



**MEASURING PRODUCTIVITY
AND EVALUATING INNOVATION IN THE
U.S. CONSTRUCTION INDUSTRY**

Building Futures Council
2300 Wilson Boulevard, Suite 400
Arlington, Virginia 22201
www.TheBFC.com



The Building Futures Council (BFC) would like to acknowledge the following task group members and individuals that contributed to this white paper:

BFC Productivity Task Group Members:

Chair: Derish M. Wolff, Chairman, Berger Group Holdings, East Orange, NJ

Task Group

Members: Jack Chiaverini, Chairman, Building Futures Council, San Anselmo, CA
Richard Van Duzer, Attorney, Farella Braun & Martel LLP, San Francisco, CA
Fernando Espana, Strategic Project Solutions, San Francisco, CA
Kevin Lathan, Construction E Link, Inc., Clearwater, FL
Bruce Miller, President, BFM Inc., Englewood, CO
Tom Sorley, President and CEO, Rosendin Electric, Inc., San Jose, CA
Leah Rockwarg, Partner, Gadsby Hannah LLP, Boston, MA
Joan Rockwell, Alexandria, VA
Ed Schreiber, Chairman, Building Technology Associates, Inc., Oak Park, MI

Principal

Researcher: Marc Luppino, Staff Economist, The Louis Berger Group, Current Doctoral Student, UCLA Department of Economics

Editors: Amy Fields, Program Coordinator, Building Futures Council
Damian Hill, Assistant Executive Director, Building Futures Council

Special thanks are in order to:

Paul Goodrum, Assistant Professor, University of Kentucky, Lexington, KY
Lisa Usher, Division of Industry Productivity Studies, Office of Productivity and Technology, Bureau of Labor Statistics, Washington, D.C.

Building Futures Council

The Building Futures Council (BFC) is a national, non-profit, private organization composed of building and construction industry decision makers concerned with challenges and rewards of the built environment. The mission of the BFC is to act collectively as a think tank to identify critical issues encountered in the building and construction process, analyzing, discussing and advocating guidelines and criteria for improving efficiency in the process and furthering the overall well-being of our nation.

Executive Summary

The objective of this White Paper is to encourage the Bureau of Labor Statistics (BLS) to continue its initial efforts and introduce and establish improved construction productivity measurement metrics so that productivity changes throughout the construction industry are properly reported and appropriately measured.

This paper reviews current productivity measurement literature, particularly that pertaining to the construction industry, discusses the need, and offers recommendations, for improved measurement of productivity in the Industry. In general, detailed construction productivity measurement has been avoided by U.S. government analysts due to a lack of adequate data and a lack of professional and academic consensus on appropriate measurement techniques and the significance of these techniques.

Statistics on long-term productivity trends are generally available for many industries in the U.S., particularly in goods-producing sectors like mining and manufacturing. The same cannot be said for the construction industry. This discrepancy is primarily due to the measurement difficulties regarding real inputs and outputs unique to the construction industry. Most of the problem involves measurements of output, particularly the problem of controlling for the change in quality in the inflation indices. The use of proxy indices in construction also contributes to the problem (e.g. using the Census Housing Index to deflate commercial and military construction). While the input data is measured in hours worked by the BLS, output is measured by the Census Bureau. In comparison to other industrial sectors, it appears a number of analysts believe, even in the absence of agreed measurable data that construction productivity growth was above average in the 1960s and early 1970s and below average in the 1990s. Furthermore, there is a perception within the U.S. construction industry that significant potential exists for developing more effective measurement processes and that evaluation of the data generated from those processes would guide and encourage increased productivity.

There have been few studies aimed at accurately quantifying construction productivity growth and future studies are surely needed to maintain a healthy U.S. construction industry. Initial studies should focus on analyzing and perhaps redefining the unique characteristics of the diverse sub-sectors of the construction process and establishing appropriate measurements of inputs and outputs. National estimates of costs of labor, material, and equipment compared to the price of the finished products may not, given the complexity of the sector, produce the most accurate or beneficial productivity data. Thus, productivity factors should, where practical, be qualified by geography, type of the product, material, etc. Future studies should also pay particular attention to recent industry innovations, such as increased offsite fabrication, new materials and improved communications, and attempt to gauge the impact of these innovations on construction productivity.

