

THE CONTRACTOR'S SELF-PERCEIVED ROLE IN SUSTAINABLE CONSTRUCTION: SURVEY RESULTS

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ABSTRACT

With the advent of sustainable building ordinances in the United States and internationally, contractors are required to deliver sustainable projects but have historically not been considered partners in developing the sustainability goals and objectives for projects. Additionally, as alternative project delivery methods gain popularity, contractors have an opportunity and—in an increasing number of cases—a requirement, to take a larger role in sustainability efforts beyond the design phase. Understanding the contractor's self-perceived role in this industry is imperative to informing their future role in the sustainable construction industry. This paper presents data and analysis of a survey of general contractors (GCs) in the Phoenix, Arizona market who are experienced with lean and now implement sustainable construction to differentiate themselves from their competitors. The survey asked GCs for their opinions and viewpoints regarding sustainable construction; respondents provided feedback about corporate profitability, growth forecast, and the perceived efficiency of the U.S Green Building Council's LEED rating system. The survey also queried contractors about implications of sustainable construction on their existing lean processes, including current and future work breakdown structures for sustainable project delivery as well as their underlying motives for involvement in these projects.

Academics from Arizona State University worked with local industry to develop the survey in 2012 and the survey was deployed in 2013. The authors sent the survey to 76 GCs and received responses from 21, representing a 27.6% response rate.

KEY WORDS

Lean construction, sustainability, LEED, green construction

INTRODUCTION

In today's hypercompetitive construction market, industry trends show owners are requiring contractors to assume a larger role than they traditionally have in project delivery. As alternative delivery methods such as Design-Build or Integrated Project Delivery (IPD) become increasingly common for design and construction services, the general contractor finds a much larger opportunity for influence in the overall project outcome (AIA 2007). This increased opportunity requires communication and trans-disciplinary understanding, but most importantly a recognition and acceptance

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of the increased responsibility on a project's lifecycle from conceptual design to turnover (Todorovic and Kim 2012). Lean construction has offered a means of improved communication between stakeholders and IPD has offered a process for increased contractor involvement throughout the project lifecycle, allowing GCs to better manage increased responsibility often coupled with alternative project delivery. GCs implementing lean practices have provided more value to owners through target value design and other means than their less-lean counterparts (Ballard 2006). GCs who were early adopters of lean seem to also be early adopters of other trends in the building construction industry that allow them to influence more of the project's lifecycle, including sustainable project delivery. This paper presents and analyses GCs' self-perceived role in sustainable construction. In particular, this paper examines how GCs deliver value to the owner (e.g., through sustainability) and the cost of this delivery.

Specifically, this paper presents data and analysis of a survey of GCs in the Phoenix, Arizona market that asked for their opinions and viewpoints regarding sustainable construction. Respondents provided feedback about corporate profitability, growth forecast, and the perceived efficiency of the U.S Green Building Council's LEED rating system. The survey also queried contractors about current and future work breakdown structures for sustainable project delivery as well as their underlying motives for involvement in these types of projects. The pilot survey was developed during 2012 with input from select Architect/Owner/Contractor representatives to ensure industry relevance. In 2013 the authors deployed the final survey to 76 GCs in the Phoenix construction market and 21 responses were received, representing a 27.6% response rate. These data were analyzed and the authors contacted a small number of survey participants, with their pre-approval, for additional qualitative responses where required. The paper concludes with a discussion of potential implications of survey results for advancing lean and green construction.

RELATED WORK

The construction industry has long been one of the largest and most important industries in an economy, but the United States construction industry has lagged behind other countries in terms of sustainable construction practices (Junilla et al. 2006). However, data illustrates a growing interest in sustainable construction in the US: at the end of 2004, only 148 buildings had been certified as the United States Green Building Council (USGBC) as LEED (Leadership in Environment and Energy Design) buildings, but currently 13,322 projects have obtained this status (USGBC 2009; 2013; Yudelson 2007). Other countries have also developed sustainable building-rating systems, including BCA Green Mark in Singapore and Green Globes in multiple countries (Wu and Low 2010). Outside of green-rating systems, research indicates that projects are seeking sustainable construction in less-easily quantified ways, i.e., using sustainable components for day-lighting, energy savings, or recycled materials, but not completing the requirements to be recognized by a green-rating system (Bernstein 2012). Despite indications that sustainable construction practice is gaining popularity, relatively little research has examined the contractor's role in the sustainable buildings industry, and even fewer resources describe the contractor's perception of their own role in this emerging industry.

