MEASURING PROJECT INTEGRATION USING RELATIONAL CONTRACT THEORY

By

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Measuring Project Integration using Relational Contract Theory

Thesis directed by Professor Keith R. Molenaar

Abstract

Traditional project design and construction delivery methods are segmental. Researchers and construction practitioners often cite the separation, or "silo effect", as a reason for poor project outcomes. Recently, design-build (DB) and construction manager / general contractor (CMGC) delivery methods have gained favor in the delivery of design and construction projects. However, DB and CMGC contracts are still two-party agreements where the contract language remains similar to traditional design-bid-build methods, which poses a problem in that the contract does little to improve interactions between the contracting parties, which is one reason claims and litigation occur regularly in the construction industry.

An emerging alternative delivery method poised to break down the silos is integrated project delivery (IPD). The use of project integration introduces an atmosphere built on collaboration, mutual respect, and cooperation. Organizations turn their attention to successful *project* outcomes instead of individual organizational outcomes. Furthermore, unlike common delivery methods, the interactions between individuals from different organizations in an IPD project become crucial. IPD uses multiparty agreements to tie major organizations together, forming a team that concentrates on the project rather than individual organizational goals.

The concept of emphasizing the project and the relationships between organizations equates with relational contract theory. Relational contract theory posits the idea that the relationship between parties is the most critical aspect in obtaining successful outcomes. Relational contract theory states that contracts include many complex aspects of interactions between the different organizations. As more interactions occur, a relationship begins to form in a manner

similar to when two people meet on the first day of school and through positive interactions and behaviors over time, they become friends, or through negative interactions and behaviors, a rivalry develops. One crucial part of relational contract theory is the acknowledgement of specific social norms, or expect behaviors, that appear in all contractual transactions and exchanges. The contractual norms are specific behaviors that one can measure based on perceptions.

Through a literature review of construction delivery methods, project integration, relational contract theory, modern contract law, and inter-organizational relationships, three research questions were developed to focus on integration and project success.

This study provides four major claimed contributions to the construction research body of knowledge. First, relational contracting can define project integration in terms of expected behaviors. Second, IPD contracts highlight integration more than DB and CMGC contracts, and DB and CMGC contracts show more relationalism than DBB contracts. Third, correlations found between the contractual norms and project success provide evidence that implementing project integration and behaving appropriately can positively influence achieving a successful project. Finally, the project integration measurement tool represents a method to investigate how integrated a project team is or is not and a way to understand how to improve the team atmosphere on construction projects.

Dedication

To my father, Elmer J. Harper (1947 – 2013), for all of the love and support he gave me for 34 years. I would not be whom I am today without his influence.

To my wife, Courtnay, for her love, wisdom, and patience in in being my partner and best friend. I would not have reached this goal without you.

And to my children, COCO and CeCe, you both have enriched my life and opened my heart in ways I could never have thought possible.

Acknowledgements

First and foremost, I must acknowledge Dr. Keith Molenaar, my advisor and mentor over the last several years. Without his help and extensive support, I would have never completed this degree and dissertation. Dr. Molenaar has been a huge influence in my life for the past decade and I feel very blessed to have had the chance to work with him over the last three years.

I would also like to acknowledge my dissertation committee. I am very grateful to have had such a wonderful committee that believed in me and assisted me when I was stuck and when I did not think I could finish this. You are all wonderful people that I admire and look up to and I hope that I can someday be as good as you all are at being a professor and mentor to students like myself.

Finally, I give thanks to the expert interviewees, the individuals that helped with the pilot survey, and the 499 survey respondents that were willing to participate in the data collection. Without this insight and willingness to participate, none of this work could have occurred. I am indebted to everyone that has helped me with the data collection over the past two years.

Table of Contents

Dissertation Format

This dissertation follows a traditional approach. There are a total of six chapters and three appendices, each addressing a specific portion of the dissertation research. I have the ability to extract three peer-reviewed journal articles in the future based on the contents in chapters 2 through 6. A summary of each chapter is listed below.

- Chapter 1 – The current chapter provides the observed problem and the research questions/hypotheses to be addressed
- Chapter 2 – The background literature review and point of departure are discussed in detail. Contents of this chapter include information on delivery methods, contracts, project integration, relational contract theory, and the differences that this research has when compared to previous research in the areas listed in the previous sentence.
- Chapter 3 – This chapter provides the systematic research methodology that was used to investigate the three research questions.
- Chapter 4 – The data analysis is provided in this chapter. The qualitative results as well as the quantitative statistical analyses are both presented briefly discussed.
- Chapter 5 – The results from the data analysis found in chapter 4 are discussed in detail.
- Chapter 6 – The final chapter includes the overall contributions that this research makes to the construction research body of knowledge. Chapter 6 also includes limitations of this research as well as ideas for future research in relational contracting and project integration.
- The References section includes all of the relevant literature cited throughout the dissertation
- Appendix A is a list of acronyms and abbreviations used throughout the dissertation report

- Appendix B is the complete and final version of the electronic survey distributed to owner agents
- Appendix C contains statistical matrices used in the statistical analyses from chapter 4

List of Figures

List of Tables

CHAPTER 1. OBSERVED PROBLEM AND PURPOSE

Many studies and reports boast the benefits associated with project integration and relational contracts. The American Institute of Architects California Council (AIA-CA) developed multiple reports, guides, and case study investigations of project integration (e.g. AIA 2011; AIA-CA 2010; 2007). Engineering News Record (ENR) has published many articles since 2007 that demonstrate the benefits of integrated projects and relational contracting (e.g. Post 2011a; 2011b; Bergeron 2008). The Lean Construction Institute (LCI) adopted project integration as an ideal part of lean construction (e.g. Forbes and Ahmed 2011; Ghassemi and Becerik-Gerber 2011; Matthews and Howell 2005). The American Society of Civil Engineers (ASCE) has published a variety of research articles related to project integration and relational contracting (e.g. Ning and Ling 2013; El Asmar et al 2013; Meng 2012).

Yet the alterations that project integration introduces to designing and constructing projects when compared to traditional and commonly used alternative methods are in some cases drastic and difficult for many to understand. Project integration focuses more on the relationships between organizations than the common delivery methods. Therefore, this research intends to uncover new information about project integration in terms of the relationships between organizations found on a construction project and the impact this has on achieving a successful project.

1.1 Observed Problem

Construction is a fragmented and specialized industry that requires proper communication and interactions with all organizations involved so that project completion occurs on time, on budget, and to the level of quality and functionality set forth by the owner. In many instances, common delivery methods used to complete a project do not provide the ideal results. Many recent research studies show that common delivery methods suffer from adversarial relationships, low rates of productivity, inefficient means and methods that lead to rework and sub-standard quality, high rate of disputes and lack of innovation. This leads to cost increases, time increases, and low quality work (Thomsen et al 2009; Lichtig 2006; Egan 2002; 1998; Latham 1994). Based on these previous studies, stakeholders have been adopting and using alternative delivery methods.

The construction industry generally understands the traditional design-bid-build (DBB) method of project delivery. Although it remains the most common method, the studies mentioned above illustrated the problems associated with DBB. To combat the DBB drawbacks, other delivery methods began to appear in recent decades. One alternate method is design-build (DB), which brings the designer and constructor together as one entity. Construction manager / general contractor (CMGC) is another method, which brings on a contractor during design phase to assist with constructability and development of the design.

