The Professional Constructor

Journal of the American Institute of Constructors

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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.

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.

 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 would like to express our deep gratitude to the following reviewers of the articles published in the Journal’s Spring and Fall 2017 Issues:

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2017 CONSTRUCTOR CONFERENCE ARTICLES

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Christine Piper and Varahee Madadi

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Establishing a Ratio of Fixed Personnel Costs to Revenue for Construction Managers
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ABSTRACT

Passage of the Level 1 Associate Constructor (AC) exam is certification that entry-level professionals have the skills and knowledge necessary to manage the process of construction. The exam is also used by university-level construction management (CM) programs in their accreditation. This paper presents the findings of a CM department head survey issued during the fall 2016 AC exam cycle. Data were compiled from 23 institutions that accounted for 67% of the students who took the exam in the fall of 2016. The majority of the departments surveyed use the AC exam in their accreditation and require students to take the exam; however, there is a great deal of variation as to how departments incorporate the exam into their curricula. The most common method was to include the exam as an assessment in a required course weighting it between 20 and 30 percent of the final grade. Most departments assist students in preparing for the exam in some fashion, but techniques vary. In general, department heads were satisfied with the exam and its logistical administration (two 4-hour sections given on a Saturday). Support was found for moving the paper-based AC exam to a computer-based format, but logistical barriers would need to be overcome.

Keywords: AC Exam, Department Head, Assessment, Survey

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INTRODUCTION

Since 1971, the American Institute of Constructors (AIC) has advanced the professionalism and ethics of the construction professional (American Institute of Contractors [AIC] 2017a; Sylvester 2011). In 1993, the AIC, along with 10 other trade and professional associations, created the Constructor Certification Commission (Commission) with the express purpose of developing a nationally recognized qualifying body of professional constructors (Hauck & Rockwell 1997; Sylvester 2011). The Commission has two levels of certification: Level 1, the level of an associate constructor (AC), and Level 2, that of the certified professional constructor (CPC). Since the first certification was awarded in 1996, over 25,000 individuals have received their AC or CPC certifications or both under the Commission’s leadership (AIC 2017a). The AC certification is earned by those with a combination of a 4-year Construction Management (CM) degree (or 4 years of qualifying experience) and the passage of the AC exam. The AC exam is a paper-based exam given in two 4-hour segments on a Saturday, administered once in late fall and once in late spring of the academic calendar. Students generally take the exam during the final year of their CM degree program (MacDonald & Sessoms 2012). The exam consists of 300 questions related to 10 unequally weighted content areas identified by industry professionals as necessary to manage the construction process (AIC 2016). The exam is accredited by the ANSI, which mandates in part that educators have no prior knowledge of exam questions (AIC 2017b). Educators may submit potential questions for consideration; however, industry professionals on the Exam Writing Committee (subcommittee of the Commission) must vet all questions for appropriateness before they are included in an exam. The exam fee for the spring/fall 2016 exam was $165.

The core objective of the AC exam is to certify that entry-level professionals have the skills and knowledge necessary to manage the process of construction (AIC 2017a); however, CM programs are also using the AC exam as part of their accreditation process. The majority of accredited CM programs receive their accreditation through the American Council for Construction Education (ACCE), with a significantly smaller percentage accredited through the Accreditation Board for Engineering and Technology (ABET). The ACCE recently changed its accreditation from a prescriptive-based process (requiring specific courses) to one more based on performance. As part of this change, the ACCE identified 20 student learning outcomes (SLOs) that programs must demonstrate they meet via direct and indirect measures. The ACCE accepts the AC exam as a direct measure for 12 and an indirect measure for 8 of the 20 SLOs (American Council for Construction Education 2017). Because it can be used as a direct and indirect measure for so many of the SLOs, the AC exam is becoming a widely used tool for accreditation. The use of the AC exam for accreditation does present a challenge, however, and that challenge is the focus of this research. The exam is comprehensive of the topics covered over a 4-year period. Studying for the exam is time consuming and requires significant effort on the part of the student. The taking of the exam itself is very laborious because it unfolds over an 8-hour day and occurs on the weekend (Carns & Bender 2002). Because the exam is given to seniors who often have secured full-time employment already, student motivation to study and treat the exam seriously is a significant challenge for CM programs. This is especially true for programs using the exam as an assessment of their students’ learning for accreditation purposes.

TARGET OF THE STUDY

This study seeks to understand what construction management programs are doing to motivate and prepare students to perform their best on the AC exam. The data collected for this study came from three separate surveys. The first survey was sent to department heads of construction management programs that use the AC exam (The term “department heads” also includes program coordinators, department chairs, and those with other similar titles). The second survey collected information from students as they completed the AC exam in the fall of 2016. The final survey was an in-depth study of students at one ACCE-accredited construction management program and was used
to further explore the impacts of specific motivation and preparation techniques and their effects on exam scores. This paper will present the findings of the first survey, wherein department heads were asked detailed questions about their specific programs, how they encourage students to perform well, and what they do at the institutional level to prepare students to be successful on the exam.

An online survey instrument was used for the department head survey. Skip logic was incorporated into the survey, so appropriate follow-up questions were asked to clarify responses. The survey included over 40 dichotomous, multi-response, 5-point Likert scale, and open-ended questions. The survey was pilot tested with faculty at the author’s institution, and the readability and clarity of the survey improved with the feedback received. The survey was administered by the AIC, distributed to all department heads from test site universities, and sent out immediately before the fall 2016 AC exam cycle, with responses collected at the end of the year. There were 26 completed surveys received from 23 universities, whose students made up 67% of the semester’s 650 AC exam test takers. Although the survey respondents were asked their university affiliation, this information was withheld from the author by the AIC to maintain anonymity. The ability to identify which universities responded is a critical component of the next phase of the study, wherein motivational and preparatory techniques are correlated to students’ exam scores. This next phase of the study will be addressed in a future publication.

**DESCRIPTION OF THE RESPONDENTS**

The program size of the respondents varied from less than 100 undergraduate students to over 500, with the median size between 200 and 300 students. The majority of the programs were ACCE-accredited (87%), with a smaller percentage accredited through ABET (8%). Some of the programs indicated that they were pursuing dual accreditation but were not accredited by both ACCE and ABET at the time of the survey. Approximately 84% of the schools that responded used the AC exam to maintain their accreditation. Perhaps not surprising was that the department heads of the programs that use the AC exam had a generally high opinion of it. When asked their overall satisfaction on a 5-point Likert scale, the average response was 3.9/5.0 (see Table 1). Most of the Likert scale questions featured write-in fields wherein the respondents could qualify their answers. For this particular overall satisfaction question, while there were suggestions for improvement (which will be addressed later in the paper), the write-in responses were favorable toward the exam and suggested that the administrators would continue to use it in the future. A few specific comments that capture the general sentiment of the survey respondents follow:

- “... gold standard for the industry.”
- “... needed tool for our industry.”
- “We are strong believers in the test; we just need to figure out how to motivate students to perform their best.”

<table>
<thead>
<tr>
<th>Question</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your overall satisfaction with the AC exam? Please select on a scale of 1 to 5, where 1 represents “not satisfied at all” and 5 represents “very satisfied.”</td>
<td>3.9</td>
<td>4</td>
<td>.7</td>
<td>17</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.
UNIVERSITY-SPONSORED TECHNIQUES TO IMPROVE MOTIVATION

A significant challenge that this study sought to address was that of student motivation to perform well on the exam, a comprehensive 8-hour assessment that requires significant effort both in preparation and in sitting for the test itself. The exam is typically given in the last year of a student’s degree program, when many have already secured post-graduation employment. Motivating students to put in the needed effort can be difficult; however, it is critical, especially because the majority of university exam sites use the exam as part of their accreditation process. Students who do not prepare, or who fail to treat the exam seriously, can misrepresent the skills and knowledge actually taught in their degree program.

Of the 23 universities that participated in the study, 73% of the programs require students to sit for the AC exam. This is a notably higher percentage than was recorded in a similar survey, which indicated that 54% of the universities that offered the AC exam required students sit for it (MacDonald & Sessoms 2012). The programs that do not require it either encourage it as a desirable professional accolade or make it one of several options in completing a course. Of the administrators who responded, 74% indicated that their programs incorporate the AC exam as a graded component of a class, but there is a great deal of variety in how programs do this. Most department heads responded that the AC exam accounts for a portion of a students’ course grade. The weighting of the exam ranged from 10% to 60% of the final grade, with a median weighting of 20%. The survey did not ask specifically which course the test was incorporated into, but a capstone-type course was mentioned several times in the write-in responses. The specific motivational strategies written in included the following:

- Require passing the AC exam to earn an A in the student’s capstone course.
- Require students to take the AC exam again in the spring if they do not pass.
- If students do not pass instructor’s comprehensive exam, they must pass the AC exam to pass the course.
- Provide a one-credit pass/fail course where the AC exam is the only graded assessment. This course is required to graduate.

Of the program representatives who responded, 26% indicated that their students needed to achieve a “minimum score” on the exam to graduate. This is also a notably higher percentage than that recorded in the MacDonald & Sessoms (2012) survey mentioned above, which found that in 2012, only 12% of programs required their students to pass. The minimum test score required to graduate ranged from 50% to 70%, with an average required score of 62%. Four of these programs (17% of those that responded) indicated that they have a stand-alone course to prepare for and take the AC exam. Carns and Bender (2002) demonstrated that a stand-alone preparation course can be very effective for students preparing for the AC exam. The impact of a stand-alone course is beyond the scope of this paper but will be explored in a future publication related to this study. Of the four programs that offer such a course, the average exam score required to pass the course was 62%, which is notably less than the AIC passing score of 70%. See Table 2 for a summary of the responses.

The survey asked department heads about other factors that may influence students’ motivation to do well on the exam. One such factor is the exam fee. Of the universities that responded to the question, 38% pay for some or all of the exam fee, using either department funds or lab fees. Of these programs, half tie paying the exam fee to a minimum score benchmark. Approximately 27% of the programs surveyed require that students retake the exam if they do not achieve an acceptable score. No program indicated that it would pay for the retaking of the exam.

... excellent process and will be extremely useful in assessing program performance on achieving student learning outcomes goals."
Another important factor to consider is the impact of the industry on students’ motivation to do well on the exam. One of the primary reasons students obtain the AC Level 1 certification is that they “have a competitive advantage in a highly competitive job market” (AIC 2017c). The survey reached out to department heads as subject matter experts concerning their local industry to determine the level of support for the exam. The first of two quantitative questions asked was “How supportive do you think your local industry and advisory board is of the AC exam?” On a 5-point Likert scale, where 1 represented “not supportive at all” and 5 represented “very supportive,” the department heads’ average response was 2.7, with a median response of 3.0 (see Table 3). The write-in comments related to this question were in line with the lackluster score. In general, the write-in responses indicated that their industry partners were somewhat supportive of the AC exam, but it was not something to which they assigned a great deal of value. One department head responded that some of their IAB members provide a $100 dollar signing bonus to students who pass the AC exam. Another department head commented that it was viewed positively, but “they value the OSHA 30-hour card more than the AC certification.” The general consensus was that outside their industry partners, the local industry was largely unaware of the AC exam and the value the certification provides. The comments below represent most of the feedback received:

- “Our advisory board is supportive but the industry has NO CLUE what this exam is about.”
- “Local industry is not asking about it, but our CM alumni and Industry Advisory Board is very supportive.”

<table>
<thead>
<tr>
<th>Question</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are students required to take (or penalized for not taking) the AC Exam?</td>
<td>Yes = 73%</td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>No = 27%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the AC exam scores incorporated into a course grade?</td>
<td>Yes = 74%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>No = 26%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skip Logic Follow-Up: What percentage of the course grade does the AC exam Account for?</td>
<td>28%</td>
<td>23%</td>
<td>19%</td>
<td>10</td>
</tr>
<tr>
<td>Do the students in your program need to earn a minimum score on the AC exam to graduate?</td>
<td>Yes = 26%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>No = 74%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skip Logic Follow-Up: What is the minimum score required on the AC exam to graduate?</td>
<td>62%</td>
<td>60%</td>
<td>8%</td>
<td>6</td>
</tr>
<tr>
<td>Is preparing for and taking the AC exam a stand-alone course with a unique course number?</td>
<td>Yes = 17%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>No = 83%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skip Logic Follow-Up: What is the minimum score required on the AC exam to pass stand-alone course?</td>
<td>62%</td>
<td>60%</td>
<td>5%</td>
<td>4</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.
• “They like it as a tool to assess student learning but are not requiring it, or the [CPC] exam, as part of their hiring and promotion process.”

A separate but related question asked, “How often do potential employers ask students about the AC exam?” On the same 1–5 Likert scale, the average score was 1.6/5, suggesting that the AC exam is not something that employers ask about often when recruiting students (see Table 3). These results were similar to those found by a study in which 130 construction companies across the country were asked to rate which of 44 certifications had the most benefit to them (El Debs, Shaurette, & Benhart 2016). In this study, the AC certification was rated 40th of 44. It is worth noting that the data was collected at the career fair of a university that does not use the AC exam, a fact which likely contributed to the poor recognition of the AC certification. Similar findings arose from a study by Bruce, Sauer, and McCandless (2008), who discovered that only 50% of those with an AC/CPC certification perceived that it increased their prestige within and beyond their organization. Because local industry does not appear to value it a great deal, it is not surprising that inquiry about it in an interview seems infrequent. Educating industry on the value of the AC certification is a critically important task for the AIC and the Commission.

DEPARTMENT-SPONSORED EXAM PREPARATION

The AC exam is a comprehensive exam covering topics taught throughout a 4-year construction management degree program. Because it is comprehensive, most students find that they need to study to refresh themselves on concepts to pass the exam. To assist with exam preparation, the AIC provides students with an AC Exam Study Guide and an online study course. However, many programs provide study sessions both within and outside of their normal coursework to prepare students for the exam. In fact, when the department heads were asked if their programs helped to prepare students for the exam, 74% indicated that their programs did so in some fashion (see Table 4). Many (48%) of the administrators also indicated their programs provide time during an existing course to prepare for the exam. The amount of time devoted to preparing for the exam ranged from 2 hours to 40, with an average preparation time of just under 13 hours. Some (17%) of the respondents indicated that their programs feature a stand-alone class with a unique course number devoted to the AC exam. Part of one program’s curriculum is a one-credit pass/fail course that requires earning a 60% on the exam to pass. This course is required for graduation, which effectively makes earning a 60% on the exam a requirement of graduation. Additionally, two programs (12%) provide approximately 5 hours of instructor-led exam preparation outside the classroom. See Table 4 for a summary of the responses.

As mentioned above, the AIC provides an AC Exam Study Guide and an online study course to help students prepare for the exam. The AIC has provided students with a study guide for many years, and it was revised in the spring of 2016. When asked their overall satisfaction of the new study guide, administrators generally responded favorably, with a Likert scale satisfaction score of 3.7/5.0 (see Table 5). The department heads provided several suggestions for topical content improvements that will be used to improve the next revision of the study guide. The most frequent comment made about the study guide was a request for more sample questions. A few examples representing the thoughts of the department heads are provided below:

• “Clear example of typical problems presented on the test.”
• “Perhaps by adding more questions at the end of each section.”
• “It would be helpful to have an online practice exam on your website.”
In addition to the study guide, the AIC provides an online study course, a new resource, to help students prepare for the exam. It was beta-tested with students in the fall 2016 exam cycle. The online study course follows the new study guide closely and provides a voiceover narrative and an interactive platform for content instruction. At the time the survey data was collected, the online study course had only been offered for one exam cycle, and because of its novelty, many of the department heads were not familiar with it. Of the 23 construction management programs whose representatives participated in the study, only nine (41%) indicated that they helped make students aware of the new online study course, whereas 52% of the respondents indicated that they were “not familiar with it.” Such unfamiliarity led to inconclusive ratings and feedback regarding satisfaction. Only six programs rated their satisfaction, with a Likert scale score of 3.4/5. There was very little write-in feedback on how to improve the online study course; one administrator wrote of its potential benefit as “course content for an instructor to use as part of [his or her] teaching.”

**EXAM ADMINISTRATION FEEDBACK**

The survey collected data on the department heads’ opinion on the logistics of the exam’s administration. Currently, the AC exam consists of two 4-hour segments and is offered on Saturday (Some universities make special accommodations for the exam to be taken one day earlier to avoid conflicts with university-sponsored events such as football games). A concern raised is that cognitive fatigue might be a factor influencing exam performance, due to the exam’s length and availability only at the end of the week. The survey addressed this issue with several questions. The department heads were asked their level of support for offering the exam on different days of the week, and the vast majority (74%) of the respondents felt that Saturday, the current exam day, is the most appropriate (see Table 6). The day with the second-highest support was Friday, at 21%.

<table>
<thead>
<tr>
<th>Question</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does your program assist students in preparing for the AC exam? Examples include exam review during class or optional exam review study sessions outside of class.</td>
<td>Yes = 74% No = 26%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Is there time devoted during an existing course to prepare students for the AC exam?</td>
<td>Yes = 48% No = 52%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Skip Logic Follow-Up: How many hours of class time of an existing course are devoted to preparing students for the AC exam?</td>
<td>13hrs</td>
<td>10hrs</td>
<td>12hrs</td>
<td>11</td>
</tr>
<tr>
<td>Is preparing for and taking the AC exam a stand-alone course with a unique course number?</td>
<td>Yes = 17% No = 83%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Does your program provide instructor-led exam preparation classes outside the classroom?</td>
<td>Yes = 12% No = 88%</td>
<td></td>
<td></td>
<td>23</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.*
Table 5: Satisfaction with AIC-Provided Preparation Material

<table>
<thead>
<tr>
<th>Question</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>How satisfied are you with the new study guide? Please select on a scale of 1 to 5, where, 1 represents “not satisfied at all” and 5 represents “very satisfied”?</td>
<td>3.7</td>
<td>4</td>
<td>.8</td>
<td>17</td>
</tr>
<tr>
<td>Does your program make students aware that the AIC provides an online study course on AC exam topics?</td>
<td>Yes = 39%</td>
<td>Not familiar with it = 46%</td>
<td>No = 15%</td>
<td>22</td>
</tr>
<tr>
<td>How satisfied are you with the online study course provided by the AIC? Please select on a scale of 1 to 5, where, 1 represents “not satisfied at all” and 5 represents “very satisfied”?</td>
<td>3.4</td>
<td>3.3</td>
<td>.5</td>
<td>6</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.

Table 6: Logistical Consideration of AC Exam

<table>
<thead>
<tr>
<th>Question</th>
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<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering the issue of “cognitive fatigue” in taking two 4-hour-long sections of an exam on the same day, which day of the week would you think would be the most effective on which to schedule the exam?</td>
<td>Sunday = 5%</td>
<td>Monday = 5%</td>
<td>Tuesday = 5%</td>
<td>Wednesday = 5%</td>
</tr>
<tr>
<td>How supportive would you be of administering the two 4-hour sections of the exam on two separate days instead of both sections on the same day to reduce cognitive fatigue as a potential factor influencing exam scores? Please select on a scale of 1 to 5, where, 1 represents “not supportive at all” and 5 represents “very supportive.”</td>
<td>1.9</td>
<td>1.5</td>
<td>1.2</td>
<td>18</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.
4-hour exam sections on two separate days. There was little support for this idea, with the department heads ranking it 1.9/5 on the Likert scale. Several comments indicated that an 8-hour exam simulates the long hours in the construction profession and that length is thus a desirable characteristic. Other comments compared the AC exam to the AIA and PE exams and posited that the rigor needed to be maintained so that construction management might not be “looked upon as a ‘less than’ profession.”

The Level 2 CPC exam has recently moved to a computer platform, and the Commission has been exploring the potential of doing the same with the AC exam. The survey included several questions addressing how well department heads would receive this change and if universities had the infrastructure to administer a computer-based exam for all of their construction management students. In general, the respondents were in favor of making the exam computer based. Of the 21 responses to the question, there was only one respondent who ranked the idea less than 3; the average ranking was 4.0/5 (see Table 7). Several qualified their opinion, adding that although they supported the test being taken on a computer, they felt the length of the exam would need to be shortened if such a change were to take place. There was concern voiced by several respondents that being in front of a computer for 8 hours might affect scores. An additional concern identified with the survey is that only 39% of the respondents indicated that their facilities include a proctored computer-testing site and the capacity to give an 8-hour exam to all students at the same time.

FUTURE STUDY

As mentioned above, the findings presented here are from one of three surveys that form a more comprehensive study. This paper identifies what CM departments are doing to motivate and prepare students for successful outcomes on the AC exam. The next phase of this study will incorporate student surveys that address motivation and preparation as well as their individual exam scores. Comparisons will be made between what CM departments are doing and how well students perform on the AC exam. This data will be used to create a best practices guide for departments administering the exam.

Table 7: Support for Computer-Based Testing

<table>
<thead>
<tr>
<th>Question</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Sample Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>How supportive would you be of changing the exam format from paper based to computer based? Please select on a scale of 1 to 5, where 1 represents “not supportive at all” and 5 represents “very supportive.”</td>
<td>4.0</td>
<td>4.0</td>
<td>1.1</td>
<td>21</td>
</tr>
</tbody>
</table>

*23 universities participated in the survey. N < 23 are due to no responses to specific questions.
REFERENCES


ABSTRACT

Construction site safety continues to be a growing concern in the construction industry. Despite the advancement in technology and government-mandated safety training, the annual injuries and fatalities of the construction industry still rank high. The complexity of construction work requires strong safety commitment from top management. Such commitment should not only be committed in theory, but also demonstrated by an aggressive implementation of safety practices. This study was conducted to investigate the organizational safety commitment of top U.S. contracting firms. Findings suggest that the top management executives of participating organizations have established organizational culture in which safety is a high priority. These chief executives hold their middle managers responsible for the safety of their subordinates. To further demonstrate their commitment to safety, many chief executives often attend safety meetings and functions with the employees. It was further revealed that in an organizational structure in which safety is a high priority, established achievable safety objectives are monitored at all levels of the organization. Likewise, line managers are directly held accountable for the safety of their subordinates. The study concluded with implications for construction safety education as well as recommendations for further study.

