance of staying with the same employer for less than 6 months, and is probably male. The typical manufacturing worker is also working longer hours, receiving lower wages (7% lower than in 1979), and getting older, but is better educated than the typical construction worker, stays longer with the same employer, and has a 30% chance of been female.

These summary statistics do not offer an upbeat profile for either construction or manufacturing. It is clear that the manufacturing industry is not immune to most of the labor-related problems affecting the construction industry. However, it is also evident that these problems affect each industry at different degrees of intensity and that construction is been affected to a greater degree than manufacturing. Even though construction pays 25% higher real wages than manufacturing, the industry finds it more difficult to recruit better-educated workers, retain current workers, and attract women.

The fact that construction work is usually more strenuous than manufacturing labor probably plays a role in the employment decision of prospective workers. However, it is unlikely this is the only factor determining career choice. The fact that most employment opportunities in construction are project-based rather than company-based probably also weighs in worker's decisions. The tarnished image of the construction industry could not be eliminated as a possible culpable either. Research is needed to determine why the construction industry is having such a hard time competing with the manufacturing industry for workers, and to outline effective strategies to improve the long-term prospectus of the construction labor force with regard to hour-worked, real wages, education, employment stability, age, and diversity.

Chapter 4: Labor Productivity Drivers and Opportunities in the Construction Industry

4.1 INTRODUCTION

Labor productivity issues are receiving increasing attention within the construction industry (Allmon et al. 2000, Teicholz 2001). This should not be a surprise as labor productivity is considered one of the best indicators of production efficiency. Higher productivity levels usually translate into superior profitability. However, there is still much that we do not know about this domain area that justifies further research. In an effort to fill part of this knowledge gap, the authors decided to explore the main drivers and opportunities for construction labor productivity. This chapter presents and analyzes the results of a survey instrument designed to quantify the relative relevance of different drivers in the determination of productivity levels and the degree of effectiveness of potential opportunities for improvement.

In order to provide the contextual foundation for the analysis developed later, it is necessary to define the concepts of driver and opportunity as they are used in this chapter. A driver is any factor that affects the productivity of a construction task. Examples of labor productivity drivers in the construction industry include weather conditions, coordination of subcontractors, scheduled overtime, material management, as well as worker motivation, training, experience, and supervision among many others. An opportunity is any technique that has the potential of improving labor productivity. Examples of labor productivity opportunities in the construction industry include improvement of construction methods, operations and administrative systems, strategic management and planning, and the use of goal setting techniques among others.

The data discussed in this chapter were gathered through a web-based survey performed during the months of September and October of 2001 with support from the Electrical Contractor magazine. Sixty-four responses were received from owners, consultants, general contractors, electrical contractors, and mechanical contractors among others. Figure 4-1 shows the participation of each group in the sample. In addition, small firms, those with less than 100 employees, comprise 52% of the sample. Medium size firms, or those with 100 to 249 employees, account for 25% of the sample, and the remaining 23% comes from large firms with 250 or more employees. Furthermore, firm owners make up 16% of the respondents, managers account for 52%, and supervisors make up the remaining 32%.

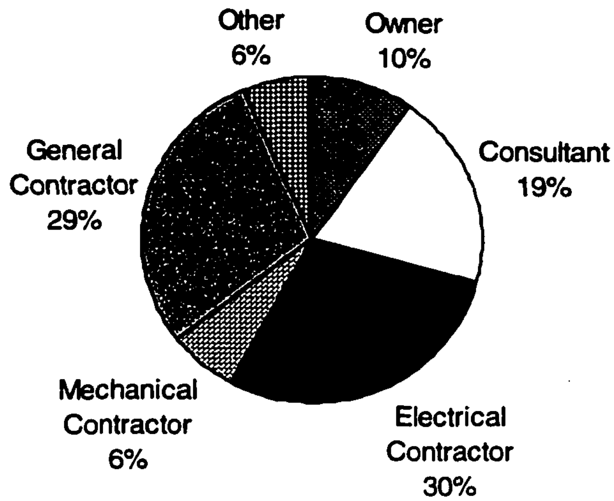


Figure 4-1: Survey Sample Composition

4.2 PRODUCTIVITY DRIVERS

There are many factors that drive or determine labor productivity in the construction industry. However, only those drivers mentioned repeatedly in the literature were included in the survey, as it would have been impractical to incorporate all possible drivers. Furthermore, in order to facilitate the thinking process of the participants, these drivers were classified into four major categories described in the following sections.

4.2.1 Management Systems and Strategies:

This category includes management skills, scheduling, material and equipment management, and quality control. Figure 4-2 shows the relative level of relevance as assessed by survey respondents. These values are normalized to show the issue or issues that obtained the highest rating in the survey with a value of 100. All other values are referenced to this one and represent the relative level of relevance on a percentage basis. For example, figure 4-2 shows quality control to be 68% as relevant as management skills or scheduling in determining construction productivity values according to survey respondents.

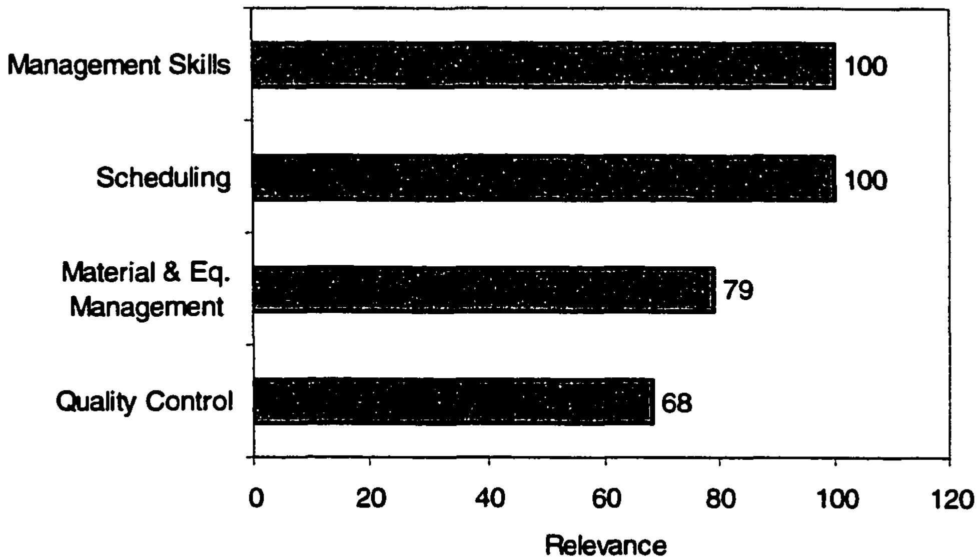


Figure 4-2: Management Systems and Strategies

The survey identified management skills as one of the two most relevant issues in determining construction labor productivity in this category. This result should not be a surprise as management skills are often cited in the literature as one of the major factors that determine labor productivity. Managers can add or reallocate resources, modify schedules, and change working methods. This, in turn, may create increased workload, crowding of workers, stacking of trades, dilution of supervision, or re-work (Halligan et al. 1994). Supervisors and managers who lack proper skills can negatively affect the performance of workers.

Scheduling was the other factor classified by survey respondents as the most relevant in determining labor productivity in this category. The scheduling of overtime, for example, may create an adverse effect on the motivation and physical strength of workers and therefore decrease their productivity (Cooper et al. 1997). Furthermore, scheduling work out of sequence can also produce loss of momentum/rhythm, as crews need to stop working on their present assignments and plan and reorganize for the new work (Thomas & Napolitan 1995).

Problems with material and equipment management have also been cited in the literature as major causes of productivity loss. Extensive multiple-handling of materials, materials improperly sorted or marked, trash obstructing access and movement of materials, running out of materials, and inefficient distribution methods are just a few instances of adverse material management conditions (Thomas et al. 1989). Even though survey respondents ranked this driver behind management skills and scheduling, the high relative relevance of 79% indicates that this is still considered a major driver of labor productivity.

Finally, quality control was ranked last in this category. Inadequate quality control/assurance programs can adversely affect labor productivity through the need for rework. The fact that this driver is ranked last seems to suggest that the major problems associated with management systems and strategies are not necessarily the systems or procedures themselves (quality control), but the people who implement and manage them (management skills).

4.2.2 Manpower:

The manpower category encompasses drivers such as worker experience, specific activity training, education, motivation and seniority. Figure 4-3 depicts the relative level of relevance of these drivers as assessed by the survey respondents.

Experience was rated as the most relevant factor in this category. Notice that at the same time seniority was considered the least relevant with only 59%. This may seem contradictory at first, but further scrutiny reveals that experience and seniority do not necessarily go hand by hand. The number of years that someone has been working in an industry is not as relevant as the specific activities performed. The quality and diversity of the work performed is far more important, according to survey respondents, than the number of years in a particular position. This clear distinction of concepts reflects an understanding of the survey respondents of the complexity of the labor issue in the construction industry.

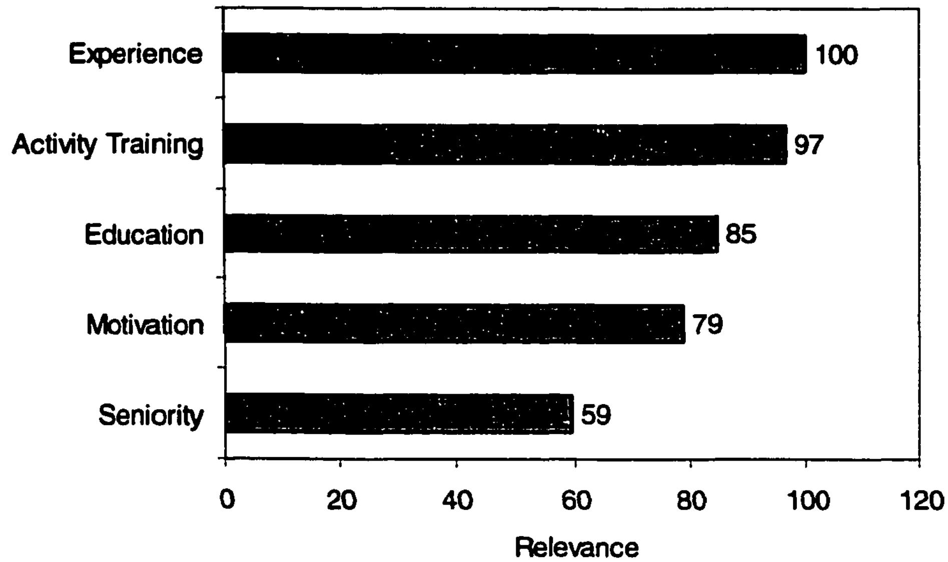


Figure 4-3: Manpower

A very close second place in this category was occupied by specific activity training. Specific activity training refers to the education provided to workers before they begin working on a particular activity. Survey respondents seem to indicate that if a worker does not possess experience in a particular operation, then the second best is to provide that training on site before the operation commences.

Education was ranked third not far behind experience and activity training. Education, in the broader context, represents a proxy of the potential that workers have to be trained and to benefit from experience.

Motivation was still considered an important driver and ranked fourth. This was a logical result, as motivation cannot replace experience, activity training, or education.

However, given the same levels of these factors, motivation is still poised to make a significant difference. Notice that even though motivation is ranked last, it still enjoys a high level of relevance with almost 80%. This indicates that survey participants are of the opinion that all of these four drivers are very important in the definition of labor productivity.

4.2.3 Industry Environment:

The industry environment (Tilford et al. 2000) category includes adverse weather conditions (Koehn & Brown 1985), uniqueness, working conditions, activity interactions, and subcontractor integration. Figure 4-4 shows the relative level of relevance of these drivers as determined by the survey respondents.

Adverse weather conditions are probably one of the most commonly cited causes for construction labor productivity losses in the literature (Christian & Hachey 1995, Halligan et al. 1994, Thomas et al. 1999). High winds, snow, high and cold temperatures, and strong rain showers are common examples of adverse weather conditions that clearly affect the productivity of workers. Quantitative studies have demonstrated that weather can account for as much as a 30% decline in productivity (Thomas et al. 1999). Survey respondents recognized the importance of adverse weather conditions as a productivity driver by placing it as the most important driver in the industry environment category.

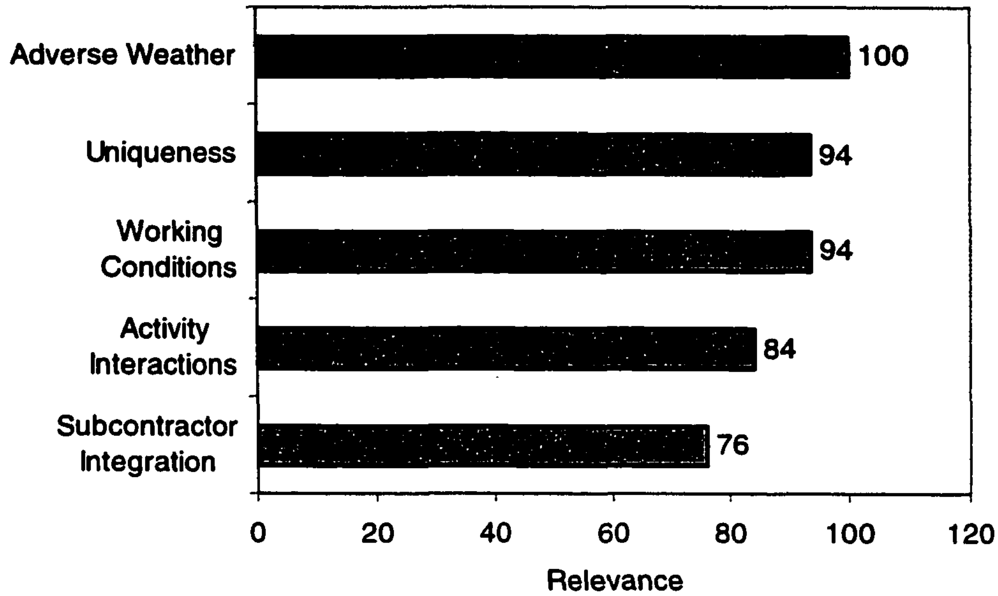


Figure 4-4: Industry Environment

Uniqueness of the industry was ranked second in this category not far behind adverse weather conditions. Several authors have addressed this issue in the literature. For example, Hadavi and Krizek (1994) explain that the construction industry is unique because of the diversity in the types, forms, and shapes of construction projects; the projects production cycles and lifetimes; the low research and development expenditures; the geographical dispersion; the labor force; and the contractual relationships. Survey respondents seem to agree with this notion of uniqueness as they ranked it at the top of this category.

Working conditions was also ranked second in this category together with industry uniqueness. Working conditions in a construction site are very different from those found at a manufacturing facility, and this can affect worker's morale and thus productivity.

Activity interactions reflect the complexities intrinsic to the construction process. Project management is nothing less than a constrained optimization problem. The difficulty arises because of the multiple constraints that cannot be easily quantified or even identified. For example, the relationship between construction methods and the supply of resources has shown that changing work methods may have little effect on the installation rates because of scarcity of resources and/or the inability to increase the rate of supply (Howell et al. 1993). Construction tasks do not happen in isolation, but as part of as ongoing process. Therefore, interactions are expected. According to the survey respondents, these interactions constitute a significant driver in the definition of labor productivity levels in construction.

General contractors tend to subcontract most of the project scope, and therefore, subcontractor integration is importance in most construction projects. Subcontractors have no control over other subcontractors' laborers and the general contractor has little control, at best, over subcontractors' workforces. Even though subcontractor integration was ranked last in this category, it is important to mention that it is still considered an important productivity driver with a 76%.

4.2.4 External Conditions:

The external conditions category includes scope changes, the economy, research and development, and information technologies. Figure 4-5 shows the relative level of relevance of these drivers as assessed by the survey participants.

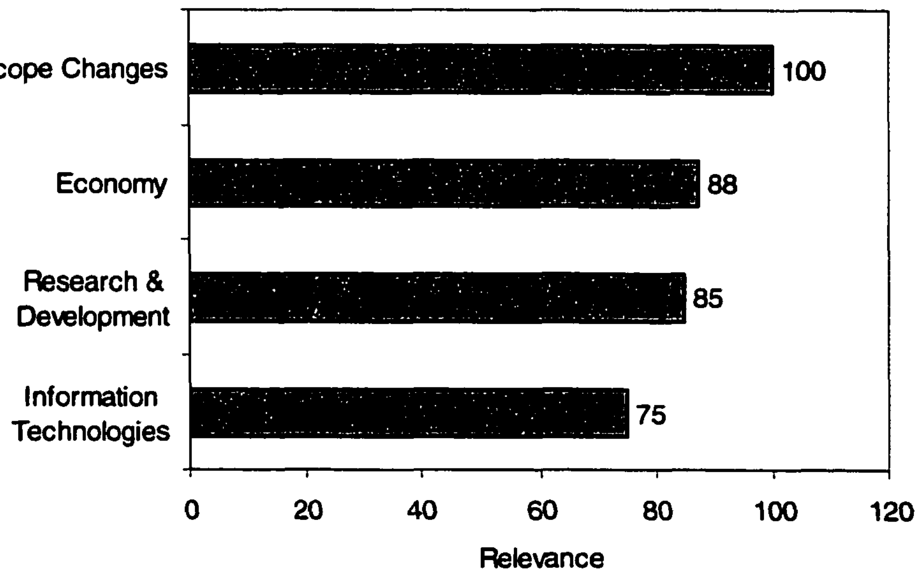


Figure 4-5: External Conditions

Scope changes are often reflected on change orders. The effect of change orders on labor productivity and efficiency has been studied by several authors. For example, Thomas and Napolitan (1995) quantified the effects of construction changes on labor productivity through a multiple-regression equation. They found an average of 30% loss in efficiency in three different case studies when changes were implemented. Survey respondents seem to be sensitive to this issue as they ranked scope changes at the top of the external conditions category.

The economy also plays an important role as a driver of labor productivity in the construction industry. It was ranked second in this category not far behind scope changes. The strong economic expansion experienced at the end of the nineties created some skilled labor shortfalls in several regions of the country. This, in turn, forced contractors to hire sub-optimal workers to fill out the gaps. Therefore, in periods of economic expansion it would not be unusual to experience a drop in the productivity of the construction labor force.

The U.S. construction industry is known for its low investment in research and development as compared to the Japanese or the European construction industries. Nonetheless, research and development are recognized by survey participants as important drivers in the determination of labor productivity. This is an interesting dichotomy where on the one hand the industry seems to recognize the relevant role that research and development can play in productivity improvement, while on the other hand it is reluctant to finance such activities.

Finally, information technologies are ranked last in this category. This is not a surprise due to the difficult time that the construction industry has had implementing emerging information technologies especially in the field. The promise of information technologies to improve labor productivity does not seem to resonate strongly among survey respondents. Therefore, information technology, by itself, is not seen as a panacea for productivity improvement.

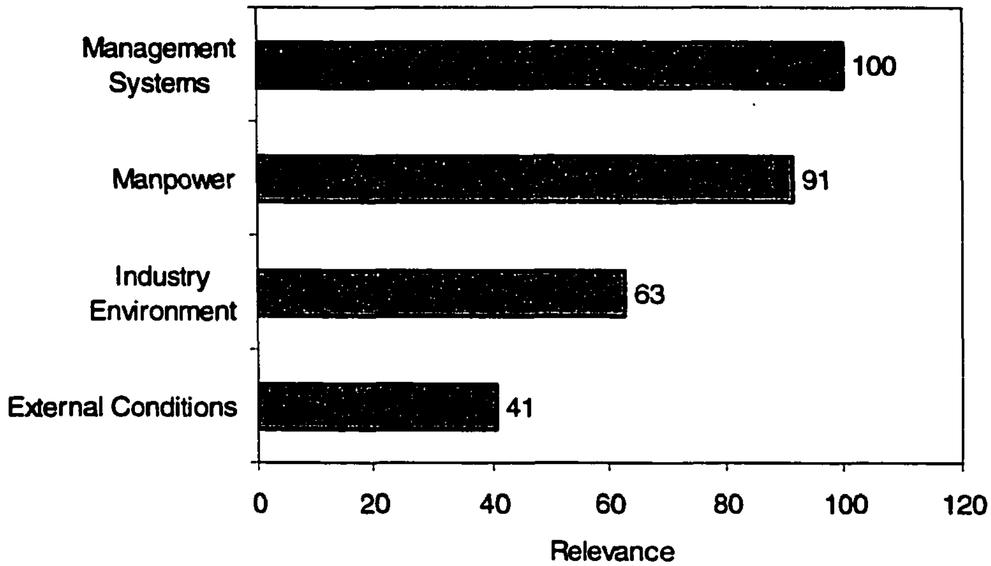


Figure 4-6: Relative Importance of Driver Categories

4.2.5 Relative Importance of Driver Categories:

Survey participants were also asked to rank the relative importance of each productivity driver category. Figure 4-6 shows these results where management systems and strategies and manpower are rated far ahead of the other two categories. Therefore, the industry environment and external conditions were considered drivers with lesser degrees of influence in determining labor productivity values. Especially interesting is the fact that external conditions ranked last with a value of only 41%, indicating that survey respondents consider construction labor productivity performance as determined inside the industry rather than by external factors. It was also surprising that the industry environment ranked as low as 63%, also reinforcing the position that survey respondents consider construction labor productivity as a variable under their control.

4.3 PRODUCTIVITY OPPORTUNITIES

Sixteen different productivity opportunities were presented to survey participants in four different categories: management systems, manpower, technology, and new techniques (Chinowsky & Meredith 2000, Gilly et al. 1987, Goodman & Chinowsky 1997, Hadavi & Krizek 1993, Hancher 1985, Karaa et al. 1989, Kumaraswamy 1997, Maloney & McFillen 1987, Mitropoulos & Tatum 2000, Rosenfeld et al. 1992, Sanvido & Medeiros 1990, Sanvido & Paulson 1992, Shah & Murphy 1995, Willenbrock et al. 1987). The results are summarized in figure 4-7. Each opportunity is represented by a pie chart divided in three different segments according to survey responses. The black segment represents the percentage of respondents that consider the opportunity as very effective. The gray segment symbolizes the percentage of participants that believe the opportunity is effective. The white segment shows the percentage of respondents for which the opportunity is not effective. This color scheme transforms figure 4-7 into a visual tool where the degree of effectiveness of opportunities can be evaluated by identifying those instances where darker colors dominate. The bigger the area occupied by darker colors, the more effective the opportunity is considered. Based on this principle, opportunities in each category have been arranged in figure 4-7 from most effective (left) to least effective (right).