The U.S. construction industry is a significant factor in the U.S. economic landscape. While creating the very support environment required for most other industrial sectors construction spending totals nearly nine percent¹ of the Gross Domestic Product (GDP).

Yet despite its importance, the BLS has not developed productivity measures for this industry. The impact of this is significant. The industry is often criticized as unprogressive, archaic, and conservative. This perception is unfounded and in many ways discourages the very talent needed to properly fuel growth and productivity.

Collectively the industry has made significant strides in recent years in developing safer work sites, shorter construction time lines, more resilient products and systems that make the built environment more productive and efficient for the industries that occupy the facilities built.

The reason given by BLS for not producing adequate measurements of production in the construction industry is the difficulty of measurement given data limitations. Over the years studies have been made by several research organizations to develop improved measurements. There remains however, much debate about their accuracy or effectiveness and these limited attempts have discouraged efforts to develop and institute improved standards for measuring productivity.

In spite of these difficulties, we believe that BLS should develop, publish and monitor measures that the industry could use to evaluate and improve their practices.

¹ The value of construction put in place in 2004 was \$1 trillion, more than 8.5% of the gross domestic product of \$11.7 trillion, according to Commerce Department data.

I. Introduction to Productivity Terminology

In general, productivity signifies the measurement of how well an individual entity uses its resources to produce outputs from inputs. Moving beyond this general notion, a glance at the productivity literature and its various applications quickly reveals that there is neither a consensus as to the meaning nor a universally accepted measure of productivity. Attempts at productivity measurement have focused on the individual, the firm, selected industrial sectors, and even entire economies. The intensity of debate over appropriate measurement methods appears to increase with the complexity of the economic organization under analysis.

There are, however, a number of different productivity measures that are commonly used. Choosing between them usually depends on the purpose of the productivity measurement and the availability of data. Productivity measures can broadly be placed into two categories. Single factor, or partial, productivity measures relate a particular measure of output to a single measure of input, such as labor or capital. Multi-factor or total productivity measures (MFP) relate a particular measure of output to a group of inputs, or total inputs used. Productivity measures can also be distinguished by whether they rely on a particular measure of gross output or on a value-added concept that attempts to capture the movement of output. Of the most frequently used MFP measures, capital-labor MFP relies on a value-added concept of output while capital-labor-energy-materials MFP (KLEMS) relies on a particular measure of gross output².

The five most widely used productivity concepts are³:

1. *Labor productivity, based on gross output.* This productivity measurement traces the labor requirement per unit of output. It reflects the change in the input coefficient of labor by industry and is useful for the analysis of specific industry labor requirements. Its main advantage as a productivity measure is its ease of measurement and readability; particularly, the gross output measure requires only price indices on gross output. However, since labor productivity is a partial productivity measure, output typically reflects the joint influence of many different factors.
2. *Labor productivity, based on value-added.* Value-added based labor productivity is useful for the analysis of micro-macro links, such as an individual industry's contribution to economy-wide labor productivity and economic growth. From a policy perspective, it is important as a reference statistic in wage bargaining. Its main advantage as a productivity measure is its ease of measurement and readability, though it does require price indices on intermediate inputs, as well as to gross output data. In addition to its limitations as a partial productivity measure, value-added labor productivity have several theoretical and practical drawbacks including the potential for double counting production of benefits and double deflation (see 3 below).

² OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity Growth. Paris: Organization for Economic Cooperation and Development, March 2001. <http://www.oecd.org/subject/growth/prod-manual.pdf>

³ Ibid.

3. *Capital-labor MFP, based on value-added.* This productivity measurement is useful for the analysis of micro-macro links, such as the industry contribution to economy-wide MFP growth and living standards, as well as, for analysis of structural change. Its main advantage as a productivity measure is the ease of aggregation across industries. The data for this measurement is also directly available from national accounts. The main drawback to the value-added based capital-labor MFP is that it is not a good measure of technology shifts at the industry or firm level. It also suffers the disadvantage of other value-added measures that have been double deflated with a fixed weight Laspeyres quantity index.
4. *Capital productivity, based on value-added.* Changes in capital productivity denote the degree to which output growth can be achieved with lower welfare costs in the form of foregone consumption. Its main advantage as a productivity measure is its ease of readability but capital productivity suffers the same limitations as other partial productivity measurements.
5. *KLEMS Multi-factor productivity.* KLEMS-MFP is used in the analysis of industry-level and sectoral technical change. It is the most appropriate tool to measure technical change by industry because it fully acknowledges the role of intermediate inputs in production. Domar's aggregation of KLEMS-MFP across industries renders an accurate assessment of the contributions of industries to aggregate MFP change. The major drawback to KLEMS-MFP is its significant data requirements, in particular timely availability of input-output tables that are consistent with national accounts. It is also more difficult to communicate inter-industry links and aggregation across industries using KLEMS-MFP than in the case of value-added based MFP measures.

