IN THIS ISSUE:

- Measuring Organization Learning Success in Commercial Construction during Economic Recession
- Contractor Feasibility in Providing Cost Segregation Studies from Detailed Estimates: A Case Study
- Factors of Employee Loyalty among Construction Management Field Personnel, Estimators & BIM/Design Specialist: Insights for General Contractors
- Construction Industry Professional Perception of Project Management Certification in the Houston Texas Region
- 2016 AGC James L. Allhands Essay Competition Winners
About the AIC:

Founded in 1971, the American Institute of Constructors mission is to promote individual professionalism and excellence throughout the related fields of construction. AIC supports the individual Constructor throughout their careers by helping to develop the skills, knowledge, professionalism and ethics that further the standing of the construction industry. AIC Members participate in developing, and commit to, the highest standards of practice in managing the projects and relationships that contribute to the successful competition of the construction process. In addition to membership, the AIC certifies individuals through the Constructor Certification Commission. The Associate Constructor (AC) and Certified Professional Constructor (CPC) are internationally recognized certifications in the construction industry. These two certifications give formal recognition of the education and experience that defines a Professional Constructor. For more information about the AIC please visit their website at www.professionalconstructor.org.

Our Mission:

▲ To promote individual professionalism and excellence throughout the related fields of construction.

▲ A qualifying body to serve the individual in construction, the Constructor, who has achieved a recognized level of professional competence;

▲ Opportunities for the individual constructor to participate in the process of developing quality standards of practice and to exchange ideas;

▲ Leadership in establishing and maintaining high ethical standards;

▲ Support for construction education and research;

▲ Encouragement of equitable and professional relationships between the professional constructor and other entities in the construction process; and

▲ An environment to enhance the overall standing of the construction profession.

AIC PAST PRESIDENTS

1971-74 Walter Nashert, Sr., FAIC
1975 Francis R. Dugan, FAIC
1976 William Lathrop, FAIC
1977 James A. Jackson, FAIC
1978 William M. Kuhne, FAIC
1979 E. Grant Hesser, FAIC
1980 Clarke E. Redlinger, FAIC
1981 Robert D. Nabholz, FAIC
1982 Bruce C. Gilbert, FAIC
1983 Ralph. J. Hubert, FAIC
1984 Herbert L. McCaskill Jr., FAIC
1985 Albert L. Culberson, FAIC
1986 Richard H. Frantz, FAIC
1987 L.A. (Jack) Kinnaman, FAIC
1988 Robert W. Dorsey, FAIC
1989 T.R. Benning Jr., FAIC
1990 O.L. Pfaffmann, FAIC
1991 David Wahl, FAIC
1992 Richard Kafonek, FAIC
1993 Roger Baldwin, FAIC
1994 Roger Liska, FAIC
1995 Allen Crowley, FAIC
1996 Martin R. Griek, AIC
1997 C.J. Tiesen, AIC
1998-99 Gary Thurston, AIC
2000 William R. Edwards, AIC
2001-02 James C. Redlinger, FAIC
2003-04 Stephen DeSalvo, FAIC
2005-06 David R. Mattson, FAIC
2007-09 Stephen P. Byrne, FAIC, CPC
2009-11 Mark E. Giorgi, FAIC
2011-12 Andrew Wasiniak, FAIC, CPC
2012-13 Tanya Matthews, FAIC, DBIA
2013-14 David Fleming, CPC, DBIA
2014-15 Paul Mattingly, CPC

THE PROFESSIONAL CONSTRUCTOR
JOURNAL OF THE AMERICAN INSTITUTE OF CONSTRUCTORS
AIC BOARD OF DIRECTORS 2016
NATIONAL ELECTED DIRECTORS

Joe Rietman, CPC
AIC National President

Ihab Saad (Elected) (2015-2018)

Greg Carender, CPC
Vice President
PricewaterhouseCoopers

James Hogan (Elected) (2015-2018)

Bradley Monson, CPC
Treasurer
State of Colorado

Greg Carender (Elected) (2015-2018)

David Dominguez, CPC
Secretary

Saeed Goodman (Elected) (2015-2018)

Ihab Saad (Elected) (2015-2018)

James Hogan (Elected) (2015-2018)

Greg Carender (Elected) (2015-2018)

Saeed Goodman (Elected) (2015-2018)


Joseph Rietman (Elected) (2013-2016)

Jim Nissen (Elected) (2013-2016)

Jim Hoskinson (Elected) (2013-2016)

David Jones (Elected) (2013-2016)

Dennis Bausman (Chair, Constructor Certification Commission)

Terry Foster (Chair, Professional Standards Committee)

Jim Nissen (Chair, Inter-Industry Committee)

Matt Conrad (Chair, AIC Ethics Commission)
**Articles:**

**Measuring Organization Learning Success in Commercial Construction during Economic Recession** ............................................................. 5  
Evan Danforth, Justin Weidman, and Clifton Farnsworth

Benjamin Hill, Mohammed S. Hashem M. Mehany, and Richard J. Gebkenk

**Contractor Feasibility in Providing Cost Segregation Studies from Detailed Estimates: A Case Study** ................................................................. 29  
Ben F. Bigelow, Jeremy Robinson, and John Killingsworth

**Factors of Employee Loyalty among Construction Management Field Personnel, Estimators & BIM/Design Specialist: Insights for General Contractors** ................................................................. 37  
Colby Humphrey and Ben F. Bigelow

**Construction Industry Professional Perception of Project Management Certification in the Houston Texas Region** ............................................ 51  
Lana K. Coble and Margaret D. Watson

**General Interest Articles** ...................................................................................... 61  
*The AGC James L. Allhands Essay Competition*
Measuring Organizational Learning Success in Commercial Construction during Economic Recession

Evan Danforth, M.S.
GH Phipps General Contractor | evanmdanforth@gmail.com

Justin Weidman, Ph.D.
Brigham Young University | justinweidman@byu.edu

Clifton Farnsworth, Ph.D., P.E.
Brigham Young University | cfarnsworth@byu.edu

ABSTRACT: The method through which organizations collect and internalize knowledge, termed organizational learning, has been theorized to significantly influence company performance. Specifically, the speed and accuracy of knowledge transfer boasted by organizational learning proponents is thought to assist companies in dealing with, and even benefiting from, environmental changes such as economic volatility. This research studied the organizational learning of fifteen commercial construction companies in the southwestern United States during the 2008-2009 U.S. recession through semi-structured interviews. It was found that the companies that exhibited dramatically higher or lower levels of organizational learning generally experienced correspondingly higher or lower performance. The contribution of these findings is to increase the understanding of organizational learning in the construction industry, demonstrate its practical applicability for company performance improvement, and outline potential means of employing organizational learning techniques in real-world scenarios

Keywords: Organizational learning, Organizational Learning Mechanism, Construction, Recession

INTRODUCTION

The ability of an organization to incorporate and assimilate the individual knowledge of its members exerts great influence on the success of the company. Such success is specifically mentioned in the ability of the organization to adapt and innovate within its environment. Rapid environmental changes, such as recessions and recoveries, are periods of time that pose great risk to companies, as well as great opportunities. Incorporating inaccurate or out-of-date knowledge from individuals, or failing to incorporate individual learning altogether, can lead to incorrect market positioning, resource investment, or other organizational strategies. Such errors may go unnoticed during a growing or stable market, but can be devastating as the market inevitably slows down. Alternatively, the collection and utilization of accurate and up-to-date knowledge throughout an organization can generate greater success in good markets, while
Measuring Organizational Learning Success in Commercial Construction during Economic Recession

protecting the organization from, or even exploiting, down markets.

Construction, as an especially cyclical industry, often experiences the extremes of these two options. Companies that have used correct and up-to-date knowledge to prepare and position themselves can experience substantial success, even in economically challenging times, while ill-prepared companies face devastating consequences even in growing markets. Unfortunately, many construction companies have no formal organizational learning plan, and consequently lack the infrastructure to adequately adapt and innovate for rapidly changing environments.

This research gives a brief explanation of the theory of organizational learning, but its ultimate goal was the exploration of its practical application within the construction industry in relation to the most recent recession. For this study, multiple respondents were interviewed within 15 commercial construction companies in the Southwestern United States. This research asked what practical methods of organizational learning were being employed within their companies and whether or not there was a correlation between organizational learning and company performance.

LITERATURE REVIEW

The manner in which organizations collect and internalize knowledge is termed organizational learning. Though numerous studies focus on organizational learning, it has remained an ambiguous term (Love et al. 2000). Theoretical discussions of organizational learning have led to multiple definitions and examples, but little empirical data. The multiple definitions can be condensed into two general schools of thought on organizational learning. Phillips noted that “the first [school of thought] views organizations as anthropomorphic entities that actually integrate individual learning and translate it into action for the organization’s benefit; the second is concerned with the identification of behavior which inhibit or disable individual learning” (Chan et al. 2005). The former, though theoretically interesting, suffers from the incongruence of attributing the human capacity of learning to a non-human entity. The latter describes an organization in which individuals learn without transmitting that knowledge to the organizational level. Maintaining knowledge at an individual level runs the risk of that knowledge being lost, misinterpreted, or underutilized. Lipshitz provided a convenient marriage of the two by suggesting “that learning by organizations occurs when individual learning... occurs within the context of organizational learning mechanisms that ensure that people get the information they need and that the products of their reflections are stored and disseminated throughout an organization” (Chan et al. 2005). Lipshitz, Popper, and Oz (1996) defined such organizational learning mechanisms as the “institutionalized structural and procedural arrangements that allow organizations to systematically collect, analyze, store, disseminate, and use information that is relevant to the effectiveness of the organization.”

Organizational learning occurs in two stages. The first stage is individual lessons learned. Organizations, having no cognitive processes, cannot learn in and of themselves. This must occur on the individual level before it can be incorporated into the organization (Love et al. 2000). The second stage of organizational learning incorporates the individual lessons learned into the organizational structure of the company so that they may be analyzed, retained, or employed as is required for the company’s benefit or improvement. This is achieved through the development of cultures, strategies, and processes (Love et al. 2000). To some extent, this second stage may occur organically within an organization, but reliance on informal methods of knowledge retention runs the risk of knowledge loss. Without formalized methods, knowledge transfer may be delayed until the knowledge is no longer current, the transferred knowledge may be incomplete or inaccurate, knowledge may not be transferred to the correct people, or it may not be retained at all. Organizational learning mechanisms are utilized to facilitate this transition between individual and organizational knowledge and reduce these potential pitfalls. This process is outlined in Figure 1.

Organizational learning and environmental volatility

Lipshitz, Popper, and Oz identified four preconditions that may support or encourage organizational learning.
“First organizations that operate in unstable and competitive environments need to improve continuously to survive. Hence these organizations… invest considerable resources in learning mechanisms that allow them to stay ahead in their fields… Second, organizations in which the cost and salience of errors are high are motivated to learn to avoid such errors (Lipshitz et al. 1996).”

These first two preconditions are copiously satisfied by the nature of the construction industry and the environment created by recessions and recoveries. Given these two preconditions alone, one could hypothesize that a great deal of organizational learning occurs within the construction industry. However, the third and fourth preconditions may have a greater affect upon organizational learning. They are “third, organizations with a leadership committed to learning invest considerable resources in developing OLMs” (Lipshitz et al. 1996), and fourth, the professionalism of the organizational members. Though professionalism involves numerous attitudes and attributes, “an important criterion by which professionals are evaluated (particularly among peers) is the extent to which they keep abreast of the state of the art in their fields” (Popper et al. 1998). It is these latter two preconditions, leadership and professionalism, that often make the difference between a learning and a stagnant organization.

Studies conducted by both McKinsey & Company and Boston Consulting Group further confirm this.

“[Though] around a third of the companies in the first quartile of their industries tumbled from their perches during the 2000 slowdown… 15% of today’s market leaders vaulted to the top during that recession” (Williamson et al. 2009).

“The rate and type of technological change in an industry are the result of environmental dynamics acting on that industry. A host of environmental factors put pressure on firms to generate and implement innovations” (Arditi et al. 1997).

Though environmental factors play a large part in recession era management, leadership which has planned for such an event can find opportunities in such turmoil. In a recent study on recession era management, Pearce and Michael noted:

“Recession-induced declines in the market value of resources not only create new threats, they provide important new opportunities. Recessions generate both an operating effect and a strategic effect. The operating effect is that the decline in resources affects our firm; the strategic effect is that the decline affects all firms. By being better able to conserve, maintain, and attract resources relative to competitors during recession, and to deploy those resources to capture customers, competitive advantage can be built” (Pearce et al. 2006).
in the management of organizations; operational changes, competitive changes, and strategic changes (Lansley 1987):

- Operational changes have predictable outcomes and do not lead to any permanent changes in the relationship between the firm and its environment. Routine pre-programmed responses based on previous experience are able to handle these changes. These environments allow firms to focus on improving their routine systems, procedures, and skills.

- Competitive changes, which are long-term and subtle, lead to changes in the structure of the industry and in relationships between the firm and its environment. These changes must be adjusted to over the long term, but do not require an immediate response. They require greater emphasis on creating systems and procedures which can develop slowly in harmony with incremental changes in the environment, and ensuring that skills are updated regularly and appropriately.

- Strategic changes are sudden and unexpected. They are unprecedented and outside the experience of the firm. Such changes require rapid and creative responses and necessitate the development of new relationships with the environment. Strategic changes in an environment necessitate organizational systems which can support the creativity and responsiveness needed to generate new concepts of business and service.

Operational change has too often been the emphasis of organizations, focusing on internal processes while paying insufficient attention to the external environment. This has led most planning to be short term (focused on specific projects) rather than long term (focused on the goals of the company). An overdependence on operational planning exposes companies to potential financial distress, misallocated resources, loss of competitiveness, and lack of growth (Dansoh 2005). Successful companies are able to go beyond planning for operational change, and have formal plans for competitive change, hence their success. However, as indicated by the failure of several successful construction companies during the recession, many are unprepared for strategic change. It is this type of environmental change in which companies in the U.S. found themselves in during the recession of 2007-2009.

The U.S. recession, as formally defined by two or more consecutive quarters of falling Gross National Product, officially began in December of 2007 and ended in June of 2009. Though the recession ended in 2009, the recession continued to affect the construction industry for multiple years after that, as the economy remained under their pre-recession values or worsened after that date. This climate of change, though generally considered detrimental to business, created an environment ripe for organizational learning. Catalysts for organizational learning include situations where employees experience a common sense of direction in how their company must transform to survive now and in the future (Kululanga et al. 2001). This suggests that though a crisis may force change upon an organization, a formal organizational learning plan can shape that change to create a positive outcome. It is within this context that this research was performed.

**METHODOLOGY**

The purpose of this research was to identify what organizational learning occurred in commercial construction companies during the 2007-2009 recession. This included identifying the organizational learning mechanisms employed, and whether there was a correlation between the level of organizational learning occurring within a company and its performance during and following the recession. A grounded theory approach, which derives a theory based upon the research performed rather than testing a predetermined theory against the data, was utilized in this research. The data was collected through a series of semi-structured interviews which included a series of specific questions, but allowed for follow-up questioning and clarification. Companies were chosen from the membership rolls of the Associated General Contractors and were selected to include variations in geographic location and firm size (in monetary volume of work done annually). The constant requirements for the research were that the firm must perform the majority of its work as general contractor (rather than subcontractor), must be based in the Mountain Division (of the United States as defined by the U.S. Census Bureau: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming) or California (Regions and Divisions 2014), and must perform the majority of its work in commercial construction.
Interviewees self-reported scores relative to their profit margins and expected future recessionary success relative to past profit margins and success (in response to interview questions 6 and 7 listed below). These scores were used as success indicators and were compared to the potential success factor of organizational learning. OLM scores were compared to success factor scores in an effort to identify potential correlation. This correlation was used to determine whether or not organizational learning within a company was related to its performance during the recession.

The interviews were conducted in fifteen different companies or divisions, including four companies based in Southern California, four Arizona companies, one Colorado based company, five companies based in Utah, and one Nevada based company. This research was performed under the premise that anonymity of the participating companies would be maintained, thus their names are not included herein. Within each company, interviews were conducted with an individual involved in company management, an individual involved in project management, an individual involved in preconstruction, and an individual involved in labor/field management. Three of the companies interviewed delegated preconstruction services to one of the other interviewees, either upper/company management personnel or project management personnel. This resulted in a total of fifty-seven interviews being conducted. Below are the interview questions:

1. What business lessons were learned in attempting to improve your company’s outlook during the 2007-2009 U.S. recession?
2. Why was this approach successful?
3. What strategies did you try that were not successful (if any)?
4. How have these changes affected your company during the recovery?
5. What systems, programs, or culture (if any) does your company use to get feedback from employees?
6. On a scale of 1 to 10, 1 being significantly worse and 10 being significantly better, how are your profit margins now as compared to before the recession?
7. On a scale of 1 to 10, 1 being significantly worse and 10 being significantly better, how do you feel that your company is positioned for future recessions because of these changes?
8. Do you have any other lessons or advice that you feel would be pertinent to research on lessons learned from the recession?

FINDINGS

Organizational learning mechanisms
Organizational learning mechanisms are the processes, cultures, or programs that a company employs, whether formally or informally, to collect, analyze, store, or disseminate knowledge throughout the company. This research identified what organizational learning mechanisms were employed by the companies studied. A comprehensive list of organizational learning mechanisms mentioned by the respondents was created. Table 1 lists these responses. They were grouped into four categories according to whether they most facilitated the collection, analysis, storage, or dissemination of knowledge. Many of the most common responses, such as employee surveys, informal communication, and general company meetings, were informal cultures or were not directly oriented toward the assimilation of lessons learned. Encouragingly, however, several responses indicated a proactive and formal approach toward organizational learning. These responses included formal lessons-learned meetings conducted at the completion of jobs, company intranet and other technology being utilized to retain the lessons learned, and employee leadership and innovation programs.

Company comparison
Respondents were also asked to report on two success indicators in the interviews; profit margins and how prepared the company may be for a future recession as compared with how prepared it was for this recession. These provided a basis for comparing company performance. The scores for profit margins are shown in Table 2. A score below 5 indicated that profit margins declined during the recession and had not yet reached pre-recession levels. A score of 5 indicated that profit margins currently matched pre-recession levels. A score above 5 indicated that
profit margins currently exceeded pre-recession levels. As an example, Company-1 achieved a score of 3.50. The interviewees from Company-1 self-reported profit margin scores (in response to interview question 6) of 4.0, 2.5, and 4.0, the average of these scores being the company score of 3.50.

**Table 1: Organizational Learning Mechanisms**

<table>
<thead>
<tr>
<th>Response Type</th>
<th>Response Rate</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLECT</td>
<td>17</td>
<td>Employee surveys</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Informal communication / open door policy</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Non learning-specific company meetings</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Employee interviews / reviews</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>End of project lessons-learned meetings</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Technology / company intranet</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Suggestion box</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Client surveys</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Company retreats</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Executive job tours</td>
</tr>
<tr>
<td>ANALYZE</td>
<td>9</td>
<td>End of project lessons-learned meetings</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Study industry trends</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Employee empowerment / ownership in problem solving and innovation</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Employee initiative committees</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Employee leadership and innovation programs</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Continual learning culture</td>
</tr>
<tr>
<td>STORE</td>
<td>8</td>
<td>Technology / company intranet</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Centralize business functions</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Lessons learned record</td>
</tr>
<tr>
<td>DISSEMINATE</td>
<td>18</td>
<td>Training / mentoring programs</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Informal communication / open door policy</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Non learning-specific company meetings</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Technology / company intranet</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Reports</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Increase management staff</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Company manual</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Company memos</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Company lessons-learned presentations</td>
</tr>
</tbody>
</table>

Note: Some organizational learning mechanisms are included in multiple categories.

**Table 2: Success Indicator – Relative Profit Margin Scores**

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>AVERAGE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5⁺</th>
<th>6</th>
<th>7</th>
<th>8⁻</th>
<th>9</th>
<th>10⁻</th>
<th>11⁺</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCORE</td>
<td></td>
<td>3.74</td>
<td>3.50</td>
<td>3.33</td>
<td>4.25</td>
<td>3.50</td>
<td>3.00</td>
<td>3.33</td>
<td>3.50</td>
<td>4.83</td>
<td>3.38</td>
<td>6.33</td>
<td>3.00</td>
<td>3.50</td>
<td>3.50</td>
<td>3.63</td>
</tr>
</tbody>
</table>

A: Companies 5 and 11 received significantly lower than average Profit Margin Scores.
B: Companies 8 and 10 received significantly higher than average Profit Margin Scores.
The mean profit margin score for all companies was 3.74 and the median score was 3.50, indicating that, on average, company profit margins fell during the recession and had not yet returned to pre-recession levels. Eleven of the fifteen companies studied fell within 15% of this average. Two company scores fell significantly below this average at 3.00 each, indicating that these two companies experienced sharper than average decline in their profit margins. Two companies significantly exceeded this average at scores of 4.83 and 6.33, indicating that they achieved higher profit margins during or immediately following the recession as compared to the other companies studied.

Interviewees were also asked to self-report their companies’ learning throughout the recession in terms of preparation for a future recession based on what had been learned and implemented during this recession. These scores are shown in Table 3. A score below 5 indicated that the company was less prepared for a future recession than it was for the last recession and suggests that its learning process was unsuccessful. A score of 5 indicated that the company was equally prepared for a future recession as it was for this recession and that no significant learning occurred. A score above 5 indicated that the company would be more prepared for a future recession and that the company was successful in its endeavors to learn and improve throughout the recession. As an example, Company-1 achieved a score of 8.83. The interviewees from Company-1 self-reported future recession preparation scores (in response to interview question 7) of 8.0, 10.0, and 8.5, the average of these scores being the company score of 8.83. The research found that the mean company score regarding preparation for a future recession was 7.19 with a median score of 7.17. On average, respondents felt their companies had learned lessons and implemented strategies that would make them more successful in a future recession. Thirteen of the fifteen companies studied had scores within 15% of this average. Company-11’s score fell significantly below this average at 4.50, suggesting that respondents within the company felt it was less prepared for future recessions. Company-8 scored significantly above the average at 9.00, signifying that the respondents were confident the company had improved significantly due to the lessons learned and strategies implemented in the recession.

