A CASE STUDY

INVESTIGATING THE RELATIONSHIP BETWEEN CONSTRUCTION CRAFT WORKERS'EMOTIONAL INTELLIGENCE AND PRODUCTIVITY ON JOBSITES

By

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A CASE STUDY INVESTIGATING THE

RELATIONSHIP BETWEEN CONSTRUCTION CRAFT

WORKERS'EMOTIONAL INTELLIGENCE AND

PRODUCTIVITY ON JOBSITES

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Abstract: Many variables affect commercial construction projects. Some of these are related to the soft sciences of construction laborers on construction projects. Past research studied Emotional Intelligence (EI) of construction managers and provided data used to predict construction project success. This research studied construction laborers instead of construction managers. The *Percent Planned Complete (PPC)* of the *Last Planner System (LPS)* was used to determine the predictability of four subcontractors on a multi-family housing project with a thirteen-week schedule in Stillwater, Oklahoma. The Emotional Intelligence score of forty-nine construction laborers was collected using the *SSEIT* and the relationship with their *PPC* was analyzed. The results provide new knowledge to the understanding of construction worker's productivity showing higher EI scores could have a negative impact on workplace productivity. With this new knowledge construction managers can understand the role EI plays with construction laborers' productivity.

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CHAPTER I

INTRODUCTION

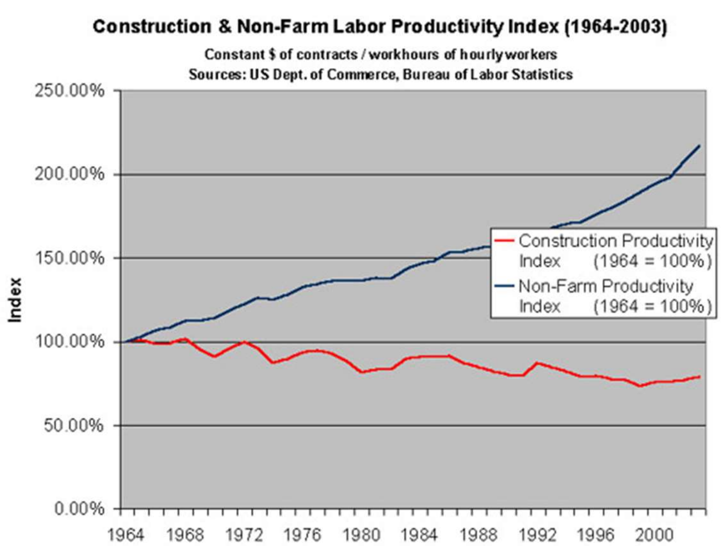
Past research analyzed commercial construction jobsite productivity to further understand how different variables affect productivity (Chang 1991; Awad and Heale 1993; Daneshgari and Moore 2011; and Abel-Wahab et al. 2015). Many forms of analysis are used to help predict the work flow on the commercial construction jobsite. Tactics in logistics, scheduling and optimal work flow have been sought, but what is often missed is human related factors. In order to help predict certain outcomes the human must be studied.

Construction jobsites are very unique with many variables affecting the process (Loosemore 2014). Research determining construction project success benefitted from studying humans who led construction projects and their intelligence (Jordan and Lindebaum 2012). Researchers discovered one type of human intelligence as Emotional Intelligence (EI) (Mayer and Salovey 1995). This intelligence has increasingly been studied in several industries with interesting results on relationships to profitability and job satisfaction (Bobik et al. 2001; Matthews et al. 2007; and Loi and Schutte 2014). While research on the relationship of construction managers and Emotional Intelligence exists, construction laborers and non-managers have not been studied. This research adds to the body of knowledge by showing the relationship of the construction laborer's Emotional Intelligence and their productivity.

SECTION 1.1 DEFINING CONSTRUCTION PRODUCTIVITY

Workplace productivity defined by the United States Department of Labor as the output of product produced by an individual with a measured input (Jacobs 2002). The U.S. Department of Labor frequently released reports on many sectors of industry showing their productivity across the nation and compared to one another. Construction productivity affected national, economic growth making construction productivity important to federal government economist (Abel-Wahab et al. 2015). Many economies international or domestic, federal or local relied on industry productivity to build their economy (Chodakowska and Nazarko 2015). The construction industry was one of the productivities measured by the United States Department of Labor.

The construction industry's decline in productivity has been researched and stated by several researchers (Awad and Heale 1993; Abel-Wahab et al. 2015; and (Chodakowska and



Nazarko 2015). Much of the decline in productivity occurred after 1970 and continues today. As shown in Figure 1, other sectors of manufacturing have seen sizable growths in productivity, but the construction industry has not grown, falling behind the national standard (Daneshgari and Moore 2011). The reasons for decline in productivity are not simple, but we know it exists and several governments worked to improve its productivity (Loosemore 2014; Vogl 2015). Impacts on construction productivity can be workplace relationships, technological advances in the construction industry, owner and architect relationships, weather impacts and supply chain or raw material supply complications (Hewage and Ruwanpura 2006). The construction productivity problem cannot be researched without determining key drivers of productivity in the construction industry. However, the uniqueness of construction projects in nature further complicate the issue (Abel-Wahab et al. 2015). In order to help solve this problem of labor productivity decline, research defined labor productivity as it related to the construction industry. Past research defined construction productivity as the work in place divided by an input such as work hours (Ganesan 1984; Howell et al. 1989; and Awad and Heale 1993), but the means of measuring this varied greatly and were not as accurate (Vogl 2015). The construction industry developed productivity metrics through The Construction Industry Institute (CII) at the University of Texas at Austin (Awad and Heale 1993; Kramer and Thomas 1988). Recent measurements were developed by the American Society of Testing and Materials International

Figure 1: Construction and Non-Farm Labor Productivity (1964-2003)

(ASTM) called job productivity measurement (JPM) which determined industry guidelines (Daneshgari and Moore 2011).

There are several ways to measure construction jobsite productivity. Measuring the cost per unit, unit installed per labor or a combination of the two were used in past research (Vogl 2015). This research used the *Last Planner System (LPS)* as developed by the Lean Construction Institute to measure the impact of predictable work flow impacting productivity (Ballard and Seymour 2000). Lean Construction used the principles of lean manufacturing and applied them to the construction industry. Developed at the Toyota Motor Corporation, Lean manufacturing eliminated waste and developed a predictable workflow impacting workplace productivity (Franz and Liker 2011). The focus of Lean Construction and *LPS* is to develop a culture in a construction process that is focused on the flow of the entire process. The byproduct of impeccable workflow is increased productivity, profit, safety and decreased waste. There are seven wastes as defined in lean: waiting, overproduction, rework, motion, transport, over-processing and inventory (Franz and Liker 2011). A lean construction project builds a culture focused on reducing or eliminating these waste through coordination. The *Last Planner System* helps a construction team achieve this with increased productivity as a result. This research used the *Weekly Work Plan*—a component of the *Last Planner System*—as a way to measure predictability of productivity at a daily level and will be discussed further in the methodology section.

SECTION 1.2 DEFINING EMOTIONAL INTELLIGENCE

Researchers (Mayer and Salovey 1995) stated human interest in Emotional Intelligence (EI) was recorded as early as the Greek philosophers. After the Greek philosophers, theologians in the Middle Ages such as St. Augustine of Hippo and St. Thomas Aquinas brought about the thought of the separation of the soul and spirit, affections and passions ((Matthews et al. 2007). In his greatest work *Summa Theologica*, Aquinas even built on Aristotle's idea of the immaterial and material leading to the idea of a dichotomous homo-sapien.

Mayer and Salovey developed the first model of Emotional Intelligence based on three processes: They were acknowledging and expressing emotions, regulating emotions and adapting emotions (Dipaolo et al. 1990; Roberts and Schulze 2005). Past research (Goleman 1997) explained the history of the development of EI based on the inadequacies of the more popular Intelligence Quotient (IQ). Researchers found humans with high IQs did not perform as expected creating hypotheses on how human intelligence developed. Research narrowed the focus of intelligence to Emotional Intelligence making it a hot topic (Matthews et al. 2004). Since the development of research in Emotional Intelligence, other intelligences were discovered leading to greater understanding of the brain and its intelligences such as tactile intelligence (Roberts and Schulze 2005). Tactile intelligence or processing is the intelligence associated with touch (Newman and Schneider 2015). Emotional Intelligence can be characterized as the ability to motivate oneself, to regulate one's emotions, control impulse, recognize others' emotions and delay gratification (Goleman 1997). Emotionally intelligent humans showed awareness of their emotions and also the emotions of others (empathy) (Dipaolo et al. 1990). It is not the deconstruction of emotions, but once emotions are constructed, an emotionally intelligent person can regulate the existent emotions (Goleman 1997).

Several tests to score Emotional Intelligence were developed. The *Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT)* (Caruso et al. 2016) and is an elaborate test most effective through use of a computer testing site. The *Wong and Law Emotional Intelligence Scale (WLEIS)*(Jordan and Lindebaum 2012) is a short format, self-reporting test using the Likert-type scale. The *Schutte Self-reporting Emotional Intelligence Test (SSEIT)* (Schutte et al. 1998) is a self-reporting, 33-question test divided up into four main categories.

