VITA
Richard D. Bruce

EDUCATION

2002-2008 Indiana State University, Terre Haute, IN
Ph.D. Technology Management, Concentration in Construction Management.

2000-2001 University of Central Missouri, Warrensburg, MO
M.S. Industrial Technology, Concentration in Construction Management.

1992-1995 The University of Kansas, Lawrence, KS
B.A. Architectural Studies

EXPERIENCE

August 2007-Present, CM Program Coordinator, University of Central Missouri
August 2002-Present, Assistant Professor, University of Central Missouri
January 2002-May 2002, Instructor, University of Central Missouri
August 2000-December 2001, Teaching Assistant, University of Central Missouri
August 1999-August 2000, General Contractor, Bruce Contracting, Paramount, CA
January 1999-August 1999, Purchasing Manager, Paragon Homes, Santa Monica, CA
June 1998-January 1999, Assistant Purchasing Manager, Shea Homes, Walnut, CA
June 1997-June 1998, Assistant Field Superintendent, Shea Homes, Walnut, CA
May 1996-June 1997, Assistant Field Superintendent, Sumitomo Realty, Irvine, CA

SAMPLES OF SCHOLARLY PERFORMANCE

Bruce, R. & Berryman C. (2007). "Incorporating the Use of Jobcams in a Construction Planning and Scheduling Course." Article peer reviewed and published in the Associated Schools of Construction *International Proceedings of the 43rd Annual Conference.* Authors presented the paper at Northern Arizona University, Flagstaff, AZ, April 2007.

Bruce, R. & Sauer, A. (2007). "Comparing the Perceived Value of Constructor Certification Among Construction Industry Stakeholders." Presented research findings of $2500 grant to the American Institute of Constructors (AIC) board of governors, Baltimore, MD, October 2007.

Sutton, J. & Bruce, R. (2005). "Closing the Assessment Loop: A Case Study of Central Missouri State University's Construction Management Program." Abstract published in *Conference Proceedings of the Best Assessment Processes VII Symposium* and presented at Rose-Hulman Institute, Terre Haute, IN, April 2005.

A STUDY OF CRAFT WORKER LENGTH OF EMPLOYMENT AT SELECT MISSOURI CONSTRUCTION COMPANIES

A Dissertation

Presented to

The Dissertation Committee

College of Technology

Indiana State University

Terre Haute, Indiana

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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by

Richard D. Bruce

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CERTIFICATE OF APPROVAL

DOCTORAL DISSERTATION

This is to certify that the Doctoral Dissertation of

Richard D. Bruce

entitled

A Study of Craft Worker Length of Employment at Select Missouri Construction Companies

has been approved by the Examining Committee for the dissertation requirement for the

Doctor of Philosophy degree

in Technology Management (Construction Management)

May 2008

David Batie, Ph.D. Date
Member
East Carolina University

Lee Ellingson, Ph.D. Date
Member
Indiana State University

Lyman Hannah, Ed.D. Date
Member
University of Central Missouri

Musibau Shofoluwe, Ph.D. Date
Member
North Carolina A&T State University

Ronald Woolsey, Ph.D. Date
Chair
University of Central Missouri

Jolynn Kuhlman, Ph.D. Date
Interim Dean, School of Graduate Studies
Indiana State University

ABSTRACT

Craft worker retention is a constant concern of construction firms who self-perform portions of projects. These companies must maintain an understanding of their work force. A methodology is presented in this study for studying information in readily available employee databases to gain such an understanding. Using a sample of 10 of Missouri's 17 largest contractors, that employ 5,277 craft workers; this study examined the employee databases to identify differences in mean length of employment based on hire age, craft, union affiliation, and company size. The analysis of variance statistical technique was utilized to test four null hypotheses. Based on the test results, the researcher was unable to reject the null hypothesis that there were no statistically significant differences between the mean length of employment for craft workers based on five hire age categories (16-24, 25-34, 35-44, 45-54, and 55 & up) or union affiliation (union versus non union). However, results indicated that operators had a statistically significant (.05 alpha) longer length of employment than carpenters, laborers, and iron workers. Also, results indicated that craft workers at medium-sized companies had a statistically significant longer length of employment than craft workers at small and large construction companies. The researcher recommended future studies to address why craft workers at medium-sized construction firms and operators in general would have a greater mean length of employment.

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INTRODUCTION

Examination of population trends and the construction industry's craft worker demographics points to an imbalance of age distribution that will affect construction activity for the next ten years (CLRC, 2005). According to the Construction Labor Research Council's Craft Labor Supply Outlook 2005-2015 that examined the population trends and construction worker demographics from the Bureau of Labor Statistics and the Bureau of the Census, the industry needs an influx of 185,000 new craft workers to offset growth and replacement needs (2005).

As older craft workers retire, construction companies must focus on attracting new talent and retaining their current workers. In a recent study by construction management consulting firm FMI, *competition for talent* was ranked first of ten top concerns for U.S. construction companies for the period 2006-2016 (Jackson, 2006). In order to maintain a competitive advantage, companies were advised to focus on retention and make faster employment decisions. This requires that companies maintain an understanding of their workforce and take proactive measures based on the data.

Need for the Study

Given the national construction craft worker demographic information and population trends, construction companies wonder if they will be able to sustain their

current business models. In the summer of 2005, a $50 million Missouri construction company hired the researcher as an intern to determine whether the company would be able to sustain their self-perform business model over the next ten years. Like many companies that offer general contracting services, this company self-performs work involving concrete and steel and subcontracts the remaining work. The company feels that if they cannot self-perform the noted areas of work, they will not have a competitive edge. Since there are no license requirements for general contractors in the state of Missouri, the company must compete against any entity wishing to submit a bid on a given project. The winner of the contract is the organization able to get the right combination of bids from subcontractors totaling the lowest bid. Thus, control over one or more areas of work gives the general contractor an advantage. As mentioned above, in order to control an area, the contractor must self-perform the work.

In order to maintain the self-perform business model, the contractor must maintain an understanding of its craft work force. If construction companies were able to identify a difference in the mean length of employment of craft workers based on their hire age group, craft category, and union or non-union affiliation, the company may be able to make quicker hiring decisions or change working conditions to retain these at-risk craft workers. They may even be able to maintain their self-perform business model. While many companies collect such information upon hiring a craft worker and store it in a database, no studies were found in the literature that address analyzing and putting this readily available information to use.

Significance of the Study

While this study addresses a gap in the literature it is significant to the construction industry because it provides actual construction craft worker length of employment information to three sets of industry stakeholders. The three sets of stakeholders that will benefit most are 1) the individual companies that provide the information, 2) all American construction companies, and 3) union and non-union organizations.

The first group of stakeholders, the 10 individual Missouri construction companies that were able to contribute data on craft workers that were hired and left the company during the chosen period, will benefit in two ways. First, each participating company will receive their own report showing just their results. If their data shows that the average length of employment of craft workers hired between the ages of 16-24 is significantly less than those hired between the ages of 25-34, the company could change their hiring strategies to focus on the latter group. The company could also target the employees hired in the age category with the lowest length of employment, identify the problem they are facing, change the condition, and ultimately retain these at-risk craft workers. Second, the company will see how their company compared to the other companies that provided information for the study. While the data will be organized by category rather than company name, the information could be used as benchmark data to improve their human resource performance relative to the other Missouri companies. Given these types of proactive retention strategies, collecting and analyzing company performance as well as benchmarking against competitors, the company may be able to sustain their self-perform business model and not lose their competitive advantage.

The second group of stakeholders includes all American construction companies. If this study finds a statistically significant difference between the categories of craft workers, another Missouri company or a company from another state may decide to examine its own employee database in the same manner. Companies may realize that they need to collect additional information as a part of their standard operating procedure so they may more adequately analyze craft worker data and improve retention.

The third group of stakeholders is union and non-union organizations. If the research finds that union craft workers have a statistically significant longer length of employment than non-union craft workers, then union organizations, such as the individual craft unions may use the information in their promotional campaigns. If there is not a statistically significant difference, or if non-union craft workers have a significantly longer length of employment than union craft workers, then the non-union organizations may use the information in their promotions. Regardless of the findings, one of these two organizations may decide to study their practices and procedures in order to improve their craft worker length of employment relative to the other organization.

Statement of the Problem

There is a gap in the knowledge base as reflected in the literature between what is known and what is unknown relative to craft worker employment length. A review of the literature yielded several turnover studies in many varied disciplines including medicine, correctional services, and even construction. These studies incorporated the use of time-intensive job satisfaction surveys to discover the relationship between demographic

information (independent variables) and turnover (dependent variable). No studies focused on examining craft worker data found in readily available employee databases.

The literature did yield studies focusing on the turnover of construction workers, but focused on the site manager (Styhre & Josephson, 2006) and construction engineer (Ruthankoon & Ogunlana, 2003) rather than the craft worker. While these types of construction employees are important, they are not as crucial to the self-perform business model as the lower level craft worker. Only one study (Shofoluwe, 1992) was found that focused on craft workers, but like the other studies, utilized a survey rather than an analysis of existing information readily available in an employee database.

If the amount of literature available can be used as an indicator of the amount of research companies have completed, the lack of such literature in this industry indicates that construction companies are not spending the time and money to understand their craft workers. If these organizations could see that their existing databases contain enough information to direct change, they may be able to use this information to retain existing craft workers and ultimately maintain their self-perform business model.

This study provides literature on the topic of craft worker length of employment as well as how it varies in relation to hire age category, craft category, union versus non-union craft workers, and company size. It also may be used as a model for all construction companies to follow in examining their own databases.

Purpose of the Study

This study addressed the lack of research concerning craft worker length of employment found in readily available employee databases. It examined the employee databases of select Missouri construction companies in order to find out if there was a

statistically significant difference in actual length of employment between 1) hire age groups of craft workers, 2) craft categories, 3) union versus non-union craft workers, and 4) small, medium, and large companies.

Research Questions

This study attempted to answer the following research questions:

1. Is there a statistically significant difference in the mean length of employment for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms?
2. Is there a statistically significant difference in the mean length of employment for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms?
3. Is there a statistically significant difference in the mean length of employment of union craft workers versus non-union craft workers at the selected Missouri construction firms?
4. Is there a statistically significant difference in the mean length of employment of craft workers at small, medium, and large Missouri construction companies?

Hypotheses

1. The null hypothesis (HO_1) is that there will be no statistically significant difference in the mean length of employment (LOE) for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms.

   HO_1: $\mu_{LOE16\text{-}24} = \mu_{LOE25\text{-}34} = \mu_{LOE35\text{-}44} = \mu_{LOE45\text{-}54} = \mu_{LOE55up}$

2. The null hypothesis (HO_2) is that there will be no statistically significant difference in the mean length of employment (LOE) for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms.

   HO_2: $\mu_{LOECAR} = \mu_{LOELAB} = \mu_{LOEOPE} = \mu_{LOEIRW}$

3. The null hypothesis (HO_3) is that there will be no statistically significant difference in the mean length of employment (LOE) of union craft workers (UCW) versus non-union craft workers (NUCW).

   HO_3: $\mu_{LOEUCW} = \mu_{LOENUCW}$

4. The null hypothesis (HO_4) is that there will be no statistically significant difference in the mean length of employment (LOE) of craft workers at small (SCC), medium (MCC), and large Missouri construction companies (LCC).

   HO_4: $\mu_{LOESCC} = \mu_{LOEMCC} = \mu_{LOELCC}$

Definition of Terms

The following words are used throughout this study and are to be interpreted using the following definitions:

At-Risk Craft Worker is a category of worker identified in this study to have a statistically significant lower mean length of employment.

Construction Industry includes the construction of buildings, heavy and civil engineering construction, and specialty trade contractors (BLS, 2007). According to the Department of Labor's (DOL) Bureau of Labor Statistics (BLS), this industry employs 6,964,000 wage and salary earners in the United States. The DOL classifies these employees across the following major occupation classifications: 1) management, 2)

professional, 3) sales, 4) office support, 5) construction and extraction, 6) installation, maintenance, and repair, and 7) transportation and material moving occupations.

Craft Worker is often used in the literature interchangeably with trade worker. However, by comparing the Department of Labor's (DOL) twenty-seven construction and extraction trade occupations to the Associated General Contractors' 15 Craft Worker classifications, one is able to see that a craft worker is not the same as a trade worker. Table 1 shows the list of DOL trade classifications and how they compare to the AGC craft categories. The major differences between the two lists are 1) the Associated General Contractors do not recognize managers, insulation workers, pipe layers, helpers, elevator operators, heating, air conditioning, and refrigeration mechanics, and line installers as craft workers and 2) the Department of Labor does not consider surveyors and field engineers as trade workers. This study used the 15 AGC craft worker classifications rather than the DOL trade classifications.

Table 1

DOL Trade Categories Versus AGC Craft Classifications

DOL Construction Occupations (2007)	AGC Craft Worker Classifications (2007)
1. First-line supervisors	Not included in the AGC list
2. Brickmasons and blockmasons	1. Bricklayer
3. Carpenters	2. Carpenter
4. Carpet installers	2. Carpenter
5. Tile and marble setters	2. Carpenter
6. Cement masons and finishers	3. Cement Mason
7. Construction laborers	4. Laborer
8. Paving equipment operators	5. Operator
9. Operators	5. Operator
10. Drywall and ceiling tile installers	2. Carpenter
11. Electricians	6. Electrician
12. Glaziers	7. Glazier
13. Insulation workers	Not included in AGC list.
14. Painters	8. Painter and Paperhanger
Not included in DOL list.	9. Surveyor/Field Engineer
15. Pipelayers	Not included in AGC list
16. Plumbers/pipefitters/steamfitters	10. Plumber
Not included in DOL list.	11. Pipefitter/Steamfitter
17. Plasterers and stucco masons	12. Plasterer
18. Roofers	13. Roofer
19. Sheet metal workers	14. Sheet Metal Worker
20. Structural iron and steel workers	15. Iron Worker
21. Helpers, construction trades	Not included in AGC list.
22. Elevator installers and repairers	Not included in AGC list.
23. Heating, air conditioning, and refrigeration mechanics and installers	Not included in AGC list. Not included in AGC list.
24. Line installers and repairers	Not included in AGC list.
25. Truck drivers	Not included in AGC list.
26. Crane and tower operators	5. Operator
27. Excavating/dragline operators	5. Operator

Craft worker category in this study denotes the four most common AGC craft categories found in the sample databases: carpenter, laborer, operator, and iron worker. AGC (2007) provides the following job descriptions for these four craft categories on their website:

> "Carpenters erect wood framework in buildings; build forms for concrete; and erect partitions, studs, joints, drywall, and rafters. Many carpenters work indoors to install all types of floor coverings, ceilings, paneling, trim, and interior systems" (AGC, 2007).
>
> Laborers handle the materials of the various craft workers (AGC, 2007).
>
> Operators (Operating Engineers/Equipment Operators) operate and maintain many different pieces of machinery on a construction site including bulldozers, excavators, and cranes (AGC, 2007).
>
> Iron Workers erect the steel framework (structural iron workers), set steel reinforcing in concrete forms (rodmen), and assemble stair rails (decorative iron workers) (AGC, 2007).

Days Here is used in this study to represent the tenure a craft worker accomplishes with their employer. Thus it is the measurement scale for length of employment.

Exit Date is used in this study to represent the date the craft worker either voluntarily left the company or was involuntarily terminated.

Hire Date is used in this study to represent the date the craft worker was hired by their employer.

Hire Period is used in this study to define the lower and upper limits of the company databases in regard to when the company started recording their employees' hire date.

Human Resource Management is the planning and controlling of people in an organization.

Job Satisfaction is one's attitude toward their current work role (Vroom, 1964).

Length of employment is the same as the traditional use of the word retention which is the amount of time a worker is employed by their organization. The phrase length of employment is used in this study to separate it from the contemporary use of retention which refers to the rate of retention rather than the period of employment.

Motivation is stimulating the interest of someone to work (Vroom, 1964).

Rate of Retention is the number of people hired and still remaining in a given period divided by the number of people hired in the same period. This retention rate figure is expressed as a percent (Waldman & Sanjeev, 2004).

Turnover is movement from an organization (Price, 1977).

Turnover Period is used in this study to define the lower and upper limits of the company databases in regard to when the company started recording their employees' last date of employment.

Assumptions

The first assumption is that the construction companies' databases included all craft workers that were hired and left the companies in the chosen period 2002-2007. The second assumption is that the databases included only craft workers that worked on Missouri projects for the chosen period. The third assumption is that the company

databases were accurate. The fourth assumption is that employees hired in a particular craft remained in that craft for the full duration of their employment.

Limitations

This study has five limitations. First, it is limited to Missouri-based construction companies found on Engineering News Records' (ENR) 2006 list of America's Top 400 Construction Companies. Second, it is limited to craft workers employed in the state of Missouri. Third, because the range of these companies' 2006 revenues range from $130.8 million to $2.305 billion, this study is limited to Missouri construction companies with 2006 revenues greater than $130.8 million. Fourth, only craft workers, not construction managers or office staff, were included in the study. Fifth, this study only examined the craft workers that were hired during the period of 2002-2007.

Chapter 2

REVIEW OF LITERATURE

Turnover literature in the fields of construction management, occupational psychology, human resource management, and business management, can be organized into three main sections. The first section, underlying theories, presents the psychological frameworks associated with turnover. The second section, turnover and retention studies, reviews the current supply of available studies in other disciplines and in the construction industry. The third section, controlling turnover, illustrates how companies are using the information to make better hiring decisions and retain employees.

Underlying Theories

Concerning psychological underlying theories for understanding turnover, a review of the literature presents several directions including organizational behavior, organizational structure, motivation, and job satisfaction. The following paragraphs present previous literature on the subjects.

Organizational Behavior

March and Simon (1958) discuss organizational behavior as the impact organizations have on their employees' behavior (p. 2). This behavior not only includes the employee's day to day actions, but also their decisions to stay or leave the

organization. In their literature review, the authors discuss three models of defining the human role in an organization: employees as passive instruments, employees as individuals, and employees as decision makers.

March and Simon refer to the first model, employees as passive instruments, as Classical Organization Theory. In this situation, the management views employees as machines. Thus, if managers maintain the equipment, i.e. their employees, the organization's efficiency should increase. The second model focuses on bureaucracy, human relations, leadership, and supervision. In this model, employees are valued as individuals rather than machines. In the third model, employees are valued as decision-makers and problem solvers.

Organizational Structure

Like organizational behavior, organizational structure includes several available formats. Because the organization impacts the employee, including their motivation, a review of the different organizational structures is necessary.

Management author Andrew J. DuBrin (2000) defines the concept of organizational structure as, "the arrangement of people and tasks to accomplish organizational goals" (p. 208). The main purpose of such an arrangement is to specify the hierarchy of authority and the formal communication system. In the above text, the author states that there are two basic structures: the bureaucratic organization and the modified bureaucratic organization. Douglas Benton (1998) makes the same observation.

In the bureaucratic organization, executives reside at the top of the multi-level organization with middle managers controlling one or several intermediate levels. Below the middle managers are first level managers who manage the front line operatives. The

organization is bureaucratic because it depicts the traditional business model in which there is a strict chain of command- both in authority and in communication.

In the second type of organizational structure, the modified bureaucratic/project management organization, the rigid chain of command is broken. Since projects are short-term operations that make use of project specific teams, composed of employees from different departments, the normal chain of command may be broken. That is, a lower level employee may have a middle manager report to him or her for the duration of the project. Although the modified bureaucratic organizational models are ideal for short-term construction projects, the primary business model in the industry is the bureaucratic organization.

The management principles most visible in a company's organizational model are communication and opportunity for advancement. Both models from above, the bureaucratic and the modified bureaucratic/project management models have vertical lines of communication connecting the various employees. Thus, if an operative were to make a suggestion to upper management, he or she would need to follow the protocol by first discussing it with their immediate supervisor.

An employee not only sees the chain of command in regard to communication in an organizational chart, but also the amount of opportunity for advancement. This opportunity, or lack thereof, may have an effect on their motivation and ultimate decision to stay with or leave a company.

Very few studies were found examining the motivation of employees compared to their organization's structure or size in the construction industry. However, Styhre and Josephson (2006) provided one such study focusing on the middle manager. The

researchers interviewed 13 site managers on 13 different construction projects and found that while the managers were content with their work situations, they were critical of their supervisor's demands on them as middle managers to overcome a "variety of heterogeneous activities" (521). Had the organizational structure been taller with a level above the site manager, this manager could have handled these activities.

Motivation

Two authors that appear most frequently in the literature discussing motivation are Maslow and Herzberg. According to Maslow (1943), the desire to self-actualize one's true potential explains much of their motivation to work. A carpenter might aspire to be a master carpenter or a construction manager. This desire might lead him or her to take several different jobs in hopes of fulfilling that desire. Herzberg (1966) presented two motives for work including a need to evade pain and a need to grow psychologically. In a previous study (Herzberg, Mausner, & Snyderman, 1959), the authors interviewed workers about a specific time they felt good about their jobs and a specific time they felt bad about their jobs. Through a series of probing follow-up questions, the authors were able to establish common satisfiers and dissatisfiers. The researchers renamed their positive satisfiers as motivators and their negative dissatisfiers as hygiene factors. The theory then became known as Herzberg's Motivation-Hygiene theory.

Since 1966 researchers have been testing Herzberg's theory by replicating his study in several different professions including doctors (Samad, 2006); nursing home administrators (Singh, 2000), and construction engineers and foremen (Rathankoon & Ogunlana, 2003). In the first two studies, the researchers used a variation of Herzberg's

questionnaire and then collected demographic data in order to predict relationships between satisfaction determinants, demographics, and length of stay.

Results are different for each study and group of profession. For instance, in *Predicting Turnover in Nursing Home Administrators* (2000), Singh found that past job-hopping was a significant predictor of tenure where as the other studies did not include it as a variable.

Thai civil engineering professors Rathavoot Ruthankoon and Stephen Ogunlana (2003) were the first to publish test results of Herzberg's theory in the construction industry. The authors asked 64 engineers and 61 foremen from 29 different construction sites to explain the circumstances of a situation that brought them great satisfaction in their job. This represented one critical event. The authors then asked respondents to explain circumstances of an unpleasant situation. This became the second critical event. Respondents then provided more critical events if they could think of any. The authors identified 345 critical events and 568 factors. They then translated their 568 factors into Herzberg's 14 categories, but had to create 4 new categories. Motivation factors included responsibility and possibility of advancement whereas hygiene factors included working conditions and site safety.

The researchers found that many factors led to both satisfaction and dissatisfaction, thus suggesting that Herzberg's theory was not applicable. While interpersonal relationships lead to both results, the authors suggested that project managers try to create strong relationships, assist others in talking through conflicts, and foster an environment of teamwork to help increase job satisfaction.

While the Herzberg model is a popular alternative to Maslow's, it is not the only other model. A second approach to studying motivation is called the existence, relatedness, and growth (ERG) model (Benton, 1998). This model is very similar in structure to the Maslow pyramid. Existence refers to the employee's physical needs, relatedness refers to the relationship needs the employee has with other people, and growth refers to the employee's need to grow in regards to creativity and change.

Another motivation model is Hackman and Oldham's job core characteristics model (1980). This model illustrates that when a knowledgeable and skilled worker is presented with a job that involves high levels of skill variety, task identity, and task significance, the consequence is high internal work motivation. Several researchers, McFillen and Maloney (1988) and Shofoluwe (1992), mentioned the Hackman and Oldham model.

Shofoluwe (1992) tested Hackman and Oldman's theoretical model in regard to the affective work outcomes of construction craftsmen. He administered a revised version of Hackman and Oldman's job diagnostic survey (JDS) to a sample of 650 union bricklayers, carpenters, and electricians. The 55 question survey asked the craftsmen to rate their job in terms of significance, variety, repetitiveness, satisfaction, and autonomy to name a few. From the ratings, the researcher was able to calculate the respondents motivating potential score (MPS) which indicated how enriching and motivating the workers felt their jobs were. The formula for MPS is provided below:

$$MPS = ((SV + TI + TS)/3) \times Autonomy \times Job\ Feedback$$

where:

MPS = motivating potential score

SV = skill variety

TI = task identity

TS= task significance

In this formula, skill variety, task identity, and task significance are weighted by having their sum divided by 3. This is different from the expectancy model discussed below which multiplies the three variables without dividing by 3.

In addition to MPS, the researcher measured the craft worker's general satisfaction and internal satisfaction of their jobs. In regard to internal satisfaction, workers rated their agreement to statements tying their personal feelings with job performance. In other words, did they feel bad when they knew that their performance was poor? General satisfaction and internal satisfaction made up the affective work outcomes.

Growth need strength (GNS) was also a measured variable. Workers were asked how much they would like each of the following to be a part of their job: stimulating work, opportunities to work independently, opportunities to learn new information, opportunities to be creative, opportunities for personal growth, and opportunities to feel accomplishment in their current job. These variables were used to answer the researcher's five questions. The questions, as well as the researcher's findings for each question, are presented in the following paragraph.

In his first research question, the researcher asked if there were relationships between job characteristics, psychological states, and work outcomes. Through a correlation analysis, the researcher found several positive correlations between the two types of satisfaction and skill variety, task identity, significance, and autonomy. In his second question, he asked what differences existed between the trade categories in regard to employee-perceived job characteristics. Through a one-way analysis of variance, the researcher showed that there were no significant differences between the craft categories in regard to their perception of task identity, significance, and autonomy. In his third research question, Shofoluwe (1992) asked what differences existed between the different trade categories in regard to growth need strength. After administering a one-way analysis of variance, the researcher discovered that only carpenters had significantly higher growth need strength when compared to electricians. In his fourth research question, he asked if there was a statistically significant difference between the craft categories in regard to motivating potential score. Results of the one-way analysis of variance indicated that there were no significant differences between the three craft worker categories. Finally, in his fifth research question, he asked if the groups differed in regard to affective work outcomes and the critical psychological states. No significant differences existed between the craft categories in regard to satisfaction. However, carpenters had higher internal work motivation than electricians.

McFillen and Maloney (1988) also surveyed unionized construction workers to address the motivational characteristics of their job. Instead of the Hackman and Oldman model, however, these researchers used the expectancy model. This model also looks at the factors involved with motivation through a formula. Instead of dividing the three

variables by 3, however, this formula relies on multiplication to factor in high levels of one variable with low levels of another. The expectancy formula can be seen below:

$$M = E \times I \times V$$

where:

M = motivation

E = expectancy

I = instrumentality

V= valence

Expectancy is based on the notion that if a worker improves their level of effort, they will improve their level of performance. As their level of performance improves, the rewards and satisfaction improve as well. Instrumentality refers to the assumption of the worker that good performance will be rewarded and bad performance punished. Thus, good performance is instrumental in obtaining rewards. The value that the worker places on the attainment of the reward is referred to as valence. Valence can be both positive, if the reward is positive such as increased pay or praise, or negative if there is punishment associated with the performance.

The researchers modified the Michigan Organization Assessment Package (1975) to suit the construction field and sent the questionnaire to over 2,800 union workers. The 32 page questionnaire included general satisfaction statements where the respondents were asked to rate their level of agreement using a one (strongly disagree) to seven (strongly agree) scale. In regard to expectancy, respondents rated their agreement to such statements as "working hard leads to high productivity" and "working hard leads to good job performance" (p. 42). In regard to instrumentality, respondents were asked if such

extrinsic rewards of high pay, promotions, and praise were results of good performance. In addition, intrinsic rewards of feeling better and opportunistic rewards of having more opportunities as a result were also rated. Valence was recorded by having the respondents indicate how important the extrinsic rewards of promotions, compensation, and fringe benefits were to them.

Unlike Shofoluwe (1992), McFillen and Maloney (1988) did not compare the groups of union workers. Instead, they focused on the relationships between expectancy, instrumentality, and valence. The researchers found that expectancy had a statistically significant relationship with effort and performance. In regard to instrumentality, the researchers did not find any statistically significant relationships between performance and rewards or punishment. They discussed in their findings that construction craft workers were not motivated by rewards or punishment because the workers did not see a tie between the two and performance. In fact, in their discussion of valence, the researchers noted that workers placed more value on their own performance levels than promotions and increased benefits.

Job Satisfaction

In *Job Attitudes: Review of Research and Opinion* (1957), authors Herzberg, Mausner, Peterson, and Capwell provide several commonly researched factors of dissatisfied workers including age, length of service, sex, education, personality, income, position, marital status, number of dependents, work history, and social class to name a few. As part of their literature review, the authors presented several studies that attempted to make connections between the variables in a variety of fields. Some of the

problems noted by the authors in comparing the various studies included varying questions and varying level of quality in research design.

Borcherding and Oglesby (1974) were able to identify several job satisfiers in the field of construction by asking foremen and superintendents open-ended questions. The challenge of their job, support from their superiors, and good crews were some of the satisfiers among the sample. The study found several factors but did not try to translate them to the established Herzberg model. Like the Styhre and Josephson (2006) research, this project addressed middle-managers versus craft workers.

Turnover and Retention

While turnover is often used interchangeably with retention, the two are not the same. Turnover is the movement from an organization (Vroom, 1964) whereas retention is staying with an organization (Waldman & Sanjeev, 2004). The calculations used to measure the two are quite different as well. In their study of major medical center workers, Waldman and Sanjeev (2004) presented the following two calculations for the terms. Average turnover was defined as the number of terminations per year divided by the average active employees in that same year. Average retention was defined as the number of specific people hired in a given year and still employed the following year divided by the people hired in the initial year.

Studies in Non-Construction Industries

Most of the turnover studies, like the Herzberg related studies, incorporate the use of a survey instrument to collect job satisfaction, interest, and biographical data. Other instruments elicit the respondents' intelligence, aptitude, and personality type (Abraham, 1976) in order to predict the likelihood of turnover. These studies required

further time and money in creating and administering a survey beyond just studying existing data.

Taplin and Winterton (2007) surveyed managers and production workers of the UK clothing industry to identify differences between companies with high turnover rates and those with low turnover rates. Variables included company size, product category, production method, payment systems, and region. After examining 1999 turnover data provided by a training organization, the researchers identified 85 high and low turnover companies. Upon contacting the firms, eight low turnover firms and six high turnover firms agreed to allow the researchers to visit with their workers. Researchers asked open-ended questions about the management style, why workers leave the organization, and why workers stay. Results showed that in low turnover firms, the workers were typically older with 30 or more years of service, had high pay levels, and an open relationship with their managers. In the high turnover firms, the researchers found it impossible to identify a typical worker. Those with five or more years of service were typically older than 40 and remained due to a lack of alternative employment.

Dollar and Broach (2006) relied on past survey data and historical employee records. In their turnover study, the researchers compared intent to leave results of past Federal Aviation Administration employee satisfaction surveys with actual turnover data in succeeding years. The researchers found that there was a significant difference between the estimated turnover (intent to leave) from the satisfaction surveys and the actual turnover ratio. Estimated turnover was measured with one of the survey questions asking if the employee intended to leave in the next year. The turnover ratio was calculated by dividing the actual number of employees that left in a given year by the

total number working that year. While intent to leave was not an accurate indicator, the authors stated that the federal sector still relies heavily on past loss records as indicators of future turnover.

Waldman and Sanjeev (2004) studied turnover and retention in a major health care facility by analyzing existing data. These researchers relied on actual turnover data to compare annual turnover and retention by job group. Thus, physician data could be compared to nurses, allied health, technical, support, and administration groups. Variables for each group consisted of the average annual turnover from 1997-2001 for all employees, the average annual turnover from 1997-2001 for just the new hires, average retention of 1995 new hires in year 1, average retention of 1995 new hires in year 2, etc. through year 5. The first variable, average annual turnover for all employees 1997-2001, was calculated as the number of terminations per year divided by the average active employees in the same year. This quantity was then multiplied by 100 to yield a percentage. The second variable, average annual turnover of new hires 1997-2001, was calculated as the number of terminations within the first year of hire divided by the number of new hires. This quantity was also multiplied by 100 to yield the percentage. The third variable, average retention of 1995 new hires in year one, was calculated as the number of people hired in 1995 still employed in 1996 divided by the number of people hired in 1995. The fourth variable, average retention of 1995 new hires in year two, was calculated as the number of people hired in 1995 still employed in 1997 divided by the number of people hired in 1995. The remaining three variables were calculated in the same manner as the first two of this series with only the still employed date being increased by one.

While the researchers did not use statistical analysis to compare the groups, this methodology enabled them to illustrate how each job group performed against all employees, against only new hires, and how they performed over time from year one through year five. It also enabled them to show how each job group compared to the other groups using the same variables.

Grubbs (1998) focused on readily available employee records, but instead of studying retention, used the data to predict the probability of turnover. In his dissertation titled *The prediction of voluntary employee turnover for a commercial bank* the author analyzed the employee database of one Mississippi bank to answer the research question of whether variables contained in regularly collected employee files could be used to predict turnover. The data included 467 employees in the period 1980-1985. Of the 467 employees, the researchers classified 213 as stayers because they remained with the company through 1985 and classified 254 as leavers because they left sometime during the period.

Whether the employee was a stayer or leaver was the dependent variable. The independent variables included age, sex, education level, race, rate of promotion, tenure, past employment, time with previous employer, number of promotions, pay increases, local level of unemployment, local level of retail sales activity, and ending pay. All of these variables were included in other studies found in the literature, however, local level of unemployment and local level of retail sales activities were new. Grubbs ultimately found that age, sex, tenure, past employment, ending pay, number of promotions, and local level of retail sales activity were significant (.05 alpha) predictor variables.

Studies in Construction

The researcher found one dissertation that addressed turnover in the field of construction. In *The Migration of Boom Town Construction Workers: Wanderlust or Adaptation* (1982) sociology major Virginia Fahys-Smith presented results of a 122 question survey she administered to 1,432 inhabitants of nine western Boom Towns. The purpose of her research was to test her hypothesis that work stability was a greater predictor of migration than wanderlust.

The researcher grouped her sixteen independent variables in three main categories: costs for remaining in a boomtown, individual characteristics, and variables testing transiency. In the first group, costs for remaining in a Boom Town, she included Boom Town conditions, dissatisfaction with facilities and services, lack of job security, status incongruence, family absent, commuting time, and lack of housing integration. In the second group, individual characteristics, she included occupation, age, education, income, marital status, family size, and upward mobility. Finally, in her third group, variables testing transiency, Fahys-Smith included wanderlust and past mobility.

Fahys-Smith utilized Pearson's product moment correlation to determine the strength of the relationship between the preceding sixteen independent variables and the dependent variable plans for migration. Because she used a survey rather than a database, the dependent variable was the respondents' plans for migration rather than their actual migration.

Unlike previous studies (ie Singh 2000), past tenure (mobility) was not a significant predictor of tenure at the current job. Another non-significant predictor was family absent. The researcher hypothesized that being away from one's family for long

periods would drive a worker to plan for an alternate job where they could be around their family. Finally, just as the author had hypothesized, wanderlust was not a significant predictor of transiency. Instead, the researcher found that work stability was a greater predictor of migration than wanderlust.

Because she used a survey rather than a database, the dependent variable was the respondents' plans for migration (intent to leave) rather than their actual migration. No study was found in the field of construction that addressed actual migration through an examination of employee databases.

Controlling Turnover

All of the dissertations and journal articles presented above provided rationales and needs for their studies often quoting the cost of turnover and the benefits of retention. Few, however, provided practical methods for solving the problem with high turnover once the company identified the significant independent variables. The following are a few methods companies and researchers have proposed for controlling turnover.

Strategic Human Resource Management (SHRM)

Following their findings that project priorities are still taking precedence over personnel needs, Raiden, Dainty, and Neale (2006) suggest that construction companies need to follow the lead of many other public and private sector organizations by employing Strategic Human Resource Management (SHRM) principles. Dubrin (2000) defines this concept as "the process of anticipating and providing for the movement of people into, within, and out of an organization to support the firm's business strategy" (p. 239). One of the guiding principles of SHRM is to align company policies in regard

to recruitment, selection, training, communications, team work, appraisal processes, job challenges, and work-life balances with the organization's business strategies (Raiden *et al.*).

Monitor and Document Retention Rates

In order to benchmark their future retention performance, construction companies must start collecting and tracking their employee data. This includes diving into their employee records to identify relationships. Clarke (2006) provides a methodology for construction companies to follow in order to track their rate of retention (RoR). The five key steps are 1) calculate the rate of retention, 2) document reasons why craft workers quit or are terminated, 3) identify patterns as to why craft workers quit, 4) take necessary corrective action, and 5) monitor the results of the corrective action. Project and company-wide rate of retention is calculated using the following formula:

$$RoR=((Tc-Ttg)/Tc) \times 100\%$$

where:

RoR = the Rate of Retention in percent

T_c = the total number of craft workers employed on the project or in the company.

T_{tg} = the total number of craft workers terminated for cause and who quit voluntarily.

While it is no different than the formula presented by FAA researchers Dollar and Broach (2006), it is an indicator of a company's retention success. Clarke believes this figure is going to be required of companies in the bidding stages of a project to show

project stakeholders that the company is a solid organization capable of delivering their services despite market or other extraneous conditions.

Waldman and Sanjeev (2004) suggest that both retention rate and turnover can be used together to provide a better picture of movement. However, these authors advocate that companies should not focus on what they do not want (turnover), rather what they do want (retention). In order to do this, company researchers need to examine how long people stay, why they left, and how much knowledge they took with them. According to the authors, retention rate enables researchers to track retention in four domains: the individual, their classification, year of hire, and year of interest. Using this methodology, one would be able to "discuss ICU nurses (a list of individuals grouped by common work) hired in 1995 (year of hire) who have stayed at least three years (3-year retention in 1998)".

Weighted Application Blanks (WAB)

Abraham (1976) suggested that companies, upon learning that relationships exist between independent and dependent variables, create a weighted application blank. The interviewer would then be able to make better hiring decisions. This is not a new concept. England (1961) suggested weighted application blanks be used by employers in the same fashion.

The literature presents several researchers that have created and tested weighted application blanks. Browne, Warnock, and Boykin (2005) created and tested the effectiveness of a weighted application blank (WAB) to determine the probability of police candidates qualifying for acceptance. They chose the WAB method due to its ability to select the top candidates at a low cost. Their WAB outperformed the pre-

existing selection technique used by the police department. In addition to biographical data (age, sex, and gender) the researchers included variables such as whether the prospective employee's alternative career path was in the same field, whether they knew anyone on the force, and whether they knew about the job.

Barrick and Zimmerman (2005) also included such non-traditional variables. These researchers found that if an applicant was referred by a current employee or knew people working in the firm the prospective employee had a better understanding of the employer's expectations. As such, they were more likely to stay than someone without such an understanding.

While weighted application blanks have been utilized successfully in the past, critics are advising against certain items traditionally used in the practice. Wallace and Vodanovich (2004) point out that the Civil Rights Act, the Americans with Disabilities Act, the Equal Pay Act, and the Age Discrimination in Employment Act all contain anti-discrimination protection clauses concerning the hiring of employees. For example, employers may not discriminate against employees over age 40. The researchers suggest that practitioners need to be aware of these policies and make sure to change their existing practices to be compliant.

Selection Testing

In addition to weighted application blanks, employers are administering hiring tests. Wolf and Jenkins (2006) state that in today's regulatory environment, these tests are being used to reinforce the company's hiring decisions if ever they are challenged in the courts. Some of the common tests include achievement tests, aptitude tests, personality tests, integrity tests, and interest tests (DuBrin, 2000). Schmidt and Hunter

(1998) suggest that no one test should be used; rather a combination should be used to assure success.

Increasing Wages and Benefits

Ever since the Wagner Act, also known as the National Labor Relations Act (NLRA) was passed in 1935, employees have been legally creating collective bargaining units and negotiating increased benefits with their employers (Jennings, 2000). While these employees enjoy higher hourly wages and a more defined pension plan than their non-union counterparts, they must pay their union dues.

The decision to be a union worker, however, is more than an economical decision. It is a philosophical dilemma (ABC, 2007). A union worker gets paid an hourly wage based on the labor contract between their local union and the contractor (Peurifoy & Oberlender, 2002). The contractor, then, pays the union employee at least the minimum wage of their classification regardless of performance. The employer cannot stipulate that the employee come in at a lower rate until performance is proven. A non-union company, however, could make such a stipulation.

Summary

This chapter provided a review the literature in regard to turnover and retention. It presented the underlying psychological frameworks associated with turnover, past turnover studies in construction and other industries, and current strategies being used to control turnover.

While a few researchers, Borcherding and Oglesby (1974), McFillen and Maloney (1988), Ruthankoon and Ogunlana (2003), and Shofoluwe (1992), have addressed the satisfaction and dissatisfaction of construction workers in relation to their

jobs, it is apparent that there is a gap in the knowledgebase relative to what is known and unknown about craft worker length of employment. Moreover, no studies were found that analyzed readily available employee records to identify the relationships between craft worker length of employment and characteristics about the worker and company. The problem of this research was to study this relationship.

Chapter 3

METHODOLOGY

This study attempted to analyze the employee databases of select Missouri construction companies to determine whether there was a statistically significant difference in the mean length of employment for 1) craft workers hired in the five hire age categories of 16-24, 25-34, 35-44, 45-54, 55 & up; 2) craft workers employed in the four craft categories of carpenters, laborers, operators, and ironworkers; 3) union craft workers versus non-union craft workers; and 4) craft workers at small, medium, and large construction companies. The following chapter provides a list of the research questions with hypotheses and a discussion of the population, variables, data analysis procedures, significance level, and statistical techniques.

Research Questions

This study addressed the following research questions:

1. Is there a statistically significant difference in the mean length of employment for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms?
2. Is there a statistically significant difference in the mean length of employment for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms?

3. Is there a statistically significant difference in the mean length of employment of union craft workers versus non-union craft workers at the selected Missouri construction firms?
4. Is there a statistically significant difference in the mean length of employment of craft workers at small, medium, and large Missouri construction companies?

Hypotheses

1. The null hypothesis (HO_1) is that there will be no statistically significant difference in the mean length of employment (LOE) for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms.

   HO_1: $\mu_{LOE16\text{-}24} = \mu_{LOE25\text{-}34} = \mu_{LOE35\text{-}44} = \mu_{LOE45\text{-}54} = \mu_{LOE55up}$

2. The null hypothesis (HO_2) is that there will be no statistically significant difference in the mean length of employment (LOE) for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms.

   HO_2: $\mu_{LOECAR} = \mu_{LOELAB} = \mu_{LOEOPE} = \mu_{LOEIRW}$

3. The null hypothesis (HO_3) is that there will be no statistically significant difference in the mean length of employment (LOE) of union craft workers (UCW) versus non-union craft workers (NUCW).

   HO_3: $\mu_{LOEUCW} = \mu_{LOENUCW}$

4. The null hypothesis (HO_4) is that there will be no statistically significant difference in the mean length of employment (LOE) of craft workers at small (SCC), medium MCC), and large construction companies (LCC).

   HO_4: $\mu_{LOESCC} = \mu_{LOEMCC} = \mu_{LOELCC}$

Population

The population for this study consisted of 17 Missouri-based construction companies who employ craft workers in the state of Missouri with revenues greater than $130.8 million. Engineering News Record (ENR) provided this population. Table 2 provides ENR's 2006 Top 21 Missouri construction companies with total self-reported revenues from $130.8 million to $2.305 billion. These companies were taken from the organization's list of 400 national construction companies. A sample of 10 out of the 17 companies (59%) provided consistent craft worker databases for the study. The paragraphs following the table explain how the population decreased from 21 to 17 and how the sample decreased from 13 to 10.

Table 2

ENR's 2006 Top 21 Missouri Construction Companies

Rank out of 400	Company Name	2006 Revenue (in $ millions)
19	J.E. Dunn Construction Group, Kansas City, Mo.	2305.0
21	McCarthy Building Cos. Inc., St. Louis, Mo.	1986.0
39	Alberici Corp., St. Louis, Mo.	1033.8
56	Walton Construction Co. LLC, Kansas City, Mo.	673.0
60	Fru-Con Construction Corp., St. Louis, Mo.	639.5
67	Insituform Technologies, Chesterfield, Mo.	582.0
96	Clayco, St. Louis, Mo.	471.0
109	HBE Corp., St. Louis, Mo.	410.0
144	Burns & McDonnell, Kansas City, Mo.	350.8
170	Fred Weber Inc., Maryland Heights, Mo.	300.5
187	S.M. Wilson & Co., St. Louis, Mo.	279.0
189	Garney Holding Co., Kansas City, Mo.	278.5
191	The Korte Co., St. Louis, Mo.	276.7
204	Clarkson Construction Co., Kansas City, Mo.	257.0
219	Herzog Contracting Corp., St. Joseph, Mo.	238.0
228	ARCO/Murray Construction Cos., St. Louis, Mo.	232.0
309	Paric Corp., O'Fallon, Mo.	171.6
325	BUCON Inc., Kansas City, Mo.	159.0
360	Brinkmann Constructors, Chesterfield, Mo.	143.5
377	BSI Constructors Inc., St. Louis, Mo.	135.4
384	HBD Contracting Inc., St. Louis, Mo.	130.8

The researcher obtained contact information for each of the companies by visiting their company web site, contacting his University's career services department, and cold calling the companies. Once an initial contact person was identified, an e-mail was sent to each contact person explaining the goals of the research and asking if they would be willing to provide their data (see Appendix A).

Upon contacting each of the 21 companies, adjustments to the population had to be made. Four companies would not provide information for various reasons. For instance, one company feared that their competitors would use it against them. The other three stated that they just did not have the manpower and time to run such a report. These four companies were included in the population. Three other companies provided information, but only for the last two to three years. These companies were also included in the population. Four more companies were willing to provide data, but did not self-perform any work in Missouri. These companies were not included in the population.

Of the 21 companies, the 4 that did not self perform work were removed leaving 17 Missouri-based construction companies employing craft workers in the state of Missouri with revenues greater than $130.8 million. While the researcher was able to acquire 13 of these 17 company databases, because only 10 of the 13 provided data for the common five-year period, the study achieved a 10 out of 17 (59%) return rate. Compared to common construction questionnaire return rates of 25-30% (Shofoluwe, 1992), 59% is a respectable achievement.

Variables

There were four independent variables in the research questions and hypotheses. First, in regards to the first research question and hypothesis, there was one continuous independent variable (hire age) that was recoded to fit in one of five categories: 16-24, 25-34, 35-44, 45-54, and 55 & up. These categories were chosen because they appear in the literature on craft worker demographics (CLRC, 2005). Second, in the second research question and hypothesis there were four categorical independent variables: carpenter, laborer, operators, and iron worker. These categories were chosen because

they were the most popular among the ten companies. Third, in the third research question and hypothesis there was one dichotomous independent variable: labor. This variable was recoded as zero for union and one for non-union. All craft workers fit into one of these two categories. They were either union members or they were not. Fourth, in the fourth research question and hypothesis there was one categorical independent variable: size. This variable was recoded as zero for small companies, one for medium-sized companies, and two for large companies. Because the revenues of the 17 companies ranged from $130.8 million to $2.305 billion with 13 companies below $700 million and 3 above $1 billion, the researcher chose to use unequal class widths to divide the companies into three groups. According to Kenkel (1996), unequal class widths is common with income data "where the difference between the largest value and the smallest value is very large and where most of the observations are concentrated in a relatively narrow range" (p. 45). Small companies included the 4 companies with 2006 revenues less than $200 million. Medium-sized companies included the 7 companies with 2006 revenues ranging from $200 million to $500 million. Finally, large companies included the 6 companies with 2006 revenues greater than $500 million. Table 3 shows the size classifications of the 17 companies in the population.

Table 3

Size Classifications of the Sample Population

Rank out of 400	Company Name	2006 Revenue (in $ millions)	Size
19	J.E. Dunn Construction Group	2305.0	Large
21	McCarthy Building Cos. Inc.	1986.0	Large
39	Alberici Corp.	1033.8	Large
56	Walton Construction Co.	673.0	Large
60	Fru-Con Construction Corp.	639.5	Large
67	Insituform Technologies	582.0	Large
96	Clayco, St. Louis	471.0	Medium
109	HBE Corp., St. Louis	410.0	Medium
170	Fred Weber Inc.	300.5	Medium
187	S.M. Wilson & Co.	279.0	Medium
189	Garney Holding Co.	278.5	Medium
204	Clarkson Construction Co.	257.0	Medium
219	Herzog Contracting Corp.	238.0	Medium
309	Paric Corp.	171.6	Small
325	BUCON Inc.	159.0	Small
377	BSI Constructors Inc.	135.4	Small
384	HBD Contracting Inc.	130.8	Small

The dependent variable for all of the research questions and hypotheses was length of employment. The researcher used days as the appropriate level of detail due to the large number of employees that worked less than one month in the pilot study database.

Data Analysis Procedures

Determining Common Hire and Turnover Periods

Each construction company was requested to provide their craft worker's hire date, exit date, date of birth, and craft category for as far back as their database would

allow. After the researcher collected the 13 databases, he manipulated the format of each file to a common format with the following column headings: Company, Size, Labor, Hire Date, Birth Date, Hire Age, Exit Date, Days Here, and Craft (see Appendix B). The files were then merged into one. The researcher sorted the file by hire date and exit date to find the common periods. The three asterisks in Table 4 indicate the 3 companies that submitted databases with hire periods consistent with the remaining companies, but limited turnover periods. As mentioned previously, these 3 companies were included in the population, but their databases were not analyzed with the 10 sample companies.

Table 4

Common Hire and Turnover Periods

Hire Period	Turnover Period
1939-2007	1977-2007
1946-2007	2000-2007
1949-2007	1997-2007
1953-2007	1993-2007
1954-2007	2000-2007
1955-2007	1950-2007
1964-2007	1990-2007
1965-2007	*2006-2007
1974-2007	1999-2007
1977-2007	*2004-2007
1987-2007	2002-2007
1992-2007	*2005-2007
1994-2007	1997-2007

Of the remaining 10 companies, all had data as far back as 1987. This could have been the lower limit of the hire period. However, in an effort to include all craft workers that left the company since a common date, the researcher chose to make the hire period

the same as the turnover period. All 10 of the remaining companies had hire data and exit data for the period 2002-2007.

The hire period and turnover period was held constant for all companies in order to control for such extraneous factors as market conditions. If one company's hire date period and turnover period included different market conditions than another contractor, then the two companies would not be directly comparable.

Randomly Recoding the Companies A-J

After determining the common hire and turnover period and removing the three companies that did not supply exit data for the 2002-2007 period, the researcher randomly assigned each of the 10 remaining companies a letter from A-J. Each of the ten company names were written on a small slip of paper. The slips were placed into a coffee can and the researcher selected one slip at a time. The first company was assigned the letter A, the second company assigned the letter B, and so forth through the letter J for the last company. While none of the companies specifically asked for anonymity, the researcher chose to build it into the research.

Determining Common Craft Categories

It was originally assumed that the four most common craft categories were carpenter, cement mason, iron worker, and laborer. Based on the data received from the contractors, however, the researcher changed the categories to carpenter, laborer, operator, and iron worker. Because, as one can see in Table 5 the most common AGC craft worker categories employed by the sample companies were Carpenter, Laborer, Operator, and Iron Worker. The total number of companies out of ten employing each category were as follows: Carpenter (9/10), Laborer (10/10), Operator 8/10), and Iron

Worker (7/10). Because none of the companies employed Glaziers, Surveyors, Plumbers, Plasterers, Roofers, and Sheet Metal Workers, these categories were left out of the table. Similarly, only one company utilized Brick Layers, Electricians, and Painters. These three crafts were left out of the table as well.

Table 5

Sample Population's Most Common AGC Craft Categories

Company	Carpenter	Cement Mason	Laborer	Operator	Pipefitter/ Steamfitter	Iron Worker
A	x	x	x	x	x	
B	x	x	x	x		x
C	x		x			
D	x	x	x	x		x
E	x		x	x		x
F			x			x
G	x		x	x	x	x
H	x	x	x	x		x
I	x		x	x	x	
J	x	x	x	x	x	x

Creating and Recoding Variables in MS Excel

Once the common file was created, common hire and turnover periods were chosen, and common crafts were selected, the researcher proceeded to create and recode the variables. The following paragraphs discuss each variable's coding in MS Excel.

First, under the MS Excel column heading Company, the researcher replaced the company's name with its randomly assigned company letter. He placed the

corresponding letter next to the first case and then copied the cell down the column until he reached the next company.

Second, under the column heading Size, company size was recorded for each craft worker based on the company's ENR 2006 revenue data. If the company's revenues were less than $200 million, the researcher placed a zero next to each craft worker to denote a small company. If company revenues were between $200 and $500 million, the researcher placed a one by each of the company's craft workers to denote they work for a medium-sized company. If company revenues exceeded $500 million the researcher placed a two by each of the company's craft workers to denote that they work for a large company.

Third, under the heading Labor, the researcher placed a zero next to each craft worker that was designated by the company as being a union craft worker and a one next to each craft worker that was non-union. Only two of the ten companies utilized both union and non-union craft workers. Only one out of the ten companies utilized only non-union workers. The remaining seven companies utilized union craft workers exclusively.

Fourth, the researcher created the hire age variable by subtracting each craft worker's date of birth from their hire date and dividing the quantity by 365 days per year. The format for the cell was then changed to a number instead of a date. If the company did not have the birth date for an individual, no value was recorded for the hire age. This was accomplished through the use of an "IF" logic formula in MS Excel.

Fifth, the researcher created the variable days here and calculated it by subtracting each craft worker's hire date from their exit date. For workers still employed, the exit date was their last check date. Again, the format for the cell had to be changed to

a number instead of a date. One company was only able to provide the last year worked and the number of hours worked in Missouri rather than the day the craft worker last worked. In this case, the researcher divided the total number of hours by 8 for a typical work day. This resulted in a marginal number of cases having more days on the job than days available in the period from 2002-2007. For instance, the five year period has a total of 365 days times 5 or 1,825 days. There were 44 out of 5,277 (.8%) craft workers with days here greater than 1,825. Due to the small amount of affected cases, the researcher decided to leave this company in the population including their craft workers with days here exceeding the amount available. This is also the reason the variable days here has two decimal places. For example, ten hours was recorded as 1.25 days. After analyzing the data with this contractor in the database, the researcher removed the contractor and ran each test again. Similar results were found with and without the contractor for all research questions. All of the tables in this study reflect the data with the contractor included.

Sixth, in regard to craft, the researcher sorted the file by craft and removed all craft workers that were not carpenters, laborers, operators, or ironworkers. He then renamed all classifications to one common format for each one. For instance, all craft workers labeled as CARPS or carpenters were renamed as just carpenter.

Seventh, the researcher opened the file in SPSS version 15. He then used visual binning to transform the continuous hire age variable to a new variable titled "Hire Age Category". The bins were created based on the CLRC categories of 16-24, 25-34, 35-44, 45-55, and 55 & up.

Significance Level

The researcher set the alpha level for all research questions to .05 prior to running the statistical analyses. Thus, he accepted a 5% probability of rejecting a true null hypothesis (type I error). Because the database included over 5,000 craft workers, a rather large amount of data, chances of accepting a false null hypothesis (type II error) were reduced.

Setting the alpha was not as critical to the researcher as it will be to future companies following the methodology. If future companies follow the methodology presented in this study and determine that there is a significant difference between the mean length of employment (dependent variable) of the five hire age groups (research question 1) or between carpenters, laborers, operators, and ironworkers (research question 2), the companies may use the information to improve the work situations of at-risk craft workers they would like to retain.

This is a positive consequence if the test is in fact correct. That is, if the company researcher rejects the null hypothesis that the means of each of these groups are equal, they would be accepting that they are different. The companies could then make changes to their hiring and promotion strategies with some assurance that their changes would have an effect on craft worker retention.

If, however, the researcher and future companies retain a false null hypothesis in their studies, they would be committing a type II error and the damages could be great. The companies could lose thousands of dollars by doing nothing. They would not see that a relationship truly does exist between these variables and miss the opportunity to

retain at-risk craft workers. Craft workers would continue to leave the company costing the organization the benefits of talent retention.

Another possible area for error is if the companies reject the null hypothesis even though it is actually true (type I error). In other words, the companies could obtain significant results showing that there is a significant difference between the groups when there actually is not. In this case, the employers would lose thousands of dollars investing in employees that had no intentions of leaving.

While the initial costs to proactively retain employees would be greater than doing nothing, there are still benefits to committing a type I error. For instance, if the companies reject the null hypothesis and start valuing their believed to be at-risk craft workers, the ripple effect could be higher craft worker morale. This is an unknown as it is a future possible return on investment. In reality, committing a type I error means that the companies will have to spend money to retain craft workers that were never at-risk. Therefore, if the companies were worried about initial costs, they would not want to lower alpha because it would increase the likelihood of having to spend unnecessary money. It is in this sense that the .05 alpha was chosen. If the alpha is lowered to .01, the probability of committing a type II error increases.

Because construction companies are not able to choose whether a project will use union versus non-union labor (research question 3) or whether they are a small or large construction company (research question 4), setting an alpha is not as critical to the employer as in the first two research questions.

Statistical Techniques

According to Minium, Clarke, and Coladarci (1999), the one-way analysis of variance (ANOVA) is used to compare the means of two or more independent groups representing different levels of a single factor. As such, the one-way ANOVA (.05 alpha) was used for all research questions. Prior to running the analyses of variance for the research questions, the researcher tested the ANOVA assumptions. According to Minium et al. the assumptions for the one-way analysis of variance are:

1. The samples are independent.
2. Each of the populations are normally distributed.
3. The populations are equally variable.

When the measured F ratio was found to be larger than the critical value leading the researcher to reject the null hypothesis, Tukey's Honestly Significant Difference (HSD) post hoc comparison was employed to find out what group comparisons provided the most difference.

Chapter 4

RESULTS AND ANALYSES

Prior to running the analysis of variance tests for each research question and hypothesis, it was necessary to examine the descriptive statistics for each of the independent variables. The following chapter provides the descriptive statistics for each of the independent variables. It then discusses the test results for the ANOVA assumptions and results for each of the research questions. When assumptions of the ANOVA were violated, further parametric and non-parametric tests were conducted. Results of those tests are provided with each affected research question.

Descriptive Statistics

A sample of 10 Missouri construction companies provided the hire date, birth date, and exit date for a total of 5,277 carpenters, laborers, operators, and iron workers. The following paragraphs present the descriptive statistics for each of the independent variables. Descriptive statistics showed the researcher that none of the independent variable categories met the ANOVA assumption of normality. Due to this violation, the researcher supported the ANOVA results with more parametric and non-parametric statistical tests.

Hire Age

There were 497 craft workers that did not have birth dates recorded, thus making it impossible to determine their hire age. In addition, there were 11 additional craft workers that were hired prior to the age of 16. These 508 craft workers were removed from the sample population for this research question for two reasons. First, the workers with missing hire ages did not necessarily fit in the <16 age category. Second, the 11 workers represent such a small subpopulation (.2%). Once these craft workers were removed, the data file was saved as a different file so the craft workers would still be present for analysis of the remaining research questions when opening the original file. Table 6 shows the frequency of craft workers in each hire age category. Table 7 shows the mean length of employment (days here) for each of the hire age categories.

Table 6

Frequency of Craft Workers by Hire Age Category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	16-24	666	13.97	13.97	13.97
	25-34	1191	24.97	24.97	38.94
	35-44	1345	28.20	28.20	67.14
	45-54	1137	23.84	23.84	90.98
	55 & up	430	9.02	9.02	100.00
	Total	4769	100.00	100.00	

Table 7

Descriptive Statistics for Mean Days Here by Hire Age Category

Hire Age	N	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
16-24	666	215.71	331.10	12.83	190.51	240.90
25-34	1191	202.29	318.01	9.21	184.21	220.36
35-44	1345	232.87	333.73	9.10	215.02	250.72
45-54	1137	222.20	327.28	9.71	203.16	241.24
55 & up	430	239.23	359.65	17.34	205.14	273.32
Total	4769	220.87	330.52	4.79	211.48	230.25

Each hire age category was severely skewed to the right as can be seen in figures 1-5. The normal curves have been superimposed. However, it is not difficult to see that the groups deviate from normality. For instance, of the 666 craft workers hired between the ages of 16 and 24, 581 (87%) were with their employer less than 500 days (1 year and 4 months).

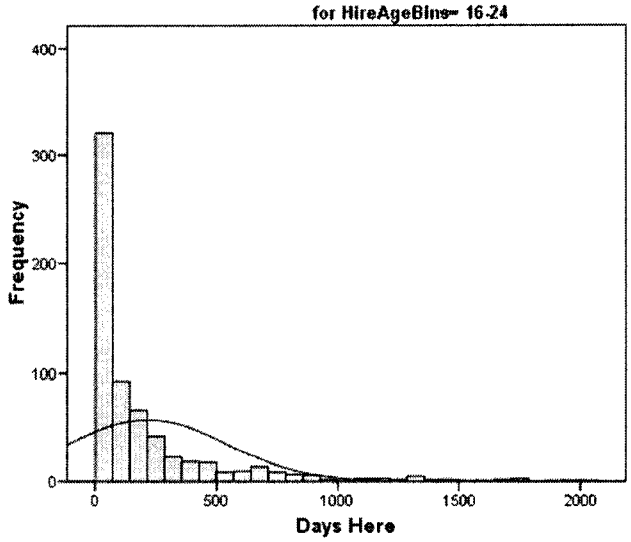

Figure 1. Frequency of days here for hire age category 16-24

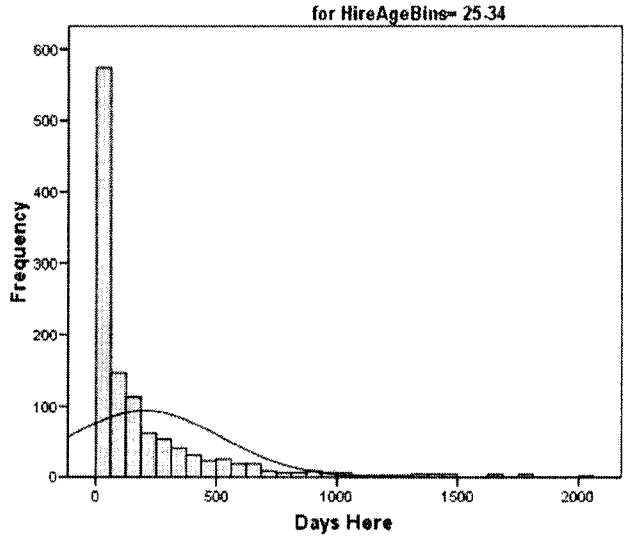

Figure 2. Frequency of days here for hire age category 25-34

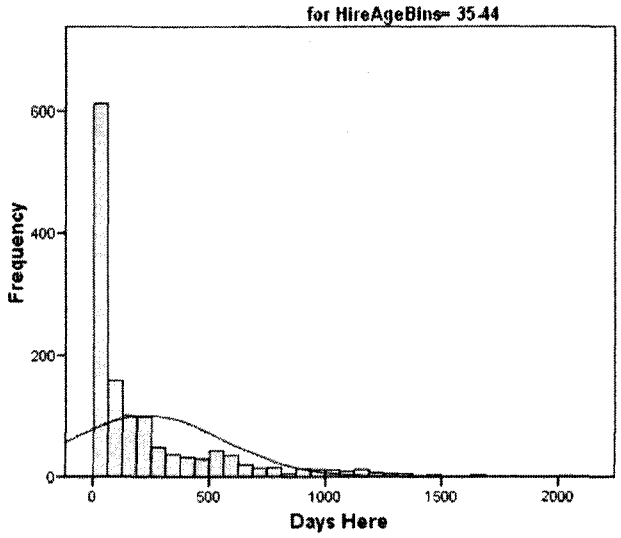

Figure 3. Frequency of days here for hire age category 35-44

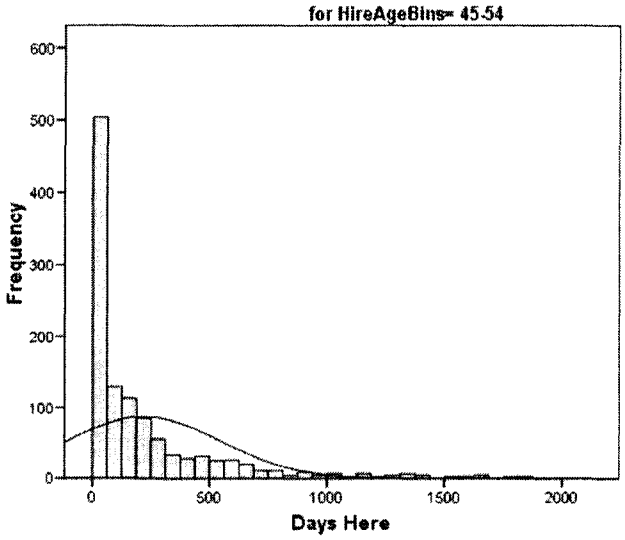

Figure 4. Frequency of days here for hire age category 45-54

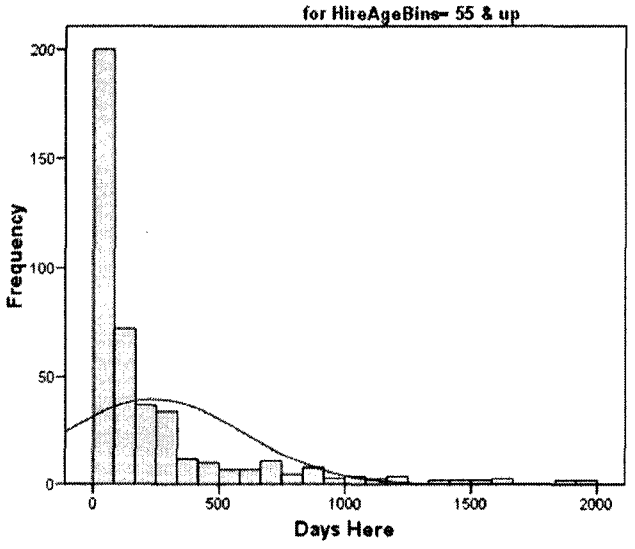

Figure 5. Frequency of days here for hire age category 45-54

While these figures visually illustrate a deviation from normality, further normality tests were completed. Table 8 shows the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality. Small significant values indicated that the hire age categories did not have normal distributions (Norusis, 2005). This departure from normality led the researcher to conduct more parametric and nonparametric statistical tests to validate the ANVOA results.

Table 8

Kolmogorov-Smirnov and Shapiro-Wilk Normality Tests for Hire Age

	Hire Age Category	Kolmogorov-Smirnov(a) Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Days Here	16-24	0.26	666	.000	0.65	666	.000
	25-34	0.26	1191	.000	0.65	1191	.000
	35-44	0.24	1345	.000	0.71	1345	.000
	45-54	0.25	1137	.000	0.68	1137	.000
	55 & up	0.25	430	.000	0.67	430	.000

a Lilliefors Significance Correction

Craft

Table 9 shows the frequency of craft workers in each craft category. Laborer was by far the most populated craft category with 42.15% of the sample population holding this title. Carpenter accounted for 25.18% of the total sample population and operators and iron workers accounted for 18.25% and 14.42%, respectively.

Table 9

Frequency of Craft Workers by Craft Category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Carpenter	1329	25.18	25.18	25.18
	Ironworker	761	14.42	14.42	39.61
	Laborer	2224	42.15	42.15	81.75
	Operator	963	18.25	18.25	100.00
	Total	5277	100.00	100.00	

Table 10 indicates a difference in the mean lengths of employment across the four craft categories. Operators had the highest mean length of employment with 51.49 more days than the next closest category (laborers).

Table 10

Descriptive Statistics for Mean Days Here by Craft Category

Craft Category	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Carp	1329.00	228.72	329.82	9.05	210.97	246.46
Lab	2224.00	235.08	356.14	7.55	220.28	249.89
Oper	963.00	286.57	414.89	13.37	260.33	312.80
Iron	761.00	232.15	374.92	13.59	205.47	258.83
Total	5277.00	242.45	364.55	5.02	232.61	252.29

Figures 6-9 represent the frequency histograms of the four craft categories. Again, all of the categories have a severe right skewness similar to the hire age categories.

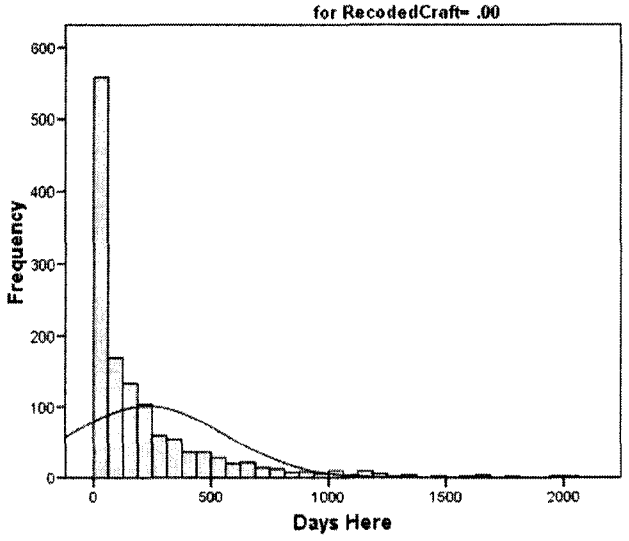

Figure 6. Frequency of days here for carpenters

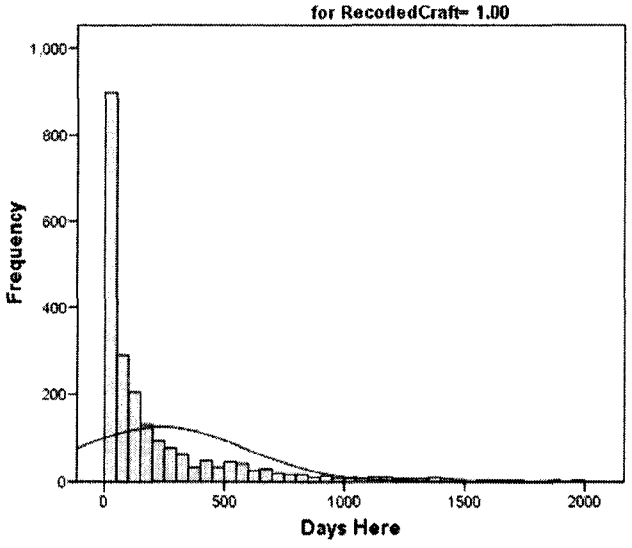

Figure 7. Frequency of days here for laborers

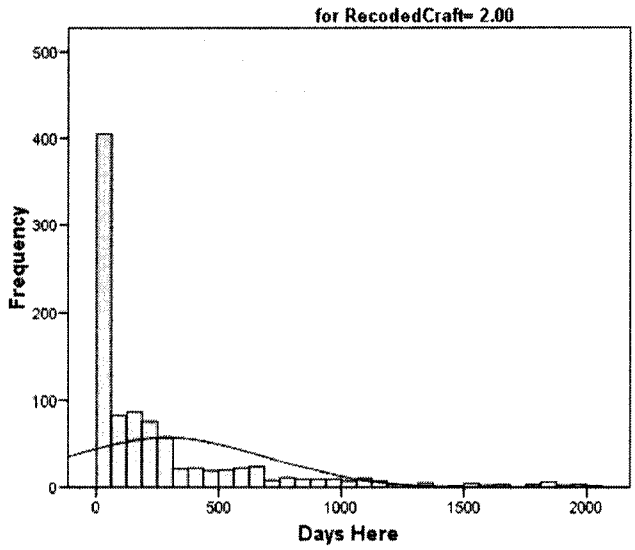

Figure 8. Frequency of days here for operators

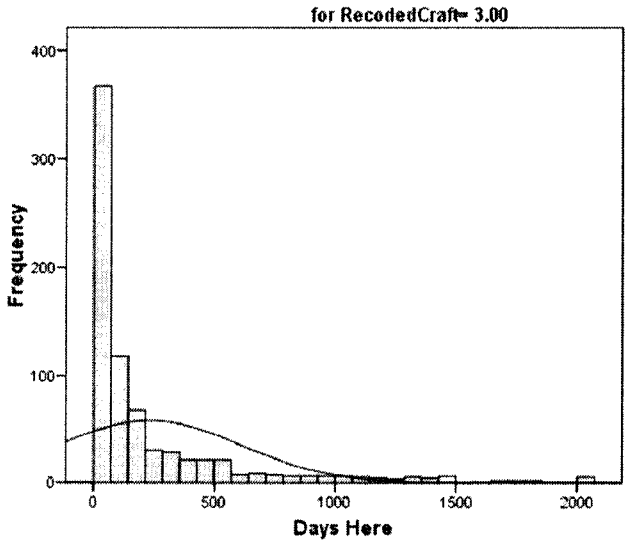

Figure 9. Frequency of days here for iron workers

Because the histograms indicate a departure from normality with severe skewness to the right, further tests for normality were completed. Table 11 shows the

results of the Kolmogorov-Smirnov and the Shapiro-Wilk tests for normality. Low significance values indicated the craft categories did not have normal distributions. This departure from normality led the researcher to conduct more parametric and nonparametric statistical tests to validate the ANVOA results.

Table 11

Kolmogorov-Smirnov and Shapiro-Wilk Normality Tests for Craft Category

	Craft Category	Kolmogorov-Smirnov(a) Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Days Here	Carpenter	0.24	1329	.000	0.68	1329	.000
	Laborer	0.26	2224	.000	0.67	2224	.000
	Operator	0.25	963	.000	0.70	963	.000
	Ironworker	0.27	761	.000	0.63	761	.000

a Lilliefors Significance Correction

Labor

Table 12 shows the frequency of craft workers by labor category. Over 90% of the sample population's craft workers were union. Table 13 provides the mean days here for the two groups. The two groups are separated by 8.76 days.

Table 12

Frequency of Craft Workers by Labor Category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Union	4769	90.37	90.37	90.37
	Non-Union	508	9.63	9.63	100.00
	Total	5277	100.00	100.00	

Table 13

Descriptive Statistics for Mean Days Here by Labor Category

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean	
Craft Category	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Union	4769	241.61	366.95	5.31	231.19	252.03
Non-Union	508	250.37	341.44	15.15	220.61	280.14
Total	5277	242.45	364.55	5.02	232.61	252.29

Figures 10-11 illustrate the distributions of both union and non-union craft workers. Again, the mean days here for the two groups show distributions with a severe right skewness.

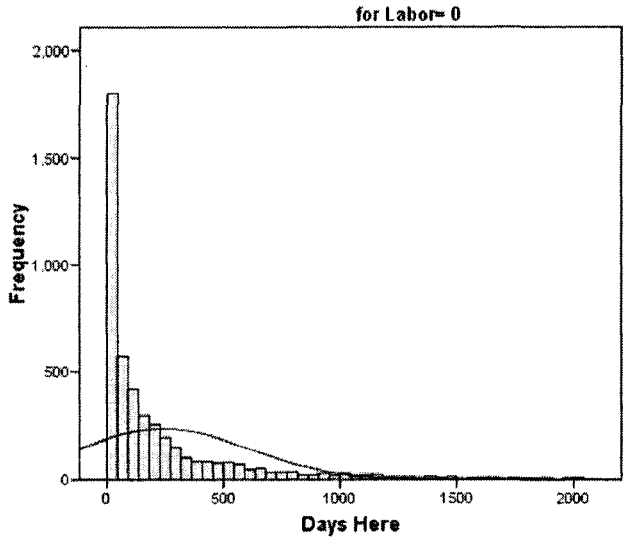

Figure 10. Frequency of days here for union craft workers

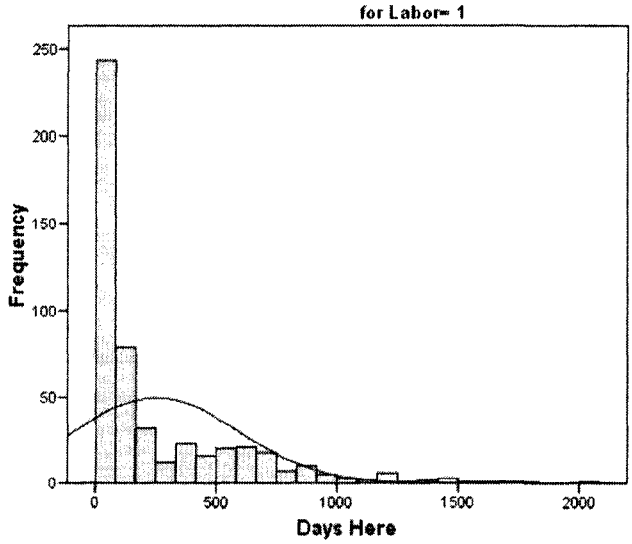

Figure 11. Frequency of days here for non-union craft workers

Table 14 shows that both union and non-union labor category distributions failed further tests for normality. The low significance values of both the Kolmogorov-

Smirnov and the Shapiro-Wilk tests for both populations, indicated that the two groups are not normally distributed (Norusis, 2005). This departure from normality led the researcher to conduct more parametric and nonparametric statistical tests to validate the ANVOA results.

Table 14

Kolmogorov-Smirnov and Shapiro-Wilk Normality Tests for Labor

	Labor Category	Kolmogorov-Smirnov(a) Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Days Here	Union	0.26	4769	.000	0.67	4769	.000
	Non-Union	0.23	508	.000	0.73	508	.000

a Lilliefors Significance Correction

Company Size

Table 15 shows the frequency of craft workers by company size. Over 60% of the sample population's craft workers came from large companies with 2006 revenues greater than $500 million. Just as with the other research questions, the histograms illustrate non-normal distributions with a skewness to the right. Table 16 shows the mean days here for the craft workers at the three company size categories.

Table 15

Frequency of Craft Workers by Company Size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Small	795	15.07	15.07	15.07
	Medium	1172	22.21	22.21	37.27
	Large	3310	62.73	62.73	100.00
	Total	5277	100.00	100.00	

Table 16

Descriptive Statistics for Mean Days Here by Company Size

Size Category	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Small	795	216.93	348.12	12.35	192.69	241.16
Medium	1172	403.62	461.79	13.49	377.15	430.08
Large	3310	191.52	308.87	5.37	180.99	202.04
Total	5277	242.45	364.55	5.02	232.61	252.29

Figures 12-14 illustrate the histograms of days here for small, medium, and large companies. The graphs are skewed to the right.

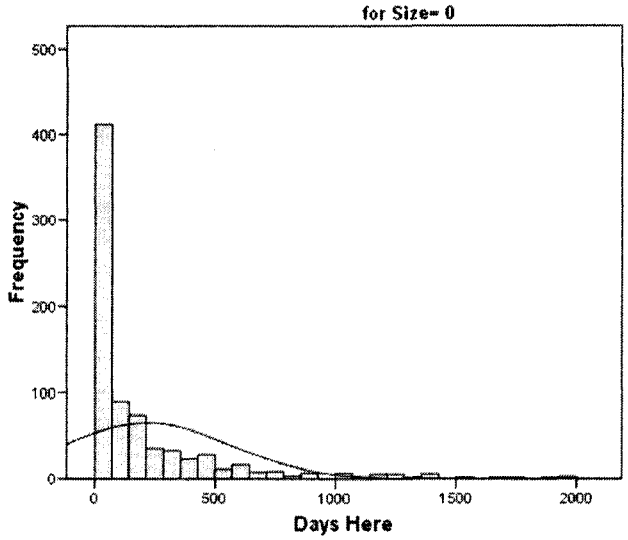

Figure 12. Frequency of days here for small companies

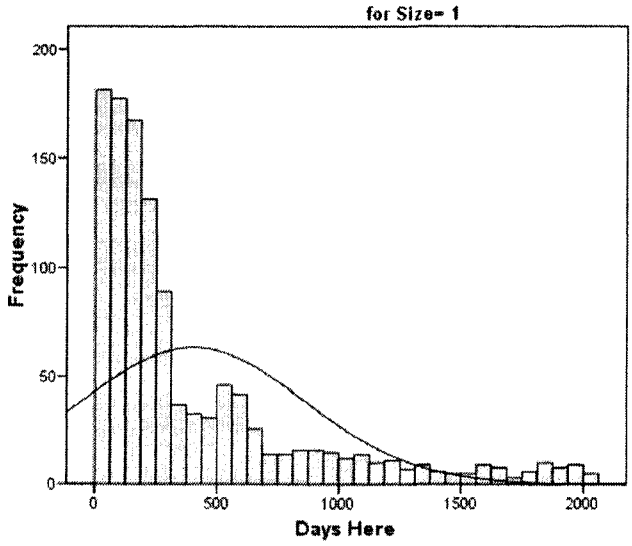

Figure 13. Frequency of days here for medium-sized companies

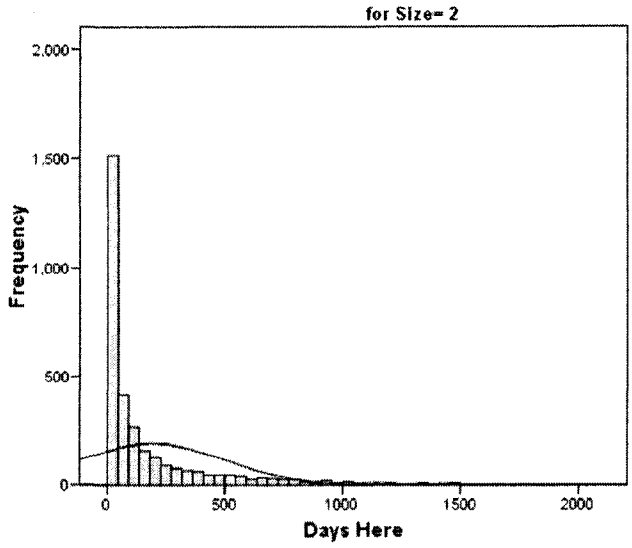

Figure 14. Frequency of days here for large companies

Table 17 shows the results of the normality test for days here by company size. The low significance for both tests indicated that the groups are not normally distributed. As mentioned previously, this departure from normality led the researcher to conduct more parametric and nonparametric statistical tests to validate the ANVOA results.

Table 17

Kolmogorov-Smirnov and Shapiro-Wilk Normality Tests for Size

	Labor Category	Kolmogorov-Smirnov(a) Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Days Here	Small	0.27	795	.000	0.64	795	.000
	Medium	0.22	1172	.000	0.76	1172	.000
	Large	0.27	3310	.000	0.64	3310	.000

a Lilliefors Significance Correction

Analysis of Variance Test Results

Because the homogeneity of variance test is provided with the ANOVA table when the test is performed in SPSS, results of the assumption tests are provided for each independent variable along with each research question and hypothesis. Further discussion beyond testing will be provided in chapter five.

Test Results for Hypothesis 1

The first research question asked if there was a statistically significant difference in the mean length of employment for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms. The null hypothesis was that there would be no statistically significant difference between the five hire age categories. Table 18 shows the ANOVA table for research question one. The F ratio of 1.76 was not significant ($p = .13$). This means that significant differences did not exist between the hire age groups in regard to mean length of employment.

Table 18

One-way Analysis of Variance of Days Here Among Hire Age Categories

Source	df	Sum of Squares	Mean Squares	F Ratio	p
Between Groups	4	769769.26	192442.32	1.76	0.13
Within Groups	4764	520103063.43	109173.61		
Total	4768	520872832.69			

Table 19 shows that the data did not meet the assumption of equal variance. Levene's statistic of 3.12 was significant ($p= .014$).

Table 19

Levene's Homogeneity of Variance Test for Hire Age

Levene Statistic	df1	df2	p
3.12	4	4764	0.01

Norusis (2005) suggests that when sample sizes are very different, as is the case with the hire age category sizes of 666, 1191, 1395, 1137, and 430, the researcher should use such robust equality of means tests as Welch and Brown-Forsythe. Since none of the groups had a zero standard deviation and sample sizes of all groups were greater than zero, the two assumptions required of both the Welch and Brown-Forsythe statistic, these two tests were appropriate (SPSS Help, version 15). Table 20 shows that both of these tests supported the previous ANOVA test as significance levels are large.

Table 20

Welch and Brown-Forsythe Equality of Means Test for Hire Age

	Statistic(a)	df1	df2	p
Welch	1.77	4	1796.34	0.13
Brown-Forsythe	1.71	4	3304.82	0.14

a Asymptotically F distributed.

Norusis (2005) suggests two non-parametric tests when the ANOVA assumptions are not met: the Kruskal-Wallis Test and the median test. Table 21 shows

the results of the Kruskal-Wallis test. The high significance value of .12 means that there were no significant differences between the means.

Table 21

Kruskal-Wallis Test for Hire Age

Chi-Square	df	Asymptotic Significance
7.37	4	0.12

The non-parametric median test yielded similar results. Table 22 shows that nearly the same amount of cases fall above the median as those below the median for each age category. Per Norusis (2005), this supports the null hypothesis that the medians are equal.

Table 22

Median Test Counts of Days Here by Hire Age Category

		16-24	25-34	35-44	45-54	55 & up
Days Here	> Median	324	563	674	593	230
	<= Median	342	628	671	544	200

Table 23 shows a significance of .08 which supports that the null hypothesis that the population medians are equal cannot be rejected. This supports previous findings.

Table 23

Median Test for Hire Age

N	Median	Chi-Square	df	Asymptotic Significance
4769	83.31	*8.25	4	0.08

* 0 cells have expected frequencies less than 5.
The minimum expected cell frequency is 215.0.

Test Results for Hypothesis 2

The second research question asked if there was a statistically significant difference in the mean length of employment for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms. The null hypothesis was that there was no statistically significant difference between the craft categories. Table 24 shows the ANOVA table for research question 2. The F value of 5.85 was found to be significant (p = .001).

Table 24

One-way Analysis of Variance of Days Here Among Craft Categories

Source	df	Sum of Squares	Mean Squares	F Ratio	p
Between Groups	3	2326359.58	775453.19	5.85	.001
Within Groups	5273	698831578.52	132530.17		
Total	5276	701157938.10			

Given the statistically significant F value, Tukey's honestly significant post hoc analysis was performed to identify which areas presented the greatest difference in means. Table 25 indicates a significant difference between operators and all other craft categories. The mean difference between operators and each of the other categories exceeded 51 days.

Table 25

Tukey's Honestly Significant Data Post Hoc Analysis for Craft

(I) Craft	(J) Craft	Mean Difference (I-J)	Std. Error	Significance	95% Confidence Interval	
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Carp	Lab	-6.37	12.62	0.96	-38.80	26.07
	Oper	*-57.85	15.41	0.00	-97.44	-18.26
	Iron	-3.43	16.55	1.00	-45.96	39.10
Lab	Carp	6.37	12.62	0.96	-26.07	38.80
	Lab	*-51.48	14.04	0.00	-87.57	-15.39
	Iron	2.94	15.29	1.00	-36.35	42.23
Oper	Carp	*57.85	15.41	0.00	18.26	97.44
	Lab	*51.48	14.04	0.00	15.39	87.57
	Iron	*54.42	17.66	0.01	9.04	99.79
Iron	Carp	3.43	16.55	1.00	-39.10	45.96
	Lab	-2.94	15.29	1.00	-42.23	36.35
	Oper	*-54.42	17.66	0.01	-99.79	-9.04

* The mean difference is significant at the .05 level.

Because the initial descriptive statistics illustrated a non-normal distribution, it was necessary to run a homogeneity of variance test with the ANOVA test. Table 26

shows the results of the test. Such a low significance means that the variances are not equal (Norusis, 2005).

Table 26

Levene's Test of Homogeneity of Variance for Craft

Levene Statistic	df1	df2	p
14.08	3	5273	.000

Table 27 shows that the more robust Welch and Brown-Forsythe test yielded the same results as the initial ANOVA despite the non-normal distributions and lack of equal variances. Both the Welch statistic of 4.81 and the Brown-Forsythe statistic of 5.60 were significant (p=.002 and .001, respectively).

Table 27

Welch and Brown-Forsythe Test for Craft

	Statistic(a)	df1	df2	p
Welch	4.81	3	2194.41	0.002
Brown-Forsythe	5.60	3	3675.41	0.001

a Asymptotically F distributed.

Table 28 shows the results of the non-parametric Kruskal-Wallis test. Such a low significance (.029) means that values from one group are larger than values in another one of the population groups (Norusis, 2005).

Table 28

Kruskal-Wallis Test for Craft

Chi-Square	df	Asymp. Sig.
9.03	3	0.029

The second non-parametric test, the median test, further supported the previous results. Table 29 shows a difference in the number of craft workers above and below the median. Table 30 further supports the previous findings with low asymptotic significance (p=.002).

Table 29

Median Test Counts of Days Here by Craft Category

		Carp	Lab	Oper	Iron
Days Here	> Median	676	1072	529	361
	<= Median	653	1152	434	400

Table 30

Median Test for Craft

N	Median	Chi-Square	df	Asymptotic Significance
5277	92.06	*14.65	3	0.002

* 0 cells have expected frequencies less than 5.
The minimum expected cell frequency is 380.4

Test Results for Hypothesis 3

The third research question asked if there was a statistically significant difference in the mean length of employment of union craft workers versus non-union craft workers at the selected Missouri construction firms. The null hypothesis stated that there was not a significant difference between the two groups.

Table 31 presents the ANOVA table for days here of union workers versus non-union workers. The F value of .265 was not significant (p=.606). While the data was found to have a non-normal distribution, table 32 indicates that the variance of the two distributions was similar (p=.585). Table 33 shows that the parametric Welch and Brown-Forsythe test yielded the same results.

Table 31

One-way Analysis of Variance for Days Here by Labor Category

Source	df	Sum of Squares	Mean Squares	F Ratio	p
Between Groups	1	35276.91	35276.91	0.27	0.606
Within Groups	5275	701122661.19	132914.25		
Total	5276	701157938.10			

Table 32

Levene's Test of Homogeneity of Variance for Labor

Levene Statistic	df1	df2	p
0.44	1	5275	0.509

Table 33

Welch and Brown-Forsythe Test for Labor

	Statistic(a)	df1	df2	p
Welch	0.30	1	638.40	0.585
Brown-Forsythe	0.30	1	638.40	0.585

a Asymptotically F distributed.

When one wants to compare the means of two non-normal populations, the non-parametric Wilcoxon and Mann-Whitney U tests may be used (Norusis, 2005). The two tests do require that the populations have continuous data and similar shapes. Because the dependent variable *Days Here* was continuous and the two distributions were skewed to the right, as seen previously in figures 10 and 11, this variable met these two assumptions. Table 34 provides the results of the test. The high two-tailed Asymptotic Significance (p=.261) supports the previous parametric findings.

Table 34

Mann-Whitney U and Wilcoxon Tests for Labor

Test Statistics(a)	Days Here
Mann-Whitney U	1174671
Wilcoxon W	12548736
Z	-1.123
Asymp. Sig. (2-tailed)	0.261

a. Grouping Variable: (0=union,1=nu)

Test Results for Hypothesis 4

The fourth research question asked if there was a statistically significant difference in the mean length of employment of craft workers at small, medium, and large Missouri construction companies. Table 35 shows the results of the ANOVA test for days here by company size. The F value of 157.62 was statistically significant (p=.000). Table 36 presents the results of Tukey's Honestly Significant Data test. It confirms the previous ANOVA test.

Table 35

One-way Analysis of Variance for Days Here by Company Size

Source	df	Sum of Squares	Mean Squares	F Ratio	p
Between Groups	1	39545945.42	19772972.71	157.62	.000
Within Groups	5275	661611992.68	125447.86		
Total	5276	701157938.10			

Table 36

Tukey's Honestly Significant Data Post Hoc Analysis for Company Size

(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Significance	95% Confidence Interval	
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Small	Medium	*-186.69	16.27	.000	-224.84	148.54
	Large	25.41	13.99	.164	-7.39	58.20
Medium	Small	*186.69	16.27	.000	148.54	224.84
	Large	*212.10	12.04	.000	183.87	240.32
Large	Small	-25.41	13.99	.164	-58.20	7.39
	Medium	*-212.10	12.04	.000	-240.32	183.87

* The mean difference is significant at the .05 level.

Table 37 provides Levene's test for homogeneity of variance for days here among the company sizes. The test illustrated that the three populations did not have equal variances.

Table 37

Levene's Test of Homogeneity of Variance for Company Size

Levene Statistic	df1	df2	p
126.71	2	5274	.000

Table 38 shows that the more robust Welch and Brown-Forsythe test yielded the same results as the initial ANOVA despite the non-normal distributions and lack of

equal variances. The low significance (.000) indicates that the means are not equal (Norusis, 2005).

Table 38

Welch and Brown-Forsythe Test for Company Size

	Statistic(a)	df1	df2	p
Welch	106.71	2	1650.27	.000
Brown-Forsythe	129.92	2	2488.75	.000

a Asymptotically F distributed.

Table 39 shows the results of the Non-parametric Kruskal-Wallis test. Such a low significance (.000) means that values from one population were larger than values in another one of the population groups (Norusis, 2005).

Table 39

Kruskal-Wallis Test for Company Size

Chi-Square	df	Asymp. Sig.
495.30	2	.000

The second non-parametric test, the Median test, further supported the previous results. Table 40 shows a difference in the number of craft workers above and below the median. Table 41 further supports the previous findings with low asymptotic significance (.000).

Table 40

Median Test Counts of Days Here by Company Size

		Small	Medium	Large
Days Here	> Median	353	921	1364
	<= Median	442	251	1946

Table 41

Median Test for Company Size

N	Median	Chi-Square	df	Asymptotic Significance
5277	92.06	*495.32	2	.000

* 0 cells have expected frequencies less than 5.
The minimum expected cell frequency is 397.4.

Chapter 5

CONCLUSIONS

Following a short summary, this chapter will present the results for each research question, a short discussion about possible reasons for the results, and the overall implications of the findings. It will then address the individualized reports prepared for each participating construction company. Finally, this chapter will provide recommendations for future work in this area.

Summary

Retaining craft workers is a critical element of the self-perform business model. In order to retain their craft workers, construction companies must study their workforce. If construction companies were provided with a methodology for analyzing the craft data they already have in their company's employee database, they would be able to identify differences in craft worker length of employment based on such variables as craft worker hire age, craft category, and union or non-union affiliation. As a result of such an analysis, the companies would be able to make quicker hiring decisions or change working conditions to retain at-risk craft workers. They may even be able to maintain their self-perform business model. While many companies collect such information upon hiring a craft worker and store it in a database, no studies were found in the literature that address analyzing and putting this readily available information to use. This study

provided a methodology that companies can follow in order to analyze key variables in their readily available databases.

Engineering News Record (ENR) provided the population. ENR's Top 400 Contractors in the United States (2006) included 21 Missouri companies (see Table 2) with total self-reported revenues from $130.8 million to $2.305 billion. Because only 17 of these companies rely on the self-perform business model, the population was reduced. The researcher was able to collect 10 out of the 17 (59%) craft worker employment databases. This was the sample population.

An analysis of variance (ANOVA) was used to test all of the research questions. When the assumptions of normality and equality of variance were not met, the researcher employed additional parametric and non-parametric tests. These tests supported the original ANOVA results for each research question.

Results

This section provides the results for each hypothesis. Statistics and critical values are provided.

Results of Hypothesis 1: There was no statistically significant difference in the mean length of employment for craft workers hired in the five hire age categories (16-24, 25-34, 35-44, 45-54, 55 & up) at the selected Missouri construction firms. The F value of 1.76 was not significant at the .05 alpha level ($p = .13$).

Results of Hypothesis 2: There was a statistically significant difference in the mean length of employment for craft workers in the four craft categories (carpenter, laborer, operator, and ironworker) at the selected Missouri construction firms. The F value of 5.85 was found to be significant at the .05 alpha level ($p = .001$). Tukey's Honestly

Significant Data post hoc analysis indicated that operators had a statistically significant higher mean length of employment than carpenters, laborers, and ironworkers.

Results of Hypothesis 3: There was no statistically significant difference in the mean length of employment of union craft workers versus non-union craft workers at the selected Missouri construction firms. The F value of .265 was not significant at the .05 alpha level (p=.606).

Results of Hypothesis 4: There was a statistically significant difference in the mean length of employment of craft workers at small, medium, and large Missouri construction companies. The F value of 157.62 was significant at the .05 alpha level (p=.000). Tukey's Honestly Significant Data post hoc analysis revealed that small and large companies have significantly lower mean lengths of employment than medium sized companies.

Discussion of Results and Implications

The review of literature addressed the lack of information regarding length of employment analysis in the construction industry. This study set out to provide information to three industry stakeholders: 1) the individual companies that provided the information, 2) all American construction companies, and 3) union and non-union organizations. While only two of the four research questions provided statistically significant differences in the means of their groups, all of the research questions impact these construction industry stakeholders. The following paragraphs provide the implications for each research question.

First, in regard to hire age, results indicated that no hire age category outperformed the other in regard to length of employment which implies that companies

can hire workers at any age and expect those workers to last as long as all other workers. In other words, hire age is not an indicator of length of employment. The sample population companies could use the information in their hiring strategies to target workers they may not currently be targeting. All other American construction companies could use the study's methodology for studying their craft worker employee database to see if there are significant differences between any of their hire age categories. If they come to the same conclusion, they could change their hiring strategies as well. In addition to visiting high schools, trade schools, two-year colleges, and four-year universities to attract new employees, based on the findings that 55 year-old craft workers last just as long as 30 year olds, the companies may decide to start targeting retirees from other industries.

Second, in regard to craft, the study revealed that operators enjoy longer lengths of employment than all other craft categories. While this implies that operators are more likely to stay with an employer longer than the other craft categories, more research needs to be conducted. If this is true, employers could use the information to determine that they need to concentrate more on the retention of the other craft categories rather than this category. Employers could decide to invest more in the training of operators since they stay with the company longer than the other categories. The information could also be used by the Operators Union to attract new entrants into the profession. Construction companies may also start comparing the benefits and working conditions of their other craft categories to this category to determine why operators have longer lengths of employment.

While the literature review did not provide any previous studies indicating that operators would have longer lengths of employment than the other groups, it is understandable given the differences between the prolonged need for the craft on the job site. Because the contractor providing the crane is often paid by the subsequent subcontractors to lift tools and equipment into place, they often remain on site longer than the others. A general contractor with its own crane may provide an operator at the beginning of the project to erect the steel. The crane operator may then remain on the job to lift the plumbing materials to each floor for the plumbing subcontractor, the electrical material to each floor for the electrical subcontractor, and so on. This is also the case with other equipment operators. The general contractor may provide a backhoe and operator to dig footings for a concrete subcontractor or complete the work rather than subcontracting the service out to a specialty contractor. Just like the crane operator example above, the backhoe operator may be on the project for the duration of the job. In the following section, the researcher recommends a follow-up study to determine if this prolonged need on the project is a determining factor in an operator's length of employment with a given company.

Third, in regard to labor, there was no statistically significant difference between union craft workers and non-union craft workers with regard to length of employment which implies that non-union craft workers are hired, leave the job voluntarily, or are otherwise laid off by job just as often as union workers. While no literature was found to support the theory that union workers were hired for shorter durations than non-union workers, given the nature of union hiring halls where union companies hire workers for job-specific temporary assignments, the researcher believed that non-union workers

would have enjoyed longer lengths of employment. The companies in the population and all American construction companies may find this finding to be equally surprising. As for implications, both union and non-union organizations may use this information in attracting new entrants and selling their labor strategies to owners and other project participants.

Fourth, in regard to the hypothesis relating to company size, medium-sized companies outperformed small and large construction companies in regard to length of employment. In fact, this category's mean length of employment nearly doubled the other two in this study. While this implies that craft workers are more likely to stay employed at a medium-sized company than a small or large company, more research needs to be conducted on the subject. If it is true, this information could be used by the medium-sized companies in their promotional campaigns. Small and large construction companies could also start comparing the benefits and working conditions of their craft workers to those available at medium-sized companies to determine areas of improvement.

As mentioned above, each participating company will benefit from this study in two ways. First, they will receive their own report showing just their results. If their data shows that the average length of employment of craft workers hired between the ages of 16-24 is significantly less than those hired between the ages of 25-34, the company could change their hiring strategies to focus on the latter group. The company could also target the employees hired in the age category with the lowest length of employment, identify the problem they are facing, change the condition, and ultimately retain these at-risk craft workers. Second, the company will see how their company compared to the

other companies that provided information for the study. While the data will be organized by category rather than company name, the information could be used as benchmark data to improve their human resource performance relative to the other Missouri companies. Given these types of proactive retention strategies, collecting and analyzing company performance as well as benchmarking against competitors, the company may be able to sustain their self-perform business model and not lose their competitive advantage.

Recommendations

The researcher recommends the following future studies to increase the body of knowledge in regard to craft worker length of employment:

1. Case studies examining the impact of analyzing readily available employee databases.
2. A regional or national replication of this study comparing geographic areas.
3. A comparison of mean length of employment for different types of construction firms including residential, commercial, and heavy civil.
4. An examination of the impact of external factors on mean length of employment such as market conditions.
5. A study to determine why medium-sized companies have a longer length of employment than small and large companies.
6. A study to determine why operators have a longer length of employment than other craft categories.
7. A study of other craft worker categories beyond carpenters, laborers, operators, and iron workers.

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APPENDIX A

INITIAL E-MAIL SENT TO POPULATION

Dear Mr. XXXXX,

This is Richard Bruce at the University of Central Missouri. I am the Program Coordinator for the B.S. in Construction Management.

I am doing some research on Missouri craft workers. My goal is to compare the mean length of employment across five hire age categories and four craft worker classifications. In order to do this, I am asking Missouri's top 21 companies (per ENR's top 400 list) to provide me with an Excel sheet with their craft workers' hire date, exit date, date of birth, and craft. This is for workers working in Missouri as far back as your database goes. I do not need any personal information on these employees.

I will be providing each company with a report showing their averages versus the group averages. I hope the companies will be able to use the benchmark data in future HR endeavors.

Please let me know if I can count on you taking part in this research. I can be reached at the contact information below.

Thank you,

Richard

Mr. Richard Bruce
Assistant Professor of
Construction Management
School of Technology
University of Central Missouri

APPENDIX B

CONVERSION OF RAW DATA

Hire Date	Exit Date	Date of Birth	Craft
6/23/03	8/4/03	4/9/1950	Carpenter
9/9/03	11/26/03	1/11/1960	Carpenter
8/17/06	3/20/07	5/17/1960	Carpenter
8/24/06	3/7/07	10/13/1959	Carpenter
9/11/06	10/31/06	11/23/1977	Carpenter
2/8/05	9/7/05	9/28/1960	Carpenter
10/31/06	8/17/07	9/18/1953	Carpenter
11/6/06	1/5/07	9/7/1974	Carpenter
7/1/02	7/11/02	12/24/1961	Laborer
7/15/02	8/2/02	10/31/1961	Laborer

Comp	Size	Labor	Hire Date	Date of Birth	Hire Age	Exit Date	Days Here	Craft
A	1	0	6/23/03	4/9/50	53.24	8/4/03	42.00	Carpenter
A	1	0	9/9/03	1/11/60	43.69	11/26/03	78.00	Carpenter
A	1	1	8/17/06	5/17/60	46.28	3/20/07	215.00	Carpenter
A	1	1	8/24/06	10/13/59	46.90	3/7/07	195.00	Carpenter
A	1	0	9/11/06	11/23/77	28.82	10/31/06	50.00	Carpenter
A	1	0	2/8/05	9/28/60	44.39	9/7/05	211.00	Carpenter
A	1	0	10/31/06	9/18/53	53.15	8/17/07	290.00	Carpenter
A	1	0	11/6/06	9/7/74	32.19	1/5/07	60.00	Carpenter
A	1	0	7/1/02	12/24/61	40.55	7/11/02	10.00	Laborer
A	1	0	7/15/02	10/31/61	40.73	8/2/02	18.00	Laborer