Aside from success indicator scores, companies were also given organizational learning mechanism scores (OLM Scores). Organizational learning mechanisms mentioned by the respondents were counted and ranked to give each company a score based on how they utilized organizational learning mechanisms. This was done by counting all references to mechanisms for the collection, analysis, storage, or dissemination of knowledge made by the respondents within each company. Repeat responses within a company were not counted. Each mechanism was given a score of 1 to 3 based on its focus on learning and its formality. Formalized mechanisms (mechanisms that were regularly scheduled and produced a permanent record) that were directly focused on learning retention or development were given a score of 3. Lessons-learned meetings conducted at project completion were examples of this type of organizational learning mechanism. Formalized mechanisms that were not directly focused on learning but that improved it as an ancillary benefit, or mechanisms that were directly focused on learning but were not formal were given a score of 2. Such mechanisms included general company meetings and employee surveys. Informal mechanisms that were not directly focused on learning retention or

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>AVERAGE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.19</td>
</tr>
<tr>
<td>2</td>
<td>8.30</td>
</tr>
<tr>
<td>3</td>
<td>7.50</td>
</tr>
<tr>
<td>4</td>
<td>6.88</td>
</tr>
<tr>
<td>5</td>
<td>6.33</td>
</tr>
<tr>
<td>6</td>
<td>7.17</td>
</tr>
<tr>
<td>7</td>
<td>7.50</td>
</tr>
<tr>
<td>8</td>
<td>6.50</td>
</tr>
<tr>
<td>9</td>
<td>9.00</td>
</tr>
<tr>
<td>10</td>
<td>7.25</td>
</tr>
<tr>
<td>11</td>
<td>6.50</td>
</tr>
<tr>
<td>12</td>
<td>4.50</td>
</tr>
<tr>
<td>13</td>
<td>6.88</td>
</tr>
<tr>
<td>14</td>
<td>7.00</td>
</tr>
<tr>
<td>15</td>
<td>8.00</td>
</tr>
</tbody>
</table>

A: Companies 5 and 11 received significantly lower than average Profit Margin Scores.
B: Companies 8 and 10 received significantly higher than average Profit Margin Scores.
development were given a score of 1. An example of this would be informal communication through an open-door policy. As an illustration, Company-1 achieved an OLM score of 14. Table 4 below demonstrates how this score was calculated.

<table>
<thead>
<tr>
<th>Organizational Learning Mechanism</th>
<th>Formalized</th>
<th>Directly Focused on Learning</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing Management Staff</td>
<td>Yes</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>General Reports</td>
<td>Yes</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>Training/Mentoring Program</td>
<td>Yes</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>Employee Satisfaction Surveys</td>
<td>Yes</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>Informal Study Industry Trends</td>
<td>No</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>Open Door Policy</td>
<td>No</td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>General Company Meetings</td>
<td>Yes</td>
<td>No</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total 14**

These company OLM scores are tabulated in Table 5. Scores ranged from 3 to 23, with the mean being 13.53 and a median at 15. Higher scores indicated a greater number of organizational learning mechanism being utilized within the company, and potentially, a greater amount of organizational learning occurring within the company. Eleven of the fifteen companies studied had organizational learning mechanism scores of 10 or above. Company-7 and Company-11 had OLM scores of 3 and Company-5 and Company-10 had OLM Scores of 5. Interestingly, the four companies with low OLM Scores made up four of the six smallest companies studied. The size of the company may correlate to the amount of organizational learning occurring within it, or to the formalization of these processes.

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Companies 5, 7, 10, and 11 received a significantly lower than average Organizational Learning Mechanism Scores.</td>
<td></td>
</tr>
</tbody>
</table>

Company ages, sizes, and locations were compared to the success indicator scores (profit margins and preparation for future recessions) but no direct correlation was found. The success indicator scores were then compared to the organizational learning mechanism scores. A total of five companies (Company-5, Company-7, Company-8, Company-10, and company-11) had success indicator scores or OLM Scores significantly outside the average. These five companies and their corresponding scores are compiled in Table 6. All other companies fell within the average in every category. The data generally appeared to correlate, except for Company-10. Company-10 appeared to have an inverse relationship between its profit margin score and its preparation for future recessions and OLM Scores. A brief study of this company explained this phenomenon. Company-10 was a construction company that had employed a great deal of organizational learning in its past. This learning created a business plan which involved reducing competition by focusing on a niche market involving disadvantaged business enterprises. This company also chose to stop work for a year and a half rather
than enter low-bid scenarios during the recession. These strategies allowed the company to operate at much higher than average profit margins; however, the decision not to participate in low-bid competitions also required the dismissal of the majority of the staff during the recession. The small staff, including only one key decision maker during the majority of the recession, allowed the company to rely on individual learning rather than organizational learning. This explained the significantly lower than average OLM score. The score describing preparation for a future recession as compared to this recession was lower than average because the respondents mentioned that they were already well prepared for this last recession and so any improvement would be incremental.

Though Company-10’s strategy provided impressive profit margin scores in the short term, the respondents stated that such a business plan would not be feasible for most other companies. They further mentioned that the strategy would not maintain its feasibility as the company grew in the recovery, and a new business plan would need to be created. Respondents noted that future company growth would also preclude the company from reliance on individual learning. That individual learning would need to be converted to organizational learning through its collection, analysis, storage, and dissemination amongst the growing number of decision makers if the company was to continue to be successful as it grew.

The company with significantly higher than average success indicator scores also had a high OLM Score. This suggests that there is a correlation between organizational learning mechanism and success indicators. This led to the theory that organizational learning directly affects company success.

CONCLUSION

This paper evaluated the use of organizational learning within commercial construction and its practical application during the most recent recession. Fifteen companies were evaluated and provided insight into organizational learning mechanisms being utilized within their companies. Companies were also evaluated on two success indicators: relative profit margin and future recession preparation. Five of the companies scored more than 15% outside of the average in at least one of the evaluated categories. Four of these companies were either all consistently high or low in their success factors scores and success indicator scores. This consistency suggests a correlation between the success factor (organizational learning mechanisms employed) and company success (measured by relative profit margins and preparation for future recessions). As a result, this research concluded with the following theories:

- The use of organizational learning mechanisms within companies increased their level of organizational learning and consequently improved their success.
- Inversely, neglecting to use organizational learning mechanisms impeded companies’ organizational learning and hindered their success.

These theories are to be considered informationally, rather than statistically, significant. They concur with
academic research into organizational learning, but go beyond the academic setting to provide a base upon which organizational learning may be practically applied in the construction industry to improve its performance. Further study on this subject should test these theories to determine their statistical significance to the industry.

REFERENCES


Benjamin Hill
U.S. Department of Labor | bill.benjamin@dol.gov

Mohammed S. Hashem M. Mehany, Ph.D., PMP
Missouri State University | Mohammedmehany@MissouriState.edu

Richard J. Gebken, Ph.D.
Missouri State University | richardgebken@missouristate.edu

ABSTRACT: Previous research has determined that improving employee congruence on organizational methods and goals leads to improved organizational performance. This research establishes a comprehensive framework of common and recommended safety practices that can be used for intraorganizational congruence data collection regarding safety practices. The research is also developing a method for congruence calculation and examine the congruence effect on the subcontractor’s safety performance metrics through a pilot study. The established framework identified and organized 170 practices under seven conceptual, safety-practice categories. The congruence analysis and the pilot study revealed several areas of high and low congruency along with significant correlations between the subcontractors’ intraorganizational congruence and their safety performance. According to these results, subcontractors are encouraged to improve, by increasing intraorganizational congruence using such frameworks and communicate their safety practices and goals effectively through the different organizational levels.

Keywords: Construction Safety, EMR, Subcontractors, Intraorganizational Congruence

INTRODUCTION

Safety risks are pervasive in the construction industry. Of all occupations, construction had the second highest rate of fatalities and the second highest rate of nonfatal injuries and illnesses for recordable cases involving days away from work, days of restricted work activity or job transfer for the private sector in 2013 (BLS, 2014).

In construction, the risk of fatalities and injuries are high due to both the physical requirements of the job and the fact that every day on a project is different in an open and uncontrolled environment. Simultaneously, the growth of healthcare costs outpaces both wage growth and inflation. As a result, the expected cost of an emergency room visit due to a work related injury is increasing and the insurance premiums to cover these incidents are a growing factor in the cost of doing business. It is becoming clear, even to smaller contractors, that the accident prevention efforts they historically tended to avoid are what they now must embrace in order to cut costs and remain competitive.

Benjamin Hill is a graduate of the M.S. Project Management program at Missouri State University. He is an investigator for the U.S. Department of Labor – Wage & Hour Division in the agency’s Kansas City District Office. His interests include the effects of wage and safety regulations on the livelihoods of employees, businesses, and economies.

Dr. Mohammed Mehany is an Assistant Professor in the department of Technology and Construction Management at Missouri State University. His research interests includes construction claims, risk management, life cycle costing, green/resilient infrastructure, lean construction, construction education, and construction safety.

Dr. Richard Gebken is an Associate Professor and Construction Management Program Coordinator in the department of Technology and Construction Management at Missouri State University. His research interests focus on effective dispute resolution in the construction industry, innovative construction contracting practices, and mobile computing technology for construction field management.
Although direct costs of a severe injury accident can be staggering, the majority of costs are usually indirect. Brun and Lamarche (2006), Tangri (2003), and Grimaldi and Simonds (1989) find that the indirect costs comprise a long list of factors including:

- Wages for working time lost by uninjured workers;
- Net cost to repair, replace, or straighten up material or equipment damaged in the accident;
- Uninsured wages paid for working time lost by injured workers;
- Extra costs due to accident-related overtime work;
- Supervisor’s wages for accident-related activities;
- Wage cost of decreased injured worker output after return to work;
- Cost-of-learning period of new workers;
- Uninsured medical costs;
- Accident investigation costs incurred by managers and others;
- Clerical costs for processing compensation or insurance forms; and
- Miscellaneous unusual costs, such as equipment rentals or hiring new workers.

Effective construction safety management helps both improve the construction industry’s image and minimize worker’s compensation rates for construction contractors. It strengthens the construction labor force and improves the quality of life for construction workers. It also allows contractors to bid on additional, and potentially more profitable, projects as requirements of minimum safety ratings exist in some construction contract language. For these reasons, concepts such as zero injury have been introduced which was emphasized in the “Zero Injury Economic” report released by the Construction Industry Institute (CII) in 1993.

Subcontractor Safety

While general contractors (GCs) are ultimately responsible for the overall safety plan on a construction project, it is subcontractors who are increasingly the linchpin for their success. The reasons for the mounting importance to subcontractors include not only the business necessity discussed above but also the increased share of physical work and legal responsibilities incurred in today’s construction industry. Subcontractors perform a vast majority of the physical work on a construction site. A 1998-99 study by Constantino and Pietroforte determined that 90.9% of the trades were subcontracted more than 75% of the time (Sacks & Harel, 2006). A similar study by CII found not only that the mean number of subcontractors on a project was 21.8 but also that they performed 70% of project work (CII, 2006).

In addition to the increased physical presence on the project site, construction subcontractors are also increasing their risk exposure. The United States Occupational Safety and Health Administration (OSHA) law 1926.16(c) states that the prime contractor assumes the entire responsibility under the contract and the subcontractor assumes responsibility with respect to his portion of the work and it also states the existence of joint liabilities. Naturally, as subcontractors perform more work, they must take a more active role in ensuring a safe work environment. Therefore, it is critical that subcontractors strive to improve safety policies and practices and not be reliant on only the GCs for safety best practices.

All subcontractors should have safety plans, as they are often required by general contractors. But optimally, the idea is to get all employees of the subcontractor on the same page regarding construction safety. This can be difficult as oftentimes construction subcontractors may be subject to different expectations and practices as they work for multiple GCs from project to project. Ideally, everyone in the company should understand how the goals and practices employed by the subcontractor in its safety plans are supposed to work regardless of the project.

Ultimately, uniformity and consistency leads to the creation of a logical system for empowering employees to consistently make decisions that suit the organizational safety goals. Management texts often describe this organizational characteristic as being synchronized, aligned, or congruent in a pursuit (Lucey 2003; and Drury, 2004). For convenience, the degree of consistency to which personnel within an organization understand and agree with each other on organization-related safety concepts and actions is defined for this paper as intraorganizational congruence. Consistency in this manner should conceivably be indicative of a company with open communication and further lead to consistency in safety-plan adjustments/improvements.
Purpose of Study
The purpose of this study is threefold. First, a system for categorizing and analyzing the level of knowledge of company safety practices must be established. This study will review the current literature and establish a framework of common and/or recommended safety policies so that it can be used as a tool for data collection. Second, this study will develop a way to calculate the intraorganizational congruence of safety practices/procedures for construction subcontractors. Creating this metric not only helps establish a baseline of understanding across management levels but also explores whether greater intraorganizational congruence occurs in some safety practices areas over others. Lastly, this study will analyze the effects of intraorganizational congruence of safety practices on safety performance. While the congruence concept is hoped to be effective for project industries in general, this paper is specifically tailored to construction subcontractors. The aim is to contribute to the empowerment of the subcontractors, so they have as much control over their safety system as they has over the work they perform.

LITERATURE REVIEW
Subcontractors need to be competent in safety practices or the construction industry’s improving safety performance will plateau (O’Brien, 2000). As construction companies look to control workers’ compensation premiums, safety is a competitive factor in determining the capabilities of businesses survival where complacency is not an option. Based on previous literature (Duffy, 2008; Hine & Lewko, 1999; Lauver & Trank, 2008), congruence has been identified as a way to increase safety performance. This literature review begins by exploring the concept of intraorganizational congruence, some general strategies to implement it, and its possible benefits. A brief overview of the general safety practice categories and a discussion of safety performance metrics will also be presented.

Intraorganizational Congruence
Organizational behavior theory defines congruence as “the degree to which the needs, demands, goals, objectives, and/or structures of one component are consistent with those of the other” (Nadler & Tushman, 1997: 34). An increase in the agreement, or congruence, between different parts of the organization leads to not only higher employee satisfaction and improved job performance (Witt, 1998) but also increased organizational effectiveness (Russo and Harrison, 2005). Congruence also helps to satisfy healthy goals of inspiring employee creativity and allowing them to develop professionally and earn respect. Some of the benefits of the intraorganizational congruence include:

- A strong, definite culture that empowers employees to perform at maximum efficiency and provides for top quality products for customers (Green & Jack, 2004);
- Increased worker creativity, competencies, predictability, commitment, accountability, and performance (Meglino, Ravin, & Adkins, 1989);
- Increased worker satisfaction, self-esteem, and overall mental health (Perr and Knight Inc., 2006); and
- Enhanced communication, coordination, and cooperation (Chatman & Barsade, 1995).

Perr and Knight Inc. (2006) claim that organizational congruence can be achieved with a three pronged strategy including unified vision, work practices, and rewards. First, vision generates tremendous energy, excitement and passion within an organization. Organizational vision can be created with three sub-elements: a significant purpose, a picture of the future, and a limited, prioritized set of values (Blanchard, 2007). Second, Uniform work practices improve personnel certainty, with respect to what they are expected to do and what they should expect of others. (Perr & Knight Inc., 2006). Lastly, in order for the reward system to help create organizational congruence it must match the outcome with the effort. Pfeffer (1998) claims that reward systems are more effective and less subject to manipulation when personnel are rewarded in groups or teams rather than on individual basis. The underlying key is that the reward is linked to the goal or target behavior.

This explanation is supported in the realm of organizational safety by Lauver and Trank (2008), whose study provides evidence supporting the idea that congruence of safety practices leads to better safety performance. These observations lead to the expectation that congruence of the individual’s values to the organizational culture increases the individual’s satisfaction, predictability, commitment, and performance.
Construction Safety Practices
A contractor’s safety practices encompass how it actually does safety, irrespective of company policy and management’s messages. For this study, the authors derived 150 practices from a comprehensive review safety literature and classified them into seven categories including personal protection equipment, general protection equipment, field activity, field documentation, organizational, hazard identification, and compliance practices. These conceptual categories serve as the framework to test whether the categorical results would satisfy intuition and to provide an example of how contractors might organize their safety programs. The following subsections describe and provide examples for each category.

Personal Protection Equipment Practices
Personal protection equipment (PPE) is the construction worker’s last line of defense and his most tangible evidence of organizational regard for his personal well-being. This practice includes but not limited to eye protection, hearing protection, and personal fall arrest systems.

General Protection Equipment Practices
General protection equipment (Gen PE) are applied to prevent accidents to any and all who by mistake or coincidence happen to approach a conceived hazard source which includes fall prevention and protection, barricades and lockout/tag out.

Field Activity Practices
Field activity practices cover the actions for preparedness, evaluations, and hazard-elimination on a project level. Practices involve toolbox meetings, drug testing and pre-task planning.

Field Documentation Practices
Field documentation practices prevent accidents and injuries in two ways. First, hazardous conditions can be identified logically, based on contradictions or conflicts that arise when comparing two or more plans or reports (Hinze & Godfrey, 2003). Secondly, hazardous conditions can be identified historically, based on lessons learned. Furthermore, keeping records is the only means a business has to track, compare, and improve performance. Safety reports, accident reports, and safety plans are the main documents in this practice.

Organizational Practices
Organizational safety practices relate the subcontractor’s safety commitment to the company as a whole. It broadly influence its safety culture through practices such as investigations, training, and incentives. These practices promote preparedness, evaluation, and hazard elimination on an organizational level. Practices involve investigations, training, and incentives.

Hazard Identification Practices
The goal of hazard identification is to eliminate the dangers encountered by construction workers during their assignments. It determines which protective and general equipment practices should be exercised, who should be checked for licenses or certifications, and what is integrated directly into several field activity and field documentation practices. These practices involve electrocution, confined spaces, and falls.

Compliance Practices
The distinct characteristic of compliance practices is that they are used to verify building permit, trade license, and specialty certification qualifications to reduce project-related uncertainties.

Safety Performance Metrics
In construction safety, there are several measuring systems. The main three types of safety performance metrics includes the days away, restricted, and transfer incidence rate (DART), the total recordable incident rate (TRIR), and the experience modification rate (EMR).

Total Recordable Incident Rate (TRIR)
TRIR are directly calculable from OSHA’s form 300 (OSHA, 2004b; Huang & Hinze, 2006). It represents roughly the annual rate of recordable injuries and illnesses per 100 employees. It is computed by multiplying the number of injuries and illnesses by 200,000 and then dividing by the number of hours worked by all employees (OSHA, 2004b).

The annual TRIR may provide a good measure for comparing a sizable list of subcontractors that specialize in the same duties. It certainly is a measure for contractors to pay attention to internally, to compare present year performance to those of previous years. TRIR is only based on the number of injuries and illnesses and does not account for severity. As an example, the industry-wide TRIR was 14.30 in 1989 (CII, 2007), and by 2012 that rate had dropped to 4.5.
(BLS, 2012). For CII member companies, who typically are progressive thinkers in terms of safety practices, had a TRIR of 0.43 in 2011 (Porter, 2013).

**Days Away, Restricted, and Transfer (DART) Incidence Rate**

Hinze and Godfrey (2003) refer to DART as the normalized lost workday/restricted work activity injuries. It’s referenced to in OSHA’s instructions in 300 and 301 forms as “the incidence rate for recordable cases involving days away from work, days of restricted work activity or job transfer” (OSHA, 2004b, p. 5). Computing this is similar to computing the TRIR. Again, the number of qualified cases is multiplied by 200,000 and divided by the number of hours worked by all employees (OSHA, 2004b).

As Hinze and Godfrey (2003) noted, “the incidence of such injuries is generally quite small, or should be quite small.” The frequency of recordable injuries that do not result in such consequences is generally higher. Unlike the TRIR, counting the number of days that the incident causes disruption does factor in severity, to an extent. But, like TRIR, DART has the weakness of not enabling comparisons between trades with naturally different rates of injuries and illnesses.

**Experience Modification Rate (EMR)**

The EMR is a metric used in the insurance industry to derive worker’s compensation premiums. “The EMR formula compares past reported losses with expected losses. Those expected losses are calculated by multiplying your audited payroll for those same past years times statewide expected loss factors for each classification code” (Priz & Priz, 2009, p. 101).

For the construction subcontractor, the EMR of each trade is rated relative to the average risk of the trade, set at 1.00. Another characteristic of the EMR of interest to this study is a component called the discount ratio (D-ratio). The interesting effect of the D-ratio is that multiple small claims will result in higher premiums than a single, equivalent, larger claim (Priz & Priz, 2009). Statistically, a single large claim has some probability of being a fluke, while multiple smaller claims are considered habitual and reasonable cause for suspecting that much larger claims will eventually occur.

The TRIR and DART rates for a particular year reflect occurrences of only that year and depend on the number of subcontractor employees. DART rates are regarded as a weak measure of safety performance (Hinze & Godfrey, 2003). TRIR provides a more accurate indication of performance when surveying only employers with similar numbers of employees, or when considering accidents due to particular causes (Hinze & Godfrey, 2003). The EMR is a lagging indicator, but provides a more stable measure with which to compare subcontractors with varying numbers of employees, as this study does. For this reason, this study exclusively uses EMR as the metric for comparison.

**METHODOLOGY**

The research began with identification of the main framework of safety practices used in the construction industry. After an extensive literature review, seven main categories were identified and further broken down into a total of 170 practices as shown in Figure 1. These 170 practices will serve as the main framework to measure intraorganizational congruence of subcontractors. In addition to that framework, the research is also testing a positive relationship between the subcontractor’s intraorganizational congruence and their safety performance. The detailed methodology adopted and the analysis procedures are as shown in Figure 1.