Previous studies conducted in construction research verify that advantages exist in using DB or CMGC over DBB (Minchin et al 2013; Konchar and Sanvido 1998; Gordon 1994). However, the contract structure remains fundamentally the same for DBB, DB, and CMGC. The contract language states the scope of work that each party is responsible for, as well as processes to use when issues or disputes arise. This means that contracting organizations make no effort to align individual interests with the project or to focus on developing a sustainable and working relationship between the contracting firms. Therefore, researchers and the construction industry have turned their attention to project integration.

Integration delivers a construction project in a way that is considerably different from a DBB, DB, or CMGC delivered project. The terms "project integration" and "integrated project" imply that uniting all the specialized and fragmented organizations and trades on a construction project will focus everyone on obtaining successful project outcomes. One form of delivering projects using project integration is integrated project delivery (IPD). IPD extensively uses project integration techniques such as multiparty agreements that create a sustainable team of representatives from multiple organizations. The project team jointly takes on the full responsibility to complete the project to the highest level possible. The team also shares in any achievements and risks that arise and all parties agree to waive claims against each other except for extreme circumstances. All of these attributes lead one to see that IPD contracts rely much more on the actual relationships between organizations than on the processes to use, making IPD projects relational contracts.

In the United States, project integration techniques and the use of IPD to deliver projects are new concepts for the construction industry, as very few organizations and projects have used formal project integration to deliver a project. However, the use of project integration is not a new concept. The United States Army Corps of Engineers (USACE) commonly considers innovative ideas and processes for constructing projects and recently the USACE used Early Contractor Involvement (ECI) to complete portions of the Levee Improvements program in New Orleans. ECI is a method of delivery similar to CMGC and incorporates project integration techniques such as partnering, collaboration, and of course, contractor involvement during design and development of a project (Bergeron 2008). Other international countries have adopted project integration on a much wider scale than the US. Australia's use of project alliancing (State of Victoria 2006; Ross 2003), and the United Kingdom's use of ECI (Song and Abourizik 2009; Highways Agency 2004) helped to present integrated project principles and techniques during the 1990's to those countries. Today, Australia and the United Kingdom commonly utilize integration for many types of projects, ranging from private vertical construction to public civil infrastructure projects.

A lack of understanding, knowledge, and experience in using project integration limits its use and expansion for the US construction industry. This research intends to investigate project integration through the relationships that occur between organizations found on construction projects. In turn, this study will attempt to discover new and interesting inferences that may reveal additional advantages in using project integration.

1.2 Purpose and Research Questions

The primary purpose of this research is to investigate project integration through the relationships that exist between organizations on construction projects by comparing project integration to critical project success factors (CSFs) and success criteria, which define project success. Previous studies provide limited knowledge about project integration and the overall effect it has on project success. Further, the construction industry as a whole lacks a clear understanding about the culture change and relational aspects that accompany the use of project integration. To formulate the research methodology, development of the research statement occurred first, which assisted with developing the research questions. Below, I list the research statement followed by the research questions for this study. Then, Figure 1-1 offers a visual summary of the research methodology that addresses each of the research questions sequentially.

Research Statement:

- Construction project integration *influences* the success of a project.

Research Questions:

Q1 How can relational contracting norms *define* construction project integration?

Q2 How can relational contracting norms *measure* construction project integration?

Q3 How does construction project integration *relate* to project success?

Question one (Table 1-1) investigates the hypothesis that project integration utilizes principles from relational contract theory, which can define project integration. This research looks to define project integration using relational contracting and correlating relational contract theory to the construction industry. To answer this question, a literature review, qualitative content analysis (CA) of standard construction contracts and interviews of construction experts will take place to determine the relevancy and importance of the independent research factors in defining project integration.

Table 1-1: Research question Q1

	Q1 How can relational contracting norms *define* construction project integration?		
Action	Define independent research factors	Determine existence of independent research factors	Confirm relevancy & importance of independent research factors
Task	Perform detailed literature review	Qualitative content analysis of standard construction contracts	Conduct expert interviews with qualified individuals
Result	Eight contractual norms are the independent factors	Contractual norms exist in construction contracts, which are relational contracts	Contractual norms are relevant and important to construction

Question two (Table 1-2) focuses on the hypothesis that a method exists for measuring project integration through expected contractual behaviors (called norms) that occur between contracting organizations on construction projects. This research addresses this question by operationalizing contractual norms as constructs with a systematic and documented procedure in an effort to measure construction project integration on a project-by-project basis. The use of a paneling approach will assist with vetting the individual statement item measures and overall refining the main survey questionnaire, which will act as the primary data collection tool in this research study. In addition to creating the contractual norm measures, I will define the project success factors and include them in the survey questionnaire as the dependent research factors.

Table 1-2: Research question Q2

Q2 How can relational contract theory contractual norms *measure* construction project integration?				
Action	Create construct maps	Generate and vet statement items	Define critical success factors	Survey construction projects
Task	Define scale of contractual norms	Develop measurement items and review with panel	Research established critical success factors and criteria to measure project success	Survey owner agencies to collect project integration & project success data
Result	Defining the extremes & median of measures	A list of statement items ready for piloting	A set of statement items that measure different aspects of project success	A data set of multiple projects across various delivery methods

The third question (Table 1-3) explores the hypothesis that a relationship exist between project integration and project success utilizing the contractual norms to measure integration on construction projects. As mentioned, this research will use a survey questionnaire to collect project attributes, contractual norms data, and data related to project success through a survey distributed to randomly selected owners and owner agents. Owner's agents are organizations that represent the owner's firm during the design and construction of a project, such as owner's representatives and construction manager agencies (CMA). The analysis of the survey responses will focus on analyzing the contractual norm measurement model as well as discovering correlations between project integration and project success using structural equation modeling analyses. Finally, validation will occur to determine if any biases affect the analysis results and to determine if the results are generalizable to the construction industry.

Table 1-3: Research question Q3

Q3 What *correlations* exist between construction project integration and project success?			
Action	Assess measurement model	Assess structural models	Validate results
Task	Perform exploratory and confirmatory factor analyses of contractual norm measures	Find correlations between project integration and project success	Evaluate any potential biases and perform follow-up interviews
Result	Precise, consistent, and accurate measures	Correlations exists between project integration and project success	Integration influences the potential to achieve a successful project

