MEASURING PRODUCTIVITY:
An Industry Challenge

Is the design and construction industry more productive today than it was a decade ago? Is it matching the achievements in productivity attained by other industries? Are technological advances being applied to the fullest possible extent? The answers may require a critical look at the data in current use and will definitely require consensus regarding productivity metrics. A collaborative approach will help the industry move forward.

By Harvey M. Bernstein

At a meeting organized in early May in Washington, D.C., by ASCE’s Civil Engineering Research Foundation (CERF), industry experts examined the widespread assumption that the design and construction industry is failing to achieve the productivity gains that have been seen in other industries in recent years. In fact, at the industry level, available data indicate that productivity is declining. In explaining why this assumption has gained currency, the participants at the meeting called particular attention to the need for performance metrics and reliable data and stressed the inadvisability of using a single factor to measure productivity. As an outgrowth of that meeting, CERF will be focusing special attention on finding collaborative ways to measure industry productivity as a first step in helping to improve industry performance. In this article CERF’s president and chief executive officer discusses the issue and describes what needs to be done to bring productivity into sharper focus. Readers are encouraged to e-mail their comments and suggestions to president@cerf.org.

A lack of reliable and meaningful information is preventing the construction industry from attaining a clear vision of productivity as it relates to design and construction. At the same time, there is strong interest in improving productivity as the industry works to conserve, design, and construct a sustainable and secure infrastructure for the 21st century. ASCE’s Civil Engineering Research Foundation (CERF) is helping the industry gain a better understanding of this subject. There is anecdotal evidence that great strides are being made in certain sectors of the industry, but the lack of widely accepted metrics and credible data makes it difficult to fully understand and evaluate the progress, as well as to devise strategies to extend these advances to other sectors.

Productivity has long been a competitive strategy for the industry; however, a variety of economic and technical challenges facing the industry require changes in the way that productivity is defined and measured. Understanding productivity in the construction industry is a complex, multifaceted task made more difficult by the very nature of the industry. The difficulties arising from familiar issues of low profit margins, small firm sizes, and industry fragmentation have been exacerbated by international competition, environmental issues, higher performance and security demands, and limitations on the supply of skilled labor and other resources. As a result, the leading engineering firms are coming to see improvements in productivity as a survival strategy and endeavoring to do better in this regard, but other parts of the industry are less able to directly address the issue. Consequently, there may not be a single adequate, universal measure of productivity for the entire design and construction industry.

As discussed by Roger Flanagan (“Productivity and Competitiveness,” CERF, 2003) and Norbert Young (“Review of Industry Productivity,” CERF, 2003) in their presentations at the CERF gathering in May, there is substantial innovation in productivity among the leading firms in the industry. They noted that the industry is today building structures of greater complexity and higher quality than in the past and is doing so in shorter periods of time. Information technology is spreading and organizing the process of project delivery and is also making its presence felt in operation and maintenance activities. It would therefore be unfair and inaccurate to say that productivity is declining across the board in the construction industry. While there are certainly areas that have suffered a loss in productivity, other areas have experienced strong growth through innovation and positive, energetic, and creative management. Unfortunately, the vast majority of the industry is well behind the curve of rising productivity, and some evidence indicates that the overall productivity of the U.S. construction industry is on a downward trend (see figure 1). Moreover, as shown in figure 2, which applies to Canada, this problem is not confined to the United States.

The larger question is whether these data reflect factors that are appropriate for defining the productivity of the construction industry. Even more to the point, is it really possible to measure productivity at the macro level of an industry or should it be measured for various industry functions? Certainly, the means to define and measure productivity must be established before the industry can effectively devise strategies to increase productivity.
Reading, in the United Kingdom, states that one problem with measuring construction productivity is that it has multiple factors, and these complicate any diagnosis of problems inherent in the industry. He also notes that since the metrics for several of these factors are mutually exclusive, partial measurements will not be able to offer meaningful insights into the larger productivity puzzle. It is, however, possible to examine several factors that influence productivity in concert. These include the skill base and culture of the workforce; technology advances; the size, scope, and type of project; the site conditions and other factors pertaining to the physical environment; the design integration of the project; and the labor/capital ratio. Such a varied list of factors will necessitate careful consideration by all project stakeholders, et cetera), the other dealing with indirect factors, which can be modified only in the longer term.

