The Professional Constructor

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First Place - Corban Williams - Clemson University
Second Place - Anas Pasha - Eastern Michigan University
Third Place - Lisa Breitenfeld - Minnesota State University, Moorhead
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ABSTRACT

Over the past several years small unmanned aircraft systems (sUAS) have gained popularity in the private sector. Recent studies have shown an increasing interest from state DOTs in the U.S. for the use of drone technology. However, most of the studies did not fully investigate the depth of program integration or application. This study combines the findings of recent studies to identify state DOTs with the most extensive sUAS operational experience. The drone champions for the six states identified, were interviewed to gain substantive insight regarding program initiation and organization, the spectrum of agency use, perceived benefits, and the DOT’s involvement with industry drone taskforces. The findings are that adoption of drone technology by state DOTs, even those with broad operational experience, is in an ‘early’ stage. Program structure for most DOTs is rather ‘loose’ and the extent of operational deployment for each of the drone applications was limited. There remains considerable interest in drone technology and agencies were optimistic concerning the impact that drones could have in their DOT.

Keywords: Drone, UAS, DOT, Department of Transportation

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INTRODUCTION

Unmanned Aircraft Systems

Unmanned aircraft systems (UAS), more commonly referred to as drones, originated with Great Britain’s development of the first pilotless aircraft in the early 1900’s. Drones have been deployed in the military for decades and recently small unmanned aircraft systems (sUAS) have gained popularity in the public sector (Dronethusiast 2019). There are two categories of sUAS – model and non-model. Model aircraft owners are considered recreational users, whereas non-modelers use sUAS for commercial purposes. The commercial use of drones started to gain traction in 2006 when the FAA issued its first commercial permit. Adoption remained slow with an average of only two new commercial permits issued by the FAA per year until 2014 (Desjardins 2016). Interest accelerated after Amazon revealed in 2013 that it was investigating the use of drones for delivery (Dronethusiast 2019).

Accompanying the increasing popularity of sUAS was the development of federal regulations regarding their use. In 2005 the FAA issued basic sUAS guidelines and subsequently, in 2007, the agency implemented policies for the operation of sUAS. These regulations required all commercial operators to obtain a Certificate of Waiver or Authorization (COAs) for specific drone use – a process that was difficult and time consuming (Speicher 2016). Public pressure to improve the process influenced the government to pass the Reform Act of 2012 requiring the FAA to develop more effective drone policies and regulations for commercial sUAS. After several years of public input and research, the FAA published Part 107 for the Title 14 Code of Federal Regulations governing sUAS use, operation, and certification in 2016 (Federal Register). In 2017 the FAA initiated their Integration Pilot Program (IPP). This program was developed to bring public and private interests together to identify additional sUAS operations, address security and privacy issues, and accelerate safe drone integration into the National Airspace System (FAA 2017).

By the end of 2018 the number of recreational drones in the U.S. reached an estimated 1.6 million and the commercial fleet expanded to more than 110,000 with strong growth expected to continue. By 2022 the FAA forecasts that the number of recreational drones will increase to 2.4 million. The fleet of registered commercial drones will climb by more than 400% to greater than 450,000 (FAA 2018). Globally, annual spending for unmanned aerial systems is expected to double to 11.5b over the next decade (Grey et. al. 2018).

To fly a commercial drone the operator must obtain a Remote Pilot Certification from the FAA and by mid-2018 more than 100,000 pilots had been certified. To support the expanding commercial use of sUAS the number of certified remote pilots is expected to grow to more than 400,000 by 2022 (Plaza 2018, FAA 2018). The FAA 2018 report noted that commercial sUAS were used primarily to collect data and aerial images. Primary usage included real estate photography (48%), industrial and utility inspection (28%), agricultural applications (17%), and state DOT and local governments (3%) (FAA 2018).

Research on the use of unmanned aircraft systems has shown how effectively implementing drones into commercial uses can improve safety, efficiency and provide cost savings (McGuire et.al. 2016). Realization of the potential of this technology has created a surge in the adoption of drones into commercial and public operations. This substantial growth has helped fuel demand, increase competition, and thus lower the price of capable drone systems. One of the fastest growth sectors has been the construction industry which experienced a 239% increase in drone use in 2017 (Zitzman 2018).

Unmanned Aerial Systems and Transportation Infrastructure

The World Road Association published a research report entitled A Report on the use of Unmanned Aerial Systems (UAS) to Remotely Collect Data for Road Infrastructure in 2017 (REDNOA 2017). This report forecast ‘huge potential for UAS applications’ in roadway infrastructure. An American Association...
of State Highway and Transportation Officials (AASHTO) study was conducted by Ni and Plotnikov in 2016. The results of this study entitled The State of the Practice of UAS Systems in Transportation, found that 17 state agencies had studied, or were currently using, drones in some aspect of their operations. Another sixteen states were exploring or supporting drone research (Ni and Plotnikov, 2016).

A subsequent AASHTO study by Ni and Plotnikov two years later in 2018 found that state DOT interest in drones had increased. Thirty-five of the forty-four states (80%) participating in the study were currently using or exploring the use of drones. Twenty state DOTs had integrated drones into their operations and another fifteen states were conducting research and/or testing to determine possible drone applications (Dorsey 2018).

The investigative efforts and operational deployment of sUAS (drones) by state transportation agencies has continued to expand. Numerous studies by universities, state DOTs, and federal agencies have been conducted to determine current interest and application by state DOTs. However, the methodology of the studies is not consistent and the participation rate is never 100% of the 50 state DOTs. These limitations make it difficult to gain a comprehensive understanding regarding the current use of drones by DOTs throughout the United States from any one study.

To obtain better insight some DOTs have developed summaries that combine the findings from several of the studies (MoDOT 2018, MDT 2018, ODOT 2016). Building on those earlier efforts this research team reviewed fifteen (15) recent studies and publications to further expand the coverage of state DOTs regarding drone research and use (AASHTO 2016, AASHTO 2018, Capers 2018, Dorsey 2016, Gillins et. al 2018, Lercel and Steckel 2018, Lillian 2018, Maguire and Doraflshan 2018, McGuire et. al. 2016, MoDOT (2018), MDT (2018), Ni and Plotnikov 2016, REDNOA 2017, ODOT 2016, UTDOT 2017). The combined findings of these studies and publications are summarized in Table 1.

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<td>Wyoming</td>
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</table>

D = Deployed; R = Research

*Data on drone activity in the noted publications was available for all but two states, Hawaii and Wyoming. Of the remaining forty-eight (48) state DOTs, all had deployed and/or were researching (investigating) the application of drones for their DOT operations. Thirty-eight (79%) of the 48 states indicated that they had operationally deployed sUAS for one or more activity and twelve (21%) were researching/investigation possible application(s).

Most studies over the past three years have shown increasing interest from state DOTs for the investigation and/or incorporation of drone technology into their operations. The elevated interest in sUAS is largely fueled by the growing list of possible applications and the technology’s
allure for improved safety, increased efficiency for the collection of data, and lowering operational cost (Dorsy 2016, Dorsey 2018).

Unmanned Aerial Systems Uses in State DOTs

As noted in Table 2, Statista (2018) categorizes the commercial use of sUAS into six groupings: photography (34%), real estate (26%), construction (26%), agriculture (21%), emergency management (8%), and insurance applications (5%). AidVid initiated a listing of commercial drone uses in 2014 which has subsequently grown to over one-hundred forty uses in twenty categories ranging from photography to weather atmospheric studies (AirVid 2018).

A number of the uses noted in AidVid’s listing have application for the development and management of transportation infrastructure. The twenty states noted in Ni and Plotnikov’s 2018 study of state DOTs that had incorporated drones were using them for a variety of functions, including aerial photography, surveying, public education/outreach, bridge inspection, emergency response, pavement inspection, scientific research, traffic control/monitoring, and high-mast light pole inspection. The number of these states that were deploying drones for each of these operational activities is shown in Figure 1.

An examination of the fifteen publications and studies utilized to develop the listing of state DOT deployment and research of sUAS (Table 1) reveals a variety of agency uses that have been organized (categorized) using several different approaches. Representative categories include traffic monitoring, structural inspection, construction inspection, documentation/monitoring, survey and mapping, and other. The categories and associated are summarized in Table 3.
As noted in the prior studies, thirty-eight (38) state DOTs, have deployed sUAS in their operations. The category of drone usage for each of these states is summarized in Table 4. The most common usage for the thirty-eight state DOTs was ‘Survey and Mapping’ which was noted as a use by 28 of the state DOTs. Close in utilization was ‘Structural Inspections’ with 27 DOTs identified as employing sUAS technology. Drones were used for ‘Traffic Monitoring’ in eleven state transportation agencies while ‘Construction Inspection’ and ‘Document/ Monitoring’ were used by eight and seven states respectively.

Based on the findings from the fifteen studies, twenty-eight of the state DOTs had utilized drones for more than one category/use, including nine (9) state agencies that have deployed operations in four (4) or more categories of use. The adoption of drone technology by state DOTs has gained significant traction over the past 3 years (Lillian 2018, AASHTO 2018).

OBJECTIVE AND METHODOLOGY

Study Objective

The fifteen cited studies and publications provide support that sUAS are being investigated and/or deployed in a vast majority of the state transportation agencies. However, all of the cited studies involve a limited sample size and most provide minimal insight regarding sUAS program development and the extent of use in the transportation agency’s daily operations. The pace at which drone technology is being adopted limits the relevancy of studies/publications dated only a few years earlier. Therefore the objective of this study was to:

Investigate the level of sUAS program development and the degree to which drone technology has been incorporated into the daily operations of state transportation agencies that have a broad exposure to the spectrum of sUAS uses.

Methodology

There are nine (9) states identified in Table 4 that have experience with sUAS in four or more operational categories. These nine states include Georgia (GA), Illinois (IL), Michigan (MI), Minnesota (MN), New Jersey (NJ), North Carolina (NC), Ohio (OH), Texas (TX), and Utah (UT). The research team randomly selected six (6) of these states (UT, OH, GA, NC, MN, NJ) for a more comprehensive investigation of drone usage within their respective agency.

To obtain the information needed to satisfy the research objectives, a personal interview with a subject matter expert (SME) with the agency would be necessary. An interview template was developed by the authors to help guide the interview process and provide a consistent approach for the interview of the SME with each state DOT. The template covered a broad spectrum of topics including sUAS program initiation, current organization and logistics, a detailed review of drone usage, an investigation of the benefits of the operational deployment of sUAS, the agency’s involvement in drone technology and industry taskforces, and the agency’s anticipated evolution of drone usage in the future.

The SME selected was the sUAS champion (program coordinator) for each of the six state DOTs. This individual was identified and subsequently contacted to obtain their commitment for participation in the study. A time convenient for each interviewee was determined and a minimum of 7 days prior to the interview each individual was provided the interview template containing the topics of inquiry. Over the course of three weeks the champion/program coordinator for all six state DOTs was interviewed for approximately one hour using an online video conference call application. The interviews were conducted in the spring of 2019. With prior permission, all of the interviews were recorded to facilitate efficient use of the champion’s time and ensure that their input was properly captured. Later, the interview recordings for each DOT were then categorized and encoded. To ensure an accurate summary of each champion’s input they were subsequently provided a copy of the
## Table 4: State DOT Use of Drone Technology

<table>
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<th>State</th>
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<th>Struct. Inspect</th>
<th>Constr. Inspect.</th>
<th>Doc. / Monitor</th>
<th>Survey Mapping</th>
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<td>Montana</td>
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<td>New Jersey</td>
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<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<td>5</td>
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<tr>
<td>New York</td>
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<td></td>
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<tr>
<td>North Carolina</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>Oregon</td>
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<tr>
<td>Pennsylvania</td>
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<tr>
<td>Rhode Island</td>
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<td>Tennessee</td>
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<td>Texas</td>
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<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Utah</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Vermont</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td>2</td>
</tr>
<tr>
<td>Virginia</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>1</td>
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<tr>
<td>Washington</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>West Virginia</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Totals 11 27 8 7 28 15
interview summary for their review and comment. The champions’ comments and edits were then incorporated prior to examination of the interview data.

**FINDINGS**

**sUAS Program Initiation**

The use of drones in the state DOT operations has gained traction over the past several years subsequent to the establishment of federal regulatory guidelines. The majority of the six DOTs that were interviewed started experimenting with drones only a few years ago in 2015 or 2016. However, Utah initiated operations in 2011 and Ohio started training in 2010-2012 and launched its first flight in 2013. When the six DOTs established their programs, the sUAS tasks that were typically anticipated included monitoring construction and traffic, aerial photography, bridge inspection, surveying, and first responder operations. A primary reason for initiation of their programs was to reduce cost, increase efficiency, and improve safety for both the agency and the public. During development of their sUAS program, most of the DOTs reached out to consultants, universities, and/or other DOTs for guidance. The state DOTs and universities that were mentioned included Utah State, Georgia Tech, and the DOTs in North Carolina, Oregon, Ohio, Utah, Delaware, Kansas, and Massachusetts.

**sUAS Current Uses**

The current uses noted by each DOT are presented in Table 5. All of the DOTs used drones for aerial photography which supports a broad spectrum of other uses including inspection, monitoring, surveying, and marketing/outreach activities. In addition, all of the DOTs were either investigating the use of drones or have currently deployed drones to supplement their bridge inspection program. Another common use identified by all of the DOTs was for communication and outreach activities. For example, the NCDOT has operationalized drones to assist with a variety of their communications needs including ribbon cuttings, public meetings, environmental programs, and construction updates.

Traffic monitoring was a use noted by five of the DOTs. Some of these DOTs had the capability to live stream data to their traffic operations center to assist with the management of high traffic flows, accident response, and disaster management. These same five states also utilized drones for as-built documentation of construction activities.

Surveying and mapping activities were being implemented by four DOTs. In addition, four states were using drones to aid with disaster management and/or to monitor avalanche, land, and rock slides. For example, the North Carolina DOT utilized drones to coordinate with the Highway Patrol and the Department of Public Safety to monitor conditions live as they unfolded after hurricane Florence. The Ohio, North Carolina and the New Jersey DOTs used drones to inspect and monitor rock falls and/or landslides that impacted their transportation infrastructure.

<table>
<thead>
<tr>
<th>Activity</th>
<th>UT</th>
<th>OH</th>
<th>GA</th>
<th>NC</th>
<th>MN</th>
<th>NJ</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial Photography</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>Bridge Inspection</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>Communication/Outreach</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>Traffic Monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>As-Built Documentation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Surveys/mapping</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Avalanche/Land/Rock Slides</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Disaster Management</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Environmental</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Quantity Surveys</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Accident Investigation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Safety Assessment</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Utility &amp; RR Inspection</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total uses</strong></td>
<td>11</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
Only half of the DOTS used drones for environmental investigation and assessment activities. Less common DOT operational uses for drones were for quantity surveys (volume calculations), accident investigation, safety assessment, and utility & railroad inspection.

The Utah DOT had the widest spectrum of drone usage followed closely by the DOTs in North Carolina, Ohio and New Jersey. The Minnesota and Georgia DOTs had operationalized a limited number of drone uses. These two states focused primarily on aerial photograph, bridge inspection, traffic monitoring, disaster management and surveying/mapping.

Subsequent to the identification of drone uses for each DOT, the research team initiated a comprehensive investigation of two of the more technical and complicated applications for sUAS – bridge inspection and surveying/mapping. Each DOT that had indicated drones were being used for one or both of these activities was probed to determine the extent that drones had been operationally deployed.

**Bridge Inspection**

All six of the DOTs had indicated drones were being used for bridge inspection activities. However, one half of the DOTs were primarily in the testing and/or experimental stage. The remaining states that were performing some level of bridge inspection had initiated operations recently (UT-2016, GA-2017, OH-2018). The types of inspection that they were performing included documentation of deck delamination, thermal photography, and top/side inspection.

Even though the majority of the state DOT bridge inspection crews had access to drones for assistance with inspection activities the extent of drone use was limited. This was in large part due to the difficulty of drone flight underneath a bridge deck and the limitations of drones to provide tactile information. As a result, the inspection role for drones has been primarily to augment normal snooper truck bridge inspection activities.

Currently, the percentage of the state’s bridge inspection program accomplished with drones is less than 10% in North Carolina, less than 5% in Minnesota, and less than 1% in New Jersey. The only state DOT that indicated wide drone usage was Utah. None of the state agencies have incorporated 3D modeling to support bridge inspection activities but five of the six DOTs expressed an interest in exploring the use of this technology.

sUAS and associated technology currently does not have widespread application for bridge inspection. However, all of the six states except NJ indicated in the interview that they intend to enhance and expand their use of drones in the agency’s bridge inspection program. For example, Minnesota plans to grow their drone bridge inspection program ‘exponentially’. Currently, they are formulating a drone bridge list that would include bridges that are more conducive to drone inspections such as high abutments, bridges over waterways, and bridges with limited access.

Ohio recognizes that flying drones on and around bridges requires the highest level of skill because the drone is likely to be exposed to areas where GPS is deprived. Therefore, the agency is launching a new program called the ‘drone deployment program’ which is intended to train bridge inspectors to cope with the challenges surrounding bridge inspection.

The primary reasons for state DOT interest in operational deployment of drones and associated technology are consistent from state-to-state. Even though only one of the states has actually analyzed the impact of using drones for bridge inspection the majority of state agencies expect drones to lower inspection costs, increase efficiency, speed up the inspection process, enhance quality, and improve pedestrian safety.

Several of the states subcontract a portion of their drone operations to third parties. Ohio noted that most of their contractors already use drones and Minnesota indicated that it would likely always utilize some third party contracts for drone operations. Minnesota noted that it has adopted this approach because drone technology advances at such a fast rate. As a result, the
agency felt they needed consultant involvement and capabilities to keep abreast of trends/developments and to supplement their drone inspection activities.

Surveying /Mapping

The use of drone technology for survey and mapping by the DOTs sampled was more limited than for bridge inspection. Four states (UT, OH, MN, NJ) indicated some application(s) by their agency. NC was pilot testing drone use, and GA did not have any current or future plans to adopt this technology. The states indicating limited application were using drones to survey/map remote areas, for planning level missions, and/or perform volumetric calculations for earthwork. However, only one state agency (ODOT) was using drones to assist on a limited basis with the evaluation/validation of contractor payment applications. Two states (UT, NJ) have utilized drones for aerial imaging for initial roadway surveys. In addition, only one of the six states (UT) generated point clouds to assist in the production of surveys produced using drone technology.

The limited use of drones for surveying and mapping operations stemmed from industry and agency concerns regarding the accuracy of surveys relying on ‘drone technology’. The champion for the Ohio DOT noted that ‘surveyors do not trust the drone data for use beyond planning level needs’. Professionally licensed surveyors are reluctant to seal drone surveys.