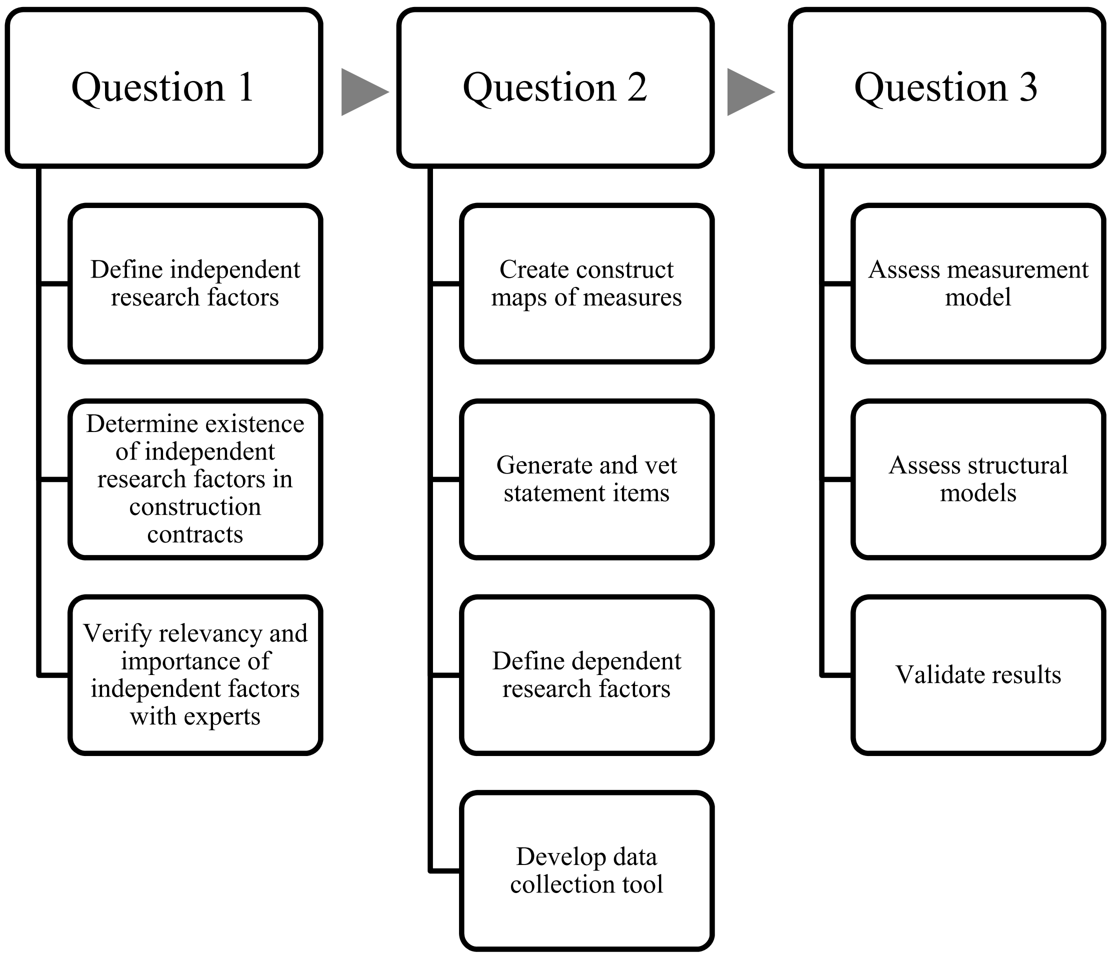

Figure 1-1: Research methodology approach

Figure 1-1 outlines the methodology to answer each of the three research questions. A formal and documented approach allows for valid and reliable results that will either support or reject the hypothesis for each question. The remaining chapters in this dissertation provide the background, methodology, data analysis, results, and conclusions based on the research methodology, respectively.

CHAPTER 2. BACKGROUND AND POINT OF DEPARTURE

The purpose of this research study is to define and measure project integration through relational contract theory contractual norms and to compare the operationalized project integration measures to project success. I used a rigorous literature review to gain an understanding of project integration and relational contracting as well as project success. In order to develop a research context, I concentrated on literature associated with construction delivery methods, project integration characteristics and techniques, integrated design and construction projects, construction contracts and law, and information on relational contract theory from the fields of psychology, sociology, law, and business. This information assisted in the development of the study's point of departure, which I formalize at the end of this chapter.

2.1 Construction Delivery Methods

Designing and constructing a project is a complex process. There exist many different ways to design and build a project and no single method is ideal for every project. Additionally, there are many individuals and organizations involved in one project due to the specialization (e.g. "silo effect") of the design and construction workforce, which adds a level of complexity to the management of a construction project. This complexity requires proper management, detailed planning, selecting the most optimal participants, and following through on promises to increase the probability of success. Different delivery methods address a project's complexity in different ways. This section details the traditional, common alternative, and integrated delivery methods used to design and build construction projects.

2.1.1 Design-Bid-Build

Most construction projects use the traditional DBB method to deliver projects. This method is the traditional, sequential process of designing the project fully (design), then procuring the constructor to build the project (bid), who then constructs the project (build). Figure 2-1 shows the contracting arrangement present in DBB. This method is well known and understood throughout the construction industry.

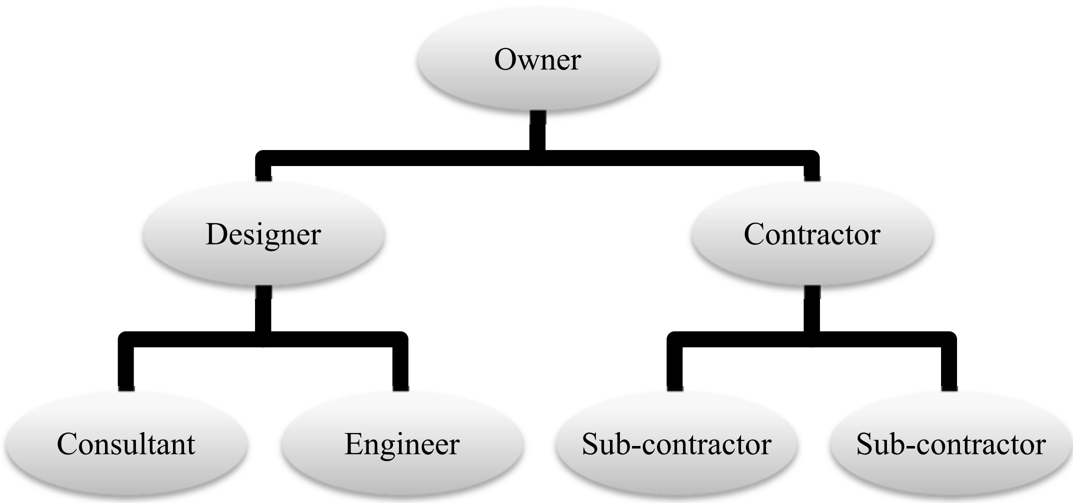

Figure 2-1: Design-bid-build contracting hierarchy

Yet DBB introduces an atmosphere that is highly competitive, adversarial and does not allow interorganizational trust to develop. This negative atmosphere leads to the unwanted results of cost overruns, time overruns, and low quality, which in turn leads to impending liability claims and litigation (Egan 1998; Latham 1994). Table 2-1 describes the positives and negatives associated with DBB.

Table 2-1: Benefits and drawbacks of DBB

Benefits	Drawbacks
Traditional, well-known method	No contract between designer and contractor
Owner retains high level of control	Low trust and collaboration between organizations
Risk allocation is understood	Highly competitive atmosphere
Well-established legal precedence	Maximizing individual organization outcomes instead of project outcomes
Design is 100% complete and addresses all owner's needs	Risks are allocated and are individual organization responsibilities, not shared responsibilities
Construction price known before starting work	Liability claims and litigation are common
	Each firm makes own decisions not joint decisions due to means and methods clauses
	Owner developed goals, not project team developed goals

2.1.2 Construction manager / general contractor

Due to the drawbacks associated with DBB, two alternative delivery methods, DB and CMGC, have gained in popularity and use since the 1980s. CMGC (also called construction manager at risk or CMAR) is an alternative method where an owner will procure a contractor early in the development or design process to act as a construction manager and assist with providing construction input during design. The contractor then constructs the project based on that design. Figure 2-2 illustrates the contracting arrangement for CMGC.

