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# The Relationship Between Information Quality and Construction Safety

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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by

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MSIE, University of Texas at Arlington, 1987

BCE, University of Dayton, Dayton Ohio, 1981

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Fatal occupational injury is a construction and management problem in the United States. Fatality rates among specialty trade contractors made up the largest percent of fatalities in construction at 62% per year. The purpose of this nonexperimental study was to examine the relationship between the quality of information in construction safety plans and construction safety among specialty trade contractors. The theoretical foundations for the study were Petersen's accident/incident theory and work systems theory. The key research question was to examine the relationship between information quality and construction safety among specialty trade contractors. A survey with closed-ended questions was used to collect primary data from a self-selection sample of 134 specialty trade contractors in the United States. Spearman rank correlation coefficient ($r_s$) was used to measure the strength of the relationship between information quality and construction safety. Results indicated that the quality of information in construction safety plans (measured by the relevance, accuracy, timeliness, and completeness of information) did not have any statistically significant relationships with construction safety among U.S. specialty trade contractors. Further research is needed to understand if the variables used in this study are relevant predictors for construction safety. This study connects with positive social change by bringing into focus quality information systems research required to improve safety among U.S. specialty trade contractors and provide safety professionals a direction for continuous safety improvement in the U.S. construction industry, thus benefitting construction stake holders.

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# Dedication

I dedicate this dissertation to my loving and supportive family. My wife Chinyere and my children Uzoma, Ikechukwu, and Tobenna consistently provided me the support and encouragement that helped me to complete this long journey. They tolerated my long hours on the computer practically seven days a week. I thank them for understanding why I suddenly became a recluse with practically no family or social life. I would also like to dedicate this dissertation to my father HRH Igwe O.C.V. Attah who slept in the Lord on February 3, 2019, my mother Lolo M. C. Attah, my uncle Prof. Charles A. Attah, MD, and my aunt Dr. Carol Attah; they inspired me to be the best I could be socially, spiritually, academically, and professionally. They are my guiding light and moral compass. I thank them for their continuous words of encouragement. I hope I have made them proud. I now look forward to returning to normal life after this difficult but rewarding journey.

## Acknowledgments

I could not complete this research without the solid support and guidance of Walden University faculty members. I am especially grateful to my committee members who guided me through the whole process. The first committee member was my chairperson Dr. David Gould who spent several hours reviewing my work to make sure that it met high quality doctoral research. The second committee member was Dr. Keri Heitner whose expertise in quantitative research method and statistical analysis was instrumental in arriving at findings that I might generalize to larger populations. The third committee member was Dr. Kenneth Sherman, the University Research Reviewer who diligently assessed and approved the dissertation. The level of quality work in this dissertation could not have been possible without the committee's many reviews and feedback.

I am also grateful to friends and relatives I might not mention who continuously cheered me on to the successful completion of this dissertation. Finally, I acknowledge my Lord, who, without His blessing, this journey could not be possible.

Table of Contents

List of Tables

List of Figures

# Chapter 1: Introduction to the Study

Construction work is hazardous. While the construction industry and government have made improvements in construction safety and health, fatal occupational injury remains a construction and management problem in the United States (U.S. Department of Labor, Occupational Safety and Health Administration [DOL], 2014; Haupt & Pillay, 2016; Mroszczyk, 2015). U.S. construction jobs account for 5% of the workforce but account for 17% of workplace fatalities (Goetsch, 2013). Fatality rates among specialty trade contractors still make up the largest percent of fatalities in construction at 62% per year (DOL, 2014; Mroszczyk, 2015). This accident and injury rate is a significant problem.

In this quantitative study, I examined the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. Chapter 1 contains an introduction to the study, the background of the problem, problem statement, purpose of the study, research questions and hypotheses, theoretical foundations, nature of the study, definitions, assumptions, scope and delimitations, and limitations of the study. I conclude the chapter with significance of the study as it pertains to theory, practice, and positive social change. I summarize the chapter and provide a transition to Chapter 2.

## Background of the Study

Under the North American Industry Classification System (NAICS; U.S. Department of Commerce, North American Industry Classification System [DOC], 2017), the U.S. construction industry is grouped as follows: (a) construction of buildings,

(b) heavy and civil engineering construction, and (c) specialty trade contractors. The focus of my research was the relationship between information quality in safety plans and safety of specialty trade contractors. Specialty trade contractors include individuals who perform framing, roofing, heating, air conditioning, plumbing, paper hanging and painting, masonry, glass and glazing, electrical, structural steel, concrete, and excavation work (DOC, 2017). Government agencies and the construction industry have taken many steps to improve construction safety, but the industry continues to be very hazardous, especially for specialty trade contractors (Goetsch, 2013; Manu, Ankrah, Proverbs, & Suresh, 2014; Mroszczyk, 2015; Yakubu & Bakri, 2013). Fatality rates among specialty trade contractors continue to account for the largest percent of construction fatalities at about 62% per year (DOL, 2014; Mroszczyk, 2015). One reason for this continued fatality rate may be that construction sites are typically multiemployer work sites and the responsibilities for safety could become decentralized with specialty trade contractors arriving from different organizations to perform their jobs and leaving (Mroszczyk, 2015; Yakubu & Bakri, 2013). Some construction firms have safety information systems in the form of safety plans, which they use to help prevent injuries and associated expenses (Boschman, van der Molen, Sluiter, & Frings-Dresen, 2013; Cameron, Hare, & Duff, 2013). Prime contractors specifically use safety plans to help prevent accidents among their own employees (Mroszczyk, 2015), but specialty trade contractors who typically come from different organizations to the job sites rely on informal sources when they made safety decisions (Kosny et al., 2013). Prime contractors could significantly improve safety of specialty contractors through effective safety plans (Hannan, 2015).

A review of over 100 peer-reviewed articles published within the last 5 years revealed that although construction firms have safety plans (Burns & Conchie, 2014; Chileshe & Dzisi, 2012), there was no reliable research on the relationship between information quality in safety plans and safety of specialty trade contractors. Prior research existed on the relationship between information quality and variables such as e-government benefits (Alenezi, Tarhini, & Sharma, 2015; Lee & Levy, 2014), and supply chain decisions (Ge & Helfert, 2013). Through this research, I might contribute new knowledge that companies could use to help save lives of specialty trade contractors and reduce associated medical, insurance, litigation, and other costs that negatively affect company profits.

Construction professionals have disagreed on the value of written safety plans (Goetsch, 2013; Hannan, 2015; Mroszczyk, 2015). One perspective was that safety professionals could invest the time they spend developing safety plans to better use at the job site. Another perspective was that construction firms could use well-written quality safety plans to help prevent injuries, accidents, illnesses, and related expenses that could negatively affect organizations' productivity and profits. Xu and Lou (2014) posited that information loss from safety plans might contribute to safety problems among specialty trade contractors.

Hosseinian and Torghabeh (2012) posited that a majority of accidents occurred when workers disregarded safety rules as outlined in safety plans. Hosseinian and Torghabeh found that construction firms could prevent accidents by identifying the root causes of accidents using accident causation theories. Such theories with a focus on management aspects, people factors, and physical characteristics of hazards might provide a context with which to explain why fatality rates continued to be high among specialty trade contractors. Petersen's (2003) accident/incident theory was the first theoretical framework for this study; the theory holds that systems failure and human errors such as decision to err, ergonomic traps, and overload are major causes of accidents.

Previous researchers had examined the effect of information quality on safety of clinical workers (Hahn, Wanjala, & Marx, 2013) and various organizational performances (Janita & Miranda, 2013). Construction safety professionals had also continuously improved safety of workers, but construction continued to be a hazardous industry (Mroszczyk, 2015; Yakubu & Bakri, 2013). No reliable research existed on the relationship between information quality in construction safety plans and safety of specialty trade contractors who continue to account for 62% of fatal construction injuries. This study was unique and contributes new knowledge to an underresearched area of information systems management on the relationship between information quality in construction safety plans and safety of specialty trade contractors. The results of this study could be used to improve the quality of information in construction safety plans that might help improve safety among specialty trade contractors. Understanding the relationship between information quality in safety plans and construction safety might also provide insight on how management could reduce insurance costs, litigation costs, medical expenses, and disability claims that negatively affect company profits. Organizations need healthy and safe workers to achieve organizational goals in an efficient and effective manner (Manu et al., 2014). This study was needed given the accident and injury rate as noted.

## Problem Statement

Fatal occupational injury was a construction and management problem in the United States (DOL, 2014; Goetsch, 2013; Mroszczyk, 2015). The general problem was that U.S. construction jobs account for 5% of the workforce but account for 17% of workplace fatalities (Goetsch, 2013). The specific problem was that fatality rates among specialty trade contractors made up the largest percent of fatalities in construction at 62% per year (DOL, 2014; Mroszczyk, 2015). Construction firms used safety plans (safety information systems) to help prevent injuries and associated expenses that could drain a firm's profits (Boschman et al., 2013; Cameron et al., 2013). Specifically, prime contractors used safety plans to help prevent accidents among their employees (Mroszczyk, 2015), but specialty contractors such as electrical contractors relied on informal sources when they made safety decisions (Kosny et al., 2013). Information loss from safety plans might contribute to safety problems among specialty trade contractors (Xu & Lou, 2014). Prime contractors could significantly improve safety of specialty contractors through effective safety plans (Hannan, 2015). This problem was important given the accident and injury rate as noted and the costs to employees, employers, and to society.

## Purpose of the Study

The purpose of this quantitative nonexperimental design study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. I collected data from 134 participants. The dimensions of information quality covered included relevance, accuracy, timeliness, and completeness of information (Ayyash, 2015; Costa, Garciá, & Raymond, 2014; Dancer, Filieri, & Grundy, 2014) in construction safety plans. The findings from this study add to the body of knowledge in the information systems management literature on construction safety. The findings might also provide useful insight to why specialty trade contractors in the United States still made up 62% of construction fatal injuries annually. Positive social change might be achieved because the findings contribute new knowledge that companies might use to help save lives of specialty trade contractors and reduce associated medical, insurance, litigation, and other costs that negatively affect company profits.

## Research Question and Hypotheses

The dimensions of information quality covered with respect to the safety of specialty trade contractors were relevance, accuracy, timeliness, and completeness of information in construction safety plans. In accord with the problem statement and purpose statement, the following four research questions and corresponding hypotheses were addressed.

RQ1: What is the nature of the relationship between information relevance and construction safety among specialty trade contractors?

$H_0 1$: There is no statistically significant relationship between information relevance and construction safety among specialty trade contractors.

$H_a1$: There is a statistically significant relationship between information relevance and construction safety among specialty trade contractors.

RQ2: What is the nature of the relationship between information accuracy and construction safety among specialty trade contractors?

$H_02$: There is no statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

$H_a2$: There is a statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

RQ3: What is the nature of the relationship between information timeliness and construction safety among specialty trade contractors?

$H_03$: There is no statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

$H_a3$: There is a statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

RQ4: What is the nature of the relationship between information completeness and construction safety among specialty trade contractors?

$H_04$: There is no statistically significant relationship between information completeness and construction safety among specialty trade contractors.

$H_a4$: There is a statistically significant relationship between information completeness and construction safety among specialty trade contractors.

## Theoretical Foundation

The first theory for this study's framework was Petersen's accident/incident theory. Petersen (1997) developed this theory as an extension of the human factors theory of accident causation. Accident/incident theory holds that systems failure and human errors (Petersen, 2003) such as decision to err, ergonomic traps, and overload were major causes of accidents (Petersen, 2000). As applied to this study, an example of systems failure could be inadequate policy or training (Li-An & Kuo, 2013; Petersen, 1996; Zhang & Ng, 2012); an example of decision to err could be misjudgment of a risk (Taroun & Yang, 2013); an example of ergonomic traps could be incompatible workstation or tools (Lingard, Cooke, & Gharaie, 2013); an example of overload could be pressure (Goetsch, 2013). Each of these conditions could contribute to the probability of an accident or incident occurring. From this perspective, availability of quality information for effective decision-making might be necessary for the safety of specialty trade contractors. I expected that accident/incident theory might provide a context that could be used to explain the relationship between information quality and construction safety among specialty-trade contractors. I provide more detailed explanation of this theory in Chapter 2.

The second theory for this study was work system theory. Alter (2013) was the originating author of work system theory and defined a work system as "a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal and/or external customers" (p. 75). Alter posited that an information system was a work system that was used to capture, transmit, store, retrieve, delete, manipulate, and display information. As applied to this study, a construction safety plan was an information system that was a work system used to capture, transmit, store, retrieve, delete, manipulate, and display information. With respect to safety of specialty trade contractors, a construction safety plan was a work system in which a worker acting in the role of a work system participant used the information in the construction safety plan to perform activities that benefit a customer. The quality of the information in the safety plan could affect the safety of the worker. I expected that work system theory might provide a context that could be used to explain the relationship between information quality and construction safety among specialty trade contractors. I provide more detailed explanation of this theory in Chapter 2.

## Nature of the Study

The nature of this study was quantitative nonexperimental research. Based on the literature I reviewed in which researchers examined the relationship between two or more variables, the researchers used a quantitative approach (Alenezi et al., 2015; Ge & Helfert, 2013). A quantitative nonexperimental design has been a widely-used research method in social sciences (Alenezi et al., 2015). Researchers typically measure the strength of a linear association between two variables in a population by the Pearson product-moment correlation coefficient if all of the assumptions were met. The values ranged from -1 for perfect negative correlation up to +1 for perfect positive correlation. Two assumptions for using the Pearson product-moment correlation coefficient were that the variables were normally distributed and linearly related (Larson & Farber, 2003). If researchers could not meet these two assumptions, they could examine the relationship between two variables using the nonparametric equivalent to Pearson correlation coefficient known as the Spearman rank correlation coefficient ($r_s$) according to Larson and Farber (2003). The values of $r_s$ ranged from -1 to +1. If the ranks of corresponding pairs of data were identical, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1. If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero.

I used a survey with closed-ended questions to collect primary data from a sample of specialty trade contractors in the United States. Some of the survey items were Likert-type scale and others were multiple-choice questions that were easy to answer. Researchers often use surveys to elicit the views of large groups of people; the goal was to accurately generalize the findings to a larger population of interest (Timmins, 2015). Well-constructed surveys are good in terms of being quantifiable for subsequent analysis and thus important in academia and professional research (Rea & Parker, 2014). The data collected from this study were used to examine the nature of relationship between dimensions of information quality and construction safety among specialty trade contractors.

I used a self-selection sampling method to collect data. A self-selection sampling method allowed respondents to decide whether they would like to participate in the study or not. While this type of sampling strategy might have a degree of self-selection bias, the main benefit was a greater level of commitment from survey participants to fully take part and complete the survey (Dalla Valle, 2016). The main limitation was that the respondents differed from nonrespondents and therefore estimating an effect from only the respondents might confound the effect and the choice to respond (Dalla Valle, 2016). In this case the sample might be biased, because it might not represent the population it was related to, and the sample distribution of the variables might differ from the same variables in the population.

The minimum sample size for this study was 82 participants. I determined the sample size using G*Power 3.1.2 on a Pearson correlation with a generally accepted power of 0.80, a level of significance at $\alpha = 0.05$, and a medium effect size of 0.3. The survey was cross-sectional. I collected data from the participants at a single period. I adopted Lee, Strong, Kahn, and Wang's (2002) survey, AIMQ: A methodology for information quality assessment. The AIMQ instrument had been validated; Alenezi et al. (2015) adopted it. Appendix A contains permission letters to use the instrument.

## Definitions

I provide the following selected definitions to help clarify key terms I used in the study:

*Construction safety:* Construction safety was based on Bureau of Labor Statistics occupational injury and illness classification system 2.01 implemented for 2011 data forward (DOL, 2014). Construction safety referred to how safe participants felt in their construction work environments based on the relevance, accuracy, timeliness, and completeness of information in construction safety plans. Participants' feelings about safety in their construction work environments might depend on the rate of:

- violence and other injuries by persons or animals;

- transportation incidents;
- fires and explosions;
- falls, slips, trips;
- exposure to harmful substances or environments; and
- contact with objects and equipment.

*Construction safety plan:* Construction safety plan was an information work system used to capture, transmit, store, retrieve, delete, manipulate, and display information (Alter, 2013; Goetsch, 2013).

*Decision to err:* Decision to err could be unconscious or it could be conscious and based on logic. Different pressures such as peer pressure, deadlines, and budget factors might influence a person to decide to behave in an unsafe manner (Taroun & Yang, 2013).

*Ergonomic traps:* Ergonomic traps referred to such things as incompatible workstations and tools (Lingard et al., 2013).

*Information accuracy:* This term meant that accurate information reflected the underlying reality. Information could be too accurate when its degree of precision exceeded the processing capability of its customer (Alenezi et al., 2015; Ayyash, 2015).

*Information completeness:* Information completeness was described as the robustness of information in terms of its depth and breadth to address the task that needed completion (Costa et al., 2014; Lee & Levy, 2014).

*Information quality:* Information quality referred to the quality of the content of information systems (Alenezi et al., 2015; Ayyash, 2015; Janita & Miranda, 2013). Along this line, information quality was defined as the fitness for use of the information provided (Ge & Helfert, 2013; Hahn et al., 2013).

*Information relevance:* This term was used to describe the extent to which information could be applied and be helpful to perform the task at hand (Dancer et al., 2014; Ge & Helfert, 2013).

*Information system:* In this context, information system was a work system whose activities and processes were completely devoted to processing information through activities that included capturing, transmitting, storing, retrieving, manipulating, deleting, and displaying information (Alter, 2013).

*Information timeliness:* Informaiton timelinss indicated that timely information was still current. This implied a dynamic process where new information became available to replace the old information (Ayyash, 2015; Dancer et al., 2014).

*North American Industry Classification System (NAICS):* NAICS was the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy (DOC, 2017).

*Overload:* This term referred to factors such as pressure, motivation, fatigue, alcohol, drugs, and worry (Goetsch, 2013).

*Prime contractor:* A prime contractor was a business firm that had a contract with the owner for the construction of a project, either for the whole project or for some portion of the project (Clough, Sears, Sears, Segner, & Rounds, 2015).

*Specialty trade contractor:* A specialty trade contractor was a contractor who performed a specific trade or craft on a construction project. According to the DOC (2017), the NAICS code for specialty trade contractors was 238. The primary subgroups within specialty trades were foundation, structure, and building exterior contractors (NAICS code 2381); building equipment contractors (NAICS code 2382); building finishing contractors (NAICS code 2383); and other specialty trade contractors (NAICS code 2389).

*Systems failure:* In this context, systems failure showed the potential for a causal relationship between management decisions/management behavior and safety. It also established broader concepts of safety in the workplace (Li-An & Kuo, 2013; Zhang & Ng, 2012).

*Work system:* Work system was a general case for thinking about systems in or across organizations. An important special case that inherited most of the properties that were applicable to the general case was an information system (Alter, 2013).

## Assumptions

The following assumptions were necessary in the context of the study.

- Participants taking the survey would be representative of the population covered under NAICS Code 238, which was the construction industry subgroup for specialty trade contractors.
- Participants would be able to understand and provide honest answers to the survey questions on information relevance, information accuracy, information

timeliness, and information completeness in relation to construction safety information system/safety plans.

- Participants would be able to understand and provide honest answers to the survey questions on measures of systems failure, overload, ergonomic traps, and decision to err consistent with Petersen's accident/incident theory.
- Participants would be able to understand and provide honest answers to the survey questions on accident that they had had or were aware of that occurred in the workplace.
- Participants would be able to understand and provide honest answers to the survey questions on how their organizations captured, transmitted, stored, retrieved, deleted, manipulated, and displayed information consistent with work system theory.
- Information on websites of DOL, Occupational Safety and health Administration (OSHA), and Bureau of Labor Statistics was relevant, accurate, timely, and complete.
- The instrument AIMQ: A methodology for information quality assessment survey by Lee et al. (2002) that I adopted had been validated.

## Scope and Delimitations

The focus of this study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors in the United States. The dimensions of information quality covered were relevance, accuracy, timeliness, and completeness of information (see Ayyash, 2015; Costa et al., 2014; Dancer et al., 2014) in construction safety plans. A review of the literature showed more dimensions of information quality such as accessibility and compatibility. I limited the coverage of dimensions of information quality to relevance, accuracy, timeliness, and completeness of information. Regarding my population of research interest, I selected specialty trade contractors because fatality rates among this subgroup still made up the largest percent of fatalities in construction at about 62% per year. The two remaining construction subgroups that I excluded from the study were construction of buildings and heavy/civil engineering construction; they accounted for about 22% and 16% fatality rates per year respectively (DOL, 2014; Mroszczyk, 2015). I selected specialty trade contractors because of the high fatality rate as noted. I also selected this subgroup because prime contractors used safety plans to help prevent accidents among their employees (Mroszczyk, 2015) but specialty trade contractors such as electrical contractors relied on informal sources when they made safety decisions (Kosny et al., 2013). My literature review revealed that there was no reliable research on the relationship between information quality in construction safety plans and safety of specialty trade contractors. This study might be generalized to the two remaining construction subgroups that included construction of buildings and heavy/civil engineering construction.

## Limitations

A few limitations might affect the results of this study. I focused the study on one subgroup of the construction industry: specialty trade contractors in the United States drawn from a SurveyMonkey audience. I did not consider the other two construction industry subgroups comprising construction of buildings and heavy/civil engineering construction. There could be situations when employees of prime contractors under these two subgroups could perform framing, roofing, heating, air conditioning, plumbing, paper hanging, painting, masonry, glass and glazing, electrical, structural steel, concrete, and excavation work that specialty trade contractors typically performed (Mroszczyk, 2015).

The way participants feel about construction safety in their work environments during the data collection period could be different from the way they feel at another period in time. Other limitations in social research that might influence the outcomes of this study included biased responses, spurious or false correlations, and not enough time for participants to complete the surveys. Some survey questions were categorized and this might force participants to respond in certain categories that limited their range of responses. Another limitation was that construction firms where study participants came from might not have construction safety information system/safety plans that would allow participants to answer questions pertaining to information relevance, information accuracy, information timeliness, and information completeness. This study took the form of nonexperimental correlational research design. A limitation of this research design was that researchers might not be able to identify or measure other variables that might influence the relationships being measured; researchers might therefore not be able to infer causality.

