

A Comparative Analysis of Regional Productivity Trends

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Throughout recent decades, the construction industry has suffered considerably from its inability to accurately target and measure key aspects of worker output that hinder productivity most. Much research has been conducted to analyze the factors contributing to labor productivity output at the work face, however, this dissertation is primarily focused on discovering key components of the building process that seem to hinder productivity from the perspective of the general contracting team. This paper's literature review looks to address historical data relating to productivity difficulties specific to the construction industry, laborers' productivity dilemma at the work face, and the resulting impact which these factors have on the management team. A survey was sent to employees of a particular California general contractor in order to gauge their perceptions on workplace productivity. Qualitative survey results were then cross-analyzed to compare findings between employees working in Northern and Southern California. Results showed that Northern California employees were far more likely to report spending an exorbitant amount of time in meetings while Southern California employees spent most of their nonproductive time waiting for either information, people or resources. The conclusion of this dissertation uses findings to offer advice and other recommendations to help improve general contractor productivity.

Key Words: Productivity, nonproductive work, efficiency, general contractor

Introduction

The construction industry is different than other business sector of the US economy in that its measurable output and profitability are highly reliant on three factors: Time, cost and quality. The way in which these three pillars of construction are considered and executed by contractors can ultimately determine whether a project turns its intended profit or ends up in the red. Another major consideration to take into account when comparing construction to other industry sectors is the inherent complexity and irregularity that comes with each individual construction project. Producing a building is far less predictable than manufacturing a widget, and for this reason, the construction industry has suffered considerably from its inability to become measurably more productive over recent decades while other industries – and the US economy as a whole – have continued to experience steady productivity growth (Dyer, 2012).

Much research has been done to identify the leading causes of sluggish construction productivity growth on a macroeconomic scale; however, the intent of this dissertation is to corroborate (or contradict) those trends against the first-hand experiences of employees from one of the largest general contracting firms in the United States. The general contractor whose employees were surveyed for this dissertation will remain anonymous for the sake of confidentiality and will henceforth be referred to in this dissertation as "The Company". Selected employees of The Company were given a survey which allowed them to provide input as to their perceived levels of productivity and output. Another component of this research was to analyze trends in employee responses by comparing results obtained by employees from the Northern California region of The Company to those of its Southern California region. The intent of this portion of the analysis was to see if employees' geographic location had any effect whatsoever on the culture surrounding company productivity.

The contents of this dissertation are divided into various sections. First, a literature review will give prominence to the existing body of knowledge regarding productivity in the construction industry from the perspectives of both laborers and contractors. Following the literature review will be a description of the methodology regarding the logistics of conducting the industry survey. Finally, a comparative analysis of the results will be performed to observe any noticeable regional trends. The latter portion of the dissertation contains a discussion that will work to convey the meaning and importance of the research findings.

Literature Review

Throughout recent decades, economists and data analytic experts alike have struggled to accurately and objectively measure productivity in the construction industry. Some experts argue that the nation's construction industry is seeing growth due to increased use of information technology, increased competition due to globalization, and changes in workplace practices and firm organizations (Dyer, 2012). Macroeconomic analyses of construction output, however, continue to raise doubt surrounding the trajectory of productivity growth. A highly-regarded analysis by Paul Teicholz, a professor of civil and environmental engineering at Stanford University, argued that construction productivity declined by 0.48%, annually compounded, from 1968 to 2000 in opposed to the labor productivity of all nonfarm industries which was estimated to increase at an annually-compounded rate of 1.71% (Dyer, 2012). Figure 1 corroborates these findings though data drawn from the U.S. Bureau of Labor Statistics, the U.S. Census Bureau and the U.S. Bureau of Economic Analysis (Dyer, 2012).