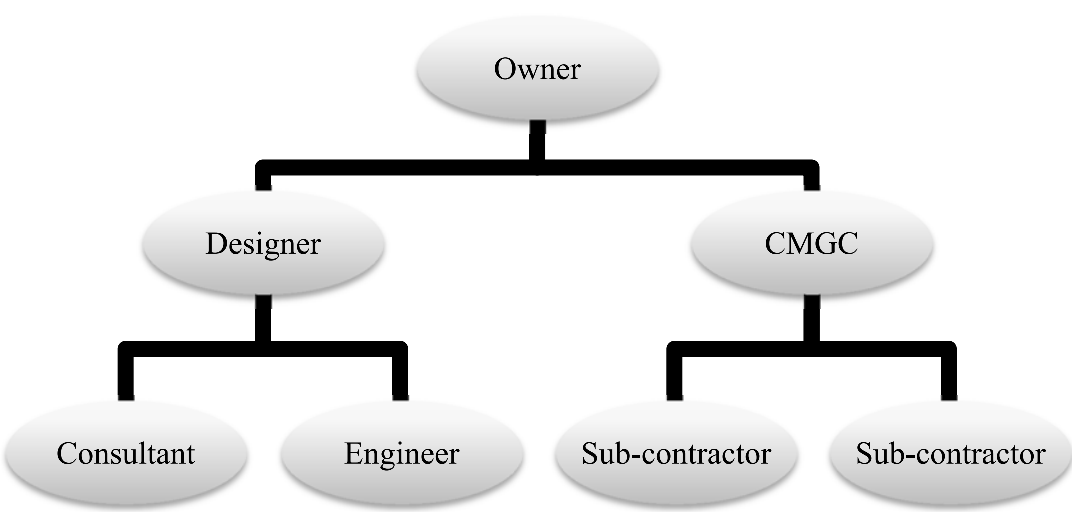

Figure 2-2: Construction manager / general contractor contracting hierarchy

One benefit of CMGC is that a contractor is available to assist with the design portion of the project, which can improve constructability. Research has found that improving constructability can reduce RFIs and change orders on a project (Gransberg and Shane 2010). Other advantages of CMGC are real-time construction pricing capabilities, improved implementation speed, ability to utilize new and innovative technologies and strategies, and the ability to create a collaborative atmosphere between the owner, designer, and contractor (Gransberg and Shane 2010). Table 2-2 lists the general benefits and drawbacks of CMGC.

Table 2-2: Benefits and drawbacks of CMGC

Benefits	Drawbacks
Early contractor involvement	Owner holds the risk of the design being adequate
Innovation potential with contractor input during design	Design costs are increased with a fee due to the CMGC firm
Can accelerate delivery	Determining contract price through negotiations can be difficult
Constructability risks reduced	Contractors and owners are less familiar with this process
Owner has more control during design	Owner holds multiple contracts with designer and CMGC firm
Procurement based on qualifications instead of low bid	No contract between CMGC firm and designer

2.1.3 Design-Build

Design-build (DB) is an alternative delivery method where the designer and contractor combine to form one entity, the design-builder. This eliminates multiple contracts with the owner and the design and construction organizations, as shown in Figure 2-3.

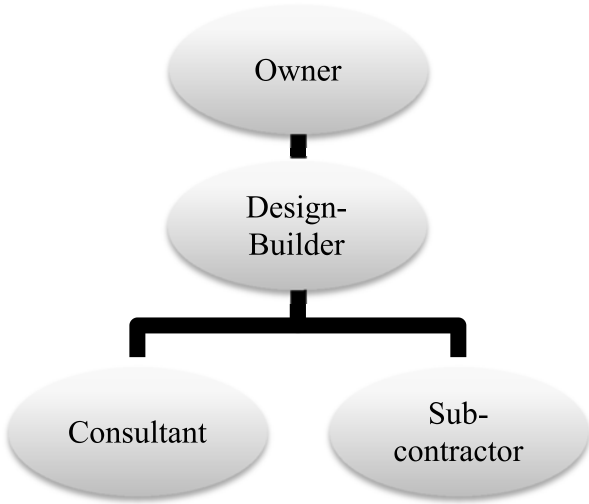

Figure 2-3: Design-Build contracting hierarchy

One of the major advantages of DB over DBB is a reduced duration to complete the project. A report to Congress by the Federal Highway Administration (FHWA) summarizes the performance of DB projects and states that on average DB projects can reduce overall project duration by 14%, decrease total costs by 3%, maintain the same high level of quality, and the total number of requests for information (RFIs) and change orders is reduced (FHWA 2006). Table 2-3 shows the common benefits and drawbacks of DB.

Table 2-3: Benefits and drawbacks of DB

Benefits	Drawbacks
Reduces project duration	Owner has less control over the design phase
Owner holds one contract with designer & builder	Less established legal precedence
Builder involved during design and development	Procurement is intensive & proposals can be costly
Cost can be determined during design	Less contractors available & experienced with DB
Schedule determined early in design	Firms maximizing individual outcomes, not project outcomes
Less claims and litigation occur	
Trust and collaboration more apparent	
Constructability risks reduced during design	

2.1.4 Integrated project delivery

IPD is an emerging delivery method that relies on teamwork, collaboration, mutual respect, and trust between all the organizations involved in the project. IPD uses project integration techniques to bring together the many organizations involved on a project to form an effective team that focuses on the project goals (AIA-CA 2007). In some instances, IPD can be a drastic culture change from other more commonly used delivery methods, in which most organizations are only concerned for the well-being of themselves and hold less concern for the project or other organizations. Unlike other delivery methods, the interactions between individuals from different organizations become crucial. IPD uses multiparty agreements to tie major organizations together, forming a team that focuses on the project. No longer can adversarial relationships exist, as that would mean unsuccessful outcomes for the project and *all* organizations involved. Figure 2-4 illustrates the multi-party contractual relationship.