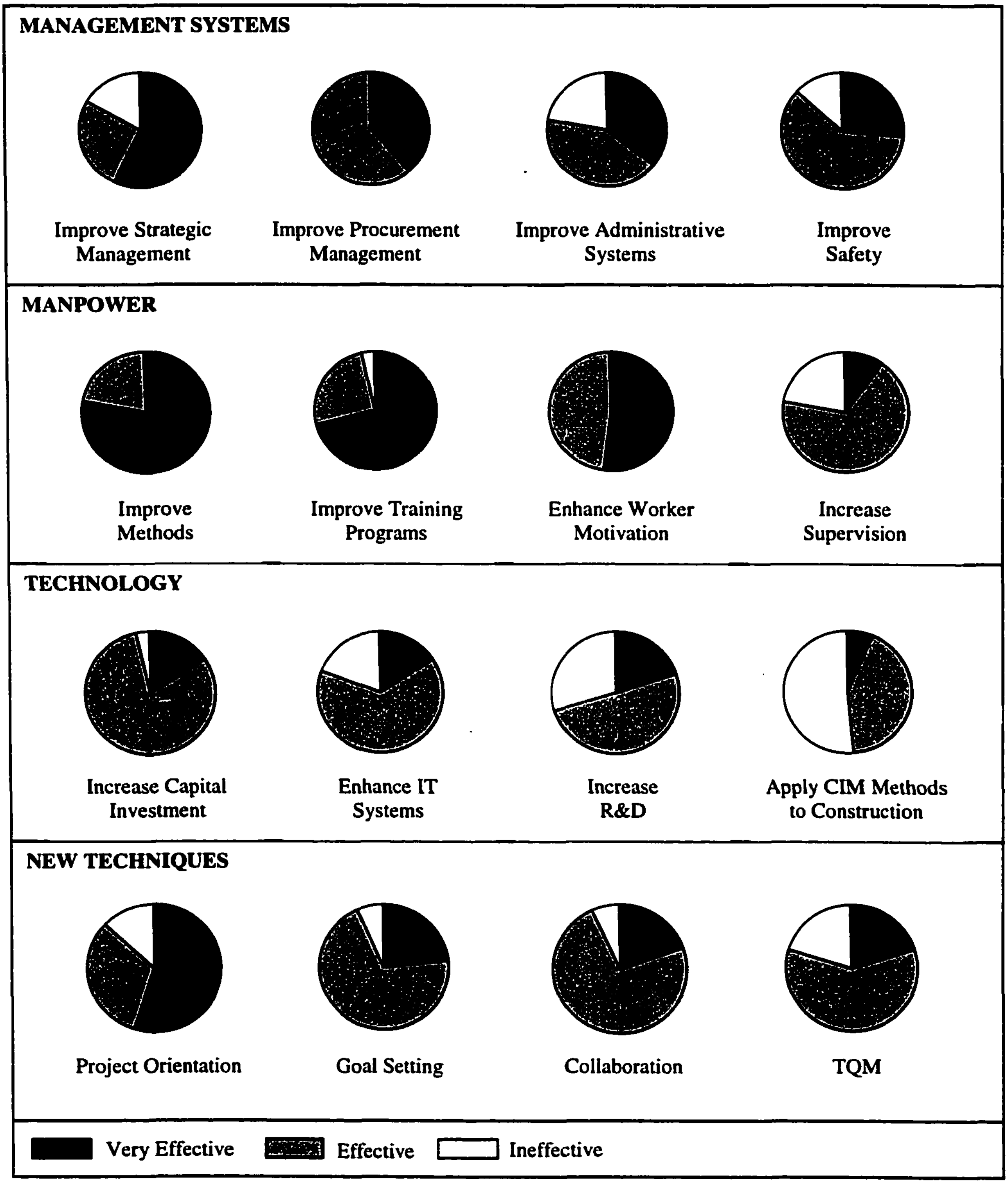


Figure 4-7: Productivity Opportunities

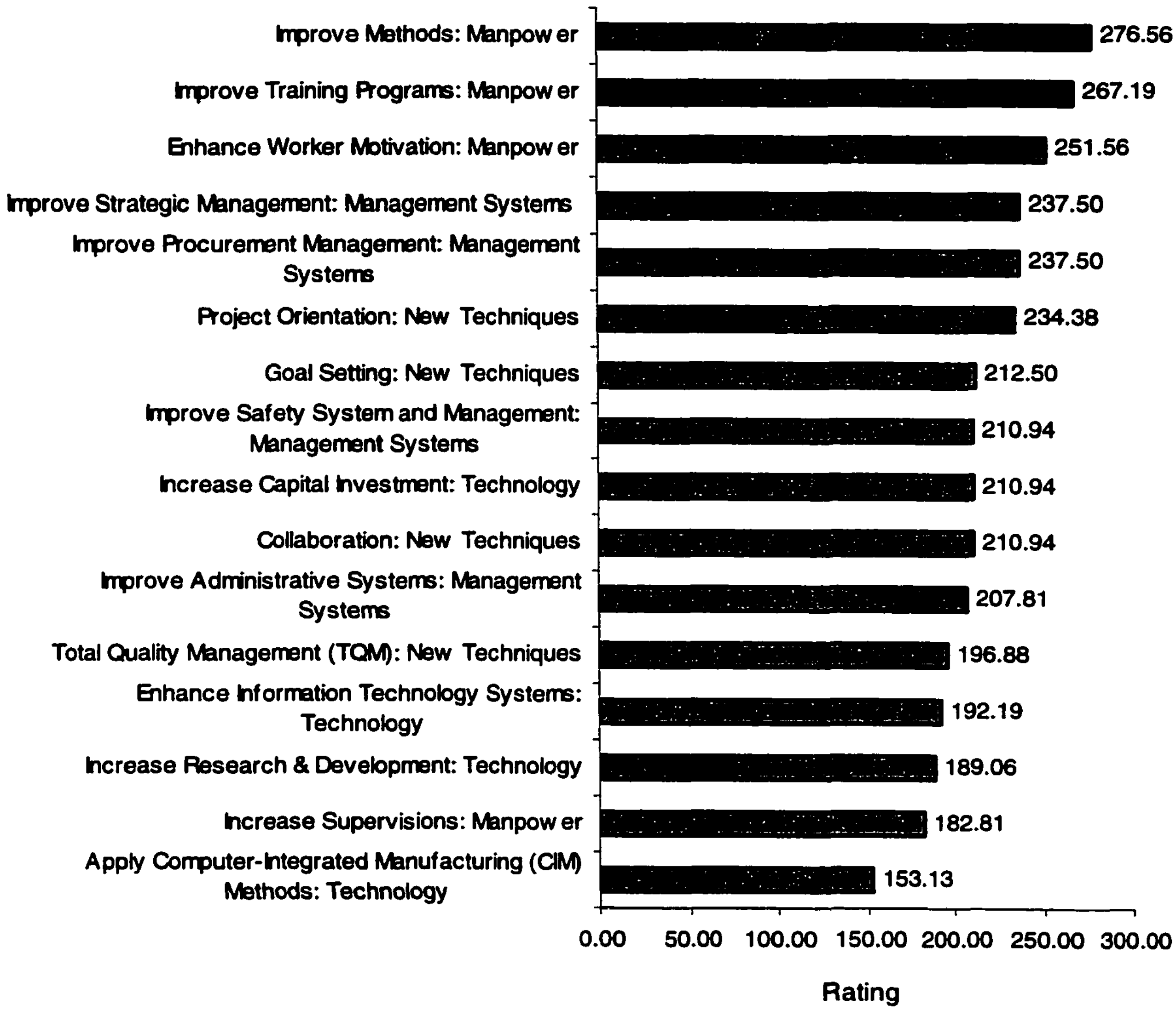


Figure 4-8: Important Rating Comparison of Productivity Opportunities

The important rating comparison of productivity opportunities in the figure 4-8 is calculated by using the percentage of the responses for "Very Effective", "Effective", "Not Really Effective" of each productivity opportunities, and putting into the formula:

Important Rating = (Very Effective x 3) + (Effective x 2) + (Not Really Effective x 1)

Therefore, by inspection of the figure 4-7 and as shown in the figure 4-8, the following five opportunities are among the most promising ones, according to the survey responses:

1. Improve Methods
2. Improve Training Programs
3. Enhance Worker Motivation
4. Improve Strategic Management
5. Improve Procurement Management

As expected, there exists a correlation between the productivity drivers introduced in the previous section, and the productivity opportunities included in the list above. The top three opportunities belong to the manpower category, while the other two belong to management systems. Management systems and strategies and manpower were the driver categories ranked at the top of the relevance scale in the previous section. This validates the results of this study, as one would expect productivity opportunities to arise from those drivers with the greatest potential for change.

4.4 SUMMARY AND RECOMMENDATIONS

The most surprising result from this study was discovering that survey respondents consider construction labor productivity to be under their control rather than to the mercy of the construction industry environment or external conditions. This state of mind is encouraging, as it allows for the exploration and implementation of innovative approaches to improve labor productivity. Survey respondents also seem to recognize that improving productivity is a management issue, and that the introduction of new techniques or technologies may be a necessary, but not a sufficient condition.

The information gathered through this survey can also serve as the means to identify further areas of investigation. For example, the five opportunities for productivity improvements recognized by the survey respondents as the most promising can definitely elicit additional research interest.

Chapter 5: Conclusions and Recommendations

5.1 INTRODUCTION

This research presents a comparison of the US construction and manufacturing labor productivity for the 1979 to 1998 period and also an analysis of the reliability and validity of the macroeconomic data, which shows the declining trend of the US construction labor productivity during this period. Moreover, the profile of the construction labor force is compared to the manufacturing industry. Information about employment, education, age, and gender for both industries is presented. An understanding of the major characteristics of the construction labor force is the logical starting point for the development of long-term strategies to offset the decline in construction labor productivity. Therefore, this research also presents the results and analysis from the responses to a survey of the factors that affect the labor productivity in the construction industry, termed as drivers, and what should be considered to enhance the construction labor productivity, termed as opportunity.

5.2 EVALUATION OF THE CONSTRUCTION LABOR PRODUCTIVITY DATA

Labor productivity is defined as the output generated per hour-worked. In order to calculate productivity values for an industry, three pieces of information are required: the industry's output, the industry's employment data, and the average number of hour-worked. The real gross domestic product (GDP) in the business and nonfarm business sectors is the basis of the output components of the major sectors' labor productivity. These output components are based upon and are consistent with the National Income and Product Accounts (NIPA), including the gross domestic product (GDP) measure, prepared by the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce. The different levels of accuracy of labor productivity between the construction industry and other industries were generated from the difference in the degree of aggregation of the collected data, as shown in figure 2-2. Budgetary constraint at the U.S. Census Bureau is one of the causes of unreliability in the accuracy level of surveyed data. Besides that, the lack of good price indexes for non-residential construction and the lack of a reliable independent annual measure in current dollars to serve as a benchmark for the monthly VIP (The Value Put in Place Program) have also caused the inaccurate estimates. These all cause the inaccurate estimates in GDP, which consequently causes the unreliable estimates in labor productivity of the construction industry.

The primary source of hours and employment data is the Bureau of Labor Statistics (BLS) Current Employment Statistics (CES) program, which provides monthly survey data on total employment and average weekly hours of production and nonsupervisory workers in nonagricultural establishments. Data on employment, hours, and earnings are collected monthly; the reference period for these data is the payroll period including the 12^{th} of the month. The same procedures of data collection methods are used for both the construction and the manufacturing industries. The data are collected by the BLS at the state level and forwarded to Washington, D.C. where all data are compiled. However, for the construction industry, most state agencies have incomplete data sets for employment and hour-worked.

There are only 17 states that have complete data. For the rest, the 34 state agencies have the incomplete data and 25 state agencies out of these 34 state agencies have no data at all for the 1979-1998 period. This research found that budgetary constraint was the main reason for incomplete data for employment and hour-worked in the construction industry. Figure 2-3 illustrates the comparison among the adjusted data, non-adjusted data, and the BLS plots. It shows that labor productivity between the BLS plots and the adjusted data is almost identical. It also shows the difference between those two data sets and the non-adjusted data. According to the non-adjusted data trend, if the BLS had all completed data sets from every state, as it did for the manufacturing industry, the results would possibly be higher. There is also one more point to consider. The accuracy level of the incomplete data from 9 states might be less reliable than those complete data from 17 states. Therefore, the adjustment performed by the BLS creates the downward bias in labor productivity values for the construction industry.

In addition to the findings of the data weakness, changes in the output mix can also generate a bias to productivity trend. Changes in the output mix can generate changes in construction labor productivity values even when labor productivity for each sector does not change. For example, when residential and commercial construction increase their share of the construction industry at the expense of industrial and heavy construction, labor productivity values for the construction industry as a whole could go down even if each sector's productivity had remained constant. Again, according to the budgetary constraints, the BEA does not keep separate records for labor productivity for each sector of the construction industry. Thus, the magnitude of this problem for the period 1979-1998 cannot be identified.

Per the results of this research, the downward sloping in the labor productivity for the construction industry during year 1979 to 1998 is clearly not reliable due to the incompleteness of collected data and the changes in the output mix. Therefore, the quality and accuracy of the collected data of the construction industry need to be improved in order to produce more reliability of the construction labor productivity trend in the future. Although - due to the unreliability of collected data - it is unclear whether the construction labor productivity declined, it will be useful to study what can be improved to enhance the construction labor productivity in the future. One of the possible avenues would be to analyze the labor profile of the construction industry. As well, studying drivers and opportunities will indicate possible directions to accomplish enhancing productivity.

5.3 LABOR FORCE PROFILE ANALYSIS FOR THE CONSTRUCTION INDUSTRY

This research presents labor force profiles of the construction industry compared to the manufacturing industry. These profiles include employment stability, education, age, hour-worked, real wages, and diversity. This research also includes the projections for labor demand to the year 2008.

The first labor force profile that was analyzed is the employment. One of the factors influencing employment is worker morale. Construction workers usually work outside and are exposed to the elements. On the other hand, most manufacturing workers work inside, which is beneficial due to controlled environments. Safety programs have also been implemented to increase the security of construction workers, and construction workers receive 25% higher wages than manufacturing workers receive. These measures should increase the morale of the construction worker, but absolute rather than relative compensations of real wages for the construction worker over the last two decades (1979 to 1999) indicate the opposite. Real hourly wages have continuously declined in both the manufacturing and the construction industries from 1979 to 1999. The difference is that the real hourly wages in the construction industry have declined at more than twice the real hourly wages rate of the manufacturing industry in the period of study.

For the same period of study, there is the increase in the average number of hour-worked in both construction and manufacturing. Construction and manufacturing workers seem to be working longer hours to maintain their purchasing power and living standards because of the decrease in real wages. In other words, they are working longer hours while feeling "obligated" which could possibly cause low morale. Low morale in the construction labor workers could be seen in the form of short-term employment with the same company. Short time working of construction workforces makes it difficult for employers to provide significant and effective training, as management is not willing to train workers who might be working somewhere else in a few months. This should be a concern for the construction industry because it will relate to workforces' skills and experiences. Consequently, lower workforce skills and experiences absolutely affect the declining trend of the construction labor productivity.

The second labor force profile that was analyzed is employees' educational attainment. The level of educational attainment of the labor force has been found to be positively correlated to its level of performance and productivity. This research found that there is a difference of educational attainment level between the construction and manufacturing industries. The majority of the labor force in both construction and manufacturing industries are classified in high school grad to high school diploma level. However, after comparing each level of educational attainment for the construction and manufacturing industries, it is found that construction workers have a higher percentage in lower levels of educational attainment (none to 12th grade and high school) than manufacturing workers. Conversely, the manufacturing industry has a higher percentage of labor force in the higher level of educational attainment than in the construction industry.

The educational attainment can be used to explain labor productivity. For example, the manufacturing industry has more labor forces with higher levels of educational attainment than labor forces in the construction industry. This can be related to the improvement in quality of work, which is clearly higher in the manufacturing industry than in the construction industry because labor forces in the manufacturing industry have more knowledge and training, so they can gain more understanding in work procedures. Consequently, labor productivity will be higher. In addition to the average lower level of educational attainment achieved by construction labor forces, which only considers formal education, one must also take into consideration on-the-job training, including apprenticeship programs. However, as shown in the previous study, there is no employer who would like to provide job training to the one who is not willing to work for the company in the long term. Therefore, in summary, the "transient" nature of the construction labor force, low educational attainment, and the lack of a formal trade-based training or apprenticeship program in the open-shop market seem to have created a void that precludes construction workers from achieving their full potential. In short, low educational attainment clearly affects the construction labor productivity.

The third labor force profile that was analyzed is employees' age. The age profiles of labor forces in the construction and manufacturing industries have been steadily changing for the last few decades as the typical worker has become older. The percentage of workers ages 25 to 54 for both industries from 1979 to 1999 has increased in the labor pool from about 65% to over 75% for this analysis period. In the same analysis period, the percentage of ages 16 to 24 in the labor pool has declined for both construction and manufacturing industries. For the construction industry, its participation in this labor pool (ages 16 to 24) has decreased from over 25% to less than 15%, while a similar decline has been experienced in the manufacturing sector.

In conclusion, this research presents that the average age of the construction workers has increased from approximately 37 to close to 39 years, while the average age of the manufacturing workers has increased from approximately 38.5 to close to 40 years. The increase in the average age of the labor force is a more critical issue in the construction than in the manufacturing industry since construction work is usually harder than manufacturing work; it requires such activities as prolonged standing, climbing, bending, and kneeling. Moreover, construction workers have to deal with risk injury work such as using sharp tools and power equipment, and risking slips or falls. Furthermore, as already known, most construction workers work outdoors, which is more uncomfortable than working in a factory with a controlled environment. Therefore, the increase in the average age of the labor force absolutely affects the construction labor productivity.

Finally, labor forces' gender was analyzed in this research. In the manufacturing industry, women take part almost one third of the total labor force, while, in the construction industry, women make up only 10% of the labor pool. This relative participation of women in the labor pool for both industries has remained more or less constant over the last couple of decades.

Projections to the year 2008, forecasted by Thomson (1999), indicate that the demand for workers in the construction industry is expected to increase at an average rate of approximately 1% per year until 2008, while there will be no increasing demand of new workers for the manufacturing industry. The results of the analyses in labor force profiles clearly reveal basic differences in labor compositions between the construction and manufacturing industries, which cause the differences in labor productivity. Therefore, enhancing construction labor forces' capability (skills, practical knowledge, education levels) and increasing the labor force's morale should be implemented in order to complement the increased demand indicated by the 2008 projection. Then, the construction labor productivity will be raised.

5.4 EVALUATION OF THE LABOR PRODUCTIVITY DRIVERS AND OPPORTUNITIES IN THE CONSTRUCTION INDUSTRY

A driver is any factor that affects the productivity of a construction task. Examples of labor productivity drivers in the construction industry include weather conditions, coordination of subcontractors, scheduled overtime, material management, as well as worker motivation, training, experience, and supervision among many others. An opportunity is any technique that has the potential of improving labor productivity. Examples of labor productivity opportunities in the construction industry include improvement of construction methods, operations and administrative systems, strategic management and planning, and the use of goal setting techniques, among others.

There are many factors that influence productivity in the construction industry. Factors and events frequently cited as causing a loss of productivity include adverse weather, scheduled overtime, out-of-sequence work, poor supervision, poor training, poor planning, low morale, unavailability of manpower, unsafe working conditions, and inadequate quality and safety management. Inefficient material management is another one of the factors that cause lost productivity at a construction site. Uniqueness is also one of the factors that affect labor productivity in the construction industry. The construction industry is unique in several aspects. The major reasons for this uniqueness are the diversity in the types, forms, and shapes of construction projects; projects' production cycle and lifetime; low research and development expenditures; geographical dispersion; labor force; and contractual relationship. All of these factors affect production rates.

The data discussed in this research were collected through a web-based survey with support from *Electrical Contractor* magazine. Sixty-four responses were received from owners, consultants, general contractors, electrical contractors, and mechanical contractors among others. There are many factors that drive or determine labor productivity in the construction industry. After doing research, drivers in the construction industry were determined into 4 main categories: Management Systems and Strategies, Manpower, Industry Environment, and External Conditions.

The first category of drivers is Management Systems and Strategies. The results of the survey identified management skills as the most relevant issue in determining construction labor productivity. Scheduling was classified by survey respondents as the second most relevant, and Material & Equipment Management and Quality Control were considered as the third and the fourth relevant factors that affect labor productivity, respectively.

The second category is Manpower. Worker experience, specific activity training, education, motivation and seniority were respectively ranked as affected drivers in this survey. The third category, Industry Environment, includes adverse weather conditions, uniqueness, working conditions, activity interactions, and subcontractor integration. Survey respondents recognized the importance of adverse weather conditions as a productivity driver by placing it as the most important driver in the Industry Environment category. Both uniqueness of the industry and working conditions were ranked as the second relevant. As generally known, interactions are expected in the processes of construction tasks. As indicated by the results from the survey respondents, the interaction between activities and subcontractor integration were ranked following.

The last category for drivers in this survey is External Conditions. The External Conditions category includes scope changes, the economy, research and development, and information technologies. As the results of the survey indicate, respondents ranked scope changes as the most relevant to labor productivity in the construction industry for this category. The Economy was ranked for the second place. Survey participants recognize research and development as the third place. Finally, information technologies are ranked last in this category.