II. Trends in U.S. Productivity Growth

The golden age of American productivity began around 1913 and lasted until the early 1970s. U.S. productivity growth during this period was much faster than both the preceding and following periods. This trend has been characterized as the “big wave.” From 1870, multi-factor productivity growth was slow until 1890, accelerating and reaching its peak in the five or six decades starting around the First World War. It then decelerated to the point where the period between 1973 and 1996 reached a similar rate to that of 1870 to 1913. Data from BLS clearly demonstrates this deceleration in productivity growth. Annual labor productivity growth averaged 2.87 percent between 1947 and 1973 compared to 1.35 percent between 1973 and 1995. Total factor productivity growth experienced a similar trend with an average annual growth rate of 1.87 percent between 1948 and 1973 compared to 0.40 percent between 1973 and 1995⁴.

In explaining the big wave, Dr. Robert Gordon at Northwestern University, has paid primary attention to the many significant inventions of the late 19th and early 20th centuries. He specifically identified four major clusters of inventions. The first was electricity, including both electric light and the electric motor. Electricity drastically reduced the true price of light and electric motors revolutionized manufacturing by decentralizing the source of power and by making possible flexible and portable tools and machines. The second was the internal combustion engine, which made possible personal autos, motor transport, air transport, and which led to suburbs, interstate highways, and supermarkets. Many of the ills of the 19th century, from manure to unplowed snow to putrid air to rural isolation, were gradually eliminated or significantly reduced as a result of the internal combustion engine. The third group of inventions included petroleum and all molecular-engineering related processes, such as petrochemicals, plastics, and pharmaceuticals. These innovations helped to reduce air pollution created by the previous reliance on coal as a main energy source, as well as making possible many new and improved products, some of which conquered illness and prolonged life. The final group of inventions was the complex of entertainment, communication, and information innovations developed before the Second World War. This set of inventions which made the world smaller traced back to the invention of the telegraph in 1844 and included the telephone, radio, movies, television, recorded music, and mass-circulation newspapers and magazines. According to Gordon, these four groups of inventions also created an increase in per-capita income and wealth that allowed an improvement in living standards even in those aspects of consumption where the inventions did not play a direct role⁵.

Changes in the size and composition of the U.S. labor-force may also have directly influenced trends in U.S. productivity growth. In the period before the First World War, immigrants were employed mainly in manufacturing. It is possible that their presence in the manufacturing labor market dampened real wage increases and delayed the introduction of labor-

⁴ Stiroh, Kevin J. “Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?” Federal Reserve Bank of New York, 24 January, 2001. p. 3.

⁵ Gordon, Robert J. “Interpreting the ‘One Big Wave’ in U.S. Long-term Productivity Growth.” Cambridge, MA: National Bureau of Economic Research, June 2000. pp. 33-35.

saving equipment. The “big wave” period of heightened productivity growth roughly coincides with the shutting off of mass immigration in the 1920s and the slow growth of the labor-force between 1930 and 1965. Resulting rising wages for low-skill workers during this period may have in turn stimulated efficiency improvements that boosted productivity. This stimulus for innovation could have subsequently deteriorated with the increased entry of teenagers and adult females into the labor force in the 1970s followed by legal and illegal immigrants in the 1980s. These new entrants have predominately gone into unskilled service jobs and may have held down the real wage in services, a sector of growing importance to the U.S. economy.

It appears that the U.S. entered a productivity revival in the late 1990s. This may have been due in part to a tightening of the labor market⁶. As a result, the national unemployment rate declined from just under six percent in 1995 and stabilized around four percent at the end of the 1990s. It is possible that concerns over rising wages also encouraged managers to explore information technology (IT) innovations as a means of improving firm performance. At any rate, IT use has spread rapidly through the U.S. economy and there is now consensus that both the production and use of IT have contributed substantially to the recent aggregate productivity revival. Data from the BLS clearly demonstrates this acceleration in productivity growth. Annual labor productivity growth averaged 2.67 percent between 1995 and 2000 compared to 1.35 percent between 1973 and 1995. Total factor productivity growth experienced a similar trend with an average annual growth rate of 1.26 percent between 1995 and 2000 compared to 0.40 percent between 1973 and 1995⁷. Still, the IT-led productivity revival has not been able, as yet, to match the productivity gains accomplished during the “big wave.”