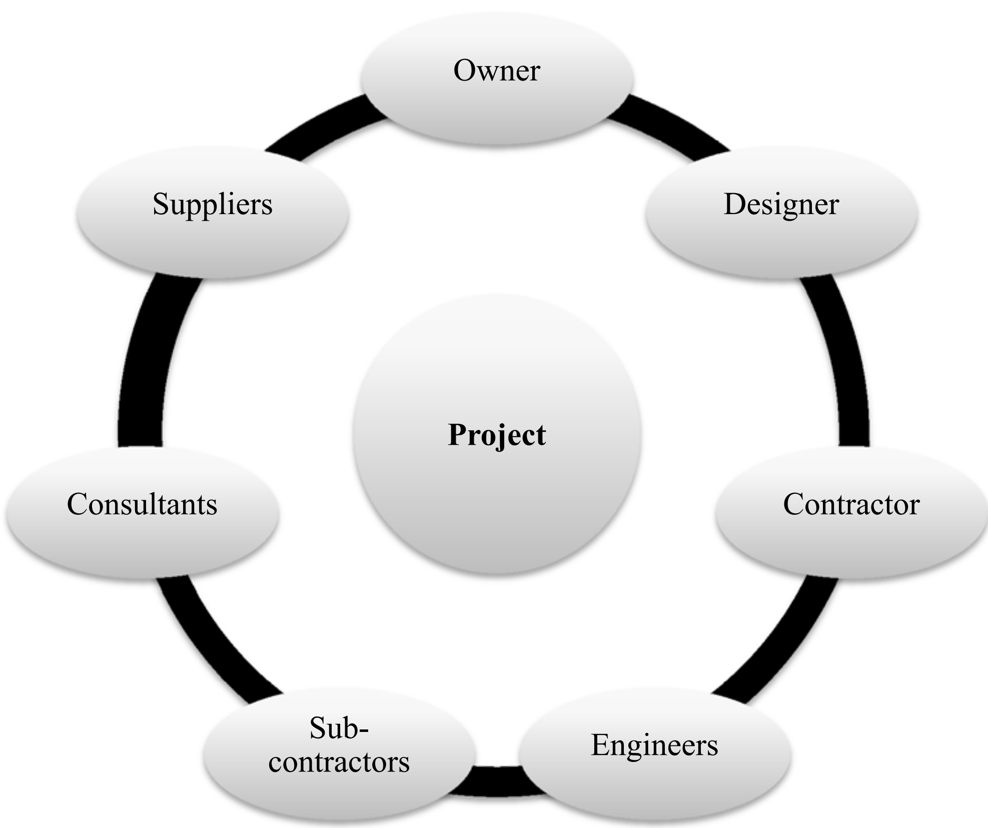

Figure 2-4: A multiparty agreement example with a central focus on the project

IPD introduces a culture of collaboration and trust, an assimilated team concept, a streamlined process, and improved project outcomes (Sive 2009). Since a multiparty agreement contractually ties all of the major organizations together, making each organizations responsible for one another, a cooperative atmosphere should develop and sustains throughout the project with a focus on maximizing project goals, which then maximizes all of the contracting organizations goals.

While the benefits of IPD can improve some of the long-standing issues associated with traditional construction project delivery methods, there is still a lack of understanding of IPD in the construction industry. Legal precedence is virtually non-existent and waiving claims is against the law in some states. Further, obtaining insurance for a multi-party agreement that ties the liability of all organizations together is very difficult and hard to find (Post 2010). Table 2-4 discusses some of the common benefits and drawbacks to IPD.

Table 2-4: Benefits and drawbacks of IPD

Benefits	**Drawbacks**
High trust and collaboration	Legal and insurance barriers
Contract exists between all major organizations	Waiver of claims not legal in some states
More cooperation, less tension	Organizations are liable for one another
Reduction in schedule is possible	High level of management required from all organizations
Sharing of risks and rewards	Owner control reduced
Joint decision-making and goal development	Procurement can be intensive and proposals can be costly
Savings shared between organizations	Lack of organizations that understand IPD process
Cost overruns are shared responsibility	

2.2 Modern Contracts

The delivery methods just summarized are examples of modern construction contracting methods. In the early part of the 20th century, modern contracting and law began to take shape. Samuel Williston penned "The Law of Contracts" in 1920, which became the fundamental resource for traditional and transactional contract law (Macneil 1973). This book provides the reasons for contract law, how to interpret agreements, along with legal rules and processes for modern contracts (Williston 1920). Williston later went on to develop some of the formal principles of contract law that still stand today. However, a drawback of Williston's work is that the only focus of his contract law is on the transaction itself. The contract law developed on Williston's work does not account for the contracting parties or the relationship that exists between these parties. Some legal experts started to realize a flaw in focusing strictly on the transaction and began moving in a different direction.

In general, contracts center on promises. When one party agrees to provide a good or service to another party and the other party agrees to compensate the first party for that good or service, the mutual agreement creates the contract. Williston's transactional law focuses on what happens when one of the parties decides not to follow through on the agreement (Williston 1920). To put it simply, when promises are broken, legal means are necessary to resolve the issue. Some did not agree with this and were looking at how the relationship can resolve the issue and avoid using legal means. When a promise is broken, organizations in a contract may want to understand why the other organization did not fulfill the promise. If a solid relationship exists between the contracting parties, it may be possible to jointly work through an unfulfilled promise or dispute internally, which means trust may not be entirely lost. When this occurs, there is no need for legal remedies and the relationship remains intact.

2.3 Project Integration

IPD is a delivery method that infuses project integration into a design and construction project. Existing literature describes project integration as *"when different disciplines or organizations with different goals, needs and cultures merge into a single cohesive and mutually supporting unit with collaborative alignment of processes and cultures"* (Baiden et al 2006). AIA-CA (2010; 2007), defines IPD as a "*project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction*". These two different definitions display similarities with a common theme of collaboration. Integrated projects create an atmosphere of collaboration by aligning project goals for all team members and providing shared rewards and shared risks, so that the team works closely together throughout design and construction of a project (Kent and Becerik-Gerber 2010).

Currently, how fully integrated a project is depends on the presence of specific principles. According to AIA-CA (2010) the common principles, each detailed further below, of pure integrated projects are:

- A multi-party contract (e.g. integrated form of agreement or IFOA);
- Early involvement of all key players beyond the design team;
- Collaborative decision-making and control;
- Shared risks and rewards;
- Waiver of claims among the contracting organizations; and
- Team-developed project goals.

The six principles listed help to set the tone for developing and sustaining the cooperative atmosphere and for organizations to align their interests with the project goals.

2.3.1 Multiparty agreement

A multi-party agreement, sometimes called an integrated form of agreement (IFOA), contractually ties together the design and construction organizations involved in an IPD project. This type of relational contract includes multiple organizations such as owners, architects, engineers, contractors, construction managers, major subconsultants and subcontractors, and other organizations vital to the success of the project. Multi-party agreements at a minimum include three organizations (Owner-Architect-Contractor), while one of the largest multi-party agreements used in the United States included 11 organizations (Post 2011a).

In a multiparty agreement, each of the organizations agree to the terms and signs the IFOA, which then ties all the organizations together into one integrated project team under one contract that centers on the overall goals of the project (AIA-CA 2007). The primary goal of multi-party agreements is to allow for maximizing of collaboration and project goals, which is difficult to do when separate contracts exist between the primary organizations or no contract exist between primary organizations (e.g. designer and contractor in DBB projects) (Kent and Becerik-Gerber 2010).

2.3.2 Early involvement of key organizations

Early involvement of key parties is a technique used on IPD projects, but it exists in other delivery methods as well. CMGC is an example when the general contractor is part of the project early in the design phase to provide important construction input and assistance. DB also includes a constructor during design as one component of the design-builder firm. IPD takes this a step further and in many cases, the major trade partners and subcontractors - such as structural, mechanical, electrical, and plumbing - are hired and involved early in the development and design of a project to enhance collaboration and reduce constructability issues by addressing them during design and not during construction (Post 2011b).

Studies have shown that more collaboration during design by the key players of a project results in fewer requests for information and change orders during construction of the project (Kent and Becerik-Gerber 2010; AIA-CA 2007). One technological advantage with early involvement is the use of building information modeling (BIM). BIM is not required for integrated projects, but with the many collaborating organizations working towards the greater good of the project, BIM can assist with reducing constructability risks and can improve best for project decision-making (Kent and Becerik-Gerber 2010; Ashcraft 2008).