Survey participants were also asked to rank the relative importance of each productivity driver category and the result is that Management Systems and Strategies, Manpower, Industry Environment, and External Conditions were ranked at first, second, third, and fourth place respectively. One hundred percent of survey respondents indicated that Management Systems and Strategies should be definitely improved in order to enhance the U.S. construction labor productivity. Moreover, Manpower was ranked as the second most important, rated 91% by respondents. These can imply that, to effectively enhance labor productivity, the construction industry should pay more attention to its internal factors than external factors. However, the external conditions must be considered.

Sixteen different productivity opportunities were presented to survey participants in four different main categories: Management Systems, Manpower, Technology, and New Techniques. The first opportunity category analyzed from the survey is Management Systems. As the results of the survey indicate, strategic management, procurement management, administrative systems, and safety were ranked for improving respectively. The second category is Manpower. Working methods, training programs, worker motivation, and supervision were ranked for improving respectively in Manpower category.

The Technology category is the third category analyzed as opportunity in the survey. As the results indicate, increasing capital investment, enhancing IT (Information Technology) Systems, increasing R&D (Research and Development), and applying CIM (Computer-Integrated Manufacturing) methods to construction were ranked respectively.

Last, for New Technology category, project oriented, goal setting, collaboration, and TQM (Total Quality Management) were ranked respectively to improve construction labor productivity.

After consideration of the survey results, the following five opportunities that should be seriously concerned are: 1) Improve Methods, 2) Improve Training Programs, 3) Enhance Worker Motivation, 4) Improve Strategic Management, and 5) Improve Procurement Management. As with the survey results of productivity drivers, the top three opportunities belong to the manpower category, and the other two are in management systems, which are ranked at the top for the construction productivity drivers. This validates the results of this research. Therefore, the results of survey prove the matching between drivers and opportunities: the construction industry should pay more attention to management systems, manpower, and technology in order to practically enhance labor productivity and to be ready to complement the increased labor demand need as the future projection. Finally, all of these will lead to the increase in the labor productivity of the construction industry in the future.

5.5 FURTHER STUDIES AND RECOMMENDATIONS

One of the best measures of production efficiency is labor productivity. Labor productivity is measured by the output per hour-worked. In this research, labor productivity is valued in terms of monetary measures of output. Therefore, the recommendation is that non-monetary measures of output should be further studied to see if the results would be different from the monetary measurement results. The results of the non-monetary measures of output might give greater accuracy and more reliable information. Furthermore, the generation of time series data for inter-sectoral productivity and the generation of productivity time series data for different sizes of projects are recommended for further studies in productivity of the construction industry. Generating and analyzing labor productivity by sector would be very useful in order to know exactly what sector creates the best, second-best, and so on in productivity. Besides that, it would be easier and clearer to point out what sectors should be improved and what are the real factors that affect productivity of these sectors. This would address the problems directly.

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APPENDIX A: INFORMATION AND DATA FOR CALCULATING AND EVALUATING LABOR PRODUCTIVITY

APDX A-1: Contact list of Northeast BLS-State Agencies for the Construction Industry.

Geographic	State	Collected Data		Contact Person	Tel.Num.
		Empl.	Hr.Wk		
	USA	All	All	Mr. Ken Shipp	(202)691-6519
NE	Connecticut	Some	Some	Mr.Brandon Hooker	(860)263-6282
NE	Maine	All	NO	Janet White	(207)287-3951
NE	Massachusetts	All	NO	Mr.Bernard Burns	(617)626-5744
NE	New Hampshire	All	Some	Mr.Bernhard Mckay	(603)228-4127
NE	New Jersey	All	NO	Mr.Lester E Wright Jr.	(609)292-7567
NE	New York	All	Some	Mr.Ed Spaight	(518)457-3800
NE	Pennsylvania	All	NO	Mr.Randall Murphy	(717)787-6466
NE	Rhode Island	All	NO	Mr.Walter Narshall	(617)565-2324
NE	Vermont	All	Some	Mr.Michael Griffin	(802)828-4153

APDX A-2: Contact list of South BLS-State Agencies for the Construction Industry.

Geographic	State	Collected Data		Contact Person	Tel.Num.
		Empl.	Hr.Wk		
S	Alabama	All	NO	Mrs.Tonya Lee	(334)353-9560
S	Arkansas	All	NO	Ms. Sue Anderson	(501)682-3194
S	District of Columb	All	NO	Mr. Charles Roeslin III	(202)724-7214
S	Delaware	All	NO	Mr.Ed Simon	(302)761-8052
S	Florida	All	Some	Mr.Bill Dobson	(850)488-1048
S	Georgia	All	NO	Mrs.Evan Little Mr.Roger Salandi	(404)656-3177, 1800-338-2082
S	Kentucky	All	NO	Mr.Carlos Cracraft	(502)564-7976
S	Louisiana	All	NO	Ms.Patty Lopez	(225)342-3147
S	Maryland	All	NO	Mrs.kay Lebitt	(410)767-2251
S	Mississippi	All	NO	Mrs.Norma Alford	(601)961-7427
S	North Carolina	All	Some	Mr.John Aultry	1800-862-0638
S	Oklahoma	All	All	Mr.Auther Jordan	(405)557-7265
S	South Carolina	All	NO	Ms.Gerri Taylor	(803)737-2717
S	Tennessee	All	NO	Ms.Linda Inman	(615)741-2284
S	Texas	All	NO	Mr.Phil Arnold	(512)491-4811
S	Virginia	All	NO	Mrs.Susan Mciver	(804)786-8223
S	West Virginia	All	All	Mr.Edward F. Merrifield	(304)558-2660

APDX A-3: Contact list of West BLS-State Agencies for the Construction Industry.

Geographic	State	Collected Data		Contact Person	Tel.Num.
		Empl.	Hr.Wk		
W	Alaska	All	All	Ms. Rachel Baker	(907)465-6037
W	Arizona	All	All	Mr. Rick Dansickle	(602)542-6481
W	California	All	Some	Mr.Robert Corkin, Mrs.Alice Schwander	(916)262-2284, (916)262-2193
W	Colorado	All	All	Mr.William LaGrange	(303)620-4977
W	Hawaii	All	All	Mr. Robin Komoto	(808)586-9032
W	Idaho	All	All	Mr.Jerry Fackrell	(208)334-6169
W	Montana	All	All	Mr.Eric Johnson	(406)444-4503
W	Nevada	All	All	Mr.Robert Murdock	(775)684-0387
W	New Mexico	All	All	Gerry P. Bradley	(505)841-8647
W	Oregon	All	All	Mr.Graham Slater	(503)947-1212
W	Utah	All	NO	Mr.Ken Jensen	(801)526-9488
W	Washington	All	Some	Mr.Dale Smith	(360)438-4837
W	Wyoming	All	NO	Mr.Tom Gallagher	(307)473-3801

APDX A-4: Contact list of Midwest BLS-State Agencies for the Construction Industry.

Geographic	State	Collected Data		Contact Person	Tel.Num.
		Empl.	Hr.Wk		
	USA	All	All	Mr. Ken Shipp	(202)691-6519
MW	Illinois	All	All	Mr.Henry L. Jackson	(312)793-2316
MW	Indiana	All	NO	Mr. Charles Mazza	(317)232-7460
MW	Iowa	All	All	Jeffrey A. Nall	(515)281-0255
MW	Kansas	All	NO	Mr.David McGee	(785)296-5037
MW	Michigan	All	Some	Mr.George Zumburs	(313)876-5485
MW	Minnesota	All	Some	Oriane Casale	(615)297-3086
MW	Missouri	All	Some	Mr.Bill Niblack	(573)751-3637
MW	Nebraska	All	NO	Mrs.Becky Raymond	(402)471-9962
MW	North Dakota	All	NO	Mr.Warren Boyd	(701)328-3048
MW	Ohio	All	All	Mr.Keith Ewald	(614)752-9494
MW	South Dakota	All	Some	Mrs.Pauline Heier	(605)626-2314
MW	Wisconsin	All	NO	Mr.Eric Grosso	(608)266-7034

APDX A-5: Construction Industry Non-Adjusted Data by Regions (States).

GDP = Gross Domestic Output (in Millions of 1996 Chained-dollars).

Employment = Number of All Employment (in Thousands).

Hr.wk = Number of Average Weekly Hour-Worked.

Sources: the Bureau of Labor Statistics (BLS), the Bureau of Economic Analysis (BEA)

Geographic: NORTHEAST (STATES)

Year	Connecticut				Maine				Massachusetts			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3019			0	942	19.4		0	4453	75.6		0
1980	2802			0	954	19.5		0	4319	77.4		0
1981	2678			0	794	17.5		0	4275	79.6		0
1982	2591	49.3	37.3	95622280	721	16.7		0	4292	78.4		0
1983	3191	54.0	38.5	108108000	761	16.9		0	4762	82.6		0
1984	3939	60.7	39.2	123730880	1000	20.4		0	5890	96.4		0
1985	4514	65.4	39.3	133651440	1177	23.4		0	6912	109.4		0
1986	5023	71.1	39.4	145669680	1375	26.9		0	7841	123.2		0
1987	5911	77.7	40.0	161616000	1650	31.5		0	8849	137.7		0
1988	6481	81.0	40.5	170586000	1778	33.3		0	9386	142.1		0
1989	6023	75.1	40.3	157379560	1777	32.7		0	8497	126.8		0
1990	4745	61.9	39.2	126176960	1554	28.5		0	6832	101.1		0
1991	4023	51.4	38.1	101833680	1230	22.0		0	5655	78.8		0
1992	3980	47.4	38.9	95880720	1257	21.1		0	5696	73.6		0
1993	4052	47.6	40.2	99503040	1249	20.9		0	6024	80.1		0
1994	4094	49.3	40.2	103056720	1241	21.0		0	6529	86.0		0
1995	4247	50.4	40.4	105880320	1222	21.7		0	6588	89.8		0
1996	4237	52.4	41.2	112261760	1342	23.2		0	6994	94.0		0
1997	4497	56.3	41.2	120617120	1345	23.3		0	7362	100.3		0
1998	4554	58.9	41.3	126493640	1407	25.1		0	7848	108.4		0

Geographic: NORTHEAST (STATES)

Year	New Hampshire				New Jersey				New York			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1057	20.9		0	7248	113.7		0	13306.92	210.3	36.3	396962280
1980	943	19.4		0	6798	111.3		0	12937.76	209.3	36.2	393986320
1981	928	20.3		0	6489	108.7		0	12611.08	213.2	35.9	398001760
1982	1029	22.8		0	6303	107.3		0	12745.90	219.6	36.0	411091200
1983	1207	24.4		0	6913	112.1		0	14147.85	230.8	36.2	434457920
1984	1285	25.2		0	8734	131.1		0	16649.05	255.2	36.8	488350720
1985	1661	30.9		0	10101	141.0		0	19373.15	285.6	36.6	543553920
1986	1945	35.2		0	10907	153.1		0	20997.00	308.9	36.8	591111040
1987	2094	36.8		0	12014	163.4		0	22011.00	328.8	36.5	624062400
1988	2097	35.9		0	13165	168.2		0	23333.00	337.8	36.4	639387840
1989	1787	30.1		0	12911	164.3		0	23370.00	336.6	37.0	647618400
1990	1300	22.5		0	11427	146.4		0	22040.00	319.8	36.8	611969280
1991	1052	17.3	39.3	35354280	9725	121.4		0	19508.00	276.9	36.5	525556200
1992	1056	16.3	39.0	33056400	9587	110.2		0	18121.00	245.3	36.4	464303840
1993	1124	16.8	39.9	34856640	9846	115.3		0	17666.00	243.5	36.8	465961600
1994	1169	17.8	41.0	37949600	10120	122.2		0	18324.00	249.6	37.5	486720000
1995	1204	19.4	41.7	42066960	9898	123.0		0	17805.00	251.3	37.6	491341760
1996	1325	20.2	40.3	42331120	10069	124.2		0	18046.00	254.4	37.7	498725760
1997	1388	20.9	39.8	43254640	10497	130.7		0	18530.00	264.9	38.0	523442400
1998	1499	23.0	40.5	48438000	10560	134.9		0	19647.00	283.5	38.4	566092800

Geographic: NORTHEAST (STATES)

Year	Pennsylvania				Rhode Island				Vermont			
	GDP	Employment	Hr.wk	(Emp x Hr.w	GDP	Employment	Hr.wk	(Emp x Hr.w	GDP	Employment	Hr.wk	(Emp x Hr.w
1979	12016	204.2		0	724	13.9		0	494	10.3		0
1980	10890	190		0	636	12.7		0	468	10.1		0
1981	9768	181		0	565	11.7		0	450	11.0		0
1982	8861	168		0	529	10.9		0	398	9.9		0
1983	9207	166		0	583	11.6		0	466	10.9		0
1984	10220	176		0	706	13.3		0	545	12.2		0
1985	11156	187		0	824	15.2		0	645	13.8		0
1986	12057	201.8		0	934	17.4		0	701	15.3		0
1987	12791	218.3		0	1046	19.6		0	752	16.5		0
1988	13835	229.6		0	1220	21.2		0	813	17.5		0
1989	14021	233.0		0	1233	20.3		0	833	17.9	39.3	36580440
1990	13698	226.8		0	1166	18.5		0	717	14.5		0
1991	12524	204.8		0	892	13.4		0	596	11.9		0
1992	12723	197.5		0	881	12.2		0	606	11.2		0
1993	12642	197.4		0	854	12.6		0	618	11.6		0
1994	13066	202.0		0	927	13.1		0	620	11.8		0
1995	12387	199.6		0	907	13.4		0	621	12.3	41.1	26287560
1996	12663	202.8		0	940	13.9		0	640	12.5	40.8	26520000
1997	13181	213.0		0	984	14.6		0	654	12.9	39.2	26295360
1998	13422	221.3		0	1046	15.9		0	689	13.8	41.3	29636880

Geographic: NORTHEAST (REGION)

Year	Northeast		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	13306915506	396962280	33.522
1980	12937763612	393986320	32.838
1981	12611079599	398001760	31.686
1982	15336429420	506713480	30.266
1983	17339085470	542565920	31.958
1984	20588148931	612081600	33.636
1985	23887527409	677205360	35.274
1986	26020000000	736780720	35.316
1987	27922000000	785678400	35.539
1988	29814000000	809973840	36.809
1989	30226000000	841578400	35.916
1990	26785000000	738146240	36.287
1991	24583000000	662744160	37.093
1992	23157000000	593240960	39.035
1993	22842000000	600321280	38.050
1994	23587000000	627726320	37.575
1995	23877000000	665576600	35.874
1996	24248000000	679838640	35.667
1997	25069000000	713609520	35.130
1998	26389000000	770661320	34.242

Geographic: SOUTH (STATES)

Year	Alabama				Arkansas				District of Columbia			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3381	75.4		0	2260	41.9		0	803	14.3		0
1980	3056	71.4		0	2162	37.6		0	716	13.2		0
1981	2561	63.9		0	1726	34.3		0	634	11.7		0
1982	2189	56.8		0	1429	29.9		0	565	10.6		0
1983	2307	59.8		0	1411	30.0		0	534	10.1		0
1984	2562	64.8		0	1637	33.7		0	587	11.5		0
1985	2941	71.4		0	1744	35.3		0	645	13.6		0
1986	3051	74.9		0	1741	36.2		0	681	14.1		0
1987	3057	75.1		0	1555	34.1		0	691	14.7		0
1988	3302	78.0		0	1567	33.3		0	714	14.0		0
1989	3290	78.1		0	1542	33.3		0	727	14.4		0
1990	3571	83.2		0	1661	37.6		0	733	14.4		0
1991	3467	78.6		0	1671	35.8		0	601	11.1		0
1992	3545	75.8		0	1847	37.4		0	502	9.0		0
1993	3644	78.0		0	1963	38.5		0	465	8.6		0
1994	3855	82.2		0	2059	41.3		0	472	9.0		0
1995	3927	86.8		0	2142	44.3		0	456	8.7		0
1996	4270	93.4		0	2263	47.2		0	462	8.9		0
1997	4371	97.2		0	2271	47.6		0	492	9.1		0
1998	4409	100.2		0	2282	48.0		0	484	9.0		0

Geographic: SOUTH (STATES)

Year	Delaware				Florida				Georgia			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	895	15.6		0	11843	241.4		0	4962	103.6		0
1980	874	14.7		0	12720	263.9		0	4861	105.2		0
1981	724	13.4		0	12943	283.1		0	4521	104.2		0
1982	813	15.4		0	11468	256.6		0	4385	103.0		0
1983	818	16.1		0	11934	268.8		0	4893	108.8		0
1984	863	16.9		0	14442	318.3		0	6387	131.5		0
1985	934	17.6		0	15815	334.3		0	7386	143.8		0
1986	930	18.9		0	16145	339.5		0	8220	151.9		0
1987	895	20.2		0	15946	341.5		0	8041	152.2		0
1988	982	21.7		0	17005	346.3		0	7991	149.8		0
1989	907	20.8		0	16840	340.2		0	7462	146.3		0
1990	915	20.3		0	16327	323.2		0	7349	146.5		0
1991	942	18.1		0	14391	276.9		0	6314	125.0		0
1992	967	17.6		0	14502	366.5		0	6379	120.4		0
1993	890	17.9		0	15695	385.3		0	6851	127.7		0
1994	804	17.4		0	16112	296.0		0	7456	139.6		0
1995	750	19.3		0	16601	308.3		0	7962	151.3		0
1996	839	21.3		0	17724	325.4		0	8700	164.0		0
1997	857	21.9		0	18015	334.3		0	8872	168.0		0
1998	855	22.5		0	18782	348.8		0	9458	181.5	47.4	447361200

Geographic: SOUTH (STATES)

Year	Kentucky				Louisiana				Maryland				Mississippi			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3916	69.2		0	7344	131.8		0	5220	107.4		0	2275	46.7		0
1980	3256	58.0		0	7588	138.6		0	4958	102.9		0	1977	43.5		0
1981	2795	52.9		0	7439	138.2		0	4536	99.7		0	1894	42.3		0
1982	2538	50.3		0	6272	123.0		0	3947	89.3		0	1651	39.6		0
1983	2375	46.6		0	5927	115.2		0	4546	101.4		0	1497	36.2		0
1984	2628	50.5		0	5997	118.3		0	5651	116.0		0	1524	37.1		0
1985	2701	54.0		0	5450	105.2		0	6772	128.8		0	1571	36.7		0
1986	2777	56.3		0	4418	90.5		0	7554	139.5		0	1535	35.2		0
1987	2958	61.6		0	3742	81.3		0	8507	152.3		0	1469	33.9		0
1988	3040	63.0		0	3911	82.3		0	9249	161.1		0	1526	35.9		0
1989	3151	65.9		0	3843	83.1		0	9300	162.5		0	1550	37.2		0
1990	3097	66.7		0	4174	92.0		0	8885	155.5		0	1608	34.8		0
1991	3025	64.0		0	4402	96.7		0	7527	129.5		0	1536	35.4		0
1992	3402	68.0		0	4670	98.0		0	6971	120.2		0	1662	39.6		0
1993	3611	70.6		0	4659	97.8		0	6843	121.1		0	1932	43.5		0
1994	3755	73.7		0	4884	104.3		0	7267	125.5		0	2105	45.4		0
1995	3631	73.7		0	4894	106.2		0	7197	127.4		0	2074	48.6		0
1996	3808	77.2		0	5323	113.2		0	7469	131.2		0	2256	50.9		0
1997	4032	81.8		0	5510	117.6		0	7848	138.3		0	2339	54.4		0
1998	4094	83.6		0	5981	126.6		0	8053	141.3		0	2526	55.7		0

Geographic: SOUTH (STATES)

Year	North Carolina				Oklahoma			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	4968	126.1		0	3675	59.1	37.8	116166960
1980	4498	118.7		0	3489	57.1	37.6	111641920
1981	4079	115.6		0	3166	54.7	37.1	105527240
1982	3550	106.8		0	3063	55.7	36.4	105428960
1983	3959	112.4		0	2799	52.4	36.9	100545120
1984	5117	132.6		0	2967	52.3	37.8	102800880
1985	6119	149.2		0	2656	45.1	36.3	85130760
1986	6528	155.2		0	2151	38.0	36.3	71728800
1987	6682	159.9		0	1760	34.6	38.5	69269200
1988	7116	165.1		0	1794	35.1	39.2	71547840
1989	7070	162.6		0	1837	36.1	38.7	72647640
1990	6963	163.7	40.4	343900960	1932	39.7	41.1	84846840
1991	6410	146.8	39.8	303817280	1844	38.7	39.7	79892280
1992	6817	145.2	39.9	301260960	2004	39.7	39.0	80511600
1993	7400	154.1	40.9	327739880	2086	42.8	39.1	87020960
1994	7860	165.3	41.6	357576960	2306	46.6	39.9	96685680
1995	8239	174.6	41.0	372247200	2272	48.3	40.0	100464000
1996	8792	188.7	40.5	397402200	2455	50.3	40.1	104885560
1997	9470	203.8	41.2	436621120	2450	51.2	38.7	103034880
1998	9879	214.7	42.0	468904800	2558	54.8	39.7	113129120

Geographic: SOUTH (STATES)

Year	South Carolina				Tennessee				Texas			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	2122	73.1		0	4321	89.2		0	25630	416.2		0
1980	2017	73.4		0	3813	81.2		0	24234	423.0		0
1981	1794	70.5		0	3393	76.2		0	23096	429.1		0
1982	1521	64.6		0	3131	72.2		0	21528	431.1		0
1983	1880	70.3		0	3196	69.6		0	21548	424.0		0
1984	2502	80.8		0	3791	78.3		0	23310	446.3		0
1985	2928	83.8		0	4198	85.6		0	23727	443.8		0
1986	3399	87.8		0	4453	90.0		0	20797	404.2		0
1987	3702	86.7		0	4560	95.2		0	17110	345.3		0
1988	4027	90.7		0	4668	96.7		0	16778	328.8		0
1989	4003	92.8		0	4619	97.2		0	16740	323.6		0
1990	4594	101.7		0	4337	92.4		0	17513	335.9		0
1991	3905	88.2		0	4114	86.5		0	18275	342.4		0
1992	3593	79.9		0	4492	88.3		0	20142	343.8		0
1993	3752	82.1		0	4878	94.3		0	20851	355.3		0
1994	3840	84.3		0	5244	101.0		0	22482	381.1		0
1995	4003	87.1		0	5571	108.9		0	23458	409.0		0
1996	4403	94.3		0	5809	113.1		0	25649	435.4		0
1997	4539	99.8		0	6100	118.1		0	26541	460.3		0
1998	4723	106.8		0	6170	120.9		0	28294	496.3		0