As shown in Figure 1, the construction safety practices identified by the literature review served as the main framework for the intraorganizational congruence measurement across the subcontractor’s levels of management (executive, project and field management). The measurement method for the intraorganizational congruence was created to measure the congruence between pairwise parties as in: (1) Executive to PM Congruence, (2) Executive to field management congruence and (3) PM to Field management congruence. The computations resulted from this measurement method were integrated in a pilot study. This quantitative pilot study is using congruence analysis along with regression analysis to identify the areas of congruence and test the effect of the congruence on safety performance respectively. The (EMR) was chosen in this study as the safety metric for comparison, mostly due to the variety of staffing levels among the participating subcontractors.
Survey Design and Administration

The survey was designed to collect responses from the subcontractor’s executive, project, and field managers. The practices-questionnaire was designed for simple completion and analysis, requesting answers of “Yes,” “No,” or “Uncertain,” regarding whether each practice is mentioned in the company’s policy. The safety ratings questionnaire was designed to collect subcontractors’ EMR, TRIR, and DART rates. An excerpt of the safety ratings questionnaire for the PPE category is shown in Figure 2. Similar questions were designed for each of the other practice areas.

The survey package consisted of five documents in a stamped, self-addressed envelope. One document was instructions, one was for collecting standard safety performance ratings, and three copies of the 170 practices questionnaire were for executive, project, and field managers to complete, independently. Both the safety ratings and practices questionnaires were programmed into the internet survey service, Inqsit©, in case anyone was more inclined to participate online. The postal system was used to provide for greater anonymity and to encourage participation. The survey requested names from neither managers nor the company and subcontractors were encouraged to neglect including return addresses on envelopes.
Thirty-one survey packages were distributed to construction subcontractors in Missouri. A total of 11 survey packages were returned, however, two of the respondents did not complete the entire set of questionnaires.

Figure 2: An excerpt of the safety ratings questionnaire for the PPE category

A Framework for Analyzing Intraorganizational Congruence of Safety Practices on Safety Performance

Spring 2016 — Volume 40, Number 01
The American Institute of Constructors | 700 N. Fairfax St., Suite 510 | Alexandria, VA 22314 | Tel: 703.683.4999 | www.professionalconstructor.org
Congruence Computation Development and Analysis

Tabbed spreadsheets were created in a Microsoft® Excel file to compute congruence percentages. Spreadsheets for each of the seven practice categories were designed to record responses and compute congruence percentages. For example, Table 1 shows how responses were recorded, per practice, for the three participants from Subcontractor 8. Responses of “Yes,” “No,” and “Uncertain” are represented in the spreadsheet as (1), (0), and (2), respectively.

Table 1: Sample of Responses to Inquiries of Subcontractor Safety Practices. (1) represents “Yes,” (0) represents “No,” and (2) represents “Uncertain.”

<table>
<thead>
<tr>
<th>PPE Safety Practices</th>
<th>SCS608: Mechanical</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Executive</td>
<td>PM</td>
<td>Field Mgmt</td>
</tr>
<tr>
<td>Hard Hat</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Safety Glasses</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Harness &amp; Lanyard</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gloves</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dusk Mask</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Respirator</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Face Shield</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Welding Helmet</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Welding Apron</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Orange Vest</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Thick-Sole Boots</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Radio-Phone</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hearing Protection</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 is the congruency table for Subcontractor 8 on personal protection practices, corresponding with Table 1. In this case, for any practice, if the two managers (at the top of the column in Table 2) agree on in Table 1, a (1) results in table 2, indicating congruence. That is, unless the two managers answered “Uncertain,” in which case a (0) results, indicating incongruence. For example, the project and field manager were both uncertain whether radio-phones were included in the company’s policy. Logically, congruence as a measure of understanding and agreement between entities should represent a state of certainty. In table 2, for each column, a manager to manager congruence is computed in the bottom row, as a mean percentage.

Table 3 summarized the manager-to-manager congruence of all practice-categories. Notice that the three left-most values in the PPE row in Table 3 are the manager-to-manager congruence calculated in Table 2. Averages are taken vertically for inter-management congruence represented in the first three bottom values in the table. Averages are also taken horizontally for practice-category congruence represented in the seven right-hand values in the table. The percentage in the lower right-hand position is the overall congruence, which is the average of averages in both directions. For purposes of this document, inter-management, practice-category, and overall congruence constitute the subcontractor’s intraorganizational congruence on its safety practices.
All manager-to-manager congruences in Table 3 are weighted according to the number of practices that were discussed earlier for each practice category to compute the inter-management congruences on the bottom row. For example, Equation 1 shows the calculation of the executive-to-project inter-management congruence for Subcontractor 8. These same weights must also be used when calculating the overall congruence in the vertical direction from the practice-category congruences.

**Equation 1. Average Exec. To PM Congruence for Subcontractor 8**

\[
\frac{(13)77\%+(23)52\%+(18)59\%+(33)33\%+(30)47\%+(16)67\%+(37)63\%}{170} = 54\%
\]
The results of the congruence analysis should explore and identify the areas of high congruence and low congruence within the safety practices framework.

Regression Analysis
As part of the validation pilot study, simple linear regression was performed between these levels of congruence and the EMRs to test for relationships between these practice-category congruence and their effect on the safety performance. Prior to any application of regression analysis, data was checked for normality. This was done using the Lillifor’s test, which is available in the Microsoft® Excel add-in, StatPro software developed by Chris Albright in 2002. Regression analyses were performed using SPSS Inc. SPSS 14.0® for Windows. The regression analysis should provide an indication of the effects of intraorganizational congruence on the subcontractor’s safety performance represented in the EMR.

FINDINGS
Based on the data from different subcontractors on 170 safety practices, data analysis has been performed using the congruence computation and regression analysis.

Congruence Findings
The highest inter-management congruence across subcontractors was between executive and project management (62%). Unexpectedly, lower congruence was detected between field managers and project managers (55%) than between field managers and executive managers (59%).

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Overall Congruence</th>
<th>Exec to PM Congruence</th>
<th>Exec to Field Congruence</th>
<th>PM to Field Congruence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>79%</td>
<td>92%</td>
<td>74%</td>
<td>72%</td>
</tr>
<tr>
<td>HVAC</td>
<td>75%</td>
<td>73%</td>
<td>76%</td>
<td>77%</td>
</tr>
<tr>
<td>Terrazzo</td>
<td>57%</td>
<td>68%</td>
<td>57%</td>
<td>46%</td>
</tr>
<tr>
<td>Electric</td>
<td>52%</td>
<td>55%</td>
<td>54%</td>
<td>48%</td>
</tr>
<tr>
<td>Plumbing</td>
<td>45%</td>
<td>45%</td>
<td>50%</td>
<td>41%</td>
</tr>
<tr>
<td>Drywall</td>
<td>24%</td>
<td>35%</td>
<td>8%</td>
<td>28%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>56%</td>
<td>54%</td>
<td>66%</td>
<td>49%</td>
</tr>
<tr>
<td>Averages</td>
<td>58%</td>
<td>62%</td>
<td>59%</td>
<td>55%</td>
</tr>
</tbody>
</table>

The highest practice-category congruence belonged to personal protection equipment (79%) and hazard identification practices (65%), with Subcontractor 1 and Subcontractor 7 on top. Of the practice categories, congruence was lowest on documentation (49%), compliance (54%), and organizational safety practices (55%). Among the subcontractors, Subcontractor 6 was estimated to have the lowest congruence in these categories.

Regression Results
The results of the regression analysis are mainly represented in table 4 and 5. Of the eleven simple linear regression analyses between intraorganizational congruence and EMR, the overall congruence as well as two of three inter-management and two of seven practice-category congruence were statistically significant at the p = 0.05 level.
Table 5. Management congruence of participating subcontractors by safety practice category.

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Average Congruence PPE</th>
<th>Average Congruence Gen PE</th>
<th>Average Congruence Field Act</th>
<th>Average Congruence Field Doc</th>
<th>Average Congruence Org</th>
<th>Average Congruence Hazard ID</th>
<th>Average Congruence Lic/Cert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>95%</td>
<td>87%</td>
<td>92%</td>
<td>70%</td>
<td>61%</td>
<td>93%</td>
<td>77%</td>
</tr>
<tr>
<td>HVAC</td>
<td>79%</td>
<td>62%</td>
<td>79%</td>
<td>82%</td>
<td>81%</td>
<td>63%</td>
<td>71%</td>
</tr>
<tr>
<td>Terrazzo</td>
<td>90%</td>
<td>51%</td>
<td>57%</td>
<td>56%</td>
<td>38%</td>
<td>63%</td>
<td>81%</td>
</tr>
<tr>
<td>Electric</td>
<td>64%</td>
<td>48%</td>
<td>54%</td>
<td>38%</td>
<td>70%</td>
<td>46%</td>
<td>38%</td>
</tr>
<tr>
<td>Plumbing</td>
<td>79%</td>
<td>71%</td>
<td>38%</td>
<td>34%</td>
<td>34%</td>
<td>59%</td>
<td>29%</td>
</tr>
<tr>
<td>Electric</td>
<td>59%</td>
<td>36%</td>
<td>20%</td>
<td>3%</td>
<td>27%</td>
<td>35%</td>
<td>0%</td>
</tr>
<tr>
<td>Drywall</td>
<td>90%</td>
<td>91%</td>
<td>74%</td>
<td>69%</td>
<td>73%</td>
<td>93%</td>
<td>75%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>77%</td>
<td>57%</td>
<td>61%</td>
<td>38%</td>
<td>50%</td>
<td>70%</td>
<td>65%</td>
</tr>
<tr>
<td>Averages</td>
<td>79%</td>
<td>63%</td>
<td>59%</td>
<td>49%</td>
<td>55%</td>
<td>65%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Table 6. Simple linear regression analysis results for EMR versus overall and inter-management congruence. Included are coefficients from the linear model $y = \beta_1 x + \beta_0$. Models are based on data from Subcontractors 1 through 6.

<table>
<thead>
<tr>
<th>Models</th>
<th>$\beta_1$</th>
<th>$\beta_0$</th>
<th>$\text{d}_t$</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
<th>Sig.</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMR vs Overall Congruence</td>
<td>-0.349</td>
<td>1.015</td>
<td>Regression</td>
<td>1</td>
<td>0.025</td>
<td>0.025</td>
<td>9.976</td>
<td>0.034</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual</td>
<td>4</td>
<td>0.010</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs. Exec-PM Congruence</td>
<td>-0.365</td>
<td>1.045</td>
<td>Regression</td>
<td>1</td>
<td>0.028</td>
<td>0.028</td>
<td>16.853</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual</td>
<td>4</td>
<td>0.007</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs. Exec-Field Congruence</td>
<td>-0.232</td>
<td>0.945</td>
<td>Regression</td>
<td>1</td>
<td>0.016</td>
<td>0.016</td>
<td>3.517</td>
<td>0.134</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual</td>
<td>4</td>
<td>0.019</td>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs. PM-Field Congruence</td>
<td>-0.384</td>
<td>1.022</td>
<td>Regression</td>
<td>1</td>
<td>0.026</td>
<td>0.026</td>
<td>12.104</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual</td>
<td>4</td>
<td>0.009</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examining table 4, the relationship between overall congruence and EMR was statistically significant ($F (1, 4) = 9.976$, $p = .034$). Of the three inter-management congruence, executive-to-project inter-management and project-to-field inter-management congruence tested as significant against EMR at ($F (1, 4) = 16.853$, $p = .015$) and ($F (1, 4) = 12.104$, $p = .025$), respectively. Of the seven practice-categories, Table 5 below shows that the only two that tested as significant against EMR were field activity practices ($F (1, 4) = 15.193$, $p = .018$) and hazard identification practices ($F (1, 4) = 12.062$, $p = .026$).
CONCLUSIONS AND RECOMMENDATIONS

This research created a framework for categorizing practices, measuring the intraorganizational congruence of those practices, and analyzing the effects of safety practice congruence on specific safety metric. While the pilot study presented analyzes only a small sample of construction subcontractors, the data show a promising result towards the possibility of a relationship between the subcontractor’s intraorganizational congruence on safety practices and their safety performance. Overall, these findings can be summarized in three broad categories – inter-management congruence, practice category congruence, and congruence/performance correlation.

Inter-management Congruence
The results of the highest inter-management congruence across subcontractors between executive and project management is consistent with the top-down driven model encouraged by scholars on organizational safety. These results also suggest that executive managers should take the lead in communicating the company’s safety vision by the principle of leadership. Furthermore, their message should most strongly reach project managers who must have the understanding and power to proactively plan, coordinate, and control project resources, including field managers. On the other hand, the field managers and project managers in this sample had a low congruency score which is pointing towards a little disconnect between the field and office.

Table 7. Simple linear regression analysis results for EMR versus practice-category congruence. Included are coefficients from the linear model $y = \beta_1 x + \beta_0$. Models are based on data from Subcontractors 1 through 6.

<table>
<thead>
<tr>
<th>Models</th>
<th>$\beta_1$</th>
<th>$\beta_0$</th>
<th>$d_i$</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
<th>Sig.</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMR vs Ave. Congruence PPE</td>
<td>-0.403</td>
<td>1.135</td>
<td>Regression 1</td>
<td>0.016</td>
<td>0.016</td>
<td>3.434</td>
<td>0.138</td>
<td>0.462</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.019</td>
<td>0.005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence GPE</td>
<td>-0.343</td>
<td>1.025</td>
<td>Regression 1</td>
<td>0.019</td>
<td>0.019</td>
<td>5.022</td>
<td>0.089</td>
<td>0.557</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.015</td>
<td>0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence Field Activity</td>
<td>-0.283</td>
<td>0.982</td>
<td>Regression 1</td>
<td>0.028</td>
<td>0.028</td>
<td>15.193</td>
<td>0.018</td>
<td>0.792</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.007</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence Field Documentation</td>
<td>-0.224</td>
<td>0.927</td>
<td>Regression 1</td>
<td>0.020</td>
<td>0.020</td>
<td>5.501</td>
<td>0.079</td>
<td>0.579</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.015</td>
<td>0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence Organizational</td>
<td>-0.206</td>
<td>0.928</td>
<td>Regression 1</td>
<td>0.010</td>
<td>0.010</td>
<td>1.634</td>
<td>0.270</td>
<td>0.290</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.025</td>
<td>0.006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence Hazard ID</td>
<td>-0.369</td>
<td>1.042</td>
<td>Regression 1</td>
<td>0.026</td>
<td>0.026</td>
<td>12.062</td>
<td>0.026</td>
<td>0.751</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.009</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR vs Ave. Congruence License/Certification</td>
<td>-0.174</td>
<td>0.908</td>
<td>Regression 1</td>
<td>0.016</td>
<td>0.016</td>
<td>3.322</td>
<td>0.142</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual 4</td>
<td>0.019</td>
<td>0.005</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
personnel. An area that should definitely be addressed through more training and open communication lines between the site and office managers.

**Practice category Congruence**

The results showed the highest congruence results between managers when it came to personnel protection equipment and hazard identification. This shows that they are almost completely affirmative in their use of PPE. This should be no surprise considering that the PPE is the last resort or the last line of defense against hazards and they are mostly aware of the hazard identification processes.

In the meantime, the results showed that managers were least congruent on field documentation and compliance practices. This can be linked to the earlier conclusion of the lack of communication between office and site personnel which will definitely affect the documentation and compliance practices.

Without clear communication between the field and corporate office, procedures may be difficult for executives to prioritize. Documentation practices are how the subcontractor is able to track safety performance and generate solutions based on trends and strategies used on previous projects. They are also how the subcontractor is able to provide the required records to occupational safety regulators and parties who care to raise disputes. All of the subcontractor’s managers should understand the documentation needs of their employer, as well as those of the project. With time, improvements in regulations and innovative processes, spurred by competition, will drive subcontractors to evolve to more holistic programs. To help ensure that existing subcontractors are able to change with competition, their managers must be congruent on their documentation practices.

**Congruence/Performance Correlation**

The regression results in general showed a significance between the subcontractor’s intraorganizational congruence on safety practices and their safety performance represented in the EMR.

An EMR of 1.0 is supposed to represent the industry average. The regression coefficients reported in the results imply that an EMR of approximately 1.0 corresponds to an intraorganizational-state of zero congruency. This would mean that the managers of the average subcontractor would have no agreement between them about which practices their company employs to manage safe work, which would contradict the study’s premise. There is no reason to suspect that the ideal model is even linear. With the small sample size, there were simply no grounds to suggest a more sophisticated statistical model. The reader should not get the impression that the regression analyses in this study generated any model accurate enough for practical application.

Again, the purpose of this study was simply to test for the possibility of a positive relationship between the subcontractor’s intraorganizational congruence on its safety practices and its safety performance. Taking into account this study’s small sample size, no definite conclusion can be drawn. With that said, this research supports the hypothesis, for the small sample obtained. If further research is conducted and the construction community decides that the relationship between intraorganizational congruence on safety practices and safety performance is strong, companies may find it beneficial to periodically use surveys, to help in making decisions, regarding their safety programs.

**Future Work**

While this study created a framework for analyzing intraorganizational congruence of safety practices on safety performance and validated the methods of calculation through a pilot study, more data are needed. Further study of the relationship between managers’ knowledge of safety practices is needed to prove the existence of the statistically significant relationship between intraorganizational congruence and safety performance. In addition, the collection of field workers’ knowledge of safety practices would help completely capture the level of congruence throughout the entire organization. Despite this fact, subcontractors are encouraged to improve, by increasing intraorganizational congruence and coordinating proactively with other project contractors. Further efforts might choose to narrow their scope to single trade specialties or to specific intervals of subcontractor sizes.

**REFERENCES**

A Framework for Analyzing Intraorganizational Congruence of Safety Practices on Safety Performance


CII (2006). Targeted safety programs. Austin, TX: The University of Texas at Austin.


OSHA (2004). Forms for recording work-related injuries and illnesses. OSHA.


Contractor Feasibility in Providing Cost Segregation Studies From Detailed Estimates: A Case Study

Ben F. Bigelow Ph.D.
Texas A&M University | bbigelow@arch.tamu.edu

Jeremy Robinson
Texas A&M University | jeremyrobinson@beckgroup.com

John Killingsworth Ph.D.
University of Wisconsin – Stout | killingsworthj@uwstout.edu

ABSTRACT: Profit margins are tight for general contractors, averaging under 3% (Construction Financial Management Association). Further, competition for projects can be very fierce, so any opportunity for increased profit or a competitive advantage in bidding bears consideration by general contractors. Cost segregation studies represent such an opportunity but the feasibility of a general contractor providing them has not been studied. A cost segregation study allows a property owner to accelerate the depreciation of certain portions of a building thus reducing tax liability and increasing cash flow. Because the information needed for a cost segregation study can be found in a detailed estimate, the general contractor is well prepared to provide this service to owners on private projects. This study explored the learning curve required for a general contractor to provide them. The results suggest that following the initial learning curve, a general contractor can offer this service, likely resulting in additional profit or a competitive advantage in bidding.

Keywords: Bidding; Estimating; Construction Finan

INTRODUCTION

Construction is an industry that is characterized by tight profit margins, and highly competitive bidding. Because margins are tight to begin with, billable services or alternative revenue streams are important considerations. Providing cost segregation reports to owners represents an untapped opportunity for general contractors (GC) to realize additional revenue by providing them as a service. Alternatively, GCs could provide cost segregation reports as an added value in their bids to gain an advantage in the bidding process. However, cost segregation reports are largely unheard of among GCs.

The connection between a cost segregation report and a GC comes in the GC’s estimate. The data needed to complete a cost segregation report is readily available in the GCs detailed estimate and historical data. As a result, for a GC, providing a cost segregation report would consist primarily of organizing existing data (the estimate) into a cost segregation report. For an owner, a cost segregation report results in a significant increase in cash-flow early in a building’s life. The increase in cash-flow to the owner is significant enough that private building owners commonly pay for cost segregation studies to be performed after construction.
is complete or upon acquisition of a “used” building, indicating that there is demand and value for cost segregation studies.

Cost Segregation is a tax strategy that is recognized by the IRS that can reduce a building owner’s tax liability (thus increasing cash flow). The reduced tax liability is achieved through accelerated depreciation of certain building components. A cost segregation report defines which building components qualify for accelerated depreciation. It is an alternative to straight line depreciation, where a building’s value is depreciated equally over 39 years. A cost segregation study allows different building components and property improvements to be depreciated over shorter time periods (5, 7, and 15 years), that are substantially faster than the straight line period of 39 years. For example, a ten million dollar office building would qualify for approximately $256,400 of depreciation each year using straight line depreciation. Using accelerated depreciation, that same building would qualify for a deduction around $382,900 in the first year of ownership, a nearly 50% increase in cash flow for the building owner, in that first year.

To take advantage of the tax benefits available through cost segregation, a building owner must have a formal cost segregation study performed on their building that includes an engineering report, where the building components and their values are segregated based on depreciable life into 5, 7, 15, & 39 year assets. The Internal Revenue Service (IRS) has guidelines for performing a cost segregation report, however many of the details governing cost segregation and what building components can be depreciated at an accelerated pace are based on case law. As a result understanding and compiling a cost segregation study requires a degree of expertise in construction as well as accounting (Ferst & MacCrate, 1999). For those reasons, the IRS requests that cost segregation studies be performed by cost engineering professionals (Babcock, 2003) and requires that studies are completed by individuals competent in construction or building methods (White, 2008). Because of these requirements, engineers typically provide the engineering report of a cost segregation study after the owner has taken possession of the building. They assemble the report based on an analysis of the building plans, and contract documents available, and an inspection of the building. Costs are then typically derived from a historic cost database.

While cost segregation studies are generally performed after construction is complete and an owner has taken possession of a building, there is no requirement that they be performed at that time. Based on the content of a cost segregation study, with some basic training on the subject, an estimator is well positioned to assemble a cost segregation report. Estimators probably don’t come to mind when thinking about taxes, or tax planning, but in the case of a cost segregation study the GC’s estimator could be the source of a significant tax benefits for building owners, and a bidding advantage or additional profit for GCs. This is because a time intensive portion of performing a cost segregation report is data collection. However, as part of the estimating process the building is already broken down into detailed components. So with a detailed cost estimate, and the actual costs of construction, assembling a cost segregation report could be as simple as assigning each line item in the detailed estimate to it’s appropriate depreciation period (5, 7, 15 or 39 year).

Cost segregation studies are produced for a fee that ranges based on building type and size so the fee a GC could charge would vary from one project to another. Alternatively, for a GC competitively bidding a project, offering a cost segregation study to an owner could represent the added value that leads to a contract award.

The purpose of this study was to analyze the feasibility of a GC providing a cost segregation study. Because there is a need for training and education to produce a study, this research documented the efforts of a construction professional to self-educate and then perform a cost segregation study using a detailed estimate. Specifically this study asked the following research questions: 1) What is the learning curve for a GC’s employee learning to produce a cost segregation study? 2) What is the feasibility of a GC offering this service? This research is significant as it represents the first empirical effort considering a GC in this capacity.

Literature Review

The value of cost segregation studies as a means for reducing tax liability and increasing cash flow in the early years of building ownership has been reported
by various authors (Maples & Hayes, 2012; Placid & Weeks, 2011; White, 2008; Lassar, Duncan, & Evverett, 2006; Zenk, 2005; Gonzalez, 2006), and it doesn’t take an expert to understand the potential benefit of increased cash flow for a business. However, cost segregation studies are not without flaw. Overly aggressive cost segregation (Soled & Falk 2004; Tax Court Rejects, 2012), or improperly prepared studies can lead to tax penalties and interest charges (Placid & Weeks, 2011), further the initial cost of a study can deter building owners from pursuing them.

As it relates specifically to a GC only two articles were found considering the role a GC could play in providing a cost segregation study. In one article Noller (2003) reports that cost segregation studies are typically unused by GC’s but represent an opportunity for them to strengthen relationships with clients and provide a competitive edge in bidding. However, the article did not include a formal, stated, methodology so the article appears to represent the opinion and experience of the author only, not formal research. Further because the author is a cost segregation analysis, there is a strong potential for conflict of interest in promoting cost segregation studies. As a result this article must be interpreted cautiously.

The second article geared specifically to the opportunity for GC’s with cost segregation studies, also lacked a formal methodology and appears to rely primarily on the author’s experience and opinion. Mascarinias (2005) discusses the challenges and opportunities for contractors in providing cost segregation studies. He reports that for a GC, preparation of a cost segregation study will require little time and effort if cost estimates are accurate. He also noted the importance of contractor participation as early as possible in a cost segregation study. However, he also indicates the possible concern contractors may have in sharing specific cost information.

As asserted by the authors of this paper, the literature, albeit scant, supports the idea of GC’s offering cost segregation studies, or at least the engineering report that a cost segregation study is based on, because they already have the information necessary to compile one (in the detailed estimate). While the information to produce a study is possessed by a GC, the knowledge of how to properly do so, likely is not. This study sought to evaluate the feasibility of a GC providing a cost segregation study. Based on the deficiencies of the existing literature, this study should serve as a building block for future research regarding cost segregation studies provided by GC’s.

Methodology
This study utilized a case study approach, where the investigators chose a new facility under construction to perform a cost segregation study and evaluate the learning curve associated with that process. The project chosen was a fairly typical commercial office building located in Texas. It consisted of a 47,000 square foot office building sitting on a 174,240 square foot site. The work included site work, structural, mechanical, electrical, and interior finish out.

The project value was just over $11,000,000. The building was placed in service in early 2014. The individual chosen to learn the process and perform the cost segregation study was employed by the GC on the project as an assistant project manager, and has over 15 years of experience in the construction industry. While preconstruction professionals rather than project management professionals would likely prepare a cost segregation study, the individual used for this study was chosen based on convenience, as they were available and willing to participate.

To simulate the learning curve of a GC’s employee having to go from little or no knowledge of cost segregation to compiling a complete report, the individual was provided with written resources such as Publication 946 from the IRS and other information on cost segregation studies, but no formal training on the subject. The researchers chose not to provide formal training in order to produce the most conservative results possible.

There are two methods recognized by the IRS for performing a cost segregation study, the first is the “Detailed Engineering Approach from Actual Cost Records” (DEAACR) and second the “Detailed Engineering Cost Estimate Approach” (DECEA). As might be expected from their names the DEAACR approach uses the actual cost data for a project while the DECEA is used when actual costs are not available. For this study a combination of the two methods were
used. Primarily the DEAACR approach was used with actual costs because of the availability of the detailed estimate. However, in some subcontractor bids sufficient detail was missing requiring the use of the DECEA. In instances where the DECEA method was used historical costs were the basis for pricing. Both methodologies were employed per the Internal Revenue Service’s (IRS) Cost Segregation Audit Techniques Guide (Cost Segregation Audit). The results of this cost segregation study on the subject project and the conclusions drawn from the employee’s experience in doing so are presented next. The authors remind the reader of the limitations of case study research, and caution the generalization of findings reported here.

Findings & Discussion

The fundamental decision in performing a cost segregation study is determining what components can be classified as §1245 or §1250 personal property, and then assigning §1245 property a 5, 7, or 15 year depreciation period. According to the IRS, section §1245 includes; personal property, other tangible property (except building and their structural components), single purposes agricultural or horticultural structures, petroleum storage facilities, and railroad grading or tunnel bore. Section §1250 includes; all real property that is not section §1245 property (IRS Publication 544). Grossly simplified; the structure of a building is §1250 property, however all furniture, fixtures, equipment (FFE) and items related specifically to business use (i.e. specialized wiring to serve a piece of equipment) qualify as section §1245 property. This classification of property and their costs is the work a GC would perform in providing a cost segregation report.

Beyond classifying §1245 and §1250 property, a number of other accounting considerations are needed for a building owner to actually depreciate their asset at an accelerated pace. For the purpose of this study some of those decisions were made to illustrate the benefits of the cost segregation study on the subject property. However, making these decisions are not intended to be part of the GCs role. The GC’s role is the cost segregation report, where project components and their costs are broken down into their depreciable lives (5, 7, 15, or 39 years). The project owner’s accountant would make decisions, regarding tax filing.

For the building in question the cost segregation report resulted in approximately 2.2 million dollars’ worth of property that qualified for accelerated depreciation. Table 1 displays a summary of the results of the cost segregation study performed on the project used for this study. As might be expected the majority of §1245 property came from FFE, however, other divisions of the project had components that were depreciable at an accelerated pace too. A detailed breakdown of this project was not the purpose of this study, so only a summary is provided.

Table 1. Property by Depreciation Period

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>§1250</th>
<th>§1245</th>
<th>§1245</th>
<th>§1245</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciable Life</td>
<td>39 Years</td>
<td>15 Years</td>
<td>7 Years</td>
<td>5 Years</td>
</tr>
<tr>
<td>Property Value</td>
<td>$9,339,776</td>
<td>$1,656,250</td>
<td>$109,309</td>
<td>$425,933</td>
</tr>
</tbody>
</table>

Table 2 displays the yearly value of depreciation for the project in question using the straight line method (no cost segregation study used) and using accelerated depreciation (through use of a cost segregation study). While over the life of the building, the total depreciable amount remains unchanged, in the first 15 years of the project’s life, the owner is able to depreciate approximately 19% of the project, as five, seven, and 15 year property. In this study there is no consideration for the replacement of these properties, despite their shorter expected life. In reality however, additional deductions would be available to the project owner in subsequent years, as expenses are incurred for the actual repair and replacement of building components. The accelerated depreciation made possible by a cost segregation study is valuable to building owners because as deductions are increased the business’ taxable income is decreased. The value of this reduction in taxable income comes in the form of an increased cash flow for the business (improvement in net present value) which can be very important, especially following a significant capital expenditure like construction of a new project.
Assuming a 35% corporate tax rate (this number will vary based on company size, and state or local taxes that may apply), in the first 15 years of ownership, the project used in this study could have claimed an additional 1.3 million dollars in depreciation, equaling over $450,000 in deferred tax payments. These benefits in the first 15 years are balanced out over the 39 year depreciable life of the project so the total amounts

<table>
<thead>
<tr>
<th>Year</th>
<th>Straight Line</th>
<th>Accelerated Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>39 Year</td>
<td>39 Year</td>
</tr>
<tr>
<td>2014</td>
<td>$234,431</td>
<td>$189,878</td>
</tr>
<tr>
<td>2015</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2016</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2017</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2018</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2019</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2020</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2021</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2022</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2023</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2024</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2025</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2026</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2027</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2028</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2029</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2030</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2031</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2032</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2033</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2034</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2035</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2036</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2037</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2038</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2039</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2040</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2041</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2042</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2043</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2044</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2045</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2046</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2047</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2048</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2049</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2050</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2051</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2052</td>
<td>$295,662</td>
<td>$239,472</td>
</tr>
<tr>
<td>2053</td>
<td>$61,692</td>
<td>$49,968</td>
</tr>
</tbody>
</table>

| $11,531,268 | $9,339,776 | $1,656,250 | $109,309 | $425,933 | $11,531,268 |
Contractor Feasibility in Providing Cost Segregation Studies From Detailed Estimates: A Case Study

depreciable are the same through straight line or accelerated depreciation. Because the totals do not change the benefits to cost segregation reports are in net present value, and the availability of money.

For the project in question the benefit of an additional $30,000 a year for the first 15 years of ownership could have a substantial impact on a business’s ability to invest in itself and grow. These numbers demonstrate the value of a cost segregation study and that a construction professional can provide them using the detailed estimate. However, these numbers do not consider the feasibility of a GC offering this service and the learning curve associated with employee training. To consider these two questions, the time logged and the perceptions of the employee who performed the study are used.

To evaluate the learning curve required for a GC to provide a cost segregation study, the employee who performed this one tracked their time spent, and provided feedback on their perceptions of the process. The researchers remind the reader that this employee was provided with no training on cost segregation reports or how to compile one, only the applicable IRS publications and guides. This was done to provide a conservative estimate of the time required for an individual with no experience or knowledge of cost segregation to produce a report. As can be seen in Table 4. The time required for the employee to learn, understand and perform this cost segregation study was substantial at 272 hours.

The researchers suspect that the total time required (272 hours) is somewhat inflated as it was worked on only briefly and intermittently over the first few months, and in all spanned more than five months. The employee also reported that they perceived a loss in efficiency because it was not a concentrated full time effort. The employee further indicated that they considered the technical aspect of identifying the building parts, and how they

<table>
<thead>
<tr>
<th>Date</th>
<th>Hours</th>
<th>Date cont.</th>
<th>Hours cont.</th>
<th>Date cont.</th>
<th>Hours cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-Jun-14</td>
<td>1</td>
<td>16-Sep-14</td>
<td>1</td>
<td>14-Nov-14</td>
<td>3</td>
</tr>
<tr>
<td>27-Jun-14</td>
<td>1</td>
<td>17-Sep-14</td>
<td>1</td>
<td>15-Nov-14</td>
<td>13</td>
</tr>
<tr>
<td>5-Jul-14</td>
<td>2</td>
<td>18-Sep-14</td>
<td>2</td>
<td>16-Nov-14</td>
<td>9</td>
</tr>
<tr>
<td>12-Jul-14</td>
<td>2</td>
<td>20-Sep-14</td>
<td>4</td>
<td>17-Nov-14</td>
<td>3</td>
</tr>
<tr>
<td>13-Jul-14</td>
<td>3</td>
<td>21-Sep-14</td>
<td>5</td>
<td>20-Nov-14</td>
<td>2</td>
</tr>
<tr>
<td>19-Jul-14</td>
<td>1</td>
<td>23-Sep-14</td>
<td>3</td>
<td>21-Nov-14</td>
<td>2</td>
</tr>
<tr>
<td>20-Jul-14</td>
<td>2</td>
<td>24-Sep-14</td>
<td>3</td>
<td>22-Nov-14</td>
<td>9</td>
</tr>
<tr>
<td>26-Jul-14</td>
<td>2</td>
<td>25-Sep-14</td>
<td>1</td>
<td>23-Nov-14</td>
<td>10</td>
</tr>
<tr>
<td>27-Jul-14</td>
<td>2</td>
<td>9-Oct-14</td>
<td>2</td>
<td>24-Nov-14</td>
<td>3</td>
</tr>
<tr>
<td>2-Aug-14</td>
<td>2</td>
<td>10-Oct-14</td>
<td>2</td>
<td>25-Nov-14</td>
<td>3</td>
</tr>
<tr>
<td>3-Aug-14</td>
<td>4</td>
<td>11-Oct-14</td>
<td>4</td>
<td>29-Nov-14</td>
<td>3</td>
</tr>
<tr>
<td>9-Aug-14</td>
<td>3</td>
<td>12-Oct-14</td>
<td>4</td>
<td>30-Nov-14</td>
<td>5</td>
</tr>
<tr>
<td>10-Aug-14</td>
<td>3</td>
<td>13-Oct-14</td>
<td>1</td>
<td>1-Dec-14</td>
<td>2</td>
</tr>
<tr>
<td>16-Aug-14</td>
<td>1</td>
<td>14-Oct-14</td>
<td>1</td>
<td>3-Dec-14</td>
<td>3</td>
</tr>
<tr>
<td>17-Aug-14</td>
<td>2</td>
<td>15-Oct-14</td>
<td>2</td>
<td>4-Dec-14</td>
<td>4</td>
</tr>
<tr>
<td>18-Aug-14</td>
<td>1</td>
<td>16-Oct-14</td>
<td>2</td>
<td>5-Dec-14</td>
<td>6</td>
</tr>
<tr>
<td>19-Aug-14</td>
<td>1</td>
<td>17-Oct-14</td>
<td>1</td>
<td>6-Dec-14</td>
<td>8</td>
</tr>
<tr>
<td>20-Aug-14</td>
<td>2</td>
<td>18-Oct-14</td>
<td>4</td>
<td>7-Dec-14</td>
<td>8</td>
</tr>
<tr>
<td>21-Aug-14</td>
<td>2</td>
<td>19-Oct-14</td>
<td>2</td>
<td>8-Dec-14</td>
<td>4</td>
</tr>
<tr>
<td>28-Aug-14</td>
<td>2</td>
<td>20-Oct-14</td>
<td>1</td>
<td>9-Dec-14</td>
<td>2</td>
</tr>
<tr>
<td>30-Aug-14</td>
<td>2</td>
<td>21-Oct-14</td>
<td>2</td>
<td>10-Dec-14</td>
<td>3</td>
</tr>
<tr>
<td>31-Aug-14</td>
<td>3</td>
<td>25-Oct-14</td>
<td>2</td>
<td>11-Dec-14</td>
<td>2</td>
</tr>
<tr>
<td>1-Sep-14</td>
<td>2</td>
<td>26-Oct-14</td>
<td>3</td>
<td>12-Dec-14</td>
<td>9</td>
</tr>
<tr>
<td>2-Sep-14</td>
<td>2</td>
<td>1-Nov-14</td>
<td>5</td>
<td>13-Dec-14</td>
<td>12</td>
</tr>
<tr>
<td>7-Sep-14</td>
<td>3</td>
<td>2-Nov-14</td>
<td>4</td>
<td>14-Dec-14</td>
<td>12</td>
</tr>
<tr>
<td>10-Sep-14</td>
<td>2</td>
<td>12-Nov-14</td>
<td>6</td>
<td>16-Dec-14</td>
<td>4</td>
</tr>
<tr>
<td>13-Sep-14</td>
<td>4</td>
<td>13-Nov-14</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total    | 272   |
interacted as being fairly easy. The challenge was in the interpretation of the tax laws, which govern the practice of accelerated depreciation, and what components can be classified for shorter depreciable lives. Because of the risks involved with tax law, the employee was instructed to take the most conservative interpretation of the law if they were not sure about a specific item. The researchers also assert that for this project, the size of the building (47,000 sf) may have contributed to an increased amount of time to produce the report.

Following the initial learning curve on this project the employee estimated that it would require about two weeks to complete a report on a project with a similar size, scope, and level of detail in the estimate. If we assume that translates to 80 working hours, conclusions regarding feasibility can be drawn. A junior estimator earning $65,000 a year, with a burden rate of 25% would cost a general contractor approximately $1,563 a week to employ. If the report required two weeks to complete (and the employee does nothing else over that period of time) that would equal $3,125 in expense to the GC to provide the cost segregation report. Following the initial learning curve, these results indicate that for a relatively miniscule cost (0.028% of total project cost in this example) the GC can provide this service to an owner. Even doubling the time commitment to four weeks results in a small investment, comparatively, on the part of the GC.

Obviously providing cost segregation reports only makes sense if owners are interested in the service. Which means GCs doing public work are unlikely to benefit from an investment in training to provide the service. For GCs doing private work, providing cost segregation reports becomes viable. The actual cost a GC might charge would vary based on the project, the authors attempted to collect data on how much is charged for cost segregation reports but were unsuccessful. In conversations with a cost segregation provider and a Certified Public Accountant it was found that cost segregation studies start around $3,000 for small projects (like a day care center) and go up from there, based on project size and scope. The researchers assert that for a project like the one in this study, that this service would easily be valued at $10,000 and perhaps at more than thirty thousand dollars, returning the investment in training to provide the service quickly. Alternatively, if the cost segregation report is offered as added value to secure a bid award, a few thousand dollars spent in order to win a multi-million dollar project is a very small investment in business development.

The learning curve to provide a report is sizeable, but not insurmountable. Once an estimator has learned to perform a cost segregation report, the numbers appear to make sense and indicate that the service is not only feasible but could provide tangible benefit to the GC. Regarding feasibility, for GC’s to offer a cost segregation study to owners it all comes down to the project, as no two are exactly alike. Private project ownership is a must, but those where ownership will be retained long term, are better candidates.

For GCs who do not want the risk, or learning curve associated with providing cost segregation reports, they remain an opportunity as GCs can partner with cost segregation professionals. Through partnering a GC would provide the project data and the clientele, while the cost segregation professional produces the report. This strategy would reduce the potential profit available to the GC, but it would also shift the risk associated with providing a report away from the GC. For contractors focusing on smaller projects this strategy may be ideal as a means to keep overhead low and still take advantage of the opportunity.

The benefits of a cost segregation study to project owners can be significant, and the information necessary to produce a cost segregation report should be found in a detailed estimate. So whether through training internal employees or partnering with a cost segregation professional to provide this service, cost segregation studies represent an opportunity that few if any GCs are taking advantage of.

The cost for a GC may only be a few thousand dollars, but the benefit to the owner is likely equal to tens of thousands of dollars a year. While the feasibility of the GC providing this service is good, the greater challenge may be in educating project owners that cost segregation reports are a service the GC can provide. As is the case with any case study, generalization of the findings should only be done with great caution. As a result the authors recommend future research replicating this study with multiple projects and employees. Additionally research is recommended to explore the actual return a GC might expect for providing this service.
REFERENCES


Factors of Employee Loyalty among Construction Management Field Personnel, Estimators & BIM/Design Specialists: Insights for General Contractors

Colby Humphrey PRC
Pinnacle Development Group | Colby@pinnacleccid.com

Ben F. Bigelow, Ph.D.
Texas A&M University | BBigelow@arch.tamu.edu

ABSTRACT: Since 2008 construction employment has dropped considerably and has remained below 2007 levels, with construction management positions still about 14% down (U.S. Department of Labor 2015). Despite the boom currently occurring in the construction industry, general contractors (GCs) are finding it difficult to fill project management positions (AGC 2014), and construction firms expect these challenges to continue (Mutikani 2014). With greater demand for managers, retaining quality people is a paramount concern. Everyone knows the adage that “money talks”, but what can a GC do to engender loyalty besides just paying more? To explore that question and attempt to better understand the factors that engender loyalty among a GC’s employees, researchers surveyed the field employees of GCs and obtained responses that provide insight into the factors that are most effective in engendering loyalty for GC’s field management employees.

Keywords: Construction, Loyalty, Employees

INTRODUCTION

The recession of 2008 resulted in a significant reduction in employment within the construction industry, lowering employment to figures well below historical averages. Since the recovery began in 2009, the construction workforce has struggled to reach pre-recession employment figures, and as of May 2015 are still below construction employment levels from 2007 (U.S. Department of Labor 2015). The data also shows that employment of construction managers and supervisors saw a similar reduction and has not recovered, it is 14.17% below 2007 levels (U.S. Department of Labor 2015).

As a result of this shortage, there is increasing concern among general contractors, that they will not have the managers and supervisors needed as the economy recovers (Associated General Contractors of America [AGC] 2014). Survey data from the AGC (2014) found that companies are increasingly finding it difficult to fill project manager and supervisory positions, limiting their ability to pursue and take on more projects. Additionally, the data suggests that construction firms expect these issues to continue into 2015 (Mutikani 2014). This data presents a serious problem for many construction firms: with fewer available managers and supervisors on the job market, it seems likely that competition to attract, and more importantly to retain, people in these positions will increase. Given this problem, the purpose of this study is to explore the factors involved with employee loyalty among field and skilled office personnel for commercial general contractors (GCs). These positions include but are not limited to: Field engineers, project managers, superintendents, assistant project managers, assistant superintendents, estimators, and BIM/design specialists.

Colby Humphrey PRC is the market research director for Pinnacle Development Group. His research interests include market trends and employee development and training issues within the construction industry.

Dr. Ben F. Bigelow is an assistant professor in the Construction Science Department at Texas A&M University in College Station, TX. His research focuses on construction education, workforce issues, housing, and Under-represented groups in construction.
Although research on employee loyalty is not new, research considering loyalty specifically among employees of GCs has not been considered. The results of this study are significant because they provide commercial GCs with empirical data indicating the best ways to shape their company culture to encourage loyalty among their personnel. Specifically this study asked: What factors most engender loyalty among General Contractor’s field personnel, estimators, and BIM/design specialists.

**Literature Review**

Due to the lack of formal research on employee loyalty at commercial GCs, literature from human resource and quality management was examined to learn what factors are involved that could be applied to GCs. Collectively, the literature points to the areas of company programs, employee relationships, and employee attitude and actions as the three primary areas of influence.

A review of existing literature on the subject of employee loyalty provides some background as to how companies seek to engender loyalty, and how employee perceptions, attitudes and actions impact their sense of loyalty to a company. Three primary factors for employee loyalty were identified: Company programs, employee relationships, and employee attitude and engagement. These factors are summarized in Table 1. Following the table each of these areas are discussed.

**Company Programs**

Several studies have sought to identify the tools employers in general can use to improve loyalty among employees. Eskildsen and Nussler (2000) found that companies looking to improve loyalty should provide six things: “structured career programs, bonus programs, pay better than similar organizations, have a structured approach to leadership, incorporate feedback, and have a culture of personal growth and development” (587). While the idea of paying more for enhanced loyalty is not a new concept, this list does serve to point out several other areas that companies can use to earn loyalty.

Another avenue being taken by companies to increase loyalty is the idea of improving work-life balances among employees through flextime or alternative.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>Citation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company programs</td>
<td>Structured career programs, flex-time policies, pay scale and bonus structure, reception and incorporation of employee feedback, employee training and development</td>
<td>Eskildsen and Nussler, 2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lingard, Brown, Bradley Bailey and Townsend, 2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Niehoff, Moorman, Blakely, &amp; Fuller, 2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roehling, Roehling, and Moen, 2001</td>
</tr>
<tr>
<td>Employee relationships</td>
<td>Relationship with management, supervisor(s), peers and co-workers, and clients</td>
<td>Coughlan, 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lockwood, 2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matzler and Renzel, 2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roehling et al., 2001</td>
</tr>
<tr>
<td>Employee attitude and engagement</td>
<td>Willingness to make personal sacrifices for the company, belief and trust in the company, agreement with company mission statement, willingness to promote company to others</td>
<td>Cox, Issa, Rinker and Koblegard, 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lockwood, 2007</td>
</tr>
</tbody>
</table>
work schedules. The key to this is that employees have to perceive and believe that management is supportive of initiatives such as flextime or alternative work schedules (Lingard, Brown, Bradley Bailey and Townsend 2007). One problem to these policies being implemented in the construction industry is that construction projects have hard-set due dates that make it more difficult to accommodate varying work schedules among employees. However, Lingard et al. (2007) found that companies implementing such policies did not suffer from delays or higher costs for construction projects. It has also been reported that to increase female participation in the construction industry these policies are imperative (Bilbo, Bigelow, Rybkowski, Kamranzadeh 2014).

Initiating programs and policies aimed at empowering employees is another way to generate greater loyalty. These policies seek to provide greater autonomy and allow employees to think independently of management in order to solve problems (Roehling, Roehling, and Moen 2001). However, one study found that empowering employees does not have an immediate impact on employee loyalty, and that it only has an indirect impact on loyalty as a result of job enrichment over time. This study found that as employees are given more control over their own activities and objectives, trust between the employee and company continues to grow. Over time (however long that may be), this study found that loyalty to the company is more likely to increase (Niehoff, Moorman, Blakely, & Fuller 2001).

Employee Relationships

Another aspect of loyalty examined in the literature is employee relationships between peers and supervisors. Matzler and Renzel (2006) found that “interpersonal trust (trust in management and trust in peers) strongly influences employee satisfaction and, as a consequence, employee loyalty” (1261). These relationships, and the informal support given through them, have been demonstrated to have a tremendous impact, positively and negatively, on employee loyalty (Roehling et al. 2001).

Research on determining the order of importance between these two relationships for individual employee loyalty – management relationships and co-worker relationships – is not conclusive. Matzler and Renzel’s (2006) study found that trust in peers had more of an impact on employee satisfaction than trust in the organization’s management, suggesting that trust in coworkers has the potential to sway loyalty more so than management or company-wide programs. Additionally, Coughlan (2005) demonstrated that employee loyalty can be molded by employee interactions and/or group training opportunities. However, Lockwood (2007) found that the “number one factor that influences employee commitment is the manager – employee relationship”. Thus, while both relationships are important to employee loyalty, it is difficult to place one above the other in terms of importance in this area.

Employee Attitudes and Engagement

Employee engagement with the organization was also identified in the literature as being a factor in employee loyalty. There is an indication that a strong link exists between high employee-involvement in the company and more positive beliefs and attitudes among employees (Lockwood 2007). This level of involvement would indicate a greater likelihood of employees staying with and being loyal to the company over time.

Other studies have sought to identify behaviors among employees that lead to enhanced loyalty. Cox, Issa, Rinker and Koblegard (2005) found the following “key behavioral indicators” for employees in regards to loyalty: Makes sacrifices for the well-being of company, promotes the company, and abides by company policy. This suggests that the best way to determine employee loyalty is to monitor their performance and compare the results of these indicators.

In order to address the lack of research on employee loyalty in construction, this study seeks to provide insight on how these three factors affect employee loyalty at commercial GCs.

Methodology

This study examined three factors that impact employee loyalty at commercial GCs: company programs, employee relationships, and employee attitude and engagement. These factors were identified in the literature as having the most potential impact on loyalty, outside of monetary compensation.

For the purposes of this study, company programs have been defined as employer-sponsored initiatives whose chief aim is to encourage the personal
Factors of Employee Loyalty among Construction Management Field Personnel, Estimators & BIM/Design Specialists: Insights for General Contractors

development, professional development, and career advancement of employees, and how these programs relate to the employee’s loyalty to the company. Employee relationships have been defined as the quality of the employee’s relationship to management, supervisor(s), peers and co-workers, and clients, and the affect of these relationships to the employee’s loyalty. Employee attitude and engagement has been defined as the employee’s belief and willingness to act on behalf of the company, and the impact of this belief and engagement on their loyalty.

The researchers used a mixed-methods research approach to identify how employees at commercial GCs view these three factors. Data was collected using a survey that provided both numeric and open-ended responses to determine the views and attitudes of respondents.

Data was obtained from employees of commercial GCs. Employee data was limited to field personnel, estimators, and BIM/design specialists. These positions were primarily identified as the following titles: Project Manager, Assistant Project Manager, Superintendent, Assistant Superintendent, Construction Manager, Field Engineer, Project Manager, Estimator, and BIM/Design Specialist.

Data from employees was collected through the online survey tool Qualtrics. Requests to participate in the survey were sent via email, which included a link to the survey. These emails were distributed by AC Business Media, as well as distribution lists provided by Pinnacle Development Group.

The Bureau of Labor Statistics (2015) estimates that there are 485,000 construction managers in the U.S. As a result, a sample of 384 was needed to ensure a confidence level of 95% with a confidence interval of 5. The actual sample consists of 498 responses, indicated a high level of externals validity in the sample. The survey was sent to 69,944 recipients; however, the researchers utilized snowball sampling by encouraging participants to send the survey to their co-workers and peers at GCs. So, the exact response rate is unknown. Based on the geographic and revenue disparity of the commercial GCs, the sample used is considered representative of the population (Gliner, Morgan Leech 2009), and can reliably provide insights on how the three identified factors influence employee loyalty at commercial GCs.

Internal validity of this study was established by two pilot studies. The researchers surveyed 10 employees from different commercial GCs to test the appropriateness of the survey questions, and the clarity of instructions to complete the survey. Upon completing the initial study, the researchers made the appropriate modifications to the survey in order to ensure it would effectively collect the data needed to address the research question. Upon completion of the initial pilot, the same process was repeated with the second group of 10 to further validate the changes.

Data were collected through an online survey using three types of questions: five-point Likert-scale questions, multiple-choice, and open-ended questions. Descriptive statistics were used to determine which of the identified factors had the greatest impact on employee loyalty. The researchers generated a mean value for each factor based on the results of the five-point Likert-scale questions. The mean value of the results for each of the three factors identified was used to measure central tendency. The researchers used this mean to determine the leading factor of employee loyalty among the sample.

Correlation and multiple regression models were created to determine how the 3 factors identified in the study related to the following dependent variables: Length of time with current company; Length of time in the construction industry; Highest level of education completed. For each dependent variable, the 3 categories of; Company Programs, Employee Relationships, and Employee Attitude and engagement were used as the independent variables. Additionally, correlation analysis was conducted of the independent variables to determine the strength of the relationship, if any, between the variables. Qualitative data, obtained through the open-ended survey questions, allowed the researchers to capture unforced responses from the respondents on areas related to employee loyalty, allowing the respondents to answer the questions in their own words.

The use of quantitative and qualitative data allowed the researchers to balance the limitations of each set of data (Tashakkori & Teddlie 2010). The qualitative work was used to obtain information that could not be obtained through the Likert-scale questions. By using mixed-methods, the researchers were able to
capture a deeper and holistic impression of the factors of employee loyalty among the respondents.

Findings
The objectives of this study were to investigate the factors of employee loyalty for field personnel, estimators, and BIM/design specialists in the construction industry, to analyze how they relate to one another, and to explore what steps contractors can take to improve loyalty in their own organizations. Descriptive and statistical analyses are provided below, followed by the conclusions.

Respondent Background Information
Approximately 39.38% of respondents have been with their current company for over 20 years (figure 1). Over 70% have been in the construction industry for more than 20 years (figure 2). Over one-third (36.69%) serve as project managers, with 13.03% serving as supervisors and 12.75% as construction managers (Figure 3). Nearly 34% of the sample population has a college degree, and 16.74% have a high school degree (figure 4).
Company Programs
For the company programs section, respondents were asked to rank on a scale from 1-5, with 1 being “no affect” and 5 being “very strong affect”, how a series of company programs impacted their loyalty. The average score for each question can be seen in Figure 5.
Of the programs presented, pay scale and bonus structure had the highest score in terms of impact of the program on the respondent’s loyalty, followed by employee training and development programs. At the end of the company programs section, respondents were asked what additional programs and/or policies they would like to see put in place at their current company. These responses are provided in Table 2.

Table 2. Frequency of Additional Programs/Policies Cited

<table>
<thead>
<tr>
<th>Program/Policy</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee recognition programs</td>
<td>45.3%</td>
</tr>
<tr>
<td>Vehicle reimbursement</td>
<td>23.1%</td>
</tr>
<tr>
<td>Technology assistance programs</td>
<td>18.4%</td>
</tr>
<tr>
<td>College tuition reimbursement</td>
<td>17.9%</td>
</tr>
<tr>
<td>Full healthcare benefits (health, dental, vision)</td>
<td>11.8%</td>
</tr>
<tr>
<td>Profit sharing/Defined contribution plan</td>
<td>9.0%</td>
</tr>
<tr>
<td>Childcare</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

One of the programs cited by respondents could fit into the categories presented; college tuition reimbursement would fit under employee training and development. Another, employee recognition programs, could fall under reception and incorporation of employee feedback, although further research would be needed to properly define the respondents’ interpretation of both these categories. However, the remaining topics are separate and should be taken into consideration when considering programs to enhance employee loyalty.

Employee Relationships

For the employee relationships section, respondents were asked to rank on a scale from 1 to 5, with 1 being “no affect” and 5 being “very strong affect”, how their relationships with management, supervisors, peers/co-workers, and customers impact their loyalty. The average score for each section has been provided in Figure 6 below. Of the relationships presented, those with management scored the highest in terms of impact on the respondent’s loyalty. In addition, respondents were asked how recognition from superiors and peers impacts their loyalty to their current company. The average score for this question was 3.77.

![Figure 6. Employee Relationships Results – Average Score](image-url)
At the end of this section, respondents were asked to explain when they feel most and least certain that their superiors, peers/co-workers, and management care whether they succeed professionally. These responses are provided in Table 3 and Table 4.

### Table 3. Frequency of Reasons for Feeling Most Certain That Supervisors, Peers/Co-Workers and Management Care About Professional Success

<table>
<thead>
<tr>
<th>Program/Policy</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>During one-on-one, informal interaction</td>
<td>49.2%</td>
</tr>
<tr>
<td>During performance evaluations</td>
<td>36.7%</td>
</tr>
<tr>
<td>During weekly meetings</td>
<td>28.8%</td>
</tr>
<tr>
<td>Being included in the decision-making process</td>
<td>10.6%</td>
</tr>
<tr>
<td>Receiving merit-based pay raises/bonuses</td>
<td>9.1%</td>
</tr>
<tr>
<td>Lack of micro-management on the job site</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

### Table 4. Frequency of Reasons for Feeling Least Certain That Supervisors, Peers/Co-Workers and Management Care About Professional Success

<table>
<thead>
<tr>
<th>Program/Policy</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of communication</td>
<td>55.3%</td>
</tr>
<tr>
<td>During evaluations</td>
<td>33.5%</td>
</tr>
<tr>
<td>Being left out of the decision making process</td>
<td>22.9%</td>
</tr>
<tr>
<td>Lack of encouragement and attention given for work done</td>
<td>21.8%</td>
</tr>
<tr>
<td>Failure to follow through on promises</td>
<td>14.5%</td>
</tr>
</tbody>
</table>

The results suggest that formal and informal communication was a key factor in respondents feeling that supervisors, peers/co-workers and management care about their professional success. Nearly half of respondents to these open-ended questions felt others cared about professional success during one-on-one, informal interactions, and 55.3% listed lack of communication as a reason not feeling that others in their company cared about their professional success. Employee Attitude & Engagement

For the employee attitude & engagement section, respondents were asked whether or not they believed that their attitude and engagement in a series of areas impacted their loyalty. The responses are provided in Figure 7 below.

Of the factors given, 83.33% of respondents indicated that their own belief and trust in the company and...
its direction impacted their loyalty. Over 50% of respondents believed that the other three factors presented impacted their loyalty as well, with agreement with the company mission statement scoring the lowest at 57.34%.

At the end of this section, respondents were asked to explain when they feel most and least engaged with their current company. These responses are provided in Table 5 and Table 6.

These results indicate that respondent’s felt most engaged when they have a sense of being an active participant in the company’s success, and least engaged when they do not feel acknowledged and are left out of key communications regarding company issues.

Factor Rankings

Lastly, respondents were asked to rank from 1 to 13, with one being the most influential and 13 being the least influential, how they identified factors ranked in terms of their influence on the respondents’ loyalty. The results are provided in Table 7 below:

<table>
<thead>
<tr>
<th>Program/Policy</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the company succeeds</td>
<td>43.7%</td>
</tr>
<tr>
<td>When effective communication is in place throughout the company</td>
<td>27.9%</td>
</tr>
<tr>
<td>When given personal freedom to perform job functions</td>
<td>27.5%</td>
</tr>
<tr>
<td>When acknowledgement and/or appreciation is given</td>
<td>23.9%</td>
</tr>
<tr>
<td>When monetarily compensated for work done</td>
<td>5.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program/Policy</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of acknowledgement and/or appreciation given by leadership</td>
<td>40.4%</td>
</tr>
<tr>
<td>When company changes and/or issues are not effectively communicated by management</td>
<td>33.8%</td>
</tr>
<tr>
<td>Lack of trust in the leadership and direction of the company</td>
<td>30.9%</td>
</tr>
<tr>
<td>When not given personal freedom to perform job functions</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor</th>
<th>Average Rankin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationships with management</td>
<td>4.7</td>
</tr>
<tr>
<td>Pay scale and bonus structures</td>
<td>5.1</td>
</tr>
<tr>
<td>Belief and trust in the company and its direction</td>
<td>5.27</td>
</tr>
<tr>
<td>Relationships with supervisor(s)</td>
<td>5.42</td>
</tr>
<tr>
<td>Relationships with co-workers/peers</td>
<td>5.67</td>
</tr>
<tr>
<td>Relationships with customers</td>
<td>7.09</td>
</tr>
<tr>
<td>Agreement with the company mission statement</td>
<td>7.63</td>
</tr>
<tr>
<td>Employee training and development opportunities</td>
<td>7.71</td>
</tr>
<tr>
<td>Willingness to promote and encourage involvement with the company</td>
<td>7.9</td>
</tr>
<tr>
<td>Flextime policies</td>
<td>8.11</td>
</tr>
<tr>
<td>Employee feedback mechanisms</td>
<td>8.65</td>
</tr>
<tr>
<td>Structured career programs</td>
<td>8.74</td>
</tr>
<tr>
<td>Willingness to sacrifice on behalf of the company</td>
<td>8.76</td>
</tr>
</tbody>
</table>
When ranking the factors to loyalty, four of the top six rankings included factors related to employee relationships (management, supervisor(s), co-workers/peers, and customers). Four of the factors within the company programs section scored in the bottom six in the average ranking of factors.

**Correlation and Multiple Regression Models**

Correlation and multiple regression models were created to determine how the 13 factors identified in the study related to the following dependent variables: Length of time with current company; Length of time in construction industry; Highest level of education completed. For each dependent variable, the 3 categories of Company Programs, Employee Relationships, and Employee Attitude and engagement were used as the independent variables.

**Company Programs**

The impact of company programs on the respondent’s loyalty was determined not to be a good predictor of the amount of time spent with the respondent’s current company. No statistically significant relationship existed for either of this group.

The impact of company programs on the respondent’s loyalty was determined to be a good predictor of the amount of time spent in the industry. Correlation and multiple regression analysis were conducted to examine the relationships between length of time in the construction industry and the five company programs identified by the researchers. Table 8 summarizes the descriptive statistics and analysis results. As can be seen, structured career programs, pay scale and bonus structures, and company mechanisms to receive and incorporate feedback were positively correlated with length of time in the industry, and flextime policies and employee training development opportunities were negatively correlated. These correlations show that as rankings for structured career programs, pay scale and bonus structures, and company mechanisms to receive and incorporate feedback went up, the length of time spent in the construction industry had a tendency to go up as well. Conversely, as the rankings for flextime policies and employee training development opportunities went down, the length of time spent in the industry had a tendency to decrease.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>B</th>
<th>β</th>
<th>Sig.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of time in the industry^</td>
<td>9.28</td>
<td>2.94</td>
<td>.013</td>
<td>.064</td>
<td>.054</td>
<td>.351</td>
</tr>
<tr>
<td>Structured career programs</td>
<td>2.94</td>
<td>1.290</td>
<td>-.084</td>
<td>-.135</td>
<td>-.116</td>
<td>.026</td>
</tr>
<tr>
<td>Flextime policies</td>
<td>3.088</td>
<td>1.3294</td>
<td>.015</td>
<td>.033</td>
<td>.026</td>
<td>.638</td>
</tr>
<tr>
<td>Pay scale and bonus structures</td>
<td>3.451</td>
<td>1.2301</td>
<td>.062</td>
<td>.162</td>
<td>.121</td>
<td>.033</td>
</tr>
<tr>
<td>Company mechanisms to receive and incorporate feedback</td>
<td>3.208</td>
<td>1.1585</td>
<td>-.041</td>
<td>-.134</td>
<td>-.101</td>
<td>.099*</td>
</tr>
<tr>
<td>Employee training and development opportunities</td>
<td>3.381</td>
<td>1.1596</td>
<td>-.134</td>
<td>-.101</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: F(5, 493) = 2.276, p < .046
^ coded as 1=1-3 years, 6=4-6 years, 7=7-10 years, 8=10-15 years, 9=16-20 years, 10=20+years
* <.05

A multiple regression analysis was conducted to evaluate how well the strength of company program variables predicted the amount of time the respondent’s had spent in the industry. The multiple regression model proved to be statistically significant, F(5, 493) = 2.276, p < .046. These results indicate that career program rankings do a good job of explaining the variations in the amount of time the respondent’s reported to have spent in the industry.

Flextime policies had statistically significant negative impact, and company mechanisms to receive and incorporate feedback had a statistically significant positive impact on length of time in the industry. These results indicate that respondents ranking
Flextime policies higher were expected to have spent less time in the industry, while those ranking company mechanisms and incorporating feedback higher on the scale were expected to have been in the construction industry longer.

The impact of company programs on the respondent’s loyalty was also determined to be a good predictor of the educational level of the respondents. Table 9 summarizes the descriptive statistics and analysis results of the correlation and multiple regression analysis. These results show that all of the career programs were positively correlated with educational level, indicating that as rankings for company program variables increased, achieved educational levels went up as well.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Correlation</th>
<th>B</th>
<th>β</th>
<th>Sig.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest level of education completed^</td>
<td>3.97</td>
<td>2.12</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Structured career programs</td>
<td>2.94</td>
<td>1.290</td>
<td>.175</td>
<td>.187</td>
<td>.111</td>
<td>.052</td>
</tr>
<tr>
<td>Flextime policies</td>
<td>3.088</td>
<td>1.3294</td>
<td>.193</td>
<td>.235</td>
<td>.143</td>
<td>.006</td>
</tr>
<tr>
<td>Pay scale and bonus structures</td>
<td>3.451</td>
<td>1.2301</td>
<td>.126</td>
<td>.038</td>
<td>.021</td>
<td>.697</td>
</tr>
<tr>
<td>Company mechanisms to receive and incorporate feedback</td>
<td>3.208</td>
<td>1.1585</td>
<td>.118</td>
<td>.060</td>
<td>.032</td>
<td>.566</td>
</tr>
<tr>
<td>Employee training and development opportunities</td>
<td>3.381</td>
<td>1.1596</td>
<td>.111</td>
<td>-.078</td>
<td>-.041</td>
<td>.492</td>
</tr>
</tbody>
</table>

Note: F(5, 493) = 5.069, p < .000
^ coded as 1=High school graduate, 2=Some college, 3=Trade/technical/vocational training, 4=Certification, 5=2 year degree, 6=College graduate, 7=Post Graduate degree
* <.05

A multiple regression analysis was conducted to evaluate how well the strength of company program variables predicted the educational level of the respondents. The multiple regression model proved to be statistically significant, F(5, 493) = 5.069, p < .000. This shows that career program rankings do a good job of explaining the variations in the educational level of the respondents.

Flextime policies had a statistically significant positive impact on educational level; this was the only variable to do so. These results indicate that respondents ranking flextime policies as more important to their loyalty were expected to have a higher level of educational achievement.

Employee Relationships
The impact of employee relationships on the respondent’s loyalty was determined not to be a good predictor of the amount of time spent with in the construction industry or the respondent’s level of education. No statistically significant relationship was determined to exist for these two groups.