Defining these relationships and establishing the relative importance of these factors are prerequisites to defining productivity. A satisfactory resolution might also include the explicit development of a value proposition with the owner, that is, explicit agreement on the particular objectives to which productivity is to be applied and on the way in which those objectives relate to profitability. Such an approach could simplify the conventional definition of productivity to include many of its implied characteristics. For example, it might prove possible to develop a definition of productivity that encompassed the efficient delivery of high-quality products and incorporated not only issues of cost-effectiveness but also those of timeliness, flexibility, and durability.

The simplest statement of this approach to productivity issue must begin with the right questions, such as the following:

- What is the purpose and function of the construction project?
- How can the project’s successful completion be gauged?
- What effect does the project delivery process have on project success and to what extent does that process improve or undermine productivity?
- What are the total resources necessary to do the job (labor, materials, equipment, information, funds, et cetera) and how can those resources be used to best effect?

Although its parameters are somewhat unclear as applied to the engineering and construction field, productivity is a universally relevant concept, one that is important because a productive industry is profitable, allowing for growth and innovation. When productivity begins to decline, innovation falters and eventually the industry stagnates. However, this loop can also prove to be positive and self-sustaining, with innovation driving productivity with new breakthroughs in materials and technologies that lead to faster and more efficient project completion, in this way allowing additional investments in new technologies as well as better and more durable products. Furthermore, in many cases the construction industry is its own end user, which makes construction productivity a characteristic that directly benefits those making the necessary investments.

As Flanagan has noted, it is critical for the industry to foster sustained productivity and growth so that there can be a shift from a comparative advantage over past performance to a competitive advantage, which will see increased efficiency and the use of cutting-edge technology by all firms. A productive industry also allows for more efficient risk management. As productivity and, by...
extension, profitability increase, the industry will be better able to absorb the risks inherent in implementing new technologies and business strategies and to face the vicissitudes of the larger business cycle. The connection with profitability may be the most important aspect of defining productivity. Figure 5, which draws on Canadian data, indicates the current crisis in profitability in that country’s construction industry.

**Figure 5** Profitability Is Declining in Canadian Construction

![Graph showing profitability decline](Image 502x351)

While the productivity trends for the construction industry may have been inconclusive and difficult to extrapolate, there are nevertheless valuable lessons to be learned from a careful examination of trends apparent in the available data. Such an examination is a necessary first step in delineating data gaps and formulating meaningful research initiatives.

Leadership in this arena at present is coming from individual firms and groups of firms, since improvements in productivity are to an increasing extent being viewed as conferring a competitive strategy. The successes of these market leaders can be used in mapping out a strategy for creating a healthy, viable, growing, and productive industry. There will have to be a strong commitment to innovation through investments in research and development (R&D). In their book _Solving the Innovation Paradox: Challenges Facing the U.S. Design & Construction Industry_ (ASCE Press, 1996), the authors—A. Lemer and the author of this article—noted that only 0.5 percent of the industry’s budget is devoted to R&D. In order to move forward, the industry will have to change its R&D investment strategies and think in radically new ways.

The most direct way to achieve productivity increases is through innovation—in concepts, tools, and methods. However, innovation in the design and construction industry is not as straightforward as in the manufacturing sector or even the service sector. Construction retains much of the labor-intensive, craft-based structure that evolved over centuries of practice. The innovative tools that have been adopted have improved labor productivity within the craft-based process, but innovation has not had the far-reaching effects that have been seen in other sectors of the economy. Extending the reach of innovation would therefore provide an opportunity for rethinking the construction industry from the ground up.

Several industry leaders at the May gathering called attention to a number of challenges in the current environment that will have to be met in any effort to raise productivity. The most common are labor shortages, the small size of firms, and low profit margins. Real wages are depressed, and there is a lack of incoming skilled labor. As C. Haas noted in his presentation (“The Skilled Workforce Shortage,” CERF, 2003), as skilled workers retire, there are fewer and fewer individuals positioned to take their place, leading to a critical labor shortfall.