To address this issue, two of the states (UT, NC) have conducted studies/tests to investigate the accuracy of drone surveying techniques. Utah found drones were most useful with softscapes where additional information about textures and water flows could be captured with a drone that are typically not recorded using traditional surveying practices. In their experience, accuracy depended on the quality of the data but it could be better than within one inch. However, Utah’s experience was that verification reports were essential for the validation of surface surveys produced using drone technologies. NCDOT performed photogrammetry testing and was unable to consistently meet accuracy requirements using only post processed camera station positions. When the agency added ground control points they were able to achieve accuracy results within 0.12’ to 0.18’.

Investigation of sUAS Benefits

Each of the DOT champions were asked what their agency considered to be the chief advantages of incorporating drone technology into their operations. The feedback that was obtained from five of the six agencies is summarized in Table 6.

<table>
<thead>
<tr>
<th>Chief Advantage(s)</th>
<th>UT</th>
<th>OH</th>
<th>NC</th>
<th>MN</th>
<th>NJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced cost</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reduced time</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Improved quality of inspection</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safer operations</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less impact on traffic</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
</tbody>
</table>

All of those reporting felt that using drone technology reduced cost and a majority of the agencies thought it also reduced the time it took to complete activities. Some agencies also felt it enhanced the quality of inspection activities, improved safety, and lowered the impact that the agency’s operations had on traffic flow.

Three of the agencies had investigated potential cost savings. In the interview, Utah indicated that they conducted a study with a state university and found a 60% savings with bridge inspections and a 50% savings with activities for deck delamination inspections. However, Utah did not find savings for other bridge inspection activities due to the FAA limitations/regulations. Minnesota found that the use of UASs for bridge inspection saved an average of 40%, in addition to eliminating the cost associated with traffic lane closures. New Jersey investigated the use of drones for high mast inspections and found that UASs increased efficiency and safety while at the same time reduced inspection cost.

sUAS Program Logistics

Drone Fleet

Most all of the state DOTs interviewed had a central
group that managed their drone program with divisional control and management of the actual drone fleet. Maintenance of the agency’s fleet of drones was most often handled by external third parties depending on the extent of work required.

The average size of an agency’s drone fleet was seven (7), but ranged from three (3) for Utah to seventeen (17) for North Carolina. The majority of the drones used by the state DOTs were multirotor-copters (similar to a helicopter) with UT and OH reporting that they also used fixed wing aircraft (similar to an airplane). Several drone manufacturers were mentioned in the interviews but the most commonly used drones were manufactured by DJI. Five of the DOTs owned at least one DJI Phantom series drone with DJI’s M200, Inspire and Mavic series also commonly used. All of the responding agencies indicated that they intend to add to their fleet.

Pilots and Training

The number of licensed drone pilots within the agencies ranged from two for Minnesota to thirteen for Utah with an overall average of seven pilots. All of the responding agencies paid for the Part 107 pilot’s exam but none of the agencies provided any financial incentive or other reward system for agency personnel receiving a pilot’s license. In the interview, Minnesota expressed that “Luckily, the excitement and interest outweights the fact that we have no incentive” {for pilots}.

Pilot training beyond that required for the pilot’s exam varied by agency. Drone pilots for the Ohio DOT were responsible for their own licensing and training. The Utah DOT was currently developing a new training program that involved both practical and objective tests. Georgia presently had mandatory training on the agency’s standard operating procedures and policies. Minnesota was in the midst of developing a formal training program for their pilots. Currently, MnDOT employees that wanted to be a pilot were required to take the Office of Aeronautics Ground Pilot school training and receive a ‘sign off’ from the school regarding their piloting capabilities in the field. Jew Jersey had one of the most comprehensive training programs. The agency has developed their own curriculum and training program covering three training phases: Phase 1 is Part 107 certification, Phase 2 is a practicum exam, and Phase 3 consists of hands-on training in the field. The entire training program takes 2 weeks.

Consultant Use

All of the state DOTs indicated that their consultants used drones for a variety of activities. Utah noted that their consultants have utilized drones for bridge inspection. In Georgia and North Carolina consultants utilized drones for project documentation. The champion for Minnesota DOT noted that consultants used drones for ‘planning-level’ surveys and disaster management whereas in New Jersey consultants use them for high mast inspection. The Ohio DOT champion noted that consultants used drones for everything that the state agency did, but more aggressively. Ohio also advised that consultant surveyors have embraced drones more enthusiastically than the agency.

Each of the state DOTs interviewed were asked what percentage of the agency’s ‘drone activities’ were contracted to consultants. Georgia advised that most all of their drone applications were performed in-house. Conversely, in Minnesota consultants were currently performing 90% of the DOT’s drone activities. However, the agency indicated that they intended to lower the consultant percentage to 60% in the future. Utah and North Carolina also contracted a substantial portion of their work to consultants. Utah was currently contracting 60-75% and North Carolina was utilizing consultants for approximately half their drone activities.

Industry Involvement and Program Potential

The DOT champions that were interviewed for this study are also actively involved in UAS application, integration, and research activities with the Federal Highway Administration (FHWA), the National Association of State Aviation Officials (NASAO, and the Transportation Research Board (TRB)). The Utah drone champion serves on the FHWA...
UAV committee. Ohio’s sUAS program leader is a member of the FHWA EDC-5 committee, the TRB helicopter committee and the geographic committee, and serves on the Ohio Attorney General’s committee on UAS. The North Carolina champion is the Vice Chair of the NASAO UAS Committee, a committee member of AV020 within TRB, a member of the UAS Subcommittee within the Aviation (AV) group of TRB, and a member of the FHWA EDC-5 UAS Integration team. Minnesota’s leader also serves on the FHWA EDC-5 committee and the TRB Structure Maintenance Committee and the sUAV champion for New Jersey serves on a subcommittee for NASAO. In addition to active involvement with the FHWA, NASAO, and TRB the champions regularly attended UAS conferences, participated in work groups, and worked closely with other DOTs to stay abreast of rapidly changing UAS technology, operational applications, and emerging governmental regulations.

Looking forward, all of the DOTs forecast an expansion of their drone program with an increasing number of pilots, drones, and agency uses throughout the DOT. Over the next 5-10 years the UAS champions predicted a larger role for drones in most categories/uses including traffic management, inspection, structural analysis, surveying, volume calculation, and communication. New Jersey summarized the DOT’s sentiment when the champion stated that the expanding role of drones would be ‘significant’.

Prior to closing out the interview, each state DOT champion participating in this study was asked to identify other states they thought had advanced UAS programs (Note: none of the champions were aware of the other study participants). Collectively, a total of fourteen different states (NC, NJ, CO, MN, AL, UT, KY, IA, OH, DE, CA, MO, MA, GA) were identified by the champions. However, only five states were mentioned by three or more champions – Utah, Ohio, North Carolina, Minnesota, and New Jersey. All five of these states are DOT’s participating in this study.

CONCLUSIONS AND DISCUSSION

The objective of this study was to investigate the degree to which drone technology has been incorporated into the daily operations of state transportation agencies. The research team interviewed the ‘drone champion’ for six state DOTs that were identified as having a broad exposure to the spectrum of sUAS uses. Each drone champion had extensive involvement in the agency’s drone program and were also actively involved in UAS application, integration, and research activities at the national level. During the interview process, five of the six states were identified as state DOTs with advanced UAS programs. The champions, along with their respective DOTs, are in many respects ‘leaders’ in the deployment of drone technology in state transportation agencies. The following conclusions are based on their input.

**Drone Technology Adoption**: The adoption of drone technology by state DOTs is in an ‘early’ stage. The six DOTs interviewed for this study all had experience with a wide range of drone activities. Program structure is rather ‘loose’ and the extent of operational deployment for most all drone applications was limited. There are a number of factors that have contributed to the slow pace of adoption including: a) sUAS are relatively new technology, b) federal guidelines/regulations for their use have only recently been established, c) equipment limitations, d) licensing and training requirements, and e) agency personnel resistance to change.

There is considerable interest in the deployment of drone technology. Agencies are optimistic regarding the favorable impact that drones could have on operational efficiency, cost, safety, and the traveling public. Agency expectations are high even with limited studies validating these anticipated outcomes. State DOTs plan to increase their drone fleet and pilot licensing/training to facilitate expansion of their drone program.

**Operational Deployment**: Drone uses experiencing operational deployment have primarily been
associated with ‘video/camera’ tasks such as aerial photography, traffic monitoring, communication and outreach, accident investigation, documentation, environmental assessment, and disaster management. For these applications the drone is used primarily as an ‘eye in the sky’. These uses require relatively simple equipment, technology and minimal pilot training which facilitates early operational deployment.

Drone applications that require more sophisticated, technologically advanced equipment, software, and pilot capabilities, such as bridge inspection and surveying, have experienced a slower pace of adoption. Equipment limitations, piloting capabilities, and federal requirements have retarded broad operational deployment of drones for bridge inspection. Technology, training, and industry resistance have restrained the use of drones for mapping, surveying, and volumetric calculations.

The forces of change are ever present and DOTs are planning to expand drone operations. One of the DOTs (MN) has been working with Intel to address some of the challenges with bridge inspection. Other DOTs are also investigating and/or deploying drone technology for certain bridge inspection activities. Similarly, to address industry resistance to the use of drones for mapping/surveying several DOTs and universities are investigating the accuracy of drone surveying techniques and volumetric calculations. The landscape for technology, equipment, and software for drone applications in the transportation sector is changing rapidly. New Jersey’s champion advised that demand from operating divisions would fuel program expansion and he forecast that “Soon, drone use will be as common as mobile phones.”

REFERENCES

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Assessing the Equity Gap in Construction Education

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ABSTRACT

There is a documented demand for an educated construction management workforce. To help meet this demand, construction education programs at numerous post-secondary institutions have established objectives and goals to recruit, train, and graduate high-quality students; and, many of these programs are charged with providing educational opportunities to students who have been traditionally underserved in higher education (e.g., female, minority, first generation students, etc.). This study compared the enrollment and retention rates, interdepartmental migration patterns, and student satisfaction and graduation success outcomes of undergraduate students enrolled in a CM program at a public university as a means of identifying trends and equity gaps between student groups. Results indicate many noteworthy trends and equity gaps exist, suggesting that the CM department of interest would be well served to better support female, Latino and other minority students, Pell eligible, and first generation students. Opportunities for future research, evaluation, program initiatives, and limitations are also discussed.

Keywords: Construction Education, Women in Construction, Latinos in Construction

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INTRODUCTION

The demand for construction managers in the United States (U.S.) is projected to grow approximately 10 percent from 2018 to 2028; faster than the average profession (BLS 2018). For individuals seeking entry into high paying construction management positions, the best prospects for employment requires construction industry experience and a bachelor’s degree in a construction-related field (BLS 2018). As a partial solution to meet the increased industry demand for qualified construction professionals, construction management (CM) programs at numerous post-secondary institutions have established objectives and goals to recruit, train, and graduate high caliber undergraduate students. Additionally, many of these institutions, particularly public institutions, are tasked with providing educational opportunities to a diverse population of students, particularly those who have been traditionally underrepresented or underserved in higher education (Strategic Plan 2015- 2020, 2015; Strategic Plan, 2016).

In spite of objectives and goals set by many institutions, low levels of participation among women (typically below 10%) and minorities (potentially below 20%) in CM education indicate disparities between goals and outcomes (Escamilla, et al. 2014; Shane et al., 2012; Del Puerto, Guggemos & Shane 2011). Potentially, these and other disparities between enrollment and retention goals in CM higher education could be associated with the well-documented recruitment and achievement (or equity) gap relating to women, first-gen, minority, lower socioeconomic status (SES), and other traditionally underserved student groups in CM education and higher-education at large (Ryan & Bauman, 2016; Bailey & Dynarski, 2001; Inman & Mayes, 1999). However, except for women and, to a lesser extent, minority students, research addressing the equity gaps in CM education is limited. To this end, the following study will identify and evaluate trends and equity gaps in a CM program at a public university in the mountain region of the U.S.

REVIEW OF LITERATURE

Female Students in Construction Education

In the U.S., women enroll in post-secondary institutions and graduate with degrees at higher rates than men (Ryan & Bauman 2016; Lopez & Gonzalez-Barrera 2014). Nonetheless, women around the world continue to enroll in construction education programs at significantly lower rates than men (Oo & Widjaja 2018; Shane et al. 2012; Del Puerto et al. 2011). According to Del Puerto et al. (2011), the percentage of undergraduate female students graduating from a CM program at a U.S. western university between 2000 and 2010 ranged from 4.6% to 12.6%, with a 10-year average of 7.9%. At a different U.S. Midwestern university, Shane et al. (2012) reported a steady decline in the percentage of undergraduate female construction engineering students, decreasing from approximately 10% in 2000 to 7% in 2006. Conversely, Oo and Widjaja (2018) reported an increase in the number of females enrolling at three Australian universities between 2006 and 2015. While one university showed only marginal improvements in the number of female enrollees, topping out at just below 5%, the other two universities experienced enrollment trends initiating at close to 10% in 2006 and terminating close to 17% by 2015 (Oo & Widjaja 2018).

Numerous factors have been posited to deter women from educational and career tracks focused on construction; thus exacerbating the gender participation gap in construction. These include: 1) a poor image of the construction industry (Menches & Abraham 2007); 2) a male-dominated and oppressive culture (Amaratunga, Haigh, Shanmugam, Lee, & Elvitigala, 2006); Dainty, Bagilhole & Neale 2000); and 3) a lack of understanding concerning construction careers (Amaratunga et al. 2006; Moore & Gloeckner 2006). To mitigate these and other deterring factors, researchers have explored the variables relating to the recruitment and retention of females in CM. For example, Bigelow, Mathew, Ritter, and Elliot (2015) ranked internships, career opportunities, and father working in construction among factors that have the highest correlation with females’ decision to pursue a CM degree while identifying mentoring, high school counselors, and work experience ranked among the lowest. These results stand in contrast to the factors posited by Del Puerto et al. (2011) and Moore and Gloeckner (2006), which included mentoring and work experience as critical variables for attracting women into the construction industry.
Minorities and Latinos in Construction and Higher Education

The occupational differences between Latinos and non-Latinos in the construction industry are well documented. For example, from 2012 to 2016, Latino workers accounted for 69% of new construction hires (Wang, Dong, & Vikraman 2016) and constituted 36% of the US construction and extraction labor force, but only accounted for 12.4% of construction managers (Census Bureau, 2016). A similar gap also exists for Latinos in higher-education outcomes. For example, as of 2016, only 15.5% of Latinos in the U.S. over the age of 25 held a bachelor’s degree as compared to 36.2% of non-Latino Whites (Ryan & Bauman 2016). On a more promising note for Latinos in construction higher education, Escamilla et al. (2018) reported a rise in the enrollment of Latino students at Texas A&M University for 2008 to 2012. As with Latinos, minority students, overall, experience an achievement gap in higher education. For example, as noted by Ryan and Bauman (2016), only 22.5% of Black students over the age of 25 possess a bachelor’s degree as compared to 36.2% Whites.

Pell Eligible Students in Higher Education

The purpose of the Federal Pell Grant Program is to provide “need-based grants to low-income undergraduate and certain post baccalaureate students to promote access to postsecondary education” (Federal Pell Grant Program 2015, p. 1). While Pell eligibility is based solely on income, Pell eligible students are more likely to come from populations traditionally underrepresented in higher education. For example, during the 2011-2012 academic year at public 4-year institutions, 62.0% of Black students and 51.9% of Latino students received Pell grants in comparison to 29.9% of White students (Trends in Pell Grant Receipt 2015). Students from low-income families are less likely to enroll and graduate from post-secondary institutions than their counterparts (Bailey & Dynarski 2001). However, for minority students, Pell funding increases the likelihood of graduation (Chen & DesJardins 2010).

First Generation Students in Higher Education

First generation (first-gen) students are defined as those attending a university or college who do not have at least one parent that completed a bachelor’s degree (Pike & Kuh 2005). In the U.S., approximately one in four undergraduate students are first-gen (Redford & Hoyer 2017). In comparison to continuing generation (con-gen) students -- defined as those who have at least one parent who completed a bachelor’s degree -- first-gen students have a higher probability than con-gen students to identify as a racial and come from a family of SES status (Inman & Mayes 1999). Furthermore, first-gen students are less likely to complete a bachelor’s degree. For example, according to Engle and Tinto (2008), 11% of first-gen students who enrolled in a bachelor’s degree program graduated within six years in comparison to 55% of con-gen students.

STUDY PURPOSE AND RESEARCH OBJECTIVES

Considering the information and literature presented, the purpose of this study is to identify trends and equity gaps between female, first-gen, minority, Latino, and Pell-eligible undergraduate CM students, and their respective counterparts, at a public university located in the mountain region of the U.S. It is intended that the results of this study will be utilized as a benchmark for evaluating trends and equity gaps and in the development of strategic initiatives to recruit and retain an increased number of traditionally underrepresented and underserved undergraduate students into CM education. Methods and results could also act as a guide for future research to address the equity gaps in construction education.

A non-experimental, comparative, and descriptive approach was utilized to address the following research objectives:

RO1: To identify trends and equity gaps in department enrollment and retention rates

RO2A: To identify trends and equity gaps in migration patterns into (towards) the CM department

RO2B: To identify trends and equity gaps in migration patterns away from (attrition) the CM department

RO3: To identify trends and equity gaps in job placement, salary, and the perceptions of undergraduate students who had recently graduated from the CM department.
Data Retrieval and Delimitations

Data for this study were retrieved from reports generated by the institution of interest’s Department of Institutional Research, Planning, and Effectiveness (IR) website. The population of interest for this study was undergraduate students majoring in the CM department. Data and reports retrieved from the IR website are publicly accessible and presented in an aggregated format with no unique student identifiers.

IR data and reports were available for differing periods and populations of students. For RO1, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latino/non-Latino undergraduate first semester CM majors. Data on department enrollment and retention rates were available for academic years 1990 to 2016. However, data for this study were delimited to academic years 2005 to 2016 to coincide with data availability from the IR migration reports (i.e., RO2A and RO2B) and to evaluate recent trends.

For RO2A, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, and non-Pell/Pell eligible undergraduate students who identified as CM majors during their final (or last) semester at the institution of interest but who did not identify as CM majors during their first semester at the institution of interest. Data were delimited to academic years 2005 to 2016. For RO2B, the populations of interest were the same undergraduate groups listed in RO2A but bound to those that identified as CM majors during their first semester but did not identify as CM majors during their final (or last) semester at the institution of interest. Data were delimited to academic years 2005 to 2016 based on availability from the IR website.