Past research studied construction productivity and Emotional Intelligence independently, with few researchers comparing the two subjects. This research focused on the dependent relationship of construction laborers' productivity and EI. Past research studied the dependent relationship of construction managers and EI as discussed in the next section but did not study construction laborers who work at the construction jobsite.

CHAPTER II

REVIEW OF LITERATURE

Several studies in regards to the impact of Emotional Intelligence (EI) and the construction industry have been published.

Past research (Jordan and Lindebaum 2012) stated a correlation existed between EI and construction management due to the types of tasks fifty-five, United Kingdom construction managers completed. Their research divided up regular tasks carried out by construction managers into five dimensions to gauge performance. The five dimensions are "managing project environment and its resource", "organizing and coordinating", "handling information", "providing for growth and development", and "motivation and conflict handling". The research focused primarily on the second, fourth and fifth dimensions requiring more emotional abilities than the other two dimensions. The test used was the Wong and Law Emotional Intelligence Scale (WLEIS). The results showed job performance and Dimension 5 (Motivation and Conflict Handling) had a positive relationship and a positive correlation between Dimensions 2 (Organizing and Coordinating) and 4 (Providing for Growth and Development). This showed EI had limited effects—mostly with conflict resolution tasks—on performance by UK construction managers. While the sample size and location being quite limited generated limited analysis, it showed EI did impact productivity in UK construction managers. However the researchers concluded the impact of EI and individual tasks should be further studied and caution should be used when building the relationship between EI and project management.

Similar in nature, another study focused on the relationship of Emotional Intelligence (EI) in construction project managers and successful construction projects in the state of Florida, U.S.A. (Nigaglioni 2016). Researchers used the *SSEIT* to determine EI, completed through an online survey of 736 managers with 74 valid responses. Six areas of success were compared to EI scores and the CPSS (Construction Project Success Survey). The areas were overall success score, cost, schedule, quality, performance safety and operating environment. The results showed a significant relationship between EI and construction success based on CPSS for these 74 construction managers in Florida, U.S.A. "As EI increases overall construction project success increases as well" (Nigaglioni 2016).

One researcher (Sunindijo 2012) defined transformational leadership as a style of leadership using charism, inspiration of followers, promotion of careful problem solving and encourage personal development. Using this definition, Sunindijo added EI with political skill in a self-created, quantitative questionnaire survey and included reported facts of construction projects based in Sydney Australia. These facts pertained to the success of the construction project including cost, quality and schedule. A total of 273 participated in the survey and the results showed a need for skill development in four major areas. This further supported the importance of EI in construction management.

One team of researchers studied the impact of EI and construction management using the interview format (Cassell and Lindebaum 2012). Nineteen project managers where interviewed with their responses recorded and analyzed. This deviated from other research by not using the survey and opened up greater discussion on the responses. These British project managers were between 26 and 66 years old with 1 to 35 years of construction experience. In this research, two narratives split into six storylines. The first narrative was "construction is male-dominated". This created four storylines: "Self-awareness –emotions are a difficult subject to talk about", "Emotions equate with weakness", "Emotions as inappropriate to display" and "Emotions as unnecessary". The second narrative was the receptiveness and resistance to EI. This split into two main storylines: "Useful to understand emotions" and "They are a core management skill and emotions as inappropriate to display". As one can see, the storylines at times contradicted each other showing the tension in the construction industry of the need for change in how projects are managed, but the inability to implement the change.

More researchers focused on soft sciences to help increase construction jobsite productivity (Edwards et al. 2011). Individual's motivation for work whether for pay, job design or power all played into the need for meaningful work. The key skills of a construction manager were instructing, active listening, judgement and decision making. Researchers identified key personal characteristics as dependability, leadership, self-control, stress tolerance, cooperation, innovation, adaptability/flexibility and initiative. As stated in past research (Goleman 1997), persons with high levels of EI can influence teams effectively. Construction managers are managers of teams and thus the link of EI to project management. The objective of the research helped the construction industry understand the importance of team building to overcome problems in the construction process. The research concluded a successful project manager enabled teams to overcome these and excel.

Further research linked workplace motivation with EI in the construction industry (Walker 2017). Walker stated the lack of job satisfaction increased and construction productivity decreased. The study of Emotional Intelligence also increased the awareness of the impact of soft sciences on construction projects. The relationship between job satisfaction and well-being, self-control, sociability and emotionality were compared with the variables of age, gender, years of experience and education taken into consideration. One hundred and seventy-nine construction workers from the United States were asked 54 questions to help determine job satisfaction and EI. No relationship existed between job satisfaction and well-being, self-control, sociability and emotionality.

Seven key principles were recognized in Emotional Intelligence (Caruso et al. 2016). EI is a mental ability, EI is best measured as an ability, Intelligent problem solving does not correspond neatly to intelligent behavior, A test's content—the problem solving area involved—must be clearly specified as a precondition for the measurement of human mental abilities, Valid test have well-defined subject matter that draws out relevant human mental abilities, EI is a broad intelligence and EI is a member of the class of broad intelligences focused on hot intelligence processing. Since found as a broad intelligence, the opportunity for humans to further develop the intelligence existed. Adults and children alike have increased their EI by further development and understanding of their own emotions as well as the emotions of others. Because of its function in the brain it will affect the body and what the body does as a hot intelligence. A hot intelligence was described as personal thoughts and feelings by Mayer, Caruso and Salovey (Caruso et al. 2016). Therefore, EI affected their performance at work mentally or physically. Researchers also linked EI and performance by managers (Matthews et al. 2007). Studies found

EI affected many aspects of positive employee attributes such as commitment, teamwork, innovation and quality of service of people in management positions. Employees with higher EI communicated ideas and feelings better, managing their emotions better without causing more stress on their team while building more trust in their relationships. Several industries found higher EI in managers impacted all aspects of job performance, but in the construction industry research showed EI's impact was task specific, limited to the task requiring "emotion processing" (Jordan and Lindebaum 2012).

One study showed the relationship between higher EI scores in project managers and project success was not evident due to the nature of the construction industry worker's psyche (Jordan and Lindebaum 2012). In fact, hiring based on EI scores was stated as a poor practice due to the fact a construction project manager—and most construction workers—do not like to discuss their emotions. This research concluded differently than other research studying project managers in Florida (Nigaglioni 2016). Using the *SSEIT* (Schutte Self-Reported Emotional Intelligence Test) and CPSS (Construction Project Success Survey), the relationship between EI and a construction project's success in cost, schedule, quality, safety and the overall CPSS score was analyzed. A strong correlation was discovered between EI in project managers and construction success. Both research differed as the first (Jordan and Lindebaum 2012) studied a sample from the United Kingdom while the second (Nigaglioni 2016) studied a sample from the United States. Other researchers also reviewed the relationship between EI and successful, construction project management, but did not perform experiments on a sample set (Edwards et al. 2011). After analyzing the construction industry's problems and impact of research on EI and managers in other industries, they concluded hiring managers based on EI would greatly improve the construction industry's problems with cost overruns and schedule delays. This differed from other conclusions (Jordan and Lindebaum 2012).

Two themes appeared with past research of the relationship between EI and the construction industry. The first was studying the relationship between construction management and EI differed among studies depending on the data size and geographical location of test subjects. However, the majority of research found greater EI in project managers can help construction project success. The second was all research found dealt solely with management and leadership, not with construction laborers. This research studied the relationship between EI and a subcontractor's *PPC* using the *Last Planner System.* It adds to the body of knowledge by studying construction laborers' productivity and their EI which have not been analyzed in this way.

CHAPTER III

METHODOLOGY

The research was performed on a commercial construction project located in the City of Stillwater, of Payne County in the state of Oklahoma. The owner of the project was Lightbearers Ministries International of Fayetteville, Arkansas. Architectural design and engineering was completed and the project started on February 4, 2016 and ended on August 15, 2016. The project site was 3.75 acres located at 718 E. 5th Avenue in Stillwater, Oklahoma as shown in Figure 2.

The scope of work included the construction of four buildings for Phase One and the earthwork and utilities for Phase One and subsequent phases. The four buildings in Phase One included twenty-two town homes. Nineteen of the townhomes were four-bedroom units and three of them were two-bedroom units. The total square footage of Phase One was 28,484 with the building foundation pads occupying 9,380 square feet. Each building reached a height of 35'-6" with a structure of wood. The project also entailed approximately 26,000 square feet of asphalt paving for parking and other site paving for sidewalks and porches. Nine buildings and a leasing office were planned for the site. All utilities were installed in Phase One with the utilities for future phases stubbed out of the ground and capped.