Better workforce management will lead to increased retention of skilled labor. Such an approach should form part of a two-tiered strategy that combines practical strategies to manage the current situation with forward-thinking initiatives and innovative approaches to management, training, and communication. Other useful strategies for the longer term could include measures to improve the image and compensation of construction workers and to tailor training programs to meet the needs of both labor and management.

The size of a firm is just one of the characteristics that can vary markedly from one company to another in the industry, but all of these characteristics have a bearing on productivity. For example, a small firm may need to have all of its partners sharing work on many different projects, thereby encouraging multitasking and generalization in order to offer as wide a range of services as possible to potential clients. Although there are efficiency gains to be had from a larger firm that encourages specialization, the benefit is not without its trade-offs. If engineers have a narrow range of proficiency, their ability to cover other areas may be limited. Such fragmentation can result in a loss of time and thus may undermine productivity.

Different firms will also run different profit margins, and the amount of profits drawn by a firm can have a domino effect on its productivity, effectiveness, and ability to deliver products. Small profit margins will mean that less is available for innovation and staffing and that there is less room for error. Firms with small profit margins are far more averse to risk than larger firms, which may be able to absorb the costs and consequences of a project that fails to adhere to its budget or schedule. Companies...
with larger profit margins may take on riskier projects and therefore have more of an incentive to apply innovative techniques or approaches. And because these firms may also have the freedom to undertake different types of projects and the capacity to take on more projects, they have more opportunities to use and benefit from innovative technologies.

To create a healthy, productive construction industry, all sectors of the industry must commit themselves to collaborative action. The most formidable obstacle here is the lack of a common vision of an efficient and productive construction industry. There is agreement with regard to measures of success, and without clear benchmarks it will not be realistic to expect strategies leading to meaningful changes across the industry. The following steps could form part of a collaborative, industry-wide approach to developing a common vision and applying comprehensive productivity models.

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| • Examine international models. Although, as Flanagan points out, the United States ranks among the leaders in overall productivity, there are still many lessons to be learned from other countries. Their approaches to customer service, project management, and overall project dynamics in many ways differ from the traditional U.S. business model and so offer opportunities for comparison. Approaches in widespread use in other countries may serve to improve the U.S. model and to suggest other areas where improvement might be possible. |
| • Examine other industries. Other manufacturing industries may suggest a variety of approaches and techniques that could be profitably applied to the construction industry, and the service sector, too, may have something to teach us. In particular, industries such as medicine, auto service and repair, and computer services bear some similarity to construction in that many of the companies are small and profit margins can be quite low. The increases in productivity that these industries have attained therefore merit careful study. |
| • Build partnerships with the client. Open lines of communication and an ongoing dialogue with the client are essential in any productive construction project. Such a relationship with the client will help each side understand the expectations of the other and therefore minimize the need for postproject corrections because of disagreements over design or design execution. The training given to both management and labor must translate into tangible results that will benefit both the client and the firm. |
| • Modernize logistics. Productivity increases may also be approached from the viewpoint of logistics, the goal here being to streamline the project delivery process. In this endeavor we can use of informa-

Innovation is needed across the board—to visionaries by investing in innovation. The size and breadth of the industry make it difficult to initially establish all-encompassing measures. The industry should therefore first be divided into logical components that lend themselves to measurement in such areas as planning, design, and construction and then into sectors, for example, transportation and buildings. Use the parameters and metrics in initiating programs to encourage and reward best practices. The measures and data collected on a consistent, objective basis will offer a credible foundation on which to assess productivity, dis-
cern trends, and formulate measures for improvement. |

The key question to be resolved is whether it is possible for the design and construction industry to experience the order–of-magnitude improvements in productivity seen in, among other fields, auto manufacturing, telecommunications, and aviation. Achieving such sweeping gains would mean a radical change in the entire approach to design and construction. This change may come to pass, but meaningful improvement is possible with change of a more evolutionary character. In either case, the endeavor will have significant benefits for the industry and its clients, that is, all of society.

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