Marthur et al. (2008) describe the importance of engaging various stakeholders in the pursuit and assessment of sustainability. They highlight the benefits of stakeholder engagement for promoting social learning and by extension, increasing the sustainability skill set of those in the construction industry. This paper extends their work on stakeholder engagement by surveying one stakeholder, the general contractor, about the pursuit and assessment of sustainability.

Korkmaz et al. (2010) conducted a survey to determine a set of metrics that can be used to evaluate high-performance sustainable building projects, ranging from contract structure to owner's attitude about sustainable building projects. The authors' survey took a narrower approach, asking exclusively about the general contractor's role in delivering sustainable projects. Korkmaz et al. explain that when a contractor becomes involved is critical to achieving sustainable building goals, and our work supports this finding. Tan et al. (2011) extend the work of evaluating sustainable project delivery and discuss the role of sustainable construction practices in increasing a contractor's competitiveness in the marketplace. That work focuses on those practices entirely within the contractor's purview, e.g., waste management on site, while this research seeks contractors' opinions on their competitiveness due to implementing sustainability more holistically on a project through collaboration with the design and owner teams. Finally, Robichaud and Anantamula (2011) discuss project management practices that can or should be implemented to achieve low-energy project delivery. The authors' survey takes a higher-level approach, seeking to understand how and why contractors pursue sustainable building projects rather than how or why they implement specific management practices.

SURVEY OF EXISTING CONSTRUCTION PRACTICE

The authors developed a survey to solicit the contractor's perceptions of their own role in the sustainable buildings, or green construction, industry. The authors targeted the Phoenix, Arizona market exclusively so our results would not be skewed by region-specific factors, including varied work breakdown structures, labor rates, and effective energy efficiency measures. Moreover, this research targeted GCs as they most often contract with the owner and thus may have more exposure to sustainability goals, requirements, and innovations for projects. Importantly, the GCs targeted also represent local industry leaders; they were first adopters of lean in the local market and they perceive sustainable project delivery to be the next competitive advantage for their organizations. The authors collected data concerning company size and experience with sustainable building projects to better understand emerging trends in the industry. This paper presents results of the survey, highlighting the influence of the contractor on sustainable construction projects, the impact of sustainability goals on project cost, and reasons why GCs choose to (or not to) pursue these projects.

METHODS

In order to collect quantifiable numeric data from multiple sources, the authors developed a survey targeted at companies in the construction industry whose primary responsibilities are those of a general contractor or construction manager. Examining this group specifically simplified the process of understanding the current industry from a consistent point of view. This target group also typically has experience with lean construction and alternative project delivery methods most often used on

sustainable construction projects. Moreover, this target group generally has varied experience and opportunities to devote significantly more resources to the development of their sustainable construction capabilities than smaller (sub-) contractors. Larger and more complex projects provide the chance to develop, implement, and measure sustainability initiatives outside of the LEED constraints. Finally, contractors of this nature are often the first adopters of new trends and technology in construction, including lean construction, and this has remained true with respect to the sustainable construction growth.

The authors developed the survey and piloted it through a small group of industry representatives with substantial construction experience who work at different companies. The initial pilot study helped to hone the survey to better investigate the respondents' answers and to extract the information in an industry-relevant context. Specifically, the industry representatives identified appropriate numerical categories (e.g., LEED silver certification increases construction cost by <2% vs. 2-5%, vs. 6-10% vs. >10%).

DATA COLLECTION AND ANALYSIS

The authors collected data over a two-month period in the beginning of 2013 through an online survey resource. This resource compiled responses into an Excel spreadsheet that simplified the process of averaging, sorting, and analyzing data. After the data was compiled, the authors worked with a small group of industry participants to analyze it. Analysis efforts focused on determining possible extrapolations and extensions of the data, especially when common responses were apparent. In working with industry representatives in addition to academics, the authors analyzed results from a theoretical point of view as well as a quantitative one. The group of data analysts all sought to understand how the findings applied to the construction industry as a whole.

RESULTS AND DISCUSSION

Analysis of numerical data from the survey illustrates the general contractors' understanding of and involvement in the sustainable building industry in Phoenix, Arizona. Figure 1 shows that 71% of the survey respondents are employed at companies with revenue in excess of \$1 billion annually, and thus represent our target audience of large general contractors who engage in lean and green practices.

Project Team Members' Ability to Influence Sustainability

Survey questions 2.1, 2.2, and 2.3 focused on the contractors' opinions regarding what members of the project team carry the most opportunity to affect the overall sustainability of the project. Survey participants were asked to select a value on a Likert scale from 1-10 based on their agreement or disagreement with the statement regarding the Contractor, Design Team, or Owner. Table 1 illustrates the survey respondents' opinions: they consistently ranked the owner as the team member with the most influence on a project's sustainability. No survey responses indicated the contractor or designer with a higher score than the owner and the average score given to the owner was 9.62 out of a theoretical maximum of 10. This indicates that the respondents heavily agreed with the statement regarding the owner's opportunities to affect the sustainability outcomes of a project. This viewpoint was commonly

expressed during the free-response questions as many responses indicated the contractors generally took a secondary role in the sustainable building decisions. Contractors rated their own opportunities for impact at 6.76 whereas the architect and owner were 9.29 and 9.62, respectively. This illustrates the contractors' perception that they have a significantly smaller capacity to influence decisions involving sustainability on a project. Contractors also report their role varies widely depending on the delivery method selected for a project. Written responses emphasized that delivery methods that involve the contractor earlier in the design phase present the contractor an increased role in impacting the sustainability of a project.

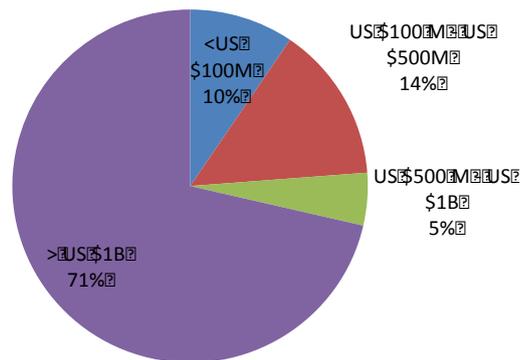


Figure 1: Survey Participant's Annual Volume

Table 1: Influence of Project Team Members on the Sustainability Outcomes of a Project (Average across respondents; scale of 1-10; 1=Disagrees Strongly, 10=Agrees Strongly)

The Contractor has numerous opportunities to impact project sustainability	The Design Team has numerous opportunities to impact project sustainability	The Owner has numerous opportunities to impact project sustainability
6.76	9.29	9.62

Contractors' Opinions About LEED

One of the authors' main objectives in creating and administering this survey was to collect contractors' opinions regarding the United States Green Building Council's LEED rating system. Multiple questions addressed this topic, ranging from perception of LEED's ability to save energy to increased project costs attributable to various levels of LEED certification. Perhaps of most relevance to the lean construction community is the cost premiums for various levels of LEED certification, as this may speak to the economic cost of the *value added* for the owner with LEED certification. The authors collected data to quantify the perceived costs associated with different levels of LEED Certification; namely, Certified, Silver, Gold, and Platinum. Figure 2 illustrates the responses: contractors felt the lower levels of Certified and Silver were easier to obtain. An overwhelming number (~88%) of respondents reported that the additional cost for LEED certification is less than 2% of the overall project costs. Reasons for this were expressed in the free responses, as two contractors stated, "Building standards today are just shy of the LEED system," and "the cost of going green has passed the tipping point and is trending down." The downward trajectory of

sustainable building cost is pivotal to its future deployment and growth in the construction industry as “Higher Initial Cost” was the highest ranked obstacle to sustainable building. This downward trend may be attributed to the inclusion of sustainable building practices into industry standards and the industry’s growing familiarity with LEED credits and the LEED system. The former has occurred over the past 10 or 15 years as sustainability gained popularity and thus afforded many in the industry opportunities to gain experience with value-enhancing components of sustainable construction. The latter raises an important issue related to the lowering costs of LEED: as owners, architects, and contractors become more familiar with LEED, they simultaneously become better able to “game the system.”

As LEED certification increasingly penetrates the construction market, owners, designers, and contractors alike develop new knowledge and skill-sets for sustainable construction. Simultaneously, they may learn how to “game the system” or “buy credits”, and may thus defeat the true purpose of LEED certification: to save energy and promote sustainability in the built environment. Indeed, some contractors expressed frustration at LEED credits they perceived to be ways to buy a higher level of certification, but not actually provide value to the project. This concern is especially pertinent with Platinum Certification, the highest distinction offered in the LEED rating system. An unusually high 71% of respondents stated that obtaining Platinum Certification would increase the first costs of the project by at least 10% of the overall construction cost with 95% agreeing the additional cost would be over 6%. This exorbitant extra cost to increase the level of the certification could be attributable to the fact that gradually design and construction professionals have learned which credits are least expensive to achieve and trended toward pursuing these credits rather than those that have the most positive affect on the sustainability of a project. That is, the number of credits required to achieve LEED Platinum certification precludes project teams from pursuing only low-cost credits and forces them to pursue higher-cost, but arguably more effective, credits as well.