2.3.3 Collaborative decision making

IPD projects instill collaborative decision-making and control. An integrated project relies on decision-making methods and processes that each contracting organization agrees to and accepts. Integrated projects reach decisions jointly and unanimously through a decision-making team that includes representatives from the primary contracting organizations that voice their opinion about the situation. Potentially secondary organizations (e.g. consultants and subcontractors) that are key to the project, but are not a part of the multi-party agreement, are a part of the decision-making team, but their involvement is more to provide advice and details of the situation and are not always privy to the ultimate decision. Further, all decisions must be made collaboratively and with the best interest of the project in mind (AIA-CA 2007).

2.3.4 Sharing risks and rewards

In most delivery methods, transferring and allocating of risk is common practice. For IPD contracts, the contracting organizations agree to combine risks and rewards while incentivizing collaboration and teamwork in order to achieve project goals (Kent and Becerik-Gerber 2010). Sharing risks and rewards occurs through different methods on integrated projects. A risk pool reserves a portion of each contracting organization's fee that can increase or decrease depending on certain criteria. At the conclusion of the project, the contracting organizations split the remaining funds. Profit sharing offers a way to determine collectively the potential profit each contracting organization can obtain rather than each organization determining their own profit.

2.3.5 Waiver of claims

One of the principles exclusive to fully integrated projects is the waiver of claims. In IPD contracts, there are specific clauses that state the organizations' privy to the multi-party agreement waives claims against each other except for wilful misconduct, fraud, or gross negligence (AIA-CA 2010). Removing the potential to sue emphasizes the project and not the individual organization. Collaboration can occur more prominently when all organization focus on the project and working through problems internally. The major drawback to this principle is that obtaining insurance when waiving liability is very complicated, more expensive than traditional insurance, hard to find and obtain, and legal precedence is limited (Post 2010).

2.3.6 Team developed goals

Similar to collaborative decision-making and control, development of project goals for IPD projects should involve representatives from all of the contracting organizations. On most projects, the owner sets the project goals and the contracting organizations try to adhere to them as best as possible. For integrated projects, a team of representatives from the key organizations meets early in the project development process to discuss and agree to appropriate project goals. Each representative provides insight that can then lead to more in-depth discussions, which in turn can lead to innovative and integrated goals. This is a change from common practices when individual organizations develop their own project goals, which may or may not be communicated to all other organizations involved in the project, creating a fragmented view of what the outcomes should be (AIA-CA 2007).

2.4 Relational Contract Theory

Transactional contract law based on Williston's work did not account for the relational aspect of a contract. Stewart Macaulay, a law professor, first discussed the idea of relational contracting. He stated that in most cases, parties subject to a contract have a tendency to get along, trust one another, and work together to ensure successful outcomes, regardless of the contract in place (Macaulay 1963). The study investigated situations when organizations referenced and utilized the contract and situations when organizations did not reference the contract and instead relied on the relationship between one another to get the task done. The concept is that contracts introduce formal and systematic methods for solving problems and disputes, but that these methods are undesirable and unneeded if organizations are willing to cooperate and work out the issue internally. Macaulay builds on the belief that people and organizations inherently have a cooperative nature and want to get along and work things out. Yet there are instances where this is not the case. When a breakdown occurs in a relationship, the contracting parties need to assess whether the benefits of using the contract outweigh the costs of possibly eliminating the relationship and any chance of future endeavors. The findings by Macaulay concluded that the dysfunction created in a business relationship when enforcing a contract is more detrimental to businesses than deciding to cooperate and jointly solve problems.

Relational contracting did not start to formalize into a research theory until Ian Macneil, a well-known legal scholar and considered by many as the father of relational contracting, began developing the formal theory, called relational contract theory. Building upon previous work in the fields of contract law, transactions and exchanges, and incorporating psychology, Macneil's theory states that contracts include many complex aspects of interactions between the different organizations. As more interactions occur, a relationship begins to form in a manner similar to when two people meet on the first day of school and over time and through interacting, they become friends. As a relationship grows in a contract, it becomes the most critical and intricate aspect to the overall success of the contract (Macneil 1980).

Contracting organizations have a choice to act with mutual respect in mind and behave properly in all aspects of a contract, which improves the probability of success or they can choose to act in detrimental ways, which reduces the probability of success. Once a positive relationship begins to develop in a relational exchange, the contracting parties expect to work together again in the future, and therefore the parties approach and manage the current exchange with great care, keeping that future relationship in mind (Macneil 1975). Relational contract theory refers to projecting exchange into the future as one of the four roots of contracting (Macneil 1980).

The other three roots of contracts are society, specialization of labor exchange, and choice. A society is the reason contracts exist. A society allows individuals to decide whether to interact cooperatively, competitively, or to not be a part of society and live autonomously (Keidel 1995). A contract, or guidelines for interaction, contains two or more parties that have a mutual interest in fulfilling one another's needs and wants, and therefore an exchange occurs. An exchange with oneself is not a contract, nor is a contract possible without the language and knowledge of a society (Macneil 1980). If every person could perform their own needs and wants, a concept hard to image, contracts would not exist. People together create a society and therefore are dependent on one another to provide the needs and wants to one another.

Specialization of labor and exchange is the individual means and methods that each party possesses in a contract. In performing a task, it may be possible that no two people will complete the task in the same manner, and outcomes could differ based on the knowledge and experience of the two parties. Additionally, no one party has the means to know how to perform all tasks as it is more efficient for people to focus on one particular area and become an expert in that area. This scenario currently describes the arrangement of the construction industry. History shows that master builders were the single parties that designed and built projects up until modern times. In recent times, the construction industry underwent fragmentation due to organizations focusing on one specific area of construction and becoming experts in that area.

Choice is the concept of freedom that parties possess and it allows them to decide how to behave and perform with other parties (Macneil 1980). This introduces social norms, the shared expectations between parties on how each other will behave, into a contract. Expected behaviors is how most parties act in most cases and there are psychological studies that shows that human beings have a natural tendency to act appropriately and cooperate. Nevertheless, when something goes awry, and one party feels they have received unfair treatment, human beings have a tendency to penalize parties that have behaved unfairly (Bowles and Gintis 2011). The choice principle comes into play when parties decide not to cooperate, then the other party or parties can choose to punish the uncooperative party.

2.5 Discrete Transactions and Relational Exchanges

Williamson (1979) makes a distinction between discrete transactions and relational exchanges by simply stating, "Discrete transactions are simple exchanges of goods and services. On the other hand, relational contracts resemble small, centralized societies that possess their own internal system of evolving norms." Discrete transactions are one-time exchanges in which there is little or no relational context between the parties (Macneil 1980). A simple purchase, such as buying a pack of gum from a convenience store, is a discrete transaction. In this exchange, each party knows their role as either the purchaser or seller and understands how to proceed with the purchaser providing money to the seller and the seller providing the pack of gum to the purchaser. If both parties fulfill their part of the deal, the transaction is complete in a matter of minutes. No further relationships exist and neither party cares about a future relationship. The manner in which each party behaved did not affect the outcome.

Relational exchanges are long-term, continuous, and complex relationships in which the individual transactions have very little importance to the contract compared to the relationship between organizations (Macneil 1980). A complex agreement, such as building a home for an owner, is a relational exchange. In such an exchange, one party agrees to provide goods and services to construct the home while the other party agrees to compensate the first party for this work. Each party has a much more complex role occurring over a longer duration and has to adapt to changing conditions. Constructing a home requires significantly more time than purchasing a pack of gum. Due to this longer duration, each party will have to interact regularly with one another, which then forms a relationship. Figure 2-5 illustrates the spectrum of commercial exchanges, ranging from discrete transactions to relational exchanges.