Geographic: SOUTH (STATES)

Year	Virginia				West Virginia			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	6385	138.4		0	2235	39.0	37.0	75036000
1980	5613	128.3		0	1928	35.8	38.2	71113120
1981	4773	116.3		0	1446	30.3	37.2	58612320
1982	4143	103.8		0	1151	24.4	36.7	46564960
1983	4740	113.9		0	1061	21.6	35.7	40098240
1984	5898	132.8		0	1139	22.0	36.5	41756000
1985	7097	152.0		0	1220	22.8	36.7	43511520
1986	8138	169.5		0	1199	22.8	36.8	43630080
1987	8872	182.9		0	1250	24.0	37.5	46800000
1988	9689	191.0		0	1296	24.3	38.1	48143160
1989	9855	195.5		0	1267	24.6	37.7	48225840
1990	8889	181.9		0	1451	27.2	37.9	53605760
1991	7586	153.0		0	1452	26.8	38.2	53235520
1992	7456	146.1		0	1508	27.7	37.3	53726920
1993	8000	153.8		0	1664	31.3	38.6	62825360
1994	8401	162.7		0	1829	34.1	38.9	68977480
1995	8470	168.1		0	1659	32.9	37.9	64839320
1996	8796	175.9		0	1722	34.4	39.1	69942080
1997	9332	186.1		0	1707	34.9	39.2	71140160
1998	9358	189.0		0	1653	34.2	36.9	65622960

Geographic: SOUTH (REGION)

Year	South		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	5909923729	191206875.8	**30.909**
1980	5416340630	182758295.9	**29.637**
1981	4611629626	164142354.8	**28.095**
1982	4213660840	151996458.1	**27.722**
1983	3860144906	140645735	**27.446**
1984	4106471694	144559508	**28.407**
1985	3875202431	128644981.5	**30.123**
1986	3350000000	115361657	**29.039**
1987	3010000000	116072158	**25.932**
1988	3090000000	119694040	**25.816**
1989	3104000000	120876631	**25.679**
1990	10346000000	482356657	**21.449**
1991	9706000000	436948105	**22.213**
1992	10329000000	435502882	**23.717**
1993	11150000000	477589811	**23.346**
1994	11995000000	523243875	**22.924**
1995	12170000000	537554151	**22.640**
1996	12969000000	572233648	**22.664**
1997	13627000000	610800192	**22.310**
1998	23548000000	1095022174	**21.505**

Geographic: WEST (STATES)

Year	Alaska				Arizona			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1474	10.1	41.3	21690760	5482	86.5	36.9	165976200
1980	1575	10.3	43.9	23512840	4830	76.5	35.6	141616800
1981	1863	12.9	46.3	31058040	4282	72.0	36.0	134784000
1982	2237	16.8	43.8	38263680	3553	64.8	35.0	117936000
1983	2590	20.8	43.2	46725120	4146	78.6	37.0	151226400
1984	2430	20.4	42.0	44553600	5099	97.0	36.4	183601600
1985	2035	18.6	42.4	41009280	5912	112	36.2	211017040
1986	1412	13.4	43.6	30380480	5880	113.1	36.1	212311320
1987	957	10.1	39.6	20797920	5088	103.2	36.3	194800320
1988	840	9.0	41.4	19375200	4765	93.7	36.4	177355360
1989	882	9.8	45.4	23135840	4398	85.8	36.6	163294560
1990	895	10.5	46.6	25443600	4194	82.5	37.4	160446000
1991	887	10.4	44.6	24119680	4098	77.1	37.0	148340400
1992	902	10.2	43.3	22966320	4328	79.6	37.9	156875680
1993	1009	11.5	43.5	26013000	4726	89.1	37.6	174208320
1994	1084	12.3	44.6	28526160	5755	107.0	38.5	214214000
1995	1078	12.8	45.7	30417920	6369	119.7	37.8	235282320
1996	1038	12.6	44.0	28828800	6745	126.2	38.2	250683680
1997	1011	12.8	42.8	28487680	6982	131.8	38.0	260436800
1998	983	13.4	43.2	30101760	7484	143.8	37.6	281157760

Geographic: WEST (STATES)

Year	California				Colorado			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	33318	448.7		0	5115	80.0	37.1	154336000
1980	31038	428.3		0	4844	77.0	37.2	148948800
1981	28816	407.6		0	4674	77.5	36.6	147498000
1982	24399	349.0		0	4761	82.9	37.1	159930680
1983	25664	366.9		0	4809	83.0	38.7	167029200
1984	31510	407.4		0	5036	89.9	39.2	183252160
1985	35409	435.8		0	4897	86.3	37.7	169182520
1986	37646	450.0	35.6	833040000	4324	77.6	36.6	147688320
1987	39386	487.2	34.5	874036800	3778	67.3	37.2	130185120
1988	41931	529.2	35.6	979655040	3597	60.4	37.7	118408160
1989	43375	560.0	36.0	1048320000	3483	60.0	38.0	118560000
1990	41867	561.8	36.1	1054610960	3568	63.6	38.6	127657920
1991	36099	514.0	35.9	959535200	3909	66.5	39.2	135553600
1992	32910	471.7	34.9	856041160	4585	74.8	39.7	154417120
1993	30587	445.7	35.4	820444560	5245	86.0	39.2	175302400
1994	32130	464.3	36.4	878827040	5862	97.1	39.7	200453240
1995	32186	485.4	36.3	916241040	5851	102.1	39.3	208651560
1996	32927	505.9	36.8	968090240	6440	111.0	39.4	227416800
1997	35272	550.0	37.4	1069640000	6784	119.0	38.8	240094400
1998	38027	611.2	37.4	1188661760	7534	132.6	39.5	272360400

Geographic: WEST (STATES)

Year	Hawaii				Idaho			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1662	23.4	36.0	43804800	1195	19.1	35.7	35457240
1980	1613	23.9	36.2	44989360	979	17.4	36.8	33296640
1981	1425	21.9	36.2	41224560	863	16.7	35.7	31001880
1982	1134	17.9	35.8	33322640	693	13.8	35.4	25403040
1983	1221	17.8	37.2	34432320	713	13.2	35.9	24641760
1984	1153	15.8	36.9	30317040	828	14.6	35.6	27027520
1985	1260	17.2	36.6	32735040	857	15.1	36.6	28738320
1986	1368	18.6	36.9	35689680	815	14.6	36.6	27786720
1987	1491	21.2	38.4	42332160	765	13.6	36.8	26024960
1988	1721	23.4	37.8	45995040	821	14.2	37.2	27468480
1989	2131	29.2	38.6	58610240	897	16.1	38.4	32148480
1990	2451	21.0	38.6	42151200	1053	18.8	39.1	38224160
1991	2603	20.4	38.0	40310400	1136	20.2	37.7	39600080
1992	2549	19.7	36.4	37288160	1346	22.2	38.3	44213520
1993	2584	19.1	37.9	37642280	1459	24.7	40.0	51376000
1994	2256	17.7	37.3	34330920	1653	28.7	38.9	58054360
1995	1987	17.0	36.7	32442800	1647	29.6	40.1	61721920
1996	1764	16.6	36.4	31420480	1661	30.6	39.4	62693280
1997	1604	16.5	35.8	30716400	1686	31.9	38.2	63366160
1998	1515	16.4	35.6	30359680	1666	32.3	35.3	59289880

Geographic: WEST (STATES)

Year	Montana				Nevada			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1214	15.6	35.2	28554240	1900	27.3	36.0	51105600
1980	1130	14.5	38.8	29255200	1796	26.2	35.1	47820240
1981	999	13.3	37.2	25727520	1686	25.4	35.8	47284640
1982	950	13.4	33.3	23203440	1239	20.0	34.9	36296000
1983	915	13.3	36.0	24897600	1219	19.4	35.4	35711520
1984	863	12.6	35.9	23521680	1339	21.8	35.9	40696240
1985	807	11.5	34.8	20810400	1460	23.9	36.0	44740800
1986	688	10.2	36.0	19094400	1583	27.7	37.2	53582880
1987	564	8.8	37.1	16976960	1625	30.1	36.0	56347200
1988	545	9.0	37.4	17503200	2051	36.3	36.9	69652440
1989	549	9.8	37.5	19110000	2525	45.1	38.5	90290200
1990	566	10.4	38.2	20658560	2715	46.8	38.0	92476800
1991	635	11.5	37.5	22425000	2414	39.8	37.4	77403040
1992	715	12.7	37.2	24566880	2504	39.2	37.3	76032320
1993	770	13.5	37.1	26044200	3022	46.9	38.0	92674400
1994	856	14.9	38.4	29752320	3471	55.7	38.0	110063200
1995	841	16.1	38.4	32148480	3719	61.6	38.2	122362240
1996	888	17.1	37.5	33345000	4697	75.0	38.6	150540000
1997	920	17.7	37.9	34883160	4966	81.6	39.7	168455040
1998	941	18.8	38.2	37344320	5189	86.0	40.2	179774400

Geographic: WEST (STATES)

Year	New Mexico				Oregon			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1762	35.6	34.8	64421760	3571	53.0	35.2	97011200
1980	1565	32.1	35.8	59757360	3050	46.5	34.5	83421000
1981	1504	33.3	36.7	63549720	2250	37.5	34.0	66300000
1982	1393	32.1	36.5	60925800	1622	28.9	33.2	49892960
1983	1424	33.7	35.8	62735920	1538	27.0	33.2	46612800
1984	1594	36.6	36.7	69847440	1776	30.2	34.5	54178800
1985	1638	37.5	35.8	69810000	1955	33.1	35.5	61102600
1986	1525	35.1	36.6	66802320	2009	34.3	35.2	62782720
1987	1359	32.1	38.3	63930360	2007	35.3	35.1	64429560
1988	1310	31.0	38.5	62062000	2315	39.9	36.2	75107760
1989	1287	30.3	38.9	61290840	2633	46.1	37.4	89655280
1990	1247	29.5	39.8	61053200	3111	52.4	37.3	101635040
1991	1261	28.4	39.0	57595200	3181	51.4	36.9	98626320
1992	1468	31.0	39.0	62868000	3216	50.4	36.6	95921280
1993	1716	35.7	40.4	74998560	3440	54.0	36.8	103334400
1994	2020	41.6	40.7	88042240	3858	61.3	37.4	119216240
1995	2096	44.1	40.2	92186640	4183	68.7	37.6	134322240
1996	1999	43.1	40.4	90544480	4927	77.6	39.0	157372800
1997	1988	42.7	40.3	89482120	5162	81.5	39.5	167401000
1998	1981	43.2	39.2	88058880	4987	81.6	37.9	160817280

Geographic: WEST (STATES)

Year	Utah				Washington				Wyoming			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	2041	35.6		0	7847	104.4		0	1498	20.8		0
1980	1763	31.5		0	6747	92.6		0	1462	20.7		0
1981	1535	28.3		0	6227	90.3		0	1442	21.0		0
1982	1382	26.9		0	4973	76.2	35.9	142250160	1225	20.0		0
1983	1488	28.7		0	4676	74.2	36.1	139288240	798	14.4		0
1984	1845	34.8		0	4923	79.6	35.9	148597280	807	14.1		0
1985	1885	35.5		0	4855	80.6	36.5	152978800	999	18.2		0
1986	1681	32.2		0	4943	84.5	36.4	159941600	839	16.2		0
1987	1400	26.7		0	4891	88.9	36.8	170119040	541	10.8		0
1988	1347	24.9		0	5452	96.6	36.8	184853760	498	10.4		0
1989	1378	25.9		0	5959	106.9	37.6	209010880	493	10.2		0
1990	1482	28.0		0	6780	117.4	37.4	228319520	509	10.7		0
1991	1651	31.7		0	7089	118.2	37.9	232948560	558	11.9		0
1992	1808	34.9		0	7573	119.2	37.5	232440000	555	11.5		0
1993	1991	39.8		0	7509	119.1	37.5	232245000	574	12.3		0
1994	2415	48.1		0	7801	123.0	37.5	239850000	652	13.6		0
1995	2662	54.8		0	7492	122.0	37.2	235996800	628	14.2		0
1996	2911	60.4		0	8011	127.9	37.9	252065320	653	14.2		0
1997	3071	64.4		0	8552	136.3	38.4	272163840	670	15.1		0
1998	3157	68.2		0	8683	143.9	37.5	280605000	699	16.0		0

Geographic: WEST (REGION)

Year	West		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	23375516639	662357800	**35.291**
1980	21380995095	612618240	**34.901**
1981	19544852954	588428360	**33.215**
1982	22555660130	687424400	**32.812**
1983	23249556564	733300880	**31.705**
1984	25041108762	805593360	**31.084**
1985	25676082377	832124800	**30.856**
1986	62193000000	1649100440	**37.713**
1987	61911000000	1659980400	**37.296**
1988	65348000000	1777436440	**36.765**
1989	68119000000	1913426320	**35.601**
1990	68447000000	1952676960	**35.053**
1991	63312000000	1836457480	**34.475**
1992	62096000000	1763630440	**35.209**
1993	62067000000	1814283120	**34.210**
1994	66746000000	2001329720	**33.351**
1995	67449000000	2101773960	**32.091**
1996	71097000000	2253000880	**31.557**
1997	74927000000	2425126600	**30.896**
1998	78990000000	2608531120	**30.281**

Geographic: MIDWEST (STATES)

Year	Illinois				Indiana			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	14010	188.0	36.2	353891200	6027	106.0		0
1980	12422	188.4	36.6	358562880	5124	92.3		0
1981	10595	167.5	36.5	317915000	4452	86.2		0
1982	9563	156.4	36.7	298473760	3862	77.1		0
1983	9649	144.2	37.5	281190000	3868	74.8		0
1984	11302	154.7	37.7	303273880	4217	79.4		0
1985	12281	171.6	37.9	338189280	4695	87.0		0
1986	12638	181.3	37.9	357306040	4889	92.9		0
1987	13168	196.2	38.0	387691200	5054	99.0		0
1988	14076	204.7	37.9	403422760	5566	107.3		0
1989	14761	213.0	38.2	423103200	5845	112.6		0
1990	15070	219.9	37.9	433378920	5931	115.7		0
1991	14393	204.9	38.1	405947880	6090	114.0		0
1992	14413	196.9	36.7	375763960	6266	113.6		0
1993	14540	200.4	37.0	385569600	6547	118.1		0
1994	15341	211.0	38.3	420227600	7162	126.4		0
1995	15262	216.7	38.6	434960240	7188	129.7		0
1996	15776	224.0	39.0	454272000	7433	134.2		0
1997	16203	230.8	38.6	463261760	7753	140.7		0
1998	16619	239.9	39.0	486517200	8000	145.7		0

Geographic: MIDWEST (STATES)

Year	Iowa				Kansas				Michigan			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3383	59.9	39.5	123034600	2919	49.9		0	9513	139.5	37.9	274926600
1980	2830	50.9	38.5	101901800	2651	46.5		0	7571	116.8	36.2	219864320
1981	2348	44.4	38.4	88657920	2281	42.7		0	6583	106.8	36.5	202706400
1982	1851	38.1	38.0	75285600	2006	39.0		0	5289	89.5	36.0	167544000
1983	1748	35.9	39.3	73365240	2077	39.7		0	5245	86.5	36.4	163727200
1984	1972	38.7	39.7	79892280	2362	43.6		0	5807	92.7	37.5	180765000
1985	1945	36.6	40.1	76318320	2363	42.3		0	6911	107.8	38.4	215255040
1986	1850	35.2	39.1	71568640	2399	43.9		0	7537	115.2		0
1987	1772	35.6	40.0	74048000	2353	45.4		0	7731	123.3	38.5	246846600
1988	1948	38.0	40.8	80620800	2240	41.6		0	8726	132.2	39.7	272913680
1989	2058	40.7	40.4	85502560	2150	40.1		0	8935	139.9	38.6	280807280
1990	2306	44.7	39.8	92511120	2082	41.6		0	8921	142.3	38.0	281184800
1991	2399	45.3	40.0	94224000	2061	41.8		0	8182	129.1	37.9	254430280
1992	2606	47.2	39.4	96703360	2331	45.0		0	8152	128.3	37.3	248850680
1993	2678	48.5	40.0	100880000	2452	45.8		0	8423	132.7	38.9	268425560
1994	2950	52.9	40.9	112507720	2648	49.2		0	9191	142.6	39.6	293641920
1995	2989	55.0	40.6	116116000	2629	51.6		0	9675	152.7	39.5	313645800
1996	3203	58.2	41.0	124082400	2863	56.7		0	10639	168.0	40.6	354681600
1997	3231	59.9	40.8	127083840	2958	58.8		0	11251	179.8	40.6	379593760
1998	3359	63.0	40.2	131695200	3027	61.5		0	11716	186.0	40.0	386880000

Geographic: MIDWEST (STATES)

Year	Minnesota				Missouri			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	5128	83.2		0	5443	92.4		0
1980	4554	76.5		0	4649	82.1		0
1981	3725	67.7		0	4151	79.0		0
1982	3154	59.9		0	3671	73.3		0
1983	3367	60.4		0	3937	74.7		0
1984	4104	67.6		0	4755	85.7		0
1985	4506	71.3		0	5194	92.9		0
1986	4800	75.0	38.0	148200000	5518	98.1		0
1987	5124	80.1	39.3	163692360	5488	98.7		0
1988	5069	77.8		0	5514	97.4		0
1989	5232	79.1	38.9	160003480	5375	97.2		0
1990	5267	79.4	39.5	163087600	5065	97.7	36.0	182894400
1991	5025	76.1		0	4832	88.9	36.0	166420800
1992	5519	77.3		0	5235	90.9	35.5	167801400
1993	5577	78.3		0	5576	96.8	36.0	181209600
1994	5846	81.1		0	6582	111.1	38.1	220111320
1995	5803	83.9	39.9	174075720	6632	111.8	38.9	226149040
1996	6246	88.9	40.5	187223400	6835	115.2	38.4	230031360
1997	6539	93.7	39.6	192947040	7090	121.0	37.4	235320800
1998	6950	101.8	39.5	209097200	7190	126.2	37.2	244121280

Geographic: MIDWEST (STATES)

Year	Nebraska				North Dakota				Ohio			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1566	32.5		0	1182	18.7		0	11027	182.9	37.6	357606080
1980	1405	29.1		0	1023	16.5		0	10004	167.4	37.6	327300480
1981	1207	26.1		0	901	15.0		0	8286	153.7	37.4	298915760
1982	1062	23.5		0	909	15.7		0	6968	134.6	37.2	260370240
1983	1048	23.5		0	1019	17.3		0	7054	130.8	37.1	252339360
1984	1223	25.8		0	787	13.7		0	8251	144.8	38.4	289136640
1985	1277	26.1		0	646	11.7		0	8845	154.0	38.4	307507200
1986	1201	24.6		0	569	10.8		0	9016	160.7	38.7	323392680
1987	1143	24.5		0	525	10.8		0	9692	176.4	38.6	354070080
1988	1219	24.5		0	492	9.9		0	10420	185.6	39.1	377361920
1989	1243	25.3		0	478	9.8		0	10648	193.6	39.1	393627520
1990	1308	27.1		0	494	10.1		0	10831	195.3	39.4	400130640
1991	1386	27.2		0	509	10.3		0	10116	178.8	39.0	362606400
1992	1533	28.3		0	568	11.0		0	10232	176.9	39.0	358753200
1993	1674	30.4		0	618	11.8		0	10903	183.3	39.6	377451360
1994	1951	33.2		0	666	12.8		0	11631	200.9	39.4	411603920
1995	1935	34.7		0	685	13.6		0	11496	205.0	39.8	424268000
1996	2172	36.6		0	772	14.9		0	12046	213.9	40.1	446024280
1997	2137	38.2		0	771	15.0		0	12452	223.1	39.8	461727760
1998	2260	41.0		0	794	15.6		0	12671	230.4	39.7	475637760

Geographic: MIDWEST (STATES)

Year	South Dakota				Wisconsin			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	761	12.9	40.6	27234480	4906	80.5		0
1980	611	10.7		0	4012	70.1		0
1981	509	9.7		0	3348	64.8		0
1982	384	8.2		0	2708	56.9		0
1983	404	8.4		0	2864	57.7		0
1984	471	9.3		0	3397	63.2		0
1985	487	9.5		0	3632	64.6		0
1986	503	9.6	39.4	19668480	3903	68.0		0
1987	490	9.6	38.9	19418880	4054	72.2		0
1988	498	9.5	40.4	19957600	4411	76.4		0
1989	511	10.3	40.3	21584680	4602	80.7		0
1990	566	11.7	40.5	24640200	4934	86.6		0
1991	576	11.8	40.1	24605360	5007	86.6		0
1992	634	12.5	40.9	26585000	5434	90.7		0
1993	664	13.2	40.3	27661920	5632	93.3		0
1994	732	14.0	41.0	29848000	5855	98.2		0
1995	690	14.1	40.9	29987880	5701	99.0		0
1996	736	14.7	41.1	31416840	6044	104.4		0
1997	764	15.2	41.1	32485440	6284	108.3		0
1998	786	16.1	40.3	33739160	6453	113.0		0

Geographic: MIDWEST (REGION)

Year	Midwest		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	38693595807	1136692960	**34.040**
1980	32828215356	1007629480	**32.580**
1981	27812440915	908195080	**30.624**
1982	23671177079	801673600	**29.527**
1983	23695998557	770621800	**30.749**
1984	27331454076	853067800	**32.039**
1985	29981225905	937269840	**31.988**
1986	28807000000	920135840	**31.307**
1987	37977000000	1245767120	**30.485**
1988	35668000000	1154276760	**30.901**
1989	42145000000	1364628720	**30.884**
1990	48026000000	1577827680	**30.438**
1991	40498000000	1308234720	**30.956**
1992	41272000000	1274457600	**32.384**
1993	42784000000	1341198040	**31.900**
1994	46427000000	1487940480	**31.202**
1995	52547000000	1719202680	**30.565**
1996	55481000000	1827731880	**30.355**
1997	57530000000	1892420400	**30.400**
1998	59291000000	1967687800	**30.132**

Geographic: CUMULATIVE NON-ADJUSTED DATA (FOR ALL REGIONS)

Year	Total regions (Nonadjusted)		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	81285951681	2387219916	**34.050**
1980	72563314694	2196992336	**33.028**
1981	64580003094	2058767555	**31.368**
1982	65776927468	2147807938	**30.625**
1983	68144785497	2187134335	**31.157**
1984	77067183463	2415302268	**31.908**
1985	83420038121	2575244981	**32.393**
1986	120370000000	3421378657	**35.182**
1987	130820000000	3807498078	**34.359**
1988	133920000000	3861381080	**34.682**
1989	143594000000	4240510071	**33.862**
1990	153604000000	4751007537	**32.331**
1991	138099000000	4244384465	**32.537**
1992	136854000000	4066831882	**33.651**
1993	138843000000	4233392251	**32.797**
1994	148755000000	4640240395	**32.058**
1995	156043000000	5024107391	**31.059**
1996	163795000000	5332805048	**30.715**
1997	171153000000	5641956712	**30.336**
1998	188218000000	6441902414	**29.218**

APDX A-6: Construction Industry Adjusted Data (by Author) by Regions (States).

GDP = Gross Domestic Output (in Millions of 1996-Chained dollars).

Employment = Number of All Employment (in Thousands).

Hr.wk = Number of Average Weekly Hour-Worked.

Sources: the Bureau of Labor Statistics (BLS), the Bureau of Economic Analysis (BEA)

There are 2 methods for adjusting data:

1. Average Adjusted Data for Specific States: this method is used for the states that have enough data but not all data.
2. Average Adjusted Data by Total States: this method is used for the states that have no data for using the first method: therefore they are adjusted by using the average value from all states, which is 38.3 for Hr.Wk.

Geographic: NORTHEAST (STATES)

Year	Connecticut				Maine			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3019	59.4	39.7	122692017	942	19.4	38.3	38637040
1980	2802	59.4	39.7	122692017	954	19.5	38.3	38836200
1981	2678	59.4	39.7	122692017	794	17.5	38.3	34853000
1982	2591	49.3	37.3	95622280	721	16.7	38.3	33259720
1983	3191	54.0	38.5	108108000	761	16.9	38.3	33658040
1984	3939	60.7	39.2	123730880	1000	20.4	38.3	40628640
1985	4514	65.4	39.3	133651440	1177	23.4	38.3	46603440
1986	5023	71.1	39.4	145669680	1375	26.9	38.3	53574040
1987	5911	77.7	40.0	161616000	1650	31.5	38.3	62735400
1988	6481	81.0	40.5	170586000	1778	33.3	38.3	66320280
1989	6023	75.1	40.3	157379560	1777	32.7	38.3	65125320
1990	4745	61.9	39.2	126176960	1554	28.5	38.3	56760600
1991	4023	51.4	38.1	101833680	1230	22.0	38.3	43815200
1992	3980	47.4	38.9	95880720	1257	21.1	38.3	42022760
1993	4052	47.6	40.2	99503040	1249	20.9	38.3	41624440
1994	4094	49.3	40.2	103056720	1241	21.0	38.3	41823600
1995	4247	50.4	40.4	105880320	1222	21.7	38.3	43217720
1996	4237	52.4	41.2	112261760	1342	23.2	38.3	46205120
1997	4497	56.3	41.2	120617120	1345	23.3	38.3	46404280
1998	4554	58.9	41.3	126493640	1407	25.1	38.3	49989160

Geographic: NORTHEAST (STATES)

Year	Massachusetts				New Hampshire			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	4453	75.6	38.3	150564960	1057	20.9	40.2	43675775
1980	4319	77.4	38.3	154149840	943	19.4	40.2	40541150
1981	4275	79.6	38.3	158531360	928	20.3	40.2	42421925
1982	4292	78.4	38.3	156141440	1029	22.8	40.2	47646300
1983	4762	82.6	38.3	164506160	1207	24.4	40.2	50989900
1984	5890	96.4	38.3	191990240	1285	25.2	40.2	52661700
1985	6912	109.4	38.3	217881040	1661	30.9	40.2	64573275
1986	7841	123.2	38.3	245365120	1945	35.2	40.2	73559200
1987	8849	137.7	38.3	274243320	2094	36.8	40.2	76902800
1988	9386	142.1	38.3	283006360	2097	35.9	40.2	75022025
1989	8497	126.8	38.3	252534880	1787	30.1	40.2	62901475
1990	6832	101.1	38.3	201350760	1300	22.5	40.2	47019375
1991	5655	78.8	38.3	156938080	1052	17.3	39.3	35354280
1992	5696	73.6	38.3	146581760	1056	16.3	39.0	33056400
1993	6024	80.1	38.3	159527160	1124	16.8	39.9	34856640
1994	6529	86.0	38.3	171277600	1169	17.8	41.0	37949600
1995	6588	89.8	38.3	178845680	1204	19.4	41.7	42066960
1996	6994	94.0	38.3	187210400	1325	20.2	40.3	42331120
1997	7362	100.3	38.3	199757480	1388	20.9	39.8	43254640
1998	7848	108.4	38.3	215889440	1499	23.0	40.5	48438000

Geographic: NORTHEAST (STATES)

Year	New Jersey				New York			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	7248	113.7	38.3	226444920	13307	210.3	36.3	396962280
1980	6798	111	38.3	221665080	12938	209	36.2	393986320
1981	6489	109	38.3	216486920	12611	213	35.9	398001760
1982	6303	107	38.3	213698680	12746	220	36.0	411091200
1983	6913	112.1	38.3	223258360	14148	230.8	36.2	434457920
1984	8734	131.1	38.3	261098760	16649	255.2	36.8	488350720
1985	10101	141.0	38.3	280815600	19373	285.6	36.6	543553920
1986	10907	153.1	38.3	304913960	20997	308.9	36.8	591111040
1987	12014	163.4	38.3	325427440	22011	328.8	36.5	624062400
1988	13165	168.2	38.3	334987120	23333	337.8	36.4	639387840
1989	12911	164.3	38.3	327219880	23370	336.6	37.0	647618400
1990	11427	146.4	38.3	291570240	22040	319.8	36.8	611969280
1991	9725	121.4	38.3	241780240	19508	276.9	36.5	525556200
1992	9587	110.2	38.3	219474320	18121	245.3	36.4	464303840
1993	9846	115.3	38.3	229631480	17666	243.5	36.8	465961600
1994	10120	122.2	38.3	243373520	18324	249.6	37.5	486720000
1995	9898	123.0	38.3	244966800	17805	251.3	37.6	491341760
1996	10069	124.2	38.3	247356720	18046	254.4	37.7	498725760
1997	10497	130.7	38.3	260302120	18530	264.9	38.0	523442400
1998	10560	134.9	38.3	268666840	19647	283.5	38.4	566092800

Geographic: NORTHEAST (STATES)

Year	Pennsylvania				Rhode Island				Vermont			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	12016	204.2	38.3	406684720	724	13.9	38.3	27683240	494	10.3	40.3	21606104
1980	10890	190	38.3	378603160	636	12.7	38.3	25293320	468	10.1	40.3	21186568
1981	9768	181	38.3	359882120	565	11.7	38.3	23301720	450	11.0	40.3	23074480
1982	8861	168	38.3	334787960	529	10.9	38.3	21708440	398	9.9	40.3	20767032
1983	9207	165.7	38.3	330008120	583	11.6	38.3	23102560	466	10.9	40.3	22864712
1984	10220	175.8	38.3	350123280	706	13.3	38.3	26488280	545	12.2	40.3	25591696
1985	11156	187.1	38.3	372628360	824	15.2	38.3	30272320	645	13.8	40.3	28947984
1986	12057	201.8	38.3	401904880	934	17.4	38.3	34653840	701	15.3	40.3	32094504
1987	12791	218.3	38.3	434766280	1046	19.6	38.3	39035360	752	16.5	40.3	34611720
1988	13835	229.6	38.3	457271360	1220	21.2	38.3	42221920	813	17.5	40.3	36709400
1989	14021	233.0	38.3	464042800	1233	20.3	38.3	40429480	833	17.9	39.3	36580440
1990	13698	226.8	38.3	451694880	1166	18.5	38.3	36844600	717	14.5	40.3	30416360
1991	12524	204.8	38.3	407879680	892	13.4	38.3	26687440	596	11.9	40.3	24962392
1992	12723	197.5	38.3	393341000	881	12.2	38.3	24297520	606	11.2	40.3	23494016
1993	12642	197.4	38.3	393141840	854	12.6	38.3	25094160	618	11.6	40.3	24333088
1994	13066	202.0	38.3	402303200	927	13.1	38.3	26089960	620	11.8	40.3	24752624
1995	12387	199.6	38.3	397523360	907	13.4	38.3	26687440	621	12.3	41.1	26287560
1996	12663	202.8	38.3	403896480	940	13.9	38.3	27683240	640	12.5	40.8	26520000
1997	13181	213.0	38.3	424210800	984	14.6	38.3	29077360	654	12.9	39.2	26295360
1998	13422	221.3	38.3	440741080	1046	15.9	38.3	31666440	689	13.8	41.3	29636880

Geographic: NORTHEAST (REGION)

Year	Northeast		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	43259192978	1434951056	**30.147**
1980	40746607630	1396953655	**29.168**
1981	38558586432	1379245302	**27.956**
1982	37469334856	1334723052	**28.073**
1983	41238012206	1390953772	**29.647**
1984	48967876439	1560664196	**31.376**
1985	56362411683	1718927379	**32.789**
1986	61780000000	1882846264	**32.812**
1987	67118000000	2033400720	**33.008**
1988	72108000000	2105512305	**34.247**
1989	70452000000	2053832235	**34.303**
1990	63479000000	1853803055	**34.243**
1991	55205000000	1564807192	**35.279**
1992	53907000000	1442452336	**37.372**
1993	54075000000	1473673448	**36.694**
1994	56090000000	1537346824	**36.485**
1995	54879000000	1556817600	**35.251**
1996	56256000000	1592190600	**35.332**
1997	58438000000	1673361560	**34.923**
1998	60672000000	1777614280	**34.131**

Geographic: SOUTH (STATES)

Year	Alabama				Arkansas			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3381	75.4	38.3	150166640	2260	41.9	38.3	83448040
1980	3056	71.4	38.3	142200240	2162	37.6	38.3	74884160
1981	2561	63.9	38.3	127263240	1726	34.3	38.3	68311880
1982	2189	56.8	38.3	113122880	1429	29.9	38.3	59548840
1983	2307	59.8	38.3	119097680	1411	30.0	38.3	59748000
1984	2562	64.8	38.3	129055680	1637	33.7	38.3	67116920
1985	2941	71.4	38.3	142200240	1744	35.3	38.3	70303480
1986	3051	74.9	38.3	149170840	1741	36.2	38.3	72095920
1987	3057	75.1	38.3	149569160	1555	34.1	38.3	67913560
1988	3302	78.0	38.3	155344800	1567	33.3	38.3	66320280
1989	3290	78.1	38.3	155543960	1542	33.3	38.3	66320280
1990	3571	83.2	38.3	165701120	1661	37.6	38.3	74884160
1991	3467	78.6	38.3	156539760	1671	35.8	38.3	71299280
1992	3545	75.8	38.3	150963280	1847	37.4	38.3	74485840
1993	3644	78.0	38.3	155344800	1963	38.5	38.3	76676600
1994	3855	82.2	38.3	163709520	2059	41.3	38.3	82253080
1995	3927	86.8	38.3	172870880	2142	44.3	38.3	88227880
1996	4270	93.4	38.3	186015440	2263	47.2	38.3	94003520
1997	4371	97.2	38.3	193583520	2271	47.6	38.3	94800160
1998	4409	100.2	38.3	199558320	2282	48.0	38.3	95596800

Geographic: SOUTH (STATES)

Year	District of Columbia				Delaware			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	803	14.3	38.3	28479880	895	15.6	38.3	31068960
1980	716	13.2	38.3	26289120	874	14.7	38.3	29276520
1981	634	11.7	38.3	23301720	724	13.4	38.3	26687440
1982	565	10.6	38.3	21110960	813	15.4	38.3	30670640
1983	534	10.1	38.3	20115160	818	16.1	38.3	32064760
1984	587	11.5	38.3	22903400	863	16.9	38.3	33658040
1985	645	13.6	38.3	27085760	934	17.6	38.3	35052160
1986	681	14.1	38.3	28081560	930	18.9	38.3	37641240
1987	691	14.7	38.3	29276520	895	20.2	38.3	40230320
1988	714	14.0	38.3	27882400	982	21.7	38.3	43217720
1989	727	14.4	38.3	28679040	907	20.8	38.3	41425280
1990	733	14.4	38.3	28679040	915	20.3	38.3	40429480
1991	601	11.1	38.3	22106760	942	18.1	38.3	36047960
1992	502	9.0	38.3	17924400	967	17.6	38.3	35052160
1993	465	8.6	38.3	17127760	890	17.9	38.3	35649640
1994	472	9.0	38.3	17924400	804	17.4	38.3	34653840
1995	456	8.7	38.3	17326920	750	19.3	38.3	38437880
1996	462	8.9	38.3	17725240	839	21.3	38.3	42421080
1997	492	9.1	38.3	18123560	857	21.9	38.3	43616040
1998	484	9.0	38.3	17924400	855	22.5	38.3	44811000

Geographic: SOUTH (STATES)

Year	Florida				Georgia			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	11843	241.4	38.3	480772240	4962	103.6	38.3	206329760
1980	12720	263.9	38.3	525583240	4861	105.2	38.3	209516320
1981	12943	283.1	38.3	563821960	4521	104.2	38.3	207524720
1982	11468	256.6	38.3	511044560	4385	103.0	38.3	205134800
1983	11934	268.8	38.3	535342080	4893	108.8	38.3	216686080
1984	14442	318.3	38.3	633926280	6387	131.5	38.3	261895400
1985	15815	334.3	38.3	665791880	7386	143.8	38.3	286392080
1986	16145	339.5	38.3	676148200	8220	151.9	38.3	302524040
1987	15946	341.5	38.3	680131400	8041	152.2	38.3	303121520
1988	17005	346.3	38.3	689691080	7991	149.8	38.3	298341680
1989	16840	340.2	38.3	677542320	7462	146.3	38.3	291371080
1990	16327	323.2	38.3	643685120	7349	146.5	38.3	291769400
1991	14391	276.9	38.3	551474040	6314	125.0	38.3	248950000
1992	14502	366.5	38.3	729921400	6379	120.4	38.3	239788640
1993	15695	385.3	38.3	767363480	6851	127.7	38.3	254327320
1994	16112	296.0	38.3	589513600	7456	139.6	38.3	278027360
1995	16601	308.3	38.3	614010280	7962	151.3	38.3	301329080
1996	17724	325.4	38.3	648066640	8700	164.0	38.3	326622400
1997	18015	334.3	38.3	665791880	8872	168.0	38.3	334588800
1998	18782	348.8	38.3	694670080	9458	181.5	47.4	447361200

Geographic: SOUTH (STATES)

Year	Kentucky				Louisiana			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3916	69.2	38.3	137818720	7344	131.8	38.3	262492880
1980	3256	58.0	38.3	115512800	7588	138.6	38.3	276035760
1981	2795	52.9	38.3	105355640	7439	138.2	38.3	275239120
1982	2538	50.3	38.3	100177480	6272	123.0	38.3	244966800
1983	2375	46.6	38.3	92808560	5927	115.2	38.3	229432320
1984	2628	50.5	38.3	100575800	5997	118.3	38.3	235606280
1985	2701	54.0	38.3	107546400	5450	105.2	38.3	209516320
1986	2777	56.3	38.3	112127080	4418	90.5	38.3	180239800
1987	2958	61.6	38.3	122682560	3742	81.3	38.3	161917080
1988	3040	63.0	38.3	125470800	3911	82.3	38.3	163908680
1989	3151	65.9	38.3	131246440	3843	83.1	38.3	165501960
1990	3097	66.7	38.3	132839720	4174	92.0	38.3	183227200
1991	3025	64.0	38.3	127462400	4402	96.7	38.3	192587720
1992	3402	68.0	38.3	135428800	4670	98.0	38.3	195176800
1993	3611	70.6	38.3	140606960	4659	97.8	38.3	194778480
1994	3755	73.7	38.3	146780920	4884	104.3	38.3	207723880
1995	3631	73.7	38.3	146780920	4894	106.2	38.3	211507920
1996	3808	77.2	38.3	153751520	5323	113.2	38.3	225449120
1997	4032	81.8	38.3	162912880	5510	117.6	38.3	234212160
1998	4094	83.6	38.3	166497760	5981	126.6	38.3	252136560

Geographic: SOUTH (STATES)

Year	Maryland				Mississippi			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	5220	107.4	38.3	213897840	2275	46.7	38.3	93007720
1980	4958	102.9	38.3	204935640	1977	43.5	38.3	86634600
1981	4536	99.7	38.3	198562520	1894	42.3	38.3	84244680
1982	3947	89.3	38.3	177849880	1651	39.6	38.3	78867360
1983	4546	101.4	38.3	201948240	1497	36.2	38.3	72095920
1984	5651	116.0	38.3	231025600	1524	37.1	38.3	73888360
1985	6772	128.8	38.3	256518080	1571	36.7	38.3	73091720
1986	7554	139.5	38.3	277828200	1535	35.2	38.3	70104320
1987	8507	152.3	38.3	303320680	1469	33.9	38.3	67515240
1988	9249	161.1	38.3	320846760	1526	35.9	38.3	71498440
1989	9300	162.5	38.3	323635000	1550	37.2	38.3	74087520
1990	8885	155.5	38.3	309693800	1608	34.8	38.3	69307680
1991	7527	129.5	38.3	257912200	1536	35.4	38.3	70502640
1992	6971	120.2	38.3	239390320	1662	39.6	38.3	78867360
1993	6843	121.1	38.3	241182760	1932	43.5	38.3	86634600
1994	7267	125.5	38.3	249945800	2105	45.4	38.3	90418640
1995	7197	127.4	38.3	253729840	2074	48.6	38.3	96791760
1996	7469	131.2	38.3	261297920	2256	50.9	38.3	101372440
1997	7848	138.3	38.3	275438280	2339	54.4	38.3	108343040
1998	8053	141.3	38.3	281413080	2526	55.7	38.3	110932120

Geographic: SOUTH (STATES)

Year	North Carolina				Oklahoma			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	4968	126.1	40.8	267606618	3675	59.1	37.8	116166960
1980	4498	118.7	40.8	251902502	3489	57.1	37.6	111641920
1981	4079	115.6	40.8	245323751	3166	54.7	37.1	105527240
1982	3550	106.8	40.8	226648587	3063	55.7	36.4	105428960
1983	3959	112.4	40.8	238532782	2799	52.4	36.9	100545120
1984	5117	132.6	40.8	281400773	2967	52.3	37.8	102800880
1985	6119	149.2	40.8	316628924	2656	45.1	36.3	85130760
1986	6528	155.2	40.8	329361991	2151	38.0	36.3	71728800
1987	6682	159.9	40.8	339336227	1760	34.6	38.5	69269200
1988	7116	165.1	40.8	350371551	1794	35.1	39.2	71547840
1989	7070	162.6	40.8	345066107	1837	36.1	38.7	72647640
1990	6963	163.7	40.4	343900960	1932	39.7	41.1	84846840
1991	6410	146.8	39.8	303817280	1844	38.7	39.7	79892280
1992	6817	145.2	39.9	301260960	2004	39.7	39.0	80511600
1993	7400	154.1	40.9	327739880	2086	42.8	39.1	87020960
1994	7860	165.3	41.6	357576960	2306	46.6	39.9	96685680
1995	8239	174.6	41.0	372247200	2272	48.3	40.0	100464000
1996	8792	188.7	40.5	397402200	2455	50.3	40.1	104885560
1997	9470	203.8	41.2	436621120	2450	51.2	38.7	103034880
1998	9879	214.7	42.0	468904800	2558	54.8	39.7	113129120

Geographic: SOUTH (STATES)

Year	South Carolina				Tennessee			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	2122	73.1	38.3	145585960	4321	89.2	38.3	177650720
1980	2017	73.4	38.3	146183440	3813	81.2	38.3	161717920
1981	1794	70.5	38.3	140407800	3393	76.2	38.3	151759920
1982	1521	64.6	38.3	128657360	3131	72.2	38.3	143793520
1983	1880	70.3	38.3	140009480	3196	69.6	38.3	138615360
1984	2502	80.8	38.3	160921280	3791	78.3	38.3	155942280
1985	2928	83.8	38.3	166896080	4198	85.6	38.3	170480960
1986	3399	87.8	38.3	174862480	4453	90.0	38.3	179244000
1987	3702	86.7	38.3	172671720	4560	95.2	38.3	189600320
1988	4027	90.7	38.3	180638120	4668	96.7	38.3	192587720
1989	4003	92.8	38.3	184820480	4619	97.2	38.3	193583520
1990	4594	101.7	38.3	202545720	4337	92.4	38.3	184023840
1991	3905	88.2	38.3	175659120	4114	86.5	38.3	172273400
1992	3593	79.9	38.3	159128840	4492	88.3	38.3	175858280
1993	3752	82.1	38.3	163510360	4878	94.3	38.3	187807880
1994	3840	84.3	38.3	167891880	5244	101.0	38.3	201151600
1995	4003	87.1	38.3	173468360	5571	108.9	38.3	216885240
1996	4403	94.3	38.3	187807880	5809	113.1	38.3	225249960
1997	4539	99.8	38.3	198761680	6100	118.1	38.3	235207960
1998	4723	106.8	38.3	212702880	6170	120.9	38.3	240784440