I used a self-selection sampling method to collect data from a sample of specialty trade contactors under the NAICS code 238. Self-selection sampling method allowed respondents to decide whether they would like to participate in the study or not. The main limitation was that the respondents differed from nonrespondents and therefore estimating an effect from only the respondents might confound the effect and the choice to respond (Dalla Valle, 2016). In this case the sample might be biased, because it might not represent the population it was related to, and the sample distribution of the variables might differ from the same variables in the population.

## Significance of the Study

### Significance to Theory

A critical gap in the information systems management literature could be filled with this research. After reviewing more than 100 peer-reviewed scholarly articles published within the last 5 years, there was a need to study the relationship between information quality in construction safety plans and safety of specialty trade contractors. Although previous researchers had examined the effect of information quality on safety of clinical workers (Hahn et al., 2013) and various organizational performances (Janita & Miranda, 2013), there was little literature on the nature of relationship between information quality and construction safety among specialty trade contractors. This study added new knowledge to this underresearched area of information systems management.

### Significance to Practice

Though firms had made improvements in construction safety, construction continued to be a hazardous industry (Yakubu & Bakri, 2013) and specialty trade contractors accounted for the largest proportion of construction fatalities (Mroszczyk, 2015). Specialty trade contractors were engaged in concrete work, masonry, carpentry, structural steel work, excavation work, plumbing, electrical, heating, air conditioning, painting and paper hanging. Understanding the relationship between information quality in safety plans and construction safety might provide insight on how management could reduce insurance costs, litigation costs, medical expenses, and disability claims that negatively affected company profits. Other significance to industry could be improved productivity, reduced number of compliance inspections and associated penalties, and more contracts for firms because of good reputation. More contracts for firms could ultimately result in improved national economy.

**Significance to Social Change**

Organizations need healthy and safe employees to achieve organizational goals in efficient and effective manner (Manu et al., 2014; Shields, 1994). A significance of this research to positive social change might be that the results could be used to improve the quality of information in construction safety plans that might help improve construction safety among specialty trade contractors. Another positive social change could be reduction in time-consuming and expensive trials and appeals in the U.S. court system. The findings from this study could also lead to collective movement by specialty trade contractors to bring about positive change in the norms, values, and ideologies of the existing construction safety system. This change might ultimately help create economic prosperity that might lead to improved standard of living among specialty trade contractors that work in the United States. Through this research, I might contribute new knowledge that companies might use to help save lives of specialty trade contractors.

## Summary and Transition

Construction work is hazardous. Among the different industrial sector jobs, construction continued to be one of the most hazardous. While the construction industry and government had made improvements in construction safety and health, fatal occupational injury remained a construction and management problem in the United States. While U.S. construction jobs accounted for 5% of the workforce, they accounted for 17% of workplace fatalities (Goetsch, 2013). Among the three construction subgroups as defined in NAICS, fatality rates among specialty trade contractors still made up the largest percentage of fatalities in construction at about 62% per year (DOL, 2014; Mroszczyk, 2015). Because of this high fatality rate among specialty trade contractors, there was a need to conduct this study. The implications for positive social change might be new knowledge that companies could use to help save lives of specialty trade contractors and reduce associated medical, insurance, litigation, and other costs that negatively affect company profits. The construction sector could ultimately generate additional economic prosperity that might lead to improved standard of living among specialty trade contractors in the United States.

I examined the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors in this quantitative study. Chapter 1 contains an introduction to the study, the background of the problem, problem statement, purpose of the study, research questions and hypothesis, theoretical foundations, nature of the study, definitions, assumptions, scope and delimitations, and limitations of the study. It also contains significance of the study as it pertained to theory, practice, and positive social change. In Chapter 2, I review, synthesize, and integrate supporting literature concerning information quality in safety plans and construction safety among specialty trade contractors. I also analyze the views and findings of other management scholars in Chapter 2 to respond to the research questions of the study. In Chapter 3, I explain the research methods, design of the study, the sample and target population, and the methods/processes of data collection and analysis.

# Chapter 2: Literature Review

In this literature review, I examine, synthesize, and integrate supporting literature on the relationship between information quality and construction safety. The general problem was that while U.S. construction jobs accounted for 5% of the workforce, they accounted for 17% of workplace fatalities (Goetsch, 2013). The specific problem was that among the three NAICS construction industry groups, fatality rates among specialty trade contractors continued to make up the largest percent of fatalities at about 62% per year (DOL, 2014; Mroszczyk, 2015).

Prime contractors used safety plans to help prevent accidents among their employees (Mroszczyk, 2015), but specialty contractors such as electrical contractors relied on informal sources when they made safety decisions (Kosny et al., 2013). Prime contractors could significantly improve safety of specialty contractors through effective safety plans (Hannan, 2015). A review of more than 100 peer-reviewed articles published within the last 5 years revealed that although construction firms had safety plans (Burns & Conchie, 2014; Chileshe & Dzisi, 2012), there was no reliable research on the relationship between information quality in construction safety plans and safety of specialty trade contractors.

The purpose of this quantitative nonexperimental design study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors in United States. The major sections of this chapter include literature search strategy, theoretical foundations, literature review, and summary and conclusions.

## Literature Search Strategy

The literature review covered information systems theories and accident causation theories leading to a significant problem, research topic, and research questions. The concept of accident causation encompassed theories central to the evolution and implementation of safety improvement measures. I reviewed, compared, and contrasted various scholarly research perspectives on information quality and construction safety. I organized the literature review according to major themes that emerged during my research.

Information used in the literature review was from peer-reviewed journal articles, books, and government sources. At least 80% of the articles were within the last 5 years. I accessed the following database sources from the Walden University library: Academic Search Premier, ABI/INFORM Complete, Business Source Complete/premier, ERIC, Google Scholar, ProQuest Dissertation & Theses Professional, ProQuest Technology Research Professional, ProQuest Central, ICPSR – Inter-University Consortium for Political and Social Research Datasets, Science Direct, SAGE Premier, Emerald Management Journals, Management & Organization Studies: a SAGE full-text collection, Communications of the ACM, and Computers & Applied Sciences. Key search terms included: *information quality, information quality analysis, information quality assessment, information quality improvement, information accuracy, information completeness, information relevance, information system, information timeliness, North American Industry Classification System, overload, prime contractor, general contractor, specialty trade contractor, specialty contractor, systems failure, work system, total data* *quality management*, *construction safety*, *construction accident*, and *construction safety plans*.

## Theoretical Foundation

Researchers from a wide range of construction management areas agreed that safety of construction workers was a major concern in the construction industry and that conducting further research on construction safety was important (DOL, 2014; Goetsch, 2013; Mroszczyk, 2015). Legal liability was a constant issue in the construction industry because of the hazardous nature of construction work (Ivensky, 2015; Rebbitt & Erickson, 2016). Ivensky (2015) argued that without a well-defined duty of safety care in OSHA regulations recognizing safety-related duties to specialty trade contractors that work on multiemployer project sites, safety liability was a major challenge for any prime contractor hiring specialty contractors. The courts might hold a prime contractor partially liable for the safety of workers even when the prime contractor was not the direct employer of the workers. Courts, for example, might assign shared liability to both the prime contractor and a specialty trade contractor who worked on the prime's project when an employee of the specialty trade contractor sustained an injury. The concept of shared liability tended to promote lawsuits and encouraged courts to at least partially hold prime contractors liable for actions of their specialty trade contractors (Ivensky, 2015; Rebbitt & Erickson, 2016). The justification was that if the prime contractors were unaware of unsafe conditions, they should have been aware of such conditions. Consequently, there was a need for prime contractors to implement safety measures that protected all workers. Prime contractors typically used safety plans to help prevent accidents among their employees (Mroszczyk, 2015), but specialty trade contractors such as electrical contractors relied on informal sources when they made safety decisions (Kosny et al., 2013). Prime contractors could significantly improve safety of specialty trade contractors through effective construction safety plans that applied to all workers on a job site. The theoretical foundations for this research were based on Petersen's (2003) accident/incident theory and Alter's (2013) work system theory.

**Petersen's Accident/Incident Theory**

Petersen's (2003) accident/incident theory was an extension of human factors theory of accident causation depicted in Figure 1.

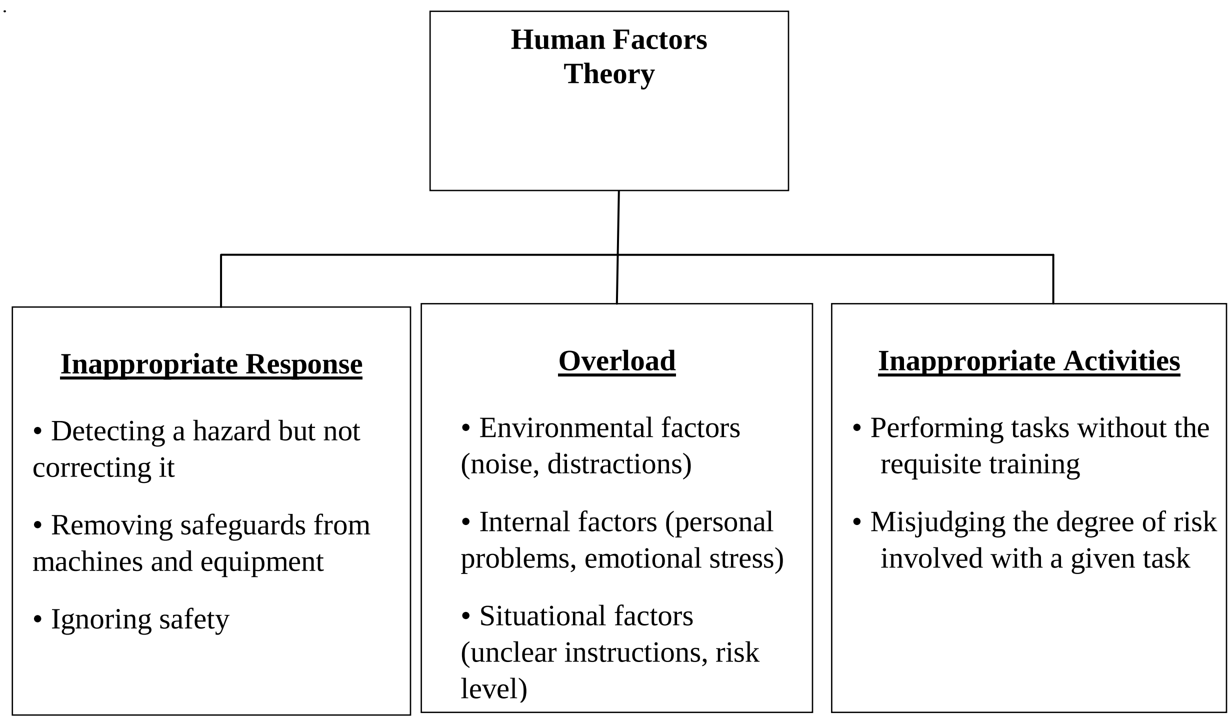


*Figure 1.* A schematic illustration of human factors theory.

Human factors theory held that accidents resulted from a chain of events that were ultimately caused by human error broadly classified into three factors: inappropriate response, overload, and inappropriate activities (Petersen, 2003). Petersen later introduced new elements such as decision to err, ergonomic traps, and systems failure as shown in Figure 2 while keeping much of the human factors theory (Petersen, 2003). The underlying assumption of Petersen's accident/incident theory was that systems failure and human errors such as ergonomic traps, overload, and decision to err were major causes of accident.

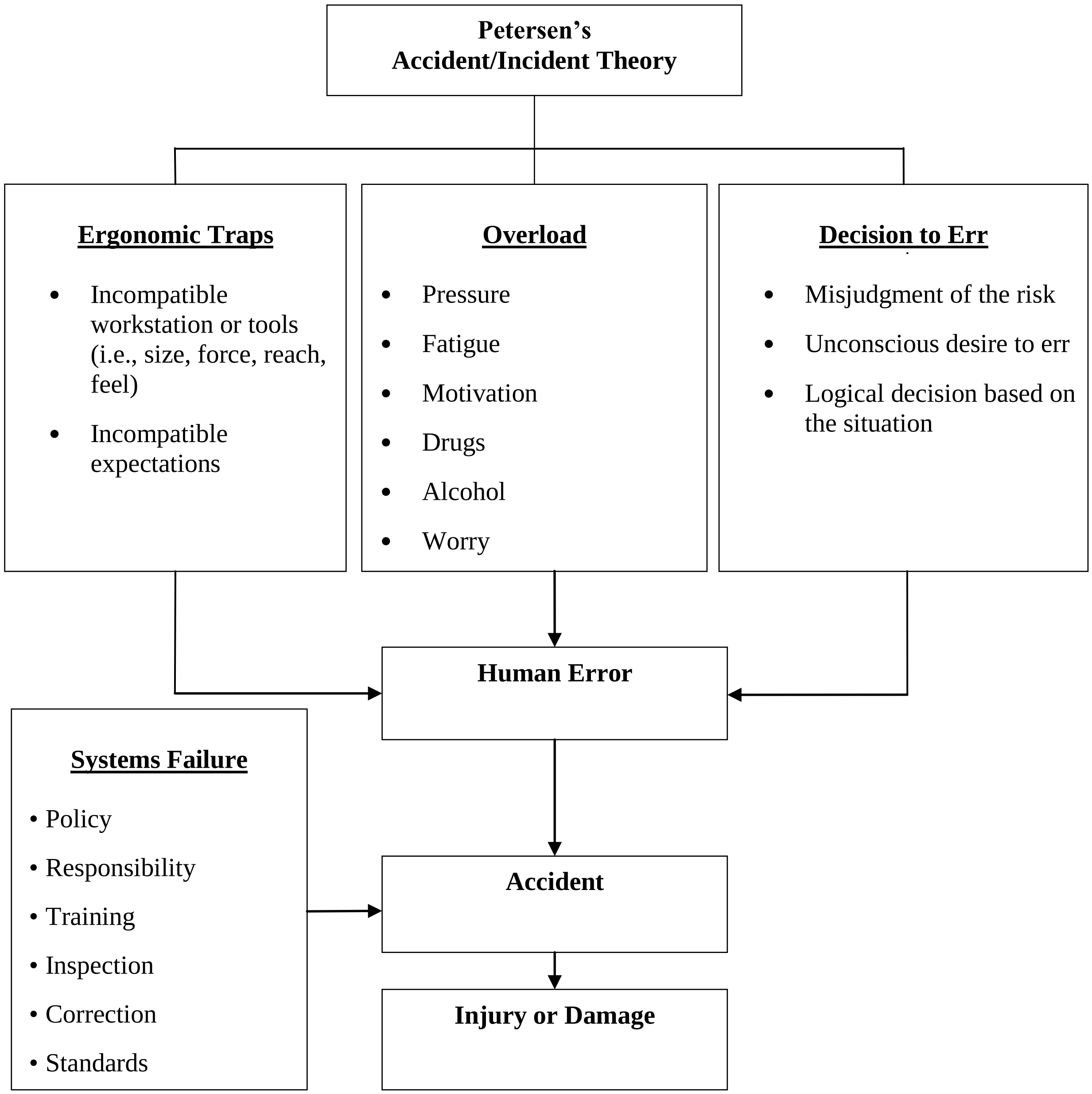


*Figure 2.* A schematic illustration of Petersen's accident/incident theory.

**How theory had been applied previously.** Petersen's (2003) accident/incident theory provided a basis for understanding the relationship between information quality in construction safety plans and construction safety among specialty trade contractors.

Petersen (2003) argued that an accident or incident was a result of (a) systems failure, and (b) a human error. Petersen noted that systems failure highlighted the potential for a causal relationship between safety and management behavior/management decisions. Systems failure covered typical safety management areas such as:

- management's policy on safety,
- an individual's responsibility and degree of responsibility,
- safety training/orientation requirements,
- systems used for inspections to determine what went wrong,
- systems used to correct what went wrong, and
- standard operating procedures and standards used.

Human error, which Petersen argued was the second cause of an accident or incident resulted from one or a combination of ergonomic traps, overload, and decision to err.

- Ergonomic traps involved human factor concepts. Incompatibility was an example of a trap that caused a worker to err because the work situation was not compatible with the worker's physique or what the worker was used to.
- Overload was about a worker's capacity which was the product of factors such as the worker's training, natural ability, stress, fatigue, state of mind, and physical condition.
- Decision to err involved some situations that seemed logical to the worker to select the unsafe act. A reason for this choice might be that the worker just did not believe that an accident would occur because of low perceived probability.

In support of this theory, Manuele (2013) agreed that management should develop work systems/methods that would help reduce injuries and fatalities in the workplace. Manuele also argued that the first step firms should take when human errors occurred was to examine workplace design and methods. Mroszczyk (2015) found that injuries and fatalities might occur because construction workers might be untrained, fatigued, distracted, or have language barriers. Mroszczyk also noted that safety responsibilities could become decentralized when multiple employers were on a job site.

**Rationale for the choice of theory.** The U.S. construction industry was marred by injuries and fatalities (Mroszczyk, 2015). While U.S. construction jobs made up 5% of the workforce, they accounted for 17% of workplace fatalities (DOL, 2014; Goetsch, 2013; Haupt & Pillay, 2016; Mroszczyk, 2015). Technological advances and increased regulations had forced construction workers to specialize so that they could keep up with all the new knowledge in the field (Mroszczyk, 2015). Specialization usually promoted deeper knowledge within a field, but it decreased understanding and knowledge across fields (Goetsch, 2013). This lack of understanding could increase the probability of accidents occurring when various specialists were working on the same project at a job site. Due to changes in the construction industry over the years, specialty trade contractors performed some of the work that prime contractors used to perform in the past. Fatality rates among specialty trade contractors continued to account for the largest percent of fatalities in construction at 62% per year (DOL, 2014; Mroszczyk, 2015). Prime contractors typically used safety plans to help prevent accidents among their employees (Mroszczyk, 2015), but specialty trade contractors relied on informal sources to make safety decisions (Kosny et al., 2013). Goetsch (2013) argued that a well-written construction safety plan could help prevent injuries, accidents, and associated expenses that could drain a firm's productivity and profits. Prime contractors could significantly improve safety of specialty trade contractors through effective construction safety plans that applied to all workers on a job site. The focus of this study was to understand the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. I expected that Petersen's accident/incident theory would provide a framework for examining this relationship.

**How theory related to present study.** Specialty trade contractors worked within a construction system where ergonomic traps, overload, decision to err, and systems failure were constantly present. As applied to this study, an example of systems failure could be inadequate policy or training (Li-An & Kuo, 2013; Zhang & Ng, 2012); an example of decision to err could be misjudgment of a risk (Taroun & Yang, 2013); an example of ergonomic traps could be incompatible workstation or tools (Lingard et al., 2013); an example of overload could be pressure (Goetsch, 2013). Each of these conditions could contribute to the probability of an accident or incident occurring. From this perspective, availability of quality information for effective decision-making might be necessary for the safety of specialty trade contractors. The premise of Petersen's (2003) accident/incident theoretical lens would encapsulate investigating the relationship between quality of information in construction safety plans and construction safety among specialty-trade contractors. The systems failure component of Petersen's (2003) accident/incident theory complemented work system theory, which was the second theoretical framework for this study.

How research questions related to, challenged, or built upon existing theory. In an attempt to challenge or build upon the existing theory, I hoped to test the theory by examining the nature of the relationship between information quality in construction safety plans (an example of information system) and construction safety among specialty trade contractors. The dimensions of information quality I covered included relevance, accuracy, timeliness, and completeness of information (Ayyash, 2015; Costa et al., 2014; Dancer et al., 2014). With these, I hope to answer the research questions. The findings, through the research questions, might either challenge or build upon the existing theory by contributing new knowledge to the information systems management field.

**Work System Theory**

Alter (2013) was the originating author of work system theory. Alter defined a work system as "a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal and/or external customers" (p. 75). Alter posited that an information system was a work system that was used to capture, transmit, store, retrieve, delete, manipulate, and display information. Some of the fields in which various researchers had applied work system theory included information systems, operations management, industrial engineering, computer science, enterprise architecture, business process management, and service science.

**How theory had been applied previously.** Murthy and Marjanovic (2014) presented a transition process from a product-centric to a customer-centric service in a complex financial organization. Murthy and Marjanovic examined the transition process through the theoretical lens of work system theory. Other researchers previously presented arguments that service systems could be seen as work systems. Work system theory allowed the researchers to capture the three key phases of the transition process as work systems snapshots and showed how the transitions occurred from one phase to another. The theory also allowed an in-depth study of the transition process through the complex and unfolding interplay of customers, strategy, products and services, people, processes, information and technology, while tracing the key success factors and challenges. The above applications were similar to the current study because a construction safety plan was an information system, which was a work system that covered interplay of such elements as safety strategy, construction processes and activities, employees as participants, roles and responsibilities, policies and procedures, information, technologies, and customers.

**Rationale for the choice of theory.** I chose this theory because Alter (2013) stated that “work system is a general case for thinking about systems in or across organizations” (p. 77). Alter further stated that information systems were work systems whose activities and processes were completely devoted to processing information through activities that were used to capture, transmit, store, retrieve, delete, manipulate, and display information. A construction safety plan was an information system, which was a work system used to capture, transmit, store, retrieve, delete, manipulate, and display information. With respect to safety of specialty trade contractors, a construction safety plan was a work system in which a worker acting in the role of a work system participant used the information in the construction safety plan to perform activities that benefit a customer. Work system theory might provide a context which could be used to explain the relationship between the quality of information in construction safety plans and construction safety among specialty trade contractors.

**How theory related to present study.** In relation to this study, specialty trade contractors were human participants that performed work (construction processes and activities) using information from construction safety plans, various construction technologies, and other resources to construct projects for prime contractors. As applied to this study, a construction safety plan was an information system, which was a work system used to capture, transmit, store, retrieve, delete, manipulate, and display information. The quality of the information in the construction safety plan could affect the safety of the worker.

**How research questions related to, challenged, or built upon existing theory.** In an attempt to challenge or build upon the existing theory, I planned to test the theory by examining the nature of the relationship between information quality in construction safety plans (an example of information system) and construction safety among specialty trade contractors. The elements of the safety plan I covered included construction processes and activities, participants, information, and technologies. The dimensions of information quality I covered included relevance, accuracy, timeliness, and completeness of information (Ayyash, 2015; Costa et al., 2014; Dancer et al., 2014) in the safety plan.