⁶ In order to enhance client satisfaction, as well as for management convenience, modern service sector organizations often overstaff in the face of high staff turnover rates. But with growing labor shortages in the late 1990s in the U.S., these practices could no longer be easily sustained. This most likely contributed, at least in part, to rising productivity.

⁷ Stiroh, p. 3.

III. Productivity Measurement Difficulties

As American society has grown and changed, the U.S. economy has become increasingly more dynamic and complex. As a result, economic measurement and analysis, particularly relating to productivity, have become more difficult and complicated. The main problem involves properly defining units of measurement, evaluating qualitative changes and obtaining reliable data for both inputs and outputs. This process is further complicated by the need to price-deflate this data in order to evaluate changes in productivity in real terms.

Measurement of inputs is problematic. Variations in the rate of input utilization are at best partially picked up in data series. In particular, the rate of capital equipment utilization, i.e. the measurement of machine hours, is rarely accomplished.

Labor input, if measured by hours actually worked, is better suited to reflect the changing rate of manpower utilization, but remains an imperfect measure^{8 9}. The increasing prominence of the service sector within the national economy has generated increased mismeasurement of labor hours. Information technology may aggravate this measurement error by allowing increased work flexibility and longer effective workdays that are not properly captured by the official statistics¹⁰.

According to the current position of the BLS, inputs are relatively well measured while measuring output is more difficult due to the introduction of new goods, quality change, and inadequate price data for parts of the non-manufacturing economy¹¹. Particularly, in measuring service-based industries, researchers have encountered several problems defining the basic unit of output. These include: enumerating the elements of a complex group of services; choosing among alternative representations of an industry's output; accounting for the consumer's role in the generation of the service output; and distinguishing between value-added and gross output data series¹².

There is also general concern for the poor quality of the price deflation. The Bureau of Economic Analysis (BEA) uses price indexes to deflate nominal magnitudes, but these price indexes are for goods or services which may not represent the full range of outputs of a given sector¹³. For services, it is especially difficult to distinguish between changes in price over time and changes in real output due to quality improvements.

There are potentially numerous quality-determining characteristics of particular services, and changes or variations in any given characteristic may be large. Thus measuring the quality

⁸ OECD Productivity Manual. p. 115.

⁹ Exposure reports to the insurance industry in the construction industry might prove useful.

¹⁰ Stiroh. p. 8.

¹¹ Dean, Edwin R. "The Accuracy of the BLS Productivity Measures." *Monthly Labor Review*, 1999, 24-34.

¹² Sherwood, Mark K. "Difficulties in the Measurement of Service Outputs." *Monthly Labor Review*, March 1994, p. 12.

¹³ Nordhaus, William D. "New Data and Output Concepts for Understanding Productivity Trends." Cambridge, MA: National Bureau of Economic Research, January 2001. p. 12.

dimension properly is crucial in order to determine real output. Unfortunately, it is often very difficult to do so¹⁴.

Measurement difficulties have specifically hampered productivity analysis of the construction industry. There is a general consensus that current construction data does not provide an adequate nor accurate measure of productivity.

The BEA does not report input data for construction because of measurement issues. There also exist well-established problems in finding appropriate price indexes for the various components of this industry in order to determine real output. For example, according to the Boskin Commission, there are numerous difficulties in measuring the quality of the housing stock and there is potentially a 0.25 percent annual upward bias in the price index for housing¹⁵.¹⁶ Thus, citing a lack of suitable data, the BLS does not publish information on productivity and unit labor costs for construction¹⁷.

Furthermore, the BLS has stated:

The BLS Producer Price Index (PPI) program has recently started an initiative to develop output price indexes for the nonresidential building construction sector, beginning with warehouse construction. However, BLS is not likely to develop and publish productivity measures for construction until data is available for several years, because BLS prefers to focus their analysis on productivity trends over time. As a result, BLS does not currently have plans to develop productivity measures for the construction industries in the near future¹⁸.