For RO3, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latino/non-Latino undergraduate students who had recently graduated from the CM department. Data were delimited to academic years 2012 to 2016 based on availability from the IR website.

Data Treatment, Evaluation, and Limitations

Data and reports were extracted directly from the IR website. Post extraction, data were aggregated into single reports addressing the research objectives. In calculating department persistence rates, weighted averages were calculated for each group utilizing all delimited years of data. For example, second-year retention rates for new females are the weighted average of all female CM cohort students between 2005 and 2016. In calculating weighted averages, the following formula was utilized (where $x_i$ is the retention rate percentage in year $i$ and $w_i$ is the number of CM major cohort students in year $i$):

$$\text{Weighted Average} = \frac{\sum_{i=1}^{n}(x_i * w_i)}{\sum_{i=1}^{n}(w_i)}$$

Research and data limitations should be considered in interpreting the results of this study. The data utilized in this study are from a single department at a land grant university in the mountain region of the US. Furthermore, while trends and equity gaps are identified, comparative or other statistical analyses were not utilized. Additional limitations include the utilization of secondary data and the steep escalation of CM student salaries during the reporting periods.

FINDINGS

Retention and Graduation

Female Student Retention

A graphic representing yearly percentage increases (or decreases) from the average student retention rate for female and male students is found in Figure 1. Overall, new (n = 757) and transfer (n = 456) male students were retained at a relatively comparable rate to the average of all new (n = 806) and transfer (n = 487) students. For new (n = 49) and transfer (n = 31) female students, trends indicated more significant year over year variability than males and an equity gap for female transfer students. For new female students, data suggest that the critical time to address program retention is during the first few years of enrollment when students experience higher than average department attrition rates. After this period, students persisted at a higher than average rate. For female transfer students, retention rates were an area of concern. Beginning in the third year, female students left the CM program at a higher than average rate, and by the eighth year, these students were 11.1% less likely than the average transfer.
student to have remained enrolled or graduated. In an industry like construction, with low female participation rates, it appears that an equity gap exists for the CM department to better support these students.

Beginning in the second year, except for the third year for new Latinos, both groups were retained or graduated at a lower than average rate. By the eighth year of evaluation, transfer minority and new Latino students were 8.6% and 6.1%, respectively, less likely than the average students to have remained enrolled or graduated.

**Figure 1. Retention Percentage Increase (or Decrease) from All Students (Average)**

**Minority and Latino Student Retention**

A graphic representing yearly percentage increases (or decreases) from the average student retention rate for minority, non-minority, and Latino students is found in Figure 2. Overall, new (n = 702) and transfer (n = 437) non-minority students were retained at a relatively comparable rate to the average of all new and transfer students. Similar to the trends observed with females, new (n = 104) and transfer (n = 50) minority and new (n = 69) and transfer (n = 30) Latino students experienced more significant year over year variability than non-minorities students. Noteworthy trends or equity gaps were apparent for all populations. By the eighth year, new minority and transfer Latino students graduated or remained enrolled in the CM program at higher than average rates. However, on average, between the second and sixth years of evaluation, new minority and transfer Latino students remained enrolled at a lower than average rate. After this time, retention or graduation percentages increase for both groups with a stark increase occurring for transfer Latino students in the seventh and eighth years of evaluation. For new Latino and transfer minority students, trends indicate an equity gap.

**Figure 2. Retention Percentage Increase (or Decrease) from All Students (Average)**

**Pell Eligible Student Retention**

A graphic representing yearly percentage increases (or decreases) from the average student retention rate for Pell and non-Pell recipients is found in Figure 3. Overall, new non-Pell eligible (n = 687) and transfer Pell eligible (n = 110) students were retained at a marginally higher rate than average. However, transfer Pell eligible students did experience increased variability, particularly during the fifth year observation. For transfer non-Pell eligible students (n = 377), trends indicate an equity gap. Overall, these students experienced a slow and steady decline in retention or graduation and, by the final year of observation, were 5.3% less likely to have graduated or been retained than the average transfer student. For new Pell eligible students (n = 119), the equity gap is more extensive than all other groups. By the second year of enrollment, new Pell eligible students left the program at a concerning rate. By the eighth year of observation, these students were less likely than the average new student to have remained enrolled or
graduated. In light of the trend presented, it appears that Pell eligibility is both positively and negatively correlated with student retention, depending on the transfer status.

Figure 3. Retention Percentage Increase (or Decrease) from All Students (Average)

**First-Gen Student Retention**

A graphic representing yearly percentage increases (or decreases) from the average student retention rate for first-gen and con-gen students is found in Figure 4. Overall, new (n = 625) and transfer (n = 325) con-gen students were retained at a marginally higher than average rate. For new (n = 181) and transfer (n = 162) first-gen students, retention and graduation trends exhibited a relative below-average trend. By the eighth year, transfer first-gen students were 3.1% less likely than the average transfer student to have remained enrolled or graduated, and new first-gen students were 4.6% less likely than the average new student to have stayed enrolled or graduated indicating an equity gap.

Figure 4. Retention Percentage Increase (or Decrease) from All Students (Average)

**Migration Patterns Into (Towards) CM**

The breakdown of first semester CM and non-CM majors that identified as CM majors during their last (or final) semester at the institution of interest is found in Table 1. For minority, female, and first-gen students that identified as CM majors during their last semester at the institution of interest, the likelihood of identifying as a CM major during their first semester was less than their non-minority, male, and con-gen counterparts indicating an equity gap for the CM program to attract secondary or other university-bound students.

Department level student migration (arrival) patterns are presented in Table 2. Overall, first semester provost/open (56.6%) and engineering related (21.8%) majors accounted for the most substantial percentage of migrants entering the CM department. At the group level, provost/open majors accounted for the most substantial proportion of migrants for all groups ranging from 62.4% of first-gen students to 35.7% of female students. Furthermore, civil

<table>
<thead>
<tr>
<th>Major Department</th>
<th>T (1130)</th>
<th>MI (196)</th>
<th>NMI (952)</th>
<th>F (78)</th>
<th>M (1070)</th>
<th>P (253)</th>
<th>NP (895)</th>
<th>FG (306)</th>
<th>CG (842)</th>
</tr>
</thead>
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<tr>
<td>CM Majors (%)</td>
<td>52.8</td>
<td>46.9</td>
<td>54.0</td>
<td>46.2</td>
<td>53.3</td>
<td>51.8</td>
<td>53.1</td>
<td>48.7</td>
<td>54.3</td>
</tr>
<tr>
<td>Non-CM Majors (%)</td>
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<td>53.1</td>
<td>46.0</td>
<td>53.8</td>
<td>46.7</td>
<td>48.2</td>
<td>46.9</td>
<td>51.3</td>
<td>45.7</td>
</tr>
</tbody>
</table>

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen
Table 2. First Semester Major of Students that Migrated into CM (Percentage)

<table>
<thead>
<tr>
<th>Major Department</th>
<th>T (533)</th>
<th>MI (104)</th>
<th>NMI (438)</th>
<th>F (42)</th>
<th>M (500)</th>
<th>P (122)</th>
<th>NP (420)</th>
<th>FG (157)</th>
<th>CG (385)</th>
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<tr>
<td>Business Intra-College</td>
<td>3.0</td>
<td>0.0</td>
<td>3.7</td>
<td>0.0</td>
<td>3.2</td>
<td>1.6</td>
<td>3.3</td>
<td>1.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Civil and Env. Engineering</td>
<td>8.5</td>
<td>12.5</td>
<td>7.5</td>
<td>11.9</td>
<td>8.2</td>
<td>9.8</td>
<td>8.1</td>
<td>5.1</td>
<td>9.9</td>
</tr>
<tr>
<td>Engineering Intra-College</td>
<td>5.0</td>
<td>2.9</td>
<td>5.5</td>
<td>2.4</td>
<td>5.2</td>
<td>5.7</td>
<td>4.8</td>
<td>5.1</td>
<td>4.9</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>8.3</td>
<td>6.7</td>
<td>8.7</td>
<td>7.1</td>
<td>8.4</td>
<td>4.1</td>
<td>9.5</td>
<td>8.9</td>
<td>8.1</td>
</tr>
<tr>
<td>Design and Merchandising</td>
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<td>0.0</td>
<td>1.4</td>
<td>14.3</td>
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<td>0.0</td>
<td>1.4</td>
<td>0.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Health and Exercise Science</td>
<td>4.2</td>
<td>3.8</td>
<td>4.3</td>
<td>9.5</td>
<td>3.8</td>
<td>4.9</td>
<td>4.0</td>
<td>6.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Provost / Open Major</td>
<td>56.6</td>
<td>61.5</td>
<td>55.5</td>
<td>35.7</td>
<td>58.4</td>
<td>59.0</td>
<td>56.0</td>
<td>62.4</td>
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<td>Biology</td>
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<td>9.5</td>
<td>1.6</td>
<td>1.6</td>
<td>2.4</td>
<td>3.2</td>
<td>1.8</td>
</tr>
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<td>Chemistry</td>
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<td>2.9</td>
<td>0.5</td>
<td>2.4</td>
<td>0.8</td>
<td>1.6</td>
<td>0.7</td>
<td>0.6</td>
<td>1.0</td>
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<tr>
<td>Biomedical Sciences</td>
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<td>0.0</td>
<td>0.7</td>
<td>4.8</td>
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<td>0.0</td>
<td>0.7</td>
<td>0.0</td>
<td>0.8</td>
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<tr>
<td>Other</td>
<td>3.9</td>
<td>1.9</td>
<td>4.3</td>
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<td>4.0</td>
<td>4.1</td>
<td>3.8</td>
<td>1.9</td>
<td>4.7</td>
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</tbody>
</table>

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “first semester” CM majors; Department majors representing less 3% of the population reported under “Other”; Bolded = Top (5) department majors

and environmental, mechanical, and intra-college engineering majors, jointly, accounted for between 19.1% and 22.1% of migrants for all groups.

Among the noteworthy trends within this section is the migration pattern of female students. While provost/open major students accounted for the most significant percentage of female migrants, the average student was more likely to migrate from a provost/open major than a female indicating an equity gap. Furthermore, design and merchandising, biology, and health and exercise sciences, jointly, accounted for 33.3% of females as compared to 5.4% of males.

Migration Patterns Away from (Attrition) CM

The breakdown of first semester CM majors that were retained or migrated away from the CM program during their last (or final) semester at the institution interest is found in Table 3. Students from all groups remained enrolled in the DCM at comparable rates ranging from 81.8% of females to 84.2% of first-gen students.

Table 3. Student Migration away from CM

<table>
<thead>
<tr>
<th>Major Department</th>
<th>T (726)</th>
<th>MI (110)</th>
<th>NMI (616)</th>
<th>F (44)</th>
<th>M (682)</th>
<th>P (157)</th>
<th>NP (569)</th>
<th>FG (177)</th>
<th>CG (549)</th>
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<tr>
<td>CM Majors Retained (%)</td>
<td>83.5</td>
<td>83.6</td>
<td>83.4</td>
<td>81.8</td>
<td>83.6</td>
<td>83.4</td>
<td>83.5</td>
<td>84.2</td>
<td>83.2</td>
</tr>
<tr>
<td>CM Majors Migrated (%)</td>
<td>16.5</td>
<td>16.4</td>
<td>16.6</td>
<td>18.2</td>
<td>16.4</td>
<td>16.6</td>
<td>16.5</td>
<td>15.8</td>
<td>16.8</td>
</tr>
</tbody>
</table>

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen
Table 4. Final Semester Major of Students that Migrated away from CM (Percentages)

<table>
<thead>
<tr>
<th>Major Department</th>
<th>T (120)</th>
<th>MI (102)</th>
<th>NMI (8)</th>
<th>M (112)</th>
<th>P (26)</th>
<th>NP (94)</th>
<th>FG (28)</th>
<th>CG (92)</th>
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<tr>
<td>Hort &amp; Land Arch</td>
<td>6.7</td>
<td>0.0</td>
<td>7.8</td>
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<td>7.1</td>
<td>3.8</td>
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<td>CIS</td>
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<td>0.0</td>
<td>0.9</td>
<td>0.0</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Finance &amp; Real Estate</td>
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<td>0.0</td>
<td>9.8</td>
<td>0.0</td>
<td>8.9</td>
<td>3.8</td>
<td>9.6</td>
<td>10.7</td>
</tr>
<tr>
<td>Design and Merchandising</td>
<td>2.5</td>
<td>0.0</td>
<td>2.9</td>
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<td>2.7</td>
<td>11.5</td>
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<td>3.6</td>
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<td>Food Science &amp; Nutrition</td>
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<td>0.0</td>
<td>4.9</td>
<td>12.5</td>
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<td>0.0</td>
<td>5.3</td>
<td>0.0</td>
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<tr>
<td>Exercise Science</td>
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<td>5.6</td>
<td>3.9</td>
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<td>3.6</td>
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<td>Continuing Ed - Admin</td>
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<td>Provost / Open Major</td>
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<td>0.0</td>
<td>3.6</td>
<td>7.7</td>
<td>2.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Languages and Cultures</td>
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<td>0.0</td>
<td>1.0</td>
<td>12.5</td>
<td>0.0</td>
<td>0.0</td>
<td>1.1</td>
<td>0.0</td>
</tr>
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<td>16.7</td>
<td>3.9</td>
<td>12.5</td>
<td>5.4</td>
<td>7.7</td>
<td>5.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Biochemistry</td>
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<td>5.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.9</td>
<td>3.8</td>
<td>0.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Ecosystem Science</td>
<td>3.3</td>
<td>5.6</td>
<td>2.9</td>
<td>12.5</td>
<td>2.7</td>
<td>3.8</td>
<td>3.2</td>
<td>3.6</td>
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<td>Forest Stewardship</td>
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<td>16.7</td>
<td>3.9</td>
<td>0.0</td>
<td>6.3</td>
<td>3.8</td>
<td>6.4</td>
<td>7.1</td>
</tr>
<tr>
<td>Human Dim of Natural Resc.</td>
<td>7.5</td>
<td>5.6</td>
<td>7.8</td>
<td>0.0</td>
<td>8.0</td>
<td>3.8</td>
<td>8.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Other</td>
<td>19.2</td>
<td>0.0</td>
<td>22.5</td>
<td>0.0</td>
<td>20.5</td>
<td>7.7</td>
<td>22.3</td>
<td>17.9</td>
</tr>
</tbody>
</table>

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “final semester” CM majors

Department majors representing less 5% of population reported under “Other”

Bolded = Top (5) department majors
Department level student migration (departure) patterns are found in Table 4, and college-level migration (departure) patterns are found in Table 5. Overall, communications, provost/open, real estate finance, human dimensions of natural resources, and horticulture and landscape architecture majors were the landing locations for the largest percentage of departing CM migrants. Numerous notable and contrasting trends emerge between student groups. For example, minority, female, Pell eligible, and first-gen students were substantially more likely to migrate into the colleges of health and human sciences and liberal arts than their respective counterparts. Conversely, non-minority, male, non-Pell, and con-gen students were substantially more likely to migrate into the colleges of agricultural sciences, business, and natural resources than their respective counterparts. Trends indicate disparate academic interests between student groups.

A disconcerting trend identified in the migration evaluation is the percentage of students that identified as provost/open majors during their last semester. It can be assumed that these students left the university without graduating. Overall, 10.0% of students that migrated away from the CM department identified as provost/open majors during their last semester. This trend was particularly detrimental to Pell eligible students, where 21.7% of students identify as a provost/open major during their last semester.

CM Graduate Perceptions and Outcomes

Student Satisfaction

The results of the student satisfaction question, “How would you evaluate your entire educational experience within your major?” are found in Figure 5. Overall, students from all groups reported a “good” or “excellent” experience within the major.

Table 5. Final Semester College of Students that Migrated away from CM (Percentage)

<table>
<thead>
<tr>
<th>College</th>
<th>T (120)</th>
<th>MI (18)</th>
<th>NMI (102)</th>
<th>F (8)</th>
<th>M (112)</th>
<th>P (26)</th>
<th>NP (94)</th>
<th>FG (28)</th>
<th>CG (92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Sciences</td>
<td>9.2</td>
<td>0.0</td>
<td>10.8</td>
<td>0.0</td>
<td>9.8</td>
<td>7.7</td>
<td>9.6</td>
<td>3.6</td>
<td>10.9</td>
</tr>
<tr>
<td>Business</td>
<td>15.8</td>
<td>5.6</td>
<td>17.6</td>
<td>0.0</td>
<td>17.0</td>
<td>3.8</td>
<td>19.1</td>
<td>10.7</td>
<td>17.4</td>
</tr>
<tr>
<td>Health and Human Sciences</td>
<td>12.5</td>
<td>5.6</td>
<td>13.7</td>
<td>25.0</td>
<td>11.6</td>
<td>15.4</td>
<td>11.7</td>
<td>10.7</td>
<td>13.0</td>
</tr>
<tr>
<td>Intra-University</td>
<td>11.7</td>
<td>11.1</td>
<td>11.8</td>
<td>12.5</td>
<td>11.6</td>
<td>19.2</td>
<td>9.6</td>
<td>3.6</td>
<td>14.1</td>
</tr>
<tr>
<td>Liberal Arts</td>
<td>27.5</td>
<td>44.4</td>
<td>24.5</td>
<td>50.0</td>
<td>25.9</td>
<td>34.6</td>
<td>25.5</td>
<td>46.4</td>
<td>21.7</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>3.3</td>
<td>5.6</td>
<td>2.9</td>
<td>0.0</td>
<td>3.6</td>
<td>7.7</td>
<td>2.1</td>
<td>7.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Natural Resources</td>
<td>20.0</td>
<td>27.8</td>
<td>18.6</td>
<td>12.5</td>
<td>20.5</td>
<td>11.5</td>
<td>22.3</td>
<td>17.9</td>
<td>20.7</td>
</tr>
</tbody>
</table>

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “final semester” CM majors
The results of the student satisfaction question, “If you could start over again, would you choose the same major?” are found in Figure 6. Overall, students would “probably” or “definitely” select CM as an academic major again. Latinos reported the highest level of satisfaction with 100% reporting they would “probably” or “definitely” select the same major again. Females reported the highest level of dissatisfaction with their major selection, with 10.3% reporting they would “probably not” or “definitely not” select the same major again.

**Figure 6. If you could start over again, would you choose the same major?**

**Advising, Studying, and Faculty Interactions**

The results of the advising question, “Did you have a faculty or staff member who was a positive influence on you while you attended [the institution of interest]?” are found in Figure 7. Overall, 90.4% of students reported a positive influence by a faculty or staff member. While minority, Pell eligible, and first-gen students reported marginally lower than average levels of positive influence, female students were more likely than male students to report no positive faculty or staff influences indicating an equity gap.