With these, I hoped to answer the research questions. The findings, through the research questions, might either challenge or build upon the existing theory by contributing new knowledge to the information systems management field.

## Literature Review

### Literature Related to Key Variables and Concepts

In this quantitative nonexperimental design study, I examined the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. Consequently, I examined, synthesized, and presented construction safety plans using Petersen's accident/incident theory (Petersen, 2003) and work system theory (Alter, 2013) to underscore the need for examining and uncovering the relationship between information quality in construction safety plans and the safety of specialty trade contractors. I focused my discussion on the following: (a) reasons for having a written construction safety plan, (b) elements of a construction safety plan, (c) communicating the construction safety plan to specialty trade contractors, and (d) evaluating the quality of information in construction safety plans.

Construction professionals disagreed on the value of written safety plans; an often prevailing criticism in the construction industry was that safety professionals could put the time spent writing safety plans to better use at the jobsite (Goetsch, 2013; Rebbit & Erickson, 2016). Whenever the subject of discussion involved written safety plans, terms like bureaucracy, red tape, paperwork, and counterproductive usually dominated the discussion (Rebbit & Erickson, 2016). Other researchers argued that well-written safety plans might help prevent injuries, accidents, and related expenses that could negatively affect a company’s overall performance (Manuele, 2013; Mroszczyk, 2015; Rajendran, Clarke, & Andrews, 2012). I discussed the reasons for a written safety plan next.

**Reasons for a written safety plan.** Rajendran, Clarke, and Andrews (2012) argued that some of the reasons construction firms should develop and maintain written safety plans would be due to ethical factors, regulatory factors, economic factors, and practical factors. From an ethical perspective, it was the right thing to do. From a regulatory perspective, there were government regulations that required construction firms to maintain a safe work environment. In terms of economic factors, an unsafe work environment could be costly. The practical reason for maintaining a written safety plan was that it was the best way to create a high-quality (Carder, 1994) work environment. Rajendran, Clarke, and Andrews posited that having a written plan would force construction firms to document their commitment to safety. Bjornsen, Nash, and Jones (2012) also argued that effective planning and implementation of a comprehensive written safety plan were necessary for a safe construction project. Dabbs (2015) found that designing detailed processes was essential, but they must be easy to follow so that every employee would have a clear understanding of expectations. Firms should also use subject-matter experts to design safety policy and procedures to ensure better policy development and compliance. Dabbs also suggested soliciting diverse opinions from employees who built the projects and from in-house safety teams to identify areas of concern and addressed real problems at the project site. I discussed the elements of a construction safety plan next.

**Elements of a construction safety plan.** As noted previously, construction safety plan was an information system which was a work system used to capture, transmit, store, retrieve, delete, manipulate, and display information. The guidelines from federal and state agencies for the construction industry (Goetsch, 2013; Manuele, 2013; Mroszczyk, 2015) was that a construction safety plan should minimally contain safety and health policy, safety and health goals, roles and responsibilities, discipline policy and standard operating procedures, job site inspections, accident investigations, record keeping, and training. The quality of information with respect to the suggested elements in a safety plan as measured by the relevance, accuracy, timeliness, and completeness of information might relate to the safety of specialty trade contractors. I discussed the suggested elements of a construction safety plan in the next few paragraphs.

*Safety policy and safety goals.* Hannan (2015), Manuele (2013), and Mroszczyk (2015) supported Petersen (2003) safety policy hypothesis. The authors argued that management commitment to safe job sites was critical; a written safety plan was evidence of management commitment and the most important component of the plan was the safety policy. Hannan, Manuel, and Mroszczyk did not address how the quality of information in the safety plan might affect safety of specialty trade contractors. Chileshe and Dzisi (2012) argued that a safety policy indicated that a firm was committed to having a safe work environment and such work environment was a high priority; they did not mention how a firm could evaluate the policy for effectiveness. Burns and Conchie (2014) argued that in addition to the safety policy, management should include a set of goals that translate the policy into measurable actions. Garber, Betit, Watters, and

Lippy (2014) noted that the safety policy described management's commitment in broad terms but the safety goals were more specific and measurable; they added that the safety goals should be challenging enough to the firm but realistic enough to be credible. The information about safety policy and safety goals should also be of high quality, otherwise, management might send confusing messages (Bahn & Barratt-Pugh, 2014). In this study, I examined the relevance, accuracy, timeliness, and completeness of information on safety policy and safety goals, and how they related to the safety of specialty trade contractors.

*Roles and responsibilities.* Cameron et al. (2013) believed that management, supervisors, employees, and safety professionals had roles and responsibilities in maintaining a safe work environment. One of management's responsibilities would be to organize, direct, control, evaluate, and revise the overall safety program. Management should set clear safety expectations and requirements for all job functions. Keeping everyone continuously engaged in the process was important. Understanding the role each individual played to maintain safe conditions was equally important. Cameron et al. posited that supervisors would represent management level closest to employees on a daily basis. Employees' responsibilities would involve maintaining a quality work environment by working safely themselves and demanding that their coworkers did the same. Safety professionals would direct, coordinate, and facilitate the company's overall safety program especially in medium-sized and larger construction companies. Specific duties for safety professionals included hazard analysis, safety audits, accident investigations, job-site inspections, record keeping, training, and reporting (Goetsch, 2013; Hannan, 2015). I examined the relevance, accuracy, timeliness, and completeness of information on roles and responsibilities, and how they related to the safety of specialty trade contractors.

*Discipline policy.* A critical element of a safety plan was accountability because simply developing rules and explaining them to employees were not sufficient; failure to adhere to the rules should result in consequences (Cameron et al., 2013; Mroszczyk, 2015). Sparer and Dennerlein (2017) further argued that consequences should be included in the discipline policy section of a construction safety plan because a safety plan without a section on discipline made the plan worthless. Sparer and Dennerlein posited that safety professionals should clearly explain in the discipline section of the safety plan that all employees at all levels were required to comply with applicable safety rules and that when in doubt, employees should err on the side of safety. I examined the relevance, accuracy, timeliness, and completeness of information on discipline policy, and how they related to the safety of specialty trade contractors.

*Job-site inspections.* Another important element of a company's construction safety plan was job-site inspections (Goetsch, 2013; Rebbitt & Erickson, 2016; Yakubu & Bakri, 2013). Job-site inspections were proactive measures that ensured a high-quality workplace because they allowed safety professionals to identify and eliminate potential hazardous conditions that might cause accidents and injuries. Rebbitt and Erickson noted that safety audit, which was the duty of safety professionals was an effective way to conduct a job-site inspection. Goetsch further argued that a safety audit involved development of a check list that was designed for a specific job site and using it as a guideline when conducting the audit. I examined the relevance, accuracy, timeliness, and completeness of information on job-site inspections, and how they related to the safety of specialty trade contractors.

*Accident investigations.* The construction safety plan should also contain a section that explained how to conduct accident investigations and who would conduct the investigations (Hosseinian & Torghabeh, 2012). Hosseinian and Torghabeh argued that because all hazards in construction jobsites were not always possible to be identified and eliminated, effective accident investigation programs were important for collecting key data. In support of this view, Haupt and Pillay (2016) argued that supervisor's safety training should cover how to conduct comprehensive accident investigation and also how to complete the required form. Karakhan (2017) stated that safety personnel could identify root causes by conducting thorough and effective incident investigations that were both prospective and retrospective; the reason was that lessons learned from investigating incidents would be incorporated into continuous improvement efforts. Based on the literature review, none of the authors addressed how the quality of information required for accident investigation related to safety of specialty trade contractors. I examined the relevance, accuracy, timeliness, and completeness of information on accident investigations, and how they related to the safety of specialty trade contractors.

*Record keeping.* Another suggested element of a construction safety plan was record keeping. Yilmaz and Çelebi (2015) found that minor occupational accidents were neither sufficiently considered nor even recorded. Yilmaz and Çelebi found that these types of minor occupational accidents contributed to major financial losses in workplaces. Cameron et al. (2013) earlier argued that in large companies, safety and health professionals were responsible for record keeping while designated employees were responsible for record keeping in smaller companies. Goetsch suggested that there should be a clear explanation in the comprehensive safety plan who was responsible for record keeping. I examined the relevance, accuracy, timeliness, and completeness of information on record keeping, and how they related to the safety of specialty trade contractors.

*Training.* Petersen (2003) argued that deficiencies in training could result in systems failure which in turn could result in an accident. Mroszczyk (2015) supported this view and stated that the training element in construction safety plan was critical because deficiencies in training could result in employees making poor choices such as taking shortcuts to save time and effort, overlooking safety when confronted with a heavy work schedule, and misperception of the risk. All these could result in human error which in turn could result in an accident. Both authors argued that safety training should be compulsory for every new employee as part of the employees orientation. Ivensky (2015) added that each new employee should receive job-site specific training before that employee would be allowed to resume work. Hannan (2015) added that management should communicate new information to employees while simultaneously refreshing old information through periodic training. None of the authors mentioned anything about the quality of information required for the training element. I examined the relevance, accuracy, timeliness, and completeness of information on training, and how they related to the safety of specialty trade contractors. The next section is a discussion on communicating the construction plan to specialty trade contractors.

**Communicating the safety plan.** Xu and Luo (2014) found that the information flow during the construction phase was different from information flow during the design stage. Information management system was not broadly used on a job site as it was used for design. Xu and Luo reported that only 5% of specialty trade contractors used information technology daily. Because of this, Hannan (2015) suggested that the prime contractors could improve safety performance significantly by using proven communication strategies with specialty trade contractors. Some of these strategies might be face-to-face meetings, bulletin board notices, posters and signs, new employee orientations, and setting positive examples. Hannan noted that the prime contractor was obligated to flow down safety requirements that complemented performance objectives of the project. The implication was that a safety plan would not be a program until it was implemented and implementing the plan meant that employees had to understand and know the contents of the safety plan.

**Evaluating the quality of information in safety plans (the work system).** Guo and Yu (2012) noted that due to the high rate of injuries and deaths in the construction industry, it was urgent and necessary to find ways to improve safety performance of construction workers. The authors suggested evaluating safety related issues such as safety climate, personal issues, and safety behavior. The goal of the overall safety process would be to recognize and eliminate hazards that might lead to injuries. Brooks (2015) found that a job safety analysis provided a method that invited employees to participate in the safety process. Brooks argued that safety professionals should conduct job safety analysis and evaluation in the area in which workers performed the task because it provided a structured opportunity to focus the employees' awareness of potential hazards in relation to the task being performed. Brooks also suggested the use of a checklist for the evaluation. With respect to this study, I used some of the suggested elements of a construction safety plan to evaluate the quality of information in the safety plan in relation to the safety of specialty trade contractors. I included some of the recommended elements of a construction safety plan in the survey questionnaire.

**Chosen Methodology and Methods Consistent with Scope of Study**

Researchers considered several research methods or designs for a given study. The literature I reviewed revealed that researchers had used quantitative, qualitative, or a combination of quantitative and qualitative methods known as mixed methods in their studies to examine construction safety in the workplace. Based on the nature of my study, a quantitative approach was more appropriate. For quantitative studies, researchers could use experimental, quasiexperimental, and nonexperimental research designs (Leedy & Ormrod, 2005). I used a correlational research design, which was a type of nonexperimental research design as it was more consistent with the scope of my study. Cook and Cook (2008) noted that correlational research design choice was consistent with research designs needed to advance knowledge in information systems management field because researchers could use it to confirm or refute suspected relationships between or among the variables being studied. Researchers could use a correlational research design to confidently predict the flow of events from a close analysis of one set of related events (Cook & Cook, 2008; Curtis, Comiskey, & Dempsey, 2016). Researchers typically measured the strength of a linear association between two variables in a population by the Pearson product-moment correlation coefficient. The values ranged from -1 for perfect negative correlation up to +1 for perfect positive correlation. Consistent with the scope of the proposed study, I examined the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. The dimensions of information quality I covered were information relevance, information accuracy, information timeliness, and information completeness.

**Research Approaches Other Researchers Used**

This section included literature on research approaches other researchers who had published articles on information quality and construction safety used. An understanding of the types of research methods other researchers used in these areas helped in the selection of an appropriate research approach for this study. In the next few paragraphs, I synthesized studies related to information quality and construction safety to produce a description of what was known about the variables, possible mixed findings by researchers, and what remained to be studied as they related to the research questions.

Hallowell, Hardison, and Desvignes (2016) conducted a study on the use of information technology to improve construction safety. Hallowell et al. introduced a series of studies that provided empirical safety data that could be used to enhance existing models. The purpose of the study was to provide a new concept for safety data integration that complemented but did not replace existing methods of safety in information technology.

The authors based their study on the more common technologies found in literature such as application of geographic information systems in construction safety planning (Bansal, 2011). Hallowell, Hardison, and Desvignes did not follow a traditional methodological approach but used an approach where they purposefully conceptualized, identified, and classified objective safety data cognizant of emerging information technologies. The authors demonstrated the framework by integrating attribute safety risk data with information retrieval, augmented reality, location and tracking systems, and building information models. Hallowell, Hardison, and Desvignes found that managers could assign fundamental attributes of a work environment to construction elements during design and planning. Once assigned, safety managers could leverage existing risk and predictive models to provide a user with objective, empirically driven feedback including predictions of safety outcomes, quantity of safety risk, and conflicts among incompatible attributes. The framework the authors employed could provide planners, designers, and managers with unbiased safety feedback that could increase in detail and accuracy as the project developed. Such data could support prevention through design and safety management in advanced work packages. The authors integrated empirical risk-based safety data with construction information technologies and provided users with insight that was counter-intuitive or otherwise thought-provoking. They provided a new concept for safety data integration that complemented but did not replace existing methods of safety in information technology. The authors' examination of the use of information technology to improve construction safety related well to the existing body of knowledge in information systems management. What remained to be studied was how attribute-based safety data could be used to support interoperability among multiple systems. My study on the relationship between information quality and construction safety could build upon the authors' work.

Karimi, Taylor, Goodrum, and Srinivasan (2016) conducted a quantitative survey study on the effect of craft worker availability on construction project safety. The purpose of the study was to empirically examine the impact of craft worker shortage on construction safety performance. Karimi et al. (2016) agreed with Chi, Han, and Kim (2013) that more research was necessary on improving construction safety in the United States. Chi, Han, and Kim previously examined the relationship between unsafe working conditions and injury severity in the U.S. construction industry. Karimi et al. (2016) constructed a database of 50 North American construction projects completed between 2001 and 2014 using information from a research project survey and the Construction Industry Institute Benchmarking and Metrics Database. Karimi et al. (2016) used t-test and Mann-Whitney test to determine whether there was a significant difference in construction project safety performance on projects with craft worker recruiting difficulty. The authors then used Poisson regression analysis to examine the relationship between craft worker recruiting difficulty and Occupational Safety and Health Administration Total Number of Recordable Incident Cases per 200,000 Actual Direct Work Hours (TRIR) on construction projects. The authors found that the TRIR distribution of a group of projects that reported craft worker recruiting difficulty appeared to be higher than the TRIR distribution of a group of projects with no craft worker recruiting difficulty with a p-value of 0.004. The result also revealed that the average

TRIR of the projects with craft worker recruiting difficulty was more than twice the average TRIR of projects without craft recruiting difficulty with a p-value of 0.035. Based on the Poisson regression analysis, there was a positive exponential relationship between craft worker recruiting difficulty and TRIR in construction projects with a p-value of 0.004. A limitation of the study was that the projects the authors used to develop the database were heavily weighted towards industrial construction at 66%. The authors noted that though there were improvements in construction safety among craft workers, there should be more research on innovative construction means and methods to continuously improve safety in the construction industry among craft workers. My research on the relationship between information quality and construction safety of specialty trade contractors might be one of the innovative construction means and methods Karimi et al. (2016) noted.

Gopinathan and Raman (2016) conducted a quantitative study on the effect of information systems quality in work-life balance among Malaysian information and communication technology employees who worked for companies that provided shared services and outsource operations on a 24-hour basis. The authors specifically examined the dimensions of information systems quality which might be useful to the information and communications technology sector on issues related to sustainable development/policy formulation to achieve a good work-life balance. The authors used non-probability purposive sampling for the study because they could not obtain a list of all of the elements of the population. They selected information and communication technology employees from companies in one section of a city called multimedia super corridor (MSC). They distributed a total of 150 self-administered questionnaires to obtain data from the respondents using a multiple method of data collection through e-mail and individual administration of questionnaires. Distributing and collecting the questionnaires took approximately three months. Out of the 150 questionnaires distributed, 79 participants responded to the survey, thereby generating a response rate of approximately 53%. The authors also adopted a 5-point Likert scale in the questionnaire to collect data for each construct of the research model. Gopinathan and Raman analyzed the responses using Partial Least Square (PLS) to arrive at the results. These results indicated that information quality and system quality had strong effect on work-life balance when compared to service quality which indicated no relationship to work-life balance. A limitation of the study was that the authors selected information and communication technology employees from companies in one section of a city called multimedia super corridor. Because of this approach, it would be difficult to generalize the findings.

Bharosa, Janssen, and Tan (2011) conducted a study in which they developed a research approach for information quality assurance in public safety networks called information orchestration. The authors defined information orchestration as a heterarchical form of information coordination consisting of a specific set of capabilities and roles for collecting, enriching, and disseminating high quality information. The authors argued that information orchestration approach offered a middle ground between hierarchical and netcentric approaches. Bharosa, Janssen, and Tan noted that one of the major problems in public safety networks was to ensure a high level of information quality during disaster response. They argued that since many evaluation reports on disaster response efforts had revealed instances of poor information quality, both practitioners and academics were in search of information architectures that assured information quality. The purpose of the study was to highlight the opportunities and hurdles for information quality assurance through information architectures. Drawing on hierarchical and netcentric approaches which were opposing to each other, the authors suggested adopting a hybrid, information orchestration-based approach to assure information quality. The authors noted that hierarchical coordination approaches resulted in architectures that dictated predefined information flows, which were dependent on structures and procedures while netcentric information coordination emphasized the need for individual self-synchronization driven by events. Bharosa, Janssen, and Tan stated that though both architectures had their advantages and disadvantages, depending on several contingencies, both included characteristics that hampered information quality assurance for relief workers. The authors contributed to existing literatures in the following ways. They specified information quality problems during disaster response efforts and exposed the need to ensure that information sharing and provision were adapted to changing circumstances. The authors also elaborated on the strengths and weaknesses of two contrary approaches for information coordination dilemma in public safety networks. Bharosa, Janssen, and Tan finally presented an information orchestration framework that constituted capabilities required for information quality assurance as avenues for a research agenda. A limitation of the study was that the authors did not adequately address the weaknesses of information orchestration methodology such as generalizability of the results and potential threats to internal and external validity.

Gogan, Baxter, Boss, and Chircu (2013) conducted literature review of leading information systems, quality, and medical journals. The purpose of the study was to use a trans-disciplinary methodology to draw attention to information quality issues in clinical handoff processes, which in turn could improve patient safety. Gogan et al. (2013) noted that due to the proliferation of academic publications, it was not feasible to locate and review every research paper on a topic. Because of this, the authors used heuristic, systematic, practical and iterative methodologies to identify and select papers for review. The authors found that trans-disciplinary analytic approach helped medical professionals improve quality of information and patient safety through more effective standard operating procedures, handoff processes, clinical pathways, and checklists. The literature review clarified clinical handoff problems and solutions from multiple perspectives. The methodology used was also useful for improving, describing, and monitoring handoff processes in the larger context of clinical processes, using a common terminology for information quality characteristics. In relation to my study, the trans-disciplinary literature review approach allowed me to review articles from a multidisciplinary perspective. I gained a broader insight to what other scholars had studied in the area of information quality and safety.

Izudi, Ninsiima, and Alege (2017) conducted a quantitative study to assess the use of personal protective equipment among building construction workers in Kampala, Uganda. The authors stated that the study was necessary because research showed that Kampala district had the highest workplace fatality and injury rates in the country. The methodology involved cross-sectional study where they collected and analyzed data from

385 respondents. Izudi, Ninsiima, and Alege found that the use of personal protective equipment such as hardhats, hand gloves, safety boots, safety harness with lanyard, earplugs, and face shields among building construction workers remained scarce. The research related well to the body of knowledge in construction safety. However, the authors did not state the theoretical framework upon which they based the study. The authors did not address the relationship between information quality and construction safety which was the focus of my research.

Henk F van, den Herder, Warning, and Frings-Dresen (2016) conducted a study where they evaluated strategies to reduce safety violations for working from heights in construction firms. The purpose of the study was to evaluate the effectiveness of direct mail strategy and a face-to-face strategy on safety violations while working from heights among construction firms compared to a control condition. The methodology involved three-armed randomized controlled trial. Construction firms with employees at risk for fall injuries were eligible for the study. The authors randomly assigned 27 cities to intervention groups where they gave eligible companies with access to internet facilities either a direct mailing strategy or a face-to-face guidance strategy. The authors assigned other companies to a control group. The primary outcomes were the type and number of safety violations labor inspectors recorded after 3 months. The authors performed a process evaluation for both strategies to determine program implementation, satisfaction, reach, knowledge, and perceived safety behavior. They also performed a cost analysis to establish the financial costs for each intervention strategy. The authors performed analyses with the intention to treat. In total, of the companies eligible for the study, 73%

(n = 69) for direct mail and 41% (n = 88) for the face-to-face intervention participated. The authors delivered intervention materials to 100% (direct mail group) and 69% (face-to-face group). Completion of intervention activities within companies was low. The result showed that there was no difference in increase in knowledge, satisfaction, and safety behavior between the intervention groups. Another finding was that costs for personal advice were 28% higher than for direct mail. Overall, the authors captured nine intervention companies in the 288 worksite measurements the labor inspector performed. Based on all worksite inspections, there were no statistical differences in mean number of safety violations (1.8–2.4) or penalties (72%–100%) existed between the intervention and control groups. The authors could not draw any conclusions about the effect of direct mail or face-to-face strategies on safety violations because of limited number of intervention companies the authors captured in the primary outcome measurements. The costs for a direct mail were lower compared with face-to-face strategy. There was no difference in awareness. The authors found attitude for safe working between workers and employers in both strategies. My assessment was that the authors adequately described the participants in terms of population, inclusion and exclusion criteria, and sampling strategy. The authors also carefully described the procedures for executing the design in a way that other researchers could replicate the study.