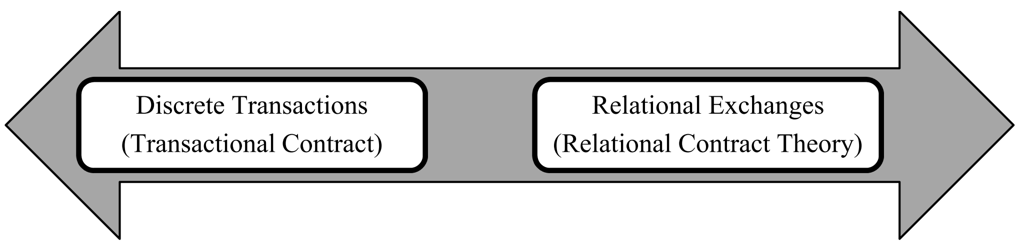

Figure 2-5: The spectrum of commercial exchange

2.6 Contractual Norms

Relational contract theory further describes the difference between discrete transactions and relational exchanges through established expected behaviors called norms. As stated above, relationship development between parties depends on behaviors. In societies, there exist certain social norms that are shared expectations of how people should behave and interact. Macneil (1980) established specific social contractual norms called contractual norms, which Macneil acknowledges as present to some extent in every transaction and exchange. The contractual norms, shown in figure 2-6, are role integrity, reciprocity, implementation of planning, effectuation of consent, flexibility, contractual solidarity, reliance, and expectations, restraint of power, propriety of means, and harmonization of conflict.

Two of the norms, effectuation of consent and implementation of planning, more closely relate to discrete transactions, and therefore, are not included in this research. Implementation of planning is the process of executing the planned course of action for an exchange. In construction projects, planning is a requirement in the contract and contracting organizations spend a great deal of time planning how to complete the project. Since construction contracts require extensive planning, there is less importance placed on implementation of planning in relational exchanges than in a discrete transaction where each party has to react in real time to the transaction. Construction contracts address implementation of planning by using scheduling and defining the roles of each party clearly and thoroughly. Project success factors address the importance of planning later in this chapter.

Effectuation of consent centers on choice. When one party decides to pursue one opportunity, then a sacrifice of other opportunities occurs (Ivens and Blois 2004). This is clearer in discrete transactions where by a person may decide to sell an item to one person, which then that person gives up the opportunity to sell that item to someone else. In relational contracts, one party may provide another contracting party the ability to take some type of action that in turn could limit the first party's actions in the future (Hakansson and Snehota 1995). However, relational contracts have the ability to adapt and consent is determined in the contract language that the contracting organizations have agreed to when they signed the contract. Signing the contract provides consent that the contracting organizations have decided to participate in the project and causes these organizations to give up other opportunities or projects.

Figure 2-6: The contractual norms from Relation Contract Theory

2.6.1 *Role integrity (RI)*

The next eight subsections discuss each of the eight contractual norms used extensively throughout this research study. According to relational contract theory, organizations privy to an exchange naturally feel cooperative, yet, a tendency to achieve internal goals remains (Macneil 1980). In true relational agreements, the organizations involved seek to overcome this tendency in order to achieve project goals instead of individual goals. Thus, organizations seek to maintain *role integrity* and to avoid reference to the contract, relying on the relationship when unexpected events occur (Macaulay 1985; 1963). Such an approach is more likely to be effective when the organizations involved are able to trust that they are dealing with others who, from experience, will behave properly throughout the duration of the project (Cannon et al 2000). When role integrity is abundantly present, the roles of organizations are complex, but are able to adapt to unanticipated events that occur on a project. The focus of the organizations involved is on aligning their individual interests with the overall project goals. A lack of role integrity occurs when organizations have simplistic roles that do not adapt well to changes or unexpected events and alignment of self-interest goals with project goals does not occur.

2.6.2 Reciprocity (RC)

Reciprocity is the attitude that each organization's success is a function of all other contracting organizations and that one cannot prosper at the expense of another. Reciprocity expresses the sentiment of joint responsibility and mutuality, as the contracting organizations are dependent on one another to be successful (Cannon et al 2000). Reciprocity exists when organizations focus on the well-being of each other, being fair to one another, and high mutual respect exists. A lack of reciprocity means organizations focus on maximizing individual outcomes, and fairness and mutual respect do not exist.

2.6.3 Flexibility (FL)

Flexibility centers on the attitude among the contracting organizations that an agreement is only a starting point, and modifications or changes can occur as the relationship and the project evolve throughout the duration of the contractual agreement (Cannon et al 2000). In construction, changes are more than likely going to occur due to unforeseen circumstances, and this norm focuses on the adaptability of organizations in making a changes. In instances of flexibility existing, the contracting organizations understand that adjustments will need to occur as the project and conditions evolve throughout the project and in turn, the organizations can adapt seamlessly. Other projects may not have this understanding and making a change with fair compensation is difficult to accomplish, meaning flexibility does not exist.

2.6.4 Contractual solidarity (CS)

Solidarity is the extent to which organizations believe that success occurs because of working cooperatively together versus competing against one another. This norm holds relational exchanges together. It dictates that organizations will stand by one another in the face of adversity and will assist one another throughout the project (Cannon et al 2000). Cooperation is the key to contractual solidarity. When contractual solidarity occurs, inter-organizational trust levels are high, and a supportive and cooperative atmosphere exists. The lack of contractual solidarity occurs when inter-organization trust is low or even non-existent and cooperation between organizations does not commonly occur.

2.6.5 Reliance and expectations (RE)

Reliance and expectations emphasize promises and commitments. Promises guide the outcomes of a project and if one organization breaks a promise and decides to act in a different manner, the contract determines the consequences (Macneil 1973). Organizations consider reliance in terms of reasonable confidence that the other contracting organizations will keep the promises made. Expectations equates with the promises made and whether a contracting organization followed through on the commitment or not (Macneil 1980). Organizations look to restitution when problems created by one organization who is unjustly enriched by making a promise and then breaking it. Reliance and expectations occurs when organizations assist and count on one another, and when organizations truly believe the other organizations will follow through on their commitments. A lack of reliance and expectations occurs on projects when organizations do not believe that they can rely on one another, and there are no expectations that the organizations will complete their commitments, which will result in restitution and reference to the contract for a remedy.

2.6.6 Restraint of power (RP)

Restraining from using power is the degree to which contracting organizations refrain from exploiting each other when given an opportunity to do so. Contractual language provides authority to certain organizations, and these organizations have the choice to use this authority to its own advantage or to restrain from using this control for the betterment of the project. Organizations anticipate that cooperation will manifest in a contracting organization's willingness to forgo short-term gains at a severe cost to the other contracting organizations (Heide and Miner 1992). The use of power not only exacerbates conflict over time, but also undermines reciprocity and contract solidarity, which opens the door for opportunism (Cannon et al 2000). When organizations refrain from using authority or control over other organizations, an atmosphere of working together to achieve positive mutual outcomes occurs. When organizations enforce their authority on other organizations for their own gains, adversarial relationships can develop and no longer are organizations working together for the betterment of the project.