The results of the advising question, “How would you rate your satisfaction with your advising related to courses, scheduling, and selecting a major?” are found in Figure 8. Overall, students reported high levels of satisfaction in relation to course, scheduling, and major advising, with almost 89% reporting “excellent” or “better than average” results. While female students reported the lowest overall levels of satisfaction with academic advising, Latino students reported the lowest levels of “excellent” satisfaction of any group and the second-highest levels of dissatisfaction.

**Figure 7. Did you have a faculty or staff member who was a positive influence on you while you attended [the institution of interest]?”**

**Figure 8. How would you rate your satisfaction with your advising related to courses, scheduling, and selecting a major?”**

The results of the advising question, “To what extent did your department emphasize spending significant amounts of time studying and on academic work?” are found in Figure 9. Overall, 74.9% of all students reported that studying was emphasized “very much” or “quite a bit.” For non-White, Latino, and first-gen students, there appears to be a perceived emphasis on the importance of spending significant amounts of time studying and on academic work. Overall,
Latino students reported the highest levels of academic emphasis, with 89.5% reporting “very much” or “quite a bit.”

Internships and Employment

The results of the question, “Did you have an internship with your employer prior to graduation?” are found in Figure 10. Overall, 56.7% of students accepted an employment position with an organization where they previously had an internship, and more than half of students from all groups did the same. Of particular note, female students were more likely than male students to return to an organization where they previously had an internship.

Salary reports for CM graduates are found in Figure 11. In evaluating compensation data, it is important to note that the average salary for all construction management graduates has increased steadily and steeply over the reporting period. Overall, students returning to an organization where they previously had an internship were more highly compensated than students who did not return to an organization where they previously had an internship. Minority students that returned to an organization where they previously had an internship received the highest levels of compensation, earning approximately $2000 more than average. Of particular note, female students reported compensation levels well below average. For female students that accepted a position with an organization where they had previously interned, the compensation was approximately $2000 less than average. For female students that accepted a position with an organization where they did not previously have an internship, reported compensation was $6000 less than average, amounting to a 10.3% wage gap.

DISCUSSION

Female Students

Noteworthy trends and equity gaps were identified in relation to female CM students that merit further
discussion. First, the relative disparity in program retention or graduation between new and transfer female students is a point of unease. While the cause of the disparity could not be identified in this paper, analysis of female transfer students at different post-secondary institutions could identify whether the observed trend is isolated to the institution of interest or a more systemic concern. Furthermore, exit surveys for students who decide to leave CM programs or first-person interviews with transfer female students could shed increased light on the variables that affect the retention gap.

In terms of student migration into CM, female students were less likely to migrate from a provost/open major than all other student groups and were more likely to migrate into CM from design and merchandising, biology, and health and exercise sciences. As such, it appears that the CM department could potentially benefit from an increased effort to recruit a greater number of female provost/open majors. As a further point of discussion, the interior architecture and design program (which is part of the design and merchandising department) requires all students to complete a construction materials and methods course in the CM department. As the second-largest major of female migrants into the CM department, migration patterns potentially suggest that exposure to CM courses could have a positive relationship with females selecting a CM major.

Migration patterns away from the CM department suggest that the academic interests of male and female students who leave the department are disparate. Given the breadth and depth of requisite skills and interest required to succeed in the CM industry, future research could evaluate the differing social drivers for male and female students in pursuing a career in the construction industry and evaluate whether the contexts utilized in meeting CM course learning objectives are in line with the interests of female students.

In terms of CM department perceptions and first destination outcomes, two noteworthy and concerning trends were identified relating to perceived faculty support and starting salaries. In light of the fact that the small number of female CM survey respondents could skew the results, the data suggests that there is an equity gap to better support female students. First, it appears that female CM students feel less supported by faculty and staff than other students. While the reasons for this were not identified, future research and initiatives, either individual or department-wide, could shed a greater understanding of the variables associated with lower perceived support. Second, an increased understanding of the salary gap would be beneficial. Notably, as it has been noted that construction has a lower gender salary gap than most industries (Bilbo, Bigelow, Rybkowski & Kamranzadeh 2014), it would be valuable to identify the magnitude of the gap at graduation statistically.

**Minority Students**

As with females, the retention gap between new and transfer minority students is a point of concern. As observed in second year enrollment rates, transfer minority students leave the CM program early in their academic careers. Again, while the reason for this trend cannot be evaluated in this paper, it appears that increased support for these students during their first (and continuing) years of enrollment and a greater understanding of the variables that adversely affect program persistence is needed.

In terms of department migration patterns, inbound patterns for minority students are similar to the average of all students. However, outbound patterns were less directed towards business or agricultural sciences than the average student and more focused on communications, sociology, and forest stewardship, suggesting a stronger pull towards majors focused on social factors or environmental stewardship.

**Latino Students**

In an inverse trend from female and minority students, transfer Latino students graduated or persisted at higher than average levels while new Latino students graduated at lower than average levels, indicating an equity gap for new Latino
students. Furthermore, both new and transfer Latino students experienced relatively high levels of variability in retention. Given this variability, future statistical analysis focused on temporal aspects relating to student program persistence could be beneficial in understanding the variability in Latino student persistence. However, at current, it appears that Latino students, in general, would benefit from increased support, particularly during the first several years of program enrollment.

**Pell Eligible Students**

Equity gaps to better support Pell eligible students were identified. Among the most pressing gaps is CM department retention rates for new Pell eligible students. As previously noted, these students had the lowest levels of department persistence or graduation rates, resulting in an eight year non-persistence rate 17.2% higher than average. Given that Pell eligible students migrated away from the CM department at a rate comparable to other groups, it can be conjectured that a partial reason for this disparity is due to higher levels of university attrition. Furthermore, Pell eligible students that migrated away from the CM department were almost twice as likely as the average student to identify a provost/open major during their final semester.

Given the time and financial resource commitment by students and the financial resources committed by the U.S. federal government to attend university, advising departments and faculty could make a concentrated effort to direct students who choose to leave the program towards a defined major that better fits the student’s academic or personal aptitude. Ideally, maximizing the probability that the resources already expended by the student and government will lead to a university degree.

**First-Gen Students**

Equity gaps exist in relation to first-gen student persistence as these students are less likely to persist than their con-gen counterparts. However, given the relative flatness of the persistence trends, it appears that the first year of program enrollment is the most pivotal time to provide increased support.

In terms of department migration into the CM program, first-gen students are slightly more likely than average to migrate from a provost/open major and are slightly less likely to migrate from engineering. In terms of migration away from the CM department, first-gen students were twice as likely to select a liberal arts major as con-gen students but more likely than minorities and women to select business degrees. These results suggest that first-gen students are potentially a less homogenous group, in terms of academic interests, than other groups.

**MOVING FORWARD**

This study utilized publicly available data to identify and evaluate trends and equity gaps for female, minority, Latino, Pell eligible, and first-gen undergraduate students enrolled in the CM department at a land grant university in the mountain region of the U.S. The results of this study identified numerous equity gaps and suggest that the CM department of interest would be well served to focus department initiatives and future research on addressing and mitigating the gaps identified.

Specifically, initiatives focused on attracting a higher number of university-bound females, Latino, Pell-eligible, and minority students could increase the number of first-semester CM majors. Potential recruitment activities could include an increased recruitment focus at high schools or junior colleges that serve more significant percentages of minority, Latino, or lower SES students, many of whom may hold a negative perception of construction-related careers (Escamilla, Ostadalimakhmalbaf, & Bigelow 2016). Additionally, open houses, summer camps, or other outreach programs for female or minority students interested in CM related careers could prove beneficial.

Additional initiatives could focus on mitigating the retention gap for students at the highest risk of attrition (i.e., new Latino, Pell eligible, and first-gen and transfer female, minority, non-Pell
eligible, and first-gen students). For example, summer bridging programs have been shown to positively affect student recruitment and academic outcomes in higher-education (Baker & Slunt 2017). Further ideas include panel discussion for first-year students where panelists specifically mention their background (e.g., first-gen, minority, etc.) as this has been shown to improve retention and academic performance among first-gen and con-gen students (Stephens, Hamedani, & Destin 2014). Furthermore, a targeted focus by faculty to female support relationships could be helpful given the disparities previously discussed, and opportunities to connect female students to industry professions should be facilitated (Moore & Gloeckner 2007). Finally, an evaluation of course objectives and the activities and context utilized to meet those objectives could be useful in ensuring that students with potentially different interests (e.g., males and females) are equally served within CM courses as research has shown that this is not always the case (Bachman, Hebl, Martinez, & Rittmayer 2009). Given the public nature of the data utilized in this study, the author suggests that researchers identify similar data sources for future evaluation and perform similar analyses.

REFERENCES


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ABSTRACT

The employee assessment process (EAP) is a formal evaluation system used by an employer to evaluate employee’s performance and behavior within a company. The objective of this paper is to determine the current state of the most common used practices for EAP in the construction industry; specifically in Southeast United States. Existing literature was reviewed to understand the historical context and the current documentation of existing EAP processes in other industries and within the construction industry. Literature revealed that there is no formal standardized process documented for EAP practice within the United States construction industry. Based on the literature findings from other industries and EAP process from construction companies outside the United States, the researchers developed a survey instrument that was distributed to a group of fifty-six participants within various general contracting companies in Southeast United States. In order to develop the standard practice, the five elements, specifically, documentation of assessment, metrics used during assessments, key components of assessment, frequency of employee assessment and level of assessment detail based on different positions within a company were analyzed.

Key Words: Employee Assessment, Construction, Evaluation, Employee Performance

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Cayla L. Anderson is a graduate student at Clemson University pursuing her M.S. in Construction Science & Management and Ph.D. in Planning Design and Built Environment. Her current research interests include construction education, workforce development, and STEM education.
INTRODUCTION

Employee Assessment Process (EAP) is an important human resource practice at the project, corporate, regional, or industry levels (Srour et al., 2006). EAP is an evaluation system that uses characteristics set by an employer for a detailed look into the behavior and performance of an employee. The construction industry is a labor intense industry where employee management issues need to be given adequate attention (Loosemore et al., 2003). When the performance of employees improves, the performance of the company improves (DeNisi and Smith, 2014). In order to achieve this high performance, managers need an effective process to evaluate the performance of their employees (Tabassi and Bakar, 2009). Understanding the EAP is necessary for training employees and aid companies to have better performance within the industry (Elnaga and Imran, 2013). With this in mind, the objective of this paper is to evaluate the current state and develop a standard practice for the EAP within the construction industry in the Southeast United States.

Background

The EAP is a formal system of evaluation that takes a detailed look into the behavior and performance of an employee at work (Kirovska and Qoku, 2014). The definition of formal is deliberate, impersonal modes of conduct (Morand, 1995). According to Hartmann and Slapničar (2009), the formality of performance management is defined as a scenario where the manager lists performance targets, both quantitative and qualitative, in written terms to increase employee’s performance. The working performance of an employee is defined as the ability and effort to complete various tasks for a given occupation (Pampouktis et al., 2019).

From what the current literature suggests, EAP is primarily concentrated on performance measurement and evaluation at the project level (Ali et al., 2013). Key Performance Indicators (KPI’s) and benchmarking as performance measurement practices are currently used in the construction industry (Horta et al., 2009). KPI’s are used during the establishment of performance and improvement targets whereas benchmarking is the practice of measuring against recognized targets. Evidence of a positive effect of training programs within an organization are also shown in previous EAP’s (Elnaga and Imran, 2013). One of the key aspects of any type of evaluation is also to have a well-defined set of criteria (Islam and Bin, 2006).

Traditionally, studies in the construction industry are focused on measuring performance metrics based on financials at the project, corporate, regional, or industry levels only (Pekuri et al., 2011).

Literature Review

A literature review was conducted to identify current approaches for EAP in other industries and in the construction industry for other countries. Literature suggests that there is no standard EAP practice within the United States construction industry. Hence, there is a need for further research in personnel management and administration methods in the construction industry especially in the United States (Carr and Maloney, 1983).

The different types of EAP approaches used in other industries are listed below.

- 360 Degree Approach (Antonioni, 1996) allows an employee to evaluate themselves before receiving an evaluation from peers. The goal is to establish an understanding of what others expect of an employee and understand how the employee views themselves on what’s expected of them.

- Absolute Approach (Wagner and Goffin, 1997) involves rating an employee against an absolute standard. This approach is used for a job analysis to evaluate how an employee is performing their job-related tasks. An example of an absolute standard is timeliness. With this example the manager collects data by marking on a scale if the employee is unsatisfactory to exemplary in being timely.
• Judgmental Approach (Lunenburg, 2012) also known as the comparative approach, utilizes a rating scale of comparing the employee on tasks outlined in the assessment. This approach is based on the expertise of the manager on the tasks required of the employee.

• Results Oriented Approach (Lunenburg, 2012) evaluates an employee on both quantitave and qualitative criteria. The focus is on whether the employee fulfills the job requirements outlined in the job description. Goal setting is a popular trait with this approach due to the expected outcome of either meeting or not accomplishing the set goal by an employee.

The different types of EAP approaches used by construction companies in other countries are listed below.

• United Kingdom (Dainty et. al, 2003): A study of the development of performance management criteria were used during the assessment of project managers in the United Kingdom (UK). In order to encourage professional development of construction project managers, focus groups were used to discuss essential criteria that a project manager must attain. The nine criteria established as a result of the study are: team building, leadership, decision – making, approachability, integrity, communication, application, self – efficiency, and external relations. Establishing criteria helps the EAP process by providing guidelines of what to evaluate in an employee.

• China (Zhai, X., 2013): A study of Chinese construction firms viewing organizational learning as a component of competitive advantage in the process of organizational development, and organizational learning by furthering their human resource practices. Organizational Learning is the study of Human Resource practices and organizational performance. Organizational Learning helps the EAP process by determining the required training each employee must go through to remain competitive within an organization.

• Nigeria (Zuofa, T., 2015): A study on the shifts in organizational culture and its effect on knowledge management (KM) in the construction industry in Nigeria. KM is the understanding of the skillset required to complete tasks at an occupation. KM helps the EAP by improving the performance of the organization through understanding the strengths of each employee.

Moreover, it was also identified that there is a need for an emphasis to be placed on performance management systems with the objective to achieve higher levels of job performance within an organization (Gruman and Saks, 2011). In addition, performance management systems also need to align with the company goals (Aguinis et. al, 2011). Previous research suggests a need for these performance management systems as part of human resource practices within the construction industry (Ofori, 2015).

METHODOLOGY

The detailed research methodology in outlined in Figure 1.
Research Goals

The aim for this study is to address the below research questions to bridge the literature gap by evaluating the current state of EAP within the Unites States construction industry.

1. What are the methods used to document EAP?
2. Which metrics are used in the EAP?
3. What are the key components of an EAP?
4. What is the level of detail and frequency of the assessment for an EAP?

Study Sample

The sampling frame for this study was limited to fifty-six construction companies representing the Southeast United States that met the following criteria.

- General contractors
- Conduct employee assessments
- Various management positions

Pilot Study

A pilot study was conducted with three construction companies to test the effectiveness of the survey instrument and the type of data collected. The pilot study revealed that there was not a standardized EAP in place supporting the findings of the literature. This necessitates the establishment of a standard EAP that is relevant to the United States construction industry.

Survey Instrument

The refined survey questionnaire was developed based on the results from the pilot test that focused on:

1. Company background information [Q1 – Q5]
2. Company qualification [Q6 – Q7]
3. Documentation of assessment [Q8 – Q10]
4. Employee assessment metrics [Q11]
5. Employee assessment components [Q12]
6. Employee assessment frequency [Q13 – Q14]

See Appendix A for the refined survey questionnaire.

Data Collection

A web-based system known as Qualtrics was used for data collection. The response rate was 44.6% (twenty-five companies) out of the fifty-six companies surveyed. Eighteen out of the twenty-five (72% of actual respondents, 32% of total study participants) companies conducted formal employee assessments that could be analyzed. The employee that conducts employee assessment from each of the eighteen companies responded to the survey. Table 1 provides the background information for the responded companies.

<table>
<thead>
<tr>
<th>Company Background</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total company respondents</td>
<td>18</td>
</tr>
<tr>
<td>Range of Annual Revenue of company respondents</td>
<td>$10M - $7B</td>
</tr>
<tr>
<td>Total companies with 50 to 100 employees</td>
<td>3</td>
</tr>
<tr>
<td>Total companies with less than 50 employees</td>
<td>2</td>
</tr>
<tr>
<td>Total companies with more than 100 employees</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 1. Company Background

ANALYSIS / FINDINGS

A frequency analysis was performed for Q8 – Q14 of the refined survey instrument.

Pilot Study

The key findings from the pilot study were:

- Employee assessments were conducted verbally face-to-face.
- Employee assessments were formally documented.
• All the employees receive a copy of their evaluation.
• Follow-up on the employee performance was conducted if a weakness was identified.

Documentation of Assessment

The study revealed that only 13% of employee assessments are handwritten compared to 87% which are conducted virtually either with electronic documents or online portal as shown in Figure 2.

![Figure 2. EAP Documentation](image)

Employee Assessment Metrics

Ahmed et. al. (2013) identified key input variables for performance evaluation of employees for various industries. These variables were used as metrics of an EAP for this study. Table 2 provides details on the metrics and their definition.

Top four metrics utilized during an employee assessment (over 80% of the respondents) are project performance, quality of work, professional goals and teamwork / cooperation as shown in Table 3. The metrics that are utilized the least during an employee assessment (less than 20% of the respondents) are business acumen and integrity.

Employee Assessment Components

To better understand the employee assessment process, some of the key components of the actual process was also analyzed. Based on the literature, a list of fifteen key components of employee assessment practices were included in the refined survey instrument. The

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Performance</td>
<td>Performance of the employee on their projects in terms of cost, schedule and their project roles/responsibilities.</td>
</tr>
<tr>
<td>Quality of Work</td>
<td>The quality of actual work delivered by the employee and the value it brings to the overall team.</td>
</tr>
<tr>
<td>Professional Goals</td>
<td>Previous set of goals completed by the employee that are set by the manager or the employee.</td>
</tr>
<tr>
<td>Teamwork / Cooperation</td>
<td>The skill of working with others within a team and company.</td>
</tr>
<tr>
<td>Self-evaluation</td>
<td>Part of the 360-degree process where the employee evaluates themselves for the period of review.</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>Knowledge of the technical components required based on the position.</td>
</tr>
<tr>
<td>Training</td>
<td>Successful completion of all required trainings.</td>
</tr>
<tr>
<td>Attendance / Punctuality</td>
<td>Regular attendance at work and overall punctuality.</td>
</tr>
<tr>
<td>Networking</td>
<td>Communication with people outside of the company such as clients, architects, engineers, etc.</td>
</tr>
<tr>
<td>Attitude</td>
<td>The overall mindset of an employee.</td>
</tr>
<tr>
<td>Productivity</td>
<td>Output of work.</td>
</tr>
<tr>
<td>Business Acumen</td>
<td>Keenness and quickness in understanding and dealing with a “business situation” in a manner likely to lead to a good outcome.</td>
</tr>
<tr>
<td>Integrity</td>
<td>Honesty, moral and ethical adherence.</td>
</tr>
</tbody>
</table>

*Table 2. EAP Criteria Definition*
respondents were asked to select every component that they currently use during their assessment of employees outlined in Table 4.

The key components of the employee assessment (over 80% of the respondents) are review of employee performance for the current year against previously stated goals and objectives, self-evaluation by the employee, both the employee and manager set goals for the upcoming year followed by the employee signing the review for acknowledgement. The components that are least utilized (less than 20% of the respondents) are the manager collecting stakeholder, peer and upper management reviews, manager periodically meeting with employee throughout the review year, and a manager evaluating the effectiveness of the assessment process.

From this study, 89% of the company’s request the self-evaluation from the employee; however, only 39% of the companies gather reviews from subordinates, peers and supervisor. Previous goal setting is an

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Performance</td>
<td>18</td>
<td>100%</td>
</tr>
<tr>
<td>Quality of Work</td>
<td>17</td>
<td>94%</td>
</tr>
<tr>
<td>Professional Goals</td>
<td>15</td>
<td>83%</td>
</tr>
<tr>
<td>Teamwork/Cooperation</td>
<td>15</td>
<td>83%</td>
</tr>
<tr>
<td>Self-Evaluations</td>
<td>14</td>
<td>78%</td>
</tr>
<tr>
<td>Team Evaluations</td>
<td>13</td>
<td>72%</td>
</tr>
<tr>
<td>Technical Communication</td>
<td>13</td>
<td>72%</td>
</tr>
<tr>
<td>Training</td>
<td>12</td>
<td>67%</td>
</tr>
<tr>
<td>Attendance/Punctuality</td>
<td>10</td>
<td>56%</td>
</tr>
<tr>
<td>Networking</td>
<td>7</td>
<td>39%</td>
</tr>
<tr>
<td>Attitude</td>
<td>5</td>
<td>28%</td>
</tr>
<tr>
<td>Employee Productivity</td>
<td>4</td>
<td>22%</td>
</tr>
<tr>
<td>Business Acumen</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Integrity</td>
<td>1</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 3. EAP Metrics
important aspect that the employees are measured against. From this study, 94% of the companies used previous goals and objectives to measure the employee for performance for the current year. Setting goals and expectation for next year was also an important aspect (83% of the respondents) for the employee assessment.  

### Employee Assessment Frequency  

Table 5 shows the results of how often employees within each position are assessed. 

Collectively, 70% of the respondents stated that all positions are evaluated once a year. 23% of the respondents stated that all positions are evaluated twice a year. Moreover, 34% of the respondents do not evaluate the President’s position.

Table 6 shows the employee assessment level of detail for each position. 67% of the respondents indicated that higher-level employees are assessed in less detail than entry level employees. Also, 78% of the respondents indicated that employees in various positions are assessed differently.  

### CONCLUSION  

The objective of this study was to evaluate the current state and develop a standard practice for the EAP within the construction industry in the Southeast United States.

---

**Table 5. EAP Frequency**

<table>
<thead>
<tr>
<th>Position</th>
<th>6 months</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>3</td>
<td>17%</td>
<td>9</td>
<td>50%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Vice-President</td>
<td>3</td>
<td>17%</td>
<td>13</td>
<td>72%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>District Manager / Project Executive</td>
<td>4</td>
<td>22%</td>
<td>13</td>
<td>72%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Project Manager</td>
<td>6</td>
<td>33%</td>
<td>12</td>
<td>67%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Other Manager</td>
<td>3</td>
<td>17%</td>
<td>14</td>
<td>78%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Engineer</td>
<td>7</td>
<td>39%</td>
<td>11</td>
<td>61%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Superintendent</td>
<td>4</td>
<td>22%</td>
<td>14</td>
<td>78%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>HR Manager</td>
<td>3</td>
<td>17%</td>
<td>14</td>
<td>78%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Admin / Support Staff</td>
<td>4</td>
<td>22%</td>
<td>14</td>
<td>78%</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Table 6. Different Position EAP**

<table>
<thead>
<tr>
<th>Statement</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees are assessed differently based on level of position within the company</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Higher level employees are assessed in more detail compared to lower level employees</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Entry level employees are subject to a probationary period</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>New hire employees are subject to a probationary period</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

It was concluded that majority of the employee assessment within a construction company was documented virtually using an online format. Majority of the companies used project performance, quality of work, professional goals and teamwork / cooperation as the top criteria in evaluating their employees. Moreover, three out of the top four criteria (project performance, quality of work and teamwork / cooperation) reflect project level performance. Professional goal set by the employee and employer in the previous year was the only criteria in the top four that was not related to project level. It was concluded that other skills not related to project level such as integrity, business acumen,
attitude, and networking were the least used criteria for the employee assessment.

The key components of the employee assessment were review of employee performance for the current year against previously stated goals and objectives, self-evaluation by the employee, both the employee and manager set goals for the upcoming year followed by the employee signing the review for acknowledgement. The components that are least utilized were the manager collecting stakeholder, peer and upper management reviews, manager periodically meeting with employee throughout the review year, and a manager evaluating the effectiveness of the assessment process. Based on the findings of the employee assessment components, it was determined that the construction companies utilized some aspects of both 360-degree approach and results-oriented approach. Regarding frequency, it was concluded that majority of the companies typically conducted the employee assessment once a year and higher-level employees are assessed in less detail than entry level employees.

This study provides the most common practices of employee assessment with the construction industry in the Southeast United States. Further research needs to be conducted to understand the detail process of the employee assessment as its being conducted. Also, the research conclusions are only applicable to general contractors located in the Southeast United States region. Further research needs to be conducted for general contracting in other regions of the United States and for sub-contractors.

RECOMMENDATION

Based on the findings of the study, the following standard Employee Assessment Process (EAP) is recommended for construction companies as outlined in Figure 3.

Below are the steps recommended for a standard EAP.

Step 1 (Study Finding): The employer and the employee set goals and the measurement metrics recommended in this study for the evaluation period (no longer than one year).

Step 2 (Study Finding): The employer monitors the employee performance.

Step 3 (Study Finding): The employee is evaluated based on the set goals and metrics.

Step 4 (Literature Finding): The employee is also evaluated based on the input from peers, supervisors and employee self-evaluation.

Step 5 (Study and Literature Finding): Employer and employee identify areas of improvement and areas of needed training.

Step 6 (Study Finding): Employer monitors employee performance after training.

Step 7 (Study Finding): Employer re-evaluates the employee performance based on the measurement metrics established in Step 1.

Step 8 (Study Finding): Repeat the process from Step 1 for the next evaluation period.
REFERENCES


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Appendix A – Refined Survey Instrument

Company Background Information
Q1: Respondents position within the company.
Q2: Company’s area of operation.
Q3: Company’s annual volume
Q4: Type of company
Q5: Number of total permanent employees

Company Qualification
Q6: Are employee assessments conducted in your construction company?
Q7: Do you conduct employee assessments in your company?

Documentation of Assessment
Q8: Are employee assessments being formally documented per proper procedure?
Q9: How are employee assessments being formally documented?
Q10: Does your company have formal job descriptions, policy handbook and job training?

Employee Assessment Metrics
Q11: What are the metrics being used in employee assessments within your company?

Employee Assessment Components
Q12: Please select the key components of your company’s employee assessment process.

Employee Assessment Frequency
Q13: For each position, select the frequency of employee assessment within your company.
Q14: Please indicate, with respect to your company’s employee performance assessment, the level of your agreement.
Examining the Pre-Construction Professional: Career Evolution, Responsibilities and Skills

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Kevin M. Hubbard, Missouri State University | khubbard@missouristate.edu

ABSTRACT

The construction industry is constantly evolving to meet the needs of clients in light of significant technological and regulatory change. The Pre-Construction Professional is one example of a new career path that has emerged in response to changing market conditions. This study investigated the Pre-Construction Professional in an effort to define when the career path emerged and why it was needed. The researchers also sought to describe the role of the Pre-Construction Professional and document their requisite knowledge and skills. The research design was based on extensive interviews with working Pre-Construction Professionals and supported by available literature. The findings of this study improve our understanding of the career which is a new opportunity for current and future industry professionals. It also provides valuable benchmarking data for firms to use when creating position descriptions and employment advertisements.

Keywords: Pre-Construction, Construction Careers, Construction Estimating

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Dr. Kevin M. Hubbard is an Associate Professor of Technology and Construction Management at Missouri State University. He earned his Ph.D from University of Missouri – Rolla. Dr. Hubbard is currently teaching at Missouri State University. His interests are in automation and device control, manufacturing systems, device design, and process optimization.
INTRODUCTION

The construction industry is made up of specially trained, highly skilled professionals that support the planning, construction, and maintenance of the built environment. While the essential need for construction (shelter, industry, artistic expression) has not changed for millennium, the materials, tools, and processes employed are constantly changing. The same is true for the roles and responsibilities of construction professionals.

The focus of this study is the Pre-Construction Professional. The problem identified by the researchers is the absence of scholarly literature addressing the emergence of the profession, the role they play in a construction project, and the skills and knowledge required to be a Pre-Construction Professional.

The researchers observed that pre-construction as a job title and designated career path is a relatively new specialization in the construction industry when compared to traditional roles such as project superintendent, project manager, and estimator. If this is a new phenomenon it leads one to question why the position was created and what factors drove the need for a new specialization? Additionally, if it is a new phenomenon efforts should be taken to document the role that Pre-Construction Professionals play in a construction project and their associated responsibilities. It is also important to document the unique skills and knowledge requisite of Pre-Construction Professionals.

Through structured interviews with current Pre-Construction Professionals, the researchers sought to answer the following questions:

1. When did the Pre-Construction Professional become a career track in the construction industry?
2. What factors contributed to the emergence of the Pre-Construction Professional in commercial construction firms?
3. How do pre-construction professionals view their role in the construction process?
4. What are the job-specific responsibilities of Pre-Construction Professionals?
5. What knowledge and skills are required to be a Pre-Construction Professional?

PURPOSE AND SIGNIFICANCE

Through investigating the previously stated questions, the researchers seek to support the needs of the construction industry and professional construction educators. The primary purpose of the study is to establish a starting point for future research on Pre-Construction Professionals and their role in the construction industry. Additionally, by describing the role of Pre-Construction Professionals this paper will introduce future construction professionals to a unique career opportunity in the industry. It may also serve to recruit individuals from other fields (Architecture/Engineering) and retain current construction professionals seeking new challenges and opportunities. By disseminating information on the responsibilities, skills, and knowledge of the profession, the study also offers benchmarking data for creating position descriptions and employment advertisements. The goal of benchmarking is to improve standards across the industry and reduce waste associated with redundant efforts.

METHODOLOGY

Design of the Study

A basic qualitative research design was used to investigate the research questions. Qualitative inquiry was selected because the phenomenon of the Pre-Construction Professional is relatively new and has not been the focus of previous systematic investigation. According to Leedy and Ormrod, qualitative methodologies are employed “when little information exists on a topic, when variables are unknown, when a relevant theory base is inadequate or missing” (2005, p.134). Because there is no previously published work on the emergence of Pre-Construction Professionals, the goal was to “understand and interpret” (Glesne 2006, p.4”) what was observed through interaction with the study participants. Without previous research
there was not adequate information to formulate hypothesis and apply experimental designs to test for relationships between variables. In the data analysis process the researchers sought to organize and group themes when appropriate, but also present multiple perspectives offered by study participants. Acknowledging that differences do exist between construction firms and individual Pre-Construction Professionals, it is reasonable to expect to see multiple perspectives “each of these perspectives having equal validity or truth” (Leedy & Ormrod 2005, p.133). Ultimately, the qualitative design was best suited to describe the emergence and nature of the Pre-Construction Professional.

**Sample Selection**

Several different strategies were employed in the selection of the study participants. A purposeful sampling approach (Leedy & Ormrod 2005) was employed to engage individuals “that will yield the most information about the topic under investigation” (p.145). To explore the emergence and the nature of the position, the researchers purposefully sought out firms and working professionals that are viewed as industry leaders engaged in the advancement of construction education and the pre-construction profession. Participant selection was also criterion based (Merriam 2009). The researchers sought out professionals working for general contracting firms in the vertical (buildings), commercial construction market with annual gross revenues in excess of $100 million. Once a core of Pre-Construction Professionals was identified, a network/chain sampling strategy (Merriam 2009) was employed to identify other candidates for inclusion in the study.

The researchers sought to interview between 5 and 10 Pre-Construction professionals representing different commercial general contracting firms across the U.S. The sample size was small enough to allow the researchers to collect a large volume of rich data through in-depth interviews and large enough to support validity through the triangulation of responses.

**Data Collection and Analysis**

For this study the researchers were the primary instrument of data collection. Telephone interviews were conducted with each participant, each lasting between one and three hours. A script of questions was prepared to investigate the research questions. The initial draft of interview questions was created from the research questions and a preliminary review of available literature. The questions were further revised through two pilot interview sessions with Pre-Construction Professionals. A copy of the interview questions is available upon request. No identifiable information was collected as part of the interview process and transcription notes were saved with un-identifiable file names. To maintain consistency in the line of inquiry and data collection practices, one member of the research team was selected to perform all interview sessions. Thorough written notes including direct quotations and summarized comments were prepared from each interview session.

Prior to data collection the study was reviewed by the Interval Review Board at the researchers’ university and issued exempt status. Participants were informed of their rights as subjects and informed consent was obtained and documented.

A thematic data analysis method was employed for this study. Interview notes were organized and coded by major themes and then further segregated into subthemes where appropriate. Frequency tables were employed to reveal patterns in the data. The goal of the analysis process was to report a summary of the findings, search for patterns within the data and offer interpretation of the data collected (Glesne 2006).

The researchers employed multiple strategies consistent with qualitative research designs to limit researcher bias and ensure the trustworthiness of the findings. The researchers obtained additional documents (position descriptions, internal memos, and training documents) to verify data obtained through participant interviews. While there was no apparent conflict of interest in the pursuit of
the study, the researchers were alert to potential “biases and theoretical predispositions” (Glesne 2006, p.167). The researchers supported credibility through persistent observation (over 20 hours) in the interview process. Finally, study participants were employed in reviewing and critiquing the findings of the study in the member checking phase.

**Limitations**

The researchers acknowledge the following limitations to the study. Because the researcher was the primary data collection instrument there was the potential for variations in the delivery and follow up inquiry for each question. Further, errors could have been made in the collection and interpretation of the participant responses. The findings are limited by how each participant interpreted each question and in their honesty in providing answers. The sample size and purposeful sampling technique may limit the generalizability of the study findings.

**Demographic Data**

Seven Pre-Construction Professionals participated in the research study. False names were assigned to each participant to provide anonymity. Accurate demographic data are attributed to each false name in order to provide additional context to direct participant quotes presented in this paper. Each of the participants was employed with commercial general contracting firms in the vertical construction market.

Mary N., Pre-Construction Director, 30 years of industry experience, 15 years in pre-construction, annual firm volume approximately 4 billion dollars, market geography continental U.S.

Steve P., Pre-Construction and Estimating Manager, 13 years industry experience, 3 years in pre-construction, annual firm volume approximately 100 million dollars, market geography U.S. Midwest.

Amanda B., Director of Estimating and Pre-Construction, 23 years of industry experience, 15 years in pre-construction, annual firm volume approximately 2 billion dollars, market geography U.S. and international.

Nathan R., Senior Estimator, 8 years of industry experience, 6 years in pre-construction, annual firm volume approximately 500 million dollars, market geography U.S. Midwest.

James T., Director of Estimating and Pre-Construction, 20 years of industry experience, 13 years in pre-construction, annual firm volume approximately 800 million dollars, market geography U.S. Midwest.

Tom D., Pre-Construction Director, 16 years of industry experience, 14 years in pre-construction, annual firm volume greater than 4 billion dollars, market geography continental U.S.

Paul M., Pre-Construction Executive, 35 years of industry experience, 20 years in pre-construction, annual firm volume greater than 4 billion dollars, market geography U.S. and international.

**FINDINGS**

**When did the Pre-Construction Professional become a career?**

The first research question investigated when pre-construction became a career track in the construction industry. This question stems from the researchers’ anecdotal observation that while common today, pre-construction titles were rare or non-existent a mere 20 years ago. This observation was supported through the literature review and through interviews with the study participants.

In researching the emergence of the Pre-Construction Professional the researchers first reviewed available literature addressing careers in the construction industry. Landers (1976) provides an index of 146 construction related careers and job opportunities ranging from design, regulatory enforcement, construction trades and positions within contracting firms. For contracting firms the following career paths were listed: Cost Engineer, Scheduling Analyst, Superintendent, Estimator and Contractor. The introduction of construction management as a delivery method and the shift away from large traditional general contracting firms with
extensive self-performance capabilities occurred in the 1970’s. Kavanagh, Muller, and O’Brien (1978) introduce construction management as “a fresh approach to meeting the forthcoming demands of society” (p. 1). In discussing construction management they reference the project manager as the “fundamental basis for the role of the construction manager” (p. 223). This time frame (late 70s-early 80’s) marks the emergence of the career track of the professional construction manager or project manager. More recently, Gould and Joyce (2014) include construction managers, project managers, superintendents, estimators, schedulers and purchasing agents in their list of construction professionals. They also note that “construction management as a profession is a relatively new entry into the field of design and construction” (p. 123). The researchers were unable to identify any source that specifically referenced a Pre-Construction Professional as a career track within a construction firm. It is important to note that pre-construction services as part of modern delivery methods is a topic that is frequently discussed in academic texts and journal articles. However, the responsibility for providing pre-construction services was typically attributed to the Construction Manager or Project Manager, an individual responsible for a project from inception through completion (Kavanagh, Muller, and O’Brien 1978). Estimators and schedulers have also been noted as part of pre-construction efforts (Gould & Joyce 2014; O’Brien 1994).

To investigate the timeline for the emergence of the Pre-Construction Professional the study participants were asked how long their firm had included the job role/title. The responses fell within two general groupings. Approximately half of responses were between 5 and 7 years (since 2012) and the other half reported between 20 and 25 years (since 1995). The researchers observed that there also appeared to be a correlation between the size of the firm in annual gross revenue and the length of time the position had existed. Firms with smaller annual gross revenue (less than 700 million) had added the position within the past 5-7 years while firms with larger gross revenue (2+ billion) had included the position for the past 20-25 years. This observation was supported by comments from study participants. Paul M. noted that “Our peer group, the top 50 in ENR, have been doing something for 15 – 20 years.” A similar response was provided by Tom D. who said “It started in the mid 90’s. However, most firms only started having Pre-Construction professionals in the last 6 or 7 years.”

The available literature and participant responses appear to support the researchers’ anecdotal observation that pre-construction as a career track is a relatively new phenomenon in the construction industry. Based on participant responses the researchers conclude that pre-construction as a career first emerged approximately 25 years ago. It also appears that in the past 5-7 years the career has achieved widespread adoption by the construction industry.

What factors contributed to the emergence of the Pre-Construction Professional?

The second research question investigated the factors that contributed to the emergence of the Pre-Construction Professional in commercial construction firms. Simply put, the researchers wanted to understand why the new position was needed in an industry that had operated for many years without it. Existing literature on the evolution of careers provides a possible foundation for understanding the emergence of the Pre-Construction professional. Miles and Snow (1996) propose that an organizations form, “its configuration of strategy, structure, and management process - determines the mix of career competencies appropriate for a particular era” (p. 97). They reference major historical organizational transitions, or waves, described by Toffler (1980). Toffler proposed that the first wave began approximately 8000 B.C. with the transition from hunting and gathering to an agriculture based society. The second wave was the transition from the agricultural society to the industrial society (industrial revolution, approximately 1860) and the third wave is the post-industrial society (approximately 1975). Summarizing Toffler, Miles and Snow (1996)
characterize the second wave organization (up to 1975) as doing everything yourself and getting better by getting bigger. In the construction industry this era was characterized by general contracting firms with extensive self-performance capabilities. In contrast, the third wave emphasized doing only what you do best and getting better by building relationships with customers, suppliers, and partners. This shift coincides with the emergence of the construction management model of project performance (mid 1970’s). They speculate that the fourth wave (2000-?) requires firms to be highly competent anytime, anywhere and get better by “competing and collaborating simultaneously” (p. 99).

Toffler’s wave theory (1980) as summarized by Miles and Snow (1996) aligns with the historical shift from large general contracting firms that performed much of their projects in house, to the rise of construction management models where contractors focused on the coordination of projects with the assistance of skilled trade partners (third wave). In predicting a fourth wave where firms will be “competing and collaborating simultaneously” Miles and Snow provide a possible impetus for the emergence of the Pre-Construction Professional.

Each of the participants was asked to share their thoughts on the emergence of the Pre-Construction Professional and explain why the position was needed/created. The prevailing theme that participants noted was changes in the preferred contractual delivery methods used in the construction industry. James T. stated, “It emerged because of the shift from design bid build work to more design/build, collaborative delivery methods”. Nathan R. commented, “What drove it (emergence of the profession) is more project delivery methods being used. Design/build project delivery includes early involvement with contractors.” From Amanda B., “One major reason would be changes in the delivery method and the speed of delivery. The need for pre-construction services corresponds with the increase in design build projects”. Similar comments were provided by other participants.

The authors propose that changes in contracting methods necessitated changes in organization form (Miles and Snow 1996), thus paving the way for the Pre-Construction Professional. If this is the case, it is implied that the previous organization form and associated positions were not adequate to support the demands of newer collaborative delivery methods. This conclusion is supported by comments from study participants. Steve P. explained that initially at his firm, preconstruction responsibilities were rolled in with project management responsibilities and addressed by the Project Manager/Construction Manager. “This cradle to grave approach has its benefits, but it is not responsive to pre-construction demands. When you are managing a project you encounter peaks and valleys of time demands which can leave the pre-construction phase unsupported at times.” An alternative approach was described by James T. who explained that early pre-construction efforts at his firm included pairing estimating and operations teams where the work was done by committee with no single leader. Nathan R. recounted that senior estimators were initially responsible for leading pre-construction efforts, which initially consisted of milestone construction estimates. However, as the scope of pre-construction services grew and as skilled professionals were being hired away to other firms, it became necessary to assign a new title that “carried more weight” and differentiated it from the traditional estimator.

While changes in project delivery methods was the primary theme in explaining the emergence of the Pre-Construction Professional, many of the respondents also noted the growing complexity of construction projects along with owner demands for compressed schedules. Two respondents linked the demands of complex healthcare projects to the emergence of the Pre-Construction Professional at their firm. The researchers propose that increased complexity and compressed schedules are factors that contributed to the transition to collaborative delivery methods. For this reason, increased project complexity and compressed schedules are worth noting when considering the emergence of the Pre-Construction Professional.
The available literature and participant responses provide valuable insight into the factors that contributed to the emergence of the Pre-Construction Professional. Study participants reported that changes in project delivery methods was the primary factor driving the need for pre-construction professional. It appears that previous organization structures and associated careers (project managers, senior estimators) were not sufficient to meet the demands of highly collaborative project delivery systems. Also, the emergence of the Pre-Construction Professional may be in part attributed to the increasing complexity of projects and owners' demands for compressed schedules.

How do pre-construction professionals view their role?

The third research question investigated how Pre-Construction Professionals view their role in the construction process? To answer this question the researchers asked participants how they would describe their job to someone not familiar with the construction industry. The goal was to present a succinct and unfiltered picture of the Pre-Construction Professional that is easily understood. Additional discussion follows the direct quotes from the participants:

“Our job is to take a developer or architect’s initial idea and make it a reality. Our job is really to understand what the client wants in their building and lead the architect.” Tom D.

“I am a conductor of an orchestra. The people playing the instruments are the owner, designer, design sub consultants, operations professional, estimators, and specialty subs. I make sure that everybody knows where we are going and how we are going to get there.” Paul M.

“Pre-Construction Managers oversee and lead the pre-construction effort in its entirety. They also have a primary responsibility in presenting information to clients.” Nathan R.

“As the Pre-Construction Director I manage everything up until we start construction, put a shovel in the dirt” James T.

The authors used the direct participant quotes along with interview notes to summarize how Pre-Construction Professionals view their role in the construction process. The following observations are presented in no particular order.

Client – Pre-Construction Professionals are client focused. While many construction professionals throughout an organization will interact with the client, the Pre-Construction Professional appears to be unique in the quantity and quality interaction with the client.

Ideas into reality – The Pre-Construction Professional is intimately involved in the conception of a project. They build with and onto ideas. This requires a broad skillset including creativity, organization, communication, and perseverance. It also requires a wide knowledge base that includes design, construction means and methods, costs, scheduling and technology.
Relationships – Relationships are how Pre-Construction Professionals do their job. To effectively engage all stakeholders in the pre-construction process, relationships must be mutually beneficial and grounded in an acceptable level of trust. Pre-Construction professionals build relationships with owners, designers, trade partners, regulatory officials, operations managers and more.

Leader – The pre-construction phase of a project has many participants. The Pre-Construction Professional is responsible for orchestrating all of the participants in the pre-construction phase of a project. This is a change from the traditional design-bid-build delivery method where work prior to the start of construction was led by the design professional. Leading a diverse group with differing objectives and personalities is challenging. This challenge is compounded because of the patchwork of contractual and non-contractual agreements between participants.

Value – Providing value for the client was mentioned several times by each of the study participants. The authors did not probe participants on what it means to provide value for the client, a topic that warrants further investigation. It is worth noting that firms may be compensated for pre-construction services or they may be provided free of charge. In both instances it appears that Pre-Construction Professionals maintain a focus on providing value for the client.

Cost, constructability, logistics, and schedule – Any description of the role of the Pre-Construction Professional would be incomplete without a reference to the basic tasks that are carried out in the execution of their duties. A more thorough discussion of job related responsibilities follows. However, a brief summary of responsibilities would include forecasting costs, providing design assistance, project planning and schedule forecasting.

What are the job-specific responsibilities of Pre-Construction Professionals?

The fourth research question investigated the job specific responsibilities of Pre-Construction Professionals. As a relatively new career path, the authors wanted to provide a comprehensive list of job responsibilities that was generated by working professionals. This information can support construction firms in creating accurate job descriptions and inform future construction professionals as they choose a career path. The following list of responsibilities is organized by the frequency of respondents that reported each item.

- Coordinating subcontractors (5)
- Constructability (4)
- Design assist coordination/ design team management (4)
- Scheduling (4)
- Estimating/Pricing (4)
- Business development (3)
- Managing support staff (estimating/engineers/schedulers/project manager) (3)
- Project leadership (3)
- Client relationship management (3)
- Risk management (2)
- Providing value for the client (2)
- Conceptual estimating (2)
- Contract arrangements (1)
- Quantity Take-off (QTO) (1)
- Teaching others (1)
- Project logistics (1)
- Budget management (1)
- Documentation (record of project changes) (1)
- Virtual Design and Construction (VDC) coordination (1)
- Writing proposals (1)
- Developing scopes of work (1)
- Regulatory agency contact (planning & zoning, permitting) (1)

When preparing the list of pre-construction responsibilities the authors were faced with the challenge of interpreting and grouping similar responses. Rather than running the risk of diluting participant responses, the authors chose to provide a larger list of responses, some with potential overlap. This is most apparent when describing responsibilities associated with project pricing that included several related responses (estimating/pricing, conceptual...
estimating, QTO, budget management).

Based on the list of responsibilities provided the unique nature of the Pre-Construction Professional become more clear. It provides a basis for comparison with other established careers in the construction industry. While the Pre-Construction Professional shares many responsibilities with the traditional professional estimator, they are unique in their responsibility for business development activities, leadership in project design, client relationship management and overall project leadership. In the same manner, comparisons can also be made between the Pre-Construction Professional and project managers, schedulers, cost engineers, etc.

What knowledge and skills are required to be a Pre-Construction Professional?

The fifth research question investigated the knowledge and skills required to be a Pre-Construction Professional. While the previous research question addressed primary responsibilities, this question is designed to identify the competencies needed to carry out those responsibilities. Study participants were asked to comment on each item (knowledge and skills) separately. However, participants were not provided a definition or distinction between the two constructs. The researchers' goal as part of this qualitative inquiry was to establish a sense for the competencies that are required to be a Pre-Construction Professional, not to propose an exhaustive taxonomy. The following summary was prepared from the interview notes and was organized by the researchers to align with the following definitions. When describing the knowledge required, the researchers are referring to declarative knowledge (Training Industry 2019), which includes facts, theories and processes. When describing the skills of a Pre-Construction Professional the researchers are referring to the ability to “apply knowledge to specific situations” (Boulet, G. 2015), with the intent to achieve a desired outcome. Additionally, it is implied that they must display a high level of the described skill.

Participants provided insight into the knowledge needed to be a Pre-Construction Professional. In the data analysis process the researchers sought to combine similarly worded items when practical. Other responses may be closely related, but were left intact to avoid the potential loss of important nuances. The following list is organized by the frequency of respondents that reported each item.

Broad understanding of construction means and methods, multiple scopes of work (4)
Understand the design process (3)
General business knowledge, understand how the project impacts the clients business model (2)
Knowledge of schedules, logistics (2)
Understand project lifecycle and business functions (pre-con., operations, office admin.) (1)
Estimating/QTO/costs (1)

Participants overwhelmingly asserted the importance of having a grounded knowledge of construction means and methods including building structures and building systems (MEP/finish/envelope, etc.). As Paul M. commented, it is not good enough to know a little about a lot of things, you need to know a lot about a lot of things.” While the list of required knowledge is extensive, Mary N. commented that “Experts can be brought in to consult on complex items and to deal with details. However, the Pre-Construction Professional must understand and be able to communicate intelligently with design and construction specialists”.

The authors propose that the knowledge required to be a Pre-Construction Professional lies within three distinct domains. In addition to extensive construction knowledge they must also understand the design process and general business principals. Knowledge of the design process is necessary due to extensive collaboration and coordination that takes place with multiple design partners in the pre-construction phase. Knowledge of general business principals allows professionals to fit project solutions to client needs in relation to their business objectives. It is necessary to provide value to the client.
Participants listed a wide range of skills needed by Pre-Construction Professionals. In the data analysis process the researchers sought to combine similarly worded items when practical. Other responses may be closely related, but were left intact to avoid the potential loss of important nuances. The following list of skills is organized by the frequency of respondents that reported each item.

Effective communicator, externally and internally (3)
High level scope of work development (2)
Listen and respond in a positive manner (2)
Leadership skills, leading a team (2)
Attention to detail (1)
Organization (1)
Build relationships work with trade partners to generate interest (1)
Understand and appreciate client needs (1)
Presentation skills (1)
Facilitating discussions (1)
Know how to ask the right questions (1)
Soft skills (1)

From this list we see that the skills of a Pre-Construction Professional can by grouped into two primary domains; soft skills and technical skills. In relation to soft skills several participants noted the importance of a high level of emotional intelligence. Emotional intelligence is defined as “the ability to understand the way people feel and react and to use this skill to make good judgements and to avoid or solve problems” (Cambridge 2019). The need for emotional intelligence is also apparent in the words that participants used to describe the required skills. “Listen and respond in a positive manner” and “understand and appreciate client needs” both allude to the need for emotional intelligence. In addition to soft skills the Pre-Construction Professional must also be a technical professional. The ability to develop effective scopes of work is a critical skill that requires attention to detail and organization. When considering the frequency of responses provided, it appears that soft skills may carry more weight than technical skills in the makeup of a Pre-Construction Professional.

When describing the knowledge and skills of Pre-Construction Professionals many study participants noted the importance of industry experience. Experience is related to, but distinctly different than knowledge and skill. In a separate question participants were asked to describe their career path to becoming a Pre-Construction Professional. While there was no prescriptive minimum years of industry experience identified, it was stressed that one does not take a position as a Pre-Construction Professional as their initial entry into the construction industry. The demographic information presented for the study participants supports this observation.

The combination of knowledge and skills identified through this research question present a picture of the unique nature of the Pre-Construction Professional. Based on the unique combination of knowledge and skills identified one can begin to differentiate the Pre-Construction Professionals from other construction professionals such as estimators and project managers.

**CONCLUSIONS AND RECOMMENDATIONS**

The investigation of the research questions has led to a number of findings that will support the construction industry and professional educators. From the participant responses the researchers conclude that Pre-Construction as a job title is a relatively new phenomenon that has emerged within the past 25 years. Additionally, it appears that widespread adoption has only happened within the past 5-7 years. Study participants indicated that that the emergence of position resulted from the transition from design-bid-build contract methods to more collaborative contract methods such as design-build and CM at risk. This theory aligns with previous research by Miles and Snow (1996) who suggest that career competencies stem from the organizational strategy, structure, and management processes employed in that era. It is therefore inferred that previously existing construction professions (project managers, estimators) were not adequate to support the demands of highly collaborative construction delivery methods in the pre-construction phase.
of project development. Participants also noted increased levels of project complexity and demands for shorter project schedules in relation to the emergence of the Pre-Construction Professional.

The next research question investigated how Pre-Construction Professionals view their role in the construction process. The rich descriptions provided by study participants communicate in layman’s terms the essence of the profession. From the responses the researchers identified six foundational elements of the position. They include a focus on clients, taking ideas to reality, building relationships, being a leader, providing value and being technically capable.

To further understand the Pre-Construction Professional the final two research questions explored job responsibilities and the skills and knowledge required. Both questions were addressed through participant interviews and from company documents including position descriptions, internal memos and training/development resources.

The most frequently noted responsibilities included coordinating subcontractors, performing constructability analysis, coordinating design work, preliminary scheduling, preliminary estimating, business development, managing support staff, overall project leadership and client relationship management. The comprehensive list of job responsibilities provides insight into the unique nature of the position and can serve as benchmarking data for firms when developing position descriptions and advertisements.

The knowledge required of Pre-Construction Professionals can be summarized into three domains; general construction knowledge, knowledge of the design process, and general business knowledge. Similarly, the skills required of professionals can be separated into two primary domains; soft skills and technical skills. While some of the skills and knowledge of the Pre-Construction Professional are shared with other construction professions, it is the distinctive mixture of these plus the emphasis on soft skills, collaboration and experience that make them unique.

A number of avenues for further study were identified through the participant interviews and the data analysis process. A primary theme for further investigation is additional documentation of relevant data to support industry benchmarking. This could include identifying the tools (software) used, reporting typical salary ranges and incentive structures, and describing where Pre-Construction Professionals fit into the hierarchy of an organization. A second emphasis for further investigation could be targeted at talent development efforts. Additional research is needed to understand the personal characteristics of successful professionals and to define the path to becoming Pre-Construction Professional. Recruiting efforts would also benefit from understanding the primary challenges faced by professionals and what they find most rewarding in their job. The concept of providing “value” for the client is central to the role of the Pre-Construction Professional and warrants further investigation. Interviews with project owners could explore the impact of pre-construction services on cost, schedule, and other project indicators. A final suggestion for further study could be focused on the future and the continued evolution of the profession. What changes might we expect in the future as relates to responsibilities and the technology tools employed by Pre-Construction Professionals?
REFERENCES


The James L. Allhands Essay was established by the late James L. Allhands, one of the founding members of AGC and a prolific writer of construction related works. The award recognizes a student essay on a specific topic that is deemed to be beneficial to the advancement of technological, educational, or vocational expertise in the construction industry. The competition is open to any senior–level student in a four or five–year ABET or ACCE–accredited university construction management or construction–related engineering program. The First Place essay author receives $1,000. His/her faculty sponsor receives $500. Both the recipient and sponsor are invited as guests of the Foundation to the AGC Annual Convention.

The winner is notified in February and the award is presented at the AGC Annual Convention.

The topic for 2020 was “Identifying and Positively Addressing Real and Perceived Barriers to Inclusion in Construction.” The essays of the top three finalist are included in the following pages.

1st place - Corban Williams, Clemson University
2nd place – Anas Pasha, East Michigan University
3rd place – Lisa Breitenfeld, Minnesota State University, Moorhead


For more information, go to the AGC Education and Research Foundation website: https://www.agc.org/about-us/awards-recognition-programs/agc-foundation-awards
Increasing Diversity and Inclusion through Mentoring Underrepresented Groups

Corban Williams, Clemson University

Abstract

The Construction Industry historically has struggled to gain traction with underrepresented groups, such as women, African-Americans, and the Hispanic/Latinx community. To combat this, industry-wide action is necessary to increase diversity and inclusion. Underrepresented communities have misconceptions about the construction industry including a lack of knowledge about the wide range of possible careers. By the AGC establishing a mentoring program with career goals and psychological attributes for grades 6-12 and college students, a positive dialog about the industry would be established. Visibility and promotion of the program would encourage students of underrepresented communities to consider a career in the construction industry.

Introduction

As an African-American male in the United States, a career in the construction industry was not one that was spoken of frequently. As a child, I had a slight obsession with Bob the Builder, as most 4 and 5-year-old boys had, but Bob the Builder was nothing more than a TV show to me, at least I thought. This thought process continued into middle school where we had to choose ‘exploratories’, similar to a major in college. I liked building and drawing plans, but I knew that I did not like math; so engineering was not an option for me. Additionally, I had family members that were successful architects, so, naturally, I figured that architecture was the best fit for me.

That all changed when I was exposed to the general contractor which built my church, Construction Dynamics, Inc., the largest African-American owned construction management and contracting firm in the State of South Carolina. I was introduced to David Myers, Director of Operations, and Clemson graduate and CEO, Nate Spells, Sr., the first African-American to graduate from the Construction Science and Management program at Clemson. This was the first time I had seen African-Americans in successful careers in construction management. Before this, I had never considered a career in the Construction Industry. I had closed myself off to considering an area like Construction Management as a career, until I saw people who looked like me in a field that was dominated by people that did not look like me, be successful in their endeavors. I refocused my interests in college, especially as I was given the opportunity to have intentional mentors and to experience the benefits of having positive, like-minded individuals as a part of my support system. Because of intentional mentorship, it has allowed me to be able to speak up and encourage other underrepresented populations to see what the construction industry has to offer.

The term “mentor” or “mentorship” is commonly defined by the Cambridge Dictionary as “the guidance provided by a mentor, especially an experienced person in a company or an education institution” (Cambridge Dictionary). In the construction industry,
the need for mentorship to underrepresented groups is important. In order to assure that the construction industry begins to gain traction as being modern, attractive and inclusive, the industry needs to consider its current techniques for increasing diversity and inclusion. This could be done via promotion and mentoring, to project a positive image to the public. By targeting underrepresented communities and providing mentorship opportunities to students early in their development, it opens up a new labor pool of potential workers.

**Self-Efficacy: How A Single Trait Can Increase Diversity and Inclusion Participation**

In order to understand what needs to be implemented in a successful mentoring program for underrepresented groups, we first need to understand the influence behind decision making. This influence can be attributed to the theory of Self-Efficacy, which “refers to an individual’s belief in his or her capacity to execute behaviors necessary to produce specific performance attainments” (Bandura). Underrepresented communities often have certain hidden nuances that can hinder their growth and belief in Self-Efficacy to enter into a ‘non-traditional’ industry such as construction. This thought process may not completely be erased through mentoring, but has been proven to help students increase their perception of themselves and their own capabilities. Mentoring can provide additional resources, such as hands-on industry experience and a support system that is beneficial to increase one’s Self-Efficacy. It has been documented that there is a correlation between Self-Efficacy and a student’s entrance and completion of a construction-related program. The power of Self-Efficacy and the student’s perception of their capability strongly influences behavior when presented with situations outside the norm. For underrepresented populations, construction careers that are seen as “successful” can be a primary factor that influences their potential talents. Through mentoring, the mentee-mentor relationship can be strengthened by reinforcing the idea that careers in the industry, especially managerial-level careers, can lead to very successful pathways. With the development of a mentoring program for underrepresented groups in the construction industry, there are two facets that are essential to the program. The first facet is that the program has a strong career base, with support and tools to help students navigate the industry and improve their networking skills. The second facet is that there is a positive psychological element. With detailed implementation, the program will be able to meet the needs of each student to open up new opportunities and promote positive attitudes about careers in the industry.

**Women and the Construction Industry: Where Are They?**

According to a NAWIC study done in Sydney, Australia, with grade 11 girls (high school junior equivalent), it was shown that none of the students could see themselves with a career in construction. “The girls not only had very little knowledge of the construction industry, but also had fears of entering the industry relating to not being heard enough or having careers being limited to holding signs or directing traffic” (Carmemolla).

Attention from construction organizations are necessary to support underrepresented groups to become champions for diversity and inclusion. As women grow up and are influenced by their environment, it is possible that they may completely rule out an industry such as construction. Variables such as environmental factors are extremely influential in women’s career choices. Some examples of this could be statements from close relatives such as, “women are not usually in construction”, or “construction management is too low level of a job”. Further refuting this point, a study done by Davey and Stoppard showed that one-third of female 12th graders surveyed expected to have occupations that were traditionally more female than their preferred occupations. A program that has had much success in changing perceptions of the industry is the Women in Construction Management Summer Institute held at Colorado State University. The Institute accepts about 30-40 female high school students each summer at CSU and teaches the young girls about the basics of Construction Project Management. The Institute also teaches values that can only come from mentorship such as self-reliance, self-efficacy and strength in numbers in the industry to promote growth and resiliency. By the end of the 2019 program, according to the year-end report, **High School Girls Learn about Construction Management at Annual CSU Institute**, “100% of participants gained a lifelong mentor that they could rely on, 100% of the participants felt that they were more informed about
leadership roles for women in the construction field and how to navigate the industry as a woman, not only recommend the program to other women, but also 100% of the participants agreed that construction is a great field for women”. The industry must create its own mentoring programs and outreach initiatives from middle school into college to overcome female perceptions of lack of interest by underrepresented groups.

The Latinx/Hispanic Population in the Construction Industry

According to the Bureau of Labor Statistics, Hispanic/Latinx workers make up over 3.2 million people in the US construction industry workforce. This percentage rounds out to about 30%, which is the largest percentage of any ethnic minority group in the construction industry. Unfortunately, only “6.9% of workers have a bachelor’s degree and 45% of all Hispanic/Latinx workers in the Construction Industry are not in managerial positions” (Bureau of Labor Statistics). It is important to include the Latinx/Hispanic population because of the massive labor pool that could be expanded in the construction industry. To combat this lack of representation in managerial positions, the Construction Management Academy Career (CMAC) was created to “prepare young Hispanic men and women—as underrepresented minorities—for successful careers and future leadership roles in construction and construction-related industries” (Escamilla, Edelmiro, et al.). CMAC is aimed at High School Juniors to highlight the industry and introduce careers in Construction Management. The program provides engagement and outreach in communities where local construction companies are based. By giving the students local connections and opportunities to see work being done in their community, it allows for tangible evidence that assists in changing the negative perception of the industry. CMAC consists of a new focus each day offering classes such as Architectural Drafting, Construction Management, Carpentry, Welding, and Agriculture. At the end of the program, a survey was taken asking the students, “How confident are you that participating in the Construction Management Academy will make a positive impact on your career choice?” (Escamilla, Edelmiro, et al.). The results showed that the majority of the students were more likely to have a positive attitude towards a career in the industry.

Similarly, At the University of Texas (Austin), the Project M.A.L.E.S (Mentoring to Achieve Latino Educational Success) uses peer-peer mentoring to “allow for longer-term bonds between undergraduates, graduate and professional mentors for Middle School and High School students of color participating in the mentoring program” (Sáenz, Victor B., et al). A study was done using Hispanic/Latinx students to identify top needs for success during their tenure at the University. The students ranked mentoring programs most frequently, making up 45% of the number 1 choice on the survey.

Increasing Participation Amongst African-Americans in The Construction Industry

African-Americans in the workforce make up a significant percentage of the total labor force in the United States, but are still extremely underrepresented in the construction industry. In 2018, less than 4% of Construction Managers and less than 5% of first-line supervisors in the United States were African-American. The number of African-Americans in Construction Management positions has not seen much growth in the past 10 years according to the Bureau of Labor Statistics. Parents and educators alike want what is perceived as best for their youth and perceptions may come from cultural and societal norms. However, these perceptions may not accurately reflect the industry in regards to career success. This further highlights the importance of having industry mentors who have navigated the industry with experience to shed light and guidance on a non-traditional career.

According to the Projections of Education Statistics to 2025, there will be an increase of “African-Americans receiving college degrees by 22%” ( Hussar, W.J., and Bailey, T.M.). As a result of this growth in this underrepresented community, certain STEM industries have made it known that increasing visibility within underrepresented groups is a problem that can be addressed through mentoring programs. STEM fields are recognizing the importance of diversity and inclusion by seizing the opportunity to recruit the new influx of college graduates. Conversely, there is a substantially higher amount of African-Americans in labor-intensive sectors of construction such as, “cement masons, concrete finishers and terrazzo workers that made
up 12.5% of the subset of the (African-American) population and highway maintenance workers that made up 12.2% of the subset of (African-American) workers in 2018” (Bureau of Labor Statistics). This increased number of African-Americans in labor-intensive jobs could correlate to how this community perceives the industry. The Colorado Association of Black Professional Engineers and Scientists (CAPBES) created a program designed to introduce and create positive mentoring impressions on middle school and high school students interested in construction. The association has noted that “(a) students career decisions are heavily influenced by their peers and (b) students tended to follow the career path of the CAPBES’ volunteers and/or instructors that the students admired” (Brigham, Dewey, et al). The increased visibility of construction professionals in the program such as teachers and mentors, have made a positive effect on the mentees and their perceptions of the industry. The majority of the middle school students thoroughly enjoyed the program and were more apt to choose construction classes. This information provides a good measurement of mentoring underrepresented students at an early age.

**Looking Ahead to the Future: Effective Program Implementation**

The AGC has already taken an important first step by asking student groups what the organization should do. The next step is for the AGC to ask Minority and Women Executives, Project Managers, Directors of Operations, etc., for their honest opinions on the direction to ensure the best course of action in mentoring young students. Correct implementation of a mentoring program would involve the creation of a diverse action team of underrepresented entry-level and seasoned construction professionals and executives. This team would be tasked with implementing the AGC’s programs at a national and local level. The AGC should provide support by offering marketing assistance and the promotion of the program for industry and legislative buy-in. The AGC could also provide support to colleges and school systems for outreach programs to women and minority students.

The execution of these programs could flow under a ‘chain mentor’ system. In this system, the underrepresented industry partners would take the lead. These industry partners at a local level would be introduced to local college students via the schools’ collegiate AGC chapter. The industry partner would mentor the college students in preparation for a career in the industry. With this ‘chain system’, the college students would, in turn, mentor high school and middle school students within the community. The AGC, both nationally and locally, would need to spearhead the effort in making connections with local school districts to identify the areas that would be best served for the program. The college students, with assistance from industry mentors, would provide enrichment opportunities for exploration of the industry for younger students. This would inspire those students to keep the ‘chain’ of success visible within underrepresented groups in the construction industry. The AGC could explore opportunities to partner with organizations such as NAMC (National Association of Minority Contractors), NAHC (National Association of Hispanic Contractors), and the NAWIC (National Association of Women in Construction) to further broaden its reach into each respective community that the organization is servicing.

It is clear that these underrepresented communities can strongly benefit from an intentional mentoring program. By the AGC creating a program to increase diversity and inclusion through mentorship for underrepresented groups, the construction industry can experience new opportunities for growth and change. If the AGC is able to forge intentional relationships with industry professionals and students of underrepresented groups, provide them with support, resources, and open lines of communication, the possibilities to promote visibility in the industry via mentoring are highly attainable. Mentoring in underrepresented communities is important to the construction industry to assist in its efforts to promote diversity and inclusion. When younger students see their mentors being successful and actively enjoying what they do, it could potentially inspire them. Regardless of the mentees’ career decision, it would change how they view the construction industry as a whole.

“With the significant increases projected for the underrepresented populations in the next several decades, it is imperative that efforts are put in place promptly to get various minority groups engaged within the Construction Industry.” These
words came from Clemson graduate Nate Spells, Sr., one of my mentors and the first African-American to graduate from the Construction Science and Management program at Clemson. The AGC has tasked students with discovering new means and methods of attracting and maintaining underrepresented groups, as well as discovering new ways to create a more inclusive environment in the construction industry. By implementing a mentorship program for underrepresented groups in the industry, it will promote and ensure increased participation. There is nothing more impactful, as a college student, than to establish that they are able to have the same opportunities that I was given through mentoring. When I graduate, I intend to commit my time and effort to support this plan for mentoring underrepresented populations. Together with the AGC, we can be highly effective in increasing diversity and inclusion in the industry.

Works Cited


Perspectives on Diversity and Inclusion in Construction

Anas A. Pasha, Eastern Michigan University

Abstract

The construction industry is rapidly growing and contractors are optimistic about the immediate and long-term growth of the industry. As demand increases, the construction industry faces a projected labor shortage crisis. As the construction industry grows, it must rise to meet the challenge of solving this labor shortage by diversifying and widening its labor pool and strategically attracting new talent. This essay offers a detailed solution that includes a redefinition of approaches to diversity, ideas for short-term policies and creative long-term policies, and a lasting vision for the industry that will guide us to continue growing progressively and avoiding crises like these in the future.

Introduction

The construction industry is rapidly growing and contractors are optimistic about the immediate and long-term growth of the industry. As demand increases, the construction industry faces a projected labor shortage crisis. The Associated General Contractors of America, the industry’s largest professional organization comprised of over 27,000 members, reports that 78% of its members are experiencing difficulty filling salaried and hourly craft positions. According to the NAHB/Wells Fargo Housing Market Index, which surveys over 140,000 members of the National Association of Home Builders, more than 82% of residential building firms expect the cost and availability of labor to be their top issue heading into the next decade. As our industry grows, we must rise to meet the challenge of solving this labor shortage by diversifying and widening our candidate pool and strategically attracting new talent. This essay offers a detailed solution that includes a redefinition of our approaches, ideas for short-term policies and creative long-term policies, and a lasting vision for the industry that will guide us to continue growing progressively and avoiding crises like these in the future.

What is Diversity and Inclusion?

To begin working on a comprehensive diversity strategy for our industry, we first have to understand what diversity is. When asked what diversity means, many people would probably say that it means including a wide range of underrepresented demographics—demographics like race, socioeconomic status, religion, and gender, into the construction industry. While this certainly is a great goal and is partially true, it is not enough because it does not cover the full breadth of what diversity really means for the workplace. I define diversity as “the inclusion of a dynamic range of people of different experiences, perspectives, backgrounds, and skills.” This view does not boil diversity and inclusion down to simply hiring people who look or speak differently; this view suggests that we look at the core spirit of diversity. Instead of focusing only on demographics, we should be looking at a broader policy of breaking down all barriers, real and perceived, to entering a fulfilling career in the construction industry. Our diversity policy should not just be a scurry to hire more people to fill temporary labor shortages, it should be a commitment and a central understanding that diversity is crucially important and allows us to work in multi-dimensional teams that are more productive, creative, efficient, and more equipped to adapt to the challenges of the modern construction industry. I invite my colleagues to consider and adopt this new, more comprehensive and integrated view. By understanding the spirit of diversity, we can propel our industry for decades to come with a long-term vision, focused strategy, and sustainable growth in mind.

The Current State of Diversity and Inclusion in Construction

I believe our industry does a fair and respectable job of addressing diversity. Company executives generally realize that a diverse employee pool contributes to the companies’ success, and many construction companies have robust diversity and inclusion policies that are serious about establishing a culture of integrating people of different backgrounds. For example, Detroit Edison’s CEO Gerry Anderson joined a nationwide commitment to advance diversity and inclusion in the workplace by signing the CEO Action for Diversity & Inclusion pledge. Daniels Building in Farmington Hills, Michigan, and Colossal Construction LLC in Atlanta, Georgia, are both Service-Disabled Veteran-Owned Small Businesses (SDVOSB) and have a strong focus on helping veterans reintegrate into the civilian
workforce. Several churches and labor unions in Detroit have partnered to organize programs designed to reintroduce those formerly incarcerated into low-risk entry-level positions in the industry and provide them with educational services and workplace development. Suffolk Construction’s free Trade Partnership program is also another exemplary commitment to train and include veteran, minority, and women-owned businesses into the industry. Legislation requiring the hiring of ethnic minorities on public works projects in Chicago, New York, and Detroit have been effective in increasing labor participation from a wider range of people of different demographics. The construction industry also faces many challenges relating to diversity. In Equality Research and Consulting Ltd’s report titled “Race Discrimination in the Construction Industry: A Thematic Review,” racism, discrimination, and exclusion continue to plague our industry.

Harassment also continues to be a pervasive issue in our industry. An article on harassment in Engineering News Record reported some 66% of respondents stated they have faced sexual harassment or gender bias in the construction workplace. In the 2018 Hiscox Workplace Harassment Study, it was reported that more than 57% of women aged 28-40, involved in the construction industry, have been the subject of sexual harassment. This figure is almost unfathomable and means that any woman considering construction as a career is actually more likely than not to be sexually harassed, assaulted, or abused on the worksite. These realities perpetuate a negative image of the industry which inevitably causes many eligible and willing employees to find work in other sectors. By redefining our commitment to integrity, diversity, and inclusion we can work toward eliminating these issues and increasing healthy, productive, and stable workplace experiences in construction.

**Short Term-Strategy**

In addressing immediate labor shortages, companies can choose to pursue highly-effective strategies that will aid in the quick acquisition and retention of the workers needed. Innovative new technologies like Blendoor and Entelo offer novel ways to interview candidates using only a phone or computer app. These programs can also use computerized augmented intelligence to interview candidates instead of tying up valuable and finite manhours of hiring managers or project managers. These apps also have incredible capabilities in using smart human analytics algorithms to analyze a candidate’s speech patterns, personality, and competence. This information is then instantly analyzed and help in hiring and managing a diverse workforce, while also helping to prevent unconscious bias from affecting hiring practices. Using Entelo, Schneider Electric’s Director of Talent Acquisition LaDonna Tucker says her company was able to “achieve incredible results, working towards increasing female representation in our talent pool to more than 40% and connecting with qualified candidates around the globe who share our mission and can drive our business forward.”

Collaborating with local technical schools is also another powerful strategy. Kelly Thomasion, a recruiter for Aerotek Technical Staffing, teamed up with local technical schools in Louisville, Kentucky. She began working with the school by helping the students prepare for the work world by answering their questions and conducting mock interviews. Through this relationship, she is able to pass along the skills employers look for and also observe qualified candidates. When these students are nearing completion of trade school, she connects them directly to open entry-level positions that are perfect for them. This benefits students as they gain entry into local companies immediately, help technical schools develop their curriculums to be more responsive to the industry and place more of their graduates into jobs, and helps employers have a consistent pipeline of new workers. Companies in Metro Detroit like Turner Construction have synergistic relationships with technical schools like Randolph Technical Center and are seeing great benefits in closing their labor shortage gaps.

Companies should also encourage their current employees to submit referrals of people they know.
According to the Society for Human Resource Management, employee referrals are the most powerful source of finding qualified candidates. Employee referrals are typically higher quality, close quicker, and tend to be retained by organizations longer.

**Long Term-Strategy**

The nature of our industry is such that we are often so busy addressing immediate and short-term issues that investing in long-term sustainability is neglected. We need to change this approach and, as some of these short-term strategies are being implemented, our industry needs to look at long-term strategies and use positive momentum to ensure prosperity into the future and avoid labor crises like the current one.

Our long-term strategy should focus on three main objectives: reframing of our industry’s image, education of the public, and education of youth.

Our long-term strategy should begin with creatively and dynamic ways to reframe the image of our industry in the minds of the general public, politics, and the media. Everyone who works in the industry knows that long gone are the days that construction was an “old boys club” controlled by a handful of large companies run by laughing executives with big bellies and hard-to-pronounce last names, smoking cigars and playing golf, while their employees, boisterous burly men, toil their days away with their only goal being to go home to a cold six (or twelve) pack. Yet this is largely the common perception amongst the general population. We need to reframe this image so that a more diverse group of people can see themselves realistically pursuing careers in our industry. The construction industry is becoming more exciting by the day—one where vast expanses of desert are being developed in western Africa, business tycoons are building islands in the ocean and vying to introduce taller, more efficient, and more expansive projects previously considered impossible, and where Chinese billionaires are recreating the Asian construction market and influencing world politics. Rebranding our industry means seeing our work with fresh eyes and displaying the world of incredible opportunities available to everyone in our industry. Other industries, like the technology industry, computer coding, and the military have already realized this need and are taking real initiative in modernizing their image. Computer geniuses are no longer seen as thin, anti-social nerds hammering away at keyboards in their mothers’ basements; they’re seen as sharp industry leaders, like Elon Musk, who are changing the face of business, innovation, and science. Computer coders are no longer imagined as weird overweight guys with five pens in their shirt pockets; They’re seen as creative young minds of all backgrounds using code to study and solve the modern world’s most pressing issues. Other industries are using social media platforms, marketing, film, children’s book, and media to rebrand and modernize their image to appeal to younger audiences. As the construction industry follows suit, we can begin getting the attention and captivating the minds of young people from an early age, improving our reputation, and increase the numbers of people from different disciplines considering construction as a viable career choice. The same way the military is hiring photographers and Ford is hiring chemists, we need to expand the opportunities in our industry. We need creative new ways to accept hard-working immigrants into our ranks. The construction industry can and should be a supportive home and a family for each and every one of its members, and we have a duty to showcase the range of exciting, fulfilling, and well-paying careers in our industry.

Public events like exciting expos and fairs are an underutilized long-term strategy. Events like the Michigan Construction Tradeshow or the Ready Set Build! Expo hosted by Turner Construction, Barton Malow, and Bedrock in Detroit are a fun and interactive way to introduce local residents, schools, and youth to the workforce. Hands-on experiences...
like making sheet metal keepsakes, welding, and operating an excavator indoors are captivating activities for the public and a real opportunity to showcase the skilled trades. Attendees can also meet apprenticeship school representatives and interact with contractors to learn the process for entering the construction industry. Workforce training and community support partners can also help attendees overcome real or perceived barriers that may limit entry into the skilled trades. When I attend these events, I regularly meet many different kinds of people from the surrounding community. Some are looking for a career change, others are high school students considering construction for the first time, and others are just looking around with their kids and enjoying their first close experience with the industry. These experiences are an important tool for raising awareness of our industry amongst the general public and allow local schools to see what we do as well as attracting candidates for preliminary interviews.

Partnering with veteran organizations has the capability to solve a great portion of the labor shortage crisis. Around 200,000 service members transition out of the military each year, making them one of the largest and most qualified candidate pools for construction. Veterans bring many great attributes to the construction industry, such as problem-solving, integrity, teamwork mindsets, accountability, perseverance, and respect. As we hire more veterans, these values will continue growing in our company cultures and the culture of the industry in general. This will continue contributing to making the construction industry more welcoming, diverse, and more inclusive.

One of the perceived barriers to entry for many people is safety. Construction accidents are always particularly tragic. The images of death and destruction seen on television and social media when these events happen are hard to replace in the general public’s minds. Anyone who has ever lost a family member to an accident or seen a building collapsing in real life or on television will never forget it. By bolstering our commitment to safety, focusing on 200% accountability, nurturing our public relations with communities and politicians, and taking care of our employees and their families, we can do our outmost in looking out for our greatest asset — Our workforce. When we hold events focused on improving the physical health and general wellness of our employees, we communicate to them that we care about who they are, not just what they produce. When little boys and girls see their parents coming home healthier and less stressed from their construction jobs, their parents are less likely to say things like “Go to college so you don’t have to do what I do.” Instead, the kids themselves may say, like I said to my grandfather when I was a little boy, “I can’t wait to do what you do!” When a young woman can feel safe stepping onto the jobsite and doing her job without being harassed by “the boys,” she will project the confidence to keep doing her job well and the people around her will notice. When safety remains our top priority, and as safety culture is constantly improved, we will have less accidents and less bad press which will gradually improve our industry’s image. Taking care of our people creates a culture of integrity in our industry that others notice and will be attracted to. This creates pride for the men and women who belong to our industry, a sense of honor and prestige for those outside of it, and makes it more likely that the sons and daughters of our people will continue their parents’ legacy by choosing a career in construction.

We are the industry that built this country from sea to shining sea—and in fact built all of civilization. We know better than anyone that we have the perseverance, the grit, and the determination to meet this temporary labor shortage and grow through it strategically by redefining our commitment to diversity and inclusion, creating a serious strategic plan based on solving short-term challenges, and fueling long-term growth. The Associated General Contractors of America (AGC) is the leading professional association for the construction industry. With over 27,000 member firms in its network, including more than 7,000 of America’s top general contractors, nearly 9,000 specialty-contracting firms, and almost 11,000 service providers and suppliers, the AGC has a huge influence on the industry. As such, the AGC has the opportunity and the responsibility for spearheading efforts to bring diversity and inclusion to the forefront of our industry’s goals. The AGC can create a special task force to study the issue of diversity and inclusion in our industry from a statistical and data-driven perspective, which can be performed by a professional organization specialized in this work like PWC or Deloitte. The AGC should also hold
workshops, events, and conferences on diversity in construction and why diversity and inclusion are important. We can invite to these conferences local and national news organizations as well as politicians and policy makers to speak. These types of endeavors are vital in spreading a positive reputation for the industry and making more people aware of our work and the opportunities available in it. These efforts are also important in persuading our more traditionally-minded member firms who may not be used to considering diversity. The AGC can also take steps in coordinating relationships with leaders of other industries who have undertaken successful company culture reformations. Through these meetings, the AGC can help create a manual of diversity and inclusion best practices to which construction companies can continuously refer.

By redefining our commitment to diversity, equality, and inclusion; thinking critically about these policies; and opening a dialogue with the professional guidance of important and relevant associations like the AGC, I believe the construction industry can begin developing a strategic platform of policies that can very effectively close this temporary labor crisis, cultivate a culture of diversity and inclusion in the industry, and allow for long-term growth and prosperity into the 21st century.

ANNOTATED BIBLIOGRAPHY


Identifying and Positively Addressing Real and Perceived Barriers to Inclusion in Construction

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Abstract

The construction industry is facing difficulties in recruiting and training new skilled workers. My essay will identify some methods companies and the AGC can use to attract new employees. Some potential solutions involve encouraging schools to expose students to the construction industry, recognizing and assisting working parents with childcare issues, companies offering employees personalized career advancement schedules, and recruiting students focused on the arts and history for detail oriented roles in the industry. The Associated General Contractors can help by advising individual companies on attracting employees and facilitate greater mentorship programs between companies and educational institutions.

Introduction

For thousands of years, construction has been an obvious career path. It has a low barrier for entry and can be done in any area of the world. In the past, the trades were passed down from generation to generation. As our economy and culture have changed, so has our workforce in the construction industry. Unfortunately, several factors have impacted the construction workforce. Between the push for all high school graduates to attend college, rising costs of childcare, and lasting effects of the 2008 recession, the industry has lost out on valuable members of the workforce. Construction is seen as back-breaking work, is sometimes looked down upon in society, and can be intimidating to newcomers. In order to address an issue that will drastically impact the success of the construction industry, we must make dramatic changes to the way we recruit employees and empower young people.

The industry has had to employ new techniques and technologies to meet customers’ schedule expectations, while managing a limited skilled workforce. To recruit a qualified workforce, scholarships have been established, skilled labor is offered sign-on bonuses, day one benefits, relocation allowances, student loan repayment assistance, and transparent wage and career advancement schedules. Entire companies exist now to help companies attract and recruit skilled workers. While entering the construction industry is increasingly attractive, people are not pursuing careers in the industry or lack opportunities to gain the skills they need to succeed.

Some physical barriers to construction are growing as technical and management-focused programs are removed from educational institutions. Many young people have simply never used a hammer or saw. Many educational programs are focusing on exposing students to the rich educational opportunities in STEM, offering courses that explore computer science, three-dimensional modeling, forensic investigation, and robotics. While these courses are valuable to society and the construction industry, it has detracted students from coursework that may encourage them to pursue a trade or management role in the construction industry. When schools shifted their electives to focus on STEM courses, many students lost out on the opportunity to take electives like woodworking, automotive sciences, and industrial arts. As a result, the issues facing the construction industry are paralleled by the automotive industry (Rogers).

While it is probable that today’s students are genuinely interested in electives that explore STEM careers, schools should strive to offer electives that give students the opportunity to explore a wide variety of careers and working environments. Many students, particularly at-risk students, would benefit from exposure to a career that allows them to be active and work within a team, and offers a lot of variety in day to day working responsibilities and environments. It is important that students feel they are working towards a future goal and their school is supporting them in that journey (Panzer).

Construction is a unique working environment, and there are many great career paths for employees beyond entry level labor or skilled trades. Exposure to a wide variety of industries is vital for young students to understand that there is a career out there that can provide them personal satisfaction and a good quality of life (How).

Another physical barrier to the industry is the rising cost of childcare. When a family is making decisions...
related to daycare, they often conclude that it is more affordable to have one parent leave the workforce than pay for daycare. In 2016, almost two million working adults across the United States left their jobs because of a lack of affordable or adequate childcare (Schochet). The construction industry could attract and utilize these parents, helping them provide a good quality of life for their family and build a satisfying career for themselves. Economist Mike Madowitz explains the financial ramifications of taking time off work to care for a child:

“A 26-year-old woman who’s making $50,000 when she takes three years off of work to attend to a child would leave not just $150,000 in lost wages on the table, but an additional $200,000 in lost wage growth — the cumulative effect of time off on future earnings — and some $165,000 in lost retirement assets and benefits. (The $165,000 includes missed 401K contributions and their assumed growth as well as reduced Social Security benefits.) That’s a potential life income loss of $514,073” (Doerer).

Many parents are faced with difficult choices surrounding work and childcare. Providing affordable childcare benefits for employees would attract young professionals that are struggling with the cost of raising children. Providing the benefit of a reliable, affordable and trustworthy source of care for employee’s children will attract people to the industry and help the public see the benefits of working in the construction industry. When employees have their needs met, they are able give their best to their employers. Top technology companies, such as Microsoft and Google, utilize these notable benefits programs to attract top talent: predictable start and end times, flexible schedules, childcare FSA, backup care options, and on-site care. Depending on the type of construction and size of the company, some of these benefits may be out of reach, but the construction industry should strive to support families in order to attract workers.

A perceived issue with the industry is that construction is back breaking work and it’s just a manual job. Many people are not aware of the opportunities that exist for skilled workers to move up to higher pay or management level responsibilities. Many people remember the massive layoffs during the 2008 recession. Many skilled workers were laid off and never returned to the industry. It is important that people know about the opportunities for advancement and how the construction industry has recovered and learned from leaner times. When talking with Generation Z members about what they are looking for in their future careers, surprisingly, a common theme is the idea of stability. Anna Blue, co-director of an organization focused on young women’s’ career development, shared her thoughts:

“Gen Z was most directly affected as children by the economic crash that started in 2008,” explains Blue. “They are the generation who watched people around them lose jobs, lose homes, lose their 401(k)s and retirement accounts. They want something that feels safe because of what they witnessed. So, they’re more interested in salary and benefits and things like that.... They want in-person relationships with their managers; they want to see their colleagues and have face-to-face collaboration because they’ve been missing so much of that being on their phones” (DeFelice).

Generation Z is looking for stability and human connection in work. A method the industry could employ would be sharing personalized career plans and pay schedules. Showing potential employees that there are opportunities for advancement could help encourage industry participation, as it would provide employees some of the personal connection and stability they are looking for in the workforce.

Personalized career paths will help employees understand employer’s expectations, and the potential opportunities for their career with the company. Sharing a plan for progression and listening to employees’ professional goals can help improve moral and loyalty to the company. Generation Z has a high drive for success: “The most important factor Gen Z looks for is opportunity for advancement” (Kessler). Providing Generation Z employees with clear and realistic projections of opportunities for
advancement would help motivate them to join the industry and feel rewarded by their careers. They may be discouraged from entering the industry as a mason, but as they’re promoted to a foreman, field engineer, and superintendent, they will appreciate and utilize their cumulative experiences in every role to achieve success.

From my perspective, as a woman in the construction industry, the environment has been very welcoming and positive. When I talk with people about my major or my job, the response is unflinchingly positive and encouraging. There are many individuals, both in the industry and the general public, that enjoy hearing my experiences as a woman in a male dominated field. While the response from others has always been positive, internally I was very nervous about my career path and felt embarrassed to tell my family or closest friends about my interest in the construction industry. When I moved from Chicago to Fargo to finish my bachelor’s degree in Construction Management, I didn’t even tell my closest friends because I felt strangely embarrassed and like the career didn’t fit with the lifestyle and culture in which I was raised. I have since realized how well the industry fits with my life and what it means to be a construction professional. I have been welcomed in every job interview, career fair, competition, group project, and class discussion. My worries about being a woman in the industry were far worse than the actual experience.

A main factor to my success in the industry has to do with the unique mentorship opportunity I had while working part-time and attending school. I joined the industry with zero understanding or experience with construction. I remember entering my first purchase order and Googling: “What is rebar?” I started working for a general contractor while I was working towards earning my associate degree at my local community college. I started as an office assistant helping with filing, expense reports, and organizing meetings. I was promoted to a purchasing agent, then became an assistant to the project management team. I was able to see a very comprehensive view of the construction process while working.

Meanwhile in school, I was trying out different classes to see which piqued my interest: architecture, interior design, engineering, drafting, project management, and construction management. I enjoyed different parts of each field but decided to pursue construction management because of the experience I gained at work. I learned about pay applications in class, and then went to work and really grasped the importance of my duties and the process more easily. In class, I learned about long lead items and payment terms and was able to understand my role as a purchasing agent better. My classes at community college were helping me explore different fields in a low-cost environment, in comparison to traditional university tuition rates. Concurrently, I was seeing firsthand how the concepts applied in the real world.

I reasonably enjoyed my job, but I wasn’t sold on the career field until I attended my first client meetings. Being able to get out of the office, even just to take measurements or meeting minutes, helped me see how construction efforts impact our clients’ success. It was rewarding to meet customers, hear about their business and guide them through the construction process. One of my favorite things about the industry is physically seeing how a construction company’s efforts can make vast improvements to a space and help customers achieve success in any line of business.

Increased mentorship and career exposure for students would help them prepare for the industry. Even just hearing an experienced project manager speak on the phone to a customer, a supplier and a subcontractor can help students understand how important communication is and gain the confidence to do it themselves. If companies allow students to work or shadow once a week, while attending vocational or professional management programs, it would greatly benefit students and help increase career readiness. Spending time in the work environment would benefit students and help them learn to build relationships and contacts in the industry. Experienced tradesmen and managers are reaching retirement age, so the next generation needs the opportunity to learn from their experiences and example in the workplace. Attending school and spending time in the industry concurrently could help escalate learning and career readiness outcomes.

Another opportunity for increasing participation in the industry involves targeting the idea of craftsmanship. Many young people aren’t aware of the opportunities in construction for detail oriented or artistically inclined people. There are many existing
structures in the United States that need preservation or improvements, but few are qualified or skilled in the art of preserving or restoring these structures. The American College of the Building Arts is an educational institution with a unique mission: “The American College of the Building Arts educates and trains artisans in the traditional building arts to foster exceptional craftsmanship and encourage the preservation, enrichment, and understanding of the world’s architectural heritage through a liberal arts education” (Urban). This program has recognized the need for individuals educated on the historical significance and mechanics of preserving and restoring structures. The American College of the Building Arts offers a Bachelor of Applied Sciences in Architectural Carpentry, Architectural Stone, Classical Architecture, Blacksmithing, Masonry, Plasterwork, and Timber Framing. Many students today are following their passion and working on degrees in graphic design, anthropology, history and art, but struggle to find a job where they can apply that knowledge without further education. There can be a lot of detail and craftsmanship required for workers in fields like masonry, casework, electric, HVAC, surveying and computer drafting. A creative problem solver who is sensitive to details could greatly benefit the industry, as they can identify and resolve problems that may be overlooked by people with different inclinations. Many students could follow their passion for the arts, while finding a rewarding career in the construction industry. Trade schools and construction companies should actively work with schools on recruiting and training artistically inclined individuals for a successful and rewarding career in the construction industry.

The Associated General Contractors can play a vital role in helping the industry address current issues in the labor market. AGC has always served as a cornerstone for bettering the construction community and allows construction companies to collaborate and communicate on broad issues and initiatives in the industry. AGC could help companies expand this mentorship/apprenticeship program and facilitate the relationship between companies and schools. Currently at my school, companies come to recruit for Summer internships and full-time jobs, but few offer opportunities for students to shadow their project managers and build relationships during school. AGC could help encourage schools to offer more vocational and trade focused electives and expose students to the unique environment of a construction trade or management job. AGC could also help advise companies on how to attract new employees through unique benefits such as: flexible hours, childcare assistance, personalized career pathways, student loan repayment assistance, and increased awareness of current employment trends. The industry has not adapted enough to meet the needs of the millennial generation, and needs to innovate to meet the expectations and needs of Generation Z.

Construction is a widespread and diverse industry. The industry has faced major challenges, but has continued to innovate and adjust to changing markets and economic situations. While change is difficult, it is necessary for the continued success and longevity of every construction company. A significant cultural shift is coming as the baby boomer generation retires and the Generation X, Millennial and Generation Z employees begin taking on new roles in the economy. Companies must adapt to employee needs and culture in order to attract new parties to the industry. While the manual nature of the industry can have a negative stigma, there are significant advantages to a career in construction. It is our duty as construction professionals to promote the industry and potentially help others find rewarding and meaningful careers in the industry. We must foster the growth and development of our employees and encourage people to explore the unique benefits the construction industry can offer.

Bibliography