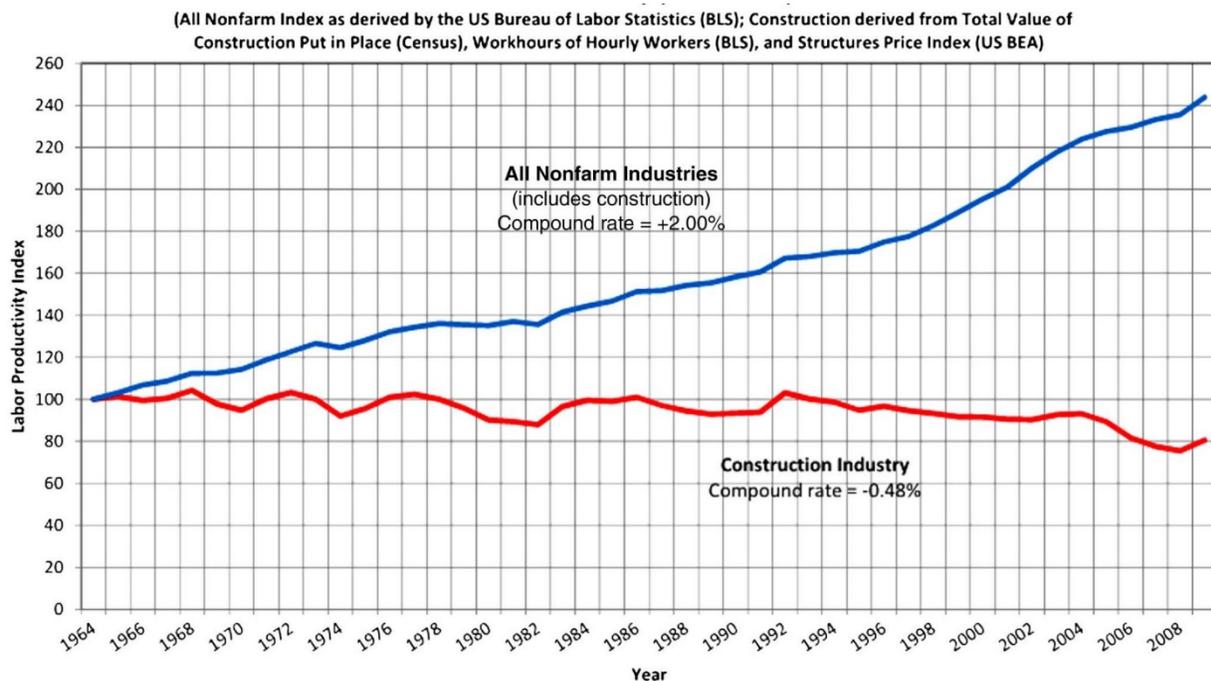


Figure 1: Labor productivity out of construction industry versus all nonfarm industries since 1964 (Dyer 2012)

The term *productivity* can be interpreted to have different meanings between industries. For the sake of this dissertation, the term *productivity* will be defined as the output of construction goods and services per unit of labor input (Jergeas, 2000). Definitions aside, productivity is something that is universally known for its ability to affect a firm's bottom line, thus being something that companies are always looking to improve upon. Further sections of this literature review will look to examine the existing body of knowledge surrounding productivity experiences from the perspectives of the laborers at the work face and the contractors overseeing their work.

Laborers' Role in Productivity

General contractors are contractually obligated to control and adhere to the project budget set out by the owner. Of all expenses contributing to the total cost of construction, typically around 30% stem from labor costs (Jergeas, 2000). For that reason, factors that affect a general contractor's productivity and profitability can be better understood by firstly considering the impacts of labor productivity. Studies relating to cost engineering have shown that anywhere from 40-60% of a typical construction workday is nonproductive time (Jergeas, 2000). From the perspective of craft workers, the major setbacks that hinder productivity most are having to wait for people and/or equipment needed to move material, discovering errors in drawings, and having questions or problems with

drawings and subsequently experiencing a slow response from the engineers to address the issue (Dai, 2009). It is interesting to note that these major craft worker setbacks addressed in Dai's research are issues that stem from responsibilities typically accounted for by the job's management team. In an activity analysis performed by Gouett *et al.*, six industrial construction sites were observed in order to "quantify the time expended by craft on productive and nonproductive activities so that productivity improvements may be determined and implemented" (Gouett *et al.*, 2011). In this case study, productive work was interpreted to include direct-work, preparatory work, time relating to tools and equipment, and time relating to material-handling. Non-productive work was interpreted to include time spent waiting, traveling, and personal time. Of the six case studies conducted, a staggering average of 40.2% of observed craft activity was categorized as nonproductive work time as seen in Table 1.