2.6.7 Propriety of means (PM)

Propriety of means is a requirement of the contracting organizations to possess adequate means to perform their obligations. Multiple paths may be available to achieve proper outcomes, meaning that there may be various options and methods available to a contracting organization to complete a commitment, but only a few may provide positive results for the project and all the contracting organizations. Therefore, the means employed must not affect the quality of the work or be detrimental to any of the other contracting organizations (van der Veen 2009).

2.6.8 Harmonization of conflict (HC)

Harmonizing conflict is the extent to which a spirit of mutual accommodation toward cooperative ends exists (Cannon et al 2000). In any contract, disputes and conflicts may arise. When this happens, organizations have a choice to either work through the issue together internally in an effort to avoid litigation, or to refer to the contract and proceed through the dispute resolution process, which can lead to mediation, arbitration, or litigation. Projects acting in harmony occur when organizations have a tendency to work through a problem internally and try to avoid referencing the contract at all times. Projects with a lack of harmony occur when organizations have an unwillingness to work through a problem together and will refer to the contract for a remedy, which commonly leads to arbitration or litigation for a solution.

2.6.9 Contractual Norms and the Commercial Exchange Spectrum

The number of and the degree to which each norm exist in a contractual relationship varies along the commercial exchange spectrum (Macneil 1980). On one extreme, discrete transactions have very few of the contractual norms occurring and with a minimal presence. On the other extreme, relational exchanges will contain most or all of the contractual norms and with higher frequencies of occurrences. Using the previous examples, the chance inappropriate behavior occurring when purchasing a pack of gum is low since the time to make the purchase is short. Even if one party decides to act out of line, the pack of gum transaction may still not be affected. However, inappropriate behavior between parties when building a home can affect the success of the current contract and probably will not lead to future business. Table 2-5 provides the commercial exchange spectrum in terms of the eight contractual norms used in this research.

Table 2-5: Commercial exchange spectrum according to relational contract theory

Discrete Transaction	Contractual norm	Relational Exchange
Simplistic role, well-defined, difficult to modify, focus on own goals	**← Role Integrity →**	Complex role, defined but easy to modify, focus on project goals
Maximizing positive outcomes for own organization, unfairness, low interorganizational trust	**← Reciprocity →**	Maximizing positive outcomes for all organizations, fairness, high organizational trust
Rigid agreement, difficulty in modifying agreement and adapting to changes, revisions cannot occur	**← Flexibility →**	Fluid agreement, ability to modify agreement and adapt to changes, revisions are expected
Low trust, lack of inter-organizational support, competitive and adversarial atmosphere	**← Contractual Solidarity →**	High trust and inter-organizational support, cooperative and working together atmosphere
Promises broken, no expectation of relying on other organizations, reliance on own organization only	**← Reliance & Expectations →**	Promises kept and completed, expectation of relying on each other
Organizations gain as much control as possible, opportunistic atmosphere, take advantage of one another	**← Restraint of Power →**	Organizations do not control one another and refrain from using power, favor mutual positive project outcomes
Organizations employ advantageous means to achieve own goals, lack proper skills and experience to perform properly	**← Propriety of Means →**	Organizations employ means to achieve project goals, possess necessary skills and experience
Organizations not willing to work through disputes internally, enforcement of contract to settle claims, litigation common	**← Harmonization of Conflict →**	Organizations prefer to work through disputes internally, contract is not enforced or referenced, waiver of claims, no litigation

2.7 Project Success

Research question Q3 focuses on gathering evidence to help understand the association between project integration and project success. Defining project success takes on many different variations since defining a successful project varies due to each person's perception and the different organizations involved on a project. I am defining project success for this research as the degree to which the project goals, objectives, and expectations are met.

Consider an example of a project that finishes over-budget and delivered late. Clearly, the budget and schedule performance were inefficient. Yet the project functions as it should and the owner, along with the design team and construction team, are satisfied with the outcome of the project. The overall satisfaction felt relates to a successful project, even though the budget and schedule underperformed. Since satisfaction relates to behaviors and a perception of how a project concluded, project success is an appropriate comparison to the contractual norms.

In terms of project success, much research since the 1980s addressed project success and developed paramount critical success factors (CSFs) that directly influence the overall success of a project (Ashley et al 1987; Sanvido et al 1992; Diekmann and Girard 1995). The definition of a CSF is those factors that can predict success on a project (Sanvido et al 1992; Rockart 1982). Using previous research in CSFs for construction projects, I selected three empirically proven CSFs of team chemistry, planning effort, and project objectives for comparison with the contractual norms and project integration.

2.7.1 Team chemistry (TC)

Team chemistry is the ability to achieve a well-organized, cohesive project team that manages, plans, designs, constructs, and operates the facility, which occurs when a team of individuals develops common goals and activities (Sanvido et al 1992). A project team initially builds a working relationship using team-building exercises, such as partnering, or from the effect of working together on previous projects. Partnering is a technique that helps to develop a working relationship when organizations that have never worked together in the past are contractually obligated to complete a project alongside one another. The history of working together influences team chemistry in that organizations that have previous experience working together successfully understand one another, and has already developed a relationship prior to conducting another project (Diekmann and Girard 1995).

The CSFs represent latent factors that I cannot measure directly. Therefore, specific success criteria measure CSFs. Success criteria are the observations of actions on a construction project that relate to CSFs. In terms of Team Chemistry, many success criteria can be used (Sanvido et al 1992). In this research, Team Chemistry focuses on the existence of a working relationship between organizations on a construction project that developed on previous projects (previous working experience), the use of a team building/partnering approach (use of partnering), and the potential for working with the same organizations again based on the outcomes of the current project (future work endeavors) (Diekmann and Girard 1995).

2.7.2 Planning effort (PE)

Planning effort is the effectiveness in receiving timely and valuable information from the owner, designer, contractor, operator, and potentially the user of the product during the design and construction phases of a project (Sanvido et al 1992). The research by Ashley et al (1987) revealed that the level of planning conducted during design and construction as one of the more critical areas in achieving overall success of a project. As planning becomes more effective during design and construction, the level of satisfaction in completing a project increases as does the probability of labeling a project successful.

Planning effort success criteria focus on the exchange of information during design and during construction (Sanvido et al 1992). Planning effort during design emphasizes the effectiveness of exchanging critical design information with one another and the effectiveness of constructability reviews. Planning effort during construction emphasizes the effectiveness of exchanging crucial information throughout the duration of design and construction as well as whether or not that exchange of information between organizations occurs effectively with all organizations on a project.

2.7.3 Project objectives (PO)

Project objectives are factors that are used frequently to measure project success (Ashley et al 1987). Budget and schedule performance are most often quantitatively measured using actual budget and schedule information, which this research intends to collect to calculated cost growth and schedule growth (Konchar and Sanvido 1998). However, measuring budget and schedule can also occur qualitatively based on the perceived level of satisfaction that project participants feel at the conclusion of a project. Quality and functionality project objectives are difficult to measure quantitatively, but the overall perception of satisfaction of each can be measured (Diekmann and Girard 1995). In this research, the four project objectives of budget, schedule, quality, and functionality were included as part of the project objectives CSF.

The success criteria for project objectives focus on determining the level of satisfaction in achieving four common project objectives of budget, schedule, quality, and functionality. As noted by Ashley et al (1987), the level of satisfaction within the organizations and individuals associated with a project leads to an accurate perception of achieving a successful project.

2.8 Point of Departure

This study builds on previous research from various fields. Researchers in construction, engineering, and management have embraced the topics of project integration, IPD, and relational contracts. