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# An Analysis On Causes Of Late Final Payment And Release Of Retainage: Electrical Subcontractors' View

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# AN ANALYSIS ON CAUSES OF LATE FINAL PAYMENT AND RELEASE OF RETAINAGE: ELECTRICAL SUBCONTRACTORS' VIEW

A Thesis

Submitted to the Faculty

of

Purdue University

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Xuejing Zhang

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American Institute of Architects (AIA)

General Contractor (GC)

Building Construction Management (BCM)

Institute Review Boards (IRB)

# ABSTRACT

Zhang, Xuejing. M.S.B.C.M., Purdue University, May 2014. An Analysis on Causes of Late Final Payment and Release of Retainage: Electrical Subcontractors' View. Major Professor: Randy Rapp.

Using the survey approach, this study identified the underlying causes of late payments and release of retainage for electrical subcontractors, attempting to answer the questions, "What were the minimum, maximum and average delay days of final payment and release of retainage?", "What were the rank of factors in terms of significance on delaying final payment and release of retainage?", and "What were the rank of factors in terms of frequency on delaying final payment and release of retainage?" A survey questionnaire was developed and distributed to about 150 professionals in electrical subcontractors. 29 reports were collected. Based upon the analysis of data, the mean value and most common value of minimum, maximum, and average delay days were concluded. Also, a detailed analysis on the significance and frequency of each factors were conducted. The contribution includes ranks of factors based on significance and frequency in terms of delaying final payment and retainage, and suggestions to improve cash efficiency for electrical subcontractors.

# CHAPTER 1. INTRODUCTION

This chapter introduces the research problem and associated research questions, as well as the scope and limitations of the study. The significance and assumptions of the research are also discussed in this chapter.

## 1.1 Problem Statement

Cash flow is crucial to the survival of any construction company. A survey shows that 60% of business failures in the construction industry are due to cash flow problems. Payments are interrelated with cash flow in that progress payments from general contractors are the primary income for subcontractors. Subcontractors need prompt payments to pay for the material, labor, equipment, and general overhead of their portion of the work; therefore, when these progress payments are delayed, a company can find itself in a dangerous and vulnerable state.

The purpose of this study is to identify the underlying causes of late payments and release of retainage for electrical subcontractors. Based on the causes identified, the researcher will provide appropriate solutions to mitigate late payment problems.

## 1.2 Research Questions

The research questions are as follows:

1) What are the minimum, maximum and average delays in days for final payment and release of retainage?
2) What are the significant causes of late final payment and release of retainage from the perspective of electrical subcontractors?

## 1.3 Scope and Limitation

This study focuses on the causes of late final payments and release of retainage from the perspective of electrical subcontractors. In order to achieve this goal, the researcher conducted a literature review to identify the major underlying causes of late final payment and release of retainage. A survey also was performed to determine how the impact of each cause on the timing of final payment, as well as how long it takes after substantial completion for the release of final payment and retainage.

This research is limited to the final payment of a construction project, which is separate from the progress payment. The researcher only examines the point of view of electrical subcontractors. The perspectives of general contractors, owners, and other major roles in construction projects are not examined in this study.

## 1.4 Significance

Late payments in the construction industry are an endemic problem that plagues both general contractors and subcontractors. Final payment is an important source of cash for

electrical subcontractors, as many construction projects have negative cash flows until the very end of a construction project (Hyung and Seung, 2005). Also, the timing of payment is a key element of a construction firm's profitability performance; because cash is the most important resource based on the time value of money (Jackson, 1999). This study intends to identify the major causes of late payments to electrical subcontractors and provides appropriate solutions to mitigate these problems. Also, this study hopes to provide professionals in the construction industry with a better understanding of the causes of late payments and increase their awareness of cash flow to a more in-depth level.

## 1.5 Definitions of Key Terms

Final payment: The last payment, from the owner to the contractor, is the entire unpaid balance of the contract sum as adjusted by any approved change orders.

Project Close-out: The sequence of activities required to settle all outstanding non-warranty issues and the process of completing final negotiations with the client, suppliers, and contractors (Halpin, 2010, p 90)

Retainage: A portion of the money the owner typically retains or holds back as an incentive for the contractor to properly complete the project (Halpin, 2010, p 87).

Time value of money: The value of money with a given amount of interest earned or inflation accrued over a given amount of time (Jackson, 1999, p 305).

Substantial completion: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the

Contract Documents so that the Owner can occupy or utilize the Work for its intended use (AIA, A201, p36).

## 1.6 Assumptions

A survey of subcontractors in the construction industry was conducted. The assumptions inherent to the survey include:

- Participants will respond honestly to all of the questions in the survey based on their personal experience and knowledge in construction.
- Participants will not answer questions they do not have enough knowledge to answer.
- An adequate number of participants were chosen in terms of survey validation statistical analysis.
- The participants have enough computer skills to answer the survey electronically.

## 1.7 Limitations

The limitations of this survey include:

- The survey was limited to the number of electrical subcontractors for which the participants worked.
- The distribution of the survey was limited by the accessibility of professional email lists.

## 1.8 Delimitations

The delimitations of the survey performed are as follows:

- The survey will not include project engineers from general contractors or project owners.
- Questions on other progress payments other than final payments will not be included in the survey.

## 1.9 Chapter Summary

This chapter provided an overview of the research, including the problem statement; research questions to be answered; the key definitions; and the significance, scopes, limitations and delimitations of the research. The next chapter presents a review of the past research on construction delays and subcontracting practices as well as project close-out and related issues.

# CHAPTER 2. REVIEW OF RELEVANT LITERATURE

## 2.1 Introduction

Research on delays in construction has a long history, and many researchers have conducted studies and surveys in this area since Baldwin and Manthei's (1971) first research on the causes of delays in building projects in the U.S. However, research pertaining to subcontractors is fairly new. Only a few articles were found on this topic until 1994 when Hinze and Tracey's paper "The contractor -subcontractor relationship: subcontractor's view," was published in the *Journal of Construction Engineering Management*. Since that time, researchers have studied this topic from different approaches and many valuable finds are revealed. The present study to identify the causes of late final payment and release of retainage from subcontractor's view is an exploratory research utilizing past research in the above areas.

This chapter provides an overview of past research related to the topics of late payment problems and subcontractors issues in the construction industry.

## 2.2 Approach to this Review

The researcher located all the related areas of this topic and summarized them into four major areas, 1), delays in the construction industry, 2) payment problems in

the construction industry, 3) the project closeout process, and 4) subcontractors in the construction industry. Then literature was reviewed and categorized, and their major findings and conclusions then were summarized. The goal of this chapter is to provide the reader a breadth reference of related research areas and the premise for the significance of the work of this study.

## 2.3 Construction Delays

Although the impacts of delays on construction projects can be disruptive and expensive, delays in construction are very common. A survey by Assaf and Al-Hejji (2005) showed that 70% of construction projects experienced time overrun and that 45 of the 76 projects considered by the survey were delayed.

Baldwin and Manthei (1971) were among the earliest researchers to address delays in the construction industry when they studied the causes of delay in building projects in the U. S. They conduct a survey on engineers, architects, and contractors and found that weather, labor supply, and subcontractors were the major causes of delay. Also, they indicated that there was no statistical difference among the three groups' opinions on the causes of delay.

Assaf et al, (1995) conducted a similar survey in Sandi Arabia. Their randomly selected sample consisted of 24 contractors, 15 architectures/engineering firms, and nine owners in Sandi Arabia. Fifty-six causes of delay were identified, which they grouped into nine

categories: material, manpower, equipment, financing, changes, government relations, scheduling and controlling, environment and contractual relationships.

They found that the most important delay factors, according to contractors, were preparation and approval of shop drawings, delays in contractors' progress, payment by owners, and design changes by owners. Architects and engineers listed the following as the most important delay causes: cash problems during construction, the relationships between different subcontractors' schedules in the execution of the project, and the lateness of the owners' decision making process. The owners group, however, stated that the most important delay factors were as follows: design errors, excessive bureaucracy in the project-owner organization, labor shortages, and inadequate labor skills.

Assaf and Al-Hejji conducted another survey in 2005 to update the above 1995 findings of Assaf et al. Their research approach was similar in that they conducted; a survey of the main players in the construction industry: the owner, the consultants and the contractors. This survey included 23 contractors, 19 consultants and 15 owners. Seventy-three causes of delay were identified in the research, and they also determined that 76% of the contractors and 56% of the consultants indicated that the average of time overrun was between 10% and 30% of the original duration. The most common cause of delay identified by all three of the surveyed groups was "change order." The three groups disagreed on one important cause in that both owners and consultants indicated labor and contractor-related causes were the severe and important sources of delay, while contractors indicated that owners and consultants were important sources of delay. This

study also revealed that the common practice of awarding contract to the lowest bidders was the most frequent delay factor.

## 2.4 Payment Problems in Construction Industry

Payment problems have been of great concern for many years in the construction industry, as well as in academia. Research on payment problems is an active thread, and researchers all over the world have conducted studies on this problem based on different scenarios. Their findings laid the foundation for research that ensued in this area.

Semple et al (1994) examined the cause of delays and cost overruns on 24 projects in Western Canada. They reviewed 24 construction claim reports on delays and cost overruns, and analyzed these reports with a special survey form. They concluded that the most common contributing factors in claims were increases in the scope of the work, weather problems, restricted accesses, and acceleration. Furthermore, contract clauses in the areas of delays, scheduling, and increases in the scope of work were mostly quoted in construction disputes. They concluded that in order to avoid disputes in construction projects, special consideration should be given to contract clauses dealing with changes/extras, disputes, soil/site conditions, and delays.

Pettigrew (2005) concluded that there were four main reasons for late payment: the complications and fragmentation of the process of construction, the highly competitive market conditions in the industry, the hierarchical structure of the industry's contractual

framework, and the fact that construction industry is always the first to experience economic recession and the last to recover from it.

Ye and Rahman (2010) conducted a survey on late payment in the construction industry in Malaysia. The target respondents were contractors in Malaysia, which were divided into four groups representing different categories of contractors. Their study concluded that the most significant underlying causes of late payment problem are deficiencies in the client's management capacity, the client's ineffective utilization of funds, the scarcity of capital to finance the project, and the clients failure to generate income from the bank.

Wu et al (2008) reviewed recent moves in mainland China to overcome accumulated payment arrears. They conducted a comparative study on similar problems but with different approaches to their resolution in other countries. Their conclusions were that contractual disputes or extra-contractual issues rooted in the system and market appeared to be the causes of payment problems. Also, the unique case in China indicated that the immature credit and legal systems in developing countries can also lead contractors and other players in the construction industry to be exposed to more risks generated by causes and forces beyond the regulation of contracts.

## 2.5 Project Close Out

The last stage of a construction project is closeout. The two goals of this stage are to ensure the project is completed in a timely manner and the facility is delivered to the user efficiently. Acceptance of the work, issuance of final payment and release of retainage

are considered as the milestones of the closure process in construction projects. Fisk and Rapp (2004) summarized the principal closure activities for medium to large projects as follows:

1. Perform closeout inspections and prepare for final inspection (p. 10).
2. Execute *Certificate of Completion* if all work has been substantially completed and all punch list items has been satisfactorily accomplished (p. 11).
3. Process contractor's request for final payment. This activity includes notifying the owner of the contractor's request for final payment and that the project is ready for occupancy or beneficial use, and thereafter obtaining the signature of the engineers, the contractor, and the owner, or their authorized representatives on the *Certificate of Completion* (p. 12).
4. The owner makes final payment and release the retainage if all the works noted on the Certificate of Completion are accomplished and all waivers of liens have been acquired (p. 13).

The last phase of the subcontract relationship is subcontractor closeout. Subcontract termination can occur when the subcontracts are fully completed or the subcontractors are replaced by the prime contractor because of inadequate performance. Specifically for subcontractors, their roles during construct closeout are as follows (Wangemann, 2001)

1. Resolve any open issues with the prime contractor and verify and settle outstanding claims, subcontract change orders, and back-charges.

2. Provide any outstanding deliverables and agree the scope of work is complete/incomplete, including but not limited to:
    - Turnover packages
    - Warranty certificates
    - As-built drawings
    - Operating manuals
    - Certificate of occupancy
    - Any other deliverable required by the subcontract
3. Return any equipment or information furnished by the government or prime contractor.
4. Issue the Final Acceptance Certificate from the project manager to the subcontractor.
5. Prepare and agree with the subcontractor's final statement of account, and the value for the final invoice. Consider whether liquidated damages, bonuses or penalties are to be applied.
6. Identify all remaining warranties, operating guarantees and continuing contractual obligations of the subcontractors. Prepare closeout change order and closeout letter.
7. Apply for release of retainage.

Knowing that the detailed process of project closeout will be helpful to the current study, the above information is important. It is not difficult to see that the cause of late final payment and retainage are related to the above activities and that the final payment and

retainage will be issued to the subcontractors only when all the work on the punch list is fully accomplished.

## 2.6 Subcontractors in the Construction Industry

Subcontractors, also referred as specialty contractors, play an important role in the construction industry. In most construction projects, the general contractor performs the basic operations and subcontracts the rest to various specialty contractors. Subcontracting is used much more extensively on housing and building construction projects than on engineering and industrial projects (Clough and Sears 1994). On many building projects, 80-90% of the work is performed by subcontractors (Hinze and Tracey, 1994).

### 2.6.1 Subcontract practice in construction industry

Before Hinze and Tracey's (1994) conducted their study on the contractor and subcontractor relationship, there was very little published information about this topic. Their study examined the contractor - subcontractor relationship from five aspects: bidding practices, subcontracting arrangements, administrative practices, payment procedures, and project close out, and their conclusions can be summarized as follows (payment procedures and project closeout will not be covered here; instead they will be discussed specifically in their appropriate topic area of this thesis):

1. Regarding bidding practice, specifically in terms of bid shopping, many of the interviewed subcontractors interviewed felt that this was a problem in the construction industry and accept it as a practice that is difficult to curtail.

2. Regarding subcontracting arrangements, the interviewees felt that many subcontracts are awarded without any formal discussion taking place between the prime contractor and the subcontractors, and this lack of communication might increase the probability of a conflict after construction work has begun.
3. With regard to administrative practices, most subcontractors indicated that they rely on their own project monitoring efforts rather than relying on the general contractor. In other words, the subcontractors do not trust that the general contractor is concerned about the best interest of the subcontractors.

Arditi and Chotibhongs (2005) conducted another study to update the findings of Hinze and Tracey's (1994) and to obtain information not only from the subcontractor's perspective but also from the point of views of general contractors and owners. They developed a questionnaire survey, which was administered to the top 450 specialty subcontractors, the top 300 general contractors and the top 250 owner firms in the U.S. Their study focused on the timelines of payment by the general contractor, the process of selecting the subcontractor, subcontractor bonding, construction insurance, safety on the construction site, partnering with various parties, and productivity issues. Their major conclusions were listed as follows:

1. Subcontractors are often paid late by general contractors because of pay-when-paid and pay-if-paid clauses included in most contract forms. This

late payment practice can be mitigated by owner's paying general contractors on time.

2. Retainage is often withheld from subcontractors but is not considered a major problem except for smaller subcontractors, where it causes serious cash flow problems.
3. Prime contractors often shop bids after the award of a contract, likely because they do not consider bid shopping unethical and think bid shopping is an effective way to increase productivity.
4. Subcontractor bonds are sometimes required by general contractors, but subcontractors do not think providing bonds are a problem for them.
5. Subcontractors and general contractors sometimes have a partnering agreement, and almost all respondents stated that a partnering agreement between subcontractors and contractors would be beneficial to both parties.

Enshassi et al, (2012) studied the major causes of problems between contractors and subcontractors in the Gaza Strip. They designed a questionnaire for contractors and subcontractors on the most important causes of problems that affect their relationship. A total of 53 problems were identified based on a literature review, and a pilot study was considered that listed five groups. Their study determined the following major causes: assigning part of the works to a new subcontractor without informing the original subcontractor, a contractor with financial problems, delays in contract progress payments, non-adherence to the conditions of the contract, non-adherence of the subcontractor to the time schedule, and lack of construction quality. In addition, involvement in in several

projects with the same contractor simultaneously, weather conditions, and on-site geological problems were also considered as minor causes of potential problems. It was also concluded by their study that there were no statistical differences between the viewpoints of the contractors and subcontractors.

### 2.6.2 Payment of Subcontractor

When it comes to payment problems for subcontractors, "pay- if- paid" and "pay -when – paid" are contingent payment clauses in the subcontract.

A "pay if paid" provision in a subcontract means that the general contractor is only obligated to pay the subcontractor if the general contractor is paid by the owner. A typical "pay if paid" clause would read as follows:

> Contractor's receipt of payment from the owner is a condition precedent to the contractor's obligation to make payment to the subcontractor; the subcontractor expressly assumes the risk of the owner's non-payment and the subcontract price includes this risk (Wertman, 2007).

It is apparent that such contract language has transferred the risk of nonpayment by the owner from the general contractor to the subcontractor. Sometimes, subcontractors agree to them, driven by the need of work-a bargaining power brought on by economic realities. However, as the majority view considers this as waiver of prime contractor's lien rights and against public policy, "pay if paid" clauses are not enforceable in all states.

Another common practice of payment clause in subcontract is that subcontractors are not paid by the general contractors until the general contractors has been paid by the owner, referred to as the "pay when paid" clause in construction industry. A typical provision in the subcontract would be as follows:

> Progress payments and final payment will be made thirty days after receipt of payment to the Contractor by the Owner.

Hinze and Tracey (1994) conducted a study on payment of subcontractors through personal interviews. The type of subcontractors in this study were mechanical (5), electrical (5), painting (5), drywall-plaster (3), masonry (2), utility (2), flooring (3), and elevator (3). Their findings on payment of subcontractors are summarized as following:

1. The pay-when-paid issue is a problem that seems to be accepted by many subcontractors. In addition, change orders, back charges, and delays in payment caused by the late completion of the work of other subcontractors are also causes of payment problems for subcontractors.
2. In terms of the amount of retainage, about one-third of the subcontractors interviewed stated that the retainage withheld by the general contractor from the payments was equal to that withheld by the owner from the general contractor.
3. Regarding the release of retainage, only one out of the 23 subcontractors interviewed received retainage between 30 to 90 days after final completion. Seventeen subcontractors (78% of all the participants) received the retainage more than six months after the final completion of the projects.

## 2.7 Chapter Summary

This chapter provided an overview of the literature related to payment problems and subcontractors issues in construction industry. The various areas of research and their significance were summarized and laid out, and the trends were discussed.

# CHAPTER 3. RESEARCH METHODOLOGY

This chapter introduces the framework in which the research was conducted. It covers the research methodology this study utilized, as well as the structure of the survey and the sample set, statistical analysis and validation.

## 3.1 Questionnaire Development

As stated in the previous chapter, this research focuses on the cause of late payment and release of retainage from the perspective of electrical subcontractors'. A survey was conducted to collect information from major groups of subcontractors. The survey questionnaire was developed to obtain information from the respondents and an appropriate statistical analysis was adopted to interpret and analyze the collected data.

The survey questionnaire consisted of 12 questions, which were designed to take the respondent ten to fifteen minutes to finish. The questions were divided into three sets: the first set of questions asked for general information about the respondent and the construction company (two questions). The second set of questions focused on the causes of late final payment problems and the last part of the questionnaire sought to find the underlying causes of delayed retainage problems.

The key independent variables intended to be measured in this study are as follows:

1. Year of working experience the respondents have in the electrical subcontract field.
2. Main roles that respondents have held in the electrical subcontract area, with these possible options: project engineer, superintendent, project managers, and others. .
3. Maximum, minimum, and average days of being issued final payment after substantial completion of a construction project.
4. Maximum, minimum and average days of being issued retainage after substantial completion of a construction project.
5. Frequency of occurrence of late final payments, measured on a scale of 1 to 5, where 1 = 0%-20%, 2 = 20%-40%, 3 = 40%-60%, 4 = 60%-80%, 5 = 80%-100%.

   The sum of the score was calculated with the following formula:

   Average of Frequency= $\frac{1\times A+2\times B+3\times C+4\times D+5\times E}{A+B+C+D+E+F+G}$ ; Where A is the number of respondents who chose never, B is for very rarely, C is for rarely, D is for occasionally, E is for frequently, F is for very frequently, and G is for always.
6. Significance of certain cause to late final payment, measured on a scale of 1 to 5, where 1 = insignificant, 2 = of little significance, 3 = moderately significant, 4 = significant, and 5= very significant.

   Average of Effectiveness= $\frac{1\times A+2\times B+3\times C+4\times D+5\times E}{A+B+C+D+E}$ ; Where A is the number of respondents who answered very significant, B is for significant, C

is for moderately significant, D is for of little significance and E is for insignificant.

The factors utilized in the survey that might impact timely final payment and release of retainage were derived from the literature review. In terms of testing the questionnaire, the researcher first reached out to three project engineers and asked them to test the questionnaire from their professional perspective. The researcher made the changes based on their feedbacks. At the proposal defense to committee members in December 2013, the committee members also provided several suggestions on the questionnaire. One of the significant comments brought up by Prof. Orczyk was that, for the benefit of data analysis, it is necessary to keep the scales as odd, rather than even. The researcher reduced the Likert scales for Question No. 7 from the original six to five. Several discussions were also conducted with other BCM faculty members and minor changes were made on the questionnaire before sending it out. The researcher finalized the questionnaire in February 2014 and sent it to the IRB Department of Purdue.

The final list of influencing factors on late final payment is shown below:

Table 3.1 *List of influencing factors on final payment*

| | | | | | |
|---|---|---|---|---|---|
| F1 | Defective work not remedied | F4 | Contingent payment clauses | F7 | GC not paid by owner |
| F2 | Schedule problems | F5 | Damage to GC or other Subs | F8 | Unsettled construction disputes |
| F3 | Lien of waiver problems | F6 | GC arbitrarily withholds money after GC is paid | F9 | Inefficient communication and follow-ups |

The final list of influencing factors on release of retainage is shown below:

Table 3.2 *List of influencing factors on release of retainage*

| | | | |
|---|---|---|---|
| R1 | Failure to provide O & M manual | R6 | Damage to GC or other Subs |
| R2 | Submission of warranty issues | R7 | GC arbitrarily withholds money after GC is paid |
| R3 | Defective work not remedied | R8 | GC not paid by owner |
| R4 | Schedule problems | R9 | Unsettled construction disputes |
| R5 | Lien of waiver problems | R10 | Inefficient communication and follow-ups |

## 3.2 Research Sample

The target population for this survey was employees having knowledge of the payment issues in electrical subcontracts. Their positions in the construction industry they held included but were not restricted to the following: project engineer, project managers, superintendent, project accountant, project administration, and other related positions.

The semi-random sampling method was applied to reach out to respondents. There were three main channels of collecting data. The first channel was to ask the Industry Outreach staff of the BCM department to distribute surveys among companies coming into the BCM career fair. The second channel was to send the questionnaire to members of the National Electrical Contractors Association (NECA); and the third channel consisted of the researcher reaching out to her personal network and distributing the survey through email and LinkedIn. The respondents from the first two channels were electrical

subcontractors located around the U.S., while the respondents of the third channel were all Indiana electrical subcontractors.

In order to make the survey process effectively as possible and not time consuming, Qualtrics, an online survey tool, was used to process the survey. All of the questions, and a cover letter and introduction to the survey were posted online, and a particular link was assigned to this survey. The respondent could access and complete the survey by simply clicking on the link.

The following measures were taken to increase the response rate. A reminder was sent one week after the first email invitation. For bounced email addresses, the researcher directly called the respondent to express the invitation to participate in the survey. Also, the researcher called company representatives and asked for their assistance to distribute the link again among their employees.

### 3.3 Permission of Survey

The approval from the Purdue IRB was obtained in February 2014 after one round of review and a few changes were made according to the IRB feedback. As stated in the IRB consent form, participants of the survey did not receive any monetary compensation for their involvement, and their participation in the survey did not present risks to them. Appendix B shows the IRB approval for this survey.

## 3.4 Statistical Analysis and Validation

Data collected through the survey were analyzed through mean response analysis to find the significant causes of the late final payment problem and release of retainage, as well as to investigate possible differences of opinions between respondents' groups. SPSS (Software Package used for Statistical Analysis) was applied to test the hypothesis and to perform all of the statistical analysis.

In terms of sensibility, a Likert scale of five was assigned to both the significance and frequency of each factor. It provided enough sensibility to reflect the perception of each respondent.

Regarding the validity of this research, there were several questions designed to collect data about the background and working experience of all respondents. Also, the respondents were numbered, and the data sources were tracked the data if some obvious outlier came up in the data. In the data examination process, a confidence level of 0.05 was set to perform the statistical analysis.

## 3.5 Chapter Summary

Determining the significant causes of late final payment and release of retainage is the primary goal of this research. To achieve this goal, a questionnaire survey was developed. Key factors that might have an impact on late final payment and release of retainage were identified through the literature review in Chapter 2. Further adjustments were made by interviews with project engineers and BCM faculty members. The final survey was

posted online and the link to the survey was sent to potential respondents in the electrical subcontracting area. The research sample was determined based on the research topic, as well as the availability of the researcher. The IRB of Purdue University granted approval for the use of this survey. To better illustrate the data collected, SPSS was applied in this study.

This chapter provides an overview of the research methodology, the key variables the survey studied, the sample test, and the statistical analysis tools that were applied. The content of this chapter served as the implementation plan of the entire study, and successful completion of the survey was the foundation of the findings of this study.

# CHAPTER 4. RESEARCH FINDINGS

## 4.1 Respondent Characteristics

The questionnaire was posted online with Qualtrics, an online survey tool. A special link was assigned to this questionnaire, and the researcher distributed the link to about 150 potential respondents. There were three main channels to distribute the survey links. First, the researcher sent survey links to colleagues during internships and asked colleagues to forward the link to anyone else they know in electrical construction; and the respondents of the first channel were mainly local electrical subcontractors. Second, the researcher asked the industry outreach advisor of the BCM department at Purdue to distribute the link to electrical construction companies from around the country who attended the Purdue BCM Career Fair. Third, through a professor, the researcher called a NECA staff member responsible for university relations and asked for their help to distribute the survey among their members, who also are located around the country. Most of this link distribution was completed via email, and a few calls were made to encourage people to complete the survey as well as follow-ups.

A total of 39 respondents started the survey, 34 of which ultimately submitted the survey. Among the 34, five respondents did not answer any of the key questions in the survey,

i.e., the impact from each possible cause on delaying final payment and release of retainage, and the frequency of each factor on delaying final payment and release of retainage. As these questions were very significant to reach the primary goal of this research, the researcher decided to drop these four responses; and the drop rate of this survey therefore was 14.7%. There were four other respondents who did not answer all of the questions but finished more than 50% of the survey, and the researcher included those answers into data analysis and nulled the unanswered part.

In terms of the characteristics of the respondents, Table 4.1 below illustrates the years of working experience the respondents had in the construction industry. From the table, it can be seen that most of the respondents fell into the 2-5 years and 10-20 years option (38% of the respondents had 2-5 years of experience and 28% had 10-20 years of working experience). The percentage of respondents with more than 20 years and less than two years of working experience were fairly low, less than 20% in total.

The construction management positions that the respondents ever held during their careers was also an important background question for this survey because such previous work experience would affect their perspectives on a certain professional area. For the same question, a vice president with 20 years of experience in construction might give a different answer compared with a two-year project engineer. Knowing the previous work experience of the respondents was considered critical to analyzing the results, and this background check also added credibility for this research.

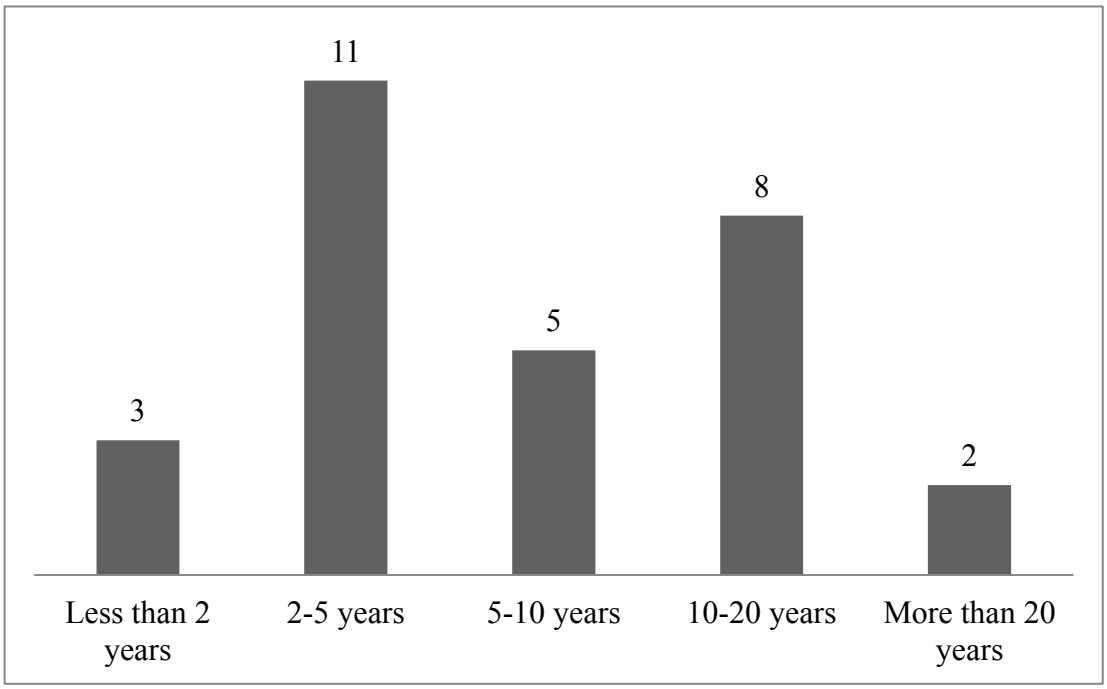


*Figure 4.1* the working experiences of respondents

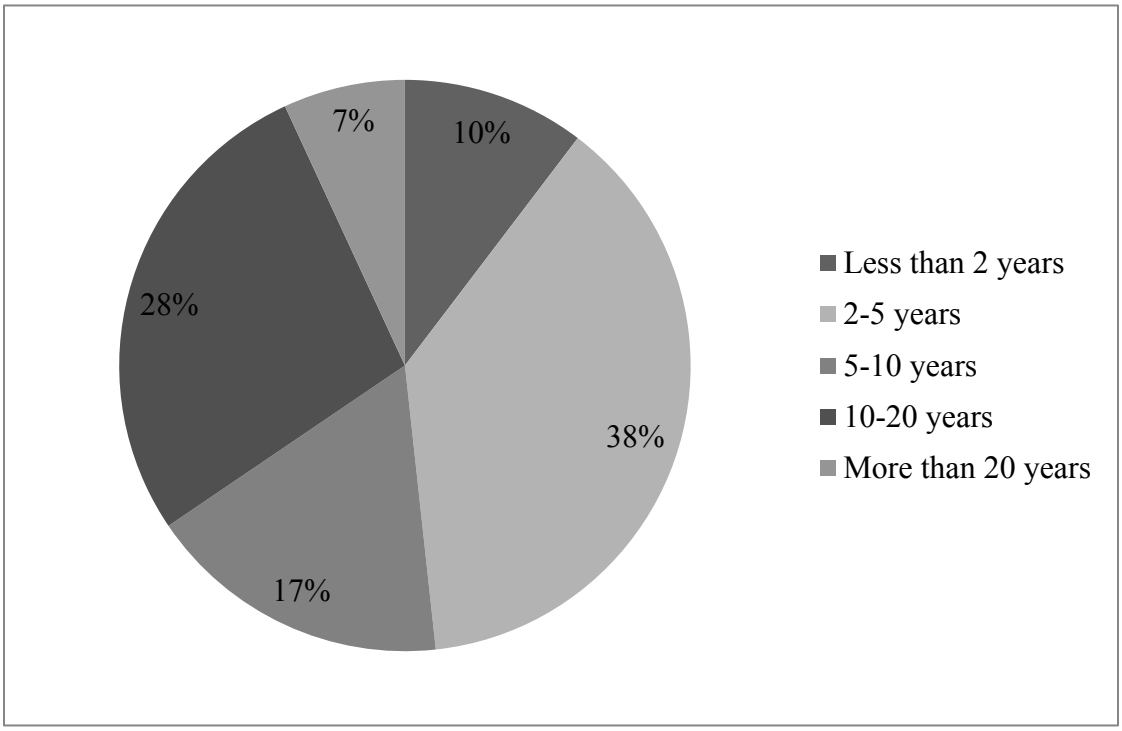


*Figure 4.2* The bar chart of Working Experiences of Respondents

A total of 29 reports were collected. Most of the respondents had held no less than two construction management positions in their career. The figure clearly illustrates that 21 out of the 29 respondents (72.4%) had been a project engineer in their career. There were four people, or 13.8% of the respondents, who had been or currently were holding a position as a superintendent or assistant. Eleven out of the 29 respondents (37.9%) had been in project control positions, such as estimating, scheduling, and cost controls. Seventeen people (58.6%) had been a project manager in their career. Eight respondents had also chosen the option of other; three of them had been a vice president; one, a president; one, a carpenter; one, a foreman; one, a field engineer; and one, an accounts receivable staff member and director of human resources.

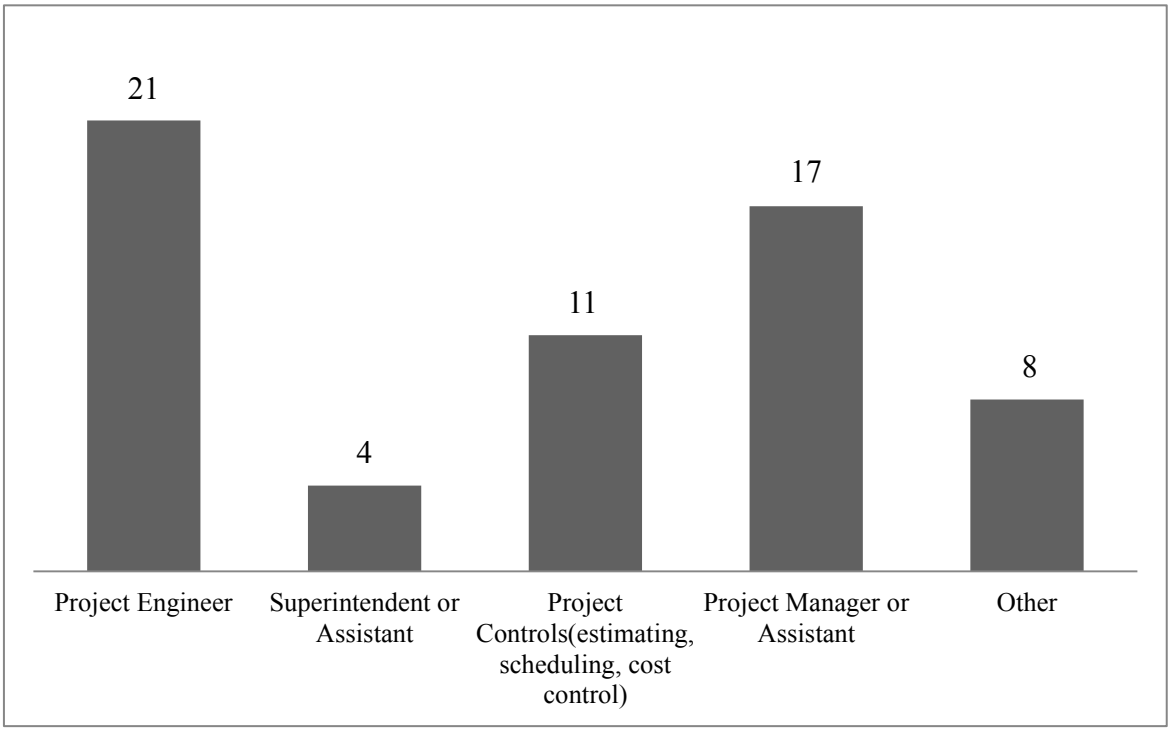


*Figure 4.3* Construction management positions respondents ever held

This figure also indicates that nearly 60% of the respondents held a position as a project manager or higher, which meant they had first-hand experience managing an entire project and presumably were knowledgeable of cost and subcontract management issues. This result also provides validity for this research.

## 4.2 Minimum Delay on Final Payment

Of all of the answers collected, the data ranged from five days to 60 days. Table 4.1 provided the descriptive statistics of the data collected, and Figure 4.4 showed the boxplot of this dataset. The boxplot indicated that there was one obvious outlier, which was five days. Considering the procedures of applying for final payment, the electrical subcontractors notified the project engineer substantial completion of the job and the project engineer would come to inspect the designated work and issued a certification, these processes would take around a week to finish. Plus the time for the general contractor to process the paper work and issue payments, the total amount of time taken should be no less than seven days. The researcher inclined to believe this answer was a typo or some extreme cases rarely happened. Based on the above reasons, the researcher decided to drop this data and processed a new statistical analysis with the rest of the dataset.

Table 4.1 *Descriptive statistics of minimum delay on final payment*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Minimum Delay | 26 | 5.00 | 60.00 | 34.5385 | 15.05784 |

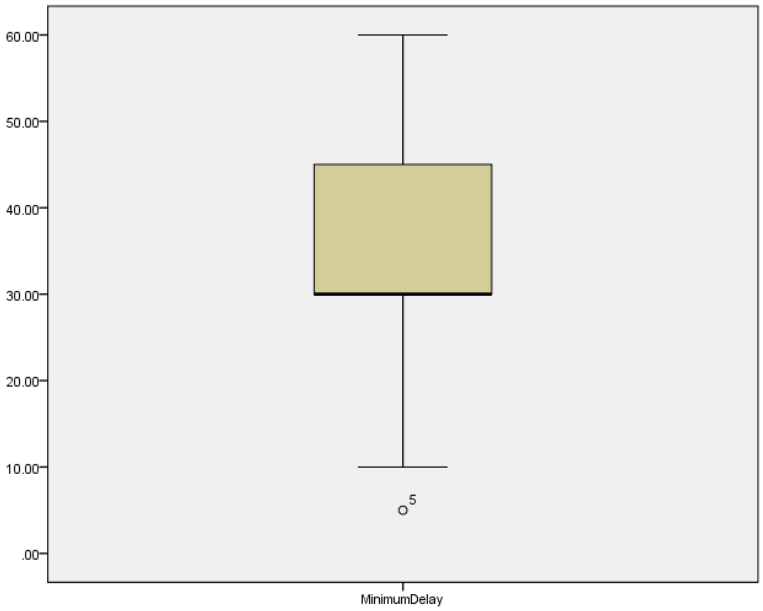


*Figure 4.4* Boxplot of minimum delay on final payment

Below are tables and figures from the statistical analysis report. Table 4.2 shows the descriptive statistics after dropping the outlier. This table indicates that the average minimum delay of final payment was 36 days. Figure 4.5 is a histogram of the number of respondents, and it indicates that 15 respondents, which are more than half of the total respondents, provided the same answer of 30 days as the minimum delay in their experiences. This fact means that 30 days (one month) was the most common minimum delay in electrical subcontracting.

Table 4.2 *Descriptive statistics of minimum delay on final payment after dropping outlier*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Minimum Delay after Dropping | 25 | 10.00 | 60.00 | 35.7200 | 14.08463 |

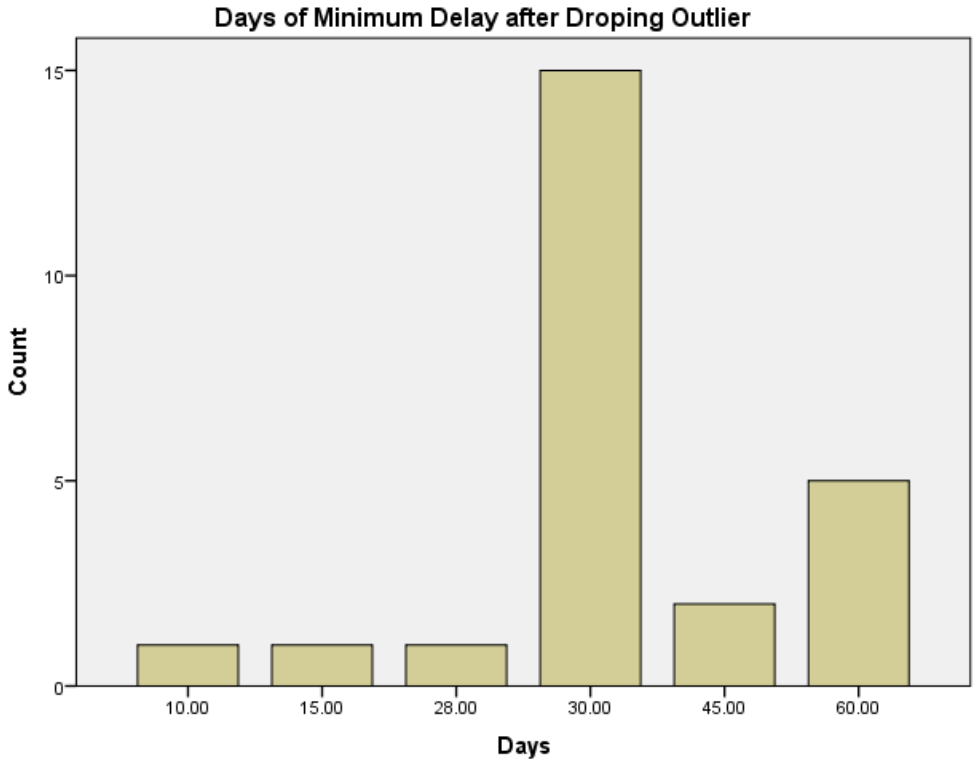


*Figure 4.5* Histogram of minimum delay on final payment after dropping outlier

## 4.3 Maximum Delay on Final Payment

The answers respondents provided for the maximum delay question were more diverse than the last question. There were also some vague statements on the maximum days. For instance, instead of answering in days, several respondents had used the time scale of month and year. To make the time scale consistent, the researcher changed the time scale as follows:

1 month = 30 days;

1 year = 12 months = 360 days.

In this question, some respondents provided a range, instead of specifying an exact number of days; for example, there was a response of 120 – 240 days. In this case, the researcher adjusted this answer as (120+240)/2=180 days.

Detailed statistical analysis reports are provided below. Table 4.3 indicates that the mean value of the maximum delay was 250 days. The shortest period of maximum delay was 84 days, and the longest was 600 days. Figure 4.6 shows that 180 days (six months), 360 days (one year) and 120 days (four months) were a common amount of maximum time that electrical subcontractors waited to collect final payment, with more than half of the respondents providing the above answers. The scatter plot offers a closer look at the distribution of the responses. The figures indicate that the responses provided were more diverse than expected, which means that the maximum delay days each respondent experienced were varied and could be different from person to person. The range of time periods was from 84 days to 600 days (see Table 4.3), and the average maximum delay the electrical subcontractors experienced fell into the range of 180 days to 350 days, skewed to the lower value.

Table 4.3 *Descriptive statistics of maximum delay on final payment*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Days | 26 | 84 | 600 | 249.77 | 132.929 |

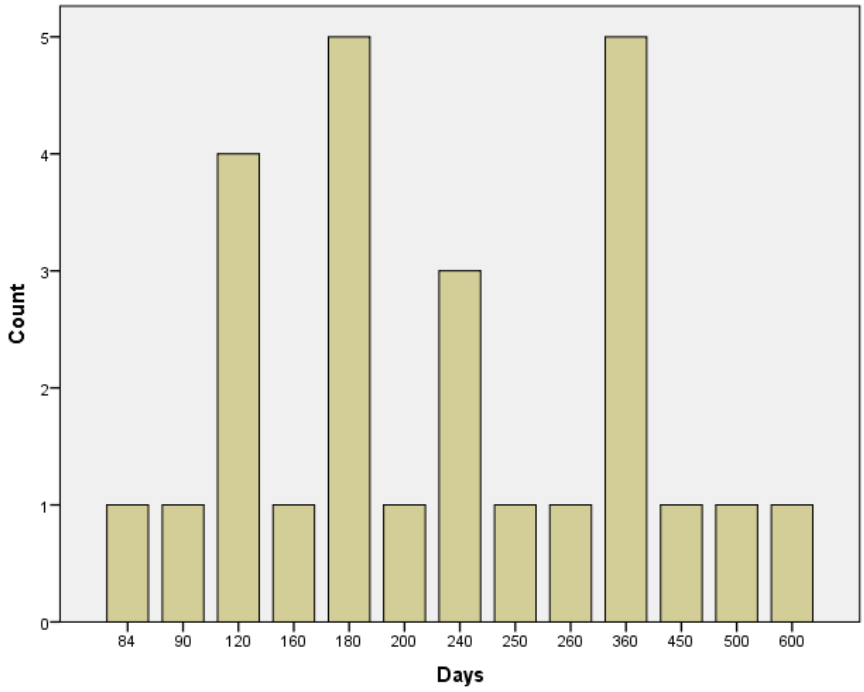


*Figure 4.6* Histogram of maximum delay on final payment

## 4.4 Average Delay on Final Payment

More respondents provided a time range for the average delays on final payment question than for the first two questions. Therefore, they are shown as follows: 60-120 days was adjusted to 90 days, 60-90 days to 75 days, 90-120 days to 105 days, 3-4 months to 105 days, and 90-100 days to 95 days. The output statistical reports from SPSS indicate the following. First, the mean value of the average delay days was 91 days, which was very close to the medium value -90 days, indicated by the histogram figure. The histogram shows that about eight people provided the response of 90 days, which was more than 25% of the total respondents. Another common average delay days response was 60 days, with six respondents providing this answer. The scatter plot of average delay is somewhat

skewed, with most of them in the range of 60 days to 120 days. Note is made that there were three responses much larger, with a value of around 180 days. The boxplot also proved that the 180 days, 180 days, and 175 days indicated by respondents 11, 20, and 21, respectively, were much larger than the average value and were considered outliers needing further examination.

Table 4.4 *Descriptive statistics of average delay on final payment*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Average Delay | 25 | 45.00 | 180.00 | 91.2000 | 38.00439 |

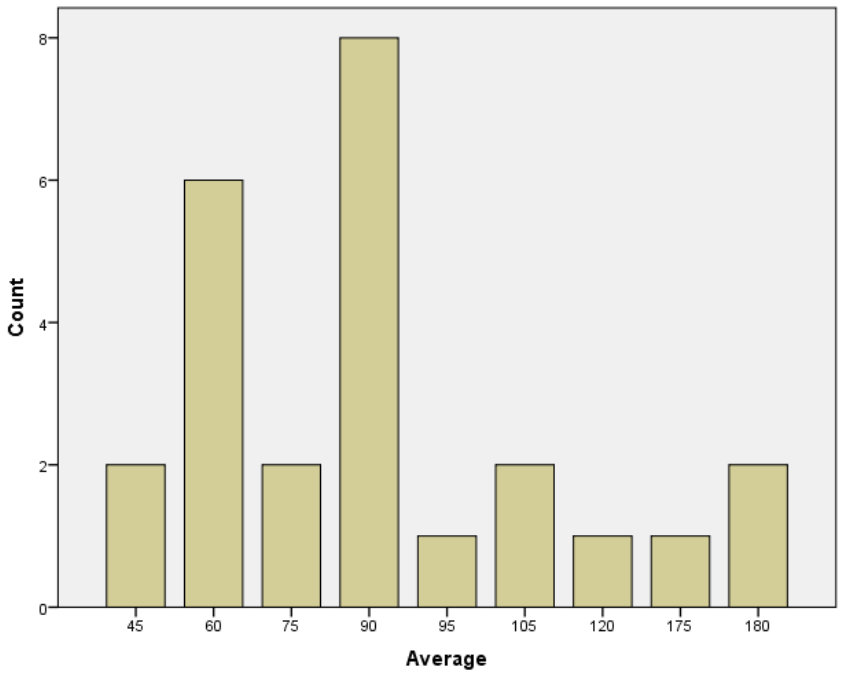


*Figure 4.7* Histogram of average delay on final payment

## 4.5 Significance of Factors on Delaying Final Payment

Twenty-seven respondents answered the question regarding the significance of the factors delaying final payment, and the descriptive statistics are shown in Table 4.5, which is the histogram of the mean value of each factor.

Table 4.5 *Descriptive statistics of significance from each factor on final payment*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| F1 | 27 | 1 | 5 | 3.67 | 1.177 |
| F2 | 27 | 1 | 5 | 2.93 | 1.072 |
| F3 | 27 | 1 | 5 | 3.22 | 1.155 |
| F4 | 27 | 1 | 4 | 2.63 | .792 |
| F5 | 27 | 1 | 5 | 2.81 | 1.210 |
| F6 | 27 | 3 | 5 | 4.37 | .688 |
| F7 | 27 | 1 | 5 | 3.81 | 1.039 |
| F8 | 27 | 1 | 5 | 3.19 | 1.178 |
| F9 | 27 | 1 | 5 | 2.81 | 1.178 |

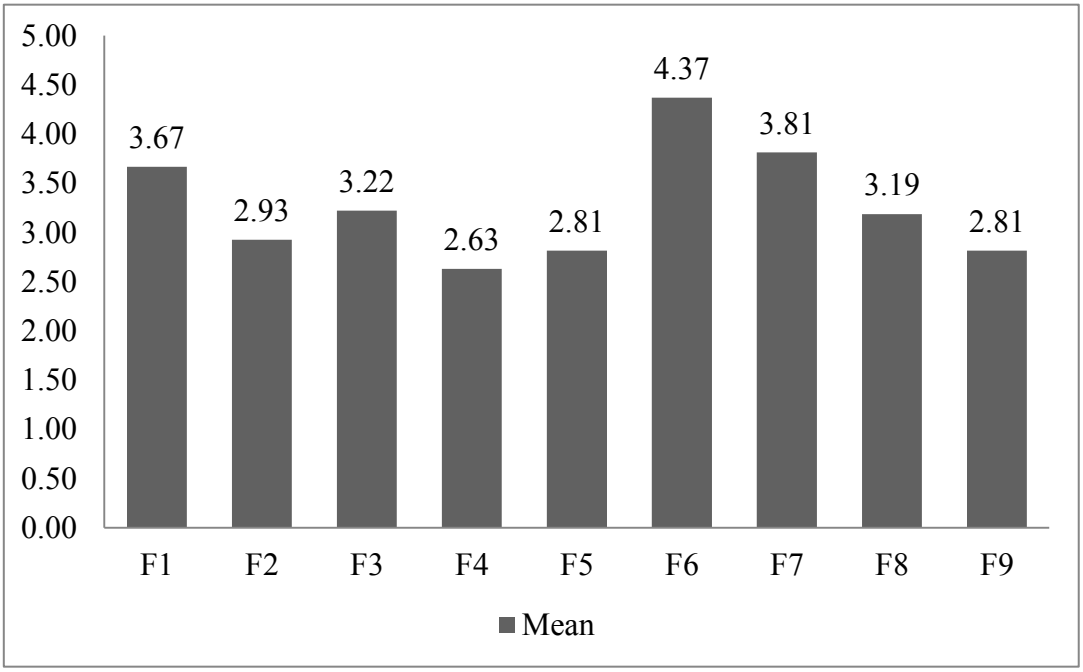


*Figure 4.8* Mean values of factors on significance of delaying final payment

The following conclusions are made based on the above figures:

Rank of the factors based on the mean value of significance. Factor F6, general contractor arbitrarily holding final payment, has the highest mean value and also was the only factor with a mean value above four. These data indicate that at least 80% of the respondents rated this factor as five, meaning it was very significant to them. The respondents agreed that this factor seriously affects the collection of final payment. Another factor that was worth mentioning is F7, general contractor not paid by the owner. This factor also has a high mean value of 3.81. Assuming that the general contractors themselves could not collect payment from the owner, it is easy to predict that there was a high possibility that general contractors would hold the final payment from subcontractors. This is a vicious cycle that hampers the efficiency of the construction industry and should be avoided. Also, defective work not remedied (F3) was also ranked high. This was also easy to understand as it is hard for electrical subcontractors to collect final payment if they are not able to finish their job accordingly. The results for the contingent payment clauses, such as "pay if paid" and "pay when paid," were different than expected, which were ranked lowest by the respondents as the data shows. There was a great deal of discussion in the academic area on these clauses and its effects on construction, but the data show that these clauses did not affect real world practice much, which needs further investigation.

Table 4.6 *Rank of factors based on significance of delaying final payment*

| Factors | Factors | Mean Value | Rank |
|---|---|---|---|
| F6 | GC arbitrarily withholds money after GC is paid | 4.37 | 1 |
| F7 | GC not paid by owner | 3.81 | 2 |

Table 4.6 Continued

| | | | |
|---|---|---|---|
| F1 | Defective work not remedied | 3.67 | 3 |
| F3 | Lien of waiver problems | 3.22 | 4 |
| F8 | Unsettled construction disputes | 3.19 | 5 |
| F2 | Schedule problems | 2.93 | 6 |
| F5 | Damage to GC or other Subs | 2.81 | 7 |
| F9 | Inefficient communication and follow-ups | 2.81 | 7 |
| F4 | Contingent payment clauses | 2.63 | 9 |

All of the mean values of each factor were larger than two, with the lowest value at 2.63. The result indicates that all the factors identified by this study had an effect on the delay of final payment, which also provides credibility to the research.

From a closer look at Table 4.6, it can be seen that the highest minimum value is for F6, general contractor arbitrarily holding money. In other words, the data show that all the respondents believed that F6 is at least a moderately significant in delaying final payment. These data reflect the fact that F6 attained the highest mean value, attaining first place on the list. Also, the smallest maximum scale occurred with contingent clauses (F4), which had the lowest mean value and was last on the list of factors.

## 4.6 Frequency of Factors on Delaying Final Payment

Of the 26 responses collected, the statistical reports from SPSS are as shown below:

Table 4.7 *Descriptive statistics of frequency from each factor on final payment*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| F1 | 26 | 1 | 5 | 2.48 | 1.447 |
| F2 | 26 | 1 | 4 | 1.96 | 1.098 |

Table 4.7 Continued

| | | | | | |
|---|---|---|---|---|---|
| F3 | 26 | 1 | 4 | 2.48 | 1.122 |
| F4 | 26 | 1 | 4 | 2.04 | 1.098 |
| F5 | 26 | 1 | 5 | 2.32 | 1.282 |
| F6 | 26 | 1 | 5 | 4.04 | 1.122 |
| F7 | 26 | 1 | 5 | 2.52 | 1.358 |
| F8 | 26 | 1 | 5 | 2.32 | 1.145 |
| F9 | 26 | 1 | 5 | 2.60 | 1.258 |

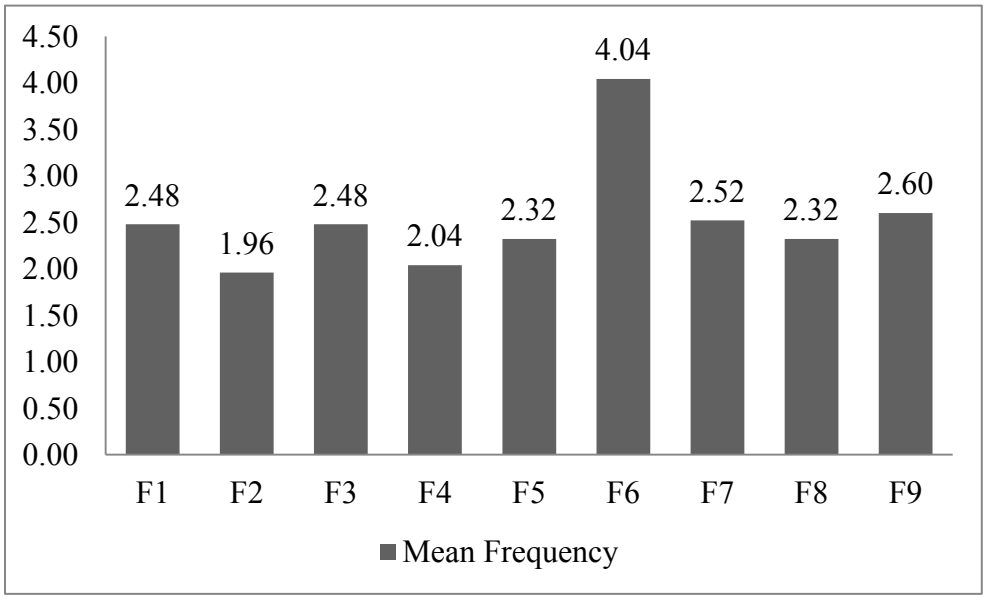


*Figure 4.9* Mean values of factors on frequency of delaying final payment

From the tables and figures above, the following conclusions were made:

F6, general contractor arbitrarily holding payment, ranked at the top again and also was the only factor that gained a mean value higher than four, which was much higher than the second factor mean value of 2.60. These data show that almost 80% of the respondents had experienced at least one payment delay caused by the general contractor arbitrarily holding payment, making this factor dominantly number one on the list. Based

on the reports, it was also concluded that schedule problems (F2) and contingent payment clauses (F4) did not often cause final payment problems in practice.

Table 4.8 *Rank of factors based on frequency of delaying final payment*

| Factors | Factors | Mean Value | Rank |
|---|---|---|---|
| F6 | GC arbitrarily withholds money after GC is paid | 4.04 | 1 |
| F9 | Inefficient communication and follow-ups | 2.60 | 2 |
| F7 | GC not paid by owner | 2.52 | 3 |
| F1 | Defective work not remedied | 2.48 | 4 |
| F3 | Lien of waiver problems | 2.48 | 4 |
| F5 | Damage to GC or other Subs | 2.32 | 6 |
| F8 | Unsettled construction disputes | 2.32 | 6 |
| F4 | Contingent payment clauses | 2.04 | 8 |
| F2 | Schedule problems | 1.96 | 9 |

Overall, all of the factors, except F6, have a mean value between 2 and 3, which means these factors have the possibility of occurring more than 20% but less than 40% of the time.

## 4.7 Minimum Delay on Release of Retainage

It was a little surprising that several respondents did not answer the questions for this retainage question. Only 25 complete responses were collected.

Below are the tables from the SPSS reports. The time range for the minimum delay in release of retainage was between 10 days and 90 days; and the average minimum delay was 34 days (see Table 4.9). The histogram shows that more than 50% of the respondents provided the answer of 30 days, meaning that 30 days (one month) was a very common

minimum delay in real world practice. This conclusion also is proven by the scatter plot (see Figure 4.10), which shows that the plots jumped up and down around the 30 days line. The plots were too scattered to form a true boxplot because the responses are too concentrated at 30 days and the distance (lower 50%) between the minimum value and the average value (20 days) was very different from the distance (upper 50%) between the maximum value and the average value (60 days). All of the statistical results show the minimum delay days at a high frequency of 30 days with other responses highly scattered.

Table 4.9 *Descriptive statistics of minimum delay on release of retainage*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Days | 23 | 10 | 90 | 34.70 | 18.386 |

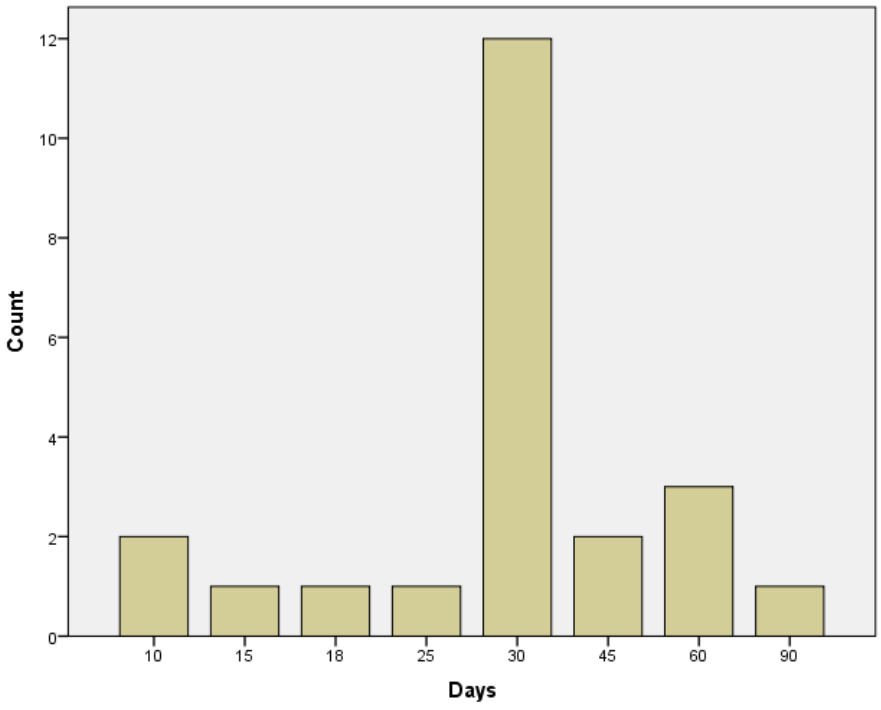


*Figure 4.10* Histogram of minimum delay on release of retainage

## 4.8 Maximum Delay on Release of Retainage

Twenty-five respondents answered this question. There was one response of "never been paid," which was too vague as input into the data analysis. Based on the personal judgment of the researcher, there might be some extreme cases where subcontractors are never paid, such as the general contractor going out of business; but if an electrical subcontractor was not paid by the general contractor for more than two years, the value of the money is significantly discounted. Therefore, for the sake of data analysis, the researcher adjusted the data "never been paid" as "720" days.

Below are the tables and figures from the SPSS reports. Table 4.10 shows that the range of maximum delay was from 60 days to 720 days. Basically, the maximum delay days varied a great deal from project to project, which is proven by the high standard deviation value of 156. The average maximum delay was 318 days; and the histogram shows that the most common response was 360 days, with eight respondents providing that answer. This result indicates that 360 days was the maximum delay that most electrical subcontractors experienced. From Figure 4.11, it can be seen that the responses were diverse, and most of them were in the range of 200 days to 400 days.

Table 4.10 *Descriptive statistics of maximum delay on release of retainage*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Days | 23 | 60 | 720 | 322.83 | 159.166 |

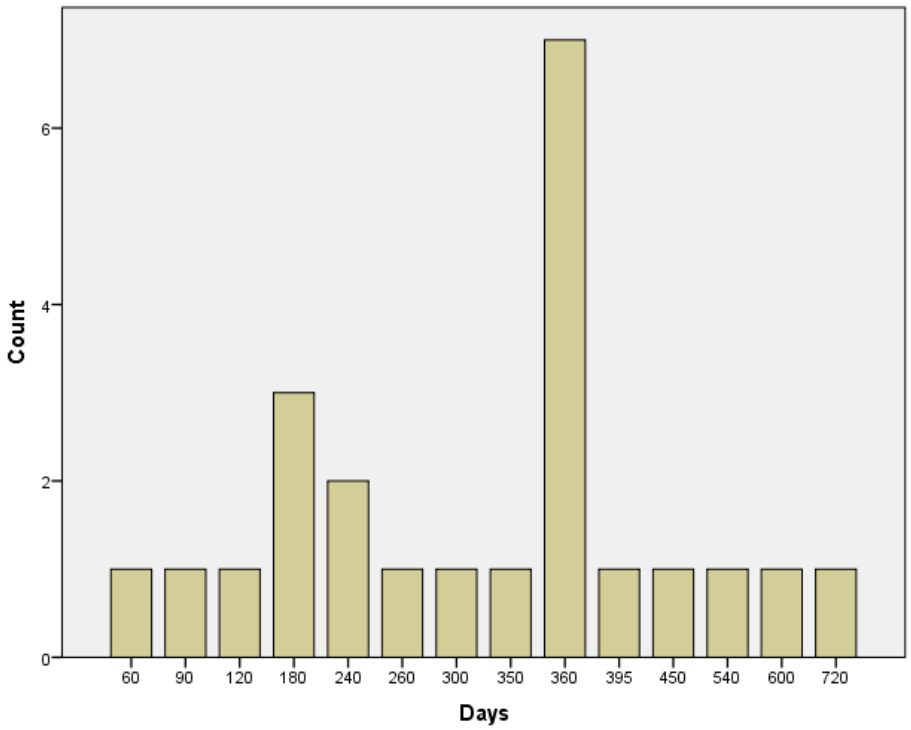


*Figure 4.11* Histogram of maximum delay on release of retainage

## 4.9 Average Delay on Release of Retainage

More respondents tended to provide a time range instead of a specific number of days when asked about the average. In this particular question, adjustments of the range of data were made as follows: 60-120 days - 90 days, 60-90 days - 75 days, 3-4 months - 105 days, and 90-120 days - 105 days.

Table 4.11 shows that the average delay in days for the release of retainage ranged from 30 days to 180 days, and the mean value was 91 days. Ninety days was the medium value and the most submitted response (seven people). This result indicates that 90 days is the average delay for release of retainage experienced by electrical subcontractors. The

scatter plot shows that the responses are scattered along the 90 days line, with most of the responses in the range of 60 days to 110 days.

Table 4.11 *Descriptive statistics of average delay on release of retainage*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Days | 23 | 30 | 190 | 92.52 | 43.525 |

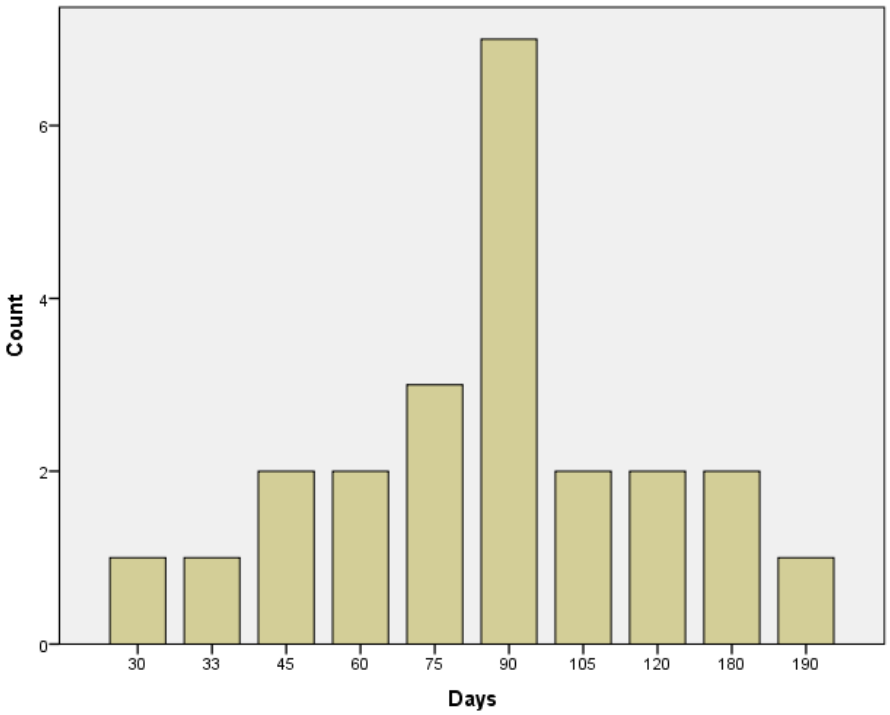


*Figure 4.12* Histogram of average delay on release of retainage

## 4.10 Significance of Factors on Release of Retainage

23 respondents successfully answered this question, and below are the tables and figures derived from the SPSS reports. Two datasets were excluded.

Table 4.12 *Descriptive statistics of significance from each factor on delaying retainage*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| R1 | 23 | 1 | 5 | 3.30 | .974 |
| R2 | 23 | 2 | 5 | 3.48 | 1.082 |
| R3 | 23 | 1 | 4 | 2.52 | .898 |
| R4 | 23 | 1 | 5 | 3.04 | 1.022 |
| R5 | 23 | 1 | 5 | 2.78 | 1.043 |
| R6 | 23 | 1 | 4 | 2.83 | 1.114 |
| R7 | 23 | 2 | 5 | 4.17 | .834 |
| R8 | 23 | 2 | 5 | 3.39 | .988 |
| R9 | 23 | 1 | 5 | 2.57 | 1.121 |
| R10 | 23 | 2 | 5 | 3.17 | .937 |

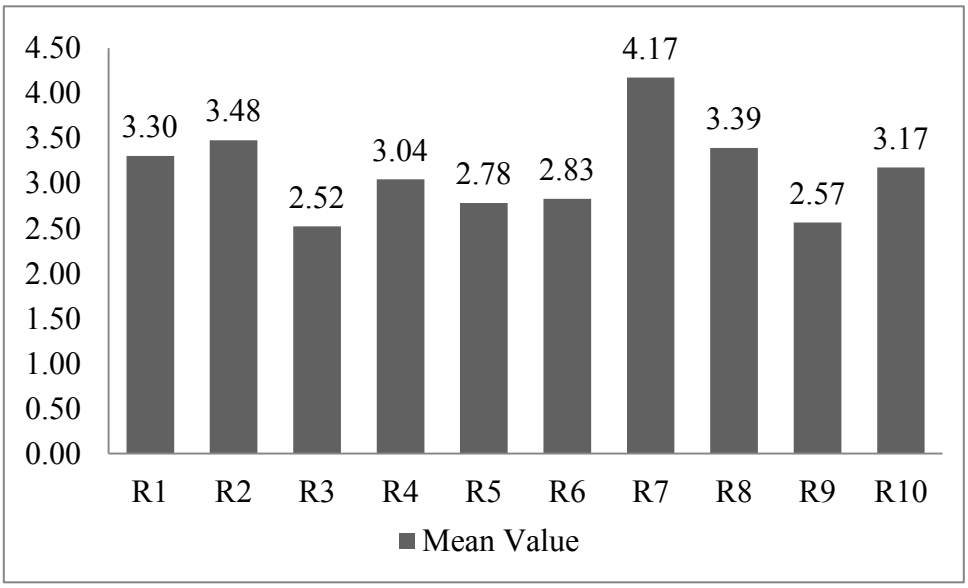


*Figure 4.13* Mean values of factors on significance of delaying retainage

The conclusions from the above statistical analysis are as follows:

Rank of factors based on significance of delaying release of retainage. As the table shows, R7, general contractor arbitrarily holding retainage from electrical subcontractors, was the factor with the highest mean value as well as the only factor with a mean value higher than four. This result indicates that almost 80% of the respondents believed that a general contractor arbitrarily holding retainage after substantial completion very significantly affects the delay of releasing retainage. The second significant factor was R2, submission of warranty issues. This factor is a problem if the electrical subcontractor fails to submit the warranty or there are problems with the warranty, which means that there is a high possibility that the retainage is delayed significantly. Also, general contractor not paid by owner (R8) and failure to provide O & M manual (R1) were also some factors that can significantly affect the release of retainage.

Table 4.13 *Rank of factors based on significance of delaying retainage*

| Factors | Factors | Mean Value | Rank |
|---|---|---|---|
| R7 | GC arbitrarily withholds money after GC is paid | 4.17 | 1 |
| R2 | Submission of warranty issues | 3.48 | 2 |
| R8 | GC not paid by owner | 3.39 | 3 |
| R1 | Failure to provide O & M manual | 3.30 | 4 |
| R10 | Inefficient communication and follow-ups | 3.17 | 5 |
| R4 | Schedule problems | 3.04 | 6 |
| R6 | Damage to GC or other Subs | 2.83 | 7 |
| R5 | Lien of waiver problems | 2.78 | 8 |
| R9 | Unsettled construction disputes | 2.57 | 9 |
| R3 | Defective work not remedied | 2.52 | 10 |

The mean values of all the factors were higher than 2.5. This result indicates that the average significance level for all of the factors have some significance in delaying final payment. This result also provides credibility to the questionnaire design.

## 4.11 Frequency of Factors on Release of Retainage

In terms of the frequency of each factor, Table 4.14 clearly summarized the key data collected from the respondents.

Table 4.14 *Descriptive statistics of frequency from each factor on delaying retainage*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| R1 | 23 | 1 | 5 | 2.04 | 1.107 |
| R2 | 23 | 1 | 5 | 2.22 | 1.347 |
| R3 | 23 | 1 | 4 | 1.96 | .976 |
| R4 | 23 | 1 | 5 | 2.57 | 1.080 |
| R5 | 23 | 1 | 4 | 1.91 | .996 |
| R6 | 23 | 1 | 5 | 2.61 | 1.305 |
| R7 | 23 | 2 | 5 | 4.04 | 1.065 |
| R8 | 23 | 1 | 5 | 2.43 | 1.237 |
| R9 | 23 | 1 | 4 | 2.30 | 1.020 |
| R10 | 23 | 1 | 4 | 1.91 | .996 |

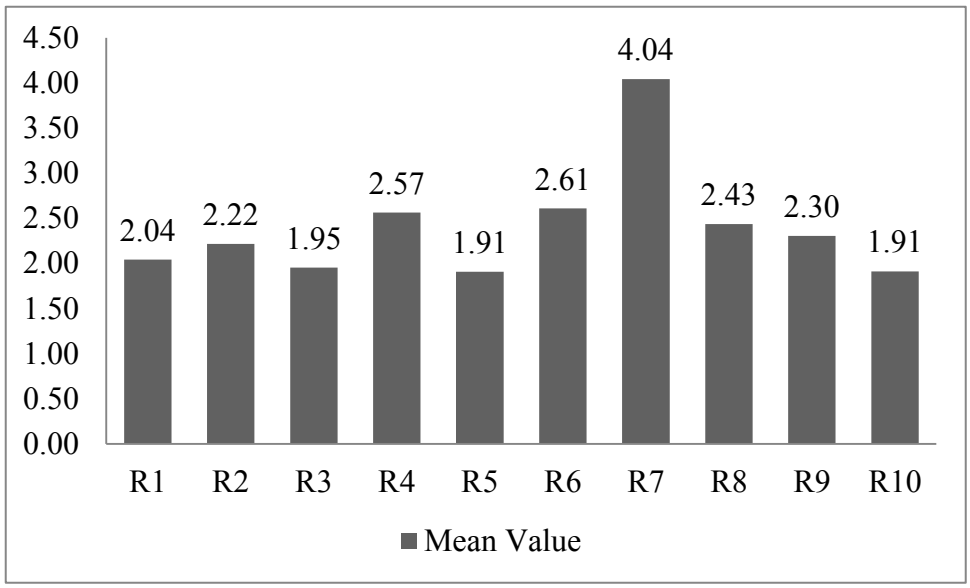


*Figure 4.14* Mean values of factors on frequency of delaying retainage

The conclusions based on statistical analysis are as follows:

Based on the mean value of each factor, a list of factors was developed. R7, general contractor arbitrarily holding retainage after general contractor was paid, ranks first, with a mean value of 4.04, and is the only factor with the mean value larger than three. This result shows that the general contractor arbitrarily holding retainage happens the most often from the perspective of electrical subcontractors. Two other factors that happen often, about 50%, were damage to general contractor or other subs (R6) and schedule problems (R4). This result indicates that there is room for improvement in communication between electrical subcontractors and general contractors, as well as between electrical subcontractors and other subcontractors for the same project. Another interesting result is that inefficient communication and follow-ups received the lowest mean value, 1.91. However, based on discussions with two professionals from a general contracting company (a vice president of that company and a project manager with more than 20 years of experience in construction), efficient follow-ups from electrical subcontractors do not occur very often on jobsites, which could lead to significant delays in the release of retainage. The same survey with respondents from general contractors might provide very different data from that of electrical subcontractors.

All of the factors except for general contractor arbitrarily holding retainage after general contractor was paid (R7) received a mean value of less than 2.61, which means that the possibility of this scenario happening was very likely less than 50%.

Table 4.13 *Rank of factors based on frequency of delaying retainage*

| Factors | Factors | Mean Value | Rank |
|---|---|---|---|
| R7 | GC arbitrarily withholds money after GC is paid | 4.04 | 1 |
| R6 | Damage to GC or other Subs | 2.61 | 2 |
| R4 | Schedule problems | 2.57 | 3 |
| R8 | GC not paid by owner | 2.43 | 4 |
| R9 | Unsettled construction disputes | 2.30 | 5 |
| R2 | Submission of warranty issues | 2.22 | 6 |
| R1 | Failure to provide O & M manual | 2.04 | 7 |
| R3 | Defective work not remedied | 1.95 | 8 |
| R5 | Lien of waiver problems | 1.91 | 9 |
| R10 | Inefficient communication and follow-ups | 1.91 | 9 |

## 4.12 Chapter Summary

This chapter presented the data collected and examined in this study. The backgrounds and experiences of the respondents were examined by the first two questions in the survey; and detailed data analysis was performed with SPSS to provide credibility for this research.

The respondents were also asked to reflect on the questions of delaying final payment and release of retainage. Based on the statistical analysis of the data collected, the mean value of the minimum delay, maximum delay, and average delay on delaying final payment and release of retainage were determined. The primary goal of this research, i.e. to develop a list of factors based on significance and frequency, was also achieved.

# CHAPTER 5. CONCLUSIONS

This research examined the major causes of delaying final payment and release of retainage. Thirty-nine electrical subcontracting professionals participated in this survey and a total of 29 responses were collected. The questions in the survey were designed to explore the phenomenon for the purpose of improving the cost management skills and cash efficiency of electrical subcontractors. This chapter provides a summary of the findings of this study, further research suggestions and limitations, and suggestions for electrical subcontractors to improve cost management.

## 5.1 Summary of Major Findings

The research questions posed in Chapter 1 of this study were as follows:

1. What were the minimum, maximum and average delay days of final payment and release of retainage from the perspective of electrical subcontractors?
2. What was the ranking of causes that lead to delays inn final payment and release of retainage from the aspects of significance and frequency independently?

The primary objectives of this research were achieved. Regarding delaying final payment, Table 5.1 shows that the mean value and the most common values of the minimum, maximum, and average delay. Table 5.2 is the ranking derived from the survey results based on the significance of each factor in delaying final payment.

Table 5.3 is the ranking based on the frequency of each factor in delaying final payment.

Table 5.1 *Mean value and most common value on delaying final payment*

| | Mean Value (Days) | Most Common Value (Days) |
|---|---|---|
| Minimum Delay | 36 | 30 |
| Maximum Delay | 250 | 240 |
| Average Delay | 91 | 90 |

Table 5.2 *List of factors based on significance of delaying final payment*

| Factors | Factors Description | Rank |
|---|---|---|
| F6 | GC arbitrarily withholds money after GC is paid | 1 |
| F7 | GC not paid by owner | 2 |
| F1 | Defective work not remedied | 3 |
| F3 | Lien of waiver problems | 4 |
| F8 | Unsettled construction disputes | 5 |
| F2 | Schedule problems | 6 |
| F5 | Damage to GC or other Subs | 7 |
| F9 | Inefficient communication and follow-ups | 7 |
| F4 | Contingent payment clauses | 9 |

Table 5.3 *List of factors based on frequency of delaying final payment*

| Factors | Factors Description | Rank |
|---|---|---|
| F6 | GC arbitrarily withholds money after GC is paid | 1 |
| F9 | Inefficient communication and follow-ups | 2 |
| F7 | GC not paid by owner | 3 |
| F1 | Defective work not remedied | 4 |
| F3 | Lien of waiver problems | 4 |

Table 5. 3 *Continued*

| | | |
|---|---|---|
| F5 | Damage to GC or other Subs | 6 |
| F8 | Unsettled construction disputes | 6 |
| F4 | Contingent payment clauses | 8 |
| F2 | Schedule problems | 9 |

The tables below summarize the findings on delaying release of retainage. Table 5.4 shows the mean value and most common values of the minimum, maximum, and average delay days on releasing retainage. Table 5.5 is the ranking derived from the survey results based on the significance of each factor in delaying retainage. Table 5.6 is the ranking based on the frequency of each factor in delaying retainage.

Table 5.4 *Mean value and most common value on delaying retainage*

| | Mean Value (Days) | Most Common Value (Days) |
|---|---|---|
| Minimum Delay | 34 | 30 |
| Maximum Delay | 318 | 360 |
| Average Delay | 92 | 90 |

Table 5.5 *List of factors based on significance of delaying retainage*

| Factors | Factors Description | Rank |
|---|---|---|
| R7 | GC arbitrarily withholds money after GC is paid | 1 |
| R2 | Submission of warranty issues | 2 |
| R8 | GC not paid by owner | 3 |
| R1 | Failure to provide O & M manual | 4 |
| R10 | Inefficient communication and follow-ups | 5 |
| R4 | Schedule problems | 6 |
| R6 | Damage to GC or other Subs | 7 |

Table 5. 5 *Continued*

| | | |
|---|---|---|
| R5 | Lien of waiver problems | 8 |
| R9 | Unsettled construction disputes | 9 |
| R3 | Defective work not remedied | 10 |

Table 5.6 *List of factors based on frequency of delaying retainage*

| Factors | Factors Description | Rank |
|---|---|---|
| R7 | GC arbitrarily withholds money after GC is paid | 1 |
| R6 | Damage to GC or other Subs | 2 |
| R4 | Schedule problems | 3 |
| R8 | GC not paid by owner | 4 |
| R9 | Unsettled construction disputes | 5 |
| R2 | Submission of warranty issues | 6 |
| R1 | Failure to provide O & M manual | 7 |
| R3 | Defective work not remedied | 8 |
| R5 | Lien of waiver problems | 9 |
| R10 | Inefficient communication and follow-ups | 9 |

## 5.2 Recommendations for Future Studies

This study successfully identified the significant factors that cause delay on final payment and release of retainage for electrical subcontractors. To improve the cost management skills and improve the cash efficiency of construction companies, there are several other topics that would benefit from investigation beyond this research. Therefore, the following are recommended topics for future studies.

1. This study surveyed electrical subcontractors. However, in order to avoid delay problems, the viewpoints of both parties are very crucial.

Administering the same survey, but from the general contractors' perspective would better show the situation from both sides.

2. From the above results, it is obvious that on all of the four ranking lists, general contractors' arbitrarily holding money from electrical subcontractors after general contractor was paid ranked at the first position. Further questions such as the following should be asked: Why did this happen? What were the reasons behind this?
3. The research developed two rankings based on significance and frequency individually. Further investigation could explore combining these two tables into one.

## 5.3 Suggestions for Electrical Subcontractors

Based on the results of the survey, some suggestions below are made to help electrical subcontractor collect payments on time.

The general contractor arbitrarily withholding money after the general contractor is paid was the dominate NO. 1 reason on all four lists of this study. The suggestion for electrical subcontractors based on this result is to closely examine the disputes history and cash flow of the general contractor when bidding a new job. After all, no job is better than losing money on a job.

The timeline of payment is also helpful for payment collection. Setting up a separate schedule for important payment milestones will be a good reminder for project engineers. Important payment milestones can be: one month before completion of the

assigned work, one week before inspection and certification issuance, the day of completion, one week after substantial completion, one month after substantial completion, and two months after completion (if unpaid).

Another suggestion is to pay attention to your paperwork, such as lien waivers and warranty issues. A complete list of paperwork is required when electrical subcontractors submit payment requests to general contractors.

Keeping good communication with the project manager from general contractor is another thing worth mentioning. Having paper works ready and keeping the general contractor informed when the job is to be completed could also help to speed up the payment collection process for electrical subcontractors.

## 5.4 Chapter Summary

This chapter presented the answers to the primary research questions posed earlier. Recommendations for future research were also made to further clarify the research area. Based on the findings of this study, suggestions to electrical subcontractors for improving cost management and cash efficiency were provided.

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# APPENDICES

Appendix A Questionnaire

## Questionnaire: Causes of Late Final Payment and Release of Retainage

### Part I: General Questions

1. For how many years you have worked in construction industry:
   a. Less than 2 year
   b. 2-5 years
   c. 5-10 years
   d. 10-20 years
   e. More than 20 years

2. What construction management positions have you had held for at least one project? (Select all that apply)
   a. Project Engineer
   b. Superintendent or Assistant
   c. Project controls (estimating, scheduling, cost control)
   d. Project Manager or Assistant
   e. Other (enter title(s))_____

### Part II: Survey on Late Final Payment and Release of Retainage:

**Substantial Completion:** the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents.

**Final Payment:** the last progress payment which is made when the Work has been completed in accordance with terms and conditions of the Contract Documents

3. What is the longest amount of time (days) after substantial completion that the general contractor release *final payment* to you? _____

4. What is the shortest amount of time (days) after substantial completion that the general contractor release *final payment* to you? _____

5. On the average, how many days after substantial completion do you estimate that the general contractor releases *final payment* to you?_____

6. Please rate the impact from each possible cause on delaying final payment.

*(Scores are assigned by circling the scale number, 1 through 5: 1. Insignificant 2. Of Little Significance 3. Moderately Significant 4. Significant 5. Very Significant)*

| | |
|---|---|
| Defective work not remedied | 1 2 3 4 5 |
| Schedule Problems | 1 2 3 4 5 |
| Lien Waiver Problems | 1 2 3 4 5 |
| Contingent payment clauses | 1 2 3 4 5 |
| Damage to GC or Other Subs | 1 2 3 4 5 |
| GC arbitrarily withholds payment after GC is paid. | 1 2 3 4 5 |
| GC not paid by Owner | 1 2 3 4 5 |
| Unsettled construction disputes | 1 2 3 4 5 |
| Inefficient communication and follow-ups | 1 2 3 4 5 |

7. In your experience, how frequently does each of the following problems delay final payment?

*(Scores are assigned by circling the scale number, 1 through 6;*
*1.0%-20% 2. 20%-40% 3. 40%-60% 4. 60%-80% 5. 80%-100%*

| | |
|---|---|
| Defective work not remedied | 1 2 3 4 5 |
| Schedule Problems | 1 2 3 4 5 |
| Lien Waiver Problems | 1 2 3 4 5 |
| Contingent payment clauses | 1 2 3 4 5 |
| Damage to GC or Other Subs | 1 2 3 4 5 |
| GC arbitrarily withholds payment after GC is paid. | 1 2 3 4 5 |
| GC not paid by Owner | 1 2 3 4 5 |
| Unsettled construction disputes | 1 2 3 4 5 |
| Inefficient communication and follow-ups | 1 2 3 4 5 |

## Part IV: Causes of Late Release of Retainage

8. What is the longest amount of time (days) after substantial completion that the general contractor release ***retainage*** to you? _____

9. What is the longest amount of time (days) after substantial completion that the general contractor release ***retainage*** to you? _____

10. On the average, how many days after substantial completion do you estimate that the general contractor releases ***retainage*** to you? _____

11. How significant the following cause is in terms of causing final payment delayed? Please rate each subject. *(Scores are assigned by circling the scale number, 1 through 5:1. Insignificant 2. Of Little Significance 3. Moderately Significant 4. Significant 5. Very Significant)*

| | |
|---|---|
| Failure to Provide O&M Manual | 1 2 3 4 5 |
| Submission of warranty issues | 1 2 3 4 5 |
| Defective work not remedied | 1 2 3 4 5 |
| Schedule Problems | 1 2 3 4 5 |
| Lien waiver problems | 1 2 3 4 5 |
| Damage to GC or Other Subs | 1 2 3 4 5 |
| GC arbitrarily withholds payment after GC is paid. | 1 2 3 4 5 |

| | |
|---|---|
| GC not paid by Owner | 1 2 3 4 5 |
| Unsettled Construction Disputes | 1 2 3 4 5 |
| Inefficient Communication and follow-ups | 1 2 3 4 5 |

12. How frequent does the following problem happen when applying for final payment?
*(Scores are assigned by circling the scale number, 1 through 6: 1.0%-20% 2. 20%-40% 3. 40%-60% 4. 60%-80% 5. 80%-100%)*

| | |
|---|---|
| Failure to Provide O&M Manual | 1 2 3 4 5 |
| Submission of warranty issues | 1 2 3 4 5 |
| Defective work not remedied | 1 2 3 4 5 |
| Schedule Problems | 1 2 3 4 5 |
| Lien Waiver Problems | 1 2 3 4 5 |
| Damage to GC or Other Subs | 1 2 3 4 5 |
| GC arbitrarily withholds payment after GC is paid. | 1 2 3 4 5 |
| GC not paid by Owner | 1 2 3 4 5 |
| Unsettled Construction Disputes | 1 2 3 4 5 |
| Inefficient Communication and follow-ups | 1 2 3 4 5 |

# Appendix B IRB Approval

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

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| | |
|---|---|
| **To:** | RANDY RAPP<br>KNOY |
| **From:** | JEANNIE DICLEMENTI, Chair<br>Social Science IRB |
| **Date:** | 02/03/2014 |
| **Committee Action:** | **Exemption Granted** |
| **IRB Action Date:** | 02/03/2014 |
| **IRB Protocol #:** | 1401014375 |
| **Study Title:** | An Evaluation on Causes of Late Final Payment and Release of Retainage: Electrical Subcontractor's View |

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b)(2) .

If you wish to make changes to this study, please refer to our guidance **"Minor Changes Not Requiring Review"** located on our website at http://www.irb.purdue.edu/policies.php. For changes requiring IRB review, please submit an **Amendment to Approved Study** form or **Personnel Amendment to Study** form, whichever is applicable, located on the forms page of our website www.irb.purdue.edu/forms.php. Please contact our office if you have any questions.

Below is a list of best practices that we request you use when conducting your research. The list contains both general items as well as those specific to the different exemption categories.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not

submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 1

- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.