But, the Building Futures Council believes most entities in the construction industry rely heavily on their cost data and almost all the information required to properly measure productivity is available in disaggregated form.

¹⁴ Sherwood. p. 15.

¹⁵ Nordhaus. p. 13.

¹⁶ One leading expert, Paul Goodrum, Assistant Professor, University of Kentucky, claims that "...the predominate problem with the Census Housing Price Index is that it measures quality characteristics of new homes based on a 1974 style home. Quality improvements in new homes that have occurred since then provide overestimates of inflation, which produce underestimates of output and underestimates of productivity". March 2005.

¹⁷ Haas, Borcharding, Allmon, and Goodrum. "U.S. Construction Productivity Trends, 1970-1998." Austin, TX: Center for Construction Industry Studies, March 1999, p. 1.

¹⁸ Usher, Lisa, Chief, Division of Industry Productivity Studies, Office of Productivity and Technology, Bureau of Labor Statistics, Washington D.C., January 2005.

IV. Attempts at Measuring Construction Productivity

There are few available studies of construction productivity trends. Between 1959 and 1976 the BLS completed a number of studies of materials and labor requirements for various types of construction. The primary goal of these studies was to assess the impact of construction expenditures on employment. Data collected at different points in time allowed for some assessment of changes in labor requirements. However, BLS did not consider the data sufficient to develop productivity series for the construction industry.

In the mid-1980s, Steven G. Allen, an economics professor at North Carolina State University, published research on construction labor productivity trends¹⁹. His research closely followed basic productivity trend analysis of unpublished BLS data on labor and material requirements for the construction industry. Allen estimated a Cobb-Douglas production function over data from the 1972 and 1977 Census of Construction Industries (CII) to determine the impact of capital-labor ratio, economies of scale, labor quality, percent unionization of the labor force, composition of output, and distribution of construction projects on construction productivity²⁰. He also derived a new price deflator for nonresidential building construction based largely upon F.W. Dodge data on the value and square footage of various types of projects. This deflator depended on the assumption that square footage was a reasonable proxy for output.

In the late 1990s, the Center for Construction Industry Studies (CCIS) of the University of Texas at Austin issued a report on U.S. construction labor productivity trends²¹. In conducting their study, the group of University of Texas economists chose to study a limited number of representative tasks of the construction industry²². Selection of tasks to be studied focused on achieving a range of technological intensity while maintaining variety in terms of trade and sector. Technological intensity was roughly defined as the ratio of equipment to labor cost per unit output. The benchmark values considered in the study were the unit labor cost and unit output figures given in Means Building Construction Cost Data, published by R.S. Means Company. The Consumer Price Index was the price deflator utilized in the study. The CCIS team also compiled a series of work sampling studies from the Austin area spanning a 25-year time period in order to track direct work rate trends of construction laborers²³. Work rate trends were then compared to their estimated productivity trends.

¹⁹ Allen, Steven G. "Why Construction Industry Productivity is Declining," NBER Working Papers 1555, National Bureau of Economic Research, 1985.

²⁰ The Cobb-Douglas function is the simplest, widely-used production function in economics. It has the following form: $Q=L^a*K^b$, where Q stands for output, L for labor, and K for capital. The exponential parameters, a and b , are estimated from empirical data.

²¹ Haas et al.

²² Selected tasks included: residential framing, commercial web joist construction, compaction, hand-trenching, welded steel pipe installation, and ceiling tile installation. See Haas et al., pp. 9-17.

²³ Work sampling measures how time is utilized by the labor force and serves as an indirect measurement of construction site productivity. During work sampling, observations of what each worker is doing at a particular instant are made and recorded. The activities of workers are normally divided into three categories: Direct Work, Supportive Work, and Delay. The three categories are typically defined as follows: Direct Work includes productive actions, picking up tools at the area where the work is taking place, measurement on the area the work is taking place, holding materials in place, inspecting for proper fit, putting on safety equipment, and all clean-up; Supportive Work includes supervision, planning or instruction, all travel, carrying or handing materials or tools, and walking empty-handed to get materials or tools; Delay includes waiting for another trade to finish work,

The CCIS study collected 50 to 60 data points from Means catalogs for each case study. The authors of this report have recommended that follow-up studies using the same methodology should expand into a wider range of construction activities distributed over construction sectors and degrees of technological intensity. Subsequent studies should more precisely define technological intensity in order to account for the significance of other factors, such as complexity, required skill level, required planning, and interaction with other tasks. Technology measurements should also be directly specified²⁴.