Geographic: SOUTH (STATES)

Year	Texas				Virginia				West Virginia			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	25630	416.2	38.3	828903920	6385	138.4	38.3	275637440	2235	39.0	37.0	75036000
1980	24234	423.0	38.3	842446800	5613	128.3	38.3	255522280	1928	35.8	38.2	71113120
1981	23096	429.1	38.3	854595560	4773	116.3	38.3	231623080	1446	30.3	37.2	58612320
1982	21528	431.1	38.3	858578760	4143	103.8	38.3	206728080	1151	24.4	36.7	46564960
1983	21548	424.0	38.3	844438400	4740	113.9	38.3	226843240	1061	21.6	35.7	40098240
1984	23310	446.3	38.3	888851080	5898	132.8	38.3	264484480	1139	22.0	36.5	41756000
1985	23727	443.8	38.3	883872080	7097	152.0	38.3	302723200	1220	22.8	36.7	43511520
1986	20797	404.2	38.3	805004720	8138	169.5	38.3	337576200	1199	22.8	36.8	43630080
1987	17110	345.3	38.3	687699480	8872	182.9	38.3	364263640	1250	24.0	37.5	46800000
1988	16778	328.8	38.3	654838080	9689	191.0	38.3	380395600	1296	24.3	38.1	48143160
1989	16740	323.6	38.3	644481760	9855	195.5	38.3	389357800	1267	24.6	37.7	48225840
1990	17513	335.9	38.3	668978440	8889	181.9	38.3	362272040	1451	27.2	37.9	53605760
1991	18275	342.4	38.3	681923840	7586	153.0	38.3	304714800	1452	26.8	38.2	53235520
1992	20142	343.8	38.3	684712080	7456	146.1	38.3	290972760	1508	27.7	37.3	53726920
1993	20851	355.3	38.3	707615480	8000	153.8	38.3	306308080	1664	31.3	38.6	62825360
1994	22482	381.1	38.3	758998760	8401	162.7	38.3	324033320	1829	34.1	38.9	68977480
1995	23458	409.0	38.3	814564400	8470	168.1	38.3	334787960	1659	32.9	37.9	64839320
1996	25649	435.4	38.3	867142640	8796	175.9	38.3	350322440	1722	34.4	39.1	69942080
1997	26541	460.3	38.3	916733480	9332	186.1	38.3	370636760	1707	34.9	39.2	71140160
1998	28294	496.3	38.3	988431080	9358	189.0	38.3	376412400	1653	34.2	36.9	65622960

Geographic: SOUTH (REGION)

Year	South		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	92234436917	3574074214	**25.807**
1980	87760749661	3531399638	**24.852**
1981	81519104832	3468165386	**23.505**
1982	73343310756	3258896965	**22.506**
1983	75424646003	3308423797	**22.798**
1984	87002290345	3685811161	**23.605**
1985	93903435229	3842744346	**24.437**
1986	93717000000	3847372248	**24.359**
1987	90797000000	3795321585	**23.923**
1988	94655000000	3841047751	**24.643**
1989	94003000000	3833539178	**24.521**
1990	93999000000	3840393417	**24.476**
1991	87462000000	3506402025	**24.944**
1992	90459000000	3643173842	**24.830**
1993	95184000000	3812524011	**24.966**
1994	100731000000	3836270475	**26.258**
1995	103306000000	4018273471	**25.709**
1996	110740000000	4259481888	**25.998**
1997	114746000000	4463550392	**25.707**
1998	119559000000	4776893094	**25.029**

Geographic: WEST (STATES)

Year	Alaska				Arizona			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1474	10.1	41.3	21690760	5482	86.5	36.9	165976200
1980	1575	10.3	43.9	23512840	4830	76.5	35.6	141616800
1981	1863	12.9	46.3	31058040	4282	72.0	36.0	134784000
1982	2237	16.8	43.8	38263680	3553	64.8	35.0	117936000
1983	2590	20.8	43.2	46725120	4146	78.6	37.0	151226400
1984	2430	20.4	42.0	44553600	5099	97.0	36.4	183601600
1985	2035	18.6	42.4	41009280	5912	112.1	36.2	211017040
1986	1412	13.4	43.6	30380480	5880	113.1	36.1	212311320
1987	957	10.1	39.6	20797920	5088	103.2	36.3	194800320
1988	840	9.0	41.4	19375200	4765	93.7	36.4	177355360
1989	882	9.8	45.4	23135840	4398	85.8	36.6	163294560
1990	895	10.5	46.6	25443600	4194	82.5	37.4	160446000
1991	887	10.4	44.6	24119680	4098	77.1	37.0	148340400
1992	902	10.2	43.3	22966320	4328	79.6	37.9	156875680
1993	1009	11.5	43.5	26013000	4726	89.1	37.6	174208320
1994	1084	12.3	44.6	28526160	5755	107.0	38.5	214214000
1995	1078	12.8	45.7	30417920	6369	119.7	37.8	235282320
1996	1038	12.6	44.0	28828800	6745	126.2	38.2	250683680
1997	1011	12.8	42.8	28487680	6982	131.8	38.0	260436800
1998	983	13.4	43.2	30101760	7484	143.8	37.6	281157760

Geographic: WEST (STATES)

Year	California				Colorado			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	33318	448.7	36.0	840504840	5115	80.0	37.1	154336000
1980	31038	428.3	36.0	802291560	4844	77.0	37.2	148948800
1981	28816	407.6	36.0	763516320	4674	77.5	36.6	147498000
1982	24399	349.0	36.0	653746800	4761	82.9	37.1	159930680
1983	25664	366.9	36.0	687277080	4809	83.0	38.7	167029200
1984	31510	407.4	36.0	763141680	5036	89.9	39.2	183252160
1985	35409	435.8	36.0	816340560	4897	86.3	37.7	169182520
1986	37646	450.0	35.6	833040000	4324	77.6	36.6	147688320
1987	39386	487.2	34.5	874036800	3778	67.3	37.2	130185120
1988	41931	529.2	35.6	979655040	3597	60.4	37.7	118408160
1989	43375	560.0	36.0	1048320000	3483	60.0	38.0	118560000
1990	41867	561.8	36.1	1054610960	3568	63.6	38.6	127657920
1991	36099	514.0	35.9	959535200	3909	66.5	39.2	135553600
1992	32910	471.7	34.9	856041160	4585	74.8	39.7	154417120
1993	30587	445.7	35.4	820444560	5245	86.0	39.2	175302400
1994	32130	464.3	36.4	878827040	5862	97.1	39.7	200453240
1995	32186	485.4	36.3	916241040	5851	102.1	39.3	208651560
1996	32927	505.9	36.8	968090240	6440	111.0	39.4	227416800
1997	35272	550.0	37.4	1069640000	6784	119.0	38.8	240094400
1998	38027	611.2	37.4	1188661760	7534	132.6	39.5	272360400

Geographic: WEST (STATES)

Year	Hawaii				Idaho			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1662	23.4	36.0	43804800	1195	19.1	35.7	35457240
1980	1613	23.9	36.2	44989360	979	17.4	36.8	33296640
1981	1425	21.9	36.2	41224560	863	16.7	35.7	31001880
1982	1134	17.9	35.8	33322640	693	13.8	35.4	25403040
1983	1221	17.8	37.2	34432320	713	13.2	35.9	24641760
1984	1153	15.8	36.9	30317040	828	14.6	35.6	27027520
1985	1260	17.2	36.6	32735040	857	15.1	36.6	28738320
1986	1368	18.6	36.9	35689680	815	14.6	36.6	27786720
1987	1491	21.2	38.4	42332160	765	13.6	36.8	26024960
1988	1721	23.4	37.8	45995040	821	14.2	37.2	27468480
1989	2131	29.2	38.6	58610240	897	16.1	38.4	32148480
1990	2451	21.0	38.6	42151200	1053	18.8	39.1	38224160
1991	2603	20.4	38.0	40310400	1136	20.2	37.7	39600080
1992	2549	19.7	36.4	37288160	1346	22.2	38.3	44213520
1993	2584	19.1	37.9	37642280	1459	24.7	40.0	51376000
1994	2256	17.7	37.3	34330920	1653	28.7	38.9	58054360
1995	1987	17.0	36.7	32442800	1647	29.6	40.1	61721920
1996	1764	16.6	36.4	31420480	1661	30.6	39.4	62693280
1997	1604	16.5	35.8	30716400	1686	31.9	38.2	63366160
1998	1515	16.4	35.6	30359680	1666	32.3	35.3	59289880

Geographic: WEST (STATES)

Year	Montana				Nevada			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1214	15.6	35.2	28554240	1900	27.3	36.0	51105600
1980	1130	14.5	38.8	29255200	1796	26.2	35.1	47820240
1981	999	13.3	37.2	25727520	1686	25.4	35.8	47284640
1982	950	13.4	33.3	23203440	1239	20.0	34.9	36296000
1983	915	13.3	36.0	24897600	1219	19.4	35.4	35711520
1984	863	12.6	35.9	23521680	1339	21.8	35.9	40696240
1985	807	11.5	34.8	20810400	1460	23.9	36.0	44740800
1986	688	10.2	36.0	19094400	1583	27.7	37.2	53582880
1987	564	8.8	37.1	16976960	1625	30.1	36.0	56347200
1988	545	9.0	37.4	17503200	2051	36.3	36.9	69652440
1989	549	9.8	37.5	19110000	2525	45.1	38.5	90290200
1990	566	10.4	38.2	20658560	2715	46.8	38.0	92476800
1991	635	11.5	37.5	22425000	2414	39.8	37.4	77403040
1992	715	12.7	37.2	24566880	2504	39.2	37.3	76032320
1993	770	13.5	37.1	26044200	3022	46.9	38.0	92674400
1994	856	14.9	38.4	29752320	3471	55.7	38.0	110063200
1995	841	16.1	38.4	32148480	3719	61.6	38.2	122362240
1996	888	17.1	37.5	33345000	4697	75.0	38.6	150540000
1997	920	17.7	37.9	34883160	4966	81.6	39.7	168455040
1998	941	18.8	38.2	37344320	5189	86.0	40.2	179774400

Geographic: WEST (STATES)

Year	New Mexico				Oregon			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1762	35.6	34.8	64421760	3571	53.0	35.2	97011200
1980	1565	32.1	35.8	59757360	3050	46.5	34.5	83421000
1981	1504	33.3	36.7	63549720	2250	37.5	34.0	66300000
1982	1393	32.1	36.5	60925800	1622	28.9	33.2	49892960
1983	1424	33.7	35.8	62735920	1538	27.0	33.2	46612800
1984	1594	36.6	36.7	69847440	1776	30.2	34.5	54178800
1985	1638	37.5	35.8	69810000	1955	33.1	35.5	61102600
1986	1525	35.1	36.6	66802320	2009	34.3	35.2	62782720
1987	1359	32.1	38.3	63930360	2007	35.3	35.1	64429560
1988	1310	31.0	38.5	62062000	2315	39.9	36.2	75107760
1989	1287	30.3	38.9	61290840	2633	46.1	37.4	89655280
1990	1247	29.5	39.8	61053200	3111	52.4	37.3	101635040
1991	1261	28.4	39.0	57595200	3181	51.4	36.9	98626320
1992	1468	31.0	39.0	62868000	3216	50.4	36.6	95921280
1993	1716	35.7	40.4	74998560	3440	54.0	36.8	103334400
1994	2020	41.6	40.7	88042240	3858	61.3	37.4	119216240
1995	2096	44.1	40.2	92186640	4183	68.7	37.6	134322240
1996	1999	43.1	40.4	90544480	4927	77.6	39.0	157372800
1997	1988	42.7	40.3	89482120	5162	81.5	39.5	167401000
1998	1981	43.2	39.2	88058880	4987	81.6	37.9	160817280

Geographic: WEST (STATES)

Year	Utah				Washington				Wyoming			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	2041	35.6	38.3	70900960	7847	104.4	37.1	201440414	1498	20.8	38.3	41425280
1980	1763	31.5	38.3	62735400	6747	92.6	37.1	178672245	1462	20.7	38.3	41226120
1981	1535	28.3	38.3	56362280	6227	90.3	37.1	174234381	1442	21.0	38.3	41823600
1982	1382	26.9	38.3	53574040	4973	76.2	35.9	142250160	1225	20.0	38.3	39832000
1983	1488	28.7	38.3	57158920	4676	74.2	36.1	139288240	798	14.4	38.3	28679040
1984	1845	34.8	38.3	69307680	4923	79.6	35.9	148597280	807	14.1	38.3	28081560
1985	1885	35.5	38.3	70701800	4855	80.6	36.5	152978800	999	18.2	38.3	36247120
1986	1681	32.2	38.3	64129520	4943	84.5	36.4	159941600	839	16.2	38.3	32263920
1987	1400	26.7	38.3	53175720	4891	88.9	36.8	170119040	541	10.8	38.3	21509280
1988	1347	24.9	38.3	49590840	5452	96.6	36.8	184853760	498	10.4	38.3	20712640
1989	1378	25.9	38.3	51582440	5959	106.9	37.6	209010880	493	10.2	38.3	20314320
1990	1482	28.0	38.3	55764800	6780	117.4	37.4	228319520	509	10.7	38.3	21310120
1991	1651	31.7	38.3	63133720	7089	118.2	37.9	232948560	558	11.9	38.3	23700040
1992	1808	34.9	38.3	69506840	7573	119.2	37.5	232440000	555	11.5	38.3	22903400
1993	1991	39.8	38.3	79265680	7509	119.1	37.5	232245000	574	12.3	38.3	24496680
1994	2415	48.1	38.3	95795960	7801	123.0	37.5	239850000	652	13.6	38.3	27085760
1995	2662	54.8	38.3	109139680	7492	122.0	37.2	235996800	628	14.2	38.3	28280720
1996	2911	60.4	38.3	120292640	8011	127.9	37.9	252065320	653	14.2	38.3	28280720
1997	3071	64.4	38.3	128259040	8552	136.3	38.4	272163840	670	15.1	38.3	30073160
1998	3157	68.2	38.3	135827120	8683	143.9	37.5	280605000	699	16.0	38.3	31865600

Geographic: WEST (REGION)

Year	West		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	68079168265	1816629294	37.476
1980	62390976583	1697543565	36.754
1981	57565444576	1624364941	35.439
1982	49562587752	1434577240	34.549
1983	51199531010	1506415920	33.988
1984	59203958187	1666124280	35.534
1985	63968069708	1755414280	36.440
1986	64713000000	1745493880	37.074
1987	63852000000	1734665400	36.809
1988	67193000000	1847739920	36.365
1989	69990000000	1985323080	35.254
1990	70438000000	2029751880	34.703
1991	65521000000	1923291240	34.067
1992	64459000000	1856040680	34.729
1993	64632000000	1918045480	33.697
1994	69813000000	2124211440	32.865
1995	70739000000	2239194360	31.591
1996	74661000000	2401574240	31.088
1997	78668000000	2583458800	30.451
1998	82846000000	2776223840	29.841

Geographic: MIDWEST (STATES)

Year	Illinois				Indiana			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	14010	188.0	36.2	353891200	6027	106.0	38.3	211109600
1980	12422	188.4	36.6	358562880	5124	92.3	38.3	183824680
1981	10595	167.5	36.5	317915000	4452	86.2	38.3	171675920
1982	9563	156.4	36.7	298473760	3862	77.1	38.3	153552360
1983	9649	144.2	37.5	281190000	3868	74.8	38.3	148971680
1984	11302	154.7	37.7	303273880	4217	79.4	38.3	158133040
1985	12281	171.6	37.9	338189280	4695	87.0	38.3	173269200
1986	12638	181.3	37.9	357306040	4889	92.9	38.3	185019640
1987	13168	196.2	38.0	387691200	5054	99.0	38.3	197168400
1988	14076	204.7	37.9	403422760	5566	107.3	38.3	213698680
1989	14761	213.0	38.2	423103200	5845	112.6	38.3	224254160
1990	15070	219.9	37.9	433378920	5931	115.7	38.3	230428120
1991	14393	204.9	38.1	405947880	6090	114.0	38.3	227042400
1992	14413	196.9	36.7	375763960	6266	113.6	38.3	226245760
1993	14540	200.4	37.0	385569600	6547	118.1	38.3	235207960
1994	15341	211.0	38.3	420227600	7162	126.4	38.3	251738240
1995	15262	216.7	38.6	434960240	7188	129.7	38.3	258310520
1996	15776	224.0	39.0	454272000	7433	134.2	38.3	267272720
1997	16203	230.8	38.6	463261760	7753	140.7	38.3	280218120
1998	16619	239.9	39.0	486517200	8000	145.7	38.3	290176120

Geographic: MIDWEST (STATES)

Year	Iowa				Kansas			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	3383	59.9	39.5	123034600	2919	49.9	38.3	99380840
1980	2830	50.9	38.5	101901800	2651	46.5	38.3	92609400
1981	2348	44.4	38.4	88657920	2281	42.7	38.3	85041320
1982	1851	38.1	38.0	75285600	2006	39.0	38.3	77672400
1983	1748	35.9	39.3	73365240	2077	39.7	38.3	79066520
1984	1972	38.7	39.7	79892280	2362	43.6	38.3	86833760
1985	1945	36.6	40.1	76318320	2363	42.3	38.3	84244680
1986	1850	35.2	39.1	71568640	2399	43.9	38.3	87431240
1987	1772	35.6	40.0	74048000	2353	45.4	38.3	90418640
1988	1948	38.0	40.8	80620800	2240	41.6	38.3	82850560
1989	2058	40.7	40.4	85502560	2150	40.1	38.3	79863160
1990	2306	44.7	39.8	92511120	2082	41.6	38.3	82850560
1991	2399	45.3	40.0	94224000	2061	41.8	38.3	83248880
1992	2606	47.2	39.4	96703360	2331	45.0	38.3	89622000
1993	2678	48.5	40.0	100880000	2452	45.8	38.3	91215280
1994	2950	52.9	40.9	112507720	2648	49.2	38.3	97986720
1995	2989	55.0	40.6	116116000	2629	51.6	38.3	102766560
1996	3203	58.2	41.0	124082400	2863	56.7	38.3	112923720
1997	3231	59.9	40.8	127083840	2958	58.8	38.3	117106080
1998	3359	63.0	40.2	131695200	3027	61.5	38.3	122483400

Geographic: MIDWEST (STATES)

Year	Michigan				Minnesota			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	9513	139.5	37.9	274926600	5128	83.2	39.4	170460160
1980	7571	116.8	36.2	219864320	4554	76.5	39.4	156733200
1981	6583	106.8	36.5	202706400	3725	67.7	39.4	138703760
1982	5289	89.5	36.0	167544000	3154	59.9	39.4	122723120
1983	5245	86.5	36.4	163727200	3367	60.4	39.4	123747520
1984	5807	92.7	37.5	180765000	4104	67.6	39.4	138498880
1985	6911	107.8	38.4	215255040	4506	71.3	39.4	146079440
1986	7537	115.2	38.3	229432320	4800	75.0	38.0	148200000
1987	7731	123.3	38.5	246846600	5124	80.1	39.3	163692360
1988	8726	132.2	39.7	272913680	5069	77.8	39.4	159396640
1989	8935	139.9	38.6	280807280	5232	79.1	38.9	160003480
1990	8921	142.3	38.0	281184800	5267	79.4	39.5	163087600
1991	8182	129.1	37.9	254430280	5025	76.1	39.4	155913680
1992	8152	128.3	37.3	248850680	5519	77.3	39.4	158372240
1993	8423	132.7	38.9	268425560	5577	78.3	39.4	160421040
1994	9191	142.6	39.6	293641920	5846	81.1	39.4	166157680
1995	9675	152.7	39.5	313645800	5803	83.9	39.9	174075720
1996	10639	168.0	40.6	354681600	6246	88.9	40.5	187223400
1997	11251	179.8	40.6	379593760	6539	93.7	39.6	192947040
1998	11716	186.0	40.0	386880000	6950	101.8	39.5	209097200

Geographic: MIDWEST (STATES)

Year	Missouri				Nebraska			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	5443	92.4	37.1	178044533	1566	32.5	38.3	64727000
1980	4649	82.1	37.1	158197578	1405	29.1	38.3	57955560
1981	4151	79.0	37.1	152224222	1207	26.1	38.3	51980760
1982	3671	73.3	37.1	141240956	1062	23.5	38.3	46802600
1983	3937	74.7	37.1	143938600	1048	23.5	38.3	46802600
1984	4755	85.7	37.1	165134378	1223	25.8	38.3	51383280
1985	5194	92.9	37.1	179007978	1277	26.1	38.3	51980760
1986	5518	98.1	37.1	189027800	1201	24.6	38.3	48993360
1987	5488	98.7	37.1	190183933	1143	24.5	38.3	48794200
1988	5514	97.4	37.1	187678978	1219	24.5	38.3	48794200
1989	5375	97.2	37.1	187293600	1243	25.3	38.3	50387480
1990	5065	97.7	36.0	182894400	1308	27.1	38.3	53972360
1991	4832	88.9	36.0	166420800	1386	27.2	38.3	54171520
1992	5235	90.9	35.5	167801400	1533	28.3	38.3	56362280
1993	5576	96.8	36.0	181209600	1674	30.4	38.3	60544640
1994	6582	111.1	38.1	220111320	1951	33.2	38.3	66121120
1995	6632	111.8	38.9	226149040	1935	34.7	38.3	69108520
1996	6835	115.2	38.4	230031360	2172	36.6	38.3	72892560
1997	7090	121.0	37.4	235320800	2137	38.2	38.3	76079120
1998	7190	126.2	37.2	244121280	2260	41.0	38.3	81655600

Geographic: MIDWEST (STATES)