The impact of employee relationships on the respondent’s loyalty was determined to be a good predictor of the amount of time spent with the respondent’s current company. Again, correlation and multiple regression analysis were conducted to examine the relationships between length of time with current company and the four relationships identified by the researchers. Table 10 summarizes the descriptive statistics and analysis results. The results show that peers/co-workers and customers were positively correlated with length of time with current company; management and supervisor(s) were negatively correlated. These correlations show that as rankings for peers/co-workers and customers went up, the length of time spent with the current company went up as well. Conversely, as the rankings for management and supervisor(s) went down, the length of time spent with the current company had a tendency to decrease.
A multiple regression analysis was conducted to evaluate how well the strength of employee relationship variables (management; supervisor(s); peers/co-workers; and customers) predicted the amount of time the respondent’s had spent with their current company. The multiple regression model proved to be statistically significant, F(4, 489) = 4.037, p < .003. These results indicate that employee relationship rankings do a good job of explaining the variations in the amount of time the respondent’s reported to have spent in with their current company.

The respondent’s relationship with customers had statistically significant positive impact on length of time with current company, and was the only variable to do so. These results indicate that respondents ranking their relationship with customers as having a greater impact on their loyalty were expected to have spent more time with their current company.

The respondent’s relationship with customers had statistically significant positive impact on length of time with current company, and was the only variable to do so. These results indicate that respondents ranking their relationship with customers as having a greater impact on their loyalty were expected to have spent more time with their current company.

**Employee Attitude and Engagement**

Employee attitude and engagement did not have any statistically significant impact on any of the four dependent variables chosen. Given this, the researchers conclude that employee attitude and engagement can not be determined by the identified dependent variables of length of time in the industry, length of time with current company or education level.

**Independent Variable Correlations**

Correlation analysis revealed a number of pertinent findings. There was a correlation between the impact the respondent’s relationship with supervisors has on their loyalty and impact the respondent’s relationship with management has on their loyalty (.702 at .000, when significant at .05). There was a correlation between the impact of the relationship with supervisors on loyalty and the relationship between peers/co-workers on loyalty (.558 at .000, when significant at .05). These findings suggest that there is a relationship between the respondents’ views of each relationship within the company and the relationship’s impact on loyalty.

There was a correlation between the impact of structured career programs on loyalty and the impact of employee training and development programs on loyalty (.554 at .000, when significant at .05). There was also a correlation between company mechanisms to receive and incorporate feedback and employee training & development (.553 at .000, when significant at .05).

**Conclusions**

Employee loyalty and retention has become a cause for concern in the construction industry, particularly as the economy grows and the competition for skilled, qualified workers intensifies in the industry. Given these concerns and based on the results of this study, the researchers provide the following three recommendations for general contractors to improve the loyalty of their current and future employees.

**Relationships Are Key To Loyalty**

Positive, healthy relationships between current employees at all levels of the organization are the most important factor to loyalty. The respondents to the survey all viewed these relationships as important...
Factors of Employee Loyalty among Construction Management Field Personnel, Estimators & BIM/Design Specialists: Insights for General Contractors

If Recruiting Industry Veterans, Highlight Company Programs

The researchers found a statistically significantly link between company programs to enhance loyalty and time in the industry. Specifically, the longer a respondent indicated they had been working in the construction industry (not just their current company), the more important company programs became to their sense of loyalty. Thus, for companies looking to hire industry veterans, promoting programs such as pay scale/bonus structures and training/development programs may be beneficial in recruiting and keeping experienced employees.

One note of caution for company programs: structured career programs received the lowest average rating of all the company programs identified by the researchers in terms of their impact on the respondent’s loyalty. This score indicates that it is the least effective program and is less likely to positively influence loyalty, simply because structured career programs are in place. This finding should be of interest to owners and executives of commercial GCs, as it indicates a need to investigate further whether structured career programs are necessary as a part of the full range of company programs being offered to enhance employee loyalty.

For Employees with Higher Education Levels, Keep Flextime Policies in Mind

Based on the results, flextime policies become more of a factor in employee loyalty the more education respondents reported to have achieved. The researchers conclude that employers should consider adjusting their flextime policies depending upon the level of education achieved by each employee, catering to the employees throughout their organization. This may assist companies in retaining employees with higher educational levels, and should also be considered if companies offer any type of tuition reimbursement and/or educational advancement programs for their employees.

Recommendations

This study does not represent an exhaustive examination of the factors involved with employee loyalty for commercial general contractor personnel. Although external validity is high for the study, the researchers caution generalization because the study was limited in that it did not differentiate between male and female employees, which may reveal a difference among the three factors presented between male and female employees in the industry. Additionally, the employee’s age was not taken into consideration as a part of this study, which may reveal generational differences among construction employees.

The results are presented to assist companies in crafting policies to improve employee loyalty within their organizations, and as to serve as a benchmark for further study into this area of research in the construction industry that has not received adequate attention. To continue building upon this work, the researchers recommend future research in the following areas:

- Is there a significant difference in these loyalty factors between men and women in the construction industry?
- Are there additional dependent variables that should be used in the analyses of factors of employee loyalty?
- How would the independent variables chosen be impacted by the age of the construction worker?
REFERENCES


Construction Industry Professionals Perception of Project Management Certification in the Houston Texas Region

Lana K. Coble, Ed.D. CPC
The University of Houston | lkcoble@uh.edu

Margaret D. Watson, Ph.D.,
The University of Houston | mwatson2@uh.edu

ABSTRACT: Individual construction design professionals are evaluated on their abilities by state licensing boards in all 50 states of North America. The construction industry has relied upon construction company licenses in 42% of the United States to ensure that buildings are constructed to local area codes. Current practices have created a credibility gap when comparing construction managers to design professionals. Only since the 1970s, have third party agencies led an effort to provide construction management professionals with a certification to establish baseline competencies. To date, research on construction manager certification has been minimal; therefore, this research attempts to contribute to needed industry knowledge and includes the process of developing a statistically reliable and valid survey as well as the opinions of owners, as well as design/construction professionals on the perceived effectiveness of current certifications. The most prominent agency certifications, which offer broad baseline competencies in the United States, were selected for this study. Professionals surveyed included architects, engineers, owners, and construction managers located in the Houston Texas region, which constitutes 15% of construction professionals across the nation.

Keywords: CM Certification, Continuing Education, Project Delivery Team Relationships

INTRODUCTION

The driving question of this study is, “Which baseline construction manager certifications are held in the highest regard by construction industry professionals in the Houston Texas region?” The parameters that define these professional roles include owners, program managers, architects, engineers, and CM’s. While law does not currently require becoming certified in the construction profession, it has become more popular in the last 30 to 40 years through the formation of the Project Management Institute (PMI), American Institute of Constructors (AIC), and Construction Management Association of America (CMAA). The focus of this research was surveying construction team members regarding certification of construction professionals. The geographical area of the respondents was the greater Gulf Coast region of Texas. Certification programs included in this evaluation were limited to the broad skill sets required for construction managers to perform per baseline standards. For the purpose of this investigation, professionals included designers (architects and engineers), owners (owner representatives and program managers), and construction managers who are or have been engaged in the construction industry. Construction managers (CM’s) are defined as project managers who lead production teams in the execution of construction projects. The significance of the Houston Texas region demographic is that the industry tends to be continuously growing when compared to other areas of the United States.

Lana K. Coble is currently a Project Executive for Tellepsen Builders, a general construction company in Houston, Texas, and a member of the AIC Education Committee. Her academic career as an educator includes five years as an Associate Professor and Adjunct Faculty in the Construction Management Program at the University of Houston.

Margaret D. Watson is a clinical professor in the college of education with a specialty in industrial organizational psychology and statistical methodology. Her tenure at the University of Houston includes Associate Dean at the university and College of Education levels.
Design Professional Licensure

Understanding the distinction between licensure and certification is also critical to the context of this research. In the construction industry, licensure is required by architects and engineers to practice design. Typical requirements for becoming licensed include completing a bachelor’s degree in the field of practice, working for a specified period under a licensed practitioner, and successfully completing extensive testing administered by a professional board. Licensure is granted at the state level of government and enables the successful practitioner to be designated as a registered architect or professional engineer in a legal context. The necessity for government issuance of licenses is based upon the need to protect the public from faulty design, which could potentially cause harm to building inhabitants. It should be noted that architects and engineers are required to acquire and maintain their license status in all 50 states in the United States.

General Contractor Company Licensure

Only 42% of US states have a requirement for construction licensing by contractors (Contractors License Reference Site, 2013). In these states, only one representative from a general construction firm is required to pass the licensure exam. In some states, where licensing is not required, however, certain specialty, second-tier contractors, such as electricians, are required to obtain licensing. Consequently, some states and cities have instituted local building codes to provide a stopgap measure to ensure that the public is protected from inferior construction. The disparity in this approach is obvious since coordination is required between state and local governing bodies, creating too many opportunities for critical requirements to be excluded due to lack of coordination. Since individual licensure is not required by governing agencies for general contracting professionals, and the final responsibility for installing designs per code lie with the construction professional, the potential for missed construction requirements may be exacerbated.

Construction Manager Certification

Certification and licensure are similar in that they both require the demonstration of a level of knowledge or ability; however, their differences are significant. Certification is administered by a professional association and does not carry restrictions to practice as licences do. Not all certifications are an acknowledgment of educational achievement or are issued by an agency appointed to safeguard the public interest. To further illuminate the parameters of some professional certifications, it is important to differentiate between those agencies that simply provide a singular skillset through continued professional development versus those who consider previous experience, educational achievement, and mastery of broader subject areas. Certification attainment will vary from each administering agency in terms of the complexity, rigor, and length of the exam required.

There are currently three predominant professional associations related to the baseline skill sets required in the construction industry. Those baseline skill sets are defined in broad scope and basic procedures that must be demonstrated by the CM’s in order to execute a project safely, efficiently, and effectively. The researcher acknowledges that the PMI certification is generic to project management and non-specific to construction content. However, the decision to include PMI certification in the study is based upon its use by the petrochemical construction sector in the Houston metropolitan area. The agencies that administer the baseline certifications through a singular exam are as follows:

- American Institute of Constructors (AIC), founded in 1971 with 2,671 credentialed members (American Institute of Constructors, 2013);
- Construction Management Association of America (CMAA), founded in 1982 with a current membership of 10,000 (Construction Management Association of America, 2013); and
- Project Management Institute (PMI), founded in 1969 with 520,000 credentialed members including project managers for technical, petrochemical, and construction industries (Project Management Institute, 2013).

Lastly, owner representatives and program managers are not required to obtain licensure to provide construction management oversight services.

LITERATURE REVIEW

Research was conducted to determine if any previous surveys addressed this subject in the construction industry. Only one related research article was located. The article was by Dr. Paul D. Giammalvo, CDT, CCE, MScPM, MRICS (2013), which addressed acceptance and perception of certifications as compared to professional engineering licensure, and it focused on the Far East and Pacific regions. It is significant to note
that Dr. Giammalvo’s study excluded the CMAA and AIC, which are two of the predominant certifying agencies in the United States.

**METHODOLOGY**

**Study Objectives**

The study’s objective was to collect rankings of CM certificates from representative construction practitioners with the intent that a fuller understanding will result as to “Which baseline CM certifications are held in the highest regard by construction industry professionals in the Houston Texas region?” The researcher’s observation is that CM certification is currently the weakest amongst the professional certification/licensure of construction team members because it remains optional within the industry framework. As the interface requirements between all project team professionals (architect, engineer, owner, and constructor) are critical to successful project execution, it is important to enlist the opinions by a representative sampling of the team members. Fellow professionals’ perceptions of the benefits of CM’s who are certified, as well as the opinions of CM’s themselves, may illuminate an understanding of the momentum which exists in the CM certification movement. Once the perceived benefits by project team members were obtained, thus providing context to this study, respondent input on their familiarity and ranking of available CM certificates was acquired through a survey.

**Population and Sample Selection**

Houston, Texas, was chosen as the sample area for several reasons. First, the Greater Houston Partnership (2013) reported that 15.4% of all US construction jobs were generated in this area. Secondly, the U.S. Department of Commerce, Bureau of Economic Analysis (2014) report on GDP by Metropolitan Area reported that the Houston area is the second largest construction market in the nation. Lastly, Houston is the second fastest growing city in the nation, with 5.3% growth in GDP vs. 3% nationally. Thus, the strength and growth in the construction economy in Houston provides a sufficient sample of professionals for this research survey.

<table>
<thead>
<tr>
<th>Construction Professional</th>
<th>US Bureau of Labor Statistics</th>
<th>Pool</th>
<th>Actual Respondents/Currently Employed²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>230,002</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>Program Manager</td>
<td>208,212</td>
<td>37</td>
<td>12</td>
</tr>
<tr>
<td>Architect</td>
<td>82,700</td>
<td>29</td>
<td>13</td>
</tr>
<tr>
<td>Civil Engineer</td>
<td>258,100</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Construction Manager</td>
<td>456,640</td>
<td>89</td>
<td>43</td>
</tr>
<tr>
<td>Totals</td>
<td>1,235,654</td>
<td>215</td>
<td>86¹</td>
</tr>
</tbody>
</table>

¹Note. Survey Total Respondents n = 109 with Fully Completed Surveys n = 108.
²Note. Numbers were interpolated to resemble survey sampling pool frame.
³Note. Survey Question Respondents n = 86 based upon current employment status.

Considerable contemplation was given to the percentages of professional practitioners who comprised the sample pool of respondents (Table 1). Roles of the practitioners in the sampling pool were selected based upon the national demographics of construction professionals, specifically architects, engineers, and CM’s, based on the US Bureau of Labor Statistics (2012). The approximate percentage of architects, engineers, and CM’s was then applied to the convenience sample pool. This pool was generated by cross-referencing the Top 400 ENR rankings (2014) for CM, program management, and design firms with contacts collected by the researcher from LinkedIn and the Association of General Contractors (AGC) Houston area directory. This approach created an approximate makeup of the construction industry professionals and allowed random responses from a specified sample frame similar to the national composition of construction professionals. The result should minimize coverage error by aligning the sample population frame...
with the target population, consequently allowing inferences to be made toward the target population regarding the topic of construction certifications. To provide further context to the characteristics of the sample pool, the researcher averaged the Top 400 (2014) ranking of each firm which employed potential respondents. The average national ranking results were as follows: CM firms 72nd, architectural firms 34th, engineering firms 107th, and program management firms 18th. The owner firms were selected based upon the researcher’s knowledge of institutions which were actively constructing projects. The institutions included major hospitals in the Texas Medical Center, state and private universities, city of Houston, and private developers and owners.

The comparison of CM’s in the respondent pool as compared to the US Bureau of Labor Statistics (USBLS, 2012), is 41.4% and 36.9% respectively. The researcher acknowledges that this database is characterized with a bias toward construction sector experience, however the methods employed in enlisting participation of the survey were consistent for all pool members. For the purpose of this pilot survey, the architect percentages were judged as non-similar, with more than a 5% point variance, 13.5% (researcher’s database) and 6.7% (USBLS). The percentages for engineers were significantly skewed at 8.9% and 20.9% respectively. The engineers’ sampling count would imply that this professional role is underrepresented in this survey, so caution should be exercised in making any inferences about engineers’ views toward construction certifications. Lastly, since there was no database to pull from regarding owners and program managers, the numbers for these two categories were interpolated to complete the sampling pool.

Response Rate
The sample population frame consisted of 215 construction professionals. There were 14 bounce-back e-mails (6.5%) due to incorrect e-mail addresses, rendering a net sample frame of 201 respondents. At the close of the survey, there were 109 responses with only one of those classified as a lurker response, as noted by Couper and Bosnjack (2010), who identified lurkers as those who viewed the survey but failed to respond. A completed response rate of 108, yielded a 53% response rate. Based upon data from the Instructional Assessment Resources from the University of Texas (Instructional Assessment Resources, 2012) this qualifies as a good response rate for an Internet survey.

Survey Questionnaire
Modality
The Internet was chosen as the mode of delivery primarily due to the geographical pool of respondents and efficiency of data analysis with Internet platforms. Psychdata Surveys was specifically chosen for its data management capability, interface with IBM SPSS Statistics, internet survey application, email notification to all respondents from a consistent and non personal email modality, and capability to skip questions based upon previous answers so that each type of respondent (owner, program manager, architect, engineer, or constructor) only had to answer questions pertaining to their position.

Question Design and Measurement Scales
The survey (Certification for Construction Professionals, 2013) was comprised of 27 questions and took an average of 8.5 minutes to complete. Survey questions were designed to either provide characterization of respondents or opinions on CM certification. The questions, which involved respondent demographic information, were created utilizing ranges in answers (i.e. age, types of projects, certificates held). Questions that required the rendering of an opinion by the respondents, were presented in two methods. The first method required a ranking of the certifications included in the survey where number one represented the highest regarded. Additional instructions to the respondents required that certifications could not be ranked with the same number. The process of providing a ranking required the respondent to render a decision, eliminating the possibility of a “maybe” opinion. The second method included questions requiring an opinion regarding the beneficial nature of certifications as perceived by the differing professional construction roles, which presented the opportunity to provide a “maybe” type of answer. In this particular survey, the questions were constructed with response options of “yes,” “no,” and “I have not thought about it so I do not have an opinion.” This scale was chosen based upon the relative newness of certifications in the construction industry. Social bias was minimized by virtue of the anonymity of responses.

Data Analysis
Survey Analysis
The survey instrument’s reliability was analyzed with SPSS to assess the ability to draw inferences to the target population on a repeated basis. Factor and parallel analyses were conducted to confirm the survey’s effectiveness in asking the appropriate questions to gather opinions from construction professionals. In all assessments, the survey passed acceptable statistical performance criteria. Reliability tests for the opinion questions produced a Cronbach’s Alpha statistic at .808. Factor analysis indicates that the variables were not providing redundant information with a correlation matrix determinate of .051. In addition, underlying factors are unlikely with a KMO value of .657. Correlations are real with p = 0 and the null rejected from the Bartlett’s test. Lastly, total variances explained are confirmed with Eigenvalues greater than 1 for two factors that explain how respondents are reacting to the survey construct:

- Variable: CM professionals should be certified by a single agency; the factor is: CM’s certifications are beneficial. (Eigenvalue = 2.819)
- Variable: One agency to certify construction management professionals will promote consistency in project execution. The factor is: administration of certification by a single agency. (Eigenvalue = 1.917)

These two factors were confirmed through a parallel analysis utilizing artificial data means, which produced Eigenvalues greater than 1 (1.423 and 1.261 respectively).

Response Analysis
An independent sample two tailed t-test with α = .05 (assuming unequal variances) was performed on respondent’s opinion questions and the results were found to be significant where p = .000. In addition, frequency calculations were conducted on all categorical data.

FINDINGS
Perceived Benefits of CM’s Certification by Team Professionals
The primary motivation for conducting this research was to assess perception of construction industry professionals toward CM’s obtaining certification. The perceived benefit by each team member is illustrated in Figure 3 with opinions reflecting that owners would view CM’S certification beneficial by 61% of respondents, architects and engineers 51%, and construction managers by 43%. Since CM’s are not required to obtain individual certification, it’s not surprising that CM’s would rank the benefits lower than professionals who are required to obtain licensure. The most compelling finding is that 61% of all respondents believe that owners of construction projects would find the most value in certified CM’s.

Figure 2. Perceived Benefits of CM’S Certification
Certification Familiarity vs. Certificate Ranking by Respondents

One of the most significant findings is that there is a wide gap (40%) in familiarity of certifications by respondents, with PMP being the most familiar and AC the least. However, when first through third place rankings of the four construction certifications were averaged together, the differences were marginal between certification rankings (8%), as shown in Figure 2.

In order to assess if there were biases by current certificate holders in favor of their own held credential, a cross tab analysis was performed. The results are shown in Table 2, which indicate a relatively small marginal difference (7.7%) of respondents choosing the certification they currently hold to rank higher than other certificates. With the small range differential in rankings by current certificate holders, the researcher can reasonably imply that bias was minimal.

![Figure 3. Respondent Familiarity vs. Ranking of Construction Management Certifications](image)

<table>
<thead>
<tr>
<th>Certification</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPC</td>
<td>26.2%</td>
</tr>
<tr>
<td>AC</td>
<td>24.1%</td>
</tr>
<tr>
<td>CCM</td>
<td>20.6%</td>
</tr>
<tr>
<td>PMP</td>
<td>18.5%</td>
</tr>
</tbody>
</table>

Note. Percentages are based upon average of first, second, and third place rankings.
CONCLUSIONS AND RECOMMENDATIONS

This survey was conducted as exploratory research based upon the researcher’s interest in both construction management and education of the professionals who perform in this industry. The driving question was, “Which baseline construction manager certifications are held in the highest regard by construction industry professionals in the Houston Texas region?” Figure 3 illustrates the ranking results where CCM was first with 29%, PMP was second with 26%, and the CPC and AC were tied for third with 21%. With only an eight percent range between the highest and lowest ranked certification, it appears that the four certifications are relatively equally ranked. The survey instrument was limited to providing only the respondent rankings and excluded their reasoning for rankings. To provide a deeper understanding of respondent rankings, the researcher recommends that future surveys include questions to address why certain certifications are ranked higher than others.

The parameters that define these professional roles include owners, program managers, architects, engineers, and CM’s. The questions were derived from the researcher’s industry experience in the commercial sector and educational teaching experience at the collegiate level in construction management curriculum. Factor analysis, reliability, parallel analysis, t-test, frequency distributions, and cross tabulation analyses were performed on the data set to determine the survey’s capability to perform as a statistical model for current and future research. All survey design indicators demonstrated success in the survey instrument’s capability to infer a construct upon the target population, and indicated that further implementation to a broader sampling pool is possible. Based upon the findings of the factorial, reliability, and parallel analysis, the survey instrument can be implemented in future research with a high degree of confidence.

The demographic information on the respondents is important to consider when understanding the context of the survey results and are presented as follows:

**Construction Manager Demographics**

- Seventy nine percent of Construction Manager respondents have worked on projects greater than $75 million across all sectors.
- All but 10% of the CM’s have worked in the commercial sector.
- Construction manager experience was distributed between tenure range categories by the following percentages; 1–5 years (12%), 6–10 years (8%), 11–20 years (15%), 21–30 years (19%), and over 31 years (16%).
- Industry experience of the respondents indicates that 50.6% have worked as a CM as compared to those presently working in the CM role, at 49.4%.

<table>
<thead>
<tr>
<th>Context</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licenses Held by Respondent</td>
<td>Architecture</td>
<td>20.2%</td>
</tr>
<tr>
<td>Licenses Held by Respondent</td>
<td>Engineering</td>
<td>11.9%</td>
</tr>
<tr>
<td>Licenses Held by Respondent</td>
<td>Company Construction</td>
<td>10.1%</td>
</tr>
<tr>
<td>Licenses Held by Respondent</td>
<td>None</td>
<td>58.8%</td>
</tr>
<tr>
<td>Certifications Held by Respondent</td>
<td>CPC (AIC Agency)</td>
<td>2.8%</td>
</tr>
<tr>
<td>Certifications Held by Respondent</td>
<td>AC (AIC Agency)</td>
<td>1.8%</td>
</tr>
<tr>
<td>Certifications Held by Respondent</td>
<td>CCM (CMAA Agency)</td>
<td>4.6%</td>
</tr>
<tr>
<td>Certifications Held by Respondent</td>
<td>PMP (PMI Agency)</td>
<td>4.6%</td>
</tr>
<tr>
<td>Certifications Held by Respondent</td>
<td>None</td>
<td>68.8%</td>
</tr>
<tr>
<td>Respondent Currently Employed in Role of:</td>
<td>Contractor</td>
<td>49.4%</td>
</tr>
<tr>
<td>Respondent Currently Employed in Role of:</td>
<td>Architect</td>
<td>12.6%</td>
</tr>
<tr>
<td>Respondent Currently Employed in Role of:</td>
<td>Engineer</td>
<td>9.2%</td>
</tr>
<tr>
<td>Respondent Currently Employed in Role of:</td>
<td>Owner</td>
<td>6.9%</td>
</tr>
<tr>
<td>Respondent Currently Employed in Role of:</td>
<td>Program Manager</td>
<td>14.9%</td>
</tr>
</tbody>
</table>

Note. Survey Total Respondents n = 109 with Fully Completed Surveys n = 108.
All Respondents Demographics

- Of all survey respondents, 85% are currently employed in the industry.
- All of the participants have worked in the United States.
- Within the commercial sector, 70% have worked for private owners; the remaining 30% have worked for government agencies.
- Academic attainment by all respondents was 4% (high school), 64% (bachelors), 28% (masters), and 4% (Doctoral).

Licensure and Certification Demographics

- Licensed architects and engineers comprised 32% of all respondents.
- Only 13% of the respondents currently hold a third party certification. Of those certificate holders, 25% were program managers, 20% owners, 16% contractors, and 11% engineers.
- Fifty percent of respondents indicated that their employer currently pays for construction management certifications, but only 43% of respondents perceived that their employer viewed certification as a benefit.

The survey did collect respondents perceptions as to which certification they were most familiar with and it is of interest to note that familiarity of the PMP far exceeded the other certifications and yet the PMP held a similar ranking to all others. Speculation by the researcher of this phenomenon included the global familiarity of the PMP certification within the petrochemical construction sector which is large in this region. An additional possibility could be that marketing outreach may be weaker by the other certification programs in the Houston Texas region. A secondary finding of interest (Table 2) is the ranking of each of the certifications obtained by each respondent, where CPC and AC professionals ranked theirs the highest at 26% and 24%, respectively. As these numbers are included in the rankings from Figure 3, the possibility exists that the familiarity and certificate holders of CCM and PMP are greater than professionals with a CPC and AC certification. It is possible that market awareness contributes to this anomaly and the only thing that is reasonable to infer from this result is that CPC and AC certificate holders have more confidence in the certification to meet construction certification needs.

Based upon the demographic and polling data gathered from this survey, it is fair to infer that the respondents have worked on large commercial sector projects (64%) located in the United States (100%) and are somewhat biased toward private project ownership (63%). One third of the respondents are professionally licensed, with only 13% currently certified. Perhaps more significant is the fact that 55% of the respondents hold neither a license nor a certificate and yet 61% believe that project owners would perceive certification as a positive and stabilizing credential. Additionally, respondents believe that 51% of architects and engineers would perceive construction management certification as beneficial.

Since fellow professionals—architects and engineers—have the social equity provided through licensure, perhaps it is time that the construction industry to take the next step in its evolution to create the same stature for CM’s by requiring certification. If prestige for construction practitioners is not compelling enough to strengthen the movement toward individual certification, then perhaps a secondary goal can emerge with an appeal to existing agencies to work together in an effort to create commonality and consistency for the benefit of the industry, its professionals, and the citizens who benefit from well executed projects. Based upon the findings of this survey in the Houston Texas region, there is compelling evidence to suggest that further research on a nationwide level would benefit the team of professionals responsible for the construction industry and certification agencies. A case can also be made to research the industrial construction sector since the majority of the survey recipients were from the commercial building sector.

REFERENCES


Each year the Associated General Contractors Education and Research Foundation (AGCERF) sponsors the James L. Allhands Essay Competition. The competition is named for (and funded by) the late James L. Allhands, a founding member of the AGC who spent his career as a prolific writer of construction related books. The essay competition is open to any senior level student in a four or five year ABET or ACCE accredited university construction management or construction related engineering program.

This year’s topic, ‘Strategies for Reducing the Environmental Impacts of Construction’, generated submissions from across the nation. Judging was conducted by AGCERF board members who are among the most esteemed leaders in the industry. The first place selection was Jordan Moran of Clemson University, the second place selection was Alex Stewart of Clemson University, and third place was Richard Pate of Auburn University. The winning articles are published in this issue.

The 2017 competition will open in July, 2016 and essays are due in November. First place winners and their faculty sponsors are awarded cash prizes of $1,000 and $500, respectively, and will be invited as guests (all expenses paid) of the AGC Foundation to the March, 2016 convention. The second place winner is awarded $500 and third place, $300. For more information on submission guidelines please see www.agcfoundation.org.

With AGC’s permission, this issue of The American Professional Constructor is featuring the top three winning essays for 2016 in our general interest category. We trust that our readership will enjoy reviewing the work of these top performers who will soon be graduating and starting their construction careers.
Strategies for Reducing the Environmental Impacts of Construction

Jordan Moran
Clemson University

ABSTRACT: Sustainable building is a complex goal to reach even for the most seasoned project managers. If they focus on the ideas to reduce, reuse, and recycle that goal becomes much more obtainable. The project manager must set his expectations and priorities from the moment the contract is signed to navigate which routes are most possible to achieve given the project scope and delivery method. The key to success is to relay the long term benefits of sustainable building on to the owner, and make them realize that up-front cost should take a back seat to life cycle. This will save the environment and the owner’s wallet.

INTRODUCTION

The Freedom Tower, Empire State Building, and Golden Gate Bridge are all symbols of the United States of America and they arose through both necessity and to add a sense of luxury to our society. These examples, along with many others in our modern day society have become standard to us. We view them as beautiful and useful but how many people really understand what it took to make those inspired dreams a reality? Since the beginning of mankind construction has been a critical part of our societies and our advancement. The strategies and methods used in this industry, in some cases, can only be described as ancient. It has only been in the past couple of decades, caused by the advancements in modern technology that these methods have truly begun to change and evolve. With our ever growing consciousness to environmental affects we have on our Earth this evolution came about through necessity. The Green movement has caused every industry to alter its practices to conform to a more environmentally conscious culture. Construction in its nature is quite destructive to the environment. The industry requires the destruction of ecosystems to make room for new structures and too gather resources. Changing this inherently wasteful industry into something that is considered Green is a struggle that project managers and superintendents face every single day on their jobs. It will require some creative thinking with the adaptation of new technology to reduce the environmental impact the construction industry has on the Earth. These new methods and strategies can be broken down into three simple categories: reduce, reuse, and recycle.

BACKGROUND

According to the U.S. Environmental Protection Agency, an estimated 160 million tons of construction and demolition waste is produced per year. The majority of this staggering number comes from the demolition and renovation of existing buildings (approximately 53% according to the EPA) while the rest is produced by new construction. The large portion of this waste that comes from renovating existing structures is caused by poor and callous building practices that were adopted throughout most of the 1900s. Many of the old systems must be replaced, which means the old must be disposed of before installing the new. This adds an additional producer of waste, the demolished material in addition to the waste from installing the new facility. Though new construction proves to be less wasteful, it still produces its fair share of materials that end up in a landfill. According to the Environmental Protection Department, approximately 25% of all landfill waste is produced by construction and demolition practices (Figure 1). Tangible construction waste is not the only environmental factor that needs to be taken into consideration however. The lifecycle cost, or more simply put the energy consumption of a structure must be thought of with the same level of intensity. According to the U.S. Energy Information Administration, in 2014, the average annual electricity consumption for a
U.S. residential utility customer was 10,932 kilowatt-hours (kWh), an average of 911 kWh per month. These numbers are among the highest in the world and prove to be a significant problem to the environment. New construction strategies must be discovered and implemented to reduce the amount of physical waste produced and energy consumption wherever considered feasible.

The first of the three methods mentioned earlier is to reduce. To expand on this one simple word, a project manager can take an active role in reducing the amount of materials used or wasted on any particular project. For this method to be successful the project manager must be active in the very early stages of the project. Pre-planning is crucial for any project to not only be successful in completion but in terms of efficiency as well. The project manager can be proactive by assisting the owner in the design stage of the process. Many decisions that are made during the design stage can greatly reduce the materials used/wasted as well as increase the efficiency of the structure, thus lowering the life cycle cost. The very first phase in accomplishing an effective reducing strategy is convincing the owner that taking steps to reduce will benefit them in the long run. Many owners focus much too heavily on the upfront cost of a project when in reality the life cycle cost is equally important to the environment and their wallets. The owner must be made aware that the use of certain materials or methods can negatively affect the maintenance or utility cost in the future. For example, one simple way to reduce the lighting cost of a building is to use more natural lighting. This idea would have to be implemented in the design process to include more windows. Refer to figure 2 which shows all the costs involved in building and maintaining a structure. Over the course of 30 years nearly half the cost incurred for the computer science building was for maintenance and energy use. Steps could have been taken during the planning phase to potentially lower this overall cost. At Clemson University, there is a building called Lee Hall 3 that was recently constructed that incorporates many aspects of green building. These ideas were implemented in the design stage of the project. The academic building provides an uncommonly large open concept feel that not only provides the users with a unique architectural feel but it also simplifies the construction process, thus reducing material usage and waste. For example, drywall is a very common construction practice but is a very large producer of waste. By designing the building around an open concept reduces the amount of drywall needed and eventually wasted. Also the Hall possesses a very unique roofing system. It utilizes what is known as a green roof, and that term is meant to be taken literally. Lee Hall, instead of using typical shingles or flat roofing system, it has a plush field of vegetation.

**Figure 1: Composition of waste disposed of in landfills in 2013 (www.epd.gov)**

**Figure 2: 30 year cost breakdown for the Gates Computer Science Building located at Stanford University (www.stanford.edu)**
This system may cause a higher upfront cost but it provides many long term benefits. These benefits include but are not limited to the following: reduce the amount of storm water runoff, moderate the heat island effect, improve air quality by producing oxygen, reduce light pollution, and extend the life span of HVAC systems. Green roofs are a relatively new type of construction but the practice is growing in popularity as the green movement gains momentum.

Another very simple way to reduce the amount of materials used and wasted on a job site is with the use of BIM modeling. BIM stands for building information modeling and larger contractors now have a division of their company that solely specializes in BIM. The uses for this technology are limitless. Currently it is being used to assist in the designing portion of the project. The structures are portrayed in a 3D format so the owner, architect and general contractor can all get a stronger grasp on the scope of the project. BIM is also used as a method to catch and avoid mistakes. This software utilizes a function known as clash detection which can be very helpful in limiting the number of mistakes that are made on the jobsite. Clash detection works by flagging any type of design flaw that physically could not be possible to construct.

For example reference figure 4, this graphic shows a mechanical piping clashing with some structural steel members. By utilizing clash detection tools this mistake can be caught early before any materials were fabricated, shipped or installed. Mistakes on the jobsite equate to more waste, money spent and can greatly affect the schedule on the job.

A project manager must balance all of his or her resources to be an affective green builder. By affectively utilizing BIM modeling and selling the owner on looking at long-term costs rather than short term, an environmentally friendly structure may be produced. If used correctly, this strategy of reducing the amount of materials needed and wasted while working with the owner to simplify the construction design a reduced schedule may also be accomplished. Complex building practices take time and can cause unforeseen issues which can cause major scheduling conflicts.

**REUSE**

The second strategy in limiting the environmental impact of construction is the concept of reusing. This idea may be hard to realize and impractical for larger jobs but for smaller jobs at any level of complexity this can be a realistic option. As stated earlier the largest portion of construction waste comes from the demolition and renovation of existing structures. Instead of demolishing and disposing of the old product, salvage and reuse as much of it as possible. For example, copper wiring is a very valuable construction material that can be very expensive at times. Salvaging old copper electrical wires could prove to cause some cost savings. This may cause some scheduling implications that need to be thought of prior to committing to such an aggressive
strategy. Extra time must be allotted for a more delicate demolition process and the salvaging of materials. Though this strategy may come across as tedious and unrealistic there are many success stories that can be found on the EPA website. One such success story is the Shops of White Oak Village project in Richmond, Virginia. This project consisted of multiple restaurants, apartment complexes and various small stores. The complexity of each type of building varied and the project management still managed to affectively reuse a significant amount of the demolished materials. The developers diverted 84,500 tons of material away from landfills. This diversion and the reuse of old materials saved the project approximately 3.6 million dollars. If this type of savings was presented to any owner it would become a very realistic and appealing option.

A process that is in its infancy but is growing incredibly quickly is known as RAP or reclaimed asphalt pavement. The asphalt pavement used on nearly every single industrial, commercial, and heavy civil project is a very large portion of the construction budget. The process includes stripping the existing pavement, grinding it into small grains or gravel like mixture and reintroducing water and other admixtures to the mix. It is an incredibly efficient process that eliminates an enormous amount of waste from the landfills. This can also prove to benefit the schedule because the lead time on asphalt materials is severely reduced. According to the NAPA or National Asphalt Pavement Association, in 2012 nearly 70 million tons of asphalt was reused through the RAP process, which means that amount of waste was diverted away from the landfills.

The idea of reusing in lieu of purchasing new materials is a fairly new technology that is being adopted around the world. It has proven in its lifetime that it provides clear benefits to the general contractor, owner, budget, schedule, and environment. This technology is a definite step in the right direction in preserving our environment and the financial well-being of owners worldwide.

**RECYCLE**

Recycling is probably the most commonly identifiable word out of the three concepts discussed in this paper. The number of construction sites with a recycle bin is growing every year. This may be the hardest movement to follow on a typical jobsite because it requires micromanaging the labor over the course of every day. The massive majority of common construction materials in today’s world can and should be recycled. The issue is getting upper management and the common labor force to truly commit to the cause. The issue with this concept is it may cause some scheduling and budgeting issues. The process of organizing and separating recyclable materials from landfill items can be tedious and noticeably time consuming, which this time must be taken into account when estimating production rates. In terms of the budget, having a recycling focused jobsite may require extra labor to sort through the waste and an extra dumpster and waste pick up crew will be required, which will add excess cost. Recycling is very important and should be viewed that way. A project manager must work actively with both the owner, to relay its benefits to the environment, and with the field team to effectively add this process to the workers’ every day working

---

Figure 5: RAP machine stripping and grinding up pavement (www.eia.gov)

Figure 6: Distribution of recyclable vs landfill materials (www.epa.gov)
practices. Reference figure 6, this diagram shows the distribution of common construction materials. The significance of this diagram is to show that 75% of all materials can be recycled. This means that nearly 75% of all construction waste, which amounts to hundreds of millions of tons, could be diverted from landfills.

**PERSONAL EXPERIENCE & CONCLUSION**

Through my experience and education with the construction industry I have been exposed to both sides of the idea of sustainable building. During my first internship experience I was on a jobsite took no steps toward any type of sustainable building. This gave me an in depth understanding the extent of the massive amount of waste that is produced every single day. My second internship experience could not differ more from my first experience. This jobsite they employed a full time engineer in charge of LEED submittals, which I took a hands on role in reviewing. This jobsite was awarded a Gold LEED certificate upon is closing. This job in particular taught me exactly what it took to achieve sustainable building. In conclusion, construction becoming a sustainable practice that helps sustain the environment rather than harming it is a very realistic goal. The key to achieving this is commitment on all levels and the realization that it will take some extra effort and maybe an extended schedule. The project manager MUST relay the benefits of green building to the owner. One of those benefits is that they can save a very significant amount of money in the life cycle cost of their buildings. Overall, sustainable building is on the rise and for the movement to continue it requires more commitment on all levels, from the project manager to the common labor force on all jobs. Management needs to take an active role in everyday activities.

**BIBLIOGRAPHY**


Strategies for Reducing the Environmental Impacts of Construction

Alex Stewart
Clemson University

ABSTRACT: In order to carry out a successful and sustainable construction project, quality project planning is essential. In this paper, I will discuss how design and preconstruction are the most important parts of a sustainable construction project. The three main points will be about the importance of selling sustainability to the owner, choosing the proper project delivery method to integrate team members, and planning for the future when designing the project. Finally, I will touch on how my own education through the Construction Science and Management program at Clemson University has prepared me for this new era of construction.

INTRODUCTION

Sustainable development has been defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs,” (Brundtland, 1987). In the grand scheme of things, the idea of sustainable construction hasn’t been around all that long. Just a few decades ago, concepts like energy-efficient materials, reduced site waste, and many environmental measures had not been emphasized nearly as much as they are today. Mankind is on the leading edge of this sustainability movement, and it’s evidenced by the existence of about 60 green building councils worldwide and over 32,000 construction projects that are registered with the US Green Building Council (Kibert 2013).

With this growing emphasis on addressing environmental concerns, utilizing resources more efficiently, and leaving a smaller footprint on our world, it has become increasingly important for current and future project managers to take control of the elements of the construction process which can affect the environment in both the short and long run. However, doing so is difficult without proper planning before the project begins. The effort and attention invested into planning a project sets the tone for its entire duration and has a huge impact on its overall success. As the complexity of a project increases, so does the importance of planning. Due to the wide array of standards and requirements that must be met, sustainable construction projects are generally more complicated than projects which are not intended to achieve sustainability goals.

Therefore, design and preconstruction have the greatest impact on the success and sustainability of a construction project. The level of attention and effort invested in these stages determines the project’s level of success in achieving its environmental efficiency goals.

DESIGN, PRECONSTRUCTION, AND SUSTAINABILITY

It’s important for construction teams to understand and handle the environmental issues that are present during the construction phase. There are plenty of ways to mitigate air quality issues, noise pollution, site waste, and other risks during this phase. However, the design and preconstruction stages of a construction project are by far the most critical to its success. During this time, the purpose and objectives of the project are determined. The owner, design team, and often the contractor together should establish a thorough plan of action, make sure that each party is on the same page, supports program objectives, and is aware of the project’s goals. Once a project is beyond these stages, any changes in its course start to cost the owner and contractor time and money. To maintain productivity and efficiency, it’s important to plan the work and work the plan. For an exaggerated example, if an owner wanted to build a 4-story motel, but decides at the beginning of the construction phase that it should
be a ten-story mixed-use development, everything about the project would have to be changed. Thorough planning is just as important, if not more, when setting goals for sustainable development. There are so many things that set sustainable projects apart from nonsustainable projects. Green design standards cover every aspect of the project including site location and size, material requirements like availability and renewability, and energy conservation goals. Because these standards deal with so many different aspects of a project, an owner can’t just decide to pursue sustainability goals once a course has been set, design is complete (depending on the delivery method), and construction has begun.

To get the most out of these early stages of a sustainability-centered project, the most important goals should be convincing the owner of the long-term benefits of sustainable construction and getting them onboard, choosing the most appropriate delivery method, and designing the actual project to mitigate environmental impacts in the field.

**Selling Sustainability to the Owner**

Project owners are consumers just like us. When they buy products, they consider whether the cost is worth the benefit. However, the owner’s perception of cost may not always be supported by facts. Marketers know that customer perception is everything, and when it comes to green construction, the common perception is that initial costs are much higher than traditional construction. Nora Knox of the US Green Building Council points to a public opinion survey conducted in 2007 by the World Business Council for Sustainable Development which shows that many people believe that green building adds a premium of 17% over normal building costs. This same study collected the costs of 146 green buildings and concluded that the extra cost for sustainable construction is actually under 2% of normal building costs on average (Knox 2015). With this being said, it is important for owners to be educated about the true initial costs of a sustainable project. Sustainable buildings also offer a multitude of savings opportunities over their lifetime. LEED certification is meant to set standards for buildings that are not only environmentally sensitive, but also cost-effective in the long run by means of energy conservation methods and other design decisions. In 2013, the World Green Building Council reported that green buildings use between 25% and 35% less energy than comparable non-green buildings (WGBC 2013). A 2003 study by Greg Kats of Capital E collected financial data from 33 LEED certified buildings built between 1997 and 2004 and concluded that after 20 years, the financial benefits of these projects were over ten times the amount of the sustainability premium (Kats 2003). The design team and contractor, if present during the design phase, should make it a priority to emphasize the long-term benefits of a sustainable project and give the owner all of the information necessary to make a decision as to whether they want to invest in a sustainable project.

**20-Year NPV vs. Green Cost Premium**

<table>
<thead>
<tr>
<th></th>
<th>Total 20-Year NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Cost Premium (LEED Gold and Silver)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: A comparison of the average green cost premium versus the average Net Present Value of LEED Gold and Silver certified buildings considered in Kats’ study.

However, this isn’t just about money. The potential of saving a few bucks in the long run or obtaining grants cannot be the only reason that the owner commits to a sustainable project. It’s about motivating the owner and getting them onboard with the sustainability effort. If the owner is excited about the project and is in it for more than just the money, but is still assured that the team is interested in helping them save money down the road, they will be much more cooperative and confident in the undertaking, which will lead to project success.

**CHOOSING A DELIVERY METHOD**

There is no such thing as a one-size-fits-all delivery method. There are multiple approaches to construction projects. Most are better suited for different purposes, and are usually chosen based on the owner’s experience, budget, time constraints, and design criteria. This section will focus primarily on Design-Build, Construction Management At Risk, and Integrated Project Delivery, and how they can improve the effectiveness of sustainable projects. These three
provide the highest level of integration, which is the most important aspect of a project delivery method when concerning sustainable construction.

**Design-Build** and **Construction Management at Risk** are both integrated delivery methods in that they overlap the design and construction phases and allow the design team and contractor to collaborate on the project’s design. Again, sustainable construction projects are very complex and require a high level of integration of all team members. Design-Build allows for this, since most DB firms either have their own design team or get to choose which design firm they work with. CMAR firms offer the same advantage by providing consulting services during design and perform work if they have the expertise. Owners choose DB and CMAR firms based primarily on qualifications, so the selection of a quality delivery team needed for sustainable construction is covered. Initial costs should not be as great of a concern to the owner if the DB or CMAR firm has thoroughly communicated the long-term gains of sustainable construction. One other advantage that these integrated delivery methods offer for sustainable projects is fast-tracking. The faster a project is finished, the sooner the owner will start to see returns on their investment. In order for a firm to yield a successful sustainable project, it must be up front with the owner and keep them involved and informed in the project.

**Integrated Project Delivery is a relatively new integrated delivery method.**

Basically, the risk is distributed among each member of the team, so the success of one person or group is dependent on the success of the IPD team. This is great for sustainable projects because everyone is equally as motivated to provide top quality in their field of expertise. However, this method is resource-heavy and is typically utilized by larger projects. Sustainable projects incorporate lots of environmentally sound and energy saving materials and equipment, and this applies to most every trade on the job. Having subcontractors working closely with the team during design will bring their specialized expertise to the design process, improve coordination, and eventually lead to a faster schedule during construction. In the field, this will help to reduce waste and reduce tensions between subs. One way of utilizing this sort of integration could be for subs to coordinate deliveries. If multiple subs need materials at the same time, instead of their suppliers using separate trucks, they could combine their shipments into one load and cut down on the number of trucks coming to and from the site. This would help to reduce material delays and having to keep materials from sitting on the site, potentially being damaged, and creating waste.

**MITIGATE ENVIRONMENTAL IMPACTS IN PROJECT DESIGN**

At this point, the owner has fully committed to a sustainable construction project and the owner, design team, contractor, and potentially the subs, are all integrated into one team. Now, the goal is to focus on material and system choices that would reduce the environmental impacts of the project.

Site choice makes a huge difference in the success of a project, as there are certain LEED standards which require the contractor to protect the natural state of the site as much as possible. Essentially, the idea is to work with what you have, disturb the site and its natural resources as little as possible, and contour the project around the natural landscape as much as possible. The most ideal approach, however, would be to choose a lot that has already been developed but is now blighted...
property. The land has already been leveled out, which minimizes the amount of excavation necessary, and untouched land would be spared. One idea would be to try and reuse any of the site’s old structure, either as being broken down and turned into new products or integrated into the new project where it stands.

As far as physical design features in the building itself, there are plenty of materials available that help to cut consumption of natural resources and reduce environmental impacts. However, knowing what’s out there right now isn’t going to be what makes the difference in your sustainable project. Sustainability is about looking forward, so it’s critical for project managers, architects, engineers, and subcontractors to always be on the lookout for what’s next. It’s important to hone your senses of prediction and noticing patterns in innovation. If a project’s integrated team has this sort of insight, this can increase its level of sustainability significantly. Instead of using proprietary technology that is difficult to upgrade or replace, shape the building around the idea of interchangeability. Prepare it for the technology that has yet to be created by preparing the building to accept change. Don’t make things like MEP equipment, high efficiency windows, high R-value insulation, recycled roofing, or any other materials hard to replace. Along with having a plan to install materials, be sure to plan how they will be replaced. Plan for today’s high-efficiency, low-emissions, eco-friendly materials to be outdated and superseded by something better and more efficient. Make sure the transition will be as smooth as possible, because it’s inevitable.

CONCLUSION AND RELATION TO CURRICULUM

The sustainability movement has completely changed the way we look at construction. As we’ve come to realize how temporary our environment is, we’ve become more aware of the importance to slow down and think about how it’s being used. Thankfully, Clemson University’s Construction Science and Management program has given me the tools necessary to react to this change as a member of the construction industry.

Sustainable construction is centered around the idea of reducing the effects that our traditionally dirty and costly industry can have on our environment. As members of the construction industry, we need to embrace this idea and convey its importance to the owners who give us work; not only for its monetary benefits, but also for the benefits it provides everyone. The CSM curriculum branches out beyond the technical aspects of construction and hones in on the business and marketing aspects of construction, which has helped me to better understand owners’ roles as customers. This portion of my curriculum has reinforced the values of working with owners instead of simply seeing them as the source of your next paycheck, and also understanding that making their problems and success your own will benefit both parties.

A sustainable project can’t be successful without a plan, and having every member of your team united under a cause, cooperating with one another, utilizing everyone’s expertise, and contributing at every point of the project is key to that plan’s success. Without a dynamic team, no amount of clever biodegradable materials or low- emissions equipment can save a project. In both my business-related classes and core construction classes, I have been taught that the quality of your planning determines the quality and success of its execution. In the many team environments I’ve been involved with here at Clemson, it’s become more and more evident that integrating a team, cooperating, and recognizing the strengths of each member is essential to the success of a project as well.

When your team is assembled and working together well, it’s important to continue forward thinking through the design phase. Project location is key when dealing with sustainability, as it impacts how the project will interact with the surrounding natural environment. Developing on blighted property eliminates the need for breaking ground on undisturbed land and provides a site that’s previously been prepared for construction. When designing the actual building, green materials are great. However, it’s even more important to plan for the next wave of technology and how to integrate it into today’s construction. Predicting these trends will set a project apart from everything else and keep it in a constant state of improvement for years. At Clemson, tomorrow’s technology is heavily emphasized, and we are constantly taught to plan for the future. The CSM department is constantly inviting innovators in the industry to speak with us and show us what’s really happening in the industry so that when we graduate, we’ll be up to speed with everyone and ready to take the next steps forward.
BIBLIOGRAPHY


Strategies for Reducing the Environmental Impacts of Construction
“Improving Erosion and Sedimentation Control Practices on Construction Projects”

Richard Pate Jr
Auburn University

ABSTRACT: There are numerous potential impacts associated with constructing our built environment; one in particular is fresh on contractor’s minds around the country and that is the erosion and sedimentation of our waterways. In this essay, I explain why this issue has become such a pivotal discussion within construction and green building efforts, what strategies have recently become available for addressing these issues, and how their implementation will affect a project’s overall budget and schedule. The strategies I have chosen to discuss are silt fence tieback systems, polyacrylamide (PAM) flocculants, and unmanned aerial vehicle inspections.

In the United States, 250% more firms reported high levels of green construction in their portfolios in 2012 compared to 2009; they expect this figure to rise an additional 33% by 2015. Globally, green construction comprises 38% of building activity, doubling from 2008 to 2012, which has led many firms to report that by 2015 the majority of their work will be green projects (Fien and Winfree 2014). However, the construction industry is still often considered one of the primary sources of environmental pollution in the world. Pressures from the general public and new government regulations are requiring construction professionals, especially project managers, to consider the environmental impacts of their projects more now than ever before. These rising expectations for sustainable design are forcing construction companies to continue looking for new and innovative strategies in order to stay competitive in this global market.

THE EROSION AND SEDIMENTATION OF WATERWAYS

On a complex project, there are dozens of different ways the environment can be impacted, directly and indirectly. In most cases it is the responsibility of the project manager to take these environmental impacts into consideration and employ the best strategies available to minimize their affects, while working within the means of his or her schedule and budget. As a result, it is crucial that a project manager be able to accurately anticipate where their project will have the most trouble meeting environmental standards.

Every year, construction sites discharge approximately 80 million tons of sediment into their storm water runoff, which on a unit area basis, is approximately 1,000 times more sediment than any other typical urban land use (Zech and Clement 2012).

This substantial amount of sediment-laden runoff is primarily due to erosion through excavation and other vegetation clearing activities, such as grading and filling. The potential environmental impacts of sedimentation are equally substantial, which according to the United States Environmental Protection Agency (USEPA) includes: reduction of important or sensitive underwater habitat, decrease in fishery reserves, loss of recreational spaces, human health dangers, increases in erosion, and rising turbidity levels.

In 2008, the USEPA proposed more stringent effluent limitation guidelines, mandating construction sites to reduce initial turbidity levels to 280 NTU. Although, these new guidelines are still under review, they have generated considerable momentum within the construction industry to test and install better practices for controlling erosion and sedimentation
from construction sites (Zech and Clement 2012). Consequently, a clear need exists for project managers and other construction professionals to begin searching out and applying new Best Management Practices (BMPs) that sufficiently address these growing concerns.

I propose implementing three strategies for erosion and sediment control that have currently become available within the construction industry: silt fence tieback systems, polyacrylamide (PAM) flocculants, and unmanned aerial vehicle inspections.

Silt Fence Tieback Systems
The silt fence is one of the most common BMPs used on construction sites for the abatement of sediment and other debris into the waterways by way of storm water runoff. They are typically installed around the perimeter of a site, where they act as a barrier for runoff which allows sediment to settle out of suspension by slowly filtering the water.

Yet, if you have spent any time out on a construction site, you know just how frustrating and prone to failure these devices can be.

Some problems are due to improper installation and poor management, however Zech et al. (2007) argue that most failures are due to “improperly designed silt fence installations.” The traditional linear design system has proven susceptible to strenuous flow along the fence which leads to substantial sedimentation, scouring at the downslope end of the system, and erosion along the toe of the fence at many upslope locations (Zech et al. 2007). Growing up working for my father’s commercial landscaping company, I am well aware of these issues. If we had a hard rain the night before, I could count on finding a section of silt fence blown out the next day because too much runoff had found a low spot and overwhelmed the fence.

I believe an feasible solution rests in the silt fence tieback system, or “J-hook,” design, which uses upward sloping hooks in the fence at intermittent points where the sediment-laden runoff can form smaller detention basins that allows much more time for settling. Studies show a significant reduction in sedimentation rates of the conventional linear design (75%) when compared to the tieback design system (90%) (Zech et al. 2007). On construction projects, particularly when large volumes of site work are involved, the true value of this system resides in its ability to minimize the chances of failure modes that come with traditional silt fence systems. The tieback design system, although it may seem quite simple, could in fact significantly reduce the amount of rework and management.

Polyacrylamide (PAM) Flocculants
For decades, chemical compounds called polymers have seen increased usage in a range of industries, particularly within water and sewage treatment, where they have proven exceptionally effective in facilitating solid-liquid separations during processing and the clarification of various types of effluents. Their effectiveness lies in their ability to enhance coagulation and/or flocculation of fine particles, allowing for more rapid settling in downstream detention practices (Toronto and Region Conservation Authority 2010). In recent years, anionic polyacrylamide (PAM), one of the more common polymer flocculants on the market, has garnered a lot of attention within the construction industry due to its low toxicity rate, coupled with its unique ability to bind soil particles together to form an erosion-resistant surface and reduce sedimentation caused by turbid construction runoff.

Proactively regulating this runoff prior to being discharged into local waterways has been a common challenge for construction managers. While controls that reduce sedimentation through technologies such as sediment basins and check dams have shown to be effective in eliminating a majority of suspended sediment, the amounts left in construction effluent remain above the threshold for USEPA standards and for protection of freshwater ecosystems (Toronto and Region Conservation Authority 2010). Thus, PAM-based treatment systems may provide a desirable alternative when project managers need additional help improving sediment removal.

In 2012, the Auburn University Highway Research Center published an extensive report on the use and application of anionic polyacrylamide (PAM). In their report they present the results of intermediate-scale experiments conducted to evaluate the performance of different PAM application methods (Zech and Clement 2012). Their conclusions confirm that PAM could in fact be a valuable tool for project managers, yet they acknowledge that PAM-products should be used in conjunction with other best management practices, such as sediment basins, control trenches, and silt
fences, until further research warrants otherwise (Zech and Clement 2012).

**Unmanned Aerial Vehicle (UAV) Inspections**

When most people envision drones, or Unmanned Arial Vehicles (UAV), they probably imagine futuristic, high-tech military machinery used for dangerous reconnaissance missions over enemy territory. In reality, UAV technology in the past few years has made significant advances, to the point that any “regular joe” can purchase and operate a small drone for recreational use for a few hundred dollars. This past semester, one of my professors who has done extensive research on UAVs through Auburn University, said that “the commercial application of this technology [speaking about the construction industry] isn’t something happening 5 or 10 years from now, contractors across the country are trying to find ways to use drones on their projects as we speak.”

With that said, the Federal Aviation Administration (FAA) has implemented strict regulations governing drones for commercial use that have made authorization a difficult and lengthy process. Contractors who wish to use UAVs on their projects must obtain a FAA 333-exemption grant, which includes aircraft registration, hiring a licensed, “qualified” pilot, and attaining operational approval. Although frustrated, many construction managers remain undeterred in their implementation of this technology. Just this last year, a project manager with Brassfield & Gorrie, LLC, applied for and received a grant from the FAA through Auburn University to study drone usage in construction in conjunction with the multimillion-dollar Grandview Medical Center project in Birmingham, AL (Tomberlin 2014).

Now, what many are beginning to see is an incredible opportunity to use this technology to monitor erosion and sediment control best management practices. In their report, *Using Unmanned Aerial Vehicles (UAVs) to Conduct Site Inspections of Erosion and Sediment Control Practices and Track Project Progression*, Perez et al. (2014) identify two specific applications: construction site storm water inspections and tracking progress progression.

On large or complex projects, erosion and storm water inspections can quickly become a slow and inefficient task. The USEPA require formal site inspections be performed on a weekly basis or within 24 hours of the occurrence of a storm event producing 0.25 in. (0.64 cm) of rainfall or greater (Perez et al. 2014). Exploiting UAVs for this purpose provides the potential for greatly accelerating this process for quality control personnel, who in the past have had to inspect the site on-foot. They can identify and document areas throughout the site with inadequate or failing erosion control devices that warrant immediate attention by quickly generating a unique aboveground perspective. Also, UAV inspections could potentially be used to locate storm water runoff routes and determine areas of the construction site that will be most susceptible to erosion and sedimentation.

Recording the progress of a project has become an essential aspect of construction management. On nearly all construction projects today, someone is left with the toilsome responsibility of walking the site and taking daily progress photos. It is a very necessary process, having a visual record of the construction activities from start to finish, but it is very time-consuming and is usually delegated down to interns or new-hires who don’t really know what to look for. With UAVs, detailed, aerial imagery can be used to document overall project progression, virtually eliminating the need for progress photos of site work like erosion abatement activities. According to Perez et al. (2014), this information can be compiled after each site visit and used to evaluate contractor progress, claims or disputes, and whether corrective actions have been taken to mitigate erosion and sediment control deficiencies identified during previous site inspections.

**Economic and Schedule Impacts**

Due to the nature of construction, any good project manager will always ask at least three questions before implementing a new strategy. How much will it cost? How long will it take? And what is the benefit? In lieu of this concern, I will explain possible impacts my proposed strategies can have on a project’s finances and schedule.

First, what is great about the silt fence tieback systems is that its implementation would create very little budget or schedule impact in the scope of a project. The only additional cost would consist of the price of the additional linear footage of fence needed to make the upward sloping hooks. Although, the time spent installing the additional fencing may take time, the potential cost-savings for rework on large projects could quickly make up for the lower production rates.
However, one thing project managers would need to take into consideration with this design is the spacing between the hooks required to maximize the efficiency of this system. For some time there was debate on the appropriate distance, but recently Zech et al. (2012) have developed a formula for accurately spacing the hooks which would inevitably mean incurring some costs for training for labors and managers.

Polyacrylamide (PAM) flocculants could have a significant impact on the feasibility of a project, especially construction sites with complex topography or excessive amounts of erosion and storm water runoff. The new USEPA effluent limitation guidelines could potentially require contractors to install and manage multiple layers of erosion control devices for certain projects. PAM flocculants provide the capability to drastically reduce the number of these controls. The savings associated with fewer conventional erosion control devices could quickly overshadow the expense incurred with the application of PAM products. Established companies, such as Applied Polymer Systems, Inc., already have performance-tested products on the market and ready for shipping. Another great advantage that PAM flocculants offer is the versatility in which they can be applied. PAM-products are available in a variety of forms. For instance, they can be dispersed as dry-granules, sprayed as a liquid by on-site watering vehicles, or introduced through a hydro-seeding mixture to provide additional protection during seed establishment. These methods give contractors the flexibility to spend less time and money on traditional practices, which can involve constant maintenance and replacements.

Finally, the impact of unmanned aerial vehicles (UAVs) is difficult to measure at this time due to the infancy of its application in erosion and sediment control practices. Current restrictions by the FAA make it challenging and time-consuming attaining authorization for using drones on construction projects, but recently it has been announced that new UAV certification regulations have been released for public comment with hopes for an official release by Fall 2016. That said, the potential impact this technology could have on the economy and schedule of large and complex project is quite extensive. Minus the cost of the equipment and training, thousands of dollars and hours of management could be saved with the proper application of these devices.

My Educational Experience

There are many experiences in my life that have prepared me for the construction industry, its environmental impacts, and the management of construction projects.

However, my time spent as a student at Auburn University in the McWhorter School of Building Science is by far the most valuable. As part of one of my classes, I was given the opportunity to visit one of the nation’s leading erosion and sediment control testing facilities, which is staffed by the university and funded thousands of dollars every year in research grants by construction companies and government agencies looking to find innovative, new practices. Auburn University is the first institution in the country that is approved by the FAA to train UAV pilots for commercial use, which has allowed me to experience a lot of this state-of-the-art technology first-hand. In regards to identifying and planning for environmental impact management, I do not believe there is a better school in the country that could have better trained me for this industry.

CONCLUSION

There are numerous potential impacts associated with constructing our built environment, the erosion and sedimentation of waterways is just one of many. The development and implementation of strategies to minimize these impacts can no longer be passed off as wishful thinking. As a future construction project manager, I believe the construction industry has a responsibility to continue developing and employing Best Management Practices, such as the silt fence tieback system, PAM flocculants, and drone inspections, thus raising awareness and promoting a new age of green building.
BIBLIOGRAPHY


Support Constructor Certification

Certification benefits all parties involved in the construction process since it raises the standards of professional practice.

Benefits to Constructors

• Provides an internationally recognized professional qualification of construction management skills and knowledge.

• Provides an analysis of individual strengths and weaknesses in the subject areas tested.

• Enhances the Constructor image as a professional to their employer, their clients, and the public.

• Provides a marketable credential that sets you apart.

Do you have a Certified Professional Constructor (CPC) on your team?

American Institute of Constructors
700 N. Fairfax St., Suite 510
Alexandria, VA 22314
703-683-4999 phone
info@professionalconstructor.org

www.professionalconstructor.org

We Support Constructor Certification
Reviewer/Publication Interest Survey

The Professional Constructor is a refereed journal published two times a year by the American Institute of Constructors (AIC). Each author’s manuscript submission is given a blind review by three AIC members to evaluate the content and style, and appropriateness as either a general interest or scholarly publication. Based upon the decision of the reviewers, each article is accepted or rejected for publication. Acceptance can be predicated upon incorporation of reviewer comments.

Approximately 10-15 articles are published annually in The American Professional Constructor. To maintain our high standards of publication, AIC requires the support of competent and committed reviewers.

We are always looking for additional industry professionals that are interested in serving on our review board. If interested please contact the journal editor at jlucas2@clemson.edu.

Jason Lucas, PhD
Assistant Professor
Department of Construction Science and Management
Clemson University
2-136 Lee Hall
Clemson, SC 29634-0507
jlucas2@clemson.edu
(864) 656-6959

Please place a mark beside each keyword that is a topic area indicating your expertise or interest. Thank you, in advance, for serving as a reviewer for The Professional Constructor.

Name: ______________________________________________________ Member No.: ______________________________________
E-Mail: ______________________________________________________ Phone No.: ______________________________________
Address: __________________________________________________________________________________________________

Topic Areas

Other ______________________________________________________

The American Institute of Constructors
American institute of Constructors

Constructor Code of Ethics

The Construction Profession is based upon a system of technical competence, management excellence and fair dealing in undertaking complex works to serve the public safety, efficiency, and economy. The members of the American Institute of Constructor are committed to the following standards of professional conduct:

I. A Constructor shall have full regard to the public interest in fulfilling his or her responsibilities to the employer or client.

II. A Constructor shall not engage in any deceptive practice, or in any practice which creates an unfair advantage for the Constructor or another.

III. A Constructor shall not maliciously or recklessly injure or attempt to injure, whether directly or indirectly, the professional reputation of others.

IV. A Constructor shall ensure that when providing a service which includes advice, such advice shall be fair and unbiased.

V. A Constructor shall not divulge to any person, firm, or company, information of a confidential nature acquired during the course of professional activities.

VI. A Constructor shall carry out responsibilities in accordance with current professional practice, so far as it lies within his or her power.

VII. A Constructor shall keep informed of new thought and development in the construction process appropriate to the type and level of his or her responsibilities and shall support research and the educational processes associated with the construction
TO SUBMIT AN ARTICLE FOR CONSIDERATION
PLEASE REVIEW THE AUTHOR’S GUIDE

For more information contact us at info@professionalconstructor.org