Zahoor, Chan, Utama, Gao, and Zafar (2017) conducted a quantitative study where they modeled the relationship between safety climate and safety performance in a developing construction industry. The first purpose of the study was to validate a safety performance measurement model in the cross-cultural setting of a developing country;

the second purpose was to highlight the variations in investigating the relationship between safety climate factors and safety performance indicators. Zahoor et al. (2017) collected data from forty multi-storey building projects under-construction in Pakistan. Based on the results of exploratory factor analysis, the authors hypothesized a safety performance measurement model. The authors tested and validated the model by conducting confirmatory factor analysis respectively on calibration and validation sub-samples. The authors confirmed a significant positive effect of safety climate on safety compliance and safety participation, and a negative effect on number of self-reported injuries and accidents. The authors could not retain the number of near-misses in the final safety performance model because it attained a lower standardized path coefficient value. Also, instead of safety participation, safety compliance had a stronger effect on safety performance. Zahoor et al. (2017) uncovered safety enforcement and promotion as a novel safety climate factor, whereas safety rules and work practices were identified as the most neglected factor. The authors contributed to the body of knowledge by uncovering the deviations in existing dimensions of safety climate and safety performance. The authors expected the refined model to concisely measure the safety performance in the Pakistani construction industry. The limitation of the study was that the result might not be generalized to other developing countries.

Burns and Conchie (2014) conducted a study on risk information source preferences in construction workers. Burns and Conchie noted that other researchers had investigated the determinants of workers’ unsafe/risk-taking behaviors in other to improve safety management and reduce accidents but there had been limited research on risk information source preferences in construction workers. The purpose of the study was to investigate whether construction workers preferred to receive information about construction risk from close sources like supervisors and fellow workers regardless of the nature of the risk or from safety professionals who were experts on construction safety risks.  Employing the help of safety officers, Burns and Conchie collected data from 106 frontline construction workers who were recruited from a single building site in the United Kingdom. The authors then measured the source from which workers preferred to receive information on a range of risks using a ranking exercise. Specifically, the authors asked the workers to rank five occupational sources which included health/safety executive, project manager, safety manager, supervisor, and coworkers according to how much they preferred each one to deliver information on eight different risk areas. These areas included back pain, asbestos, site transport, slips/trips, heights, housekeeping, and site-specific/job-specific risks. The authors found that coworkers generally preferred to receive risk information from supervisors and safety managers. A corresponding analysis also revealed that workers' risk information source preference was risk dependent and source expertise could influence it. The findings from this study highlighted the role of safety managers in risk communication and in building trust among construction workers in high-hazard organizations. Burns and Conchie made original contribution through this study in construction safety. In relation to my study, there was a need to investigate the relationship between the quality of information in construction safety plans and construction safety among specialty trade contractors.

Karakhan (2017) stated that due to its complex nature construction was a high-hazard industry. The author noted that in the United States, the industry frequently experienced the highest number of fatal work injuries. The author agreed with Goetsch (2013) and Mroszczyk (2015) that although construction accounted for less than 5% of the U.S. workforce, it accounted for about 20% of occupational fatal injuries in the industry. Karakhan posited that maintaining an injury-free workplace in construction was difficult because of the inherent uncertainty of the built environment. The author argued that site managers could reduce incidents if they properly identified and eliminated root causes. Site personnel could identify root causes by conducting thorough and effective incident investigations that were both prospective and retrospective in that lessons learned from incidents were incorporated into continuous improvement efforts. Incident investigation included discoverable and documented analysis of how an organization solved occupational issues emanating from near misses and incidents (Behm & Powell, 2014). Karakhan used this framework as the basis to posit that the main goal was to identify the root causes that led to undesired outcomes so that management could implement appropriate preventive and corrective actions. Occupational and safety health professionals agreed that improving the quality of incident investigation reports could lead to improved safety performance. Karakhan proposed a construction incident investigation model that relied on the Six Sigma define, measure, analyze, improve, and control (DMAIC) cycle. The author concluded that the competitive construction environment left small margin for error because safety performance affected productivity, worker morale, project schedule, and cost. The Six Sigma DMAIC cycle is a problem-solving framework that a construction employer could use to define, measure, analyze, improve and control defects, including workplace hazards. Applying the DMAIC cycle to incident investigations could also help to promote a team approach and create a collaborative environment to safety. The application of DMAIC in safety improvement could also encourage continuous improvement.

Murthy and Marjanovic (2014) used a work system perspective to understand a process transformation from product-centric to customer-centric services in a financial institution. The purpose of the study was to help build an increased understanding of the business, strategic, cultural and other changes in an organisation's transition process from product-centric to customer-centric services. Murthy and Marjanovic offered an exploratory case study which they conducted in a complex financial organisation in the context of their customer-facing services. Using the work system theoretical lens, which Alter (2013) developed, the authors examined the transition process following the argument Alter made previously, that service systems could be work systems. This holistic theory allowed the authors to capture the three major phases of the transition process as work systems snapshots and demonstrated how the transitions occurred from one phase to the next. Work system theory allowed the authors to conduct an in-depth study of the transition process through the complex and unfolding interplay of customers, strategy, services/products, people, processes, information and technology. The authors traced the success factors and major challenges. In relation to my study, work system theory might provide a context, which I could use to explain the relationship between information quality and construction safety among specialty trade contractors.

Lee et al. (2002) developed a methodology and survey instrument for assessing information quality in organizations. Lee at al. (2002) noted despite a decade of active research and practice, the field lacked comprehensive methodologies for assessing and improving information quality in organizations. The authors developed such a methodology called AIM quality (AIMQ) which formed a basis for assessing and benchmarking information quality. The authors illustrated the methodology by applying it to five major organizations. The methodology encompassed a model of information quality, a questionnaire to measure information quality, and analysis techniques for interpreting the information quality measures. Lee at al. (2002) developed and validated the questionnaire and used it to collect data on the status of information quality in organizations. Alenezi et al. (2015) adopted the model and used it to investigate the strategic relationship between information quality and e-government benefits. Ayyash (2015) also used the model to determine the dimensions of information quality that influenced customer satisfaction of services in e-banking. In relation to my study, I used the model to examine the nature of the relationship between the quality of information in construction safety plans and construction safety among specialty trade contractors.

## Summary and Conclusions

Chapter 2 contained literature search strategy, theoretical foundations, review of literature that includes studies related to quality of information in construction safety plans and construction safety. I reviewed, synthesized, and integrated supporting literature concerning information quality in safety plans and construction safety among specialty trade contractors (Hannan, 2015; Mroszczyk, 2015). I also analyzed the views and findings of other management scholars to respond to the research questions of the study. I examined accident/incident theory (Petersen, 2003) and work system theory (Alter (2013), which formed the theoretical basis of this study.

I identified, examined, and discussed major themes in the literature review such as risk information preference in construction workers (Burns & Conchie, 2014). I discussed dimensions of information quality which consisted of information relevance, information accuracy, information timeliness, and information completeness (Ayyash, 2015; Costa et al., 2014; Dancer et al., 2014). I presented an overview of reasons for having a written construction safety plan (Manuele, 2013; Mroszczyk, 2015; Rajendran, Clarke, & Andrews, 2012) and against having a written construction safety plan (Rebbit & Erickson, 2016). I discussed elements of a construction safety plan (Goetsch, 2013; Manuele, 2013; Mroszczyk, 2015), communicating the construction safety plan to specialty trade contractors (Hannan, 2015: Xu & Luo, 2014), and evaluating the quality of information in construction safety plans (Brooks, 2015; Guo & Yu, 2012). The last part of the chapter contained some research methodologies (Leedy & Ormrod, 2005) that might be applicable to this study. A review of the research methods showed that a quantitative study using a survey to collect data and nonexperimental correlational research design (Cook & Cook, 2008; Curtis et al., 2016) were most appropriate for this study.  In the last part of the chapter, I examined some research approaches other researchers used and their findings in the area of information quality and construction safety. In Chapter 3, I explain the research methods, design of the study, the sample and target population, and the methods/processes of data collection and analysis. I focus on the relationship between information quality in construction safety plans and construction safety among specialty trade contractors.

# Chapter 3: Research Method

The purpose of this quantitative nonexperimental design study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. Dimensions of information quality I covered included the relevance, accuracy, timeliness, and completeness of information in construction safety plans. The major sections I covered in this chapter include my research design and rationale, methodology, data analysis plan, threats to validity, and summary of the chapter.

## Research Design and Rationale

The variables in this study were the quality of information in construction safety plans and construction safety among specialty trade contractors. Specifically, I examined the quality of information in construction safety plans using the following dimensions of information quality: information relevance, information accuracy, information timeliness, and information completeness. The authors of the literature I reviewed had used quantitative, qualitative, or a combination of quantitative and qualitative methods known as mixed methods in their studies to examine construction safety in the workplace. Zahoor et al. (2017) used a quantitative approach to examine the relationship between safety climate and safety performance in a developing construction industry. Roelofs, Sprague-Martinez, Brunette, and Azaroff (2011) used a qualitative approach to investigate Hispanic construction worker perspectives on factors that affect worksite safety and risk. Sparer and Dennerlein (2017) used a mixed methods approach to examine how traditional safety incentive programs in the construction industry emphasized low injury rates, thereby rewarding underreporting injuries instead of achieving any actual reduction in injuries. The research design I selected for this study was the approach that aligned well with my problem statement, purpose of the study, and research questions. I evaluated the strengths and weaknesses of each method.

A researcher uses a quantitative approach to measure and analyze data; using quantitative approach, a researcher could also study the relationship between variables in detail and could test hypotheses using statistics (Leedy & Ormrod, 2005). These were advantages because researchers were more objective about the findings of their research. Leedy and Ormond (2005) noted that a key disadvantage of the quantitative approach was that researchers did not conduct their studies in natural settings or discuss the meaning things had for different people as qualitative researchers did. Another disadvantage was that researchers must study a large sample of the population because the larger the sample of people in the studies, the more statistically accurate the results would be. The qualitative approach made it easy for a researcher to acquire clearer understanding of the targeted audience because the types of questions asked during the process started with *why* (Gentles, Charles, Nicholas, Ploeg, & McKibbon, 2016). As qualitative approach required smaller scales, low cost was also an advantage. A qualitative approach would not have been suitable for this study because the relationships between variables were not measurable; the data collected could be skewed because qualitative researchers appeared to interpret the study based on their own perspectives (Gentles et al., 2016). Researchers who used mixed methods approach combined qualitative and quantitative methods. An advantage of mixed methods approach is that researchers could incorporate the strengths of qualitative and quantitative methods in their studies (Halcomb & Hickman, 2015; Kaur, 2016). The mixed methods approach might not be the best approach for this study because it could require excessive time and resources to collect, combine, and analyze data for both quantitative and qualitative methods (Katz, Vandermause, McPherson, & Barbosa-Leiker, 2016).

Based on the nature of my study, a quantitative approach was more appropriate. Researchers can use experimental, quasi-experimental, and nonexperimental research designs in quantitative studies (Leedy & Ormrod, 2005). An experimental research design is a controlled method of observation in which variables are manipulated in order to observe their effects on other variables (Campbell & Stanley, 1963). An experimental research design offers a higher degree of control because it allows for manipulation, randomization, and control of the research sample resulting in greater internal validity (Leedy & Ormrod, 2005). Quasi-experimental designs are designs in which the researcher “lacks the full control over the scheduling of experimental stimuli which makes a true experiment possible” (Campbell & Stanley, 1963, p. 34). Nonexperimental research designs are systematic empirical inquiries in which researchers do not have direct control of variables because they effectively cannot be manipulated or because their manifestations had already occurred (Kerlinger, 1986).

The experimental design was not applicable because of the nature of its process for planning a study to meet specified objectives. Planning an experiment properly was difficult in ensuring that the right type of data and a sufficient sample size and power were available to answer the research questions of interest as clearly and efficiently as possible. Experimental design works well when researchers are able to allocate participants to different conditions in an experiment. Quasi-experimental research shares similarities with the traditional experimental design or randomized controlled trial, but it lacks the element of random assignment to treatment or control (Campbell & Stanley, 1963).

For this study, I used a quantitative nonexperimental correlational research design. Its connection to the research questions was that I examined the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. The dimensions of information quality I covered were information relevance, information accuracy, information timeliness, and information completeness. A time constraint consistent with this design choice was that correlation was dynamic instead of static; variables that tended to be related at some point might at some other point exhibit no correlation (Curtis et al., 2016). The conclusions researchers draw from correlational research might be relatively temporary because multiple interfering variables might also influence the results more than the central variables (Curtis et al., 2016). The nonexperimental research design choice was consistent with research designs needed to advance knowledge in information systems management field because researchers could use it to confirm or refute suspected relationships between or among the variables being studied (Cook & Cook, 2008). Researchers could use nonexperimental research design to confidently predict the flow of events from a close analysis of one set of related events (Cook & Cook, 2008; Curtis et al., 2016). Researchers typically measure the strength of a linear association between two variables in a population by the Pearson product-moment correlation coefficient when data are normally distributed and parametric testing is appropriate. The data I collected were not normally distributed, hence nonparametric testing was appropriate. I therefore measured the strength of a linear association between two variables by the Spearman rank correlation coefficient. The values ranged from -1 for perfect negative correlation up to +1 for perfect positive correlation.

## Methodology

### Population

The target population for this study was specialty trade contractors across the United States classified under NAICS code 238 (DOC, 2018). I used a self-selection sampling method to collect data from participants through SurveyMonkey's voluntary participant pool. The primary subgroups within NAICS code 238 were foundation, structure, and building exterior contractors (NAICS code 2381); building equipment contractors (NAICS code 2382); building finishing contractors (NAICS code 2383); and other specialty trade contractors (NAICS code 2389). Specialty trade contractors were not responsible for the entire project; they usually subcontracted their work from prime contractors or might work directly for the owner of the property (DOC, 2017).

### Sampling and Sampling Procedures

I used a self-selection sampling method to collect data. Self-selection sampling method allowed respondents to decide whether they would like to participate in the study or not. While this type of sampling strategy might have degree of self-selection bias, the main benefit was a greater level of commitment from survey participants to fully participate and complete the survey (Dalla Valle, 2016). The main limitation was that the respondents might be different from nonrespondents, therefore estimating an effect from only the respondents might confound the effect and the choice to respond (Dalla Valle, 2016). The sample might be biased because it might not represent the target population when compared to the use of simple random sampling technique (Molenberghs et al., 2014). The sample distribution of the variables might differ from the same variables in the population.

I included in the sampling frame volunteer respondents who performed jobs represented under the NAICS Code 238 and drawn from the larger SurveyMonkey audience. I excluded specialty trade contractors who performed jobs under the NAICS Code 236 (construction of buildings) and NAICS code 237 (heavy and civil engineering construction). I used SurveyMonkey platform to evaluate the sampling frame for potential problems (Asan & Ayhan, 2013) such as clusters of elements (when sampling units were listed in groups instead of individually), incomplete frames (when sampling units found in the population were not in the list), and blank foreign elements (when some of the sampling units in the sample frame were not part of the research population). The minimum sample size was 82 participants. I determined the sample size for a Spearman correlation using power analysis. I conducted the power analysis in G*Power using an alpha of 0.05, a generally accepted power of 0.80, a medium effect size ($\rho = 0.3$) for a two-tailed test, and the assumption that Spearman's rank correlation coefficient was identical to Pearson product-moment coefficient computationally. Because of this assumption, I conducted power analysis using software for estimating power of a

Pearson's correlation. Based on this assumption, I determined the required sample size to be 82. I received 154 responses. Out of the 154 responses, 134 potential participants (87%) gave their consent while 20 (13%) did not give their consent to be in the study. I validated a total of 134 who identified themselves with the following subgroups under NAICS code 238:

- 61 (45.50%) identified with NAICS code 2831 (Foundation, structure, and building exterior contractors),
- 30 (22.40%) identified with NAICS code 2832 (Building equipment contractors),
- 22 (16.40%) identified with NAICS code 2383 (Building finishing contractors), and
- 21 (15.70%) identified with NAICS code 2389 (Other specialty trade contractors).

The 134 respondents who gave their consent to be in the study exceeded the minimum sample size of 82 that I determined using G*Power 3.1.2 and was sufficient. The larger sample size accounted for no responses, incomplete responses, and for those whose organizations did not have a safety plan. I used 90 participants because out of the 134 participants who gave their consent to be in the study, 90 indicated that their firm had written safety plans. Using the sample size of 134, a level of significance at $\alpha = 0.05$ (two-tails), and a medium effect size of 0.3, I ran a post hoc power analysis using G*Power 3.1.9.2 to determine the achieved power. The achieved power was 0.945, which exceeded the power of 0.8 used in priori power analysis to arrive at minimum sample size of 82 (see Figure 3).

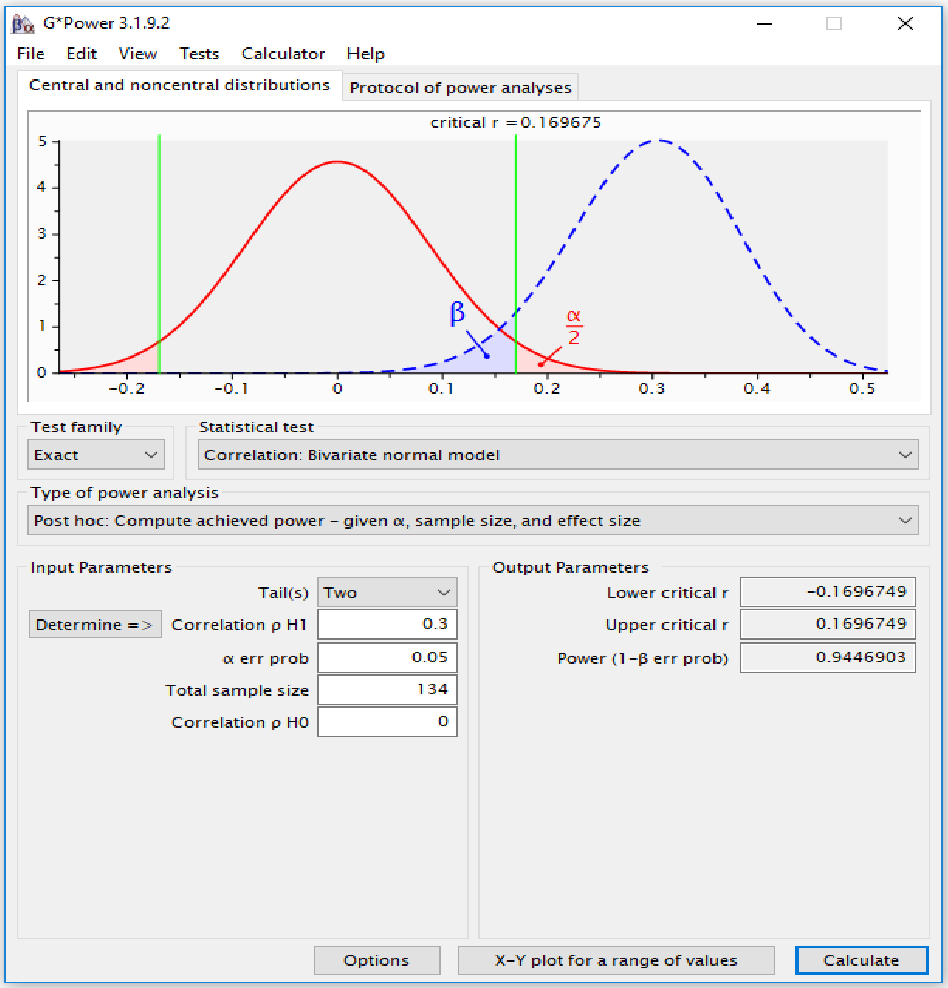


*Figure 3.* G*power post hoc analysis on sample size 134.

## Procedures for Recruitment, Participation, and Data Collection (Primary Data)

**Data collection.** I collected primary data for this study through SurveyMonkey, an online survey platform. I provided the survey to SurveyMonkey who invited participants through SurveyMonkey Contribute, a database where individuals could voluntarily sign up to be survey participants. I used SurveyMonkey to administer the survey because it was more cost effective and easier to administer than a traditional paper-based survey. SurveyMonkey also had the ability to store the survey data on a website database, which I could export into Microsoft Excel or any other statistical software such as the Statistical Package for the Social Sciences (SPSS). The participants were from a target population of U.S. specialty trade contractors who were volunteer SurveyMonkey audience. Appendix D contains the SurveyMonkey permission to access the participants. Participants were at least 18 years old. I used a self-selection sampling method to collect data because it allowed respondents to decide whether they would like to participate in the study or not. The main benefit of using this method was a greater level of commitment from survey participants to fully participate and complete the survey (Dalla Valle, 2016; Kline, 2017). When participants signed up, they were asked for information, which allowed SurveyMonkey to match participants' information and interests to the study requirements. SurveyMonkey then sent the survey to those participants who met the requirements and who could self-select to participate or opt out. I evaluated the sampling frame for potential problems. Participants in this study appeared to be a fair representation of the population of interest who had access to the internet.

The demography of specialty trade contractors I collected information on included the subsectors of NAICS Code 238 as follows.