Looking forward to the growth of the sustainable building industry, it is important to gain an understanding of what obstacles exist for the progress of the industry as a whole. Figure 3 reports the contractors’ responses concerning obstacles to sustainability in the construction industry. The survey reveals contractors’ most significant concern is cost. This was reflected by 90% of contractors selecting “Higher Initial Cost” as an obstacle to sustainable building. Contractors also report “Difficulty/Cost of Certification process on a project” is a major concern (selected by 57% of respondents). These two obstacles were by far the most commonly chosen. Surprisingly, the respondents did not select other obstacles initially thought to have a large impact in a majority of cases. For example, at the onset of the sustainable building trend, government incentives were lauded as the way to push the development of a self-reliant sustainable building market. Perhaps the market has begun to progress past that point as only 19% of contractors responded that the “Lack of Government Incentives” was an obstacle to sustainable building.

Also worth noting is that many municipalities across the United States require a certain level of LEED certification, typically Silver (e.g., Arizona Governor’s Office 2005). Contractors indicated in the free responses that they have seen a growth in the popularity of sustainability components of projects that are not included in the LEED criteria as local governments require certification. Occasionally these have been

selected in addition to LEED certification (typically when the component has a quick pay-back period), but contractors also reported that owners will pursue sustainable components instead of LEED certification.

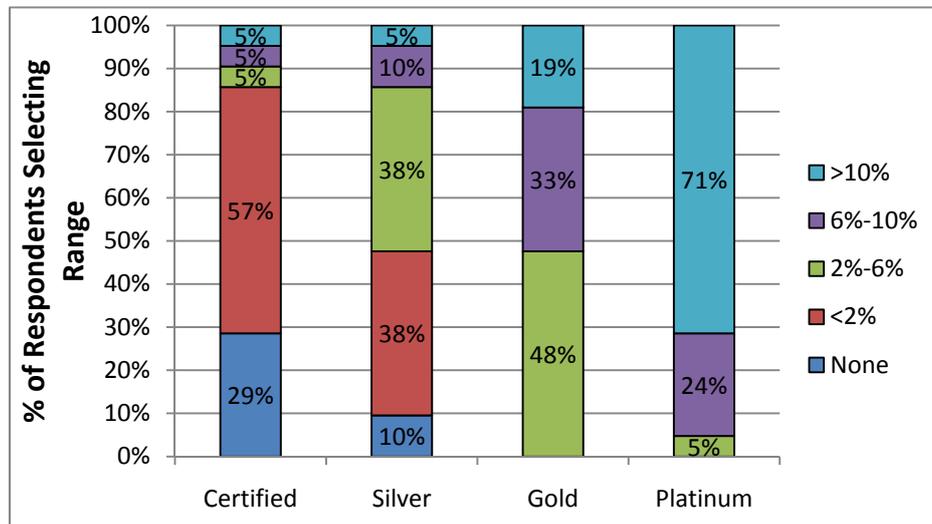


Figure 2: Perceived cost increase for various levels of LEED Certification

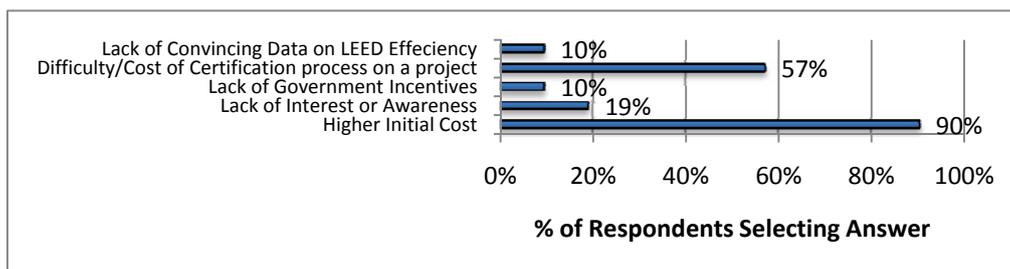


Figure 3: Reported Obstacles to Sustainable Building

Finally, the survey asked respondents to select reasons they pursue sustainable building projects. Figure 4 illustrates these results. Contractors most commonly report their involvement in sustainable building was in response to owner's requests. This exemplifies how contractors will tend to take a secondary role in establishing sustainability objectives for a project unless prompted by an owner. For example, the instance of a contractor influencing an owner for LEED Certification is highly unlikely, especially in light of LEED's additional upfront costs. Some respondents did explain that their companies have instituted paperless jobsites and diversion of waste materials, but these do not represent a front-end planning approach to improving the sustainable performance of a project, but rather a secondary approach to sustainability. Results also indicate contractors feel pursuing sustainable building projects reflects corporate social responsibility, as the second and third most common results were "Right thing to do" and "positive effect on the environment" showing that contractors do feel they have a moral obligation to future generations to preserve resources. In construction, a predominantly price-based industry, this illustrates a common understanding by participants in the industry of their long-term effects. The authors note this positive outlook could be a reflection of the contract structures our

respondents typically engage in, as the majority of their projects are not awarded based on a low-price selection process.

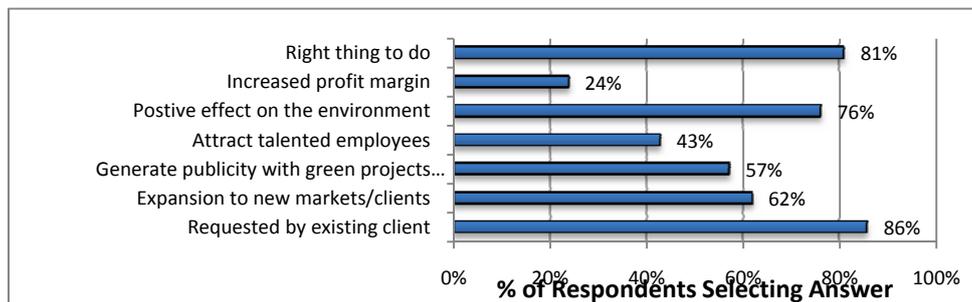


Figure 4: Motivation for Contractors to Pursue Sustainable Building Projects

EMERGING TRENDS AND LOOKING FORWARD

While reviewing the data in its totality and comparing the relationships between common answers and themes, a set of trends regarding the sustainable building industry emerged. The authors highlight these below:

- Sustainable building as a concept and practice is on the rise, albeit how it is measured or pursued is shifting. While some contractors expressed frustration with the relevancy of the LEED rating system, they also believed that building in a sustainable manner should be pursued whether or not a LEED certification is desired. This may drive the continued development of sustainable building outside of the parameters of LEED credits and certification. Sustainable design is becoming a standard business practice rather than owner-requested specialty.
- The overall perception of sustainable building is positive both from contractors and the general public. Most feel it should be pursued, with cost being the major deterrent. Lowering the upfront price and providing an understanding of life cycle cost savings is vital to the future acceptance of sustainable building, as emphasized by Koskela and Tommelein (2009). The general public typically doesn't have knowledge regarding sustainable components, but LEED is recognized. Forty-eight percent of contractors said sustainable building certification increases the resale or leasing value of a building by 5% or higher. This finding is supported by Miller and Pogue (2009), who report an increased lease value of LEED certified space in the commercial real estate market.
- Contractors perceive they have a substantially smaller ability to impact the sustainability of a project than other project team members. Importantly though, alternative delivery methods that provide involvement during the preconstruction and design phases and offer opportunities not typically afforded the contractor.
- Limited data from smaller contractors showed a large disparity in opinions and involvement with sustainable building between the large and small contractors. The larger general contractors (those with over \$1 billion in

annual volume) showed much more involvement with and interest in sustainable building, although the findings would need to be substantiated with more research.

The sustainable building industry is constantly evolving as the contractors and architects adopt new techniques and strategies that produce increasingly sustainable buildings. The progress of the industry is exciting, but also presents project team members with new responsibilities, expectations, and opportunities. Understanding these changes is needed for contractors to successfully adapt to the industry and minimize inefficiencies that result from the changes.

CONCLUSIONS

The state of the sustainable construction industry is in a time of transition with an unknown immediate future. As LEED is revamped or the industry shifts away from its use, sustainability is taking root in new approaches and procedures that present an optimistic view on the future of the industry. Contractors are aware of their growing ability to influence the sustainability objectives of a project, but also realize their opportunities are fewer in number and scale than those of other project team members. Contractors have learned and began to standardize during-construction measures like waste diversion, paperless jobs, and indoor air quality management as their contribution for building in a more sustainable manner. Moreover, these practices represent waste reduction and lean practices in within the organization. Continued research efforts that emphasize how upfront costs can be lowered in addition to quantifying and highlighting life-cycle costs and pay-back periods is extremely important to propel further growth in sustainable construction. Costs will lower naturally over time, but creating and disseminating knowledge regarding the changes will help the industry adopt improvements quicker, thus saving money and environmental resources alike. Thus, the industry can advance lean and green processes, adding value while minimizing waste.

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