Ultimately, by collecting a reduced number of data points per activity and by expanding the number of activities studied, a broader and more statistically significant picture of the overall productivity trends for the U.S. construction industry could be obtained. A larger sample size would allow for a greater statistically significant correlation to be investigated between technological change, depressed real wages, and productivity improvement²⁵.

standing, sitting or any non-action, personal time, and late starts or early quits. The direct work rate is calculated as the percentage of time spent on Direct Work in all working hours. See Haas et al., p. 18.

²⁴ Ibid., p. 3.

²⁵ Ibid., pp. 24-25.

V. Trends in U.S. Construction Productivity

Despite the previously described studies, there is little scholarly consensus concerning even the direction of U.S. construction productivity trends. Current perceptions of productivity trends also have not been well quantified.

According to estimates by Allen, between 1948 and 1968 labor productivity may have grown more rapidly in construction than in manufacturing, finance, retail trade, and services. Between 1950 and 1968, real output per hour rose at an annual rate of 2.2 percent, possibly reflecting unsatisfied demand for new residential construction following low production levels during the Great Depression and World War II. For the period between 1968 and 1978, productivity continued to grow in most other sectors of the economy; but except for a brief upturn between 1974 and 1976, construction productivity steadily declined over the same period at an annual rate of 2.4 percent. According to Allen's estimates based on unpublished BLS data, only the mining sector had worse productivity performance for that period²⁶. In addition, estimates based on the conventional growth accounting framework suggested a 21.4 percent drop in labor productivity between 1968 and 1978, while estimates based on Allen's production function approach suggested only an 8.8 percent decline. Between 1977 and 1984, the BLS index of values of output per worker declined an additional 15.1 percent²⁷.

A 1986 review of construction productivity concluded, however, that it was difficult to conclusively demonstrate an actual decrease in construction productivity in the first half of 1980s. This study found no clear trend in the labor to output ratio that would indicate changes in productivity. It found that technological change had produced no significant effect on residential productivity and that trends toward industrialized housing and prefabricated components remained stable²⁸. The study also detected little to no change in the concentration of producers as of 1982. Still, it concluded with almost certainty that construction productivity growth had been slower than in most other industries in the United States²⁹.

A 1993 National Association of Home Builders' (NAHB) study suggested that productivity in home building might be lower than in other types of construction³⁰ and limited data on special trade establishments obtained from the Census on Construction suggested that output per worker was lower for those that specialized in residential construction. The NAHB study also expanded on previous work and found that residential construction productivity had not risen above the levels measured in 1969 and 1971.

²⁶ Allen, p. 1.

²⁷ "Labor Shortages and Productivity in the Home Building Industry: Background Paper for the 1998 Building Industry Technology Roundtable." National Association of Home Builders Research Center, 1998, p. 11.

²⁸ One reason for this finding may be that offsite construction productivity savings are often assigned to manufacturing sub-sectors.

²⁹ Jack Fawcett Associates, *The Impacts of Structural Change in Residential Construction Employment*, Submitted to: U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C., 1986, p.111.

³⁰ NAHB Research Center 1998, p. 12.

A 1999 study conducted by the Center for Construction Industry Studies (CCIS) of the University of Texas at Austin found no overall decrease in construction productivity between 1970 and 1998. According to this study, overall productivity may have decreased during the 1970s but recovered in the 1980s. The study provided unpublished BLS data on construction total factor productivity (TFP) that would appear to back this assessment of productivity trends. While not all of the tasks studied within the CCIS report demonstrated increased output, though the majority did so, all tasks reflected decreasing unit labor costs in real terms. The authors of this study argued that both trends signaled an increase in productivity and estimated dramatic productivity increases for some construction tasks, such as a 500 percent increase for ceiling tile installation during the early 1990s and a 260 percent increase in compaction³¹.

The CCIS report also included an indirect analysis of productivity, based on work sampling reports and direct work rates. The CCIS work sampling analysis found that direct work rates have not changed much over the last two decades, at least, in the Austin area. This stagnation may be due to the static nature of the construction labor force and to the lack of management and supervision improvements over the past two decades. According to these findings, it appears that while construction productivity may have increased in the 1990s, there is still significant room for improvement³².

³¹ Haas et al., pp. 21-23.

³² Ibid., p. 19.