Table 1
Summary of Activity Percentages from Six Case Studies (Gouett et al. 2011)

Activity	Project A (%)	Project B (%)	Project C (%)	Project D (%)	Project E (%)	Project F (%)	Average (%)
Productive							
Direct-work	27	31	42	28	30	28	31.2
Preparatory work	11	13	13	16	9	12	12.1
Tools and equipment	19	8	12	12	7	11	11.4
Material-handling	8	4	2	4	5	8	5.1
Nonproductive							
Waiting	12	15	11	16	21	14	14.9
Travelling	17	16	13	13	24	23	17.6
Personal Time	5	13	7	11	6	5	7.7

Contractors' Views on Productivity

The concerning high rates of nonproductive time experienced by construction laborers begs the question of what can be done from a management standpoint to change this statistic. It is the function of management to improve productivity (Jergeas, 2000), therefore an examination of contractors' outlook on this issue is imperative. In a survey conducted by Faridi and El-Sayegh, a sample of 93 large and medium-sized general contractors in the UAE were encouraged to rank specific instances which they saw as contributing most to their projects' delays. This survey by Faridi and El-Sayegh was able to obtain the responses of 52 contractors, 46 consultants and seven owners. The survey results showed that the leading causes for delay were preparation and approval of drawings, inadequate early planning of the project and slowness of the owner's decision-making (Faridi, 2006). Results also showed that contractors and consultants agreed on many factors that contribute to their experienced delays, however, discrepancies existed between the two demographics as contractors were much more concerned with shortages of material than their consultant counterparts. Conversely, consultants were much more likely to be concerned with issues relating to financing during the construction process than contractors. The sparse body of knowledge dedicated to uncovering specific construction management productivity inhibitors has been the catalyst for the ensuing research. The following sections will dive into the methodology of this dissertation's data collection process and will attempt to provide further analysis as to the factors affecting productivity delays from the point of view of the general contractor.

Methodology

This section of the dissertation is intended to provide an explanation as to the method in which new data was collected in support of the research. Also discussed in this section is the reasoning and rationale behind the decision-making process of selecting and wording individual survey questions. The intended goal of this survey is to allow industry professionals to share their personal experiences with productivity in the workplace. Much information is available regarding construction productivity on a national and international scale, however this survey's intent is to take a closer look at how productivity is perceived by employees within a given general contractor. By scaling down the research to a smaller survey group of employees within the same company, two things become possible: Firstly, more descriptive responses can be obtained through the use of short answer

questions, and secondly, a cross-comparison analysis can be performed on company employees of different geographical regions to see if differing company cultures play a role in influencing workplace productivity.

The survey was divided into three sections. The first section was primarily intended to gain an understanding of who was filling out the survey. Questions from this first section asked basic questions such as name, job title, years in the construction industry, years with The Company and current job location. Initially, the researcher thought to omit questions that required respondents to identify themselves by name for the sake of honest and transparent responses. After further consideration, the researcher concluded that surveys without names would make it difficult, impossible rather, to identify who had and had not completed the survey. This proved to be a beneficial decision as employee names that were not registered as having completed the survey were easily able to be identified and further contacted to encourage survey completion. The ability to identify respondent completion was the one and only reason why employee names were requested in the survey. Employee names and identities have been concealed in this dissertation in order to maintain the respondents' anonymity.