Figure 2: The Construction Site Plan of Lightbearers Apartments

SECTION 3.1

EXPERIMENT SETUP

Over twenty companies worked on site for approximately five months. With differing personalities among the subcontractors on site, coordination became critical. The author was the site superintendent of the project and held weekly planning meetings on the jobsite every Tuesday morning. The author used two portions of the *Last Planner System (LPS)* in lean construction to help create work flow and increase productivity. One portion of the *LPS* used was the *Weekly Work Plan (WWP)* as shown in Figure 3. This was a plan simple in material and logic, but effective. The author constructed the plan out of butcher paper and divided it into a grid. In column one the subcontractors were listed with each having their own row. Each column from left to right represented a future day of work to be planned with the date of the specific day labeled in duration of the project. Along the top row was the specific day. Each company in

Figure 3: The Jobsite Weekly Work Plan

column one had an assigned, colored sticky note used for the day's date was written on a sticky note to change as the project progressed. Each day represented a work day and weekends were included. When a company had a task needed to be completed during the week, they used a standard format for their sticky notes.

In Figure 4 we see the standard format for all trades to coordinate their work. First, we knew it was the plumbing subcontractor as the color pink was their assigned color. Second at the top of the sticky note was the abbreviation “Int Plbg UG” which meant “interior plumbing underground”. This was the task. The bottom, left section was the area where this work took place. In this case, it was “BLDG 5” (Building Five). The bottom, right section was the number of men planned to complete this task. In this case it was four men as shown in Figure 4.

Lastly, the number nine circled was marked on the sticky note in Figure 4. This was a reference to the variance list (see Table 1). These variances will be explained further.

Table 1: List of Tracked Variances

Item	Variances
1	Weather
2	General Contractor
3	Architect
4	Engineer
5	Owner
6	Other subcontractor

Figure 4: The Plumber Sticky Note

At the end of each day if a job was completed the author drew a line through the task as shown in Figure 5.

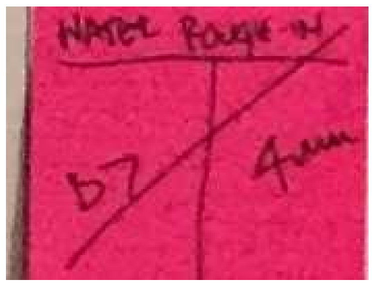


Figure 5: The Sticky Note (Completed Task)

In Figure 4 there was no line, but the number nine circled. This denotes an incomplete task with the variance impacting completion as “9” or as Table 1 shows “9: City/Inspectors”, meaning a city inspector or requirement prevented the subcontractor from completing the specific task. At the end of each day and week the *Percent Planned Complete (PPC)* was calculated to determine the predictability of the subcontractor’s productivity and the project. The *PPC* calculation was a simple equation completed with the weekly work plan as shown below. Based on this value, the percentage of tasks completed in a day or week by a subcontractor could be captured and recorded.

$$Percent\ Planned\ Compete\ (PPC) = \frac{\#\ of\ tasks\ completed\ in\ the\ work\ week}{\#\ of\ tasks\ planned\ in\ the\ work\ week}$$

In review *The Last Planner System* was a unique way to understand this jobsite’s predictable work flow. The *LPS* was created build predictable work flow and expose interruptions to work flow (Ballard and Seymour 2000). The tools developed within *LPS* are *The Pull Plan, the Weekly Work Plan, Percent Planned Complete (PPC) and Tracking of Variances. PPC* in this research was achieved by taking the number of completed, planned activities of a subcontractor divided by the number of planned activities, communicated by a percentage value. When a task was not completed, a variance (see Table 1) was assigned for the reason of the incomplete task. This system helped determine the underperforming subcontractors immediately and identified the variances impacting their work flow.

SECTION 3.2 DATA COLLECTION

Two main categories of data were collected on this project. The first was the *Percent Planned Complete (PPC)* for each subcontractor for the duration of the project. The second was the Emotional Intelligence (EI) score for each willing participant. The data collection for *PPC* occurred at the end of each day and week. These percentages were recorded in a simple spreadsheet with each subcontractor labeled and each day and week recorded as shown. Table 2 represents data at a week level. The participating companies are found in the left column. This sample shows weeks nine and ten and the percentages show the *PPC* of the specific subcontractor for the specific week. For example, the concrete subcontractor completed 66.67% of the planned tasks in Week 9, but did not plan any tasks in Week 10, thus no value was recorded.

Table 2: A Sample of the PPC Records Spreadsheet

Subcontractor	Week 9	Week 10
Concrete	66.67%	
Plumbing (Utility)	0.00%	50.00%
Plumbing (Building)	20.00%	85.71%
Electrical		100.00%

Wood Framing	100.00%

Pictures of each weekly work plan were recorded to ensure reliability and accuracy of the calculations.

The data collection for the EI score was completed by a survey called *SSEIT* (Schutte Self-Reported Emotional Intelligence Test) (Schutte et al. 1998). The survey contained thirty-three questions, each having a Likert scale response with the number one denoting "Strongly Disagree" up to five denoting "Strongly Agree". This survey was developed and published after testing with 346 individuals from the southeast United States. Questions 5, 9, 15, 18, 19, 22, 25, 29, 32, 33 pertained to perception of emotion, questions 2, 3, 10, 12, 14, 21, 23, 28, 31 pertained to managing own emotions, questions 1, 4, 11, 13, 16, 24, 26, 30 pertained to managing others' emotions and questions 6, 7, 8,17, 20, 27 pertained to utilization of emotions (Schutte et al. 1998). Questions five, twenty-eight and thirty-three were reversed scored to ensure participant engagement (see Appendix 1). Before work took place, each subject was asked to participate without reimbursement or coercion. Each subject was given an adult consent form as shown in Appendix 2 to ensure the subject was not pressured in any way. The survey, consent form and script were submitted to the Oklahoma State University Institutional Review Board (IRB) and the results are included in Appendix 3. Any unique information of the individual was not obtained through the surveys and the surveys were securely kept after recording. The scores of each subject were entered into a spreadsheet and analyzed (see Table 3). The right column contains data retrieved from a completed survey and the participants answers to the questions. Participant 1 answered a “5” on the first three questions of the survey in this example.

Table 3: Sample of Emotional Intelligence (EI) Individual Scores Spreadsheet

Emotional Intelligence Survey

QUESTION:	ANSWERS					Participant 1
What age range do you fall in?	< 20	21-30	31-40	41-50	50 >	31-40
How many years of experience do you have in construction?						20
What specialty work do you perform (example: plumber, electrician, painter, etc.)						Electrician

QUESTION	SCALE: Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
I know when to speak about my personal problems to others	1	2	3	4	5	5
When I am faced with obstacles, I remember times I faced similar obstacles and overcame them	1	2	3	4	5	5
I expect that I will do well on most things I try	1	2	3	4	5	5

SECTION 3.3 DATA ANALYSIS

Forty-nine unique, individual’s Emotional Intelligence (EI) scores were combined with the corresponding trade *Percent Planned Complete (PPC)* to develop the master spreadsheet. Thirteen weeks of *PPC* was gathered and further broken down into the *PPC* for specific trades for each day. Each laborer was given a number based on the number of laborers in each subcontractor group. Each subcontractor was given a number with “1” being associated with concrete foundation workers, “2” being associated with wood framing, “3” being associated with plumbing and “4” being associated with electrical. The mean EI score for all employees was 119.56 with a median of 118. Data collected from forty-nine unique individuals from four different companies was sorted and arranged by trade. The four trades are the plumbing, concrete, electrical and wood framing with the individual labor’s EI scores and their company’s *PPC* as the focus of this study.

SECTION 3.4 RESEARCH HYPOTHESES

The primary hypothesis of this study investigated the relationship between the individual EI of the subcontractor’s jobsite employees and the *PPC* of the different subcontractors. The primary hypothesis had two, secondary hypotheses. The first, secondary hypothesis studied whether the medians of the subcontractor’s *PPC* and individual EI scores differed. The second, secondary hypothesis studied whether the medians of the subcontractor’s *PPC* and individual EI scores differed.

SECTION 3.5 STATISTICAL TEST

To determine normality the Anderson-Darling normality test was used on both sets of data. This test gives a p-value of the data to determine if the hypotheses of normality should be accepted based on large values of A_n^2. The Anderson-Darling calculation is as follows based on the *Cambridge Dictionary of Statistics* (Everitt, B.S. 2002):

$$A_n^2 = -\frac{1}{n}\left[\sum_{i=1}^{n}(2i-1)\{log z_i + \log(1 - z_{n+1-i})\}\right] - n$$

Where $x_{(1)} \leq x_{(2)} \leq \cdots \leq x_{(n)}$ are the ordered observations, s^2 is the sample variance, and

$$z_{(i)} = \Phi\left(\frac{x_{(i)} - \bar{x}}{s}\right)$$

where

$$\Phi(x) = \int_{-\infty}^{x} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}v^2}\, du$$

The Kruskal-Wallis test used in this research was developed to determine the median difference of two or more groups in non-parametric data (Guo et al. 2013; Kruskal and Wallis 1952). It was not developed to show which of the groups differed in median, but only if there was a difference. The data was grouped and summed, and if there is no tie in the sum, the test statistic used (*H*) was reached by using the following equation (Guo et al. 2013):

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{c} \frac{R_i^2}{n_i} - 3(\mathrm{N}+1)$$

Whereas N is the total number of EI scores of all samples when testing the EI scores and the total number of PPC when testing the *PPC* scores. The variable n_i represents the number of values in the *i*th sample with R_i being the sum of ranks in the *i*th sample. The variable *k* is the number of samples in each test (Kruskal and Wallis 1952). Because the data was non-parametric the chi-squared probability chart was used with the *H* value and the degrees of freedom being *k*-1. If the *H* value was greater than the corresponding chi-square value based on the calculated degree of freedom, the hypothesis was rejected. If ties exist in the data the ranks were adjusted based on rank then the calculation was:

$$H_c = \frac{H}{C}$$

Whereas C was:

$$C = 1 - \frac{\sum T}{N^3 - N}$$

Whereas *N* represented the number of observations of EI or *PPC* when testing each group. The variable *T* represented:

$$T = (t-1)t(t+1) = t^3 - t$$

This equation was used for each group of ties with *t* as the value of tied observations (Kruskal and Wallis 1952). Using the Kruskal Wallis statistical test on the EI score of all forty-nine workers and the *PPC* of the four subcontractors, the data identified the relationship between the individual EI and the subcontractor's *PPC*. The tests showed the medians did differ and the post-hoc, Bonferroni correction was used to show which medians differed and which were similar. In order to protect against a Type I error in small sample sizes, the Bonferroni correction takes alpha and divides it by the number of test to be analyzed (α/m) (Everitt, B.S. 2002). Then each group is compared and the value of the pairwise comparison is compared to the median. The Bonferroni correction was created for use with only small amounts of comparisons and in this case the amount was no more than six (Everitt, B.S. 2002).

In summary, the data collected was categorized in two variables. The first variable was the *PPC* collected by recording the daily *PPC* of each subcontractor in a simple spreadsheet. The second variable was the individual EI scores collected by a survey. A master spreadsheet contained the results for analyzation. Using the Anderson-Darling test, the data was test for normality. Finally, the relationship of the data was tested using the Kruskal-Wallis test and the Bonferroni correction.

CHAPTER IV

RESULTS

The data for the individual EI scores for all forty-nine construction workers had a mean of 119.84 with a median of 118 and a standard deviation of 15.69. Forty-four of the forty-nine scores fell between 96 and 141. The highest range of scores as shown in Figure 6 resided in the range of 156-171 and the lowest range of scores was 66-81.

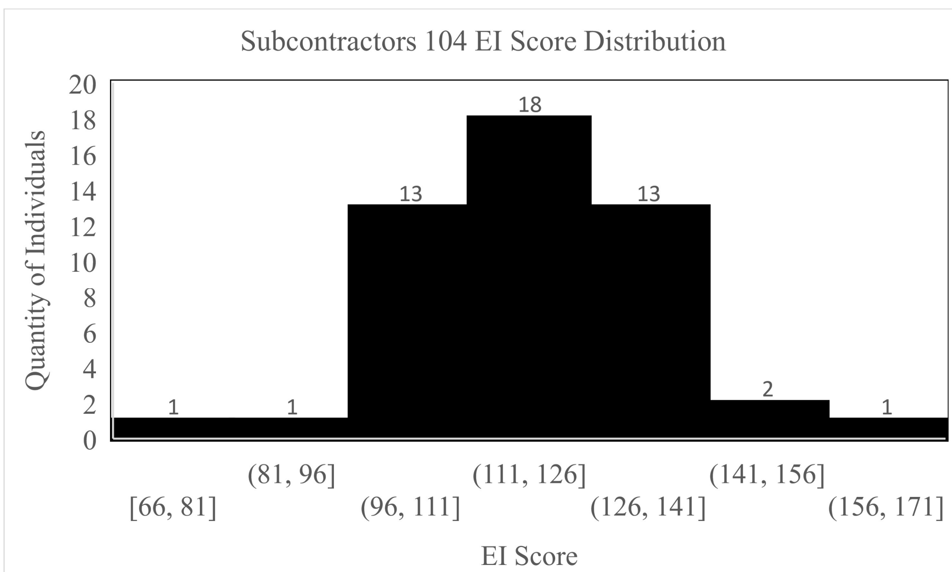


Figure 6: Concrete, Wood Framing, Plumbing and Electrical Subcontractors EI Score Distribution

The daily *PPC* data for the concrete, wood framing, plumbing and electrical subcontractors for the duration of the project had a mean of .72 with a median of .875 and a standard deviation of .3398. This data was right skewed having a distribution towards the higher *PPC* and a much higher median than mean. As shown in Figure 7, the days with *PPC* is 561 with the highest *PPC* possible at 100%. The range with the fewest days was in the *PPC* range between 44%-66% as shown in Figure 7.

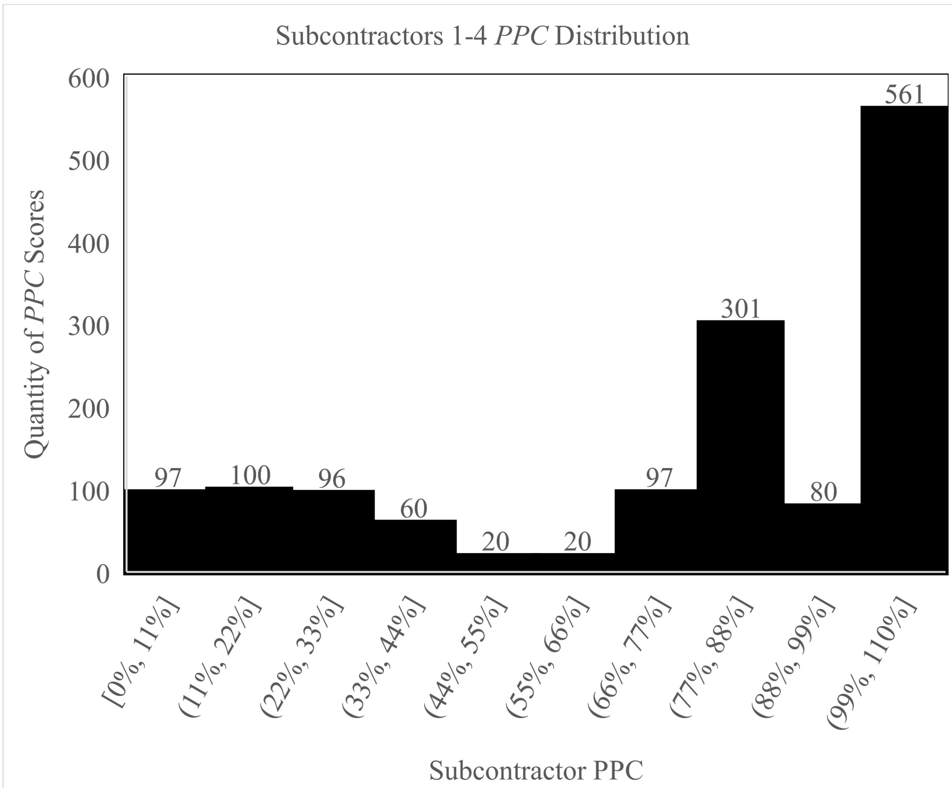


Figure 7: Concrete, Wood Framing, Plumbing and Electrical Subcontractors PPC Distribution

The Anderson-Darling test for normality was performed on both sets of data using the calculation shown in Section 3.6. As shown in Figure 8, the mean was 119.8, the standard deviation was 15.69, N represents the sample size, AD is the Anderson-Darling value at .577 and a large p-value. The p-value of the normality test for the individual EI scores was greater than ∞=.05, thus making the data normal. Most of the data centered around the line showing normal distribution with a few outliers.

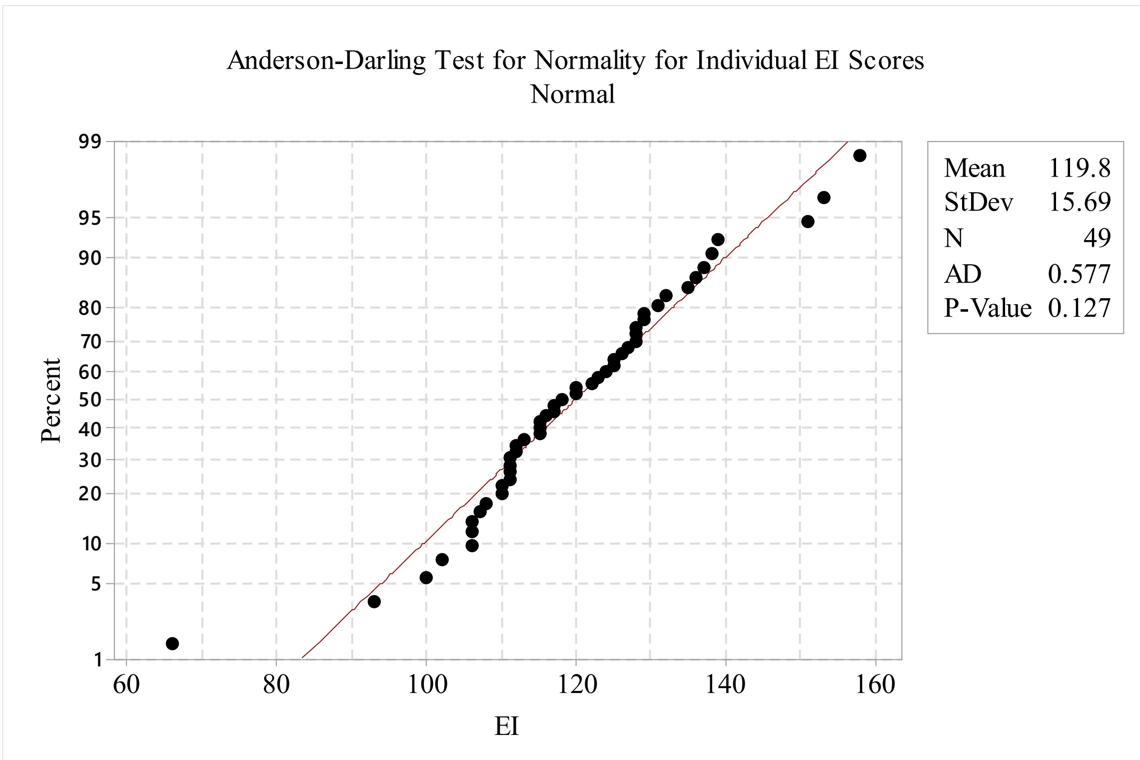


Figure 8: The Anderson-Darling Test for Normality of EI Score Data for the Concrete, Wood Framing, Electrical and Plumbing Subcontractors

As shown in Figure 9, the results of the Anderson-Darling normality test were conclusive. Over a span of 1,432 days the forty-nine participants worked, the mean *PPC* was 72.58%. However, the Anderson-Darling value was very high, creating a very low p-value $< \alpha = .05$ and rejecting the null hypothesis. This confirmed the data is not normal. The graph also showed this as many *PPC* values were the extremes of the scoring (0% and 100%). These values meant the task planned was not completed (0%) or it was completed (100%).

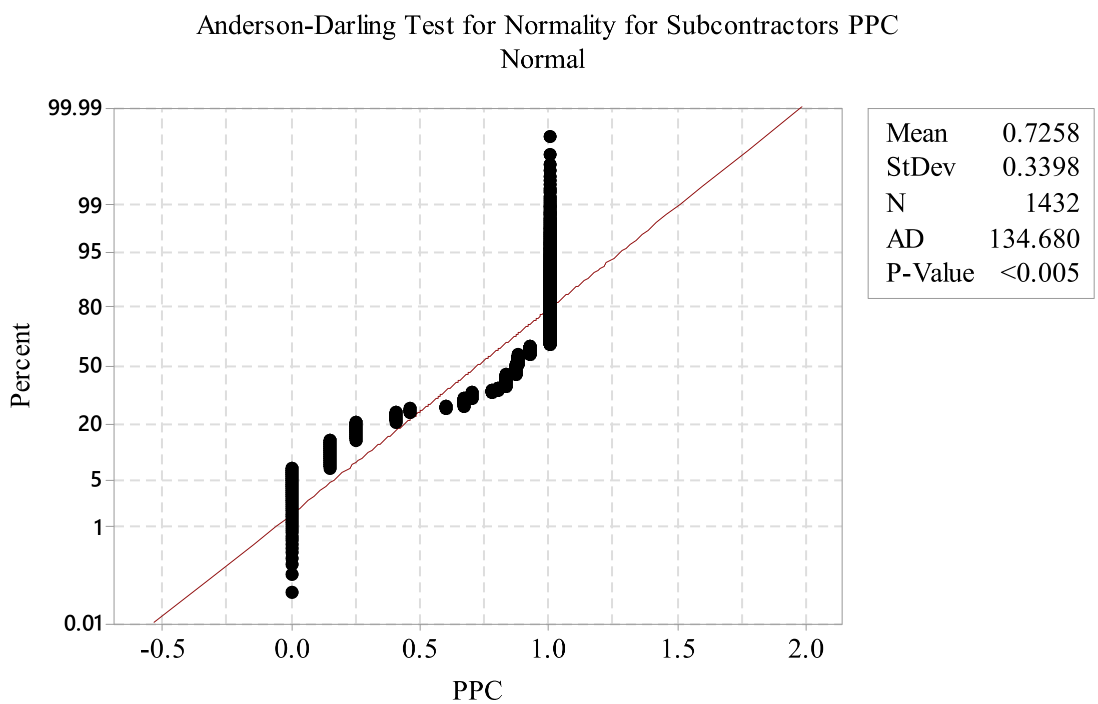


Figure 9: The Anderson-Darling Test for Normality of *PPC* Data for the Concrete, Wood Framing, Electrical and Plumbing Subcontractors

SECTION 4.1 TESTING EMOTIONAL INTELLIGENCE SCORES

The first set of data tested was the EI survey results of all employees of the concrete, wood framing, plumbing and electrical subcontractors totaling forty-nine laborers as shown in Table 4. The concrete subcontractor had nineteen participants, the wood framing subcontractor had twenty participants, the plumbing subcontractor had the least amount at four participants and the electrical subcontractor had six participants. All subcontractors had their entire crews onsite participate in the research. The wood framing subcontractor had the highest individual EI score at 158 and the lowest at 66 as shown in Table 4.

Table 4: EI Survey Scores for Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Employee	Concrete	Wood Framing	Plumbing	Electrical
1	128	129	153	118
2	116	112	151	125
3	111	128	120	108
4	117	115	139	93
5	111	138		110
6	112	115		110
7	132	111		
8	123	158		
9	106	137		
10	124	102		
11	106	107		
12	125	127		
13	120	129		
14	128	111		
15	113	122		
16	106	100		
17	131	115		
18	126	117		
19	136	135		
20		66		

The Kruskal-Wallis test allowed comparison of the EI scores of the forty-nine laborers from concrete, wood framing, plumbing and electrical subcontractors. In Table 5, N represents the group size, the median is the EI median score, the mean rank is the sum of the individual ranks of each sample added up by group (the average rank was given in tied situations) and the Z-Value was the number of standard deviations the specific group's mean is from the overall mean. First the medians of the subcontractor's EI was calculated and ranked. The results in Table 5 showed the medians of concrete, wood framing and electrical subcontractors are similar even-though each sample size differed. The plumbing subcontractor had a much higher median average EI score, but also the lowest sample size. The concrete and wood framing subcontractors had the two highest sample sizes and the medians and mean ranks were very similar. The plumbing subcontractor was the only group with a positive z-value because the plumbing subcontractor's median is much higher than the average of all four groups.

Table 5: The EI Score Medians of Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Sub	N	Median	Mean Rank	Z-Value
Concrete	19	120	24.8	-0.08
Wood Framing	20	116	24.9	-0.04
Plumbing	4	145	41.9	2.46
Electrical	6	110	14.8	-1.88
Overall	49		25.0	

There are three values created in a Kruskal-Wallis test: The Degrees of Freedom (DF), the H-value and the P-Value. The DF is the number of groups minus one (4-1=3). The H-value is calculated based on the calculation in Section 3.6. The H-value determines the p-value based on the chi-square distribution and the DF. Lastly the p-value determines the probability of the test.

Because the number of groups was less than five, a test to show whether ties in the data existed produced two H-values very similar in value at 8.67 and 8.68 meaning the data had very little ties. If the H-value is greater than the chi-squared value based on the degrees of freedom, then it is significant data (Guo et al. 2013; Kruskal and Wallis 1952). As shown in Table 6, it is not and the p-value was less than α =.05. Therefore, the null hypothesis can be rejected and the alternate hypothesis can be accepted showing the medians of the four groups differed.

Table 6: The Kruskal-Wallis Test of EI Scores for Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Method	DF	H-Value	P-Value
Not adjusted for ties	3	8.67	0.034
Adjusted for ties	3	8.68	0.034

The chi-square approximation may not be accurate when some sample sizes are less than 5.

The Kruskal-Wallis only showed differences between the medians of two or more variables existed but did not show which specific medians differed. The post hoc, Bonferroni correction identified medians by creating a pairwise comparison. Three of the six subcontractor pairs had a p-value less than α=.05 and showed the medians differed significantly as shown in Table 7. The critical value is the Bonferroni correction value. The number of standard deviations between the compared subcontractor's median EI score determined the Z-value. As shown in Table 7 the common subcontractor in pairwise comparisons arriving at larger Z-scores was the plumbing subcontractor.

Table 7: The Bonferroni Correction for the Kruskal Wallis Test on EI Scores for Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Subs	Z vs. Critical value	P-value
Plumbing vs. Electrical	2.94302 >= 2.128	0.0033

Concrete vs. Plumbing	2.17515 >= 2.128	0.0296
Wood Framing vs. Plumbing	2.17054 >= 2.128	0.0300

The picture of the results from the Bonferroni correction of the Kruskal-Wallis test of the EI scores for the concrete, wood framing, plumbing and electrical subcontractors was captured in Figure 10. On the left side of the figure is the confidence intervals of the EI scores for each subcontractor with the median marked by a white line in the interval. The concrete and wood framing subcontractor's intervals and medians are close in value. The plumbing subcontractor's interval is much larger and higher based on the high median and lower sample size. The electrical subcontractor's interval is similar to the concrete and wood framing subcontractors' intervals. On the right side of Figure 10 the pairwise comparisons between every group is showed in relation to the Bonferroni correction value (2.128) The comparions between the concrete, wood framing and electrical subcontractors were most consistent in Z-scores. The comparison between concrete and wood framing was closest to the Bonferroni correction value because their medians and mean rank as shown in Table 5 were most similar. Each group the plumbing contractor was included in produced a corresponding Z-score exceeding Z. This showed the plumbing subcontractor's median EI score was much different than the three other subcontractors studied.

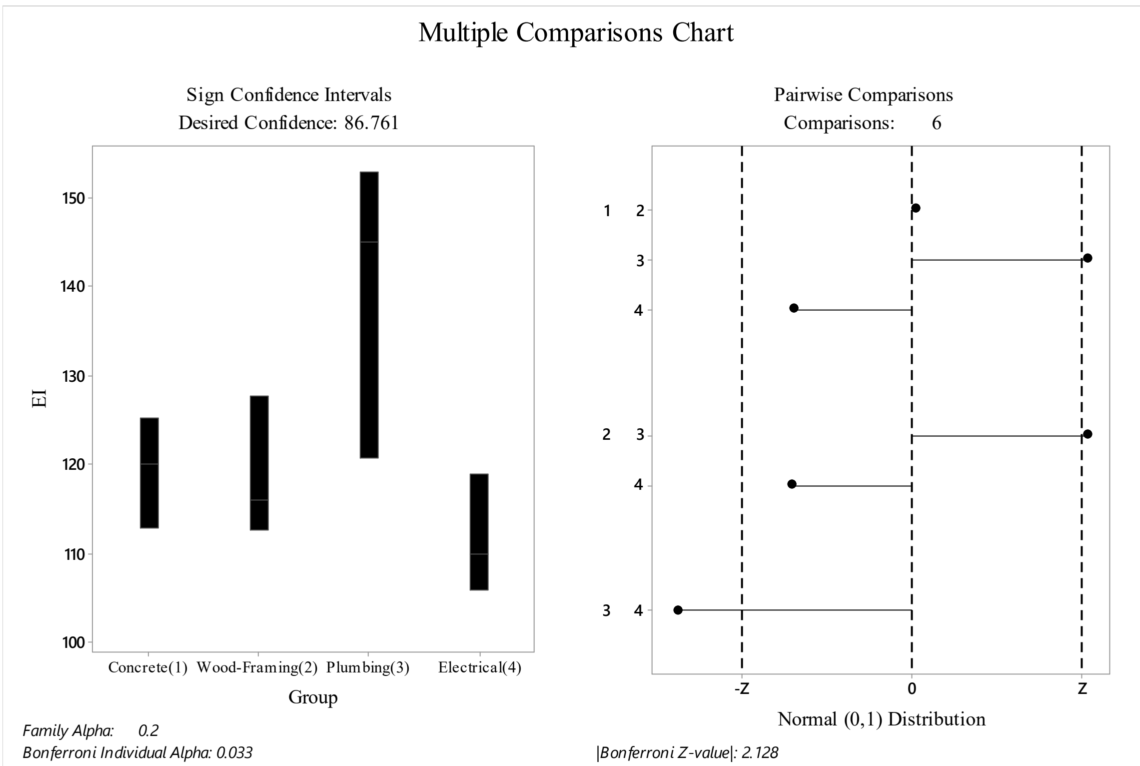


Figure 10: The Bonferroni Correction for the Kruskal Wallis Test on EI Scores of Concrete, Wood Framing, Plumbing and Electrical Subcontractors

SECTION 4.2 TESTING SUBCONTRACTOR *PPC* SCORES

The second data set was the Subcontractor *PPC*, comprised of the *PPC* from each day of the thirteen-week schedule of each subcontractor as shown in Table 8. The Kruskal-Wallis results first calculate a median and mean rank. N represents the group size, the median is the *PPC* median score, the mean rank is the sum of the individual ranks of each sample added up by group (the average rank was given in tied situations) and the Z-Value was the number of standard deviations the specific group's mean is from the overall mean. The wood framing group size was much larger because the total days of recorded *PPC* and the number of participants increased the data size. The electrical subcontractor had a very high median and mean rank. With a value of $1.\overline{0}$ this meant the *PPC* was 100%. After further review the electrical subcontractor had days of 0% *PPC*, but only 0% and 100% *PPC* were recorded. Thus the 0% days were omitted in the median calculation. The author was the superintendent on the job and witnessed the electrical subcontractor as a very organized and determined team player. Most days the electrical subcontractor would arrive earlier than everyone else in order to complete the planned tasks. Thus, the reason why the median for the electrical subcontractor was $1.\overline{0}$. The wood framing subcontractor's mean was closest to the overall mean, possessing the smallest Z-value.

Table 8: The PPC Medians of Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Subcontractor	N	Median	Mean Rank	Z-Value
Concrete	133	0.25000	321.1	-11.58
Wood Framing	859	0.92308	780.3	7.14
Plumbing	224	0.45455	375.4	-13.44
Electrical	216	1.00000	1060.1	13.25
Overall	1432		716.5	

There are three values created in a Kruskal-Wallis test: The Degrees of Freedom (DF), the H-value and the P-Value. The DF is the number of groups minus one (4-1=3). The H-value is calculated based on the calculation in Section 3.6. The H-value determines the p-value based on the chi-square distribution and the DF. Lastly the p-value determines the probability of the test. Table 9 showed the data had very large H-values making the p-values very small. The difference of the H-values also confirmed multiple ties of samples existed and the average mean rank was used to determine the overall mean rank. Since the p-value was less than α =.05, the null hypothesis can be rejected and the alternate hypothesis can be accepted showing the medians of *PPC* between the four groups differed.

Table 9: The Kruskal-Wallis Test of PPC for Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Method	DF	H-Value	P-Value
Not adjusted for ties	3	443.52	0.000
Adjusted for ties	3	472.90	0.000

The Kruskal-Wallis test showed differences between the medians of two or more variables existed but did not show which specific medians differed. The post hoc, Bonferroni correction identified medians by creating a pairwise comparison. All subcontractor pairs had a p-value less than α =.05 and showed the medians differed significantly as shown in Table 10. The critical value is the Bonferroni correction value (2.128). The number of standard deviations between the compared subcontractor's median EI scored determined the Z-value.

Table 10: The Bonferroni Correction for the Kruskal Wallis Test on PPC of Concrete, Wood Framing, Plumbing and Electrical Subcontractors

Subcontractors	Z vs. Critical value	P-value
Plumbing vs. Electrical	17.9284 >= 2.128	0
Concrete vs. Electrical	16.7406 >= 2.128	0
Wood Framing vs. Plumbing	13.4757 >= 2.128	0
Concrete vs. Wood Framing	12.3033 >= 2.128	0
Wood Framing vs. Electrical	9.1794 >= 2.128	0

The picture of the results from the Bonferroni correction of the Kruskal-Wallis test of the EI scores for the concrete, wood framing, plumbing and electrical subcontractors was captured in Figure 11. On the left side of the figure is the confidence intervals of the EI scores for each subcontractor with the median marked by a white line in the interval. The concrete subcontractor had a small confidence interval central to the median. The wood framing subcontractor possessed a reasonable interval, but differed greatly from the concrete and plumbing subcontractors. The electrical subcontractor possessed a small internval also focused around the median. On the right side of Figure 11 the pairwise comparisons between every group is showed in relation to the Bonferroni correction value (2.128) Nearly all pairwise comparisons exceeded Z except for one: the pairwise comparison between concrete and plumbing subcontractors. Both had the lowest *PPC* thus making this comparison difference small. Because of the high *PPC* median of the electrical subcontractor (100%), the comparisons were skewed. However the subcontractor furthest from perfection (100%) with a larger sample group was the plumbing subcontractor.

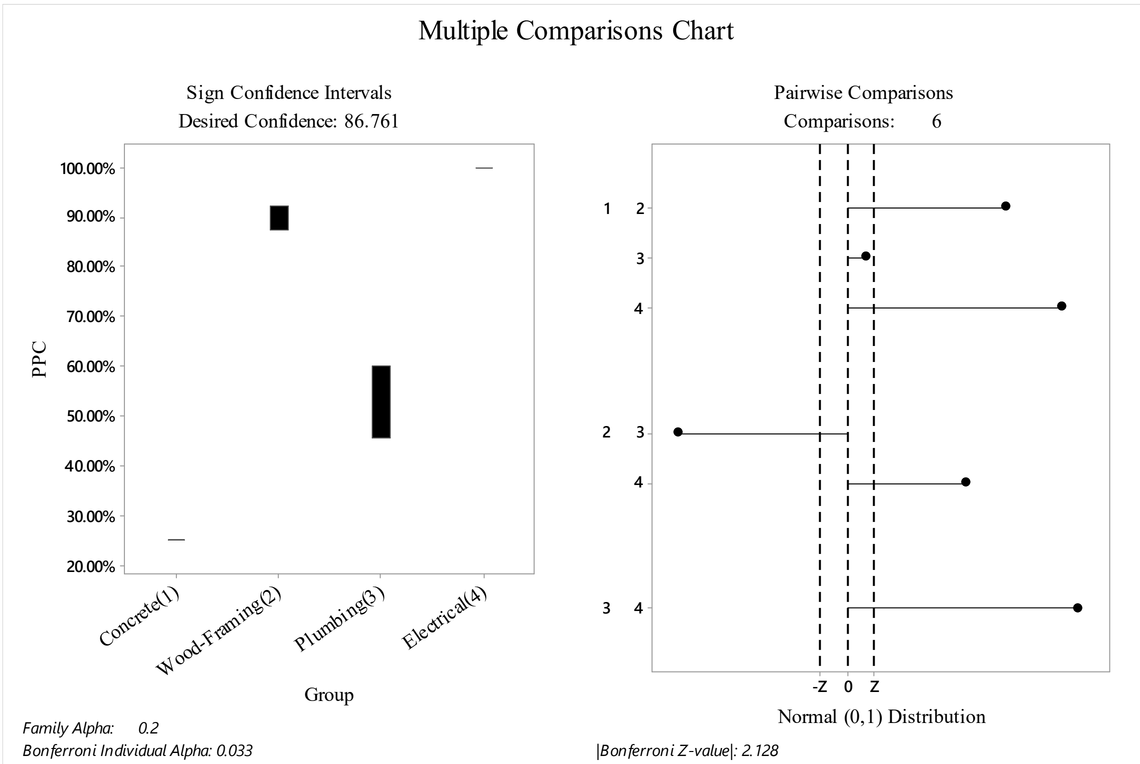


Figure 11: The Bonferroni Correction for the Kruskal Wallis Test on PPC for Concrete, Wood Framing, Plumbing and Electrical Subcontractors

SECTION 4.3 THE CORRELATION BETWEEN SUBCONTRACTOR *PPC* AND EI

The Spearman Rho correlation was used to figure the correlation between all EI scores and the Subcontractor *PPC*. Since the data was not normal a non-parametric formula was used. The Spearman Rho calculation is:

$$\rho = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n^3 - n}$$

With n being the individuals, and d as the difference between the two variables (Everitt B.S. 2002). The result of this test was -.238 showing a weak relationship between the two groups with a negative relationship as EI increases, the Subcontractor *PPC* decreases.

SECTION 4.4 THE CALCULATION OF DIFFERENCES IN SURVEY RESPONSES

Lastly the survey question responses of the concrete, wood framing, plumbing and electrical subcontractors were analyzed. First the median survey score per question of the plumbing subcontractor was compared to the concrete subcontractor's responses. The difference was recorded based on the plumbing subcontractor's response value minus the concrete subcontractor's response. The same calculation then was applied to the wood framing and electrical subcontractors. DM is the difference of the medians of each question and X is the other subcontractor's median survey question responses as shown below:

$$DM = Median\ of\ Survey\ Question\ Response\ by\ Plumbing\ Subcontractor - X$$

The results are shown in Table 11. Questions 5, 28 and 33 were omitted as they were reversed scored based on the *SSEIT* standard template (Schutte et al. 1998).

Table 11: The Median Differences of Survey Responses Per Groups

Question	Median Difference Between Plumbing & Concrete	Median Difference Between Plumbing & Wood Framing	Median Difference Between Electrical & Plumbing
1	0.9	0.8	0.6
2	1.1	0.6	0.3
3	0.4	0.4	0.3
4	0.5	0.4	1.1
6	1.3	1.1	0.5
7	1.5	1.0	1.8
8	0.3	0.5	0.4
9	0.9	0.9	0.4
10	0.8	0.4	0.6
11	-0.1	0.0	1.1
12	0.5	0.7	1.3
13	-0.1	-0.1	1.0
14	1.0	0.9	1.4
15	0.6	0.6	0.4
16	0.3	0.1	-0.5
17	1.2	1.1	1.7
18	0.5	0.7	0.3
19	0.1	-0.1	-0.3
20	1.2	1.0	1.8
21	0.7	0.4	0.1
22	1.0	1.0	0.6
23	0.8	0.7	1.1
24	0.4	0.7	0.2
25	1.0	1.1	0.5
26	0.8	0.9	1.8
27	0.8	1.3	1.7
29	0.4	0.6	1.4
30	1.3	1.2	2.1
31	1.2	0.8	1.8
32	0.8	1.1	1.0

CHAPTER V

DISCUSSION

Construction project managers are important to construction teams, but do not perform the physical labor of building projects. Many management positions office off of the construction jobsite thus creating a latency in the impact on construction costs and schedules. Construction managers do impact contracts, hire certain companies as well as build schedules, but the physical labor of building a project usually occurs on the construction jobsite distanced from the project manager's office. Using the *LPS* and *SSEIT* survey, this research focused on construction laborers' EI and the relationship of EI to their productivity on a construction jobsite.

The *SSEIT* survey asked questions inquiring of the participants emotions as a way to score how the construction workers respond to their own emotions as well as other's emotions. Using four categories the emotional intelligence of a participant can be quantified with this survey. Many of the participants joked or gave surprising reactions when they read the questions as they felt "weird" answering the questions. Many of the participants expressed confusing looks when they filled out the survey. When the survey was offered, audible groans or complaints about the survey were heard by the author.

The plumbing subcontractor had a different response than the other three subcontractors. The participants with the plumbing subcontractor celebrated involvement in the survey and even stated "we love this type of stuff". While taking the survey all participants from the plumbing subcontractor seemed more contemplative than the other subcontractors, slowly answering the questions. Many of the questions from the survey dealt with positive thinking of current situations as well as the survey participants' behavior. The survey also used the word "emotion", as several of the participants asked for clarification on this word. As stated previously the plumbing subcontractor had the highest median EI score, but the second lowest median *PPC*. The electrical subcontractor had the highest median *PPC,* but the lowest median EI score.

When the three groups were compared to the plumbing subcontractor based on the median survey score of each question, several observations of the data were made. The two groups with the highest differing scores per questions were the plumbing and electrical subcontractors. The ten questions with the highest difference between the plumbing and electrical subcontractors are show in Table 12.

Table 12: Survey Question Responses Differences in Plumbing vs. Electrical

Question Number	Question	Median Response Difference Between Plumbing and Electrical
30	I help other people feel better when they are down	2.1
7	When my mood changes, I see new possibilities	1.8
20	When I am in a positive mood, I am able to come up with new ideas	1.8
26	When another person tells me about an important event in his or her life, I almost feel as though I have experienced this event myself	1.8
31	I use good moods to help myself keep trying in the face of obstacles	1.8
17	When I am in a positive mood, solving problems is easy for me	1.7
27	When I feel a change in emotions, I tend to come up with new ideas	1.7
14	I seek out activities that make me happy	1.4
29	I know what other people are feeling just by looking at them	1.4

12	When I experience a positive emotion, I know how to make it last	1.3

Question 29 pertained to perception of emotion in the EI model used (Schutte et al. 1998). Questions 12, 14 and 31 pertained to managing own emotions; questions 26 and 30 pertained to managing others' emotions and finally questions 7, 17, 20 and 27 pertained to the utilization of emotions category in the EI model. In four of the six questions pertaining to utilization of emotion, the plumbing subcontractor scored much higher than then electrical subcontractor.

In the *PPC* scores the concrete and plumbing subcontractors were closest in similarity, but all subcontractor's median *PPC* differed from each other significantly. This can be represented by experience in the weekly planning meetings held at the construction jobsite. The author was the estimator, project manager and superintendent for the duration of the construction project in Stillwater, OK. The plumbing subcontractor was least cooperative. They struggled to coordinate work, come to meetings and follow through with commitments. Confrontation occurred about their struggles in which they did not seem aware of other's frustrations. All employees of the plumbing subcontractor including ownership were nice, cordial people, but could not establish a predictable work flow. This can be shown in Table 13 as all variances impacting the project were recorded. Variances 7 (Poor planning of labor) and 8 (Poor planning of material) are controlled by the subcontractor while the remaining variances are outside the control of a subcontractor. Variance 7 instances occurred when work was incomplete due to the planning subcontractor's lack of providing ample man-power to complete the task. This received a mark of "7". The plumbing subcontractor had the most recorded variances under "Variance 7", thus confirming their difficulty with maintaining a consistent work flow (see Table 13).

Table 13: Recorded Variances of Concrete, Wood Framing, Electrical and Plumbing Subcontractors

Variances		Concrete	Wood Framing	Plumbing	Electrical
1	Weather		2	6	2
2	General Contractor				
3	Architect				
4	Engineer			2	
5	Owner				
6	Other subcontractor		1		
7	Poor planning of labor	4	4	20	
8	Poor planning of material		1		
9	City/Inspectors		3	6	
10	Other			2	

The electrical and plumbing subcontractors differed the most in overall EI median scores and more specifically pertaining to questions from the category: utilization of emotion. Lastly the Spearman Rho correlation between EI scores and *PPC* showed a negative relationship as EI increased, *PPC* decreased. Therefore, subcontractor laborers with higher EI scores could be less productive on construction jobsites. While past research showed EI can have a positive affect on construction productivity at a management level, the effect of EI on construction productivity could differ at a laborer level. Furthermore, subcontractor laborers having higher utilization of emotion scores could be less effective in their planning, with a reduced median *PPC* and incur more self-controlled variances impacting their workflow.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This research studied the relationship between productivity and the Emotional Intelligence of a construction employee on a commercial construction jobsite. It showed the importance of understanding productivity of construction laborers and does not focus on managers. Past research focused on the project management or supply chain of construction projects, but this research focused on the exact place where projects are physically built. The results help managers and decision makers to rethink how construction laborers should be treated and evaluated on a construction jobsite. Further research should be accomplished to gain clarity on the EI of a subcontractor laborer, but this research showed the possibility of a new way to develop construction laborers in other intelligences. Past research showed EI is important at a management level but did not study construction laborers.

This research reveals three points about the data. First the plumbing subcontractor was unique from the other three groups. The plumbing subcontractor had the second lowest PPC of the groups, the lowest PPC of the groups with over two hundred data points and the greatest difference between the subcontractor with the highest *PPC*. Second the electrical subcontractor had the lowest EI median and the highest *PPC* median. Lastly a negative correlation between EI and *PPC* existed showing as EI increased, *PPC* decreased. Based on the research the following recommendations can be made.

An increased sample population will determine further conclusions. Expanding the data past one project will also increase the validity of the data to ensure proper analysis. Data collected from an entire calendar year will contain multiple weather seasons and holidays impacting construction work. Also studying 300 laborers increases the data points available for analysis. Lastly studying a minimum of 30 projects with all being in the same area of a country and same genre of construction (i.e. wood structure, multi-family housing) with different project teams and subcontractors will increase the data pool.

Previous research showed the limitation of self-reporting surveys in measuring EI (Edwards et al. 2011) (Caruso et al. 2016). Therefore, a future experiment using EI score based on an interview format as well as periodic testing through the duration of the project at differing days and times will ensure greater amounts of data on the EI score. Lastly other intelligences can be studied to determine the relationship with construction laborer productivity. EI is included in the broad intelligences, but so is tactile processing (tactile intelligence). Tactile reasoning could have a greater positive influence on productivity of a construction laborer than EI.

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APPENDICES

APPENDIX 1: THE EMOTIONAL INTELLIGENCE (EI) SURVEY

Emotional Intelligence Survey

QUESTION:	**ANSWERS**				
What age range do you fall in?	< 20	21-30	31-40	41-50	50 >
How many years of experience do you have in construction?					
What specialty work do you perform (example: plumber, electrician, painter, etc.)					

	SCALE				
QUESTION	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I know when to speak about my personal problems to others	1	2	3	4	5
When I am faced with obstacles, I remember times I faced similar obstacles and overcame them	1	2	3	4	5
I expect that I will do well on most things I try	1	2	3	4	5
Other people find it easy to confide in me	1	2	3	4	5
I find it hard to understand the non-verbal messages of other people	1	2	3	4	5

Some of the major events of my life have led me to re-evaluate what is important and not important	1	2	3	4	5
When my mood changes, I see new possibilities	1	2	3	4	5
Emotions are one of the things that make my life worth living	1	2	3	4	5
I am aware of my emotions as I experience them	1	2	3	4	5
I expect good things to happen	1	2	3	4	5
I like to share my emotions with others	1	2	3	4	5
When I experience a positive emotion, I know how to make it last	1	2	3	4	5
I arrange events others enjoy	1	2	3	4	5
I seek out activities that make me happy	1	2	3	4	5
I am aware of the non-verbal messages I send to others	1	2	3	4	5
I present myself in a way that makes a good impression on others	1	2	3	4	5
When I am in a positive mood, solving problems is easy for me	1	2	3	4	5
By looking at their facial expressions, I recognize the emotions people are experiencing	1	2	3	4	5
I know why my emotions change	1	2	3	4	5
When I am in a positive mood, I am able to come up with new ideas	1	2	3	4	5

I have control over my emotions	1	2	3	4	5
I easily recognize my emotions as I experience them	1	2	3	4	5
I motivate myself by imagining a good outcome to tasks I take on	1	2	3	4	5
I compliment others when they have done something well	1	2	3	4	5
I am aware of the non-verbal messages others people send	1	2	3	4	5
When another person tells me about an important event in his or her life, I almost feel as though I have experienced this event myself	1	2	3	4	5
When I feel a change in emotions, I tend to come up with new ideas	1	2	3	4	5
When I am faced with a challenge, I give up because I believe I will fail	1	2	3	4	5
I know what other people are feeling just by looking at them	1	2	3	4	5
I help other people feel better when they are down	1	2	3	4	5
I use good moods to help myself keep trying in the face of obstacles	1	2	3	4	5
I can tell how people are feeling by listening to the tone of their voice	1	2	3	4	5
It is difficult for me to understand why people feel the way they do	1	2	3	4	5

APPENDIX 2: THE ADULT CONSENT FORM

ADULT CONSENT FORM

OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: Emotional Intelligence's Relationship with Productivity on a Construction Jobsite

INVESTIGATORS:

Jason Mayes M.S.

Department of Civil Engineering

Jason.mayes@okstate.edu

C: 214-549-9182

PURPOSE:

This study will examine the relationship between Emotional Intelligence (EI) and productivity on a construction jobsite.

PROCEDURES

You will complete a 33 question questionnaire based on the Likert Scale (a scale of 1 to 5). Please answer truthfully as it will be performed anonymously. The results of the questionnaire will be compared with productivity on the jobsite.

RISKS OF PARTICIPATION:

There are no known risks associated with this project which are greater than those ordinarily encountered in daily life. Each participant will take an anonymous questionnaire. These questionnaires will be compared with productivity on the construction site.

BENEFITS OF PARTICIPATION:

If you are interested, we will send you a copy of the results of the study when it is finished.

CONFIDENTIALITY:

Your involvement if agreed requires you to take an anonymous survey. Your name will not be associated with your survey or recorded in any way. The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored on a password protected computer in a locked office and only researchers and individuals responsible for research oversight will have access to the records. Data will be destroyed three years after the study has been completed. You will not be identified individually as we will be looking at the group as a whole.

CONTACTS :

Dr. Phil Lewis PhD.

Civil Engineering

Oklahoma State University

207 Engineering South

Stillwater, OK 74078

Phil.lewis@okstate.edu

P:405-744-7207

PARTICIPANT RIGHTS:

I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION:

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older.

Preface the signature lines with the following statement (expand if appropriate):

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

APPENDIX 3: OKLAHOMA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

Oklahoma State University Institutional Review Board

Date:	Monday, March 07, 2016
IRB Application No	GC162
Proposal Title:	Emotional self-awareness questionnaire on a construction project
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 3/6/2019

Principal Investigator(s):

Jason Mayes	Phil Lewis
	207 EN
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

ADULT CONSENT FORM

OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: Emotional Intelligence's Relationship with Productivity on a Construction Jobsite

INVESTIGATORS:

Jason Mayes M.S.
Department of Civil Engineering
Jason.mayes@okstate.edu
C: 214-549-9182

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If you are interested, we will send you a copy of the results of the study when it is finished.

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I affirm that I am 18 years of age or older.
Preface the signature lines with the following statement (expand if appropriate):
I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

Okla. State Univ.
IRB
Approved 3-7-16
Expires 3-6-19
IRB # GC-16-2

SCRIPT FOR THE EMOTIONAL INTELLIGENCE RELATIONSHIP WITH PRODUCTIVITY SURVEY

"Hello my name is Jason Mayes and I am currently working on my thesis at Oklahoma State University. I would like to present an opportunity for you to be involved in some research! I have a quick, 36 question survey and I would be grateful if you could complete one. This survey is anonymous and does not require any name, address or other personal information. It is a survey to see how you handle emotions. I will leave blank copies here on the table. If you would like to participate, please fill out the survey and place in the envelope here. Whether you participate or not does not impact your job security! Thank you for your help!"

VITA

Jason Donald Mayes

Civil Engineering

Master of Science

Thesis: A CASE STUDY INVESTIGATING THE RELATIONSHIP BETWEEN CONSTRUCTION CRAFT WORKERS'EMOTIONAL INTELLIGENCE AND PRODUCTIVITY ON JOBSITES

Major Field: Civil Engineering

Biographical:

Education:
Completed the requirements for the Bachelor of Science in Landscape Horticulture and Design at Purdue University, West Lafayette, IN/U.S.A., in May, 2003.

Completed the requirements for the Master of Arts in Biblical Studies at Dallas Theological Seminary, Dallas, TX/U.S.A., in 2006.

Completed the requirements for the Master of Science in Civil Engineering at Oklahoma State University, Stillwater, OK/U.S.A., in 2018.

Experience:
Lightbearers Ministries Apartments (2014-present)
The Beck Group (2010-2014)
Austin Commercial (2006-2010)
ValleyCrest Companies (2003-2006)

Professional Memberships:

Lean Construction Institute Community of Practice-Oklahoma (Present)
Lean Construction Champion-Annual Congress (2013)
The Beck Group Lean Committee Chairman (2013-2014)
Lean Construction Institute Community of Practice-Dallas, TX-Core Team (2012-2014)
LEED Accredited Professional