Key Words: Organizational safety commitment; Safety leadership, Construction safety, Safety management

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INTRODUCTION

Construction safety continues to be an on-going concern among all construction stakeholders. Accidents and injuries amount to millions of dollars in contractor indirect expenses every year. These costs exclude other associated costs such as pain, suffering and grief. These high human and financial costs have contributed to the continued interest in various ways to improve safety performance in the workplace (Nahrgang, et al. 2007; Zohar & Laria, 2004). In spite of the achievements made towards accident prevention on construction sites, construction industry continues to record increase in fatal workplace injury. A review of 2014 preliminary fatal injury results published by the National Census of Fatal Occupational Injuries (as reported by Bureau of Labor Statistics (BLS)) shows that construction-related fatalities increased by 6% from that of 2013. Further analysis also revealed that Falls, Slips, and Trips increased by 10% to 793 in 2014 from 724 in 2013.

It is a known fact that risk is inherent in all aspects of life and construction work is no exception. However, in construction industry, risks are often augmented by the project environment, size and complexity of the construction project. As the size and complexity of the project increases, the risk involved also increases (Shofoluwe, Bogale, & Yeboah, 2013). In their study of risk management practices of major contractor firms in United States, Shofoluwe et al. (2013) found Safety to be at the most top of construction project risks identified by the study respondents. Their research findings further revealed that Safety ranked number one across all contractor classifications.

Safety experts and construction researchers have offered various solutions to combat the rising wave of fatalities in the construction industry. One suggested area for further investigation is the degree to which organization and management exert influence on safety performance (Nahrgang, et al. 2007). When one reviews the safety policy of a typical major construction firm, what first catches one’s attention is the safety commitment statement.

Whether this statement is adhered to is often difficult to know. With this in mind, it is suffice to argue that an investigative study is needed to look at the construction industry leadership with specific attention to organizational safety commitment. Thus, this paper reports the findings of a study conducted to investigate the organizational safety commitment of selected top Engineering News Record (ENR) contracting firms in United States. It is expected that these findings would shed light into the degree of organizational commitment that the participating firms allure to jobsite safety practices. It is also hoped that the implications drawn from the findings would enable contracting firms place more emphasis on construction safety commitment at the organizational level.

LITERATURE REVIEW

Overview of Construction Safety

A thorough review of literature on safety practices in the general industry and in construction industry in particular reveals a myriad of studies. This section reports pertinent previous studies on construction safety practices. As safety continues to be a major concern in the construction industry, Haslam et al. (2005) found that deficiencies with risk management accounted for 84% of all accidents. They further wrote that “poor safety performance of the construction industry continues to give international cause for concern” (p. 1).

Safety culture has gained popularity among the factors that contribute to unsafe practices in the workplace. Safety culture has been defined by various individuals and organizations including Fernandez-Muniz, et al. and The Confederation of British Industry (as cited in Zou, 2011). A review of these definitions revealed some commonalities including ideas, set of beliefs, attitudes, and patterns of behavior of members of an organization with regard to safety commitment. With this definition in mind, Zou and Sunnindijo (2010) investigated construction safety from the cultural perspective. The authors argued that poor attitudes toward safety
and lack of interest in safety issues were contributing factors to high accident rates on construction jobsite. These findings paralleled that of Fung et al. (2005) who reported that the lack of sound safety culture has been blamed for many safety-related injuries. The authors advocated for effective organizational safety culture. Similarly, in a case study of safety culture among five international contracting firms, Zou (2011) found that “all cases reflected the importance of a commitment and leadership from top management as fundamental factor in shaping a strong construction safety culture” (p. 9). As part of their organizational safety commitment, the author concluded that clear authority and accountability were established at the corporate level and that reward system was established for safe behavior.

Other research scholars have focused on other aspects of safety with significant implications for improving safety performance. For instance, in their investigation of the role of project owners in fostering construction safety, Hang and Hinze (2006) reported that owners could positively influence project safety performance. They further argued that owners are “making efforts to improve the project safety performance, with a focus on setting their expectations on zero injuries, selecting safe contractors, and developing the safety culture on their projects...” (p. 9). Mohammed (2002) identified factors affecting the safety climate in construction site environment, and concluded that a positive correlation existed between the safety climate and safe behavior. Similarly, Langford et al identified five factors that could influence the attitudes of construction workers towards safe behavior as organizational policy, supervision and equipment, industry norms, risk taking, and management behavior (as cited Choudhry et al. 2008). A review of past safety research also shows that safety has positive associations with factors such as site management and control, site supervision and leadership, site safety management, and the influence of the general contractor on subcontractors (Jannadi & Bu-Khamsin 2002). Loushine et al. (2006) tied construction work environment to decrease in quality and safety performance. They also argued that the main barriers to implementing a successful safety management system appeared to be due to the nature of the construction process.

Organizational Safety Leadership and Safety Performance

The role of organizational leadership in workplace safety cannot be overemphasized. In order to better understand the importance of safety leadership to construction safety performance; it would suffice to first review the underpinning theoretical background of safety leadership. Safety leadership is defined as “the process of interaction between leaders and followers, through which leaders can exert their influence on followers to achieve organizational goals under the circumstances of organizational and individual factors” (Wu, et al., 2016, p. 790). The authors argued that leadership in safety is regarded as both transformational and transactional as depicted in Full Range Leadership (FRL) model. Further, Avolio et al. (1999) stated that transactional leadership involves monitoring and rewarding, whereas transformational leadership is related to inspiring and motivating the employees. They further listed four dimensions of transformational leadership as (1) Idealized influence; (2) Inspirational motivation; (3) Intellectual stimulation; and (4) Individualized consideration. Transactional leadership is said to contain two dimensions, including contingent reward and management-by-exception. Wu et al. (2015) stated that the FRL model containing transformational leadership and transactional leadership could be regarded as the foundation of the safety leadership structure.

In a study involving safety-related behavior as a social exchange, Hoffman et al. (1999) examined the role of perceived organizational support and leader-member exchange (LMX). The authors found that perceived organizational support was significantly related to safety communication and that LMX was significantly related to safety communication, safety commitment and accidents. Nahrgang et
al. (2007) conducted a meta-analysis of safety and organizational constructs to predict safety performance and found that safety-related and general organizational antecedents have moderate to strong relationships with safety climate. The authors also found that leadership and safety climate demonstrated moderate positive relationships with positive safety behavior.

A review of past studies on management role on safety performance identified Heinrich as the first researcher to link the incidents of workplace accidents and injuries to lack of management commitment to safety. Heinrich further argued that ninety eight percent of accidents are presentation by management (as cited in Abuddayyeh et al., 2005). In a related study conducted to investigate management’s commitment to construction safety, Abudayyeh et al. found correlation between management commitment to safety and injury and illness rates. The authors argued that “most incidents injuries on construction sites are direct result of [contractors] not adhering to their established safety procedures” (p. 2). Similar studies conducted by Helander (1991) and Mattila et al. (1994) also concluded that a successful safety program requires management commitment.

In a study of factors affecting safety performance on construction sites, Sawacha et al. (1999) reported findings that “suggest that variable related to the ‘organizational policy’ are the most dominant group of factors influencing safety performance in the United Kingdom” (p. 309). The authors also found the following five important issues to be associated with site safety: (1) Management talk on safety; (2) Provision of safety booklets; (3) Provision of safety equipment; (4) Providing safety environment; and (5) Appointing a trained safety representative on site (p. 309). In order to ensure a successful safety program, Reese et al (1999) suggested that three conditions must be met. They include: (1) Management commitment and leadership; (2) Safe working conditions; and (3) Safe work habits by all employees. Along the same premise, Levitt (as cited in Mitropoulos, et al., 2005) identified the attitude of top management as a significant organizational factor associated with safety performance while Molenaar et al. (2002) cited organizational culture as an impediment to promoting safety performance at the organizational level. Jannadi (1996) also argued that in order to reduce construction site injuries, top management must be accountable and committed to the corporate safety policy. Jaselskis et al. (1996) also argued in support of Jannadi that management commitment and involvement in safety was the most important factor for a satisfactory safety program.

RESEARCH METHOD

This study was conducted to investigate the organizational safety commitment of selected major contracting firms in the United States. One major objective of the study was to assess the level of commitment that top executives demonstrated towards to construction safety. The population for the study consisted of top 400 Engineering News Record (ENR) contractors listed in the ENR publication. Of this population, a sample of 150 participants was randomly selected to participate in the study. A structured survey questionnaire developed and piloted by the researchers was used to gather information relative to respondents’ demographics and their level of organizational safety commitment. The questionnaire consisted of three parts. The first part solicited general information about the respondents’ organizations, including relative business practices. The second part probed questions about the respondents’ organizational safety history. First, respondents were asked to list their organizations’ experience modification rate (EMR) for the years 2012 through 2014. The EMR is a numerical value used by insurance companies to assess the safety performance of construction firms. It is used to assess previous cost of injuries and the probability of future risk. In most cases, the lower the EMR, the lower the worker compensation insurance premiums. Next, the respondents were also asked to provide certain information concerning their safety record for the year 2014. This information included:
(1) Number of injuries; (2) Number of lost workday cases; (3) Number of restricted workday cases; (4) Number of cases with medical attention only; and (5) Number of fatalities. Part three consisted of twenty (20) structured organizational safety commitment factors that were developed, validated and piloted by the researchers. In order to assess their level of organizational commitment to safety, respondents were asked to respond to the twenty-item factors based on their degree of importance or relevance. These factors were based on a Likert scale of 1 to 5; where 5 represents Strongly Agree (SA); 4 represents Agree (A); 3 represents Disagree (D); and 2 and 1 represent Strongly Disagree (SD) and No Opinion (NO), respectively. The mean rating value of each factor was determined using the following formula:

\[
\text{Mean Rating} = \frac{\sum W \times F_i}{n}
\]

Where:

- \( W \) = weight assigned or scale value of respondent’s response for the specified safety commitment factor: \( W=1, 2, 3, 4 \) and 5;
- \( F_i \) = frequency of the \( i \)th response;
- \( n \) = total number of respondents to the specified safety commitment factor;
- \( i = \) response scale value = 1,2,3,4 and 5 for negligible risk, low risk, moderate risk, high risk, and extreme risk, respectively.

**Data Analysis**

A total of 37 completed and usable questionnaires were returned, yielding a response rate of 24.7 percent. The data collected was analyzed using both descriptive and inferential statistics. Descriptive statistical method was used in analyzing the data collected in Parts 1 and 2 of the survey instrument. An SPSS statistical software was employed in calculating the mean ratings of the organizational safety commitment factors. A Pearson correlational analysis was performed to assess the degree of associations among the organizational safety commitment factors.

**FINDINGS**

**Company Profiles**

Analysis of data revealed that the majority of the responding officers hold the title of CEO, President or Vice President. Only few were in the lower administrative cadre. About 31% of the responding officers have been on their present positions between 10 and 15 years while 28% have been on their current positions between 5 and 10 years. When asked to indicate their companies’ classifications, an overwhelming 71% classified their companies as Building construction (Institutional, Educational, Residential, and Commercial) while 17% of the respondents were classified as Engineering firms. Data analysis also revealed that 66% of the responding firms perform over $100 million in annual volume of business while 31% realize between $21 million and $100 million. The dollar amount of average job size ranged from $2 million to over $41 million, with the majority of respondents in the $2-10 million range.

Figure 1 presents information on the number of employees with safety-related degrees. The data revealed that about 56% of the respondents indicated that between 5 and 51 of their employees hold such degrees while 23% reported that 51-100 of their employees hold safety-related degrees.
Table 1 presents information on the Experience Modification Rates of the responding firms. This data reveals three-year safety performance of the responding organizations. A closer review of the data shows that two firms recorded EMR in excess of 1.0 in any particular year; an indication of higher than normal incident or accident rates. The two firms recorded mean EMR values of 1.05 and 0.99 with corresponding standard deviations of 0.17 and 0.19, respectively. Table 2 presents the safety incidence record of the responding firms for the fiscal year, 2014. The data revealed that the largest recorded incidence happens to be number of restricted workday cases (1162), followed by number of injuries and illnesses (614) and number of cases with medical attention only (423), respectively. Two deaths were recorded during the period. The responding firms also indicated that their foremen hold regular toolbox safety meetings as part of their safety commitment. An overwhelming number of respondents (70%) reported holding this meeting on weekly basis while the rest hold the meetings on a monthly or quarterly basis. Concerning onsite safety inspection, the titles held by the personnel who conduct the safety inspections were Safety Director, Superintendents, and Safety Supervisors.
Table 2. Safety Incidence Record (FY 2014)

<table>
<thead>
<tr>
<th>Responding companies</th>
<th>Number of injuries and illnesses</th>
<th>No of lost workday cases</th>
<th>No of restricted workday cases</th>
<th>No of cases with medical attention only</th>
<th>No of facilities</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>0</td>
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<td>2</td>
<td>19</td>
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<td>4</td>
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<tr>
<td>3</td>
<td>18</td>
<td>0</td>
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</tr>
<tr>
<td>4</td>
<td>42</td>
<td>3</td>
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<td>5</td>
<td>44</td>
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<td>23</td>
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<tr>
<td>6</td>
<td>55</td>
<td>8</td>
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<td>23</td>
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<td>7</td>
<td>42</td>
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<tr>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
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<tr>
<td>9</td>
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<td>3</td>
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<td>10</td>
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<td>0</td>
<td>1</td>
<td>0</td>
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<td>26</td>
<td>60</td>
<td>8</td>
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<td>48</td>
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<td>27</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>54</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>614</strong></td>
<td><strong>170</strong></td>
<td><strong>1162</strong></td>
<td><strong>423</strong></td>
<td><strong>2</strong></td>
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</table>
Organizational Safety Commitment

Respondents were asked to rank a number of organizational safety commitment factors. Table 3 presents the top 10 most-ranked factors. At the top of the list, is factor 1 in which 100% of the respondents strongly agreed or agreed that “Safety plans are developed with input from the safety personnel or safety consultant”. Safety commitment factors 2 and 3 were tied in the second place. Specifically, an overwhelming 81% of the respondents strongly agreed while 19% agreed that “Foremen, Superintendents, and other craftsmen are made aware of the safety requirements in their organization” Likewise, 73% of the respondents strongly agreed and 27% agreed that “Safety rules and regulations are part of job rules”. Ranked number 3 are safety commitment factors 4, 5, and 6. In Factor 4, 70% of the respondents strongly agreed while 30% agreed that “The Chief Executive creates an organizational culture in which safety is a high priority” In Factor 5, 70% of respondents strongly agreed and 30% agreed that “Project managers and superintendents are proud of their projects’ safety performance”. In organizational safety commitment Factor 6, 65% of the respondents strongly agreed while 35% agreed that “New construction employees are always trained to be aware of imminent hazards and to understand safe work practices”.

The ranking of organizational safety commitment factor 4 came as a surprise to the researchers. The researchers hoped that this factor would rank number 1, considering the fact that some past studies have concluded that in order to improve construction safety performance, the top executive must play a key role, including creating an organizational culture in which safety is a high priority. Ranked number 4 is safety commitment factor 7 in which an overwhelming majority (78%) of respondents strongly agreed that their organizations have a separate safety departments and maintain their own safety staff. Although ranked 7, it is noteworthy to note that about 57% of respondents strongly agreed while 38% agreed that their chief executive officer often take time to attend safety meetings or function (Factor 11). Similarly ranked is Factor 10 in which 54% of respondents strongly agreed that their chief executives hold line managers directly responsible for the safety of their subordinates.

The labor union appears not to have any profound negative effects on the respondents’ organizational safety efforts. A correlational analysis was performed to assess any possible degree of associations among select organizational safety commitment factors. Two factors (4 and 8, Table 3) were found to show the strongest correlations between them. Specifically, those chief executives who have created an organizational culture in which safety is a high priority (Factor 4) also ensure that achievable safety objectives are established and monitored at all levels of organization (Factor 8) (r = 0.708; sig = <.0001). Another notable correlations exist between organizational safety commitment Factor 4 and 11 (r = 0.544; sig = 0.0006). In other words, those chief executives who have created an organizational culture in which safety is a high priority are also more likely to take time to attend safety meetings or functions with other employees. Correlation was also found between the Chief executives who hold their line managers directly accountable for the safety of their workforce and project managers and superintendents who are proud of their projects’ safety performance (r = 0.52; sig = 0.0011).

This correlation suggests that project managers and superintendents who are held responsible by their top management for the safety of their workforce are more likely to take onsite safety seriously; thus, they tend to be proud of their project safety performance.

CONCLUSIONS AND RECOMMENDATION

This study was conducted to investigate the organizational safety commitment of top U.S. contracting firms. The study findings yielded several significant findings which have been generally discussed earlier in this paper. This section presents the summary of the study findings along with recommendations for further study.

As onsite safety continues to be an issue in the construction industry, the role of top management...
cannot be overemphasized. The findings of this study support the assertions that top management must lead by example by creating an organizational structure in which safety is a top priority. As revealed in the study, the participating organizations have safety plans that were developed with input from the safety professionals. This was to ensure that the plan covers all the essential elements of effective safety practices. Consequently the safety rules and regulations spelt out in the safety plans have become part of job rules and are monitored at all levels of the organization. To ensure that safety rules and regulations are adhered to, the chief executives hold line managers directly accountable for the safety of their subordinates. Also, as part of their organizational safety commitment, construction supervisors and their craft workers were made aware of the safety requirements of the organization. Likewise, it was

<table>
<thead>
<tr>
<th>Organizational Safety Commitment Factors</th>
<th>Mean</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Safety plans are developed with input from the safety personnel or safety consultant</td>
<td>4.80</td>
<td>1</td>
</tr>
<tr>
<td>2. Safety rules and regulations are part of job rules</td>
<td>4.78</td>
<td>2</td>
</tr>
<tr>
<td>3. Foremen, superintendents and craftsmen are made aware of the safety requirements in the organization</td>
<td>4.78</td>
<td>2</td>
</tr>
<tr>
<td>4. The chief executive creates organizational culture in which safety is a priority</td>
<td>4.69</td>
<td>3</td>
</tr>
<tr>
<td>5. Project managers and superintendents are proud of their projects’ safety performance</td>
<td>4.69</td>
<td>3</td>
</tr>
<tr>
<td>6. New construction employees are always trained to be aware of imminent hazards and to understand safe work practices</td>
<td>4.69</td>
<td>3</td>
</tr>
<tr>
<td>7. This organization has a separate safety department, and maintains its own safety staff</td>
<td>4.61</td>
<td>4</td>
</tr>
<tr>
<td>8. The chief executive ensures that achievable safety objectives are established and monitored at all levels of organization</td>
<td>4.58</td>
<td>5</td>
</tr>
<tr>
<td>9. This organization has a reporting system which provides feedback to concerned personnel on safety performance</td>
<td>4.56</td>
<td>6</td>
</tr>
<tr>
<td>10. The chief executive holds line managers directly accountable for the safety of their subordinates</td>
<td>4.47</td>
<td>7</td>
</tr>
<tr>
<td>11. The chief executive sometimes takes time to attend safety meetings or functions with other employees</td>
<td>4.47</td>
<td>7</td>
</tr>
<tr>
<td>12. Construction supervisors are trained to spot signs of potential substance abuse in their crew members</td>
<td>4.25</td>
<td>8</td>
</tr>
<tr>
<td>13. Training sessions are usually organized for foremen to help them develop skills in conducting toolbox meetings</td>
<td>4.22</td>
<td>9</td>
</tr>
<tr>
<td>14. When projects are too small to keep safety professionals on the site, jobsite managers usually appoint job safety reps</td>
<td>4.06</td>
<td>10</td>
</tr>
</tbody>
</table>
found that all new employees are trained in the recognition of hazards and to understand safe work practices. The findings also suggest that labor union has no profound negative effects on the safety efforts of the participating organizations.

The results of Pearson correlational analysis revealed that several organizational safety commitment variables correlated with each other. For example, in an organizational structure in which safety is a high priority, an established achievable safety objectives are often monitored at all levels. Similarly, in an organizational structure in which safety is a high priority, line managers are directly held accountable for the safety of their subordinates. It was also found that in any organization where safety is a high priority, the top management often takes time to attend safety meeting or functions with employees. This practice signals to employee the genuine interest of the chief executive in the safety of the employees. Lastly, in an organization where the top management holds the line managers directly accountable for the safety of their subordinates, those line managers are often proud of their projects' safety performance.

In light of the results of this study, one could conclude that the chief executives of top contracting firms who participated in this study have established an effective organizational safety culture where line managers are held responsible for the safety performance of their projects. This safety commitment is demonstrated by the result of this study that shows many correlates among the safety commitment factors. These findings have implications for the field of construction management education. While it is essential to continue to emphasize the requirements of various areas of occupational safety and health standards, it is equally crucial that construction safety education includes discussions on the importance of safety leadership and the essential roles of top management in ensuring the safety and health of construction workers.

This study was limited to a random selection of top 150 ENR contracting firms in United States. It is recommended that a further study that would look into the organizational safety commitment of medium size firms in any geographic region of United States be conducted.

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Are We on the Same Jobsite? The Millennial Generation vs. Construction Industry Employees

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ABSTRACT

This paper gives an overview of a study conducted in a geographical area of the US to understand the millennial generation’s perception of the workplace of the construction industry. Many organizations face the challenge of integrating diverse generations in a workplace. With the retirement of a large number of Boomers and the current intake of Millennials in the workplace, organizations are facing a challenge to attract and retain the millennial generation. Workplace expectations of the millennial generation and employees are compared with the expectations of the workplace amongst different generations in the construction industry.

Keywords: millennials, workforce, retention, generations

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LITERATURE REVIEW

The current construction industry consists of four generations working together with each other. The four groups are The Silent Generation, the Baby Boomers, Generation X and Generation Y also known as The Millennials. The Silent Generation includes those born between 1925 and 1945; Baby Boomers between 1946 and 1964; Generation X between 1965 and 1980 and the individuals born after 1980 are known as The Millennials or Generation Y (Lancaster & Stillman, 2002). Each generation has a set of characteristics by which they are defined. These characteristics include their approaches towards their work, technology and family.

Silent Generation (1925- 1945)

The Silent Generation is also known as the Traditionalists. This generation was raised during World War II, and has undergone some of the hardest times when compared to all the other generations (Strauss & Howe, 1991). Their opinions towards family, religion, work and the government were deeply affected by the situations that had arisen during the Great Depression and the World War II. Influenced by the Great Depression and World War II this generation is known to be conservative, disciplined and have a sense of obligation towards the company for which they work. They like formality, a chain of command, need of respect and prefer to make decisions based on issues that have affected them previously (Kersten, 2008). The Silent Generation has been characterized as loyal, dedicated, oppose risk and believe in teamwork and collaboration. At work they show consistency and uniformity; seek out technological advancements; display command-and-control leadership reminiscent of military operations and prefer hierarchical organizational structures. Even though they may be uncomfortable with ambiguity and change, they
are considered to be stable, detail-oriented and hardworking. They are uncomfortable with conflict and reticent when they disagree with anything in the workplace (Zemke, Raines, & Filipczak, 1999). They also consider work to be their duty, and they always have an obligation to the organization for which they work (Lancaster & Stillman, 2002; Kupperschnidt, 2000).

**Baby Boomers (1946–1964)**

The Baby Boomers got their name because there was an increase in the birthrate when many troops came home from World War II. The Boomers grew up in times of economic and educational expansion, which lead them to embrace an attitude of entitlement—an entitlement to and an expectation to obtain the best from life (Smola & Sutton, 2002). This generation was brought up to respect people of authority, but as they witnessed their idiosyncrasies, they learned not to trust anyone over 30 (Karp, Fuller, & Sirias, 2002). Their period of growth was prosperous; and hence, they are known to be idealistic, optimistic and responsible for many social movements in American history like the Civil Rights movement and the Women’s movement (Lancaster & Stillman, 2002). The Baby-Boomer generation, approximately 85 million strong, are the largest cohort currently in the workplace and the one associated with a large number of leadership positions (Trunk, 2007). The large size of this generation has been a cause for an increase in competition for resources and opportunities. In 2008, the oldest Baby Boomers turned 62 and most of them are in the middle or late period of their careers. In the next 25 years, the entire generation is expected to reach their traditional retirement age (Callanan & Greenhaus, 2008). The individuals of this generation have been characterized to believe that success can be achieved only through hard work and sacrifice. They are considered to be workaholics who prioritize their careers, believe in paying dues, familiar with step-by-step promotion and seek meaning in their life from their work (Kupperschnidt, 2000; Raths, 1999; Strauss & Howe, 1991). The Boomers, being confident task completers, want their achievement to be recognized, but may be insulted by constant feedback (Glass, 2007). Although they have been characterized as being goal-oriented, they are known to be more process-oriented rather than results-oriented. They are also known for their optimism and intuition to avoid conflicts in the workplace (Zemke et al., 1999). The individuals of this generation value health, wellness, personal growth and gratification and also seek job security (Raths, 1999).

**Generation X (1965–1980)**

Around 33 percent of the U.S. population belongs to Generation X, which were born between the years 1965 and 1980 (Bureau of Labor Statistics in AARP, 2007). The ‘X’ in Xers refers to the namelessness of the group (Beutell & Wittig-Berman, 2008) because they are considered to be a group of individuals without a clear identity; having generally diminished expectations; and feelings of alienation, pragmatism, conservatism and detachment (Corbo, 1997). Generation X is described as cynical and skeptical (Lancaster & Stillman, 2002). This may have been the response to witnessing many negative events while growing up which included an increase in crime and divorce rate (Losyk, 1997). This generation had both parents working; and, hence, they are also known as latchkey kids because they were taking care of themselves everyday (Kupperschnidt, 2000; Strauss & Howe, 1991). This may have been the reason that individuals of this generation developed skills of independence, adaptability and resilience (Thiefold & Scheef, 2004). Their untrustworthiness of the corporate sector may have been the influence of seeing their parents getting laid off even though they spent all their time at work (Kupperschnidt, 2000). Work is a difficult challenge, and they believe in working smarter rather than harder (Lancaster & Stillman, 2002). Unlike the Boomers, they do not define themselves based on the career path they have or will achieve. When dissatisfied with things at work, they will leave and find another job. They have very little loyalty towards their company, but would place their loyalty with their peers.
and their immediate supervisor. They look towards improving their career security rather than concentrating on job security. They value continuous learning and skill development and are ruled by a sense of accomplishment (Bova & Kroth, 2001). Their approach towards solving problems in the workplace is practical and even though there is a great amount of research that confirms the cynical nature of individuals of this generation, there is evidence that they are motivated to achieve, self-starting and resourceful (Strauss & Howe, 1991; Lancaster & Stillman, 2002).

Generation Y or Millennials (1981-2000)

This generation is also referred as the Millennial, Nexters and Echo Boomers. According to the Bureau of Labor Statistics in 2007, Generation Y comprises 25 percent of the U.S. workforce.

Millennials do not have a long-term attachment or commitment towards the organization and regard their job as a means for building their career resume (Howe & Strauss, 2000). The Millennials regard fun in the workplace, not as a benefit, but as a requirement, unlike the Boomers who oppose workplace fun and Xer’s who are mostly indifferent towards workplace fun. They are also known as the “Trophy Generation” or “Trophy Kids” because of the trend to reward everyone for participation rather than rewarding only the winners. Members of this generation are described as people with confidence, conventional, optimistic, and socially conscious and being civic-minded. They prefer collective action and team work and desire to have flexibility in their work schedules. They grew up with technologies in abundance and modern ones being developed regularly and are considered to be digital natives. They are generally unafraid of new technologies and are usually the first ones to try, buy and spread word about new gadgets and technologies (Glass, 2007). Having access to technology and the Internet has been a source for exploring the world and getting information instantaneously (Zemke et al., 1999). They have a preference towards working with clear expectations and a desire to maintain a well-defined career path (Westernam & Yamamura, 1996). Unlike the Boomers, this generation is unwilling to dedicate much of their daily life to work. They prefer having a balance between their work life and other interests (Smola & Sutton, 2002). Having been raised in an environment with constant feedback, individual attention and praise, they expect the same level of feedback from the workplace in terms of individual development in the workplace (Ng, Shweitzer, & Lyons, 2010).

METHODOLOGY

Based on the literature studied and the objectives that are to be achieved, a survey questionnaire to measure the perceptions of industry with respect to the current workplace attributes was developed for students in a mid-size public university located in the southeastern part of the United States and the employees associated with construction companies that are located in the same region. The questionnaire was structured to obtain responses from questions in the format of rank order scale, Likert-scale and multiple choice. The first section of the questionnaire requested data about the age of the respondent, their status in the construction industry and the level of experience the respondent has in the construction industry. The next section consisted of rank-order and multiple choice questions that would solicit input on the opinion of the students and employees about the requirements of a construction industry workplace. This includes the workplace attributes, benefits, opportunities of career improvement, rewards, training, ways to attain work-life balance, and opportunity of travelling. The next section consisted of a series of questions that evaluated their opinion on the work habits that are being practiced in the construction industry. These questions also included statements in the literature that older generations stated as the least favorable characteristics of the millennial generation.

The participants in the study were students of
the Department of Construction Science and Management (CSM) at Clemson University and construction industry employees of the Industry Advisory Board (IAB) and Corporate Partners. The Construction Science & Management Department offers a comprehensive educational program designed to produce motivated, well-educated, responsible citizens with the management and technical skills requisite for leadership positions in the construction industry. The university is located in the southeastern part of the United States. The department offers both undergraduate as well as graduate programs with an enrollment of around 180 undergraduates and 25 graduate students. The department not only provides classes on the campus, but also has a master’s program through distance learning and interacts with various firms in the construction industry through student chapters and guilds associated with the department. Apart from having these provisions, the department has an Industry Advisory Board and Corporate Partners that are comprised of members from the industry that help provide assistance and guidance to the CSM department. For the purpose of this research members of the Industry Advisory Board and the Corporate Partners will be referred to as Construction Industry Employees (CIE).

Convenience sampling was considered for the purpose of this study. One of the populations considered are the employees of the construction industry. Since the research was based on understanding the generational differences of the workplace in the construction industry, questions related to the level of experience and their job position in the construction company was not considered. The second group of respondents considered comprised of students. The millennial generation is not homogeneous. Each person’s values and attitudes may differ by race, gender and their social and economic background they have been associated with. They may not have realistic expectations of the environment, attributes and practices in a professional work environment. The findings or results merely represent the expectations and choices of a professional workplace in the construction industry. Furthermore, the students with previous work experience may have been dissatisfied with their experience in the industry and it is unknown whether this issue may have had an impact on the participants’ work values. Both the samples of the population considered were restricted to a single geographical area of the United States. The relatively small size and geographical restrictions may have biased the results of the survey.

The questionnaire was distributed via survey monkey to the Construction Industry Employees that are located predominantly in the southeastern states of the US. After the results were obtained, the raw data was formulated in an excel file for analysis. The analysis of data obtained was done using one-way analysis of variance, chi-square test for independence and t-test for means using a 95% confidence level to determine statistical significance.

FINDINGS

The survey was distributed to 103 students from sophomore, freshman, junior, senior and graduate level of classes. There were 42 survey links sent to construction industry employees. There was a 100% response rate from the students and a 62.5% (N=25) response rate from the construction industry employees. Of the total of 128 responses, 19.6% (N=25) of the respondents belonged to the Construction Industry Employees and 80.4% (N= 103) of the respondents were CSM students at Clemson University. Also, 113 (or 88.28%) of the respondents belonged to the millennial generation, 8 (or 6.25%) to Generation X and 7 (or 5.47%) to the Baby Boomer generation. Of the 113 respondents belonging to the millennial generation, 103 respondents were students and 10 belonged to the population of Construction Industry Employees (CIE). Only 20 (or 19.42%) of the respondents belonging to the population of students (N= 103) had no experience working in the construction industry. A summary of the respondents is shown in Table 1.
Table 1: Distribution of respondents in the survey

<table>
<thead>
<tr>
<th>Generation</th>
<th>Student</th>
<th>Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millennial (&lt;33)</td>
<td>103</td>
<td>10</td>
</tr>
<tr>
<td>Generation X (34-49)</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Baby Boomer (50-68)</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Silent Generation (&gt;69)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total no. of respondents</td>
<td>128</td>
<td></td>
</tr>
</tbody>
</table>

To understand the expectations of the millennial generation about the attributes of the workplace in the construction industry, three aspects were considered for the purpose of the research: work, home, and community. To analyze the work preferences of the millennial generation, ranking-type questions regarding workplace attributes, benefit packages, rewards and training/development opportunities were considered. The first aspect measured to analyze the perspective of the millennials are the workplace attributes when he/she considers a job in the construction industry. Out of the 103 student responses, 54 (or 52.43%) of them ranked ‘job security and career advancement opportunities’ as their top priority. Similarly, 13 responses of the 25 responses (or 52%) from the construction industry employees ranked it as their top priority. ‘Competitive pay and benefits’ is another attribute considered to be top priority for 25.24% of the student respondents and 36% of the construction industry employee respondents. Around 40% of the student respondents considered ‘health and dental insurance’ as their top priority while 52% of the construction industry employees considered ‘incentives and rewards based on performance’ to be their top priority amongst the given benefit packages offered by the construction firm. In terms of the rewards to be offered by the company, 87% of the student responses and 64% of the construction industry employee responses ranked ‘bonus’ as their top priority. Extra time off was another priority considered by 28% of the construction industry employee respondents. When asked about training/development opportunities a majority of both populations ranked ‘Continuing education workshops and seminars’ as their top priority. Some of the respondents marked ‘location of job’ to be their top attribute when they considered a job in the construction industry.

The other aspect considered for the purpose of this research is how the millennial generation achieves a work-life balance and their perspective of community service while working in the construction industry. While a majority of the construction industry employees considered ‘flexible work hours’ as their top priority, the millennials divided their priority between ‘flexible work hours’ and ‘travel distance from work’. When ranking the community services that are of high priority, millennials considered ‘volunteer opportunities in the community’ while a majority of the construction industry employee’s ranked ‘membership in professional societies’ as their top priority. The null hypothesis for each of the aspects states that there is an unequal probability that the respondents pick the attributes. The one-way ANOVA analysis resulted in a significant F-value thus rejecting the null hypothesis. This analysis deducts that the respondents had an equal probability of selecting any of the attributes considered for both home and community. Based on the ranking priorities of each group of respondents and the significance of the results achieved, the attributes considered to be of top priority by a majority of the respondents are shown in Figure 1.

Another criterion considered to be important in the construction industry is the amount of travel required on a daily basis as well as considering travelling as a part of the job description offered. Of the entire sample, 60 respondents (53%) of the millennial generation consider travelling as an opportunity. Around 81 of the millennial respondents prefer to travel less than 50 miles on a daily basis. The other respondents considered travelling up to 100 miles but very few people considered travelling more than 100 miles on a daily basis. Chi-square test of independence was performed to examine the relation between different generations and their preference to travel. The relations between the variables was significant, \( \chi^2 (2, 128) = 26.85, p = 0.05 \). This shows that millennials consider travelling as an opportunity.
In order to understand other parameters the millennial generation and employees consider for the ideal workplace, questions related to job performance, social activities in the workplace, communication methods, the environment of the workplace, and technology were asked. Respondents were asked to rate each statement based on a Likert-type scale of: 1= strongly disagree, 2= Disagree, 3= neither agree nor Disagree, 4= Agree, 5= strongly agree.

To get an insight on the different factors that improve ‘job performance’, statements that included close supervision and job performance reviews were considered. Millennials are split on the neither agree nor disagree (33.01%, N= 103) vs. agree (33.98%, N=103) that ‘close supervision improves their job performance’ while the construction industry employees agree (54.17%, N= 25) with the statement. When asked their opinion about ‘job performance reviews’ both the construction industry employees and the millennials strongly agree that the performance reviews are to be taken seriously (58.33%, N= 25; 49.02%, N= 103). To consider their attitude towards ‘formality in workplace’ both millennials and the construction industry employees appreciated formality in speech and dress in the workplace. The construction industry employees (54.17%, N= 25) agree with the statement ‘enjoy attending company sponsored events’, while the millennial generation disagree with that statement (38.24%, N= 103).

To understand their perceptions about ‘methods of communication’, both the millennial generation and the construction industry employees are inclined towards the preference of communicating in person rather than using electronic methods. In terms of ‘receiving important information and updates by impromptu meetings’, the majority of the employees agree (75%, N= 25) with the statement and 51.46% of the millennial generation (N= 103) agree with that statement. When asked if they would look at other ‘job opportunities’ and remain loyal to their existing employers, a majority of both the millennial generation and the construction industry employees agreed with the statement. Figure 2 and Figure 3 denote the frequency of responses on the Likert scale of the students and construction industry employees with the statements related to the environment of the workplace in the construction industry.

Figure 1: Work place attributes perceptions: Students vs. CIE
To understand the view of the samples of the population on working individually or as a team the aspects of their working preference and the effectiveness were considered. While millennials were split on the neither agree nor disagree (34.95%, N= 103) vs. agree (38.83%, N= 103) on their preference of ‘working on group projects than individual projects’, a majority of the construction industry employees neither agreed nor disagreed (45.83%, N= 25) with the statement. When asked their opinion on ‘team work being more effective in accomplishing projects’, the construction industry employees stood by the neither agree nor disagree (45.83%, N= 25) while students strongly agreed (33.01%, N= 103) with that statement. However, both construction industry employees and millennials agreed (45.83%, N= 25; 49.51%, N= 103) with the statement of increasing
productivity in a workplace by having ‘competition amongst coworkers’. ‘Flexible work hours’ are considered to be a priority by the millennials (41.75%, N= 103) associated with the construction industry but the employees were split between neither agree nor disagree (37.50%, N= 25) vs. agreeing (37.50%, N= 25) with the statement. To understand the perception of ‘technological advancement’ in the company the aspects of incorporating technology and keeping up with latest technology were asked. Employees strongly agreed (50%, N= 25) that the company should be associated with the latest technology to create a competitive opportunity while a majority of the students agreed (53.92%, N= 103) with the same and both samples of the population were in agreement (46.53%, N= 103; 62.50%, N= 25) with their comfort level of learning and keeping up with changes in the technology.

The research is based on a data obtained from a mix of generations in the construction industry as students and employees. However, the sample considered was for convenience of the research and the sample size being small may cause a possibility of biased results. While literature states that the millennial generation is associated with stereotypes, this study shows that the millennials think much similarly to the other Baby Boomers and Generation X respondents belonging to the construction industry. This can be seen in their preferences of workplace attributes. Table 2 shows the preferences of the majority of responses ranked in the top two positions. One of the attributes considered to affect the preference of the workplace by both the millennial generation and the construction industry employees is the geographical location of the workplace or the jobsite. This shows that the perception of the millennials is not very different from the other generations working in the workplace. This may contradict the research done by Ng et al., 2010 that the perceptions of the younger generation and the Baby Boomers differ in terms of workplace attributes and expectations.

The research data also show that the millennials consider close supervision and job performance reviews to improve their performance on the jobs. This enhances the statement that the millennial generation expect the same level of feedback that they have received throughout their upbringing in terms of development in the workplace from their supervisors/mentors/employers according to Ng et al., 2010. They also appreciate formality in the workplace which contradicts the SHRM study (Burke, 2004) that the millennials prefer an informal workplace. The millennials also have a strong preference to work in teams and group projects and consider that as a factor to be more effective in accomplishing the project when compared to work individually on the project. They consider technology to be a factor to create a competitive environment and also agree that they are comfortable with keeping up to date with the latest technologies. Apart from that they believe in competition amongst co-workers to increase productivity in the workplace. The millennials, according to this research study, consider flexible work-hours to be a priority to meet personal or family commitments and give less consideration to working more than 60 hours a week on a regular basis. This enhances research studies (Dries et al., 2008; Hewlett et al., 2009; Kowske et al., 2010; Smola & Sutton, 2002) that state that millennials prefer a work-life balance when compared to the earlier generation. The results of the research study show that a majority of the millennial generation prefers working in a company with a formal organizational structure and following an established chain of command, but does not prefer attending company sponsored social events for employees and their families. This shows that the population of this study has a preference of keeping their personal life and work life separate from each other.

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However, there was no significance for the data obtained from the statement that millennials do not mind working more than 60 hours a week and their preference of working in a company with an organized structure vs. an unorganized structure. Another common stereotype attached with the millennials is their method of communication. Based on literature by Zemke et al., 2000; Solna & Hood, 2008, the results state that the younger generation consider communicating by electronic methods rather than communicating in person. The research conducted for the considered sample of

<table>
<thead>
<tr>
<th>Workplace Attributes</th>
<th>Students Perception</th>
<th>Employee Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank 1</td>
<td>Job security and career advancement opportunities</td>
<td>Job security and career advancement opportunities</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Competitive pay and benefits</td>
<td>Competitive pay and benefits</td>
</tr>
<tr>
<td>Benefit Packages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank 1</td>
<td>Health and Dental Insurance</td>
<td>Incentives and rewards based on performance</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Incentives and rewards based on performance</td>
<td>Health and Dental Insurance</td>
</tr>
<tr>
<td>Rewards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank 1</td>
<td>Bonus</td>
<td>Bonus</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Extra time off</td>
<td>Extra time off</td>
</tr>
<tr>
<td>Training/Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank 1</td>
<td>Continuing education workshops and seminars</td>
<td>Continuing education workshops and seminars</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Additional university degree</td>
<td>Additional university degree</td>
</tr>
<tr>
<td>Achieve Work-Life Balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rank 1</td>
<td>Flexible work hours</td>
<td>Flexible work hours</td>
</tr>
<tr>
<td>Rank 2</td>
<td>Travel distance from work</td>
<td>Travel distance from work</td>
</tr>
</tbody>
</table>

Table 2: Perceptions of the workplace attributes by the majority of respondents
the millennial generation students in the construction industry proved otherwise; they prefer communicating in person rather than by electronic methods and welcome impromptu meetings to receive important information and updates. Though the millennials considered for the purpose of this research do not consider working more than 60 hours a week being a salaried employee, they do not mind working overtime if a project is behind schedule until the project is back on schedule. They consider travelling as an opportunity if it is a part of the job description, but also consider travel less than 50 miles on a daily basis to a job site.

This research study indicates that the millennial generation may have differences in the preference of the workplace in the construction industry when compared to other generations, but their priorities are however similar to the other generation construction industry employees. While most of the stereotypes attached to the millennial generation are considered to be applicable for millennials in the construction industry, there are a few stereotypes that are not applicable to this research study for the considered sample. However, the results obtained from the respondents may be biased because of the small sample size of the population and its restriction to only one geographical area of the United States.

CONCLUSIONS AND RECOMMENDATIONS

This research study used the framework of work, family and community to examine the ideal workplace attributes that the millennial generation considered in the construction industry. Unlike many research studies that state that the perspective of the millennial generation is completely different from the perceptions of the previous generation, the millennials of the construction industry prove to disagree. While the employers of the construction industry concentrate on finding how different the millennials view the workplace, responses show that the millennials may not have a completely altering view of the workplace in the construction industry when compared to the other generations. This research study shows that although the millennials have different expectations of the workplace, they are very much similar to the attributes that current employees of the construction industry who belong to different generations. Based on the results obtained from respondents considered in this research study, the preferences of the millennial generation in the workplace of the construction industry are:

- Flexible work hours to meet family/personal commitments.
- Believe in team work and job performance reviews.
- Do not mix personal and work life.
- Prefer to communicate in person rather than using electronic methods and do not mind impromptu meetings to receive important information.
- They prefer using the latest technologies and do not mind learning and keeping up with the changes.

Some of the other common cited considerations by the respondents having the dream job with a perfect work environment are:

- Competitive work environment with challenging projects.
- A structured environment that allows free means of communication amongst the employees and employers.
- Balance of work and family life.
- Benefits in terms of paid vacations or extra days off.
- Work should not be restricted to the home office but should involve active participation at the project site.

It is recommended that with a larger sample of the population, other aspects such as the number of years of experience in the construction industry and the job position of the respondents should be considered to analyze if there are differences with respect to the level of experience and the position they are associated with in the company. Due to the
lower number of responses obtained from employers in the construction industry, they were considered as construction industry employees for the purpose of this research. However, obtaining a higher response rate from the employers would give their preferences of the workplace. This will help in a comparative analysis of the expectations of the construction industry workplace from two aspects such as generational differences and student-employee-employer expectations.

The millennial generation comprises of the individuals that represent the workforce of the future. Hence, the findings reported in this research can inform employers on how to best attract and engage the next generation of skilled workers. The millennial generation has a capability to encompass their knowledge and skills to fulfill both personal and societal goals. This proves to be an opportunity that employers of the construction industry to fulfill the missions of their organization in serving the community. While the millennial generation have their own drawbacks, if effectively managed and retained they have the potential to become one of the great generations to serve in the construction industry.

REFERENCES


A Case Study in Developing an Integrated Project Delivery (IPD) Course

Ehsan Mousavi-Rizi, Clemson University | mousavi@clemson.edu

Kevin Grosskopf, University of Nebraska, Lincoln | kevin.grosskopf@unl.edu

ABSTRACT

The following paper highlights the design and implementation of a 3 credit-hour, interdisciplinary technical elective in integrated project delivery including design-build (DB), construction manager at risk (CMAR) and construction manager/general contractor (CM/GC) delivery methods. In this course, architecture, engineering and construction management students were organized into teams of competing firms. Each team was issued a project request for qualifications (RFQ) and request-for-proposal (RFP) that culminated in the delivery of a statement of qualifications, written proposal and oral presentation for DB, CMAR and CM/GC services. Teams were provided commercial, institutional and heavy-highway construction documents (CDs) appropriate for each delivery method including conceptual-schematic CDs for design-build and design-development CDs for design-assist CMAR and CM/GC. Projects and industry mentors were provided by Kiewit Corporation and DLR Design Group. The goal of this effort was to introduce the concept of ‘best value’ contracting as an alternative to traditional design-bid-build delivery to prepare students to compete in the Associated Schools of Construction student competitions, and, to prepare students for successful careers in design and construction management.

Key Words: design-build, CM-at-risk, GM/GC, project delivery

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Dr. Kevin Grosskopf is a Professor in the Durham School of Architectural Engineering and Construction at the University of Nebraska-Lincoln. Dr. Grosskopf has served in various capacities in the commercial building and utility industry since 1987 and is a licensed General Contractor in the State of Florida. Professor Grosskopf teaches courses in construction cost estimating and cost control.

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The AIC Professional Constructor is re-publishing this article as a supplement to the presentation “A Case-Study in Integrated Project Delivery (IPD)” presented by Kevin Grosskopf at the 2017 Constructor Conference.
INTRODUCTION

The American Institute of Architects defines IPD as “a project delivery method that contractually requires collaboration among the primary parties; owner, designer, and builder; so that the risk, responsibility and liability for project delivery are collectively managed and appropriately shared” (CMAA 2012). Key advantages of integrated delivery strategies such as design-build (DB), construction manager at-risk (CMAR) and construction manager/general contractor (CM/GC) include varying degrees of contractor involvement during the design phase, and, the ability to overlap or ‘fast-track’ design and construction activities (Figure 1).

![Figure 1. ‘Fast-track’ DB vs. traditional DBB.](image)

As alternatives to traditional design-bid-build (DBB), integrated delivery methods have proven to improve project performance while reducing time and cost. As a result, sales from DB and CMAR projects alone are forecast to exceed $US180B by 2017, or roughly 40% of the U.S. vertical construction market (Tulacz 2014). The objective of this paper is to present a pedagogical approach for developing an integrated project delivery course to supplement traditional design-bid-build instruction in ASC member programs.

METHODOLOGY

The focus of the integrated project delivery (IPD) course was alternative delivery methods during the preconstruction project award phase. Student teams were issued a project request for qualifications (RFQ) and request-for-proposal (RFP) that culminated in the delivery of a statement of qualifications, written proposal and oral presentation for DB, CMAR and CM/GC services. The goal of each project team was to demonstrate best-value. Best-value was defined as a project approach that most cost effectively and time efficiently met the objectives of the Owner’s program.

Each team was required to communicate its best-value approach in three (3) project award phases. The first phase was the Statement of Qualifications (SOQ) phase, where teams provided the Owner general company information in an effort to demonstrate the character, capital, and capacity to successfully complete the project. The second project award phase was the Proposal phase, where SOQ pre-qualified teams provided the Owner project specific information including design concepts, methods and materials and workflow management techniques it will use to deliver best-value. The third and final project award phase was the Presentation phase where teams provided an oral overview of the written proposal to the Owner.

Students were first organized into three (3) teams of six (6) students each based on project type, discipline and student career preferences. Students were assigned project team roles and responsibilities (Figure 2) throughout the qualifications, proposal and presentation process.

Team 1 – Creighton University Athletic Facility (DB)

This design-build (DB) project included full design and construction planning of a new 34,000sf athletic facility. Proposal requirements included site selection, programming, conceptual design (site plan, renditions, interior and exterior elevations, floor plans, and space use summary), preliminary cost estimates and proposed schedules for construction. This project team consisted of students from Architecture (2) and Construction Management (4) programs and included a commitment to Leadership in Energy and Environmental Design (LEED).
Team 2 – Peter Kiewit Institute Renovation

This construction manager at-risk (CMAR) project included design-assist and buildout of an existing 54,000sf institutional shell space. Proposal requirements included design completion (floor plans, interior elevations, materials and equipment selection, value-engineering and constructability analyses), detailed cost estimates and schedules for construction. This project team consisted of students from Construction Management (6) and included a commitment to safety, security and minimizing occupant disturbance during construction.

Team 3 – Tennessee DOT I-40 Rehabilitation

This construction manager/general contractor (CM/GC) project included design-assist and construction of a 3-span interstate bridge replacement. Proposal requirements included design assistance (value-engineering and constructability analyses), cost estimates and schedules for construction. Included in this project was demolition, temporary structures, and planning of detour routes. This team consisted of students from Civil Engineering (2), Construction Engineering (2) and Construction Management (2) programs and included a requirement for self-performing of 30% or more of the work. Additionally, this project included a commitment to traffic safety and disadvantaged business enterprises (DBEs). Next, students were provided three (3) project assignments representing the three ‘short-listing’ and selection phases typical of alternative delivery including qualifications, proposal and presentation phases.

Assignment 1 - Request for Qualifications (RFQ)

In assignment 1, teams were responsible for design, preconstruction, and construction services required to complete the project in accordance with the RFP documents. Specifically, teams were required to submit a Statement of Qualifications according to the criteria below (Table 1). Prequalified teams would then be invited to submit proposals for design, preconstruction, and construction services.

Assignment 2 - Request for Proposal (RFP)

Next, prequalified teams were invited to submit a written Proposal for design, preconstruction, and construction services according to the criteria below (Table 2). Teams demonstrating best-value in terms of project performance, time and cost were invited to interview for design, preconstruction, and construction services.
Table 1. Request for qualifications (RFQ).

<table>
<thead>
<tr>
<th>I. Company Information</th>
<th>II. Relevant Experience</th>
<th>III. Project Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. History</td>
<td>a. Specialized experience</td>
<td>a. Organizational chart</td>
</tr>
<tr>
<td>b. Business structure</td>
<td>b. Past Projects</td>
<td>b. Team members</td>
</tr>
<tr>
<td>c. Organizational chart</td>
<td>i. Name and description</td>
<td>i. Position</td>
</tr>
<tr>
<td>d. Description of services</td>
<td>ii. Contract value</td>
<td>ii. Role</td>
</tr>
<tr>
<td>e. Self-performed work</td>
<td>iii. Size ($) and scope</td>
<td>iii. Qualifications</td>
</tr>
<tr>
<td>f. Licensure</td>
<td>iv. Completion and duration</td>
<td></td>
</tr>
<tr>
<td>g. Insurance</td>
<td>v. Photos or renderings</td>
<td></td>
</tr>
<tr>
<td>h. Bonding capacity</td>
<td>vi. References</td>
<td></td>
</tr>
<tr>
<td>i. Financial statements</td>
<td></td>
<td></td>
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<tr>
<td>j. Quality program</td>
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<td>k. Safety programs and EMR</td>
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<td>l. Subcontractor selection</td>
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<td>m. Backlog</td>
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</tbody>
</table>

Table 2. Request for proposal (RFP).

<table>
<thead>
<tr>
<th>I. Design</th>
<th>II. Schedule</th>
<th>III. Budget</th>
<th>IV. Construction Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Space use summary</td>
<td>b. Construction schedule</td>
<td>i. $/GSF</td>
<td>i. Site access</td>
</tr>
<tr>
<td>c. Site plan</td>
<td>i. Critical path items</td>
<td>ii. Schedule of values</td>
<td>ii. Staging &amp; storage</td>
</tr>
<tr>
<td>d. Exterior renderings</td>
<td>ii. Long lead time items</td>
<td>b. Design fee</td>
<td>iii. Equipment</td>
</tr>
<tr>
<td>e. Floor plan(s)</td>
<td>iii. Milestones</td>
<td>i. Schematic design</td>
<td>iv. Temp utilities</td>
</tr>
<tr>
<td>f. Material and equipment selection</td>
<td>c. Fast-tracking</td>
<td>ii. DDs</td>
<td>v. Traffic flow</td>
</tr>
<tr>
<td>g. Special considerations</td>
<td></td>
<td>iii. CDs</td>
<td>c. Safety and security</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Preconstruction fee</td>
<td>d. Inspections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. Commissioning</td>
</tr>
</tbody>
</table>
Assignment 3 - Proposal Presentations

Teams invited to interview for design, preconstruction, and construction services provided an oral Presentation to a panel of Owners representatives (e.g. Kiewit & DLR industry panel) with selected team(s) awarded a contract for design and preconstruction services. Upon successful completion of design and preconstruction services, a contract amendment was negotiated with the selected team to include a Guaranteed Maximum Price (GMP) for construction services. Course content was organized to follow the general order of project assignments beginning with the preparation of a qualifications statement (Table 3). In turn, the project was intended to provide a ‘Capstone’ case-study of key competencies learned in the course. Team breakout sessions with industry mentors were organized bi-weekly culminating in oral presentations to an industry panel.

RESULTS

Team 1 – Creighton University Athletic Facility (DB)

The design-build (DB) team provided site selection, conceptual design, preliminary cost estimates and proposed schedules for the construction of a new 34,000sf athletic facility. The team began with a rationale for site selection based on compatibility with adjacent athletic facilities, available utility connections and minimal disturbance to student and vehicular traffic. Included within the design was space allocation and orientation with 4D walk-thru animation (Figure 3).

Table 3. Course content and schedule (Jackson, 2011).

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project Delivery</td>
<td>Project delivery methods; DBB, DB, CMAR and CM/GC.</td>
</tr>
<tr>
<td>2</td>
<td>Introduction</td>
<td>Roles, responsibilities and organizational models; performance requirements, contractual relationships; integration of design, construction cost and schedule.</td>
</tr>
<tr>
<td>3</td>
<td>Procurement*</td>
<td>Qualifications and best-value selection; negotiated fees and competitive factors; request for qualifications (RFQ); request for proposals (RFP).</td>
</tr>
<tr>
<td>4</td>
<td>Team Assignment 1: Qualifications</td>
<td>Selecting the team; analyzing and responding to the RFQ, making the short list; statement of qualifications (SOQ).</td>
</tr>
<tr>
<td>5-6</td>
<td>Team Assignment 2: Written Proposal*</td>
<td>Analyzing and responding to the RFP; managing and aligning proposal development tasks, written proposal and oral presentation.</td>
</tr>
<tr>
<td>7</td>
<td>Design and Construction Cost*</td>
<td>Developing the budget; designing to budget; programming, conceptual and schematic design, design development, and construction document stages.</td>
</tr>
<tr>
<td>8</td>
<td>Design and Construction Cost</td>
<td>Design fee; construction (management) fee; guaranteed maximum price (GMP), buyout, contingencies and shared savings.</td>
</tr>
<tr>
<td>9</td>
<td>Design and Construction Schedule*</td>
<td>Fast-track design and construction scheduling.</td>
</tr>
<tr>
<td>10-11</td>
<td>Special Topics</td>
<td>Building information modeling (BIM); Leadership in Energy and Environmental Design (LEED); lean design and construction.</td>
</tr>
<tr>
<td>12-14</td>
<td>Team Assignment 3: Oral Presentation*</td>
<td>Preparing and delivering the oral presentation. Scoring criteria, presentation strategies, contract negotiation, post-award phase.</td>
</tr>
<tr>
<td>15</td>
<td>Student Presentations</td>
<td>SOQ, proposals and oral presentations; design-build summer internships; ASC student competitions.</td>
</tr>
</tbody>
</table>

* Student team breakout session(s) with industry mentors.
Also included within the design-build approach was a focus on material durability and constructability. The team chose a steel structure with precast concrete-brick inset panels to reduce O&M requirements, increase productivity and utilize offsite prefabricated material assemblies. This approach reduced time, cost and site logistics while also reducing on-campus construction traffic and manpower. Additionally, the team incorporated high-efficiency equipment such as geothermal HVAC systems with variable air volume distribution and LED lighting. Also included were low-flow water fixtures and grey water recovery for on-site landscape irrigation, that collectively qualified the project for a LEED Gold certification. The total turnkey cost of the project was $8.4M with a design and preconstruction fee of 6.5%. The team successfully negotiated a GMP for construction services with a 10% contingency. Project duration was 15 months, 3 months less than planned for traditional DBB delivery.

Team 2 – Peter Kiewit Institute Renovation

The CMAR team provided design-assist and buildout of an existing 54,000sf institutional shell space. Because the building was partially occupied, a phased construction plan was developed to minimize occupant disturbance during construction (Figure 4). Related, on-campus site access and staging areas were limited, requiring just-in-time delivery and installation of major equipment systems.

Included within the design-assist approach, the team provided several alternate material and equipment selection options intended to reduce initial and lifecycle cost as well as reduce construction time. Examples include use of modular wall systems that could be reconfigured to future space use changes. The team also used BIM 360 software for clash detection of MEP and structural systems and to avoid unnecessary demolition of interior partitions. Together, the team’s design assist and construction plan resulted in a 13-month, $7.1M GMP for construction services. Additionally, the team’s 0.68 EMR demonstrated a proven ability to maintain site safety for workers as well as building occupants.
Team 3 – Tennessee DOT I-40 Rehabilitation

The CM/GC team provided design-assist preconstruction services under a negotiated fee, and, a firm-fixed price bid for the demolition and replacement of a 3-span interstate bridge. Project restrictions limited bridge lane closures to weekends between 9:00PM Friday and 5:00AM Monday. As a result, the CM/GC team proposed accelerated bridge construction (ABC) design modifications that would allow entire 3-segment bridge spans to be demolished and replaced with a 56-hour window. This required large pre-positioned pre-cast bridge spans to be assembled on site and placed utilizing specialized equipment and pick design as well as temporary support structures and false work. Additionally, CIP abutments were proposed in lieu of precast piles so that abutments could be completed prior to bridge demolition and to minimize lane closures. Additionally, the team was required to develop an I-40 detour plan, and, provide continuous access to local businesses and residential areas during construction. The team successfully negotiated a preconstruction fee of $275,000 with a fixed price bid of $6.4M. Included were negotiated general requirements (4%), G&A (6%) and contingency (8%) as well as >30% self-perform and >5% DBE subcontractor and supplier contracts.

Throughout the 16-week semester, project teams met bi-weekly with industry mentors who were each former project managers on each of the student projects, culminating in oral presentations to an industry panel of Kiewit and DLR senior management and executive staff (Figure 5).

Oral presentations for each team were evaluated by the Kiewit-DLR industry panel using a scoring rubric (Table 4) which was used in part to calculate student grades on the project, as were student peer evaluations. Together, the three project assignments comprised 85% of the students’ grade (15% SOQ, 40% proposal, 25% presentation). The remaining 15% of students’ grades were based on course assignments and exams.
In addition to peer evaluations of team members, students were also asked to complete course and instructor evaluations. Overall, students rated the course 3.8 on a 5-point scale. Additionally, students were given the opportunity to elaborate on specific aspects of the course that helped (or hindered) learning and ways the course could be improved.

The majority of students cited industry mentors as being a positive course attribute. Students also cited teamwork, presentations and the project as being a value-added experience for not only a better understanding of alternative delivery methods and the preconstruction process, but also in terms of personal and professional development.

### Figure 5. Kiewit and DLR industry mentors (left) and final project review panel (right).

### Table 4. Oral presentation scoring rubric.

<table>
<thead>
<tr>
<th></th>
<th>Creighton</th>
<th>UNK</th>
<th>Eric Roumph</th>
<th>Paul Eiting</th>
<th>B.J. Kienit</th>
<th>Mark Baxter</th>
<th>Zac Vaiskunas</th>
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<th>Mousavi</th>
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<th>Average</th>
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<td>8</td>
<td>10</td>
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<td>10</td>
<td>8</td>
<td>7</td>
<td>9</td>
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<tr>
<td>Design Solution</td>
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<td>14</td>
<td>18</td>
<td>15</td>
<td>20</td>
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<td>20</td>
<td>18</td>
<td>18</td>
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<tr>
<td>Schedule</td>
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<td>19</td>
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<td>16</td>
<td>15</td>
<td>17</td>
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<td>Budget</td>
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<tr>
<td>Site Utilization</td>
<td>20%</td>
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<td>12</td>
<td>19</td>
<td>10</td>
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<td>15</td>
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<td>Risk and safety plan</td>
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<td>Bonus point (optional)</td>
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<td>10</td>
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<tr>
<td>Bonus point (optional)</td>
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<tr>
<td>Budget</td>
<td>20%</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>15</td>
<td>12</td>
<td>15</td>
<td>19</td>
<td>20</td>
<td>15.44</td>
<td></td>
</tr>
<tr>
<td>Site Utilization</td>
<td>20%</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>15</td>
<td>16</td>
<td>10</td>
<td>17</td>
<td>19</td>
<td>16.11</td>
<td></td>
</tr>
<tr>
<td>Risk and safety plan</td>
<td>10%</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>8.00</td>
<td></td>
</tr>
<tr>
<td>Bonus point (optional)</td>
<td>5%</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>67</td>
<td>75</td>
<td>94</td>
<td>75</td>
<td>81</td>
<td>78</td>
<td>93</td>
<td>100</td>
<td>95</td>
<td>84.22</td>
</tr>
</tbody>
</table>
Ironically, some of the same course attributes cited as being helpful by some students, were cited as being problematic by others. Specifically, having multiple faculty participate in instruction provided a wealth of perspective and experience for some, but created confusion for others. Similarly, while many viewed the project and teams as a more realistic alternative to traditional classroom and textbook delivery, some were uncomfortable with what they perceived as a lack of structure particularly with regard to subjective exam content and grading. Other issues cited as being problematic were the disparities in building information modeling (BIM) competencies between groups, and the complexity of project RFPs given that students were mostly 3rd year students.

DISCUSSION

Design Build has experienced outstanding growth over other delivery methods, specifically the design-bid-build method (Songer et al. 1996; Beard et al. 2001). Thus, an astute response to this shift in the market demand seems necessary. Present students are going to be future professionals, who are very likely to deal with the design-build delivery method and must obtain ample knowledge about this process. Serving as a team member will enable students to listen to each other’s opinions. Although very challenging at the beginning, learning in a multi-disciplinary environment helped students stay involved with the course and their semester project.

“I had originally taken this course just to fill a requirement but ended up taking a ton out of it and it was by far my favorite class of the semester.”

Working in an environment where individuals with various expertise gather to solve a problem is the future of our collaborative industry. This course set-up was able to provide that environment for students to practice collaboration on real-world problems. An architecture student made the following comment:

“It was also helpful to hear about things that need to happen on the construction site to start construction. Architecture students could benefit from that. Things like staging and cranes and construction scheduling and budgeting could be extremely beneficial. Good course to pair CM (construction management) and ARCH (architecture) students together to understand a project fully from SOQ to Proposal phase and what exactly is involved in selling a project to a client.”

Existing construction curricula have mainly evolved around the low-bid mentality. The current transformation in delivery method from low-bid to best value, from prescriptive specifications to performance requirements, and from multiple contracts to the single source responsibility (Shrestha and Fernane 2016) is not simply a slight ‘tweak’ of traditional delivery methods (Jackson 2011). Thus, this course has been developed to not only teach those concepts, but also provide an environment where students can practice these new methods and experience the difference. In addition to preparing students for successful careers in construction, this course was also developed to provide a value-added technical elective, and, to prepare students to compete in the ASC student competitions.
REFERENCES


Advantages and Disadvantages of GM/GC Delivery in Transportation Construction

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ABSTRACT

Construction manager / general contractor (CM/GC) delivery is an alternative method for delivering construction projects, characterized by an integrated team approach involving the owner, designer, and contractor during the design phase of a project. This paper identifies the principal advantages and disadvantages associated with CM/GC delivery regarding process risk, project risk, and innovation in transportation construction for individual parties. Public owners, general contractors, and design engineers with considerable CM/GC experience on transportation projects were surveyed to explore the CM/GC processes that most affected them individually. This research validates the perception that CM/GC processes provide a balanced approach for sharing risk. The advantages for individual groups were similar, suggesting that the principal advantages of using CM/GC delivery are well defined and the benefits for individual groups are aligned with the benefits of the overall process. On the other hand, differences in the principal disadvantages suggest that individual groups are deterred by dissimilar aspects of the process. These detractors specifically provide challenges that must still be overcome to strengthen the process.

Keywords: CM/GC, Project Delivery, Risk Management, Construction Management

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INTRODUCTION

Design-bid-build (DBB) has traditionally been the delivery method used for procuring and managing design and construction services for transportation infrastructure projects across the U.S. However, in recent years, with deteriorating transportation facilities and increasing urban populations, there has been increasing pressure on public agencies to utilize alternative methods to deliver infrastructure projects better, faster, and cheaper (Gransberg 2013). Construction manager / general contractor (CM/GC) delivery is an alternative method that has recently been introduced to meet this demand. In this delivery method, owners, contractors, and design engineers work together to meet project goals, especially with regard to managing risk and incorporating innovation in challenging transportation infrastructure projects. However, since this method is still relatively uncommon in civil construction applications, it is important to identify how these processes affect individual parties. Therefore, this research was initiated to explore how CM/GC processes impact public owners, design engineers, and general contractors individually and how CM/GC processes lead to effective innovation and appropriate allocation of both project and process related risks.

LITERATURE REVIEW

Design-bid-build (DBB) delivery has been the traditional approach for managing design and construction services of public infrastructure works. In DBB delivery, the design and construction services are procured under separate contracts, with design selected through qualifications and construction selected through a competitive low-bid system (Minchen et al. 2014). However, this method has been noted to include certain negative aspects such as fostering adversarial relationships between project parties, limiting innovation, and allowing significant growth in project cost and duration (Minchen et al. 2014). To help alleviate these problems, alternative delivery methods are being used with more frequency. Design-build (DB) delivery, utilizes the designer and contractor acting as a unified team to deliver a project at a set price (Minchin et al. 2014). This method has proven effective for transportation projects for well over two decades, but many owners dislike releasing control over the design process. A more recent alternative method, construction manager / general contractor (CM/GC) delivery, has become increasingly popular, because it addresses the concern of owner control over design (CDOT 2015). In CM/GC delivery the public owner engages a design professional and contractor under separate contracts. The contractor acts as a construction manager providing consulting and estimating services in the development and design phases of the project, and as the general contractor providing management and construction services during the construction phase (West et al. 2012). Although the design engineer and contractor work together, they are not linked together contractually (Gransberg and Shane 2010). Because design and construction processes are directed by the owner, the public agency maintains control over the design, budget, schedule, and flexibility in meeting the changing needs of the project.

There have been a number of studies performed in understanding how CM/GC processes affect transportation infrastructure projects. West et al. (2012) concluded that the two most important elements of CM/GC success are managing risk and creating an environment of trust. Tran and Molenaar (2015) indicated that the three principal advantages of using CM/GC delivery include the ability to innovate, allocate risk, and generate cost savings. CM/GC processes allow for more flexibility in allocating risk to the appropriate parties throughout the project, thus increasing the ability to innovate and lowering the cost (CDOT 2015). CM/GC delivery also allows for increased innovation because the typical CM/GC environment is rich in collaboration (Minchin et al. 2014). Managing both project and process related risk is important within CM/GC delivery, because the presence of risk determines cost, impacts schedule, and affects quality. Risk can generally be thought of as uncertainty that can have a positive or negative effect on cost, time, quality, etc. (Ashley et al. 2006). Project related risks are those associated with each unique construction project, such as traffic management, unknown utilities, or specific material availability. Process related risks, on the other hand, are those inherent to the construction process, such as exceeding budgeted costs, delays in schedule, low quality, collaboration, and flexibility. Although the overall CM/GC process and the affects to the project have been studied,
Advantages and Disadvantages of CM/GC Delivery in Transportation Construction

this research was initiated to specifically establish how CM/GC processes affect public owners, design engineers, and general contractors, individually.

METHODOLOGY

The primary form of data gathering for this research included surveying individuals experienced in CM/GC delivery using the Delphi method and compiling responses through pattern coding. The Delphi method is characterized by multiple rounds of information gathering, and is widely used for gathering data from experts (Hallowell and Gambatese 2010). A mixed methods approach was utilized for evaluating the data. The first part of the survey consisted of free response questions regarding the perceived top three advantages and disadvantages of the CM/GC process to each individual party, types of projects best suited for CM/GC delivery, and the ability for risk management and innovation to occur in CM/GC delivery. The mechanics for coding this data included selecting the relevant responses within the context of the research framework, identifying repeating ideas, organizing them into coherent categories, grouping themes into abstract concepts, and providing the cumulative response (Auerbach and Silverstein 2003). This type of content analysis is often used to identify and report population trends and obtain feedback from experts. The survey also asked participants to rate CM/GC processes relative to design-bid-build (DBB) and design-build (DB) project delivery and the perceived level of risk sharing occurring in these different delivery methods.

Three different groups were targeted to participate in this research: contractors, public owners, and design engineers with extensive CM/GC experience on transportation projects. Fifty-one individuals participated in this study, distributed equally between the three different groups. The number of experts participating in this research met appropriate sampling guidelines for this type of research (Hallowell and Gambatese 2010). The individuals selected to participate in this research included representatives from experienced public transportation agencies, construction companies, and design firms in states that were early adopters of CM/GC delivery. The results represent the collective experience of seven public agencies, ten construction companies, and ten engineering design firms.

FINDINGS

The primary purpose of this research was to investigate the perception of advantages and disadvantages of CM/GC delivery within the transportation industry for designers, owners, and contractors, individually. The intention was to compare and contrast the principal motivators and detractors for each of the individual parties. Research participants were asked to identify the top three advantages and disadvantages of the CM/GC delivery process to themselves. Pattern coding was used to separate participant responses into three principal categories: process risk, innovation, and project risk. Process risk was further broken into four distinct sub-categories that emerged: collaboration and flexibility, cost, schedule, and quality, as shown in Figure 1. Tables 1 and 2 identify the number of responses regarding the various advantages and disadvantages of using CM/GC delivery identified by each party.

The relative breakdown of participant responses for the advantages associated with these six categories of results is shown in Figure 1. Note that the data shown in this figure represents the normalized distribution of the advantages and disadvantages provided by survey participants, which were later subdivided into the categories and sub-categories shown during data analysis. It is further noted that various parties could very well have different perspectives related to these variables. For example, a contractor could experience a profitable project and see that as an advantage while an owner might perceive this as a project going over budget and therefore a disadvantage of the process. Therefore, Figure 1 is simply meant to show the relative perceptions that exist for the three parties regarding the six categories shown. All three parties provided significantly more response associated with quality, than any of the other categories. The other categories elicited a fairly uniformly distributed response for the remainder of the advantages listed. These results imply that all three parties find personal advantage and motivation for participating in CM/GC delivery in similar ways. On the other hand, disadvantages
Advantages and Disadvantages of CM/GC Delivery in Transportation Construction

The specific advantages of using CM/GC delivery for each of the individual parties are summarized in Table 1, according to overall response frequency. As with the previous figure, this data provides the distribution of the relative perception of the advantages of using CM/GC for each party. Fifteen different types of advantages were noted. Enhanced design through constructability generated significantly more response than any other, followed by improved project risk management and collaboration, flexibility, and reduced disputes. This means that each of the individual parties greatly value the effect that collaboration during design helps them in fulfilling their individual responsibilities throughout the entire project. In general, all three parties acknowledged individual benefits in a similar sequence, although designers did not acknowledge benefit in nearly as many areas. Owners acknowledged more personal benefit with regard to minimized changed orders and added scope. Cost certainty and minimized change orders were also listed by owners in two previous studies (Gransberg and Shane 2010; Schierholz et al. 2012), implying that cost-related advantages are principal motivators for owners to choose CM/GC delivery. Designers acknowledged benefitting from owner controlled design. Conversely, designers did not indicate as much personal benefit for managing project risk or collaboration, flexibility, and reduced disputes, as did contractors and owners. All three parties indicated that working in an innovative environment drew them to CM/GC delivery. Similar to the benefits of the overall process, individual parties generated responses for personal benefit that followed a strong teamwork theme.

The specific disadvantages of using CM/GC delivery for each of the individual parties are summarized in Table 2, according to overall response frequency. As with the previous table, this data provides the distribution of the relative perception of the disadvantages of using CM/GC for each party. Sixteen different types of disadvantages were generated. Unlike the advantages of CM/GC delivery, the disadvantages did not appear to follow a similar sequence, thus indicating that the disadvantages of CM/GC delivery for the individual parties are not aligned. Contractors were most concerned about control, less profit due to open book accounting,
associated with generating the request for proposal (RFP), and subjectivity in the selection process. Owners generated the largest variety of response and identified the principal disadvantages to them as the high demand on qualified staff, the lack of competitiveness in bidding, and the added cost and effort associated with design and construction. Designers generated the least variety in response and indicated disadvantages associated with the added cost and effort associated with design and construction, the contractor being brought into the design process too late, questions over control, and the added time in design and construction. There was very little overlap between the top disadvantages for the individual parties, indicating that the parties are concerned with different process elements. The disadvantages identified by the different project participants for themselves specifically identify issues of CM/GC delivery that may be a deterrence individually. While many disadvantages to the process were similar to those identified in prior studies (Gransberg and Shane 2010; Schierholz et al. 2012), disadvantages by project role were more varied. Acknowledging and addressing these differences should be the next focus in strengthening the CM/GC process.

### Equitable Risk Sharing

Project delivery risk theory indicates that most of the risk is held by the owner in DBB delivery, most by the contractor in DB delivery, and balanced risk sharing in CM/GC delivery because of the deliberate distribution of risk to the party best able to handle it (CDOT 2015). Project delivery risk theory also indicates that the total risk for DB or DBB delivery remains the same, while CM/GC delivery reduces the overall risk on a project. One unique objective of this research was to gage the perception of risk sharing that actually occurs for these different delivery methods. Research participants were asked two specific questions to explore the perceptions of general risk theory. First, what percentage of risks are borne by the contractor under the three different project delivery methods? Participants collectively indicated that the contractors on DBB projects carry about one-third of the risk, conversely meaning that the other two-thirds of the risk is borne by the owners (Figure 2). Individually, contractors felt that they carried more DBB related risk than did the other two groups. On the other hand, participants collectively indicated that the contractors on DB projects carry about two-thirds of the risk (Figure 2). Individually, the perception was much closer between groups. Finally,

### Table 1: Summary of advantages of using CM/GC delivery for individual parties

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Contr.</th>
<th>Own.</th>
<th>Des.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced design through constructability</td>
<td>14</td>
<td>9</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>Improved project risk management</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Collaboration, flexibility, reduced disputes</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Owner design control</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Environment supporting innovation</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Best value selection process</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Minimized change orders and added scope</td>
<td>2</td>
<td>8</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Fair market value and open book accounting</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Optimized schedule</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Schedules focused on goals/reduced impact</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Real time pricing and value engineering</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Phasing and accelerated start to schedule</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Third party coordination</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Design phase savings</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Additional preconstruction time</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
participants collectively indicated that risk is equally shared between the contractor and owner with CM/GC delivery. This latter result was nearly unanimous across all three groups. These results indicate that although there are some differences in perception regarding the level of risk carried by the contractor for DBB and DB delivery, CM/GC processes support equitable risk sharing. Second, is overall project risk reduced by CM/GC delivery? More than 80% of participants agreed that CM/GC processes did reduce total project risk, but without consensus regarding how much.

Although this research didn’t specifically investigate the actual level of risk carried by individual parties, it did indicate that CM/GC risk negotiation processes led parties to feel like they were equally sharing the risk. Shared management of risk was a constant theme repeated by participants in this research. Contractors noted that with DB delivery they felt the weight of being responsible for most project risk. However, with CM/GC delivery, risks were less often seen as owner risk to be managed solely by the owner, or as a contractor risk to be managed solely by the contractor. Rather,

Table 2: Summary of disadvantages of using CM/GC delivery for individual parties

<table>
<thead>
<tr>
<th>Disadvantages</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added cost and effort in design and preconstruction</td>
<td>1 7 6 14</td>
</tr>
<tr>
<td>High demand on qualified staff</td>
<td>3 11 0 14</td>
</tr>
<tr>
<td>Questions over control</td>
<td>7 2 4 13</td>
</tr>
<tr>
<td>Lack of competitive bidding</td>
<td>0 10 1 11</td>
</tr>
<tr>
<td>Subjective selection process</td>
<td>5 2 0 7</td>
</tr>
<tr>
<td>Contractor sometimes brought in late</td>
<td>1 1 5 7</td>
</tr>
<tr>
<td>Added time in design and preconstruction</td>
<td>0 3 4 7</td>
</tr>
<tr>
<td>Open book accounting means less profit</td>
<td>6 0 0 6</td>
</tr>
<tr>
<td>Cost of request for proposal</td>
<td>5 0 0 5</td>
</tr>
<tr>
<td>Difficulty of collaboration and disputes</td>
<td>2 2 1 5</td>
</tr>
<tr>
<td>Accelerated schedule conflicts with right of way</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Negotiation phase</td>
<td>0 3 0 3</td>
</tr>
<tr>
<td>CM/GC learning curve</td>
<td>1 2 0 3</td>
</tr>
<tr>
<td>Transparency in innovation and value engineering</td>
<td>2 1 0 3</td>
</tr>
<tr>
<td>Lack of change orders</td>
<td>1 0 0 1</td>
</tr>
<tr>
<td>Not suitable for smaller/simpler projects</td>
<td>0 1 0 1</td>
</tr>
</tbody>
</table>

Figure 2: Perceived risk carried by the contractor for different delivery methods
Three of the top four overall advantages to reducing process risk for the parties individually were quality related, including enhanced design by constructability, owner design control, and best value selection. The other was the ability to improve collaboration. Three of the top four overall disadvantages related to process risk for the parties individually were cost related, including added cost and effort in design and construction, high demand on qualified staff, and lack of competitive bidding. A quality related disadvantage, questions over control, rounded out the top four disadvantages. Farnsworth et al. (2016) provides a detailed analysis of the advantages and disadvantages to process risk when using CM/GC delivery for transportation projects.

Project Risk

The ability for CM/GC delivery to affect project related risk generated 13% of the collective results regarding the advantage responses and only 1% of the disadvantage responses. The three research groups were asked to rate the ability of CM/GC delivery to minimize and manage project risk compared to both DBB and DB project delivery (Figure 3). The overwhelming majority of respondents indicated that project risk is managed better using CM/GC delivery over traditional DBB delivery. With DB delivery, however, the results were not nearly as strong. Most still felt that CM/GC delivery provided better project risk management capability than DB delivery. However, each group did have some respondents who felt DB provided a superior method of managing project risk.

Research participants were asked to identify the types of projects that were best suited for CM/GC delivery. In general, respondents stated that CM/GC delivery was ideal for projects for which the owner needed to maintain control, possibly where the owner was under strict scrutiny and with a large dollar amount. Respondents further indicated that projects with challenging construction constraints and atypical challenges involving schedule, procurement, urban reconstruction, utility coordination, complex facilities or structure, geotechnical issues, political or stakeholder issues, or difficult levels of traffic were appropriate for CM/GC delivery. CM/GC candidate projects were described as complicated, multi-disciplinary, cost-sensitive, time-impaired,
and complex. Respondents often repeated the phrase “high risk” in association with CM/GC projects, including projects with multiple unknowns, risks that were difficult to quantify, and undefined or variable scope. In short, the project characteristics that pose a threat to project objectives under other delivery methods are ideal characteristics for CM/GC delivery. Owners, noted that CM/GC delivery may not be suitable for small or simple projects (Table 2). Although this only showed up once as one of the top three disadvantages, other respondents also confirmed this notion in other comments. For projects described as low risk, straightforward, with no sensitive community settings, and a low dollar project value, CM/GC may not work as well or may have minimal benefit. CM/GC delivery would require more difficult implementation or more coordination than should be necessary for a smaller project. This should be highly considered by agencies looking for reasons to implement CM/GC delivery. CM/GC delivery should also not be considered a one size fits all delivery method, and agencies should consider the value provided by selecting CM/GC delivery on a project.

Participants indicated that within CM/GC processes, project-specific risks were better understood and planned for than in DBB delivery, and risk levels were more manageable than in DB delivery. Further, the integrated team approach provided by CM/GC delivery created an ideal setting for risk identification and management, and the iteration of design and risk analysis promoted the identification of new risk. Effectively identifying issues up front led to fewer change orders during construction. Eighty percent of participants agreed that CM/GC processes succeeded in reducing the overall risk of construction and helping project teams manage risk. According to the participants, this risk reduction resulted from collaborating early and often, more effectively identifying and accounting for unknowns (e.g., material supplies, existing conditions, etc.), team discussion of risks, all parties quickly formulating plans and solutions, the ability to easily incorporate minor design changes to avoid potentially damaging contract delays, and understanding construction means and methods.

According to the research participants, the sharing of risk savings under CM/GC processes was a complex issue that varied from contract to contract. Risk savings are essentially contingency funds not used or other project costs not needed because of effective risk management. Risk savings were differentiated by those associated with the design or construction phases of the project. During the design phase, the team worked to retire risks, avoid risks entirely, and mitigate unavoidable risks. These...
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Risk reduction efforts were ultimately an investment in reducing the cost eventually payed for realized risks. Participants indicated that this allowed the owner to more closely pay for actual conditions during construction. Therefore, the owner was the principal recipient of savings associated with design phase risk reduction. During the construction phase, the sharing of risk savings was based on risk and contingency ownership. The party holding the contingency for the risk was the party that would retain any unused contingency for unrealized risk. A contingency account was typically established based on contractor and designer input, and if the risks did not materialize the savings often stayed in the owner’s budget. CM/GC processes made it possible for the owner to hold the majority of the contingencies, and in this way, the owner also then generally received a majority of risk savings in the construction phase. Even with owner held risk, the contractor could be consulted and a price established in case of risk occurrence. Participants indicated that the savings were often reinvested back into the project to build more scope, thus benefitting the project and the individual parties involved. Participants noted that although a majority of risk savings belonged to the owner, the contractor could still benefit indirectly from risk savings. Generally, contractors were able to cater the project to their expertise, and thus maximize the cost benefit to the owner and themselves. In some instances risk savings were split, when risks were identified and the responsibility shared during construction.

Unfortunately, owner-dominance over the benefit of risk savings was identified by contractors as a disadvantage of CM/GC delivery. While risk saving and open book processes were highly beneficial to the owner, it was important to build trust and recognize that the contractor must make a fair profit on the project. However, it was difficult to reconcile ‘fair’ to all team players. Having shared savings clauses did not significantly incentivize contractors, but rather added a layer of administration necessary for production of auditable financial records of project costs (Gransberg 2013). Participating contractors for this research were asked which method of delivery they preferred. Although, risk savings sharing and lower profit margins were identified as disadvantages of CM/GC delivery, 73% of participating contractors indicated that they still preferred CM/GC to DBB or DB delivery. Respondents indicated that contractors generally make the most profit through DB delivery, but that CM/GC was the best option from an integrity standpoint and provided the greatest value to all parties. While DB delivery allowed contractors to control the project, the risk was inherently higher. Therefore, CM/GC delivery was preferred from a project risk standpoint.

Innovation

Innovation is another specific approach for addressing the risk associated with highway construction. Innovation can be thought of as either new or inventive materials, techniques, or processes used in a non-traditional manner for addressing construction related challenges. While the initial implementation of innovation produces risk, the additional risk is often offset by cost and schedule savings. Innovation in CM/GC projects has been linked to savings of up to 11% of the construction bid, by allowing the contractor to perform work more efficiently (Alder 2012). CM/GC delivery has further been referred to as the ideal method to use when a project contains opportunities and risks that are best addressed through innovation. An integrated CM/GC team can more effectively identify opportunities for innovation and potential risks that may threaten a suggested innovation. CM/GC also allows the owner to distribute and balance the risk of innovation appropriately between project team members (Alder 2012).

The ability for CM/GC delivery processes to foster innovation generated 8% of the collective response regarding the advantages, and 3% of the disadvantages. Individually, an environment supporting innovation was the fourth (tied) most common advantage acknowledged in this research (Table 1). The three research groups were asked to rate the ability of CM/GC delivery to contribute to innovation compared to both DBB and DB delivery (Figure 4). The overwhelming majority of respondents indicated that innovation occurs more readily using CM/GC delivery over DBB delivery. However, relative to DB delivery, the perceived results were mixed. About half of the owners indicated that CM/GC delivery provides an environment conducive to innovation better than DB delivery, but significantly fewer contractors and...
designers felt similarly. This may be because owners play a lesser role in DB delivery, and don’t fully see the innovation occurring therein. The majority of respondents (especially designers) felt that CM/GC delivery allowed for at least equal innovation as DB delivery. On the other hand, each group (including about a third of the contractors) had respondents that still felt DB delivery provides an environment for better innovation, perhaps because owner involvement hampers their ability to freely innovate.

Participants noted that the incentive to innovate in CM/GC delivery typically began during the selection phase, by asking proposers to discuss their approach to innovation during design, how innovation savings would be tracked and reported, ways for minimizing project cost and schedule, and past performance in providing innovation in construction projects of similar size and complexity. This allowed owners to evaluate several approaches to the project prior to selection. Because CM/GC processes involved the contractor in the design and creation of the contract documents, the contractor was able to contribute early to the development of innovation. In DB delivery the contractor directed design to meet the program, yet protect the profit margins. However, with CM/GC delivery, contractors were motivated to innovate during the design phase to drive costs down, so that the owner could award the construction phase.

Participants indicated that CM/GC processes supported innovation by more effectively identifying project-related opportunities and threats. The success of CM/GC delivery is reliant upon designers, sophisticated owners, and contractors with proven experience in the highway construction industry working toward common goals. Participants acknowledged that having the contractor provide input during design helped maximize the innovative capacity of the collective team. This further increased the likelihood of discovering unforeseen threats and identifying opportunities to enhance project goals, ultimately accelerating innovation. Further, CM/GC processes led to more confidence in implementing innovation because concerns were dealt with before completing the plans. This also meant that team members were more familiar with and more willing to accept their portion of risk associated with the innovation. Another way that CM/GC processes fostered innovation was through balanced risk distribution. Sharing risk eliminates the need for a single party to bear the entire risk. CM/GC processes allowed each member of the integrated experienced project team to communicate their perspective regarding the risk approach. As the team began to understand and trust each other, they became more willing to offer innovative ideas and more apt to buy into innovation they helped develop. CM/GC processes effectively enabled the team to consider
the risk associated with applying an innovation and appropriately delegate risk ownership.

Several participants noted that the transparency necessary for innovation and value engineering to occur was a disadvantage associated with CM/GC delivery. CM/GC processes rely heavily on trust, which can take time to develop. Some owners expressed concern that contractors may knowingly hold information back. Conversely, some contractors were concerned that CM/GC processes exposed all their value engineering ideas. However, in a second round of questioning, most did not see transparency as a barrier to implementation. It seems that as owners and contractors become more experienced with CM/GC processes, they are more apt to quickly establish an environment of mutual trust. Because the selection process is highly competitive, contractors need to include their innovation and value engineering ideas within the proposal if they want to be seriously considered for the project. Also, because innovations often focus on means and methods that are not readily transferred, contractors are at little risk of losing the value of an innovation to a competitor. By disclosing innovations, contractors demonstrate their understanding of the project and their willingness to partner. Likewise, owners should be willing to compensate fairly to help foster the climate of trust necessary for innovation to thrive.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research was to explore the effects of CM/GC project delivery on process risk, project risk, and innovation in transportation construction projects, and compare how CM/GC processes affect public owners, design engineers, and general contractors, individually. This research indicates that the majority of experienced CM/GC delivery users agree that CM/GC process result in an overall reduction in project risk. Further, and perhaps more importantly, all three groups were nearly unanimous in their perception that CM/GC processes lead to equitable risk sharing. Not only is the risk balanced between contractors and owners, but CM/GC processes more readily allow for appropriately allocating the risk to the party best able to handle the risk. Although the actual distribution of risk may vary from project to project, simply having the perception of equal risk sharing certainly leads to more open trust and collaboration, the very essence of successful CM/GC delivery execution. This is an important finding, in that both experienced owners and contractors have validated the integrated team approach fundamental to CM/GC delivery. As CM/GC delivery for transportation construction continues to grow, maintaining balanced risk sharing must be continually safeguarded.

The principal advantages of using CM/GC delivery to the individual groups included improved project risk management, collaboration, and enhanced design through constructability. Disadvantages, on the other hand, varied quite differently between individual parties. This in turn indicates that each individual group still ascertain undesirable aspects of using the CM/GC process, each deterred by something differently. Generally, notable disadvantages included increased cost in design and preconstruction, high demand on qualified staff, questions over control, and a lack of competitive bidding. The noted disadvantages do not appear to be fatal features of the CM/GC process because of the overwhelming positive feedback regarding CM/GC delivery provided in this research. However, having an understanding of what individual groups consider to be negative aspects of CM/GC delivery provides a basis for strengthening the process further by resolving differences and reinforcing mutual benefit. Finding solutions to the disadvantages identified in this research should be the focus of further research.

Research participants shared their perception of the ability of CM/GC to minimize project risk and contribute to innovation relative to DBB and DB delivery. With regard to DBB delivery, nearly all responses suggested that CM/GC delivery is better at minimizing project risk and contributing to innovation. When CM/GC delivery was compared to DB delivery, the results were mixed. Most felt that CM/GC delivery was better or at least equal to minimizing project risk relative to DB delivery. Respondents also acknowledged that CM/GC processes do indeed promote innovation, but not necessarily better than DB delivery. About half of the owners indicated it was better, but this may simply be the result of a more hands on experience for them when utilizing CM/GC delivery. Most designers and contractors felt that DB and CM/GC delivery equally contribute to innovation. These results indicate that CM/GC delivery provides benefit compared to DB delivery, with regard to project risk and innovation. However, there are many who feel that DB delivery
is better than, or at least equal to, CM/GC delivery, with regard to reducing project risk and increasing innovation.

The results of this study can be utilized to strengthen the processes associated with CM/GC, as the transportation construction industry continues to expand the use of this delivery method. This research is unique in that it identifies similarities and differences in how owners, contractors, and designers within the construction industry value CM/GC processes with regard to process risk, project risk, and innovation. Understanding these perceptions is an important element in continuing to strengthen the process. By reconciling differences and reinforcing common advantages, the CM/GC delivery process can be further enriched. Finally, although this research was specifically performed within the transportation construction industry, many of these findings may be applicable to other sectors also using the CM/GC delivery process. As more projects using the CM/GC delivery method continue to be completed within the highway sector, more performance data is becoming available. Future research should focus on using this information to accurately quantify the cost, schedule, and quality implications of using CM/GC delivery.

REFERENCES


Hispanic Workers: Identification of Factors Impacting Fatal and Non-Fatal Injuries in the U.S. Construction Industry

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ABSTRACT

The ever-evolving nature of the construction industry, along with using heavy equipment and hazardous materials, increases the potential of accidents and injuries among Hispanic workers, the utmost at-risk population in this industry. This paper seeks to integrate the previously disconnected body of knowledge surrounding the leading factors impacting adverse safety outcomes among Hispanic workers, as well as the list of initiatives taken by the construction industry to effectively address the risk factors between 2000 and 2015. Searches were conducted through library engines and databases, along with the queries in established publications in the construction industry. The articles were critically reviewed to provide a clearer understanding of the current state of Hispanic worker safety in the construction industry. We conclude by suggesting directions for future work associated with improving Hispanic worker safety at construction sites.

Keywords: Hispanic Construction Worker, Safety Training among Latino Construction Workers, Latino Immigrant Construction Workers, Safety Issues for Hispanic Construction Workers, Workplace Fatalities and Hispanic Workers

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Introduction

The demographics of the United States of America have been transforming at a rapid pace and reflect one of the most diverse countries in the world. In fact, today, more than 30% of Americans belong to racial and ethnic minority groups, and midway through this century minorities will constitute almost 50% of the American population (US Census Bureau 2010). The Hispanic population is growing at the fastest pace and represents the largest minority in the US (National Research Council 2008). In this paper, the terms “Hispanic” and “Latino” are used interchangeably. According to the US Office of Management and Budget (OMB), Hispanic or Latino refers to “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The term ‘Spanish origin’ can be used in addition to Hispanic or Latino” (US Department of Labor 2012). In 2013, there were almost 54 million Hispanics living in the US, accounting for 17% of the US total population (US Census Bureau 2013). At this point, the largest Hispanic population was in California, with 14.7 million (US Census Bureau 2013a), and the highest percentage resided in New Mexico (47.3%) (US Census Bureau 2013b). The US Census Bureau projects that the Hispanic population will constitute 25% of the total population in the US by 2050 (Tossi 2006). In addition, projections estimate that people of Hispanic origin will add 37.6 million people to the labor force, an 80% total growth rate, while non-Hispanics will add only 9 million workers between 2010 and 2050 (Toossi 2012).

Hispanic workers play a central role in the US construction industry and have a remarkable impact on US construction activities. According to the Bureau of Labor Statistics (2013a), Hispanics constitute 44.3% of the US construction industry—the number of Hispanic employees in the construction industry is higher than in any other industry. In particular, Hispanics account for almost one in every four workers in the construction industry (US Department of Labor 2012). From 1990 to 2010, the number of Hispanic workers in the construction industry almost tripled, from 9% (705,000) in 1990 to 24% (2.2 million) in 2010 (CPWR 2013).

Within the construction industry, employee safety is a major challenge (McGraw-Hill Construction 2013). Representing 18% of fatal injury cases, the construction industry holds the greatest fatality rate across various industries. According to the Bureau of Labor Statistics (2013b), in 2012, 775 workers were killed in the private construction sector. Additionally, Lavy et al. (2010) mentioned that “[a] major challenge faced by American construction companies is the continually increasing number of fatalities among its Hispanic workers.” It is, therefore, imperative to identify potential factors and variables negatively impacting the safety of Hispanic workers and to attenuate their effects.

Background

Hispanic Workforce Demographic

The Hispanic workforce in construction is internally diverse. There were more than 2.2 million Hispanic construction workers in 2010, and 75% of them were born outside the US. The majority of foreign-born workers in construction (82%) were born in Latin American countries, with Mexico accounting for 54% of foreign-born workers, followed by El Salvador (6%), Guatemala (5%), Honduras (4%), and a small percentage from other countries in that area (CPWR 2013). Hispanic construction workers are usually young, have little formal education (Roelofs et al. 2011), receive less training, and earn lower wages than non-Hispanic construction workers (Valenzuela et al. 2006; Ochsner et al. 2012). While 18% of non-Hispanic construction workers were union members in 2010, only 7% of Hispanic workers in the construction sector were unionized, revealing that Hispanic construction workers are less likely to be union members (CPWR 2013).

Fatal and Non-Fatal Injuries

The construction industry accounts for the greatest number of Latino worker deaths (BLS 2012). According to the Bureau of Labor Statistics (2012),
the number of fatal injury cases faced by Hispanic workers is more than twice the number of fatalities faced by Hispanic laborers in the transportation industry with the next-closest fatality numbers (Janicak 2013). Despite the overall decline in work-related injuries in the construction industry, occupational fatalities among Latino workers have risen by one-third (Dong et al. 2010b). In 2012, 222 Hispanic construction laborers were killed on job sites, a 12.7% growth from 2011, compared to an 8.7% growth for the overall construction industry (Dong, Largay & Wang 2014).

Literature has cited numerous hazards faced by construction workers, including “lifting heavy loads; maintaining awkward postures; working at heights; experiencing pressure to work quickly; and exposure to chemicals, outside elements, noise, and radiation” (Menzel & Gutierrez 2010). Falls to lower levels are the main cause of fatalities in the construction industry (Dong et al. 2009; Banik 2010; Wendelboe & Landen 2011; Hu et al. 2011; Siddiqui 2014). In 2010, there were 802 deaths in the construction industry, and fall injuries accounted for about 33% of all fatal work injuries in construction (CPWR 2013). The demographics and characteristics of fatal falls demonstrate that fatal injuries are more likely to occur among Hispanic workers than among their non-Hispanic counterparts (Dong et al. 2009). In addition, it was found that immigrant or foreign-born workers encounter a higher risk of fall as the number of fatal falls for foreign-born Hispanic construction workers is considerably higher than the number of fatal falls for Hispanic workers born in the US (Dong et al. 2009). For instance, between 2003 and 2008, 40% of occupational deaths among Hispanic construction workers were caused by falls; almost 80% of those workers were foreign-born (Dong et al. 2010c). In 2010, highway incidents (26.1%) and contact with objects (17.6%) were the second and third leading causes of fatal injuries in construction, respectively (CPWR 2013).

In addition to the considerable number of fatal injuries, the construction industry also suffers from a high rate of non-fatal injuries (Levin 2008). In 2010, there were 74,950 non-fatal injuries resulting in days away from work in construction; being struck by an object was the leading cause of non-fatal injuries in construction. Moreover, falls were the second highest cause of non-fatal injuries in the construction industry (CPWR 2013).

Musculoskeletal disorders are more prevalent among Hispanic construction workers (Caban-Martinez et al. 2010). A study among Hispanic construction workers showed that 47% of workers reported chronic musculoskeletal pain 30 days prior to their interview date; of these, 87% announced that the musculoskeletal pain interfered with their work activities (Caban-Martinez et al. 2010)

**Injury Underreporting**

Research reports an undercounting of actual occupational injuries in published injury cases (Azaroff et al. 2002; Ruser 2010; Schoenfisch et al. 2010). In particular, underreporting workplace injuries is widespread among Latino workers (Buchanan et al. 2005). Dong et al. (2011) confirmed injury undercounting within the construction industry and showed that official data sources, such as the Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses (SOII), underreport 75% of severe injuries among Hispanic workers in small construction establishments. According to the US Census Bureau (2009), more than 80% of construction companies with payrolls are establishments (1 to 10 employees) (Dong et al. 2011), and they are the most likely to underreport injuries (Larsson 2003; Leigh et al. 2004; Dong et al. 2011). There are numerous factors that impact undercounting of actual occupational injuries, including restrictions on the scope of the workers covered, incomplete capture of injury cases that are reported in other systems, and unreported cases (Ruser 2010)

**Establishment**

Research shows that Latinos working in the residential sector are less risk averse than Latinos in the commercial or heavy civil construction sectors (Bowman et al. 2013). In addition, injury rates are
higher among Hispanics when compared to their non-Hispanic counterparts in residential construction (Dong and Platner 2004; Dong et al. 2010). In general, the residential construction industry is dominated by immigrant workers due to their willingness to take fewer benefits in comparison to unionized workers (Saucedo & Morales 2010). Roofers represent the highest number of injuries among residential construction workers (CPWR 2008).

**Medical Records**

A study on more than 7,000 medical records of construction workers reported that Hispanics are almost 30% more likely to have medical conditions due to workplace injuries compared to white non-Hispanics (Dong et al. 2010). In addition, research shows ethnic disparities in monetary compensation claims among construction laborers injured on construction sites. A study by Friedman, Ruestow, and Forst (2012) linked medical records and worker compensation data and indicated that “white non-Hispanic construction workers are awarded higher monetary settlements despite the observation that for specific injuries the mean temporary total disability and permanent partial disability were equivalent to or lower than those in Hispanic and black construction workers.”

**Purpose of the Study**

The purpose of this paper is to explore the current state of literature in order to identify factors contributing to the disproportionate number of workplace injuries among Hispanic workers. In particular, this paper aims to answer the following research questions: What is known about the factors contributing to the high rate of fatal and non-fatal injuries among Hispanic workers? The paper then discusses the initiatives executed by construction companies as related to improving safety among Hispanic workers.

**Methodology**

The research method employed for this study consists of a literature review and deduces its conclusion from referring to bibliographic information, including peer-reviewed papers, conference proceedings, and other valid forms of literature (Ostadalimakhmalbaf & Simmons 2015). This research method, proposed by Swanson (1986), is called Literature-Based Discovery (LBD), is widely accepted by research communities and is used in a large number of research studies (Weeber et al. 2001; Srinivasan 2004; Kostoff et al. 2006).

Peer-reviewed research papers published after the year 2000 were extracted from four databases including Web of Science, Scopus, Engineering Village, and ASCE Library. Articles in peer-reviewed journals and conference papers comprise a primary source of reviewed information. To narrow the scope of search results, articles in this literature review were chosen based on the following criteria: language, text availability, article type, and publication date. In addition, technical reports from famous effective local and national research institutes, government documents, and other literary sources were also gathered in order to obtain a holistic literature review. The key words used in search engines include the following: Hispanic Construction Worker, Hispanic Workers High Rates of Injury, Safety Training among Latino Construction Workers, Latino Immigrant Construction Workers, Safety Issues for Hispanic Construction Workers, Workplace Fatalities and Hispanic Workers.

Data interpretation is accomplished using the concept of triangulation that includes cross-referencing different sources of information about the same phenomenon (Dixit et al. 2010). This paper applies a similar approach by referring to various literature sources in order to identify factors causing high fatality rates among Hispanic construction workers. After the factors are identified, the information is arranged using a table.
Findings: Causal Factors of Fatal and Non-Fatal Injuries of Hispanics in Construction

Lack of Proficiency in the English Language

Language is a substantial barrier to safety and health for Hispanic construction workers and can impact communication at a job site and eventually raise safety concerns (Anderson et al. 2000; Kouyoumdjian et al. 2003; Brunette 2004; Acosta-Leon 2006; Jorgensen et al. 2007; Dai and Goordum 2010). Halverson (2003) stated that “[t]he primary method of communication is language. If you can’t communicate effectively, then you can’t maintain legitimate safety practices on the job.” According to the Center for Protection of Workers’ Rights (2008), 42% of foreign-born workers cannot speak English very well, and another 42% cannot speak English at all. Failure to communicate effectively decreases the safety of both Latinos and their English-speaking coworkers (Vazquez 2004; CDC 2008). Jaselskis (2004) stated that the inadequate communication flow between English-speaking Americans and Hispanics on a job site has been proved to be a major source of accidents in the construction sector. Likewise, Flory (2001) mentioned that Hispanic workers’ lack of understanding of the hazards around them is the primary cause of fatalities among them. Furthermore, an in-depth interview with 47 Spanish-speaking construction workers from a wide range of construction careers and with a broad range of experience demonstrated that the majority of participants did not understand a considerable amount of safety training when it was taught in English (Ruttenberg & Lazo, 2004). In a survey conducted by Canales et al. (2009) with 97 Hispanic construction craft workers on heavy/highway and commercial projects in Iowa, 55% of respondents reported that a lack of communication is the main barrier on the job site. Additionally, Vazquez (2004) mentioned that almost 30% of Hispanic workers do not speak English. A study by Dong et al., (2013), which utilized nationally representative data from the 2008 Survey of Income and Program Participation, found that “[m]ore than 80% of Hispanic construction workers did not speak English at home and 37% of Hispanic construction workers did not speak English very well or did not speak English at all.” They further discovered that English proficiency was considerably associated with healthcare utilization, and language barriers intensified health disparities among Hispanic workers in the construction industry (Dong et al. 2013). A study by Trajkovski and Loosemore (2006) in the Australian construction industry, very similar in context to the US construction industry, demonstrated that “linguistic ghettos” are created when non-English-speaking migrant workers use their native language to communicate on the job site (Jaselskis et al., 2008). Furthermore, Jaselskis et al. (2008) stated that one of the primary dangers of such linguistic ghettos is the limited ability of migrant workers to interpret safety warnings.

Cultural Differences

Cultural barriers are other factors negatively impacting Hispanics’ safety. Brunette (2004) stated that once Hispanic workers immigrate to the US, they bring with them varied histories, cultural sensibilities, strong health beliefs, and a different cultural background in comparison with non-Hispanic workers. Thompson and Siddiqi (2007) asserted that it is impossible to separate Hispanic cultural issues from safety issues. Understanding cultural differences is the first step to develop positive safety performance for Hispanic workers (Jaselskis et al. 2008). Mismanaging cultural diversity can result in lower morale, lower productivity, and higher accident rates (Loosemore & Lee 2002).

A study by Menzel and Gutierrez (2010) showed that Hispanic workers do not insist that supervisors provide safety gear because they feel frightened by speaking with a person in a position of authority, and they do not communicate due to “machismo and respect for elders.” “Machismo,” or hypermasculinity (Arciniega et al. 2008), a standard behavior displayed by many Latino men, is one of the cultural factors influencing safety and injury rates. Hispanic workers feel that they are less “manly” if they
bring up concerns about safety to a supervisor, and, therefore, they are inclined to ignore safety issues on a job site (Thompson & Siddiqi 2007). “Respeto,” or respect for authority (Robertson et al. 2007; Furman et al. 2009), is another cultural factor influencing the safety of Hispanic workers. Vazquez and Stalnaker (2004) stated that a person in a position of authority has exceptional importance in Hispanic culture, and it is uncommon for Latinos to challenge a supervisor or instructor.

**Low Educational Attainment and Literacy Barriers**

Low educational attainment and illiteracy are other major factors influencing the training of Hispanic workers on safety issues; it will eventually impact the injury rate among Hispanic construction laborers (Boone 2003; Vazquez 2004; Farooqui, Ahmed & Saleem 2007; O’Neal, Shaffer & Rummer 2007; Dong et al. 2009). Regarding foreign-born Hispanic construction workers, this challenge becomes even greater due to their low level of education (Villalobos 2014). Brunette (2004) stated that “a small but significant portion of Hispanic workers are illiterate in their own language,” revealing the illiteracy and lack of education of foreign-born, Spanish-speaking workers. Kochhar et al. (2005) reported that that 62% of foreign-born Latinos have less than a high school diploma in comparison to 20% for Caucasians and 31% for African-Americans, which means that the non-native Hispanics’ understanding of educational construction safety materials could be considerably lower than their English-speaking worker counterparts (Villalobos 2014).

**Inadequacy of Safety Training**

The inadequate training and supervision of workers is another factor contributing to risk and injury among construction workers (Pransky et al. 2002; Buchanan et al. 2005; CDC 2008; Johnson 2010; Kaskutas et al. 2010; Williams et al. 2010; Menzel & Shrestha 2012). In a study by O’Connor (2005) on 50 young Latino construction workers, participants reported that they had received very little health and safety training, particularly those with low English-language literacy (Nissen 2007). Similarly, in a qualitative study conducted in Spanish among Latino workers in Las Vegas, participants identified a lack of or inadequate safety training as a factor contributing to injury risk (Menzel and Gutierrez 2010). It was further found that employer size influences safety training. As evidence, laborers and painters working for small contractors reported that their employers provided no, limited, or ineffective training, while sheet metal workers recruited by large construction companies reported that their employers had strong health and safety training programs (Menzel and Gutierrez 2010).

**Immigration Status Challenge**

Immigration status of Hispanic workers is another contributor to the disparate injury and illness rates between Hispanic and non-Hispanic construction workers (Valenzuela et al. 2006; Seixas et al. 2008; Panikkar et al. 2012). Sanders (2007) stated that the majority of immigrant Hispanic workers employed in the US construction industry are the sole supporters of not only their immediate families, but their distant relatives, too (Lavy, Aggarwal & Porwal 2010). Furthermore, due to the economic burden on immigrant Hispanic workers to stay employed (Walter et al. 2002; Lopez del Puerto et al. 2013), they are more inclined to be employed in more hazardous occupations (Azaroff et al. 2004; Brunette 2005; McCauley 2005) that offer fewer opportunities for worker control of the work process and less job security (Roelofs et al. 2011). As a result, they are exposed to higher rates of fatal occupational and non-fatal occupational injuries than those who are native-born (Ahonen and Benavides 2006). According to Arcury et al. (2014), immigrant Latino workers, irrespective of their documentation status, are not commonly inclined to communicate with anyone who might be associated with the government, such as safety inspectors and health officials, due to past discrimination and fear of deportation. Additionally, according to the Widely Human Rights Immigrant Community Action Network, “publicized enforcement actions by immigration officers and local police increased
workers’ fears and distrust” (Williams et al. 2010). Moreover, insecurities associated with immigration status, such as fear of losing their job or facing deportation (Aizenman 2008; Irizarry 2009), are major factors causing widespread underreporting of workplace injuries among Latino workers (Buchanan et al. 2005). In addition, less accessibility to training and general civil rights is another effect of the absence of immigrant Hispanic workers’ legal authorization to work (Aveiga 2007).

**Lack of Work Safety Culture**

Lack of work safety culture is another factor affecting the safety of Hispanic workers in the construction industry (Ochsner et al. 2008). A qualitative study by Roelofs et al. (2011) showed that Hispanic construction workers face excessive pressure to work quickly and fear supervisor retaliation, mostly in the form of getting fired or not being offered future work, if they point out unsafe conditions. In addition, Dong et al. (2009) stated that the presence of deficiencies such as inadequate funding and operational capabilities could result in “cutting corners” related to safety and health training and safety equipment installation and usage, leading to high rates of injury and death on construction work sites among Hispanic workers.

Literature findings are shown in Table 1.

**Recommendations: Initiatives Executed by Construction Companies**

In this section, we review the various initiatives taken by different organizations to enhance Hispanic workers’ safety. These are recommendations made by these organizations to address the high rate of injuries among Hispanics workers in the construction industry in the United States.

Hands-on training is one of the initiatives taken by construction companies to address safety concerns (Thompson and Siddiqi 2007). It is a powerful method to improve safety understanding, bridge literacy and language barriers, and reduce injuries (Vazquez and Stalnaker 2004; Nash 2004). Hands-on training assists workers in learning safety skills for dealing with tools and equipment that they are expected to operate on the job sites (Lavy et al. 2010).

English as a Second Language (ESL) courses are another training method designed to overcome language barriers on construction sites. ESL courses can enhance the communication between a company and its Hispanic workers and assist the Hispanic labor force in understanding construction risks (Jaselskis 2004). Vocabulary cards are other tools used by supervisors to improve the English communication skills of Hispanic workers (Lavy et al. 2010).

A safety training program at the Dallas/Fort Worth airport reveals another effort to improve Latino construction workers’ safety. In partnership with the two main contractors for the airport project, BEST Institute Inc. developed a 40-hour safety program to train almost 13,000 workers (nearly half of them took the course in Spanish). The Best Institute used a culturally based approach to train workers, meaning the instructors were from the same culture and spoke the same language as workers. The multi-billion dollar project had a remarkable safety record: 23 million man-hours of construction had no fatalities and lower injury and illness rates in comparison to the national average for heavy construction projects (Nash 2004; Boone 2003).

Another safety training program was developed by the Associated Builders and Contractors Mid-Gulf Chapter to help workers learn construction phrases and words in English and to teach Hispanic workers about job safety in Mobile, Alabama. The program involved new teaching aids, including crossword puzzles and versions of television game shows such as Wheel of Fortune and Concentration (OSHA 2005).

Bilingual initiatives have addressed inadequate communication among Hispanic construction workers (O’Connor 2002; Stakes 2006). In order to help Hispanic employees overcome the language barrier, the Occupational Safety and Health Administration (OSHA) has run radio and
television advertisements on Spanish-language stations (Thompson and Siddiqi 2007). In addition, OSHA has offered 10- and 30-hour-training programs in both English and Spanish [Occupational Safety and Health Administration n.d.]. According to the OSHA Training Institute (2011), trainers are required to spend 1.25 hours on falls in the 10-hour multi-subject course (Menzel and Shrestha 2012). Moreover, OSHA has provided bilingual dictionaries for both workers and employers to understand frequent safety words used at construction sites (Lavy et al. 2010). Furthermore, OSHA has developed the OSHA en Español Website for Spanish-language workers, as well as online publications such as cards, posters, and public service announcements in Spanish (Stakes 2006). However, there are numerous problems with the material available on the OSHA Website, such as being very text-heavy, even in their Spanish versions, and needing a high reading skill for effective interpretation of materials (Evia 2010). In addition, while translating material into Spanish can help, it is not essentially a practicable safety training method for all Hispanic construction workers, as many of them are not literate in Spanish or English (Evia and Patriarca 2012).

A bilingual communication and safety training program performed by Torcon, Inc. in New Jersey has reduced workplace injury rates by about 30% and has enhanced

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<tr>
<th>Risk Factors</th>
<th>Description</th>
<th>Sources</th>
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<tr>
<td>Lack of Proficiency in the English Language</td>
<td>Inadequate communication flow between English-speaking Americans and Hispanics in the job site; lack of understanding of hazard and safety training when taught in English; linguistic ghettos</td>
<td>Anderson et al. (2000); Flory (2001); Halverson (2003); Kouyoumdjian et al. (2003); Brunette (2004); Jaselskis (2004); Ruttenberg and Lazo (2004); Vazquez (2004); Acosta-Leon (2006); Trajkovski and Loosemore (2006); Jorgensen et al. (2007); CDC (2008); Jaselskis et al. (2008); Canales et al. (2009); Dai and Goordum (2010); Dong et al. (2013)</td>
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<tr>
<td>Cultural Differences</td>
<td>Machismo or hypermasculinity; respeto or respect for authority</td>
<td>Loosemore and Lee (2002); Brunette (2004); Vazquez and Stahlaker (2004); Robertson et al. (2007); Thompson and Siddiqi (2007); Arciniega et al. (2008); Jaselskis et al. (2008); Furman et al. (2009); Menzel and Gutierrez (2010)</td>
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<tr>
<td>Low Educational Attainment and Literacy Barriers</td>
<td>Little formal education; illiteracy and lack of education among foreign-born, Spanish-speaking workers</td>
<td>Boone (2003); Vazquez (2004); Kochhar et al. (2005); Farooqui, Ahmed &amp; Saleem (2007); O’Neal, Shaffer &amp; Rummer (2007); Dong et al. (2009)</td>
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<td>Inadequacy of Safety Training</td>
<td>Little health and safety training among Hispanic workers with low English-language literacy; small contractors: no, limited, or ineffective training; large contractors: strong health and safety training programs</td>
<td>Pransky et al., (2002); Buchanan et al. (2005); O’Connor (2005); Nissen (2007); Johnson (2010); Kaskutas et al., (2010); Menzel and Gutierrez (2010); Williams et al., (2010); Menzel and Shrestha (2012)</td>
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<td>Immigration Status Challenges</td>
<td>Being employed in more risky occupations; underreporting workplace injuries; insecurities associated with immigration status such as fear of losing their job or facing deportation; less accessibility to training and general civil rights due to absence of legal authorization to work</td>
<td>Azaroff et al., (2004); Brunette (2005); Buchanan et al. (2005); McCauley, (2005); Ahonen and Benavides (2006); Aveiga (2007); Sanders (2007); Aizenman (2008); Irizarry (2009); Lavy, Aggarwal &amp; Porwal (2010); Panikkar et al. (2012); Lopez del Puerto et al. (2013); Arcury et al. (2014)</td>
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<tr>
<td>Lack of Work Safety Culture</td>
<td>Facing excessive pressure to work quickly; fearing supervisor retaliation; cutting corners</td>
<td>Dong et al. (2009); Roelofs et al. (2011)</td>
</tr>
</tbody>
</table>
employee relations. The Torcon Inc. safety program incorporated several items: for job sites with Hispanic workers, contractor supervisors were mandated to be bilingual; site safety orientations were held in both English and Spanish; written orientation materials, health and safety posters, safety training videos, and emergency evacuation procedures were in both languages; and all the company’s contractors were required to hold weekly bilingual safety meetings with documentation that the contractor’s employees attended (Baukh 2004).

In order to advance the safety and health among day laborers in construction, OSHA Region V held a Construction High-Risk Worker Summit in Hillside, Illinois. The summit included several events, such as providing opportunity for two panels of high-risk construction laborers to discuss their experiences regarding safety on job sites, presentations on effective educational methods for day laborers, and adoption of health and safety into recruitment training programs by construction professionals.

**Using New Technologies**

Clevenger and Lopez del Puerto (2011) developed a construction safety training module featuring building information modeling (BIM)-enabled 3D visualization in order to improve safety training for Hispanic construction workers. A training module was developed to test the effectiveness of using this method to train Latino construction workers. In an effort to develop the training module, a Google SketchUp model was viewed as a 3D animation depicting a sequence of scenes to demonstrate different construction stages. The researchers then produced an interactive training module using Adobe Captivate 5 software. The animations were narrated at a limited literacy level and used generic, “standard” Spanish, a language familiar to the workers. In addition, they comprised basic OSHA laws and workers’ rights to safe and healthy conditions. Findings of the initial training module development and implementation suggest that 3D visualization can be an effective tool to train a diverse population.

A study conducted among Hispanic workers in the Philadelphia region explored how to effectively reach Latino construction with safety and fall prevention messages through social media, including email, text messaging, and Facebook. According to the findings, text messaging (SMS) and Facebook were both useful, yet different and specific, for reaching Latino construction workers. In addition, it was found that emails are a less effective means of reaching Hispanic workers than Facebook and text messaging (CPWR 2014).

Research has shown that enhancing work safety climate can result in improving work safety among Latino residential construction workers (Zohar 2010). In order to improve work safety climate among Latino immigrant workers in western North Carolina, a cross-sectional survey was conducted among 119 Latino residential framers, roofers, and general construction workers. Researchers further used an interactive voice response (IVR) system among more than 75% of the respondents for collecting longitudinal daily diary data for up to 21 days. The survey included questions regarding the perception of workers toward personal protective equipment (PPE) and work safety climate. The results demonstrate the positive associations of work safety climate with individual (glove-related risks) and collective work safety behaviors (attended daily safety meeting, not needing to use damaged equipment, not seeing coworker create an unsafe situation) of Latino construction workers (Arcury et al. 2012).

In order to decrease fatal falls from ladders among Latino construction laborers, the entertainment-education television show Telenovela (Spanish-language soap opera) was employed. Three ladder safety messages were embedded in the show’s storyline: use the appropriate ladder for the job, secure the top and bottom of the ladder, and avoid holding tools in your hands as you climb a ladder. The results of the pre- and post-show audience surveys indicate that employing culturally relevant media can be an effective method for educating Latino construction laborers about ladder safety.
Community-Based Participatory Research Efforts

The importance of community-based participatory research (CBPR) with community-based groups such as worker centers is gaining wider acceptance by occupational safety and health research communities and is being used in a large number of research studies because it offers the possibilities of more effective intervention and valid evaluation (Goldenhar et al. 2001; Israel et al. 2005; Daltuva et al. 2009; Minkler et al. 2010; DeSouza et al. 2012; Ochsner et al. 2012). The next few paragraphs will discuss the CBPR programs undertaken to promote the health and safety knowledge and skills of Hispanic construction workers.

CBPR conducted by Forst et al. (2013) aimed to enhance knowledge, hazard identification, and self-efficacy of foreign born, Hispanic construction workers. For that purpose, worker leaders from so-called Worker Centers trained, serving as Hispanic worker peer-educators; a total of 446 workers were trained over three years by 32 worker leaders. The findings indicate that using a CBPR approach resulted in enhancing awareness of workplace hazards and self-efficacy among low-wage, low-literacy Hispanic construction workers.

In order to improve working conditions for day laborers, a partnership between the San Francisco Department of Public Health’s and La Raza Centro Legal’s Day Labor Program and Women’s Collective implemented a project called Jornaleros Unidos con el Pueblo (Day Laborers United with the Community) from 2003 to 2007. The project used CBPR, in which the knowledge, demands, and participation of day laborers were reflected. The project included various interventions, such as peer-led vocational training on construction skills and safety, a 10-week United Workers’ course designed to make workers become aware of rights and leadership competencies, a participatory research study that documented challenges encountered by 280 Bay-Area domestic workers, and 12 digital stories profiling day laborers’ lives and workplace hazards (San Francisco Department of Public Health n. d.).

In an effort to promote fall protection among Latino construction laborers, research was conducted among Latino workers and small residential contractors in San Francisco and Philadelphia by the Labor Occupational Health Program, University of California at Berkeley, and the Philadelphia Area Project on Occupational Safety and Health (PhilaPOSH). It was found that economic circumstances, along with inadequate enforcement and vulnerabilities of the foreign-born workforce, are major factors influencing fall risk in residential construction. Furthermore, the researchers inferred that raising awareness of fall protection cannot be executed exclusively by focusing on Latino laborers in the construction industry and further research is required on incentives to impact contractor behavior and assist the progress of adoption of fall protection measures (Teran et al. 2015).

Protección en Construcción was a community-university-labor partnership project undertaken in Lawrence, Massachusetts, an area comprising a considerable Hispanic immigrant workforce. The project developed technical interventions for fall prevention and silica exposure prevention for Hispanic construction workers in the Lawrence metropolitan area. The intervention was a contractor and supervisor training program called Leaders in Safe Construction (LISC). The LISC program used in-class and on-worksite training to identify and address hazards, safety communication, and leadership approaches (CDC 2013b).

Another project for improving safety practices among Latino roofers was performed by Virginia Tech University in collaboration with the community organization HOlA of Wilkes County, using a lay health advisor (LHA)-based lesson, from 2011 to 2014. The project had three aims: develop and execute a linguistically and culturally appropriate LHA-based safety education curriculum addressing fall prevention among immigrant Latino construction workers roofers; document preliminary evidence of the effectiveness of the LHA-based program;
and identify refinements for the program to enable decisive effectiveness. The LHA-based safety lesson used an educational flipchart: “Get Smart Working in Roofing! / ¡Ponte Listo Trabajando en Roofing!” The flipchart was developed employing the results of the researchers’ previous research, a review of existing research literature, and in-depth, semi-structured interviews with 10 Latino roofers (CDC 2013; Occupational Safety and Health Research Center (OSHRC) 2015).

Another CBPR was developed and performed to train immigrant day laborers as safety liaisons in Newark, New Jersey. Safety liaisons executed numerous activities, including facilitating 10 OSHA classes, holding quarterly meetings, initiating a worker council (consejo), using safety audits, and maintaining a relationship with OSHA. The results from the first 30 months of this five-year project indicated that while classroom training is crucial for informing workers about health and safety, it is not sufficient to build health and safety leaders; addressing both safety and wage theft enforcement improves worker involvement; direct relationship with OSHA is empowering; and although training workers about job site hazards and their legal rights is promising, it is a limited intervention and major changes would require employer engagement (Ochsner et al. 2012).

A collaboration among university-based researchers, a community-based worker organization, and an area labor union implemented a project to investigate the impact of a peer-led participatory health and safety training program for Latino day laborers working in residential construction in New Jersey. During the program, participants were engaged in a series of tasks requiring teamwork and active problem-solving focused on applying safe practices to situations encountered at work sites. The results of the follow-up survey conducted among participants after project completion show considerable growth in use of PPE (hard hats, work boots, safety vests, and fall-arrest safety harnesses), and many participants described taking a more active role in providing a safer job site (Williams et al. 2010).

**Conclusion**

This paper reviews and summarizes the literature available in the area of Hispanic worker safety. The paper started with a look at the current demographic state of Hispanic construction workers, then looked at contributing factors to the disproportionate injury and illness rates between Hispanic and non-Hispanic construction workers, consolidating research results in a way that makes them easily accessible to scholars and construction professionals, and finally looked at diversity initiatives that have assisted practitioners in decreasing the fatality rate and injuries of Hispanic workers in the construction industry. By concentrating on the aspects relevant to the safety of Hispanic workers, this paper creates a rough draft that can be further developed in future and continuing studies.

After reviewing the current state of the literature associated with Hispanic worker safety, we would like to suggest a few directions for future research. Additional research should investigate safety training programs for non-native English speaking construction workers, and innovative ways to make it more accessible through using new technology and leveraging existing technology effectively.

While effective leadership has been found to enhance safety performance in dangerous and risky working environments (Flin and Yule 2004), little research has been conducted on the influence of leadership on Hispanic worker safety. For instance, future research should explore the relationships between different facets of immediate supervisors’ leadership and their Hispanic workforce safety outcomes in construction projects. Future scholarly work in these areas will broaden construction professionals’ understanding to prioritize their proceedings for improving safety outcomes for Hispanic workers through leadership on construction sites.
References


Hispanic Workers: Identification of Factors Impacting Fatal and Non-Fatal Injuries in the U.S. Construction Industry


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Establishing a Ratio of Fixed Personnel Costs to Revenue for Construction Managers

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ABSTRACT

The construction industry is subject to cyclical periods of growth and recession. In each of these periods, executive construction managers are faced with making decisions about expanding or discharging professional staff. A financial model is presented to determine the relative range of fixed personnel costs to revenue. This ratio range establishes a lower and upper limit of industry behavior by using the average and a single standard deviation. Data was collected using a survey of construction financial managers. Respondents are self-reporting 2013 financial data for their respective construction organizations. Stratification of the participants is made by revenue sizes and micro-industry. A range of the ratio was found and presented as a means to measure individual construction company performance. Construction companies can use the ratio range based on the entire industry or specifically for the micro-industry to which the company belongs. The ratio can be used to determine and measure competitive behavior. This research is presented as original evaluation of actual industry financial reports. Limitations of the research include accuracy of self-reported data, and implications of economic cycles.

Keywords: Construction Financial Management, Cost Controls, Financial Ratios, Managerial Accounting

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Introduction

In the construction industry, fixed costs tend to stay constant within a relevant range of revenue (Peterson, 2013). The majority of costs, however, are variable costs. These variable costs include all direct costs and a portion of the indirect costs. On average, direct costs (e.g. materials, labor, subcontractors, and equipment directly associated with a specific project), represent 80% to 90% of all revenue. Indirect costs, or overhead, are additional costs which cannot be specifically associated with a project, and represent another 10% to 15% (Jeffery J. Seay, 2015). These indirect costs will have a fixed portion and a variable portion. The fixed portion of overhead costs will exist and remain relatively constant regardless of the volume of sales revenue, whereas variable overhead will adjust as the volume of sales changes over time. The remaining percent of revenue (typically 3% - 5%) after direct and indirect costs are considered is the net profit margin (Risk Management Association, 2016). The type of construction work performed (e.g. commercial, residential, road construction, specialty trade, etc.) will impact these percentages (Holland & Hobson Jr., 1999). For example, we might reasonably expect heavy/highway contractors to observe higher direct costs in proportion to their revenue because of the enormous amount of materials and equipment required to perform each dollar of work. Commercial prime contractors may have higher levels of professional staff because of the number of subcontractors and interacting building systems in a project. Depending on the size and complexity of the project, some of the professional staff might be considered direct costs or indirect costs (Jeffery J. Seay, 2015). Another factor, competition, often dictates the ceiling for profit margins, while the floor is established by the growth goals of the company. Professional estimators have a challenging job evaluating their competition, minimizing costs, and maximizing profits.

The fixed portion of indirect costs is generally associated with the operation of the business, including professional salaries and benefits, business insurance, office and facilities expenses. The construction industry maximizes the benefit of each asset through efficient and strict maintenance of those fixed assets. As revenues increase, contractors take on the associated workload until assets (primarily professional staff) are strained beyond efficiency and capacity. At this point in growth, additional personnel are hired, facilities are expanded, vehicles are purchased and, as a result, fixed costs make a large incremental change (Schleifer, Sullivan, & Murdough, 2014).

![Figure 1: Incremental Change in Fixed Costs Over Time](image-url)
Literature Review

In managerial accounting practices, industries use financial ratios to evaluate organizational performance and financial health (Chen & Shimerda, 1981). These ratios were initially developed and used by financial institutions, but have evolved as an internal measure for managerial decision making within an organization (Drury, 1981). Financial institutions such as banks and sureties use the analysis of financial statements to mitigate risk associated with the borrower (Severson, Russell, & Jaselskis, 1994) (Lisowsky, Minnis, & Sutherland, 2016). Internally, construction firms will use financial benchmarking for evaluating management decisions (Ramirez, Alarcon, & Knights, 2004) and compare their performance to their competition in the industry (El-Mashaleh, Michin Jr., & O’Brien, 2007). In a 2004 review of published works on benchmarking, Anderson and McAdam encourage the development of forward-looking, or predictive performance measures to improve management decisions (Anderson & McAdam, 2004). This study examines the development and application of one such measure: the ratio of fixed personnel costs to sales revenue. The review of literature has found that no such study has been performed or evaluated.

The hiring and discharge cycle is inherent in the construction industry, and post-recession construction companies are paying a premium for skilled craftspeople as construction costs continue to escalate (Rider Levett Bucknall, 2016). Furthermore, in an industry that is heavily influenced by collective bargaining, employees have increased costs to hire in order to offset the increased risk of unemployment (Matsa, 2010). Historically, firms have discharged employees during slow periods, or extensive periods of financial distress (Serfling, 2016). Little is known, however, regarding the use of financial ratios in the construction industry to make managerial decisions related to expansion or discharge of fixed assets, specifically professional personnel.

Research Questions

For executive construction management, the decision to take on additional overhead expense comes with balancing fixed costs with the ability to generate revenue and maintain or improve profit margins. The question is often, “How much additional revenue can we take on without needing to increase our fixed costs?” or “At what point in our revenue growth do we invest in additional personnel and other related fixed costs?”

The challenges of managing personnel are exacerbated during an economic recession. Negative growth in revenue requires the same analysis of fixed costs, and the question in this scenario is, “How long do we maintain fixed costs before I have to make a decision to lay off personnel or liquidate equipment?” Delays in decision making to either increase or decrease investment of fixed costs could become costly. Regardless of the revenue trend, upward or downward, the decision to increase or decrease fixed costs results in a change in efficiency. Thus, determining a relevant range of revenue to fixed personnel costs becomes a critical tool in managerial decision making.

Context for the Research Problem

As sales revenue increases or decreases from one reporting period to another, construction companies tend to function within a range of revenue without making changes to the fixed personnel costs. Figure 2 demonstrates an example of increasing revenues, and the construction company continues to manage this increased revenue with the same levels of personnel (a fixed asset). In turn, the ratio between revenue and the relative fixed personnel costs approach the upper limits of the range of revenue. In this scenario, personnel become overworked and inefficient. Project managers, at this point, experience burnout and have difficulty managing this increased load. To further complicate the issue, many project managers use this as justification to make the jump to other job opportunities (Schwartz & Erikson, 2009). Now, the contractor has an increased workload and a decreasing professional staff. However, as revenues turn downward in economic recession periods, the ratio between revenue and fixed personnel costs approach the lower limits of the relevant range of revenue. This represents a period...
of underworked personnel and inefficiency. This inefficiency may result in negative cash flows, and push management to take on low-profit yielding jobs to merely maintain cash flow. Managing an appropriate level of professional staff requires a proactive approach to understanding the balance and relationship between fixed personnel costs and revenue size. By evaluating the upper and lower limits of the fixed personnel costs to revenue ratio, an exception rule is established internally. Knowing both the historical trends of the organization and that of the industry helps managers make executive decisions about expansion or laying off personnel.

In the construction industry, a similar exercise is used to determine breakeven volumes. By dividing fixed costs by the established contribution margin observed in the company, managers are able to determine at what level of revenues the company has covered their fixed costs, and at which point they begin to observe a margin of profit (Powers, 1987). Figure 3 shows that the breakeven volume of sales revenue is lower than the lower limits of the fixed costs to revenue ratio. This is true because the lower limits of the ratio of fixed personnel costs to revenue in this study will always contribute to a margin of profits, whereas the breakeven volume of sales revenue does not consider profits. If the lower limits of this ratio do not generate a profit, then the company has set that limit too low. If a company only observes annual revenues at the breakeven volume level, it has spent too much on overhead.

An established range of revenue based on fixed costs serves to gauge the efficiency of a company’s professional human resources, or personnel assets. Applying the principle of management by exception (Brownell, 1983) and, as revenues change, a construction executive might readily identify at what point resources are most efficient. An established ratio between revenue and fixed personnel costs serves as an internal measurement standard of performance. The relevant range of revenue provides parameters describing behavior in the industry. The challenge, however, is that no such ratio has been established to measure this relationship. Furthermore, a single ratio representing the entire construction industry serves a limited purpose for company owners and executives to measure their own performance relative to their peers. A range must be established to understand the upper and lower limits of
Establishing a Ratio of Fixed Personnel Costs to Revenue for Construction Managers

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efficiency. Additionally, within the construction industry there exists a number of micro-industries, wherein are found a large variety of companies undertaking projects of differing complexities, revenues, and trade types (Bureau of Labor Statistics, 2016). The North American Industry Classification System (NAICS) categorizes major industries and micro-industries. In the United States, the construction industry is categorized under NAICS 23. Construction micro-industries are classified by the third through sixth digit after 23. A comparison of fixed costs to revenue ratio for a small residential company or a large-scale, heavy-highway contractor to an industry average will certainly favor one and make the other appear as a poor performer. As such, a ratio of fixed costs to revenue must be established for each NAICS code, and at multiple revenue levels.

Research Methods

The purpose of this research is to establish an exception rule, or accounting ratio that examines the relationship between fixed personnel costs and revenue in the construction industry. This ratio is intended to be used as a management tool when accompanied with established upper and lower limits, thus establishing a range of performance standards. The intent is to establish the range of revenue to fixed costs related to the construction industry as a whole, and for micro-industries within NAICS 23.

Data Collection

Each year, construction companies self-reported the previous year’s financial data anonymously through Construction Financial Management Association (CFMA)-sponsored software, called Benchmarker. The data is collected electronically from responses to a survey administered by Industry Insights, Inc. In partnership with CFMA, Industry insights collected 688 survey responses from the 2014 survey. The 2014 CFMA Benchmarker Survey collected financial data for the 2013 fiscal year. Individual identifiers, or markers, were removed from the dataset prior to this researcher receiving the dataset. The dataset was provided by CFMA to this researcher for the express purpose of conducting the analysis of this study. Permission for the use of the dataset was obtained from CFMA. Once the researcher received the dataset, it was further cleaned by eliminating non-responsive or incomplete responses. For example, one respondent was eliminated for having submitted duplicate reports. Other responses did not provide
financial data in their responses. Of the original dataset, 619 respondents returned a value for question, “STATEMENT OF OPERATIONS: Most Recent Year-End: Revenue: Construction Contracts”, hereafter referred to as revenue. This step eliminated 68 respondents from the sample set.

Data Analysis

To establish fixed personnel costs, the survey question entitled, “STATEMENT OF OPERATIONS: Most Recent Year-End: SG&A Expenses: Base Payroll / Payroll Related (Exclusive of Owner Bonuses)” was used. Additionally, the survey question entitled, “STATEMENT OF OPERATIONS: Most Recent Year End: Total Revenue” was used as the denominator for the ratio. Of those reporting revenue, 605 respondents reported fixed personnel costs, effectively eliminating 14 additional respondents. A ratio was established between the relationship of fixed personnel costs and revenue. The mean of all ratios was then determined at 6.37%, and a single standard deviation was determined with the same sample at 7.8%. Elimination of outliers beyond two standard deviations provides a sample size of 97.7% of qualified respondents (13 respondents), whereas elimination of outliers beyond only one standard deviation provided a sample size of 94.4% of qualified respondents. As such, one standard deviation was chosen as the acceptable standard for eliminating outliers. Because we were using the standard deviation to establish the range of the exception rule, a narrower range creates a competitive analysis. The use of a standard deviation to analyze financial behavior is well established (Latane’ & Rendelman, Jr., 1976) (Brown, Christensen, Menini, & Steffen, 2016) (Santos & Soukiazis, 2016). Companies observing a higher ratio than a single standard deviation are spending more on professional staff than their competitors. On the other hand, companies observing a lower ratio than the upper limits of the range are in danger of overworking their professional staff. Additionally, one standard deviation maintained 94.4% of the qualified respondents, which is an indication that the distribution is not normal, and that most companies are observing ratios very close to the mean. The use of one standard deviation eliminated 33 respondents, thus having provided a sample size of 572 respondents.

Having eliminated outliers, a mean was again established from the sample size at 5.2% and a standard deviation of 3.19%. This sample size, n = 572, represents the entire construction industry, NAICS 23. Stratification of respondents was made by revenue size. All data points in the sample were ordered by revenue size, after which groupings were made by 30 respondents. A mean and standard deviation were established for each of these groupings to determine trends.

Separately, stratification was performed by NAICS sub codes (micro-industries). Within the survey instrument, companies declare their NAICS category by indicating what percentage of their revenue is generated in each NAICS category. For this study, the highest recorded percentage established in which category they were placed. Of the 572 qualified respondents, 27 did not identify a NAICS category for their organization. Micro-industries with a minimum of ten respondents were stratified and a mean and standard deviation established. Some micro industries were combined because of similarities in work performance and structure, (e.g. NAICS 238350 – Finish Carpentry Contractors was combined with NAICS 238390 – Other Building Finishing Contractors, and other similar trades). Micro industries with high respondent rates (e.g. NAICS 238220 - Plumbing, Heating, and Air Conditioning with 73 Respondents, and NAICS 236220 - Commercial and Institutional Building Construction with 168 respondents) were stratified by both NAICS sub code and revenue size. This stratification allowed evaluation of changes in revenue size within the more specific NAICS sub code.

Results

The entire sample population (n = 572) was ordered by self-reported revenue size and grouped by 30 firms. All 572 companies were ordered in terms of lowest to highest reported revenue. The grouping was made of the first 30, the second 30, and so forth. For each grouping of 30 companies, the mean and standard deviation were established for the relationship between fixed personnel costs and revenue.
The average revenue size was established for the same grouping and noted in Figure 4 along the X-axis. A trendline (Plaut & Davis, 2014) (Givoly, Hayn, & Katz, 2016), or best-fit line, was calculated to determine a decline or inclining change in the ratio over revenue size. Subsequently, the declining trendline was found at $y = -0.0029x + 0.084$ which demonstrates the diminished relationship between fixed personnel as a percentage of increasing revenues. Therefore, a smaller construction company, in terms of revenue size, observed higher proportional levels of fixed personnel costs. As a construction company increases revenue, a lower percentage of sales is used to cover fixed personnel costs. The standard deviation is observed to be relatively stable with a slight declining trend as revenue size increases. At a revenue size of $2.4M$ the standard deviation is 4.4%, whereas at a revenue size of $900M$, the standard deviation is recorded at 1.3%.

When stratified by NAICS sub code, micro industries were ordered by lowest mean score. The upper and lower limits of the relevant range of revenue to fixed personnel costs were calculated by subtracting or adding the standard deviation to the mean score provided in Table 1. For example, the ratio for NAICS 236220 – Commercial and Institutional Building Construction is 3.45% with an upper limit of 1.04% and a lower limit of 5.86%.

Where the number of responses in a micro-industry exceeded 30, they were further ordered by revenue size and stratified by groupings of 10. The average revenue size was established for these groupings of 10 respondents. An example using NAICS 236220 Commercial and Institutional Building Construction was noted in Figure 4. The calculation of a trendline in each NAICS sub category found that there was a decline in percentage of fixed personnel costs to revenue size as revenue size increases. The trend was consistent with the aggregated data set.

This was found in NAICS sub categories 236220 Commercial and Institutional Building Construction, NAICS 237310 & 237990 Highway Street and Bridge, and Other Heavy and Civil Engineering (combined subcategories for this analysis), NAICS 238210 Electrical, and NAICS 238220 Plumbing, Heating, Air Conditioning.

For those micro-industries with sufficient respondent numbers, the upper and lower limits of the relevant range of revenue to fixed personnel costs were calculated by subtracting the standard deviation to the mean score. An example for NAICS 236220 Commercial and Institutional Building Construction was noted in Table 2.
Interpretation

This research established a relative range of revenue to fixed personnel costs for the construction industry. More specifically, the research also found sufficient results to establish ratios for most micro-industries within NAICS 23. Analysis of the strata provides insight into management behavior in each micro-industry and at a continuum of revenue. These behaviors can be used by industry as benchmarks for their respective management decisions.

The results of this study demonstrate a declining trendline for the entire industry in the percentage of fixed personnel costs to revenue, as the revenue of the organization increases. When considering this same ratio observed from one NAICS sub-code, or micro-industry to another, there is some

### Table 1: Ordered Ratio Means by NAICS Sub-code

<table>
<thead>
<tr>
<th>NAICS</th>
<th>NAICS Title</th>
<th>NAICS Mean</th>
<th>Standard Deviation</th>
<th>Upper Limit</th>
<th>Lower Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>236116</td>
<td>New Multi Family</td>
<td>2.363%</td>
<td>1.468%</td>
<td>0.895%</td>
<td>3.832%</td>
</tr>
<tr>
<td>236220</td>
<td>Commercial and Institutional Building Construction</td>
<td>3.451%</td>
<td>2.408%</td>
<td>1.043%</td>
<td>5.860%</td>
</tr>
<tr>
<td>236210</td>
<td>Industrial Building Construction</td>
<td>4.079%</td>
<td>1.735%</td>
<td>2.344%</td>
<td>5.813%</td>
</tr>
<tr>
<td>237110</td>
<td>Water and Sewer Line</td>
<td>4.607%</td>
<td>3.007%</td>
<td>1.600%</td>
<td>7.615%</td>
</tr>
<tr>
<td>237990</td>
<td>Other Heavy and Civil Engineering</td>
<td>4.639%</td>
<td>1.511%</td>
<td>3.128%</td>
<td>6.150%</td>
</tr>
<tr>
<td>237310</td>
<td>Highway Street and Bridge</td>
<td>5.052%</td>
<td>3.063%</td>
<td>1.989%</td>
<td>8.115%</td>
</tr>
<tr>
<td>238110</td>
<td>Poured Concrete Foundation and Structure</td>
<td>5.547%</td>
<td>3.327%</td>
<td>2.220%</td>
<td>8.874%</td>
</tr>
<tr>
<td>238120</td>
<td>Structural Steel and Precast Concrete</td>
<td>5.752%</td>
<td>3.095%</td>
<td>2.657%</td>
<td>8.846%</td>
</tr>
<tr>
<td>238210</td>
<td>Electrical</td>
<td>6.685%</td>
<td>3.099%</td>
<td>3.585%</td>
<td>9.784%</td>
</tr>
<tr>
<td>238910</td>
<td>Site Preparation</td>
<td>6.823%</td>
<td>3.318%</td>
<td>3.506%</td>
<td>10.141%</td>
</tr>
<tr>
<td>238220</td>
<td>Plumbing, Heating, Air Conditioning</td>
<td>7.040%</td>
<td>3.824%</td>
<td>3.216%</td>
<td>10.863%</td>
</tr>
<tr>
<td>238160</td>
<td>Roofing</td>
<td>7.486%</td>
<td>4.311%</td>
<td>3.175%</td>
<td>11.797%</td>
</tr>
<tr>
<td>Various</td>
<td>Various Trades</td>
<td>7.934%</td>
<td>2.541%</td>
<td>5.393%</td>
<td>10.474%</td>
</tr>
</tbody>
</table>

### Table 2: Ratios by Revenue Size for NAICS 236220 Commercial and Institutional Bldg. Construction

<table>
<thead>
<tr>
<th>Revenue Size</th>
<th>NAICS Mean</th>
<th>Standard Deviation</th>
<th>Upper Limit</th>
<th>Lower Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3,760,951.05</td>
<td>6.98%</td>
<td>4.303%</td>
<td>2.679%</td>
<td>11.284%</td>
</tr>
<tr>
<td>$7,972,536.75</td>
<td>5.10%</td>
<td>2.489%</td>
<td>2.609%</td>
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<tr>
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<td>$148,919,631.65</td>
<td>2.75%</td>
<td>1.242%</td>
<td>1.506%</td>
<td>3.990%</td>
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<td>$205,423,117.46</td>
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<td>$377,049,498.95</td>
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<td>$1,628,793,033.50</td>
<td>2.52%</td>
<td>1.074%</td>
<td>1.444%</td>
<td>3.592%</td>
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variability. This finding supports natural behavioral differences between construction trades and revenue sizes as one would expect to observe. For example, a Commercial and Institutional Building Construction (NAICS 236220) company (ratio of 3.45%) will generally carry half the fixed personnel cost burden as a Plumbing, Heating, and Air Conditioning (238220) company (ratio of 7.04%).

Observing the ratio by NAICS, certain classifications were found with more or less variability in their resultant ratio. The Commercial and Institutional classification, for example, had less variability in their ratio than specialty trade companies, meaning that the ratio of a Commercial and Institutional construction company was found to be smaller than a specialty trade construction company, such as an Electrical contractor (238210) or Roofing contractor (238160). The Commercial and Institutional classification was the highest response rate of any of the participants. The higher response rate helped to define the ranges of the ratio better and eliminate outliers.

For NAICS 236220 Commercial and Institutional Building Construction, the average reported sales revenue was $155,011,030. Table 2 orders the upper and lower limits of the ratio of fixed personnel costs to revenue, determined by revenue size of the organization. This table is specific to NAICS 236220. The closest grouping with the average sales revenue ($155,011,030) would be $148,919,631. Having established the ratio for the Relevant Range of Fixed Personnel Costs to Revenue from 3.99% to 1.506%, the level of inefficiency for a commercial construction company can be measured. At the mean, a commercial construction company at $155,011,030 can expect to invest $4,262,803 in fixed personnel costs.

\[
$4,262,803 = 0.0275 \times 155,011,030 
\]

Operating at $4.2M in fixed personnel costs, and as revenues increase, personnel will work effectively until the upper limit is reached (1.506%).

\[
$4,262,803 / 0.01506 = 283,054,669 
\]

When revenues reach $283,054,669, the commercial construction company operating at $4.2M in fixed personnel costs can expect to experience inefficiencies in their professional staff. At this point, this organization may observe higher departure rates, critical managerial errors, inaccurate estimates of time and materials, etc.
In opposition, the same organization, experiencing an extensive period of financial distress (i.e. economic recessions), cannot maintain the same levels of professional staff. Using the same operating level of $4.2M in fixed personnel costs, revenues decline to 3.99% at which point the staff becomes underworked, and there is insufficient revenue to support the personnel costs.

\[
\frac{4,262,803}{.0399} = 106,837,176 \text{ sales revenue.}
\]

Recall that an organization’s contribution margin is determined by 100% (revenue total) less variable cost margin. The variable cost margin includes all direct costs and the variable portion of the indirect costs. The remaining percentage of revenue after variable costs are considered is intended to pay for fixed costs and produce net profit. The contribution margin is the sum of fixed costs and net profits divided by total revenue. An average construction company with a variable cost margin at 92-93%, observes a contribution margin between 7 to 8%. At 2.5% profit margin, the total fixed costs of the company account for 4.5 to 5.5%. At 3.99% fixed personnel costs, at the lower limit of the ratio, there is very little room for other fixed costs. With a contribution margin at 8%, and assuming total fixed costs at $5,876,000 (5.5%), the break-even volume is $73,450,558. At revenues between $73M to $106M, profit margins suffer and the company’s ability to meet other fixed cost obligations are diminished. If revenues above $106M cannot be reached, the solution is to discharge some professional staff and lower the fixed personnel costs.

**Conclusion**

Managers in the construction industry and in sub-categories of the industry can use Tables 1 through 5 to evaluate the relationship of their own revenue size to fixed costs. Tables 3, 4, and 5 NAICS 237 Heavy & Highway, Utility Contractors, 238210 Electrical Contractors, and 238330 Plumbing, Heating and Air-Conditioning Contractors, respectively, are provided in the appendix. Understanding and comparing their ratio to the industry will help them to make critical decisions in the hiring practices related to revenue growth or reduction. This exception rule, when used accordingly will help companies remain competitive within their respective micro-industries. This tool also helps them establish goals for improvement and increased productivity in their professional staff.

Extrapolating conclusions from the declining trend of the ratio, we can observe that as a company...
grows in terms of revenue size, the organization should expect to observe lower professional costs proportionally to the revenue. Assuming that the mark-up remains constant, organizations will observe higher profit margins. Alternatively, the organization now has the resources to invest dollars into other fixed assets such as increasing sales staff, expanding profit centers, etc. The most powerful use of this ratio is the management of fixed personnel costs and the competitive advantage created by its management.

This study introduces the use of the ratio between fixed personnel costs and total revenue. The source of the data is limited to the analysis of one year’s self-reported financial returns. As such, the opportunity for future research includes the observation of the ratio over time. Additionally, the comparison of the ratio and the resulting trendline might be compared to economic changes to determine if there is a correlation. This correlation may inform us of the managerial behavior of fixed personnel costs during recession, recovery, or growth economies. Future research should consider other key financial ratios in comparison to economic environments to determine which financial managerial behaviors are more indicative of financial success. A predictive model can thus be developed to assist companies in preparation of dynamic economies. Considering the differences between financial reporting systems in the United States, Europe, and underdeveloped countries, future research should consider those nuances and attempt to determine the application of this study in non-U.S. economies.

Other studies might include a more specific analysis of small construction companies. Very small construction companies, (firms with less than $5,000,000 in annual sales revenue) often lack the financial resources to employ construction financial managers. In many instances, managers lack understanding of financial measurement instruments (Formoso & Lantelme, 2000). An appropriate study may include a survey of small construction company owners to determine what those owners understand about construction financial principles.

Limitations

A number of variables would impact the results of this study and should be considered. Certain limitations will naturally exist as conclusions are taken from a single reporting cycle. Business cycle behavior will certainly change in varying economic conditions. These conditions may be regional and closely related to market demands and supply. Additionally, self-reported financials may not be recorded with perfect and consistent accuracy. The author makes no claims upon the accuracy of the self-reported financial data or the data collection methods by which CFMA administers the survey. For this study, all companies self-reporting their financial statements use U.S. GAAP (Generally Accepted Accounting Principles). As such, limited comparisons and conclusions can be made internationally where IFRS (International Financial Reporting Systems) and IAS (International Accounting Standards) are used (Ampofo & Sellani, 2005). However, there are some commonalities that exist in financial reporting and provide an opportunity for benchmarking as a means for comparing competitive management strategies (Costa, Formoso, Kagioglou, Alarcon, & Caldas, 2006) (Horta, Camanho, & Da Costa, 2010).

One consideration for higher fixed personnel costs may be the competitive nature of the industry. The estimating department in many companies, for example, may accrue costs which must be absorbed into the company’s overhead. If the company has a high level of unsuccessful bids because of the competitive market environment, their overhead would be higher than their competitors. Future research might consider case studies to observe financial ratio behavior for companies with varied levels of bid success.

Companies’ internal methods may vary for certain costs. For example, some level of direct costs may have been included, which will increase the numerator in the ratio (Holland & Hobson Jr., 1999). On the other hand, a larger firm may be able to associate management costs directly to a project. These limitations provide an excellent opportunity
for greater study and examination. An inventory of current practices and varying revenue sizes of companies would contribute to a more consistent evaluation of the ratio of fixed costs to revenue.

Acknowledgements

This research was possible because of the participation of the Steve Tenney and Brian Summers of Construction Financial Management Association and Scott Hackworth of Industry Insights, who administered the survey from which the financial data has been collected. The authors would like to recognize the generosity and the leadership from both organizations. The research was conducted without third-party funding.

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References


Establishing a Ratio of Fixed Personnel Costs to Revenue for Construction Managers


### Appendix

#### Table 3: Ratios by Revenue Size for NAICS 23-7 Heavy & Highway, Utility Construction

<table>
<thead>
<tr>
<th>Revenue Size</th>
<th>NAICS Mean</th>
<th>Standard Deviation</th>
<th>Upper Limit</th>
<th>Lower Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 5,464,323.24</td>
<td>7.736%</td>
<td>3.144%</td>
<td>4.592%</td>
<td>10.880%</td>
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<tr>
<td>$ 12,149,852.98</td>
<td>6.120%</td>
<td>2.643%</td>
<td>3.477%</td>
<td>8.763%</td>
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<tr>
<td>$ 18,038,154.24</td>
<td>5.613%</td>
<td>2.673%</td>
<td>2.940%</td>
<td>8.285%</td>
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<tr>
<td>$ 27,586,747.67</td>
<td>4.394%</td>
<td>1.493%</td>
<td>2.900%</td>
<td>5.887%</td>
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<tr>
<td>$ 41,284,783.17</td>
<td>4.228%</td>
<td>2.270%</td>
<td>1.959%</td>
<td>6.498%</td>
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<td>$ 77,601,927.23</td>
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<td>$ 169,506,764.47</td>
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<td>1.359%</td>
<td>1.994%</td>
<td>4.711%</td>
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<tr>
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<td>3.616%</td>
<td>1.145%</td>
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<td>4.761%</td>
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<tr>
<td>$ 601,146,614.44</td>
<td>3.176%</td>
<td>1.292%</td>
<td>1.884%</td>
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#### Table 4: Ratios by Revenue Size for NAICS 238210 Electrical Contractors

<table>
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<tr>
<th>Revenue Size</th>
<th>NAICS Mean</th>
<th>Standard Deviation</th>
<th>Upper Limit</th>
<th>Lower Limit</th>
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<tbody>
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<td>$ 4,096,780.24</td>
<td>8.463%</td>
<td>1.730%</td>
<td>6.733%</td>
<td>10.193%</td>
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<td>$ 9,624,017.01</td>
<td>6.531%</td>
<td>2.478%</td>
<td>4.053%</td>
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<td>$ 15,471,130.26</td>
<td>7.837%</td>
<td>3.291%</td>
<td>4.546%</td>
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<td>$ 29,746,051.27</td>
<td>6.306%</td>
<td>2.063%</td>
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<td>$ 61,339,127.13</td>
<td>7.618%</td>
<td>3.660%</td>
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<td>$ 94,620,167.41</td>
<td>5.250%</td>
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<td>$ 208,881,597.18</td>
<td>3.253%</td>
<td>2.184%</td>
<td>1.069%</td>
<td>5.436%</td>
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#### Table 5: Ratios by Revenue Size for NAICS 238220 Plumbing, Heating and Air-Conditioning Contractors

<table>
<thead>
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<th>Revenue Size</th>
<th>NAICS Mean</th>
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<th>Lower Limit</th>
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<td>$ 4,054,211.87</td>
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<td>3.478%</td>
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<td>$ 10,362,725.98</td>
<td>7.529%</td>
<td>3.711%</td>
<td>3.818%</td>
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<tr>
<td>$ 17,872,515.88</td>
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<td>3.718%</td>
<td>4.152%</td>
<td>11.588%</td>
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<td>$ 24,657,909.81</td>
<td>4.006%</td>
<td>2.109%</td>
<td>1.896%</td>
<td>6.115%</td>
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<td>3.948%</td>
<td>2.888%</td>
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<td>5.193%</td>
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<td>$ 192,523,562.39</td>
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