Year	North Dakota				Ohio			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	1182	18.7	38.3	37242920	11027	182.9	37.6	357606080
1980	1023	16.5	38.3	32861400	10004	167.4	37.6	327300480
1981	901	15.0	38.3	29874000	8286	153.7	37.4	298915760
1982	909	15.7	38.3	31268120	6968	134.6	37.2	260370240
1983	1019	17.3	38.3	34454680	7054	130.8	37.1	252339360
1984	787	13.7	38.3	27284920	8251	144.8	38.4	289136640
1985	646	11.7	38.3	23301720	8845	154.0	38.4	307507200
1986	569	10.8	38.3	21509280	9016	160.7	38.7	323392680
1987	525	10.8	38.3	21509280	9692	176.4	38.6	354070080
1988	492	9.9	38.3	19716840	10420	185.6	39.1	377361920
1989	478	9.8	38.3	19517680	10648	193.6	39.1	393627520
1990	494	10.1	38.3	20115160	10831	195.3	39.4	400130640
1991	509	10.3	38.3	20513480	10116	178.8	39.0	362606400
1992	568	11.0	38.3	21907600	10232	176.9	39.0	358753200
1993	618	11.8	38.3	23500880	10903	183.3	39.6	377451360
1994	666	12.8	38.3	25492480	11631	200.9	39.4	411603920
1995	685	13.6	38.3	27085760	11496	205.0	39.8	424268000
1996	772	14.9	38.3	29674840	12046	213.9	40.1	446024280
1997	771	15.0	38.3	29874000	12452	223.1	39.8	461727760
1998	794	15.6	38.3	31068960	12671	230.4	39.7	475637760

Geographic: MIDWEST (STATES)

Year	South Dakota				Wisconsin			
	GDP	Employment	Hr.wk	(Emp x Hr.wk)	GDP	Employment	Hr.wk	(Emp x Hr.wk)
1979	761	12.9	40.6	27234480	4906	80.5	38.3	160323800
1980	611	10.7	40.4	22486509	4012	70.1	38.3	139611160
1981	509	9.7	40.4	20384966	3348	64.8	38.3	129055680
1982	384	8.2	40.4	17232651	2708	56.9	38.3	113322040
1983	404	8.4	40.4	17652960	2864	57.7	38.3	114915320
1984	471	9.3	40.4	19544349	3397	63.2	38.3	125869120
1985	487	9.5	40.4	19964657	3632	64.6	38.3	128657360
1986	503	9.6	39.4	19668480	3903	68.0	38.3	135428800
1987	490	9.6	38.9	19418880	4054	72.2	38.3	143793520
1988	498	9.5	40.4	19957600	4411	76.4	38.3	152158240
1989	511	10.3	40.3	21584680	4602	80.7	38.3	160722120
1990	566	11.7	40.5	24640200	4934	86.6	38.3	172472560
1991	576	11.8	40.1	24605360	5007	86.6	38.3	172472560
1992	634	12.5	40.9	26585000	5434	90.7	38.3	180638120
1993	664	13.2	40.3	27661920	5632	93.3	38.3	185816280
1994	732	14.0	41.0	29848000	5855	98.2	38.3	195575120
1995	690	14.1	40.9	29987880	5701	99.0	38.3	197168400
1996	736	14.7	41.1	31416840	6044	104.4	38.3	207923040
1997	764	15.2	41.1	32485440	6284	108.3	38.3	215690280
1998	786	16.1	40.3	33739160	6453	113.0	38.3	225050800

Geographic: MIDWEST (REGION)

Year	Midwest		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	65865609954	2057981813	**32.005**
1980	56856308567	1851908966	**30.701**
1981	48385156156	1687135708	**28.679**
1982	41425331338	1505487847	**27.516**
1983	42279710188	1480171680	**28.564**
1984	48647815363	1625749526	**29.923**
1985	52781002336	1743775635	**30.268**
1986	54823000000	1816978280	**30.173**
1987	56594000000	1937635093	**29.208**
1988	60179000000	2018570898	**29.813**
1989	61838000000	2086666920	**29.635**
1990	62775000000	2137666440	**29.366**
1991	60576000000	2021597240	**29.964**
1992	62923000000	2007605600	**31.342**
1993	65284000000	2097904120	**31.119**
1994	70555000000	2291011840	**30.796**
1995	70685000000	2373642440	**29.779**
1996	74765000000	2518418760	**29.687**
1997	77433000000	2611388000	**29.652**
1998	79825000000	2718122680	**29.368**

Geographic: CUMULATIVE ADJUSTED DATA (FOR ALL REGIONS)

Year	Total regions (Adjusted)		
	GDP	(Emp x Hr.wk)	Labor Productivity
1979	269438408113	8883636377	**30.330**
1980	247754642441	8477805824	**29.224**
1981	226028291995	8158911337	**27.703**
1982	201800564702	7533685104	**26.786**
1983	210141899408	7685965169	**27.341**
1984	243821940334	8538349164	**28.556**
1985	267014918956	9060861640	**29.469**
1986	275033000000	9292690672	**29.597**
1987	278361000000	9501022798	**29.298**
1988	294135000000	9812870874	**29.974**
1989	296283000000	9959361413	**29.749**
1990	290691000000	9861614792	**29.477**
1991	268764000000	9016097697	**29.809**
1992	271748000000	8949272458	**30.365**
1993	279175000000	9302147059	**30.012**
1994	297189000000	9788840579	**30.360**
1995	299609000000	10187927871	**29.408**
1996	316422000000	10771665488	**29.375**
1997	329285000000	11331758752	**29.059**
1998	342902000000	12048853894	**28.459**

APDX A-7: Construction Industry National Data (from BEA and BLS).

GDP = Gross Domestic Output (in Millions of 1996-Chained dollars).

Employment = Number of All Employment (in Thousands).

Hr.wk = Number of Average Weekly Hour-Worked.

Sources: the Bureau of Labor Statistics (BLS), the Bureau of Economic Analysis (BEA)

Year	USA				
	GDP	Employment	Hr.Wk	Emp x Hr.Wk	Labor Productivity
1979	269437	4463	37.0	8586812000	**31.38**
1980	247762	4346	37.0	8361704000	**29.63**
1981	226024	4188	36.9	8035934400	**28.13**
1982	201799	3904	36.7	7450393600	**27.09**
1983	210140	3946	37.1	7612623200	**27.60**
1984	243823	4380	37.8	8609328000	**28.32**
1985	267020	4668	37.7	9151147200	**29.18**
1986	275030	4810	37.4	9354488000	**29.40**
1987	278358	4958	37.8	9745444800	**28.56**
1988	294137	5098	37.9	10047138400	**29.28**
1989	296286	5171	37.9	10191006800	**29.07**
1990	290690	5120	38.2	10170368000	**28.58**
1991	268765	4650	38.1	9212580000	**29.17**
1992	271746	4492	38.0	8876192000	**30.62**
1993	279176	4668	38.5	9345336000	**29.87**
1994	297191	4986	38.9	10085680800	**29.47**
1995	299608	5160	38.9	10437648000	**28.70**
1996	316419	5418	39.0	10987704000	**28.80**
1997	329283	5691	39.0	11541348000	**28.53**
1998	342902	6020	38.9	12177256000	**28.16**

APDX A-8: Manufacturing Industry National Data (from BEA and BLS).

GDP = Gross Domestic Output (in Millions of 1996-Chained dollars).

Employment = Number of All Employment (in Thousands).

Hr.wk = Number of Average Weekly Hour-Worked.

Sources: the Bureau of Labor Statistics (BLS), the Bureau of Economic Analysis (BEA)

Year	USA				
	GDP	**Employment**	**Hr.Wk**	**Emp x Hr.Wk**	**Labor Productivity**
1979	857524	21040	40.2	43982016000	**19.50**
1980	822478	20285	39.7	41876354000	**19.64**
1981	859564	20170	39.8	41743832000	**20.59**
1982	809449	18780	38.9	37988184000	**21.31**
1983	858827	18432	40.1	38434406400	**22.35**
1984	950477	19372	40.7	40998900800	**23.18**
1985	976219	19248	40.5	40536288000	**24.08**
1986	961753	18947	40.7	40099430800	**23.98**
1987	1046300	18999	41.0	40505868000	**25.83**
1988	1120200	19314	41.1	41277880800	**27.14**
1989	1111600	19391	41.0	41341612000	**26.89**
1990	1102300	19076	40.8	40471641600	**27.24**
1991	1066300	18406	40.7	38954458400	**27.37**
1992	1085000	18104	41.0	38597728000	**28.11**
1993	1122900	18075	41.4	38911860000	**28.86**
1994	1206000	18321	42.0	40013064000	**30.14**
1995	1284700	18524	41.6	40071116800	**32.06**
1996	1316000	18495	41.6	40008384000	**32.89**
1997	1385500	18675	42.0	40786200000	**33.97**
1998	1448700	18805	41.7	40776762000	**35.53**

APPENDIX B: LABOR FORCE DATA AND INFORMATION

APDX B-1: Average Real Hourly Wages Data (in Dollars per Hour).

Remark: In Real 1982-Chained Dollars.

Source: the Bureau of Labor Statistics (BEA).

Year	Construction	Manufacturing
1979	12.29	8.89
1980	11.61	8.49
1981	11.47	8.47
1982	11.63	8.49
1983	11.59	8.57
1984	11.38	8.62
1985	11.17	8.65
1986	11.13	8.68
1987	10.95	8.54
1988	10.84	8.44
1989	10.70	8.28
1990	10.35	8.14
1991	10.10	8.07
1992	9.92	8.04
1993	9.81	8.01
1994	9.80	8.03
1995	9.76	8.00
1996	9.73	8.03
1997	9.86	8.10
1998	10.08	8.19
1999	10.21	8.25

APDX B-2: Average Weekly Hours Worked Data.

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry	Manufacturing Industry
1979	37.0	40.2
1980	37.0	39.7
1981	36.9	39.8
1982	36.7	38.9
1983	37.1	40.1
1984	37.8	40.7
1985	37.7	40.5
1986	37.4	40.7
1987	37.8	41.0
1988	37.9	41.1
1989	37.9	41.0
1990	38.2	40.8
1991	38.1	40.7
1992	38.0	41.0
1993	38.5	41.4
1994	38.9	42.0
1995	38.9	41.6
1996	39.0	41.6
1997	39.0	42.0
1998	38.9	41.7

APDX B-3: Working Period Data.

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry							
	Total	1 -3 months	4 - 6 months	7 - 12 months	13 - 36 months	37 - 60 months	61 - 84 months	more than 84
1996	573112	145263	146647	158157	94826	22584	5635	0
1998	512521	104585	158165	116107	115722	12508	2916	2518
	in Percentage							
1996	100.00	25.35	25.59	27.60	16.55	3.94	0.98	0.00
1998	100.00	20.41	30.86	22.65	22.58	2.44	0.57	0.49

Year	Manufacturing Industry							
	Total	1 -3 months	4 - 6 months	7 - 12 months	13 - 36 months	37 - 60 months	61 - 84 months	more than 84 months
1996	1475541	190770	245204	361935	624449	36624	12012	4547
1998	1335228	271005	201426	337746	461483	36824	26745	0
	in Percentage							
1996	100.00	12.93	16.62	24.53	42.32	2.48	0.81	0.31
1998	100.00	20.30	15.09	25.29	34.56	2.76	2.00	0.00

APDX B-4: Classes of Work Forces Data.

Remark: Data in Thousands

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry					Manufacturing Industry				
	Total Employed	Wage & salary workers		Self-employed workers	Unpaid family workers	Total Employed	Wage & salary workers		Self-employed workers	Unpaid family workers
		Private Industries	Government				Private Industries	Government		
1979	**6299**	4612	507	1131	49	**22137**	21642	133	332	30
1980	**6065**	4373	504	1149	39	**21593**	21088	125	350	30
1981	**5907**	4255	483	1129	40	**21460**	20949	129	354	28
1982	**5756**	4134	462	1118	42	**20286**	19756	153	354	23
1983	**6149**	4445	501	1158	45	**19946**	19383	166	372	25
1984	**6665**	4881	512	1235	37	**20995**	20459	155	359	22
1985	**6987**	5143	502	1301	41	**20879**	20355	157	347	20
1986	**7288**	5373	513	1369	33	**20962**	20423	148	370	21
1987	**7456**	5501	544	1384	27	**20935**	20420	144	354	17
1988	**7603**	5640	508	1426	29	**21320**	20770	140	394	16
1989	**7680**	5740	481	1423	36	**21652**	21095	136	406	15
1990	**7696**	5665	534	1463	34	**21184**	20616	120	430	18
1991	**7087**	5115	502	1447	23	**20434**	19870	130	419	15
1992	**7013**	5002	512	1465	34	**19972**	19435	131	392	14
1993	**7220**	5141	496	1555	28	**19557**	18989	112	443	13
1994	**7493**	5427	545	1506	15	**20157**	19618	107	426	6
1995	**7668**	5681	516	1459	12	**20493**	19937	104	433	19
1996	**7943**	5952	479	1496	16	**20518**	20018	83	407	10
1997	**8302**	6333	458	1492	19	**20835**	20334	71	421	9
1998	**8518**	6512	474	1518	14	**20733**	20232	68	427	6
1999	**8987**	6919	508	1545	15	**20070**	19609	76	381	4

APDX B-4: Classes of Work Forces Data. ---- (Cont'd)

Remark: Data in Percentages

Year	Construction Industry					Manufacturing Industry				
	Total Employed	Wage & salary workers		Self-employed workers	Unpaid family workers	Total Employed	Wage & salary workers		Self-employed workers	Unpaid family workers
		Private Industries	Government				Private Industries	Government		
1979	**100.00**	73.22	8.05	17.96	0.78	**100.00**	97.76	0.60	1.50	0.14
1980	**100.00**	72.10	8.31	18.94	0.64	**100.00**	97.66	0.58	1.62	0.14
1981	**100.00**	72.03	8.18	19.11	0.68	**100.00**	97.62	0.60	1.65	0.13
1982	**100.00**	71.82	8.03	19.42	0.73	**100.00**	97.39	0.75	1.75	0.11
1983	**100.00**	72.29	8.15	18.83	0.73	**100.00**	97.18	0.83	1.87	0.13
1984	**100.00**	73.23	7.68	18.53	0.56	**100.00**	97.45	0.74	1.71	0.10
1985	**100.00**	73.61	7.18	18.62	0.59	**100.00**	97.49	0.75	1.66	0.10
1986	**100.00**	73.72	7.04	18.78	0.45	**100.00**	97.43	0.71	1.77	0.10
1987	**100.00**	73.78	7.30	18.56	0.36	**100.00**	97.54	0.69	1.69	0.08
1988	**100.00**	74.18	6.68	18.76	0.38	**100.00**	97.42	0.66	1.85	0.08
1989	**100.00**	74.74	6.26	18.53	0.47	**100.00**	97.43	0.63	1.88	0.07
1990	**100.00**	73.61	6.94	19.01	0.44	**100.00**	97.32	0.57	2.03	0.08
1991	**100.00**	72.17	7.08	20.42	0.32	**100.00**	97.24	0.64	2.05	0.07
1992	**100.00**	71.32	7.30	20.89	0.48	**100.00**	97.31	0.66	1.96	0.07
1993	**100.00**	71.20	6.87	21.54	0.39	**100.00**	97.10	0.57	2.27	0.07
1994	**100.00**	72.43	7.27	20.10	0.20	**100.00**	97.33	0.53	2.11	0.03
1995	**100.00**	74.09	6.73	19.03	0.16	**100.00**	97.29	0.51	2.11	0.09
1996	**100.00**	74.93	6.03	18.83	0.20	**100.00**	97.56	0.40	1.98	0.05
1997	**100.00**	76.28	5.52	17.97	0.23	**100.00**	97.60	0.34	2.02	0.04
1998	**100.00**	76.45	5.56	17.82	0.16	**100.00**	97.58	0.33	2.06	0.03
1999	**100.00**	76.99	5.65	17.19	0.17	**100.00**	97.70	0.38	1.90	0.02

APDX B-5: Education Attainment Data.

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry					
	Total	None - 12th grade	High school grad - High school diploma	Some college - Associate degree	Bachelor' s degree	Master's, Professional, and Doctorate degree
1992	**8306088**	1926727	3749033	1867344	640275	122709
1993	**8131481**	1856043	3589107	1962915	620882	102534
1994	**7885990**	1731494	3568851	1860453	632569	92623
1995	**8396587**	1922930	3677818	2030271	651487	114081
1996	**8626725**	1907119	3799612	2075007	725882	119105
1997	**9018990**	1996598	4051513	2129862	685922	155095
1998	**9178991**	2017469	4143571	2201653	687773	128525
1999	**9400453**	2017194	4131361	2297967	825524	128407
2000	**9549908**	2148512	4219210	2303737	741379	137070
	in Percentage					
1992	**100.00**	23.20	45.14	22.48	7.71	1.48
1993	**100.00**	22.83	44.14	24.14	7.64	1.26
1994	**100.00**	21.96	45.26	23.59	8.02	1.17
1995	**100.00**	22.90	43.80	24.18	7.76	1.36
1996	**100.00**	22.11	44.04	24.05	8.41	1.38
1997	**100.00**	22.14	44.92	23.62	7.61	1.72
1998	**100.00**	21.98	45.14	23.99	7.49	1.40
1999	**100.00**	21.46	43.95	24.45	8.78	1.37
2000	**100.00**	22.50	44.18	24.12	7.76	1.44

APDX B-5: Education Attainment Data. ---- (Cont'd)

Year	Manufacturing Industry					
	Total	None - 12th grade	High school grad - High school diploma	Some college - Associate degree	Bachelor' s degree	Master's, Professional, and Doctorate degree
1992	22069389	4065463	9399949	4822307	2866170	915500
1993	21591423	3834041	8995715	4878837	2887087	995743
1994	21390151	3551799	8736149	5212159	2903564	986480
1995	21557744	3683533	8636210	5158100	3058670	1021231
1996	21572716	3532835	8511848	5388967	3007255	1131811
1997	22201356	3637995	8831675	5321738	3292507	1117441
1998	21696229	3465913	8604831	5367395	3215921	1042169
1999	21178087	3261410	8332851	5315752	3221843	1046231
2000	21294433	3157891	8309452	5448246	3278398	1100446
	in Percentage					
1992	100.00	18.42	42.59	21.85	12.99	4.15
1993	100.00	17.76	41.66	22.60	13.37	4.61
1994	100.00	16.60	40.84	24.37	13.57	4.61
1995	100.00	17.09	40.06	23.93	14.19	4.74
1996	100.00	16.38	39.46	24.98	13.94	5.25
1997	100.00	16.39	39.78	23.97	14.83	5.03
1998	100.00	15.97	39.66	24.74	14.82	4.80
1999	100.00	15.40	39.35	25.10	15.21	4.94
2000	100.00	14.83	39.02	25.59	15.40	5.17

APDX B-6: Ages of Work Forces.

Remark: Data in Thousands

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry					Manufacturing Industry				
	Total Employed 16 years and over	16 to 19 years	20 to 24 years	25 to 54 years	55 years and over	**Total Employed 16 years and over**	16 to 19 years	20 to 24 years	25 to 54 years	55 years and over
1979	**6299**	472	1077	3975	775	**22137**	1107	3210	14677	3143
1980	**6065**	372	929	3992	772	**21593**	945	2974	14613	3061
1981	**5907**	297	882	3976	752	**21460**	794	2940	14722	3004
1982	**5756**	265	846	3931	714	**20286**	583	2571	14236	2896
1983	**6149**	269	964	4173	743	**19946**	561	2377	14168	2840
1984	**6665**	312	1004	4582	767	**20995**	634	2534	15050	2777
1985	**6987**	325	990	4866	806	**20879**	579	2418	15134	2748
1986	**7288**	321	1049	5142	775	**20962**	522	2306	15418	2715
1987	**7456**	317	1008	5323	809	**20935**	496	2158	15600	2681
1988	**7603**	304	1023	5462	814	**21320**	539	2146	16017	2618
1989	**7680**	304	913	5630	832	**21652**	514	2049	16461	2629
1990	**7696**	264	858	5761	813	**21184**	488	1963	16174	2559
1991	**7087**	192	747	5405	743	**20434**	380	1781	15866	2408
1992	**7013**	164	700	5396	754	**19972**	369	1660	15593	2351
1993	**7220**	179	669	5600	774	**19557**	362	1599	15316	2281
1994	**7493**	219	760	5724	790	**20157**	401	1722	15780	2254
1995	**7668**	259	721	5899	791	**20493**	434	1777	15978	2307
1996	**7943**	249	738	6124	834	**20518**	397	1626	16107	2389
1997	**8302**	258	783	6408	853	**20835**	412	1663	16320	2441
1998	**8518**	279	825	6533	881	**20733**	431	1614	16242	2446
1999	**8987**	325	893	6820	948	**20070**	423	1509	15689	2449

APDX B-6: Ages of Work Forces. ---- (Cont'd)

Remark: Data in Percentages

Year	Construction Industry					Manufacturing Industry				
	Total Employed 16 years and over	16 to 19 years	20 to 24 years	25 to 54 years	55 years and over	**Total Employed 16 years and over**	16 to 19 years	20 to 24 years	25 to 54 years	55 years and over
1979	**100.00**	7.5	17.1	63.1	12.3	**100.00**	5.0	14.5	66.3	14.2
1980	**100.00**	6.1	15.3	65.8	12.7	**100.00**	4.4	13.8	67.7	14.2
1981	**100.00**	5.0	14.9	67.3	12.7	**100.00**	3.7	13.7	68.6	14.0
1982	**100.00**	4.6	14.7	68.3	12.4	**100.00**	2.9	12.7	70.2	14.3
1983	**100.00**	4.4	15.7	67.9	12.1	**100.00**	2.8	11.9	71.0	14.2
1984	**100.00**	4.7	15.1	68.7	11.5	**100.00**	3.0	12.1	71.7	13.2
1985	**100.00**	4.7	14.2	69.6	11.5	**100.00**	2.8	11.6	72.5	13.2
1986	**100.00**	4.4	14.4	70.6	10.6	**100.00**	2.5	11.0	73.6	13.0
1987	**100.00**	4.3	13.5	71.4	10.9	**100.00**	2.4	10.3	74.5	12.8
1988	**100.00**	4.0	13.5	71.8	10.7	**100.00**	2.5	10.1	75.1	12.3
1989	**100.00**	4.0	11.9	73.3	10.8	**100.00**	2.4	9.5	76.0	12.1
1990	**100.00**	3.4	11.1	74.9	10.6	**100.00**	2.3	9.3	76.4	12.1
1991	**100.00**	2.7	10.5	76.3	10.5	**100.00**	1.9	8.7	77.6	11.8
1992	**100.00**	2.3	10.0	76.9	10.8	**100.00**	1.8	8.3	78.1	11.8
1993	**100.00**	2.5	9.3	77.6	10.7	**100.00**	1.9	8.2	78.3	11.7
1994	**100.00**	2.9	10.1	76.4	10.5	**100.00**	2.0	8.5	78.3	11.2
1995	**100.00**	3.4	9.4	76.9	10.3	**100.00**	2.1	8.7	78.0	11.3
1996	**100.00**	3.1	9.3	77.1	10.5	**100.00**	1.9	7.9	78.5	11.6
1997	**100.00**	3.1	9.4	77.2	10.3	**100.00**	2.0	8.0	78.3	11.7
1998	**100.00**	3.3	9.7	76.7	10.3	**100.00**	2.1	7.8	78.3	11.8
1999	**100.00**	3.6	9.9	75.9	10.5	**100.00**	2.1	7.5	78.2	12.2

APDX B-6: Ages of Work Forces. ---- (Cont'd)

Year	Construction	Manufacturing
	Average Ages (Years Old)	Average Ages (Years Old)
1979	37.07	38.42
1980	37.73	38.71
1981	38.04	38.81
1982	38.15	39.25
1983	37.97	39.36
1984	37.91	39.10
1985	38.07	39.23
1986	37.92	39.36
1987	38.16	39.48
1988	38.19	39.39
1989	38.49	39.51
1990	38.70	39.55
1991	38.95	39.69
1992	39.18	39.76
1993	39.27	39.76
1994	38.98	39.58
1995	38.98	39.55
1996	39.08	39.79
1997	39.02	39.78
1998	38.95	39.80
1999	38.86	39.92

APDX B-7: Gender Distribution of Work Forces.