- Foundation, structure, and building exterior contractors (NAICS Code 2381)
    - Poured concrete foundation and structure contractors (NAICS Code 23811)

- Structural steel and precast concrete contractors (NAICS Code 23812)
- Framing contractors (NAICS Code 23813)
- Masonry contractors (NAICS Code 23814)
- Glass and glazing contractors (NAICS Code 23815)
- Roofing contractors (NAICS Code 23816)
- Siding contractors (NAICS Code 23817)
- Other foundation, structure, and building exterior contractors (NAICS Code 23819)

➢ Building equipment contractors (NAICS Code 2382)

- Electrical contractors (NAICS Code 23821)
- Plumbing, heating, and air-conditioning contractors (NAICS Code 23822)
- Other building equipment contractors (NAICS Code 23829)

➢ Building finishing contractors (NAICS Code 2383)

- Drywall and insulation contractors (NAICS Code 23831)
- Painting and wall covering contractors (NAICS Code 23832)
- Flooring contractors (NAICS Code 23833)
- Finish carpentry contractors (NAICS Code 23835)
- Other building finishing contractors (NAICS Code 23839)

➢ Other specialty trade contractors (NAICS Code 2389)

- Site preparation contractors (NAICS Code 23891)
- All other specialty trade contractors (NAICS Code 23899)

**Informed consent**. Once the participants clicked on the study link contained within the survey invitation letter on SurveyMonkey platform, I provided a statement of implied consent on the first page. This statement included whom to contact if there were concerns about the participants' treatment during the survey. I also requested an acknowledgement of consent by selecting the "next" button and by clicking submit at the end of the survey. I collected data through a web survey with 19 questions scored on a Likert-type scale, as well as the four demographic questions. I replaced missing survey values by series mean data using SPSS. I did not collect names of participants through the survey instrument or at any time during the study; I kept the responses confidential.

The consent form also contained debriefing information where I informed participants that participation was voluntary. If they decided to participate in the study, they had the right to change their minds during the study. The participants could stop and exit the study at any time; they could also skip any questions they did not feel comfortable answering. The consent form had a hyperlink to the survey web page. The participants had 31 days to complete the survey.

## Instrumentation and Operationalization of Constructs

A survey of the variables used to measure the success of information systems revealed that information quality was one of the six categories commonly employed in MIS research (Delone & McLean, 1992). The direct access of information from various sources by information users and the growth of data warehouses had increased the awareness of and need for high quality information in organizations (Lee et al., 2002). Lee et al. (2002) noted that MIS researchers had always regarded the quality of information to be important. For this study, I adopted a previously validated instrument by Lee et al. The name of the instrument was AIMQ: a methodology for information quality assessment. AIMQ was appropriate for this study because the methodology included a questionnaire to measure information quality and analysis techniques for interpreting the measures of information quality. Lee et al. (2002) developed and validated the questionnaire and used it to collect data on the status of information quality in organizations. Appendix A contains my letter seeking permission to use the AIMQ survey instrument as well as permissions the co-authors granted me to use the instrument.

Due to the natural alignment between quality and safety (Rajendran, Clarke, & Andrews, 2012; Walker, Peters, Hampson, & Thompson, 2001), I used the AIMQ survey instrument to collect data on information quality and construction safety. Walker et al., 2001 noted that safety could be viewed as a broad quality measure. Rajendran, Clarke, and Andrews (2012) examined the feasibility of integrating safety and quality management, the parallels between quality management responsibilities and safety, and the interrelationship between quality and construction safety. Rajendran, Clarke, and Andrews found that the process of managing quality control was similar to the process of managing safety and that in the construction industry many employers were already assigning quality management responsibilities to the safety department. Goetsch (2013) also noted that total safety management (TSM) was to safety management what total quality management (TQM) was to quality management.

I adopted the construct I used in this study from previous related literature where they proved to be valid and reliable. I operationalized two types of variables for this study: the predictor variables measuring dimensions of information quality, and the criterion variable measuring construction safety. Dimensions of information quality included the relevance, accuracy, timeliness, and completeness of information in construction safety plans. Construction safety referred to how safe participants felt in their construction work environments based on the relevance, accuracy, timeliness, and completeness of information in construction safety plans. The survey measured five subscales: the four dimensions of information quality (predictor variables) and construction safety (criterion variable). Except the demographic questions, all the questions were designed for an 11-point Likert-type scale by Lee et al. (2002) ranging from 0 representing “not at all” to 11, representing “completely”, with 5 pointing to “neutral” status. For the predictor variables, there were four items on relevance and accuracy respectively, five items on timeliness, and six items on completeness. For the criterion variable, there were four items covering information in relation to construction safety in the participants’ work environments. Appendix B contains the questionnaire items. I combined the scores of each variable as an average to derive a final score. Higher scores represented higher construction safety as determined by how safe participants felt in their construction work environments. I treated all the variables as interval level variables.

To conduct correlational analysis for this study, I provided participants guidelines to select from the 11 AIMQ Likert-type scales that represented a score on how safe participants felt in their construction work environments based on the relevance, accuracy, timeliness, and completeness of information in construction safety plans.

Using the relevance of information in the construction safety plan as an example, a score of 0 for the questionnaire item “This information is relevant to our work” would mean that the participant felt that the information did not at all contribute to the participant’s safety in the construction work environment. For the same questionnaire item, a score of 10 would mean that the participant felt that the information completely contributed to safety in the construction work environment. Thus, based on the relevance, accuracy, timeliness, and completeness of information in construction safety plans, the range 0 to 10 reflected the intensity of participants' feelings on construction safety for a given questionnaire item while results of the analysis of multiple items revealed a pattern that contained the scaled properties (Frankfort-Nachmias & Nachmias, 2008).

To establish the reliability and validity values of the instrument relevant to their

use in the study, Lee et al. (2002) performed statistical analyses using SPSS for Windows. The authors tested the construct reliability of the information quality using the Cronbach alpha. The values they got ranged from 0.94 to 0.72 which indicated that the measures of each dimension were reliable. The authors measured all items on a 0 to 10 scale where 0 was not at all and 10 was completely. Items labels with (R) were reverse coded. The Cronbach alpha values for relevancy, accuracy, timeliness, and completeness with corresponding questionnaire items were as follows (Lee et al., 2002).

Relevancy. (four items, Cronbach alpha = .94)

- This information is useful to our work.
- This information is relevant to our work.
- This information is appropriate for our work.

- This information is applicable to our work.

Accuracy. (four items, Cronbach Alpha = .91)

- This information is correct.
- This information is incorrect. (R)
- This information is accurate.
- This information is reliable.

Timeliness. (five items, Cronbach Alpha = .88)

- This information is sufficiently current for our work.
- This information is not sufficiently timely. (R)
- This information is not sufficiently current for our work. (R)
- This information is sufficiently timely.
- This information is sufficiently up-to-date for our work.

Completeness. (six items, Cronbach Alpha = .87)

- This information includes all necessary values.
- This information is incomplete. (R)
- This information is complete.
- This information is sufficiently complete for our needs.
- This information covers the needs of our tasks.
- This information has sufficient breadth and depth for our task.

Lee et al. (2002) noted that multi-dimensional, information quality was a single phenomenon. Hence the dimensions were not inherently independent. This dependence among the dimensions eliminated the applicability of path analysis in the validation of the survey. The authors, therefore, used the standard Cronbach alpha to assess reliability.

The statistics for assessing the reliability of the instrument were from completed surveys from 261 participants in five organizations representing healthcare, financial, and manufacturing sectors. For the population, there were respondents in each organization representing all information systems professionals, information collectors, and information consumers. Participants focused their responses on a set of information important to the organization such as patient information in healthcare organizations. Lee et al. (2002) used a pilot study to develop the instrument. The purpose of the pilot study was to initially assess the reliability of the items for each of the dimensions of information quality and to use the pilot study to reduce the number of items per dimension from eight to number of items that was practical to use. The authors followed standard methods for questionnaire development and testing.

My plan to provide evidence for reliability and validity was to provide the actual questionnaire items by Lee et al. (2002). The questionnaire items included values, which ranged from 0.94 to 0.72; these values showed that the measures of each dimension of information quality were reliable.

To establish sufficiency of instrumentation to answer the research questions for this study, I selected four of the 15 dimensions of information quality Lee et al. (2002) used. The 15 dimensions with corresponding Cronbach Alpha values were as follows:

1. Accessibility (four questionnaire items, Cronbach Alpha = 0.92)
2. Appropriate amount (four questionnaire items, Cronbach Alpha = 0.72)

3. Believability (four questionnaire items, Cronbach Alpha = 0.89)
4. Completeness (six questionnaire items, Cronbach Alpha = 0.87)
5. Concise representation (four questionnaire items, Cronbach Alpha = 0.88)
6. Consistent representation (four questionnaire items, Cronbach Alpha = 0.83)
7. Ease of operation (five questionnaire items, Cronbach Alpha = 0.85)
8. Accuracy (four questionnaire items, Cronbach Alpha = 0.91)
9. Interpretability (five questionnaire items, Cronbach Alpha = 0.77)
10. Objectivity (four questionnaire items, Cronbach Alpha = 0.72)
11. Relevancy (four questionnaire items, Cronbach Alpha = 0.94)
12. Reputation (four questionnaire items, Cronbach Alpha = 0.85)
13. Security (four questionnaire items, Cronbach Alpha = 0.81)
14. Timeliness (five questionnaire items, Cronbach Alpha = 0.88)
15. Understandability (four questionnaire items, Cronbach Alpha = 0.90)

The four dimensions of information quality I used for this study were relevancy, accuracy, timeliness, and completeness. Based on this information, the instrumentation was sufficient to answer the research questions, which I restate under data analysis plan.

## Data Analysis Plan

The software I used for analysis was SPSS 24.0. SPSS provided robust quantitative models acceptable for conducting complex statistical analyses (Field, 2013). Data cleaning and screening procedures required careful consideration because they affected the final statistical results significantly (Fields, 2013). I used SPSS to clean the data. Data cleaning involved consistency check and treatment of missing responses. I used consistency checks to identify the data, which were logically inconsistent, out of range, or had extreme values. I treated missing responses carefully to minimize their adverse effects by assigning a suitable value or deleting them methodically (pair wise or case wise deletion). Field (2013) noted that missing responses posed problems if their proportion to total responses was more than 10%. The research questions and hypotheses were as follows.

**Research Questions and Hypotheses**

RQ1: What is the nature of the relationship between information relevance and construction safety among specialty trade contractors?

$H_0$1: There is no statistically significant relationship between information relevance and construction safety among specialty trade contractors.

$H_a$1: There is a statistically significant relationship between information relevance and construction safety among specialty trade contractors.

RQ2: What is the nature of the relationship between information accuracy and construction safety among specialty trade contractors?

$H_0$2: There is no statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

$H_a$2: There is a statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

RQ3: What is the nature of the relationship between information timeliness and construction safety among specialty trade contractors?

$H_0$3: There is no statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

$H_a3$: There is a statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

RQ4: What is the nature of the relationship between information completeness and construction safety among specialty trade contractors?

$H_04$: There is no statistically significant relationship between information completeness and construction safety among specialty trade contractors.

$H_a4$: There is a statistically significant relationship between information completeness and construction safety among specialty trade contractors.

The process of data-analysis involved three steps: data preparation, descriptive statistics, and inferential statistics. These steps corresponded to Trochim and Donnelly’s (2008) 3-step process that followed a specific order. The first step was to prepare and organize the survey data for analysis. Under data preparation, I reversed the scores on four reverse-coded Likert-type questions. The second step was to describe the data with descriptive statistics; this process provided a summary of the survey results. The third step was to test the research hypotheses using inferential statistics. I used the results from the inferential statistics to infer the nature of the relationship between information quality dimensions (relevance, accuracy, timeliness, and completeness) and construction safety among specialty trade contractors. Trochim and Donnelly (2008) noted that researchers used inferential statistics to determine something about a population, based on a sample; researchers used descriptive statistics to organize, summarize, and present data in an informative way. The specific descriptive statistics used to describe sample characteristics and the variables were frequencies and percentages, including approximate number of specialty trade contractors in the subsectors of NAICS Code 238. I presented data in the form of tables, charts, and graphs. The specific measure of central tendency I presented was the mean; the specific measure of variability I presented was standard deviation. Researchers typically measured the strength of a linear association between two sets of interval-scaled or ratio-scaled variables in a population by the Pearson product-moment correlation coefficient ($r$). The values ranged from -1 for perfect negative correlation up to +1 for perfect positive correlation. I assessed the distribution of the data for normality by visually examining a scatterplot of the data points to see how close the dots hovered close to the line (Field, 2013).

The two assumptions for using the Pearson correlation coefficient were that the variables were normally distributed and linearly related (Larson & Farber, 2003). I tested the distribution of the data from my sample for normality by performing the Shapiro-Wilk test of normality. The test revealed that the assumption for normality was not met. Consequently, I rejected the assumption. I presented a detailed discussion of the Shapiro-Wilk test of normality in Chapter 4. Because the assumption for normally distributed data was not met, I used the nonparametric equivalent to Pearson correlation coefficient known as the Spearman rank correlation coefficient ($r_s$) to examine the relationships between selected dimensions of information quality and construction safety among specialty trade contractors. The values of $r_s$ ranged from -1 to +1 (Caruso & Cliff, 1997; Larson & Farber, 2003). If the ranks of corresponding pairs of data were identical exactly, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1.

If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero. The selected dimensions of information quality I used were relevance, accuracy, timeliness, and completeness. The statistical test I used to determine the significance of the correlation coefficient $r_s$ was the Spearman correlation test. A *p* value of less than .05 for a two-tailed test (Field, 2013) using 90 participants and 88 degrees of freedom was required for significance. I used 90 participants because out of the 134 participants who gave their consent to be in the study, 90 indicated that their firm had written safety plans and answered all the questions on the four predictor variables (relevance, accuracy, timeliness, and completeness). I provide more details on data collection in Chapter 4.

## Threats to Validity

Validity was the extent to which researchers used an instrument to measures what the instrument was intended to measure (Frankfort-Nachmias & Nachmias, 2008; Leedy & Ormrod, 2005; Rutkowski & Delandshere, 2016). Two types of threats to validity were external and internal threats. I discussed these threats as they applied to my study and how I addressed them.

### External Validity

External validity was the degree to which the conclusions in a researcher’s study held for other individuals at other times and in other places (Rutkowski & Delandshere, 2016; Trochim & Donnelly, 2008). Threats to external validity compromised a researcher’s confidence in stating whether or not the results of the study were applicable to other groups or the extent to which a researcher could generalize the conclusions drawn to other contexts (Campbell & Stanley, 1963; Leedy & Ormrod, 2005; Rutkowski & Delandshere, 2016). One of the main reasons researchers adopted quantitative research designs was to be able to generalize from the sample being studied to the population the researcher drew the sample from; in some cases, researchers generalized across populations (Rutkowski & Delandshere, 2016; Trochim & Donnelly, 2008). The target population for this study was U.S. specialty trade contractors who were SurveyMonkey audience. The primary subgroups within specialty trade contractors (NAICS code 238) were foundation, structure, and building exterior contractors (NAICS code 2381); building equipment contractors (NAICS code 2382); building finishing contractors (NAICS code 2383); and other specialty trade contractors (NAICS code 2389). Specialty trade contractors were not responsible for the entire project; they usually subcontracted their work from prime contractors or might work directly for the owner of the property (United States Department of Commerce, 2017). For this study, two threats to external validity I considered were selection biases and operationalization of constructs and variables I wanted to measure.

I considered selection biases as threats to external validity because if the sample I studied did not represent the population I hoped to generalize, a selection bias had occurred. The presence of selection bias made it difficult to argue that results from a biased sample could be generalized to the wider population. Parametric statistical procedures relied on assumptions about the shape of the distribution in the target population and about the form or parameters of the assumed distribution (Skene, Bunce, Freemantle, & Doré, 2016). Such an assumption is a normally distributed data. I used nonparametric statistical procedure (Spearman's rank correlation) to address selection bias because it relied on few or no assumptions about the shape or parameters of the population distribution from which the sample was drawn (Skene et al., 2016).

I considered operationalization of constructs and variables as threats to external validity because in quantitative research designs, researchers had to narrow down broad concepts of interest into constructs that they could measure (Leedy & Ormrod, 2005; Trochim & Donnelly, 2008). The purpose of this study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. As information systems researchers viewed information quality from a wide range of dimensions (Alenezi et al., 2015; Ayyash, 2015; Lee & Levy, 2014), I might not be confident that my study was construct valid. To address this threat to external validity, rather than examining the broad concept information quality, I examined four of the many dimensions of information quality consisting of information relevance, information accuracy, information timeliness, and information completeness.

**Internal Validity**

Internal validity referred to the extent which a research design and the data allowed the researcher to draw accurate conclusions about the cause and effect, and other relationships in the data (Leedy & Ormrod, 2005; Rutkowski & Delandshere, 2016). With the application of internal validity, a researcher might make inferences on whether one variable caused a change in another variable, instead of other unrelated forces causing the change. Internal threats were those that related to treatments, procedures, or experiences by participants in the study that prevented the researcher from arriving at the correct conclusion. Threats to internal validity of a research design included maturation, history, mortality, instrumentation, testing, selection, rivalry and demoralization, diffusion of treatment and compensatory equalization (Drost, 2011). For this study, some threats to internal validity I considered were selection, not obtaining the minimum sample size, instrumentation, statistical conclusion validity, and weakness of nonexperimental correlational design.

Selection referred to a situation where a researcher selected participants who had certain characteristics that predisposed them to have certain outcomes. I used nonparametric statistical procedure (Spearman's rank correlation) to address selection bias because it relied on few or no assumptions about the shape or parameters of the population distribution from which the sample was drawn (Skene et al., 2016). I addressed the threat of not obtaining the minimum sample size by recruiting many potential participants. Instrumentation posed a threat when the instrument changed between a pre-test and post-test, thus affecting the scores on the outcome. I addressed this threat by adopting an existing and validated AIMQ instrument by Lee et al. (2002). I also assessed the validity of this study by making sure that the questions in the survey measured what they were supposed to measure. Statistical conclusion validity was the degree to which conclusions (based on the data) about the relationship among variables were reasonable. Under statistical conclusion validity, two types of errors could occur. The first one was Type I error in which the researcher rejected the null hypothesis, H0, when it was true. The second one was Type II error in which the researcher did not reject the null hypothesis, H0, when it was false. I addressed this threat by ensuring that I used adequate sampling procedures (including obtaining large sample size), reliable measurement procedures, and appropriate statistical tests. The last threat was threat due to the weakness of nonexperimental correlational design. The weakness was that researchers were not able to identify or measure other variables that might influence the relationships being measured; researchers might therefore not be able to infer causality. I addressed this threat by ensuring that I selected the participants from a homologous group of specialty trade contractors.

## Construct Validity

Construct validity referred to how well a researcher translated or transformed a behavior, concept, or an idea, into a functioning and operating reality so that the researcher could legitimately make inferences from the variables in a study (Trochim & Donnelly, 2008). Threats to construct validity occurred when researchers used inadequate measures and definitions of variables (Drost, 2011). In relation to this study, threats to construct validity might arise from lack of reliability of participants' responses. Responses to certain questions might vary among groups. For example, specialty trade contractors within the NAICS Code 2381 could answer a question on relevance of information in a construction safety plan with completely, whereas specialty trade contractors within the NAICS Code 2382 might answer it with not at all. Hence, if I scored the question disregarding group classification, the responses might cancel each other out.

**Ethical Procedures**

Studies that involved human subjects in the behavioral and social sciences posed ethical issues associated with any research process. Researchers therefore needed to be aware of ethical obligations to their colleagues, participants, and discipline to ensure that published data were trustworthy and sound (Greenwood, 2016). Federal agencies and local institutional review boards defined guidelines researchers should follow for any human subject research (Klitzman, 2012). I adhered to these guidelines in this study. I obtained permissions from institutions as required before I collected data. I instructed the survey-hosting site not to collect any personal information from participants. I kept participants anonymous and their participation was voluntary. The survey invitation letter contained a consent form and information on participants' protections and rights, and approval from institutional review board. I obtained approval from The Walden University Institutional Review Board before collecting data for the study which would be stored in a safe location for 5 years to comply with Walden University's security policy. At the end of the 5-year period, the data would be destroyed.

## Summary

This chapter contained details of the methodology and design of the study. I explained why quantitative nonexperimental design was the appropriate design I used in answering the research questions and testing hypotheses in the first section. I provided justification for the use of correlational research design and its connection to the research questions in examining the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. In the second section, I described the target population, sampling and sampling procedure, and sample size I used in the study. The target population for this study was U.S. specialty trade contractors who were SurveyMonkey audience. The participants included primary subgroups within specialty trade contractors (NAICS code 238). These subgroups were foundation, structure, and building exterior contractors (NAICS code 2381); building equipment contractors (NAICS code 2382); building finishing contractors (NAICS code 2383); and other specialty trade contractors (NAICS code 2389). I used self-selection as the sampling method. The goal of the study was to obtain a minimum sample size of 82 participants, but I obtained and validated 134 participants. The third section contained a detailed description of the survey materials used for data collection and data analysis. I performed data collection with an online survey instrument using closed-ended questions. In the data analysis, I used descriptive and inferential statistics to test the hypotheses. The final section contained ethical considerations and protection of participants' rights that were required in any research involving human subjects. I present the findings and results of the study in Chapter 4.

# Chapter 4: Results

Chapter 4 contains a brief review of the purpose, research questions, and hypotheses. The chapter also contains information on data collection, study results, and summary. The purpose of this quantitative nonexperimental design study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. The dimensions of information quality covered included relevance, accuracy, timeliness, and completeness of information in construction safety plans. I addressed the four research questions and corresponding hypotheses that I presented in Chapter 1.

Chapter 4 includes an overview of data collection strategies, including timeframe for data collection, response rates, data cleaning and screening, and sample characteristics. I also discuss the results of the statistical tests to include the general descriptive statistics, correlation analysis, and hypothesis testing. The statistical test I used to determine the significance of the correlation coefficient $r_s$ was Spearman correlation test. A $p$ value of less than .05 for a two-tailed test (Field, 2013) using 90 participants and 88 degrees of freedom was required for significance. I finally summarize the findings and provide a transition to Chapter 5.

## Data Collection

### Time Frame, Response Rates, and Sample Characteristics

The data collection timeframe was 31 days. I used a previously validated instrument called AIMQ: A methodology for information quality assessment that Le et al. (2002) developed to collect data. There were no major discrepancies in data collection or the actual recruitment and response rates. Participants were recruited from SurveyMonkey audience who volunteered to take the survey. There were 154 responses. Out of the 154 responses, 134 participants (87%) gave their consent to be in the study while 20 participants (13%) did not give their consent. Table 1 contains the demographic subsector of participants under NAICS code 238 who gave their consent to be in the study. The sample represented the subsectors of the population of interest.

Table 1

*Demographic Subsector of Respondents Who Gave Their Consent*

| | NAICS code | Count | (%) |
|---|---|---|---|
| Foundation, structure, and building exterior contractors | 2381 | 61 | 45.50 |
| Building equipment contractors | 2382 | 30 | 22.40 |
| Building finishing contractors | 2383 | 22 | 16.40 |
| Other specialty trade contractors | 2389 | 21 | 15.70 |
| | Total | 134 | 100.00 |

Out of the 134 participants who gave their consent to be in the study, 90 (67.16%) indicated that their firm had written safety plans, 43 (32.10%) indicated that their firms did not have written safety plans, and one (0.74%) did not indicate either way. In the survey, the participants who indicated that their firms had written safety plans could continue with the rest of the survey and answer questions on the relevance, accuracy, timeliness, and completeness of information in the safety plans. The participants who indicated that their firms did not have written safety plans were not allowed to continue with the rest of the survey. The 90 participants who continued with the rest of the survey answered all the questions. The participant who did not indicate whether there was a written safety plan in the firm or not did not complete the rest of the survey. Hence, there were missing data in the responses that I determined to be incomplete surveys. I did not use the incomplete surveys for the study.

## Study Results

### Descriptive Statistics

I present in Table 2 the mean and standard deviation for the variables used in the study. Relevance had the highest mean and standard deviation with values of 7.91 and 1.83 respectively. Timeliness had the lowest mean and standard deviation with values of 6.16 and 1.49 respectively among the predictor variables.

Table 2

*Mean and Standard Deviation (SD) for Variables*

| Variable | Mean | SD | No. of items |
|---|---|---|---|
| Construction safety | 2.98 | 1.93 | 4 |
| Relevance | 7.91 | 1.83 | 4 |
| Accuracy | 6.74 | 1.76 | 4 |
| Timeliness | 6.16 | 1.49 | 5 |
| Completeness | 6.93 | 1.70 | 6 |

I computed two internal consistency estimates of reliability for the selected dimensions of information quality scale; the two estimates were coefficient alpha and a split-half coefficient expressed as a Spearman-Brown corrected correlation (Warrens, 2015). Before I conducted the internal consistency estimates of reliability, I determined that all items used the same scale and reverse-scaled four Likert-type scale questionnaire items that were reverse coded. For this study, the value for coefficient alpha was .885. Vaske, Beaman, and Sponarski (2017) noted that generally, alpha scores of .65 or higher were acceptable when showing internal reliability of an instrument. For the split-half coefficient, I split the scale into two halves such that the two halves would be as equivalent as possible. In splitting the items, I considered the sequencing of the items. One of the halves included relevance and timeliness, while the other half included accuracy and completeness. The value for the split-half coefficient was .937. The two internal consistency estimates of reliability for the selected dimensions of information quality scale indicated satisfactory reliability.

**Evaluation of Statistical Assumptions**

Before I completed the statistical tests, I examined the data for missing values, outliers, normality, linearity, and homoscedasticity. As I report later in this section, the data I collected did not meet the assumption of normally distributed data. I then used Spearman rank correlation coefficient ($r_s$), the nonparametric equivalent to Pearson product-moment correlation coefficient ($r$), to measure the strength of the association between information quality in construction safety plans and construction safety among specialty trade contractors. I used bivariate correlation model to analyze data between the predictor variables and criterion variables. I also used the Bootstrap option (Field, 2013) in SPSS to obtain some robust confidence intervals. The statistical test I used to determine the significance of the correlation coefficient $r_s$ was the Spearman correlation test. A $p$ value of less than .05 for a two-tailed test (Field, 2013) using 90 participants and 88 degrees of freedom was required for significance. The dimensions of information quality (predictor variables) I measured were relevance, accuracy, timeliness, and completeness of information in construction safety plans. The criterion variable was construction safety. I next present my examination of the data for missing values, outliers, normality, linearity, and homoscedasticity.

First, I examined the data for missing values. The missing values as reflected in SPSS were as a result of the algorithm I used to structure the survey. Based on the algorithm, not all the154 participants who responded to the survey would answer all the survey questions. For example, the first set of missing values in SPSS resulted from participants who were instructed to select only one of the four NAICS code classifications. The second set of missing values resulted from participants who indicated that their firms did not have written safety plans. Ninety participants who indicated that their firms had written safety plans answered all of the 19 quantitative questions for a total of 1,710 Likert-type responses without the four demographic and one "yes" or "no" questions. The sources of the missing values as reflected in SPSS are shown in Table 3.

Table 3

*Sources of Missing Values*

| Participants | Valid | System missing | Total. |
|---|---|---|---|
| NAICS code 2381 | 61 | 93 | 154 |
| NAICS code 2382 | 30 | 124 | 154 |
| NAICS code 2383 | 22 | 132 | 154 |
| NAICS code 2389 | 21 | 133 | 154 |
| Have safety plan | 133 | 21 | 154 |

Note: One participant who consented did not indicate if firm had written safety plan.

Next, I evaluated the data for outliers. Variable histograms (see Figure 4) appeared to reveal one lower bound outlier for accuracy. I further examined outliers statistically and confirmed that there was one lower bound outlier for accuracy. I listed the results of this statistical analysis in Table 4.

Table 4

*Outlier Upper and Lower Limits and Extreme Values*

| Variable | Lower bound | Upper bound | Min | Max . |
|---|---|---|---|---|
| Construction safety | 2.65 | 3.31 | 1.00 | 8.00 |
| Relevance | 7.53 | 8.29 | 2.50 | 10.00 |
| Accuracy | 6.37 | 7.11 | 0.00 | 10.00 |
| Timeliness | 5.85 | 6.48 | 3.40 | 10.00 |
| Completeness | 6.57 | 7.28 | 1.67 | 10.00 |

*Note:* There was one lower bound outlier for accuracy.

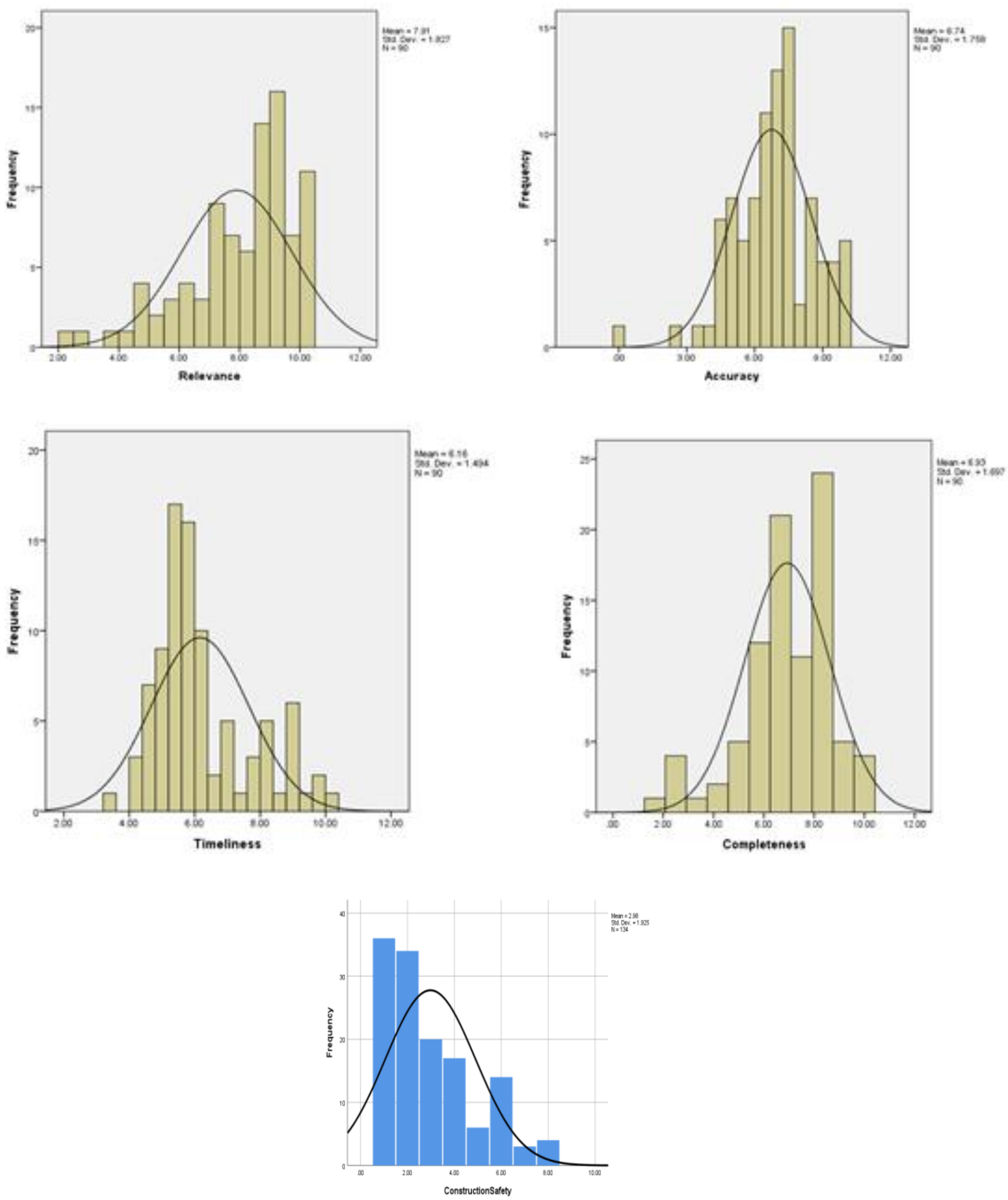


*Figure 4.* Histograms of data set

Third, I performed tests of normality using histograms (see Figure 4), Q-Q plots (see Figure 5), and statistically validated the normality with the Shapiro-Wilk test of normality (see Table 5).

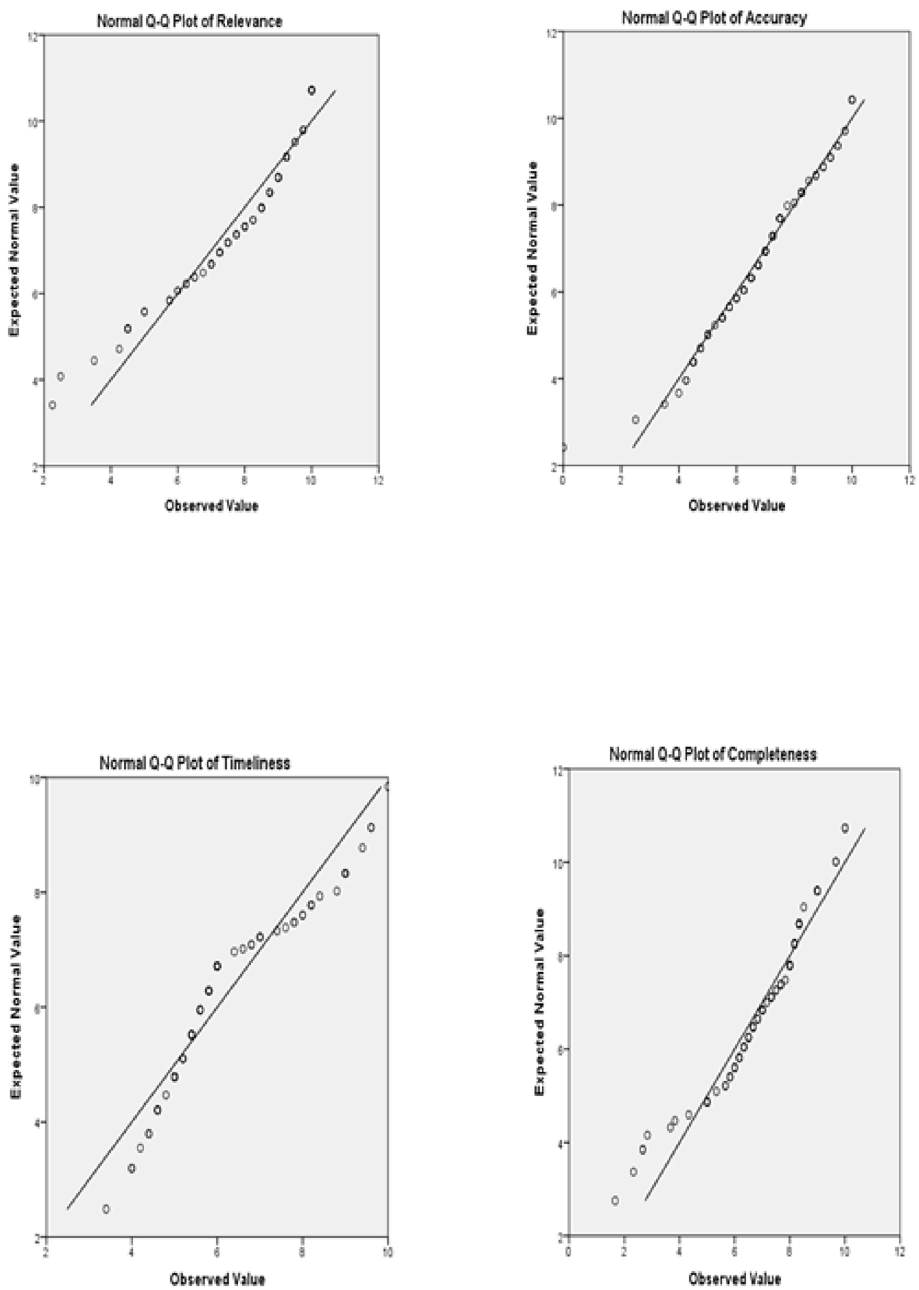


*Figure 5*. Q-Q Plots for data sets.

The Q-Q plots seemed to follow a linear pattern and implied that the data were normally distributed.

To test the assumption for normality, I performed the Shapiro-Wilk test of normality. The assumption was that the data were normally distributed given a chosen level of alpha. The chosen alpha level for my test was .05. After I performed the Shapiro-Wilk test of normality, the *p* values were less than .05. Consequently, I concluded that the data were not normally distributed. Table 5 contains the result of the Shapiro-Wilk test of normality.

Table 5

*Shapiro-Wilk Test of Normality*

| Variable | Statistic | Sig |
|---|---|---|
| Construction Safety | .87 | < .05 |
| Relevance | .90 | < .05 |
| Accuracy | .97 | < .05 |
| Timeliness | .89 | < .05 |
| Completeness | .94 | < .05 |

I next used scatterplots to understand the linear relationship between the predictor variables and criterion variable. The scatterplot for construction safety and relevance, as shown in Figure 6, indicated that the two variables appeared to be linearly related such that as the relevance of information in a construction safety plan increased, construction safety appeared to increase. The regression equation for predicting construction safety was

$$\textit{Predicted Construction Safety} = \textit{0.01 Relevance} + 2.76$$

The equation offered some predictability, but many data points fall far off the line, indicating poor prediction for those points.

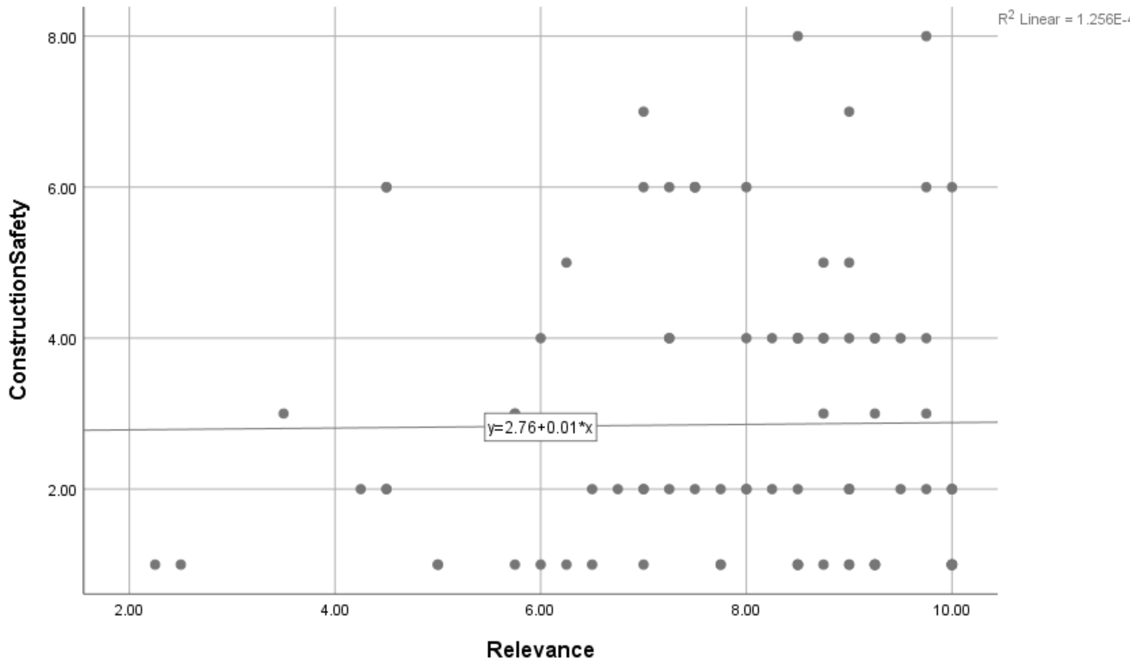


*Figure 6.* Scatterplot of construction safety and relevance.

The scatterplot for construction safety and accuracy, as shown in Figure 7, indicated that the two variables appeared to be linearly related such that as the accuracy of information in a construction safety plan increased, construction safety appeared to increase. The regression equation for predicting construction safety was

$$Predicted\ Construction\ Safety = 0.10\ Accuracy + 2.18$$

The equation offered some predictability, but many data points fall far off the line, indicating poor prediction for those points.

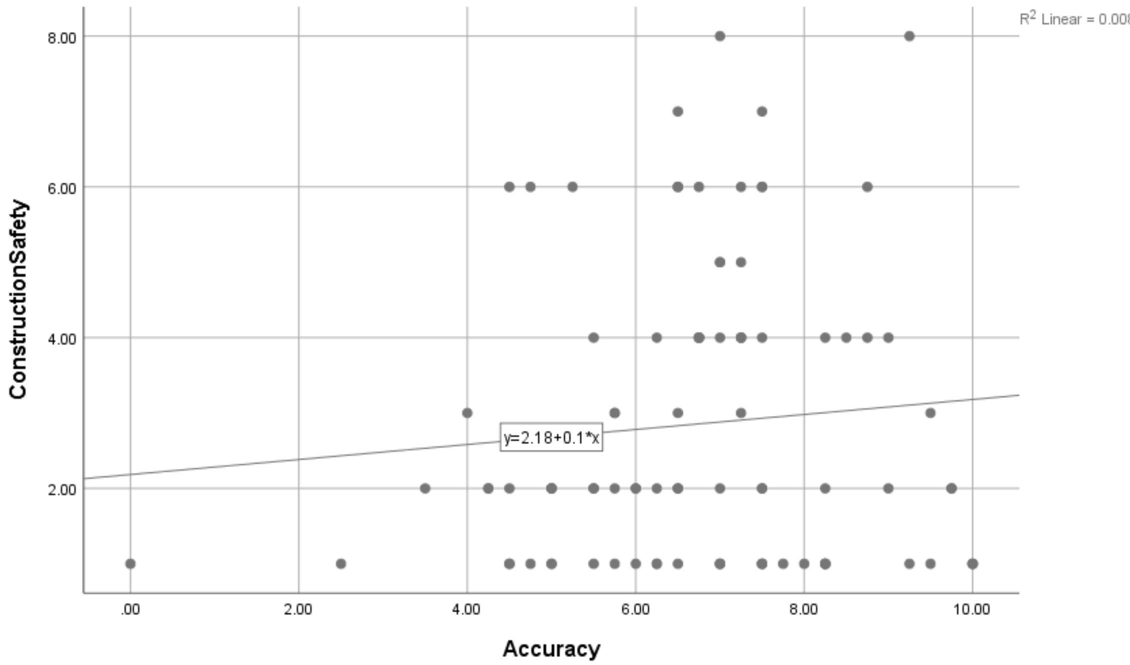


*Figure 7.* Scatterplot of construction safety and accuracy.

The scatterplot for construction safety and timeliness, as shown in Figure 8, indicated that the two variables appeared to be linearly related such that as the timeliness of information in a construction safety plan decreased, construction safety appeared to increase. The regression equation for predicting construction safety was

$$\textit{Predicted Construction Safety} = -0.07\ \textit{Timeliness} + 3.29$$

The equation offered some predictability, but many data points fall far off the line, indicating poor prediction for those points.

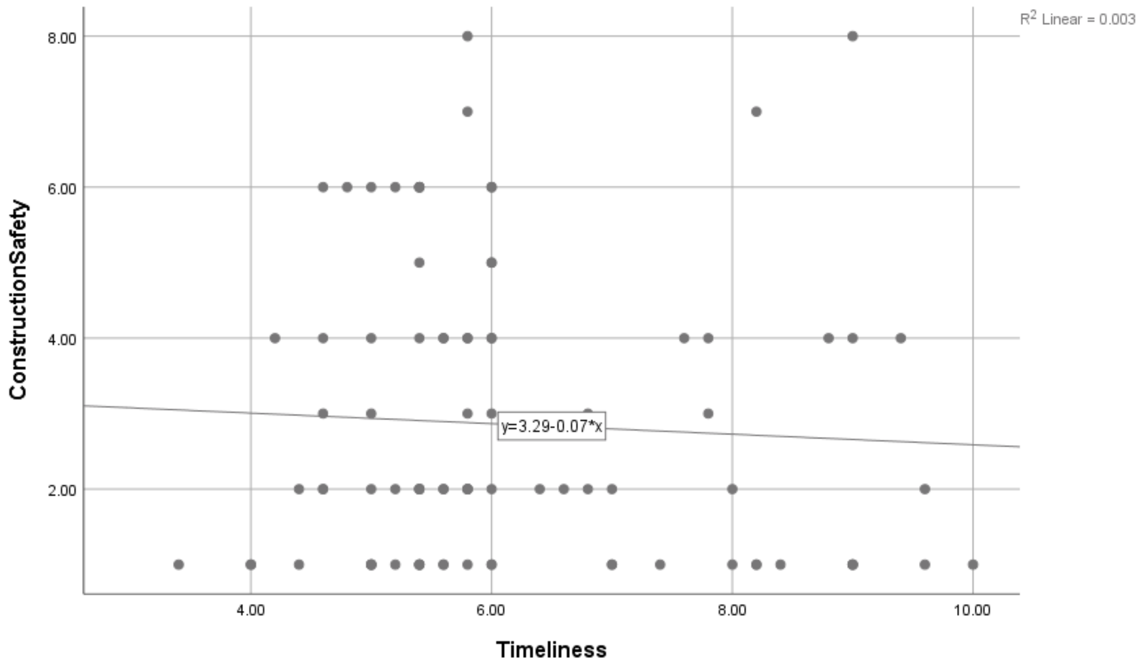


*Figure 8.* Scatterplot of construction safety and timeliness.

The scatterplot for construction safety and completeness, as shown in Figure 9, indicated that the two variables appeared to be linearly related such that as the completeness of information in a construction safety plan increased, construction safety appeared to increase. The regression equation for predicting construction safety was

*Predicted Construction Safety = 0.02 Completeness* + 2.68

The equation offered some predictability, but many data points fall far off the line, indicating poor prediction for those points.

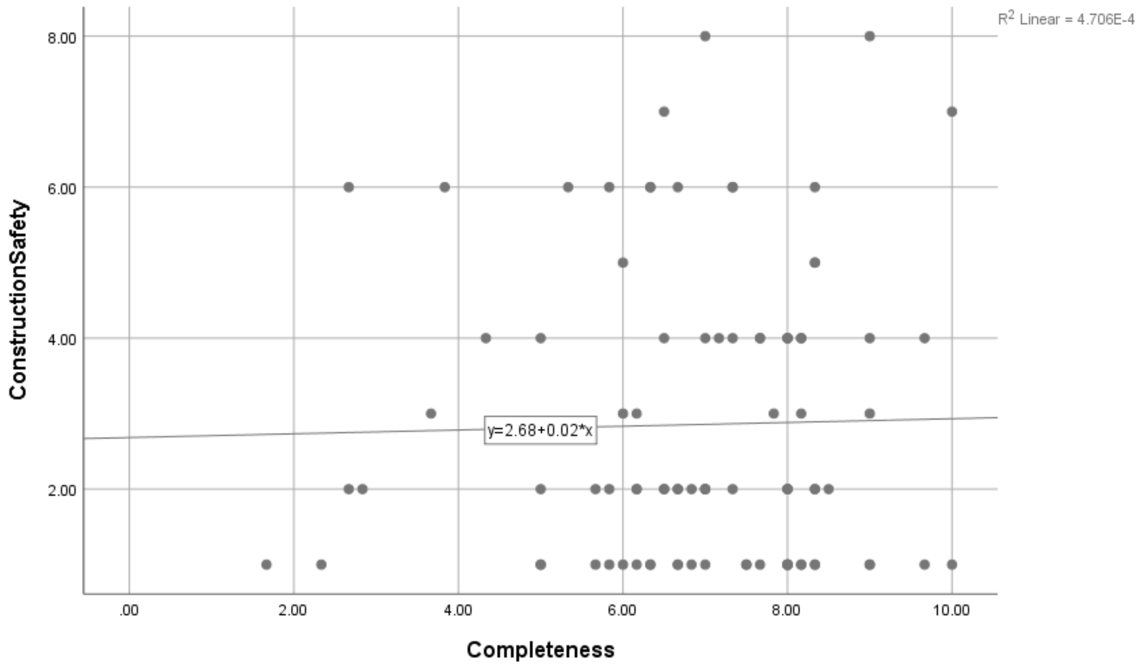


*Figure 9.* Scatterplot of construction safety and completeness.

I finally examined homoscedasticity by a scatterplot for the regression model with one axis for the predicted scores and the other axis for the standardized residuals (see Figure 10). The results seemed not to support the assumption of homoscedasticity.

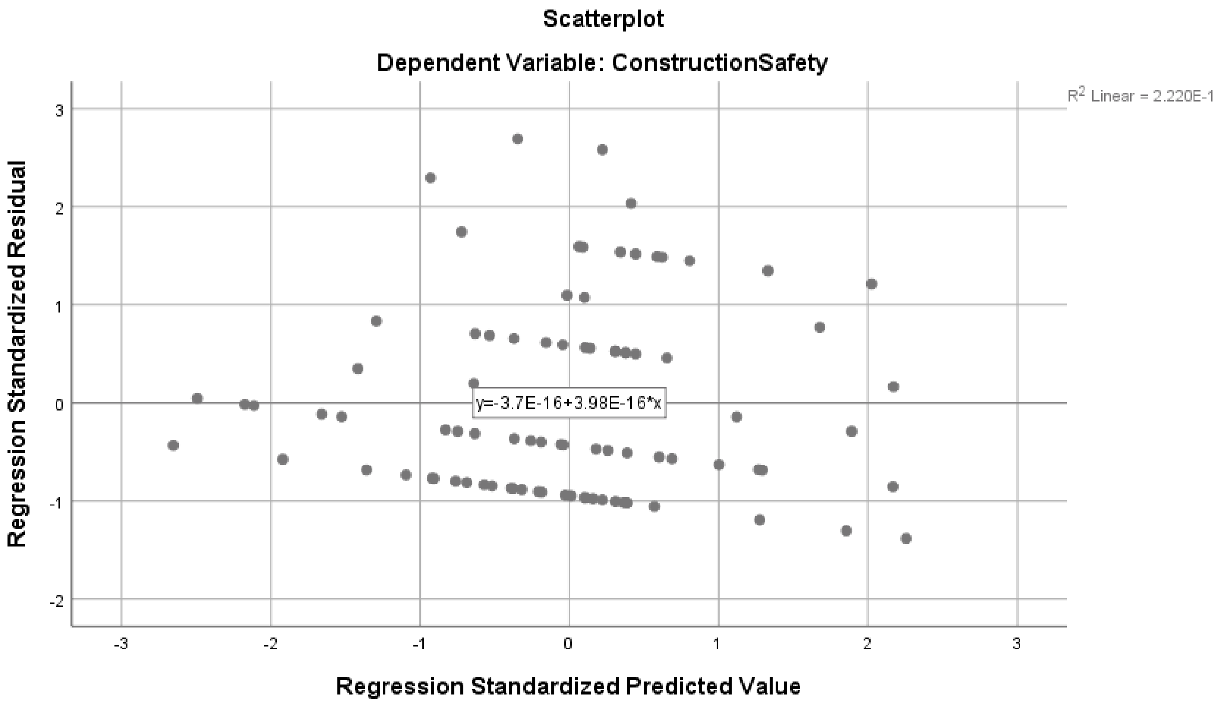


*Figure 10.* Scatterplot for homoscedasticity.

## Statistical Analysis Findings

To test the assumption for normality, I performed the Shapiro-Wilk test of normality. The assumption was that the data were normally distributed given a chosen level of alpha. The chosen alpha level for my test was .05. After I performed the Shapiro-Wilk test of normality, the p values were less than .05. Consequently, I concluded that the data were not normally distributed. Table 5 contains the result of the Shapiro-Wilk test of normality. Since the assumption of normality was not met, I used the nonparametric equivalent of Pearson's product-moment correlation coefficient, the Spearman rank correlation coefficient. For this study, I considered a *p*-value of .05 or less statistically significant for the two-tailed tests. I conducted the hypotheses testing using 90 participants because in the survey, the participants who indicated that their firms had written safety plans could continue with the rest of the survey and answer questions on the relevance, accuracy, timeliness, and completeness of information in the safety plans. The 44 participants who indicated that their firms did not have written safety plans could not continue with the rest of the survey.

Meanwhile, to determine the achieved power using 90 participants, a level of significance at $\alpha = 0.05$ (two-tails), and a medium effect size of 0.3, I ran another post hoc power analysis using G*Power 3.1.9.2. The achieved power was 0.827, which again exceeded the power of 0.8 that I used in the priori power analysis to arrive at minimum sample size of 82 (see Figure 11). I considered the 90 participants who indicated that their firms had written safety plans to be sufficient for the rest of the study.

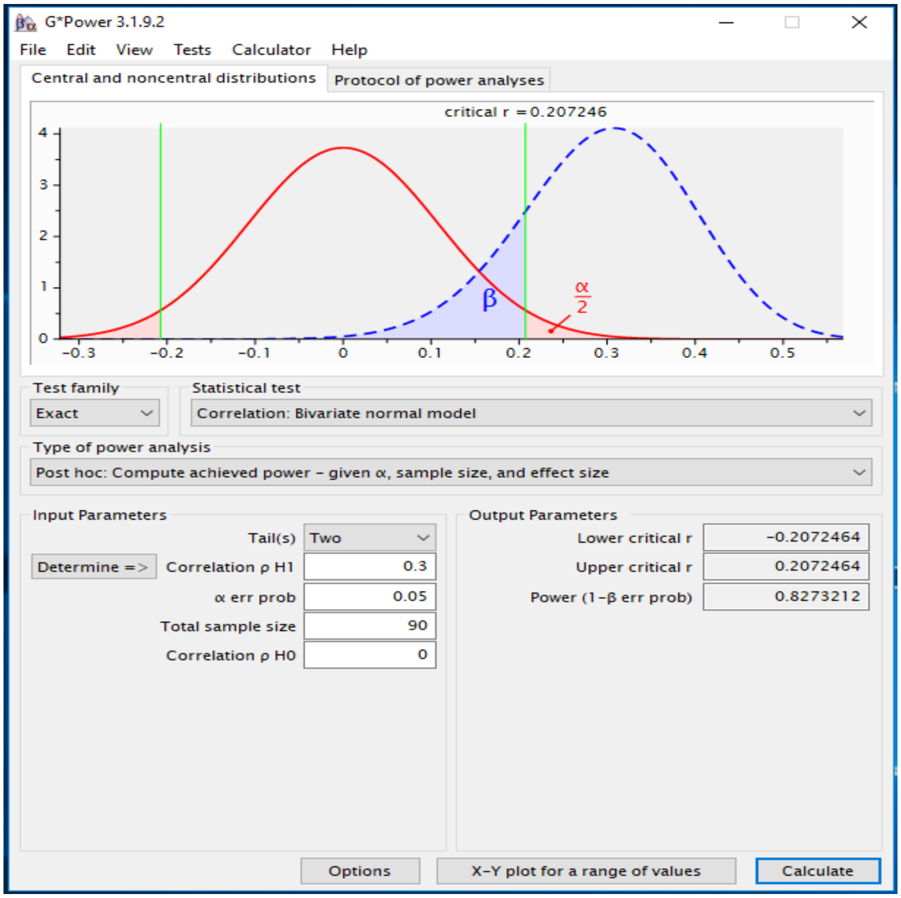


*Figure 11*. G*power post hoc analysis on 90 participants.

In this section, I presented the statistical analysis findings. I divided this section into four parts according to Research Questions 1 through 4 with corresponding hypotheses.

**Research Question 1 and Hypotheses**

RQ1: What is the nature of the relationship between information relevance and construction safety among specialty trade contractors?

$H_0$1: There is no statistically significant relationship between information relevance and construction safety among specialty trade contractors.

$H_a1$: There is a statistically significant relationship between information relevance and construction safety among specialty trade contractors.

I present the results of Spearman rank correlation coefficient analysis and the assessment of *p*-value for a two-tailed test with 88 degrees of freedom which I used to determine significance.

**Spearman rank correlation coefficient analysis.** To assess $H1_{o,}$ I conducted a Spearman rank correlation coefficient analysis for 90 participants to determine if a statistically significant relationship existed between the relevance of information in a construction safety plan and construction safety among specialty trade contractors. Spearman rank correlations were typically denoted with the coefficient, $r_s$. The values of $r_s$ ranged from -1 to +1. If the ranks of corresponding pairs of data were identical exactly, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1. If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero. I used Cohen's standard (1988) to assess the correlation coefficients to determine the strength of the relationship. Coefficients above .50 represented a large association, coefficients between .30 and .49 represented a medium association, and coefficients between .10 and .29 represented a small association. The result of the correlational analysis showed that there was no significant relationship between the relevance of information in a construction safety plan and construction safety among specialty trade contractors, $r_s(88) = -.082$, $p > .05$ (see Table 6). This suggested that no association existed between the relevance of information in a construction plan and construction safety among specialty trade contractors. No statistical significance could therefore be interpreted. The null hypothesis, which held that there was no statistically significant relationship between information relevance and construction safety among specialty trade contractors could not be rejected.

Table 6

*Spearman's rho Correlations*

| | | Relevance | Accuracy | Timeliness | Completeness | Construction safety |
|---|---|---|---|---|---|---|
| Relevance | Correlation Coefficient | 1.000 | .705** | .445** | .726** | -.082 |
| | Sig. (2-tailed) | . | .000 | .000 | .000 | .444 |
| | N | 90 | 90 | 90 | 90 | 90 |
| Accuracy | Correlation Coefficient | .705** | 1.000 | .623** | .772** | .039 |
| | Sig. (2-tailed) | .000 | . | .000 | .000 | .717 |
| | N | 90 | 90 | 90 | 90 | 90 |
| Timeliness | Correlation Coefficient | .445** | .623** | 1.000 | .737** | -.033 |
| | Sig. (2-tailed) | .000 | .000 | . | .000 | .755 |
| | N | 90 | 90 | 90 | 90 | 90 |
| Completeness | Correlation Coefficient | .726** | .772** | .737** | 1.000 | -.005 |
| | Sig. (2-tailed) | .000 | .000 | .000 | . | .963 |
| | N | 90 | 90 | 90 | 90 | 90 |
| Construction safety | Correlation Coefficient | -.082 | .039 | -.033 | -.005 | 1.000 |
| | Sig. (2-tailed) | .444 | .717 | .755 | .963 | . |
| | N | 90 | 90 | 90 | 90 | 134 |

*Note.* **. Correlation is significant at the 0.01 level (2-tailed)

## Research Question 2 and Hypotheses

RQ2: What is the nature of the relationship between information accuracy and construction safety among specialty trade contractors?

$H_0$2: There is no statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

$H_a2$: There is a statistically significant relationship between information accuracy and construction safety among specialty trade contractors.

I present the results of Spearman rank correlation coefficient analysis and the assessment of *p*-value for a two-tailed test with 88 degrees of freedom which I used to determine significance.

**Spearman rank correlation coefficient analysis.** To assess $H2_{o,}$ I conducted a Spearman rank correlation coefficient analysis for 90 participants to determine if a statistically significant relationship existed between the accuracy of information in a construction safety plan and construction safety among specialty trade contractors. Spearman rank correlations were typically denoted with the coefficient, $r_s$. The values of $r_s$ ranged from -1 to +1. If the ranks of corresponding pairs of data were identical exactly, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1. If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero. I used Cohen's standard (1988) to assess the correlation coefficients to determine the strength of the relationship. Coefficients above .50 represented a large association, coefficients between .30 and .49 represented a medium association, and coefficients between .10 and .29 represented a small association. The result of the correlational analysis showed that there was no significant relationship between the accuracy of information in a construction safety plan and construction safety among specialty trade contractors, $r_s(88) = .039$, $p > .05$ (see Table 6). This suggested that no association existed between the accuracy of information in a construction plan and construction safety among specialty trade contractors. No statistical significance could therefore be interpreted. The null hypothesis, which held that there was no statistically significant relationship between information accuracy and construction safety among specialty trade contractors could not be rejected.

**Research Question 3 and Hypotheses**

RQ3: What is the nature of the relationship between information timeliness and construction safety among specialty trade contractors?

$H_0$3: There is no statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

$H_a$3: There is a statistically significant relationship between information timeliness and construction safety among specialty trade contractors.

I present the results of Spearman rank correlation coefficient analysis and the assessment of *p*-value for a two-tailed test with 88 degrees of freedom which I used to determine significance.

**Spearman rank correlation coefficient analysis.** To assess $H3_{o,}$ I conducted a Spearman rank correlation coefficient analysis for 90 participants to determine if a statistically significant relationship existed between the timeliness of information in a construction safety plan and construction safety among specialty trade contractors. Spearman rank correlations were typically denoted with the coefficient, $r_s$. The values of $r_s$ ranged from -1 to +1. If the ranks of corresponding pairs of data were identical exactly, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1. If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero. I used Cohen's standard (1988) to assess the correlation coefficients to determine the strength of the relationship. Coefficients above .50 represented a large association, coefficients between .30 and .49 represented a medium association, and coefficients between .10 and .29 represented a small association. The result of the correlational analysis showed that there was no significant relationship between the timeliness of information in a construction safety plan and construction safety among specialty trade contractors, $r_s(88) = -.033$, $p > .05$ (see Table 6). This suggested that no association existed between the timeliness of information in a construction plan and construction safety among specialty trade contractors. No statistical significance could therefore be interpreted. The null hypothesis, which held that there was no statistically significant relationship between information timeliness and construction safety among specialty trade contractors could not be rejected.

**Research Question 4 and Hypotheses**

RQ4: What is the nature of the relationship between information completeness and construction safety among specialty trade contractors?

$H_0$4: There is no statistically significant relationship between information completeness and construction safety among specialty trade contractors.

$H_a$4: There is a statistically significant relationship between information completeness and construction safety among specialty trade contractors.

I present the results of Spearman rank correlation coefficient analysis and the assessment of *p*-value for a two-tailed test with 88 degrees of freedom which I used to determine significance.

**Spearman rank correlation coefficient analysis.** To assess $H4_o$, I conducted a Spearman rank correlation coefficient analysis for 90 participants to determine if a statistically significant relationship existed between the completeness of information in a construction safety plan and construction safety among specialty trade contractors. Spearman rank correlations were typically denoted with the coefficient, $r_s$. The values of $r_s$ ranged from -1 to +1. If the ranks of corresponding pairs of data were identical exactly, the value of $r_s$ was +1. If the ranks were in reverse order, the value of $r_s$ was -1. If the ranks of the corresponding pairs of data had no relationship, the value of $r_s$ was equal to zero. I used Cohen's standard (1988) to assess the correlation coefficients to determine the strength of the relationship. Coefficients above .50 represented a large association, coefficients between .30 and .49 represented a medium association, and coefficients between .10 and .29 represented a small association. The result of the correlational analysis showed that there was no significant relationship between the completeness of information in a construction safety plan and construction safety among specialty trade contractors, $r_s(88) = -.005$, $p > .05$ (see Table 6). This suggested that no association existed between the completeness of information in a construction plan and construction safety among specialty trade contractors. No statistical significance could therefore be interpreted. The null hypothesis, which held that there was no statistically significant relationship between information completeness and construction safety among specialty trade contractors could not be rejected.

**Summary**

In Chapter 4, I presented the results of the research study on the relationship between information quality and construction safety. The predictor variables were relevance, accuracy, timeliness, and completeness of information in construction safety plans. The criterion variable was construction safety.

I used descriptive statistics such as means, standard deviations, histograms, and scatterplots to describe the data. The statistical test I used to determine the significance of the correlation coefficient $r_s$ for the four null hypotheses ($H1_o$, $H2_o$, $H3_o$, and $H4_o$) was the Spearman correlation test. A *p* value of less than .05 for a two-tailed test using 90 participants and 88 degrees of freedom was required for significance. None of the results yielded any statistically significant findings and I could not reject any of the four null hypotheses. Table 7 contains a summary of the null hypotheses test results.

Table 7

*Summary of Null Hypotheses Test Results*

| Null hypotheses | Description | Reject/Fail to reject |
|---|---|---|
| $H1_o$ | There was no statistically significant relationship between information relevance and construction safety among specialty trade contractors. | Fail to reject |
| $H2_o$ | There was no statistically significant relationship between information accuracy and construction safety among specialty trade contractors. | Fail to reject |
| $H3_o$ | There was no statistically significant relationship between information timeliness and construction safety among specialty trade contractors. | Fail to reject |
| $H4_o$ | There was no statistically significant relationship between information completeness and construction safety among specialty trade contractors. | Fail to reject |

In Chapter 5, I discuss the interpretation of research findings, limitations of the study, and recommendations for further research. I also discuss implications for research, practice, and positive social change.

# Chapter 5: Discussions, Conclusions, and Results

The purpose of this quantitative nonexperimental correlational study was to examine the nature of the relationship between information quality in construction safety plans and construction safety among specialty trade contractors. I conducted this study because no reliable research existed on the relationship between information quality in construction safety plans and safety of specialty trade contractors who continued to account for 62% of construction fatal injuries. This study was unique because it contributes new knowledge to an underresearched area of information systems management on the relationship between information quality in construction safety plans and safety of specialty trade contractors. The results of this study could be used to improve the quality of information in construction safety plans that might help improve safety of specialty trade contractors. Understanding the relationship between information quality in safety plans and construction safety might also provide insight on how management could reduce insurance costs, litigation costs, medical expenses, and disability claims that negatively affect company profits. This study was needed given the injury rate as noted.

I used descriptive statistics such as means, standard deviations, histograms, and scatterplots to describe the data. The statistical test I used to determine the significance of the correlation coefficient $r_s$ for the four null hypotheses ($H_01$, $H_02$, $H_03$, and $H_04$) was Spearman correlation test. A $p$ value of less than .05 for a two-tailed test using 90 participants and 88 degrees of freedom was required for significance. None of the results yielded any statistically significant findings, and I could not reject any of the four null hypotheses.

## Interpretation of Findings

From my literature review, I found that construction professionals disagreed on the value of written safety plans (Goetsch, 2013; Hannan, 2015; Mroszczyk, 2015). One perspective was that safety professionals could invest the time they spent developing safety plans to better use at the job site. Another perspective was that construction firms could use well-written quality safety plans to help prevent injuries, accidents, illnesses, and related expenses that could negatively affect organizations' productivity and profits.

An early finding from this study before I performed detailed statistical analyses of the data appeared to confirm the disagreement among construction professionals on the value of written safety plans. Out of the 134 participants who gave their consent to be in the study, 43 (32.10%) indicated that their firms did not have written safety plans while 90 (67.16%) indicated that their firms had written safety plans. One (0.74%) did not indicate either way. It was insightful and informative to know that 32.10% of the participants who gave their consent to be in the study stated that their firms did not have written safety plans. It was beyond the scope of this study to examine why such firms did not have written safety plans.

I used four research questions to form the basis for inquiry in this study. The 90 participants (67.16%) who indicated that their firms had written safety plans responded to all the research questions. In each of the four research questions, I asked what was the nature of the relationship between relevance, accuracy, timeliness, or completeness of information in construction safety plans and construction safety among specialty trade contractors. The results of the correlation analyses for all four null hypotheses showed no statistically significant relationship between information relevance, accuracy, timeliness, or completeness of information in construction safety plans and construction safety among specialty trade contractors. No correlation matrix yielded any statistically significant findings. All the *p* values were more than .05. In other words, there was no statistically significant relationship between information relevance, accuracy, timeliness, or completeness of information in construction safety plans and construction safety among specialty trade contractors. Therefore, I failed to reject the four null hypotheses. Based on these results, the quality of information in construction safety plans appeared not be important to specialty trade contractors. The results appeared to support the finding by Kosny et al. (2013) that specialty trade contractors relied on informal sources to make safety decisions in the work place.

In the context of Petersen's (2003) accident/incident theoretical framework, reliance on informal sources to make safety decisions in the work place was an example of systems failure. The underlying assumption of Petersen's accident/incident theory was that systems failure and human errors such as decision to err, overload, and ergonomic traps were major causes of accident. Systems failure covers typical safety management areas such as management's policy on safety, safety training/orientation requirements, and standard operating procedures. In support of Petersen's (2013) accident/incident theory, Manuel (2013) argued that management should develop work systems/methods that would help reduce injuries and fatalities in the workplace. A construction safety plan is an example of such work system.

In the context of work systems theoretical framework, Alter (2013) defined a work system as “a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal and/or external customers” (p. 75). Alter posited that an information system was a work system that was used to capture, transmit, store, retrieve, delete, manipulate, and display information. A construction safety plan is an example of a work system. Based on the findings from this study, specialty trade contractors might not value the quality of information in construction safety plans, hence they relied on informal sources to make safety decisions. Work systems theory assumes that workers may or may not comply with design or expectations regarding where, how, and when they should perform activities (Alter, 2013). Alter noted that in many situations, strict adherence to rules and procedures might make it difficult to perform work efficiently. This might be one of the reasons there was no statistically significant relationship between the quality of information in construction safety plans (as measured by relevance, accuracy, timeliness, and completeness of information) and construction safety. The recommendation, therefore, is that safety professionals and managers should not ignore the importance of quality information in construction safety plans when trying to manage construction safety. Prime contractors typically used safety plans to help prevent construction injuries among their employees (Mroszczyk, 2015). Although the data suggested no statistically significant relationship between the predictor variables (relevance, accuracy, timeliness, and completeness of information) and criterion variable (construction safety), other factors could have influenced the outcome of the results. I describe some of these factors next.

The wording of the questions might have been a factor and rephrasing the questions might have produced a different result. For example, the participants might have not paid attention to the reverse coded questions and responded as if the questions were not reverse coded. There was one reverse coded question each for both accuracy and completeness, and two reverse coded questions for timeliness. The scatterplot for construction safety and timeliness, as shown in Figure 5, showed that the two variables appeared to be inversely related while the other three predictor variables had a direct relationship with the criterion variable. The two reverse coded questions for timeliness might have influenced the relationship between construction safety and timeliness. Another factor that could have affected the result of the study was the composition of the sample size of the study. Using a larger sample size could have produced a different result.

## Limitations of the Study

The use of nonparametric analyses such as Spearman's rho have the desirable property of making fewer assumptions regarding the distribution of data in the population from which samples are drawn (Caruso & Cliff, 1997). However, they have two main limitations. First, they are generally less statistically powerful than equivalent parametric procedure when the data are truly approximately normal. This means that there is smaller probability that nonparametric analyses will reveal that two variables are associated with each other when they are truly associated (Caruso & Cliff, 1997). A nonparametric test would require a slightly larger sample size to achieve the same power as the equivalent parametric test. The second limitation associated with nonparametric tests is that the results are typically less easy to interpret than those of parametric tests (Mircioiu & Atkinson, 2017). The reason is that many nonparametric tests use ranked values in the data instead of the actual data.

Some limitations to generalizability, validity, and reliability arose from execution of this study. I focused the study on one subgroup of the construction industry (NAICS code 238) specialty trade contractors in the United States drawn from SurveyMonkey audience. I did not consider the other two construction industry subgroups comprising construction of buildings (NAICS code 236) and heavy/civil engineering construction (NAICS code 237). There could be situations when employees of prime contractors under these two subgroups could perform framing, roofing, heating, air conditioning, plumbing, paper hanging, painting, masonry, glass and glazing, electrical, structural steel, concrete, and excavation work that specialty trade contractors typically performed (Mroszczyk, 2015). Although I made an effort to exclude subcontractors from NAICS code 236 and NAICS code 237, they might have inadvertently participated in this study simply because they performed the types of jobs that specialty trade contractors typically performed.

The way participants feel about construction safety in their work environments during the data collection period could be different from the way they feel at another period in time. Other limitations in social research that might have influenced the outcomes of this study included biased responses and spurious or false correlations. Some survey questions were categorized and this might force participants to respond in certain categories, which limited their range of responses. Another limitation was that only 90 (67.16%) of the 134 participants who gave their consent to be in the study answered all the questions on information relevance, information accuracy, information timeliness, and information completeness. The next limitation was that this study took the form of nonexperimental correlational research design. Due to the limitation of this research design, I was not able to identify or measure other variables that might have influenced the relationships being measured; I was therefore not able to infer causality.

## Recommendations

As no reliable research exists on the relationship between information quality in construction safety plans and safety of specialty trade contractors, there is opportunity for future researchers to expand on this study through experimental research to determine if the quality of information in construction safety plans has any effect on the safety of specialty trade contractors. Another recommendation for future research would be to examine the underlying reasons why some firms do not have written safety plans for their specialty trade contractors as an initial finding from this study revealed that 32.10% of the participants responded that their firms did not have written safety plans. This may be an opportunity for qualitative researchers to gain a deeper understanding of this phenomenon using open-ended questions. Open-ended questions will give participants the freedom to express themselves. Further, while there was no evidence to support that timeliness of information in a safety plan (predictor variable) had a significant relationship with construction safety among specialty trade contractors (criterion variable), future researchers may examine why there was an inverse relationship between the two variables. Intuitively, it would appear both variables would have a direct positive relationship between them (see Figure 8).

It might also be worthwhile to research how the four specialty trade contractor subgroups under NAICS code 238 (NAICS code 2381, NAICS code 2382, NAICS code 2383, and NAICS code 2389) would compare to each other under the current research topic. Another recommendation would be to extend future research on this current topic across North America. The scope of the current study was limited only to specialty trade contractors in the United States. Extending the research across North America would widen the scope of a future study culturally and socially.

## Implications

Based on the results of this study, there is still much to be discovered about the relationship of quality of information in construction safety plans and construction safety among specialty trade contractors. While there is opportunity for scholars to build on this study, there is much to learn for those wishing to make positive social change in construction safety at both the individual and organizational levels. Xu, Zou, and Luo (2018) noted that in construction safety, several competing project requirements such as schedule and cost might take priority over safety. Construction workers might also change their safety habits when they are under stress or working in difficult operating environments. Safety trainings can conflict with habitual unsafe behavior within construction groups and may lead to incidents or accidents (Lafuente, Abad, & Vaillant, 2018). Safety attitudes and behavior could be inconsistent among team members; the influence from their coworkers could be greater than that from the organization's safety professionals and managers (Liang, Ken-Yu, Zhang, & Su, 2018). This makes it difficult for safety leadership to be effective in managing construction crews consisting of specialty trade contractors.

**Implications for Research**

My goal with this research was to reduce a critical gap in the information systems management literature by studying the relationship between information quality in construction safety plans (an information system) and safety of specialty trade contractors. By focusing on the safety of specialty trade contractors, there is potential to take findings from this study and recreate the study for other construction sectors with a goal of improving their safety information systems. I expected that from this study, I might add new knowledge to this under-researched area of information systems management. Very little has been uncovered in the literature regarding the relationship between various dimensions of information quality in construction safety plans and construction safety among specialty trade contractors. By uncovering the relationship between information quality in construction safety plans and construction safety among specialty trade contractors, researchers can use this study to further diagnose safety problems in the construction industry. Finally, as mentioned in study limitations, researchers can use this study as a basis to broaden the participant pool to other countries in North America to confirm or reject that the study hypotheses work within other specialty trade contractors outside the United States.

**Implications for Practice**

Though firms had made improvements in construction safety, construction continued to be a hazardous industry (Yakubu & Bakri, 2013) and specialty trade contractors accounted for the largest proportion of construction fatalities (Mroszczyk, 2015). Aside from causing human tragedy and economic loss, injuries and fatalities significantly affect the productivity and reputation of the construction industry; minimizing injuries and fatalities is a major issue that the industry must continue to address (Kivrak & Kia, 2018). Within this context, I wanted to see if the relationship between information quality in construction safety plans and safety of specialty trade contractors might provide insight on how management could reduce insurance costs, litigation costs, medical expenses, and disability claims that negatively affected company profits. I also wanted to see if construction professionals could use the finding to improved productivity, reduced number of compliance inspections and associated penalties, and obtain more contracts for their firms because of good reputation. More contracts for firms could ultimately lead to improved national economy. This study placed a spotlight on information quality and construction safety. While the results of this study showed no statistically significant relationship between the quality of information in construction safety plans and safety of specialty trade contractors, the study results may provide insight to safety practitioners in having a deeper understanding of safety issues in construction. By acknowledging and addressing the quality of information in construction safety plans, there is potential for safety professionals to close a gap between those who see the need for written safety plans and those who do not. A combination of many elements leads to creation of a successful construction safety program. Effective information dissemination on safety management may help managers improve and promote safety by creating a climate of teamwork. The development of effective quality safety plans and participative safety program are not overnight successes. The process is ongoing through continuous quality and safety improvement programs.

**Implications for Positive Social Change**

The reason for conducting this research related to a central question. What was the relationship between information quality and construction safety? Organizations need healthy and safe employees to achieve organizational goals in efficient and effective manner. Fatality rates among specialty trade contractors still make up the largest percent of fatalities in construction. Although there was not sufficient evidence to reject the null hypotheses of the present study, it was evident that the research problem still needs to be studied further. The fatality rate appeared to have increased from 62% (DOL, 2014) to 63.4% based on 2016 OSHA published data (DOL, 2016).

One of the expected significances of this research to positive social change was that the results might be used to improve the quality of information in construction safety plans to help improve safety of specialty trade contractors. Another expectation was that the results from this study could lead to reduction in time-consuming and expensive trials and appeals in the U.S. court system. To bring about positive change in the norms, values, and ideologies of the existing construction safety system, specialty trade contractors could start a collective movement to draw more attention to this problem. The change might ultimately help create economic prosperity that might lead to improved standard of living among specialty trade contractors that work in the United States. Through this research, I expected to contribute new knowledge that companies might use to help save lives of specialty trade contractors. Finally, by focusing on quality of information in construction safety plans as it relates to safety of specialty trade contractors, safety professionals can redirect the focus in understanding why some firms do not have written safety plans. A safety plan is an information system that safety professionals can use to effect positive social change at the individual, organizational, and societal levels.

## Conclusions

In this study, I examined the nature of the relationship between the quality of information in construction safety plans and safety of U.S. specialty trade contractors. The theoretical foundations for the study were Petersen's accident/incident theory and work systems theory. I used both theories to examine the extent they provided contexts to explain the relationship between information quality in construction safety plans and safety of specialty trade contractors. Empirical results showed that the quality of information in construction safety plans measured through relevance, accuracy, timeliness, and completeness of information had a weak linear relationship with construction safety among specialty trade contractors. Among the predictor variables, timeliness had an inverse relationship with construction safety. Statistical analyses and hypotheses testing indicated that there was no statistically significant support that relevance, accuracy, timeliness, and completeness of information in construction safety plans predicted construction safety of specialty trade contractors. Although I found that 32.10% of firms did not have written safety plans, it will be important for safety professionals to promote the use of written safety plans. Wilbanks (2018) noted that hiring firms value quality written safety program and frequently demand that their contractors submit one to be eligible to perform work. A written safety plan is a key component of a written safety program. In this study, I extended prior research on information systems management by addressing a gap in the literature and examining how the quality of information in construction safety plans related to construction safety of specialty trade contractors in the U.S. Further research is needed, however, to understand if the variables I used in this study are relevant predictors for safety of specialty trade contractors in other North American countries. Results indicated that the quality of information in construction safety plans (measured by the relevance, accuracy, timeliness, and completeness of information) did not have statistically significant relationship with construction safety among U.S. specialty trade contractors. This study connects with positive social change by bringing into focus quality information systems research required to improve safety among U.S. specialty trade contractors and providing safety professionals a direction for continuous safety improvement in the U.S. construction industry.

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Appendix A: Permission Letters to Use/Reproduce Published Instrument

**From:** Aloysius Attah <aloysius.attah@[redacted]>
**Sent:** Friday, March 29, 2019 7:09 AM
**To:** Strong, Diane M <dstrong@[redacted]>; Richard Y Wang <rwang@[redacted]>; y.lee@[redacted];bkahn@[redacted]

**Subject:** Permission to Reproduce AIMQ Survey/Questionnaire Tool

Dear Drs. Strong, Wang, Lee, and Khan:

I am a PhD candidate from Walden University writing my dissertation titled *Relationship between Information Quality and Construction Safety*, under the direction of my dissertation committee chaired by Dr. David Gould, who can be reached at david.gould@[redacted].

On June 10, 2017, I sought and obtained your permission to use the ***AIMQ: a methodology for information quality assessment*** survey/questionnaire instrument in my research. My original request did not include permission to reproduce the instrument in my dissertation. With this in mind, I will be honored if you grant me additional permission to reproduce the instrument in my dissertation. I look forward to your response.

Sincerely,

Al

**Aloysius A. Attah**
PhD Candidate
Information Systems Management
School of Management
College of Management and Technology
Walden University
100 S Washington Ave #900,
Minneapolis, MN 55401

Re: Permission to Reproduce AIMQ Survey/Questionnaire Tool

RW

Richard Y Wang rwang@[redacted]

Reply all|
Yesterday, 3:57 PM
dstrong@[redacted]
Aloysius Attah;
y.lee@[redacted]
bkahn@[redacted].
Inbox

I concur.

V/r, Rich.
Pardon errors by smart iPhone

Lee, Yang <Y.LEE@[redacted]>

Reply all|
Yesterday, 8:13 PM
Richard Y Wang <rwang@[redacted]>;
dstrong@[redacted];
Aloysius Attah;
bkahn@[redacted]

Same here, and good luck.

Yang

Sent from my mobile device.
Please excuse brevity and typos.

On Mar 30, 2019, at 4:07 AM, Strong, Diane M <dstrong@[redacted] > wrote:

Dear Aloysius,

You have my permission to reproduce our AIMQ questionnaire in your dissertation with appropriate acknowledgement of its source.

Congratulations on finishing up your dissertation work.

Best regards,
Diane Strong
**Diane M. Strong, Ph.D.**
[redacted]

**From:** Aloysius Attah
**Sent:** Saturday, June 10, 2017 6:26:44 PM
**To:** [redacted]
**Cc:** [redacted]
**Subject:** Permission to Use AIMQ: a methodology for information quality assessment

**Letter Seeking Permission to Use Survey/Questionnaire Tool**

June 10, 2017
Yang W. Lee, PhD
Northeastern University
[redacted]

Dear Dr. Lee:

I am a PhD student from Walden University writing my dissertation titled ***Relationship between Information Quality and Construction Safety,*** under the direction of my dissertation committee chaired by Dr. David Gould, who can be reached at david.gould@[redacted].

I would like your permission to use the ***AIMQ: a methodology for information quality assessment*** survey/questionnaire instrument which you developed with Drs. Strong, Kahn, and Wang (copied) in my research study. I would like to use and print your survey under the following conditions:
I will use the surveys only for my research study and will not sell or use it with any compensated or curriculum development activities.
I will include the copyright statement on all copies of the instrument.
I will send a copy of my completed research study to your attention upon completion of the study.
If these are acceptable terms and conditions, please indicate so by replying to me through e-mail.

Sincerely,

Al

**Aloysius A. Attah**
PhD Candidate
Information Systems Management
School of Management
College of Management and Technology
Walden University

Re: Permission to Use AIMQ: a methodology for information quality assessment

Strong, Diane M [redacted]

Reply all

Sat 6/10/2017, 6:23 PM

Aloysius Attah;

[redacted]

AIMQ Permission

You replied on 6/10/2017 8:50 PM.

Aloysius,

I am fine with you using the AIMQ survey. I also want to add that you cite our paper in any documents or papers who produce as part of your research.

Good luck with your research.

Diane Strong

Richard Y Wang [redacted]

**From:** [redacted]

**Sent:** Saturday, June 10, 2017 10:28 PM

**To:** Aloysius Attah; [redacted]

**Subject:** RE: Permission to Use AIMQ: a methodology for information quality assessment

Reply all

Sat 6/10/2017, 10:28 PM

Aloysius Attah;

+3 more

Fine with me.

***Thanks,***

***Richard Wang***

[redacted]

***Please forgive typos, grammatical errors, etc. – getting the message to you is important.***

Aloysius Attah

Reply all|

Sat 6/10/2017 8:50 PM

To:

[redacted]

You forwarded this message on 6/10/2017 9:05 PM

Dr. Strong,

Thank you very much for granting me the permission to use the AIMQ survey. Yes, I will cite your paper in all documents and papers I produce as part of my research.

Best Regards,

Al Attah

# Appendix B : Survey Questionnaire

**Section 1**

**Questions related to demographic information of specialty trade contractors (NAICS Code 238)**

Review the classifications under A, B, C, and D carefully and circle **only one classification** that best describes your construction subsector. Next, within the classification you selected, please circle **only one number** that best describes the type of specialty trade contractors you best identify with.

**A) Foundation, structure, and building exterior contractors (NAICS code 2381)**

1. Poured concrete foundation and structure contractors
2. Structural steel and precast concrete contractors
3. Framing contractors
4. Masonry contractors
5. Glass and glazing contractors
6. Roofing contractors
7. Siding contractors
8. Other foundation, structure, and building exterior contractors

**B) Building equipment contractors (NAICS code 2382)**

1. Electrical contractors
2. Plumbing, heating, and air-conditioning contractors
3. Other building equipment contractors

**C) Building finishing contractors (NAICS code 2383)**

1. Drywall and insulation contractors
2. Painting and wall covering contractors
3. Flooring contractors
4. Finish carpentry contractors
5. Other building finishing contractors

**D) Other specialty trade contractors (NAICS code 2389)**

1. Site preparation contractors
2. All other specialty trade contractors

## Section 2

**Question related to existence of written construction safety plan in your firm**

My firm has a written safety plan (select one)

A) Yes

B) No

If you answered "Yes", continue the survey from Section 3.

If you answered "No", STOP the taking the survey

## Section 3

**Questions related to quality of information in your construction safety plan**

Some of the recommended elements of a construction safety plan are safety policy/goals, employee roles/responsibilities, discipline policy, job-site inspections, accident investigations, record keeping, and training. With this in mind, provide your responses to the statements described in A, B, C, and D below.

**A) The following items address the "RELEVANCE" of information in your firm's construction safety plan in relation to construction safety as you perform your work.**

On a scale of **0** to **10**, rate the relevance of information in relation to construction safety in your work environment.

| | **0 = not at all** | | | | | | | | | | **10 = completely** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) This information is useful to our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| b) This information is relevant to our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| c) This information is appropriate for our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| d) This information is applicable to our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**B) The following items address the "ACCURACY" of information in your firm's construction safety plan in relation to construction safety as you perform your work.**

On a scale of **0** to **10**, rate the accuracy of information in relation to construction safety in your work environment.

Item labels with "(R)" are reverse coded.

| | **0 = not at all** | | | | | | | | | | **10 = completely** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) This information is correct. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| b) This information is incorrect. (R) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| c) This information is accurate. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| d) This information is reliable. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**C) The following items address the "TIMELINESS" of information in your firm's construction safety plan in relation to construction safety as you perform your work.**

On a scale of **0** to **10**, rate the timeliness of information in relation to construction safety in your work environment. Item labels with "(R)" are reverse coded.

| | **0 = not at all** | | | | | | | | | | **10 = completely** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) This information is sufficiently current for our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| b) This information is not sufficiently timely. (R) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| c) This information is not sufficiently current for our work. (R) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| d) This information is sufficiently timely. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| e) This information is sufficiently up-to-date for our work. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

**D) The following items address the "COMPLETENESS" of information in your firm's construction safety plan in relation to construction safety as you perform your work.**

On a scale of **0** to **10**, rate the completeness of information in relation to construction safety in your work environment. Item labels with "(R)" are reverse coded.

| | **0 = not at all** | | | | | | | | | | **10 = completely** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) This information includes all necessary values. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| b) This information is incomplete. (R) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| c) This information is complete. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| d) This information is sufficiently complete for our needs. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| e) This information covers the needs of our tasks. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| f) This information has sufficient breadth and depth for our task. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

From "AIMQ: A Methodology for Information Quality Assessment," by Y. W. Lee, D.M. Strong, B. K. Kahn, and R. Y. Wang, 2002, *Information &Management,Volume 40*, pp.133-146.

# Appendix C: Walden Institutional Review Board Approval Number

The Walden Institutional Review Board number for this study was 06-19-18-0372690.

# Appendix D: SurveyMonkey Permission Letter

SurveyMonkey

**SurveyMonkey Inc.**
www. surveymonkey.com

**For questions, visit our Help Center**
help.survemonkey.com

**Re: Permission to Conduct Research Using SurveyMonkey**

To Whom It May Concern:

This letter is being produced in response to a request by a student at your institution who wishes to conduct a survey using SurveyMonkey in order to support their research. The student has indicated that they require a letter from SurveyMonkey granting them permission to do this. Please accept this letter as evidence of such permission. Students are permitted to conduct research via the SurveyMonkey platform provided that they abide by our Terms of Use at https://www.surveymonkey.com/mp/legal/terms-of-use/.

SurveyMonkey is a self-serve survey platform on which our users can, by themselves, create, deploy and analyze surveys through an online interface. We have users in many different industries who use surveys for many different purposes. One of our most common use cases is students and other types of researchers using our online tools to conduct academic research.

If you have any questions about this letter, please contact us through our Help Center at help.surveymonkey.com.

Sincerely,

**SurveyMonkey Inc.**