The second section of the survey was a multiple choice section primarily composed of questions aimed to gauge employee agreeableness with posed statements related to workplace productivity. The order in which statements were presented was intended to alternate between statements that were likely to be perceived as being positive and those that were likely to be perceived as having a slightly negative connotation. In this section, eight statements were posed for employees to respond using an ordinal ranking scale of agreeableness. After each statement, the respondent had the ability to rate their perceived level of agreeableness on a 1 through 5 scale. In this case, a response of 1 indicated that the respondent strongly disagreed with the aforementioned statement, a response of 3 indicated neutralities towards the statement and a response of 5 indicated strong agreements with the proposed statement. Questions in Section 2 were developed with the intent of allowing employees to gauge their personal experiences with productivity against findings that came about through prior research. It is important to note that some questions in this section were also the product of the researcher's own experiences with productivity in the industry.

The third and final section of the survey was a free response section which gave the respondents a chance to voice their individual experiences, concerns and recommendations regarding workplace productivity. Here, six open-ended questions were asked with the intent of acquiring qualitative feedback that may address issues and trends that were not brought to attention through previous research.

The Research Sample

The target research sample for this dissertation was intended to embody a range of employees from The Company with varying job titles, geographical locations and years of industry experience. All parties contacted for their input were employees of The Company whom the researcher has worked with in the past. The sample selection process was also heavily influenced by ensuring a balance of Northern and Southern California employees with comparable job descriptions for the sake of conducting the cross-regional analysis. Survey prospects were contacted via email in which contained the electronic survey along with a brief explanation of how their input was intended to be used. Fourteen employees were initially contacted of which five responded. Ten days later, follow-up emails were sent to those employees that registered as not yet having completed the survey. The secondary outreach yielded an additional two responses for a total of seven employee responses (50% response rate). The relatively low number of responses created some difficulty in performing the cross-comparison analysis, however, valuable feedback was obtained nonetheless. The general information regarding survey respondents can be seen in Table 2.

Table 2
Breakdown of survey respondents based upon various factors

Job Title	Current Job Location	Years in Construction Industry	Years with The Company
Project Engineer	Southern California	3	2

Superintendent	Southern California	8	7
Project Manager	Southern California	2	2
Project Engineer	Sothern California	1	1
Sr. Project Manager	Northern California	7	7
Asst. Superintendent	Northern California	6	6
Project Manager	Northern California	8	4

Analysis of Results

This portion of the dissertation is aimed at conducting an analytical review of the results obtained from the survey. In doing so, every effort will be made to recognize trends in the survey responses as well as to compare the results to findings from previous research and hypotheses.

Due to the limited number of responses obtained from the survey, it was difficult to statistically justify the results of the close-ended questions posed in Section 2. With that being said, the open-ended free response questions of Section 3 were much more helpful in providing analytical substance to the dissertation. In Section 3, six free response questions were asked of the employees which allowed them to provide anecdotal input relating to their personal experiences with productivity in the workplace. The results from each free response question were examined and broadly categorized based off of noticeable trends, ideas and themes. Upon further analysis, these categories were then broken down into more definable subcategories into which responses were ultimately assigned. This method of analysis was very useful in obtaining conclusive data from the free response results. Some of the most revealing questions and results are analyzed below; all other responses from Section 3 can be found in Appendix B at the end of this dissertation.

Question 1: What task(s) occupies the majority of your productive work time?

Responses to this question were analyzed and categorized into the following groups: Subcontractor coordination, external outreach, responding to deviations from scope/schedule, internal processes, and logistical issues. Results showed that Northern California employees spent most of their productive work time responding to items that arose in response to changes in their projects’ scopes or schedules. Southern California employees, on the other hand, reported spending a majority of their productive work time conducting external outreach (i.e. purchasing outreach, design-assist review/feedback) as well as performing internal processes such as compiling quantity take-offs or drafting official documents for review.

Question 2: What task(s) occupies the majority of your non-productive work time?

Responses from this question were categorized into the following groups: Meetings, waiting on others, and internal tracking processes. Of all the free response questions, this one in particular resulted in the most unanimous results from a distinct group of the sample population. Almost all Northern California employees reported that their non-productive work time was mostly spent attending irrelevant or repetitive meetings. Time spent waiting on others and time spent conducting internal tracking processes were the other general trends that were primarily reported by Southern California employees. In all, this question was able to call attention to the productivity dilemma relating to excess time spent in meetings and begs the question of what can be done to fix it.

Question 3: What do you feel The Company can improve upon to help promote a more productive work environment?

Responses from this question were categorized into the following groups: Standardization of processes, clearer identification of employee roles and objectives, implementation of efficient meeting leadership workshops, and encouraged mentorship. Northern California employees were more likely to report that The Company could do a better job at teaching productive meeting leadership for its employees. This recommendation is valid given the

Northern California employee outlook on non-productive meetings. Southern California employees, on the other hand, were more likely to feel that The Company could do a better job at standardizing its building practices and procedures to accommodate the nuances that exist from project to project.

Question 4: *What aspect of the building process do you see as having the greatest potential for improved productivity industry-wide?*

Responses from this question were categorized by proposed advancements relating to the following groups: Software/technological, material tracking, decision-making, and process alignment. The two most common aspects of the building process that respondents saw as having the greatest potential for productivity improvements were technological advancements as well as better coordination between parties. Respondents commonly shared the feeling that building software of the future must do a better job of integrating within one another to minimize the disconnect between programs that exist today. Furthermore, respondents of both geographical regions were in agreement that there is great potential for improvement when it comes to clarifying coordination between working entities. A shared feeling amongst surveyed industry professionals is that there are often too many people in charge of coordination processes which commonly leads to information being lost in translation by the time it reaches the laborers at the work face.

Conclusion

In an effort to discover if contractors' regional differences have an effect on employee productivity and output, this dissertation was able to effectively validate and disprove various research questions. Based off of the findings from this research, it can be concluded that regional differences do affect how employees spend their non-productive work time. The exorbitant amount of time that Northern California employees spend in meetings is an issue that must be addressed, and can possibly be corrected through the implementation of effective meeting leadership workshops. Southern California employees have a different issue at hand commonly spending and excessive amount of time waiting for information, people and resources. Knowing this information, it would be prudent of The Company's leadership to find ways to standardize company practices in ways that can significantly decrease the amount of time that its employees spend away from tasks that benefit overall team output. Although regional differences do exist between the Northern and Southern California branches of The Company, it is important to note that the two geographical demographics shared many of the same feelings regarding their own productivity. With that being said, one can deduce that the two regions are actually quite similar in regard to their observed output. The nature of this research created limitations by restricting the research sample to employees residing in the same state. In further research, it may be beneficial to conduct a similar comparative analysis on employees of The Company who work in California versus those that work in Maryland, for example, where The Company also performs a large amount of work. This wider form of analysis may be better equipped to emphasize the productivity trends that exist as a result of regional differences in company culture and operation.

References

- Dai, J., Goodrum, P. M., & Maloney, W. F. (2009). Construction Craft Workers' Perceptions of the Factors Affecting Their Productivity. *Journal of Construction Engineering and Management*, 135(3), 217-226.
- Dyer, B., Goodrum, P. M., & Viele, K. (2012). Effects of Omitted Variable Bias on Construction Real Output and Its Implications on Productivity Trends in the United States. *Journal of Construction Engineering and Management*, 138(4), 558-566.
- Faridi, A. S., & El-Sayegh, S. M. (2006). Significant factors causing delay in the UAE construction industry. *Construction Management and Economics*, 24(11), 1167-1176.
- Gouett, M. C., Haas, C. T., Goodrum, P. M., & Caldas, C. H. (2011). Activity Analysis for Direct-Work Rate Improvement in Construction. *Journal of Construction Engineering and Management*, 137(12), 1117-1124.

Jergeas, G. F., P.Eng, Chishty, M. S., & Leitner, M. J. (2000). Construction Productivity: A Survey of Industry Practices. *AACE International Transactions*, P6.1-P6.7.

Appendix A – Results from Survey Section 2

Statement	n	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
My daily output is hindered by time waiting for information (approved change orders, RFIs, etc.)	7	14.3%	14.3%	28.6%	42.9%	0.0%	100.0%
My daily output is hindered by time waiting for resources (material, equipment, etc.)	7	0.0%	42.9%	28.6%	28.6%	0.0%	100.0%
I consider the meetings I attend to be productive with respect to my work responsibilities.	7	0.0%	14.3%	42.9%	42.9%	0.0%	100.0%
The meetings that I attend are conducted efficiently.	7	0.0%	14.3%	42.9%	42.9%	0.0%	100.0%
The goals and objectives of the company are clearly communicated within project meetings.	7	0.0%	0.0%	42.9%	28.6%	28.6%	100.0%
My current work environment helps to maximize my overall efficiency and output.	7	0.0%	0.0%	42.9%	57.1%	0.0%	100.0%
My project team's leadership makes timely decisions to enhance team output.	7	0.0%	0.0%	14.3%	42.9%	42.9%	100.0%
I consider a portion of my daily work activities to be redundant with respect to tasks previously performed by myself or others?	7	14.3%	42.9%	42.9%	0.0%	0.0%	100.0%

Appendix B – Results from Survey Sections 3

What task(s) occupies the majority of your productive work time? Feel free to provide an explanation.

- Take-offs & Trade Partner Interactions
- Area to cover. The size of the project is a challenge to physically cover all issues and follow thru with your hands on.
- Currently, purchasing outreach and design-assist review and feedback
- Working with other people to draft documents, part of my "productive work time" is also spent checking up/waiting on others.
- Follow up about missed deadlines for rfis, submittals, change orders, billing, etc.
- Updating Schedule based on changes and missed dates.
- Coordination with subcontractors for issues resolution.

What task(s) occupies the majority of your non-productive work time? Feel free to provide an explanation.

- Utilizing the Restroom
- Required meetings that don't apply to my individual work or area. Waiting for my turn to discuss my topics.
- Internal information tracking
- Waiting on other people to send documents.
- Meetings with multiple entitles- consultants, owner, architect, sub
- Long meeting of which maybe sometimes 5 or 10 minutes is all that's needed for myself out of hours.

- Multiple repeated meetings that take up significant time out of my day.

What do you feel Clark Construction has done well to promote a productive work environment?

- Provide a good work load
- Yes
- At the project team level, effective distribution of responsibilities and tasks
- Clark Construction fosters an environment where questions are encouraged and therefore one can work more efficiently using the experience of colleagues.
- Always offering help and encouragement to reach out to resources in the company.
- Open office layout with teams grouped together has allowed for easier access to team members.

What do you feel Clark Construction can improve upon to help promote a more productive work environment?

- None
- More of a mixture of seasoned employees and young professionals to mentor.
- Continued standardization of processes/procedures; broaden application of standard processes/procedures to accommodate nuances of distinct projects
- More clearly define everyone's roles and expectations.
- Teach everyone how to run a productive meeting and understand what the objectives are.
- Clark is doing it's best at this time promote as productive of an environment as possible.

During your time at Clark, what kind of changes have you seen, if any, that have been implemented to streamline the overall building process?

- VDC has expanded & Software development has improved
- New technologies such as VDC
- n/a
- Plan of day meetings, SIPS schedule, posted plans in the office that communicate clearly to everyone.
- As with most of the industry, technology and programs. Hyperlinking, inspection processes, etc have all gotten quicker. Safety items as well.
- N/A

What aspect of the building process do you see as having the greatest potential for improved productivity industry-wide?

- VDC
- Streamlining answers from the design team and owner
- Software development for project management feels immature at this time. Each software resource we use feels like it has a high potential for future optimization and enhanced integration with other systems. Too much software diversity due to narrow capacities of distinct software types.
- Close-out
- Inventory materials with barcodes so they can be delivered to correct spot and located after delivery. Offsite fabrication or offsite sorting for efficient stocking. Verification of installed work/survey with 3d scanners.
- Getting the latest coordinated information down to the actual workers. Still seems to be an issue out there. Big jobs struggle with this. Lots of people in charge coordinating, lots lost in translation.
- Project Management Software