Remark: Data in Thousands

Source: the Bureau of Labor Statistics (BEA).

Year	Construction Industry			Manufacturing Industry		
	Total	Male	Female	Total	Male	Female
1979	6299	5836	463	22137	15304	6834
1980	6065	5580	485	21593	14807	6786
1981	5907	5425	482	21460	14671	6789
1982	5756	5268	488	20286	13723	6562
1983	6149	5640	509	19946	13454	6492
1984	6665	6104	561	20995	14160	6835
1985	6987	6370	617	20879	14127	6752
1986	7288	6663	625	20962	14225	6737
1987	7456	6793	664	20935	14061	6874
1988	7603	6899	704	21320	14301	7019
1989	7680	6992	687	21652	14566	7086
1990	7696	7032	664	21184	14315	6868
1991	7087	6485	602	20434	13752	6682
1992	7013	6393	621	19972	13399	6574
1993	7220	6603	617	19557	13249	6309
1994	7493	6775	718	20157	13686	6471
1995	7668	6906	762	20493	14020	6473
1996	7943	7147	796	20518	13950	6568
1997	8302	7518	784	20835	14152	6683
1998	8518	7721	798	20733	14138	6595
1999	8987	8101	886	20070	13647	6423

APDX B-7: Gender Distribution of Work Forces. ---- (Cont'd)

Remark: Data in Percentages

Year	Construction Industry			Manufacturing Industry		
	Total	Male	Female	Total	Male	Female
1979	100.00	92.65	7.35	100.00	69.13	30.87
1980	100.00	92.00	8.00	100.00	68.57	31.43
1981	100.00	91.84	8.16	100.00	68.36	31.64
1982	100.00	91.52	8.48	100.00	67.65	32.35
1983	100.00	91.72	8.28	100.00	67.45	32.55
1984	100.00	91.58	8.42	100.00	67.44	32.56
1985	100.00	91.17	8.83	100.00	67.66	32.34
1986	100.00	91.42	8.58	100.00	67.86	32.14
1987	100.00	91.11	8.89	100.00	67.17	32.83
1988	100.00	90.74	9.26	100.00	67.08	32.92
1989	100.00	91.04	8.96	100.00	67.27	32.73
1990	100.00	91.37	8.63	100.00	67.57	32.43
1991	100.00	91.51	8.49	100.00	67.30	32.70
1992	100.00	91.16	8.84	100.00	67.09	32.91
1993	100.00	91.45	8.55	100.00	67.75	32.25
1994	100.00	90.42	9.58	100.00	67.90	32.10
1995	100.00	90.06	9.94	100.00	68.41	31.59
1996	100.00	89.98	10.02	100.00	67.99	32.01
1997	100.00	90.56	9.44	100.00	67.92	32.08
1998	100.00	90.64	9.36	100.00	68.19	31.81
1999	100.00	90.14	9.86	100.00	68.00	32.00

APPENDIX C: DATA AND INFORMATION FOR DRIVERS AND OPPORTUNITIES IN CONSTRUCTION INDUSTRY

APDX C-1: Survey Questionnaire Method for Construction Labor Productivity Drivers and Opportunities

1) Literature Review of Papers and Journals

The author started by searching for papers and journals that relate to construction labor productivity during the period of year 1980 to year 2000. Examples of key words that were used for searching are "construction productivity", "labor productivity", "construction labor", "construction workforce", "construction productivity trends", and so on. After reviewing approximately fifty papers and journals, the author had some idea and information of what people have been concerned about the factors that can affect labor productivity in the construction industry. The author also learned what can be used to enhance construction labor productivity.

2) Listing the Construction Labor Productivity Drivers and Opportunities

From a review of papers and journals, the author made lists of the factors that affect construction labor productivity (Drivers) and lists of methods or techniques that have potential to improve and enhance construction labor productivity (Opportunities). The construction labor productivity drivers are: unrealistic estimates, poor planning, inadequate quality & safety management, fragmented nature of construction industry itself, adverse relationships in most construction contracts, inefficient material management, material delay, management constraints, adverse weather conditions, changes in the scope and complexity of works, scheduled overtime, out-of-sequence work, disruption, dilution of supervision, unavailability of manpower, low morale, poor supervision, poor training, unsafe working condition, uniqueness of individual projects, many nonrepetitive processes of the construction industry, lack of management skills, low research and development expenditures, geographical dispersion, low information technology, environment control problem due to construction products are built in place, low tolerances in construction products, motivational impact of work crews, variable in workforce, subcontractor problems, owner influence, accidents & injuries, impact of environmental contamination on construction projects, process mobilization or start-up, operational delay, and interaction between sub cycles.

The lists of the construction labor productivity opportunities are: to develop training programs, to develop the management and planning systems, consider material management, recognize foremen's management, enhance the workers' motivation, use goal setting method, short term goal setting, develop the information technology, improve construction information systems, apply the quality-circles method, apply computer-integrated manufacturing (CIM) concepts to construction (CIC), apply Total quality management (TQM) concepts to construction, develop operation management, work harder, work smarter (methods improvement), increase capital investment (equipment, technology, etc.), further research into management of the design process, develop the motivation of work crews, develop the safety system and management, management in transportation of equipments, management in the delivery of materials, apply the strategic management, apply the decision-making method, evaluation and feedback, and project orientation program.

3) **Grouping into Main Categories**

From the lists of the construction labor productivity drivers and opportunities, entries were organized into four main categories for drivers (management systems and strategies, manpower, industry environment, and external condition), and four main categories for opportunities (management systems and strategies, manpower, technology, and new techniques).

Factors that affect construction labor productivity (Drivers):

Manage Systems and Strategies

- Poor Scheduling and Planning (Scheduling Overtime, Out-of-Sequence Works)
- Poor Budget and Cost Estimating (Unrealistic Estimates)
- Supervisors' and Managers' Lack of Management Skills
- Poor Quality Control
- Poor Training Programs
- Poor Safety Management
- Poor Material and Equipment Management (material delay)

Manpower

- Low Education Level
- Low Experience
- Low Motivation (Salary. Work Environment)
- Not enough Training
- Short Term Working

Industry Environment

- Adverse Weather Conditions
- Subcontractor Problems
- Uniqueness of Individual Projects. The Industry's Many Nonrepetitive Processes
- Unsafe Working Conditions
- Environment Control Problem because Construction Products are Built In Place
- Process Mobilization or Start-Up
- Interaction between Sub-Cycles

External Conditions

- Economic Crisis
- Changes in the Scope and Complexity of Works
- Low Information System and Technology
- Low Research and Development Expenditures

Methodologies that have potential to enhance construction labor productivity (Opportunities):

Management Systems and Strategies

- Management of the Transportation of Equipments
- Management of the Delivery of Materials, and Material Management
- Develop Operation Management
- Develop Strategic Management and Planning Systems
- Develop Safety System and Management

Manpower

- Develop Training Programs
- Enhance Workers' Motivation (Salary)
- Work Harder
- Work Smarter (Methods Improvement)

Technology

- Apply Computer-Integrated Manufacturing (CIM) Concepts to Construction (CIC)
- Develop Information Technology
- Increase Research and Development Budget
- Improve Construction Information Systems
- Increase Capital Investment (Equipment, Technology, etc.)

New Techniques

- Use Goal Setting Method (Short-Term Goal Setting)

- Apply Total Quality Management (TQM) Concepts to the Construction Industry
- Apply Project Orientation Programs
- Apply Decision-Making Method, Evaluation and Feedback Techniques

4) Forming Questionnaires for Construction Labor Productivity Drivers and Opportunities.

In the survey questionnaires, participants are asked to rate each factor and methods according to how relevant and effective they are in construction labor productivity. The participants are also asked to give participants' information (type of company, size of company, and position of the participant).

5) Developing the Survey Questionnaires

The author developed the survey questionnaires with assistance from construction professionals who have work experience in the construction industry and have seen many problems of labor forces in the construction industry.

6) Finding participants

Finding people who have work experience related to the construction industry and are willing to participate in the survey, and complete the questionnaires on construction labor productivity. Therefore, the responses to the survey from the participants provide valuable information since they are only from those people who want to participate in the survey.

7) **Distributing the Survey Questionnaires.**

The survey questionnaires were sent to those willing to participate in this study to complete the survey.

8) **Collecting the Responses and Analyze the Results.**

The responses to the survey questionnaires were collected over four to six weeks.

APDX C-2: Web-Survey Questionnaires

[Title]:
Labor Productivity in The Construction Industry

[Introduction / Web Greeting]:
This survey has two major sections. The first one includes statements about factors that affect labor productivity in the construction industry. The second one inquires about methods to improve the productivity of workers.

[Part 1]:
Section 1: Factors that Affect Labor Productivity in The Construction Industry

This section presents a series of statements organized in five major areas:

1. Management Systems and Strategies
2. Manpower
3. Industry Environment
4. External Factors

For each statement you must decide how relevant it is in determining labor productivity levels. At the end of the section you must rank each one of the four areas according to their relative level of importance in determining labor productivity levels.

1 Management Systems

1	2	3	4
Extremely Relevant	Relevant	Not Too Relevant	Not At All Relevant

Scheduling and Planning (Scheduling Overtime, Out of Sequence Works)

[1] [2] [3] [4]

Management skills (Budget & Cost, Supervisors, Safety & Training Programs)

[1] [2] [3] [4]

Quality Control

[1] [2] [3] [4]

Material and Equipment Management (Material Delay)

[1] [2] [3] [4]

2 Manpower

1	2	3	4
Extremely Relevant	Relevant	Not Too Relevant	Not At All Relevant

Education (Formal Education)

[1] [2] [3] [4]

Experience (Work Experience in the Construction Industry)

[1] [2] [3] [4]

Motivation (Salary, Work Environment)

[1] [2] [3] [4]

Activity Training (Not Enough Training)

[1] [2] [3] [4]

Seniority (Short Term Employment)

[1] [2] [3] [4]

3 Industry Environment

1	2	3	4
Extremely Relevant	Relevant	Not Too Relevant	Not At All Relevant

Adverse Weather Conditions

[1] [2] [3] [4]

Subcontractor Integration (Problems)

[1] [2] [3] [4]

Uniqueness of Individual Projects, The Industry's Many Nonrepetitive Processes

[1] [2] [3] [4]

Working Conditions

[1] [2] [3] [4]

Activity Interaction (if a process in the work-cycle run into-
-problems, the following process cannot start.)

[1] [2] [3] [4]

4 External Conditions

1	2	3	4
Extremely Relevant	Relevant	Not Too Relevant	Not At All Relevant

Economy (Economic Crisis)

[1] [2] [3] [4]

Changes in The Scopes and Complexity of Works

[1] [2] [3] [4]

Information Systems and Technology (Low Computing Usage)

[1] [2] [3] [4]

Research and Development (Low Expenditures)

[1] [2] [3] [4]

Please rank, in ascending order from the most important [1] to the least important [4], the main categories that you think will affect productivity in the construction industry.

Main Categories			
1	2	3	4
Management Systems and Strategies			
1	2	3	4
Manpower			
1	2	3	4
Industry Environment			
1	2	3	4
External Conditions			
1	2	3	4

If you know of any other factors that you think will affect productivity in construction, please write them down in the box below.

[Part 2]:

Section 2: Methods to Improve Labor Productivity in the Construction Industry

This section presents a series of statements organized in four major areas:

1. Management Systems and Strategies
2. Manpower
3. Technology
4. New Techniques

For each statement you must decide how effective it is in improving labor productivity in construction. At the end of the section you must rank each one of the four areas according to their relative level of importance in improving labor productivity levels.

1 Management Systems and Strategies

1	2	3	4
Very Effective	Effective	Not Really Effective	Absolutely Not Effective

Improve Procurement Management (Delivery of Equipments and Materials)

[1] [2] [3] [4]

Improve Administrative Systems (Operation Management)

[1] [2] [3] [4]

Improve Strategic Management (Planning Systems)

[1] [2] [3] [4]

Improve Safety System and Management

[1] [2] [3] [4]

2 Manpower

1	2	3	4
Very Effective	Effective	Not Really Effective	Absolutely Not Effective

Improve Training Programs

[1] [2] [3] [4]

Enhance Workers' Motivations (Salary, Working Conditions, etc)

[1] [2] [3] [4]

Increase Supervisions (Work Harder)

[1] [2] [3] [4]

Improve Methods (Work Smarter)

[1] [2] [3] [4]

3 Technology

1	2	3	4
Very Effective	Effective	Not Really Effective	Absolutely Not Effective

Apply Computer-Integrated Manufacturing (CIM) Concepts to Construction (CIC)
(using more computerized systems)

[1] [2] [3] [4]

Enhance Information Technology Systems

[1] [2] [3] [4]

Increase Research and Development Expenditures

[1] [2] [3] [4]

Increase Capital Investments (Equipment, Technology, etc)

[1] [2] [3] [4]

4 New Techniques

1	2	3	4
Very Effective	Effective	Not Really Effective	Absolutely Not Effective

Use Goal Setting Method (Short Term Goal Setting)
(set up goals as benchmarking in each step to encourage workers)

[1] [2] [3] [4]

Apply Total Quality Management (TQM) Concepts to Construction
(control the quality of products and use customers' expectations as goals)

[1] [2] [3] [4]

Apply Project Orientation Programs
(to help workers understand what they do)

[1] [2] [3] [4]

Collaboration: Apply Decision-Making Methods, Evaluation and Feedback Techniques
(set up meeting times to receive workers' feedback from every working area-
-and let them share ideas together to achieve the best results)

[1] [2] [3] [4]

Please rank, in ascending order from the most important [1] to the least important [4], the main categories that you think will improve productivity in the construction industry.

Main Categories			
1	2	3	4
Management Systems			
1	2	3	4
Crew, Worker, Manpower			
1	2	3	4
Technology			
1	2	3	4
Apply New Techniques			
1	2	3	4

If you know of any other methods that you think will improve productivity in construction, please write them down in the box below.

[Evaluator's Information]:

EVALUATOR'S INFORMATION: Type of Company

1. Owner
2. Consultant
3. Electrical Contractor
4. Mechanical Contractor
5. General Contractor
6. Others

EVALUATOR'S INFORMATION: Size of Company (by numbers of employees)

1. Small (1-99)
2. Middle (100-249)
3. Large (250 or more)

EVALUATOR'S INFORMATION: Position of Evaluator

1. Owner

2. Manager

3. Supervisor

Thank you very much for your opinion!

APDX C-3: Construction Drivers and Opportunities Survey Data.

CONSTRUCTION LABOR PRODUCTIVITY WEB-SURVEY RESULTS

Factors that Affect Labor Productivity in The Construction Industry: Drivers

	Extremely Relevant		Relevant		Not Too Relevant		Not At All Relevant	
	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)
Management Systems and Strategies								
1) Management Skills	50	78.13	14	21.88	0	0.00	0	0.00
2) Scheduling	50	78.13	14	21.88	0	0.00	0	0.00
3) Material & Equipment Management	32	50.00	26	40.63	0	0.00	6	9.38
4) Quality Control	16	25.00	44	68.75	4	6.25	0	0.00
Manpower								
1) Experience	54	84.38	10	15.63	0	0.00	0	0.00
2) Activity Training	50	78.13	14	21.88	0	0.00	0	0.00
3) Education	36	56.25	28	43.75	0	0.00	0	0.00
4) Motivation	30	46.88	32	50.00	2	3.13	0	0.00
5) Seniority	12	18.75	42	65.63	8	12.50	2	3.13
Industry Environment								
1) Adverse Weather	36	56.25	20	31.25	8	12.50	0	0.00
2) Uniqueness	28	43.75	32	50.00	4	6.25	0	0.00
3) Working Conditions	26	40.63	38	59.38	0	0.00	0	0.00
4) Activity Interactions	18	28.13	44	68.75	2	3.13	0	0.00
5) Subcontractor Integration	12	18.75	46	71.88	6	9.38	0	0.00
External Conditions								
1) Scope Changes	12	18.75	46	71.88	4	6.25	2	3.13
2) Economy	6	9.38	46	71.88	10	15.63	2	3.13
3) Research & Development	10	15.63	34	53.13	14	21.88	6	9.38
4) Information Technologies	2	3.13	44	68.75	12	18.75	6	9.38

Ranking the main categories themselves:

	Important level 1		Important level 2		Important level 3		Important level 4	
	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)
1) Management Systems and Strategies	36	56.25	16	25.00	12	18.75	0	0.00
2) Manpower	22	34.38	28	43.75	10	15.63	4	6.25
3) Industry Environment	8	12.50	9	14.06	30	46.88	17	26.56
4) External Conditions	4	6.25	2	3.13	8	12.50	50	78.13

CONSTRUCTION LABOR PRODUCTIVITY WEB-SURVEY RESULTS

Methods to Improve Labor Productivity in The Construction Industry: Opportunities

	Very Effective		Effective		Not Really Effective		Absolutely Not Effective	
	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)
Management Systems and Strategies								
1) Improve Strategic Management	37	57.81	17	26.56	7	10.94	3	4.69
2) Improve Procurement Management	24	37.50	40	62.50	0	0.00	0	0.00
3) Improve Administrative Systems	23	35.94	26	40.63	12	18.75	3	4.69
4) Improve Safety System and Management	17	26.56	39	60.94	6	9.38	2	3.13
Manpower								
1) Improve Methods	49	76.56	15	23.44	0	0.00	0	0.00
2) Improve Training Programs	46	71.88	16	25.00	1	1.56	1	1.56
3) Enhance Worker Motivation	33	51.56	31	48.44	0	0.00	0	0.00
4) Increase Supervisions	6	9.38	43	67.19	13	20.31	2	3.13
Technology								
1) Increase Capital Investment	11	17.19	50	78.13	2	3.13	1	1.56
2) Enhance Information Technology Systems	10	15.63	41	64.06	11	17.19	2	3.13
3) Increase Research & Development	14	21.88	32	50.00	15	23.44	3	4.69
4) Apply Computer-Integrated Manufacturing (CIM) Methods to Construction	5	7.81	26	40.63	31	48.44	2	3.13
New Techniques								
1) Project Orientation	34	53.13	20	31.25	8	12.50	2	3.13
2) Goal Setting	15	23.44	44	68.75	3	4.69	2	3.13
3) Collaboration	14	21.88	45	70.31	3	4.69	2	3.13
4) Total Quality Management (TQM)	15	23.44	35	54.69	11	17.19	3	4.69

Ranking the main categories themselves:

	Important level 1		Important level 2		Important level 3		Important level 4	
	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)	Absolute Values	Percentages (%)
1) Management Systems and Strategies	36	56.25	20	31.25	5	7.81	3	4.69
2) Manpower	24	37.50	32	50.00	6	9.38	2	3.13
3) Technology	7	10.94	10	15.63	35	54.69	12	18.75
4) New Techniques	9	14.06	17	26.56	7	10.94	31	48.44

CONSTRUCTION LABOR PRODUCTIVITY WEB-SURVEY RESULTS

EVALUATOR'S INFORMATION : Type of Company

	Number of Responses	Response Ratio (%)
1) Owner	6	9.38
2) Consultant	12	18.75
3) Electrical Contractor	19	29.69
4) Mechanical Contractor	4	6.25
5) General Contractor	19	29.69
6) Others	4	6.25

EVALUATOR'S INFORMATION : Size of Company (by numbers of employees)

	Number of Responses	Response Ratio (%)
1) Small (1--99)	33	51.56
2) Middle (100--249)	16	25.00
3) Large (250 or more)	15	23.44

EVALUATOR'S INFORMATION : Position of Evaluator

	Number of Responses	Response Ratio (%)
1) Owner	10	15.63
2) Manager	33	51.56
3) Supervisor	21	32.81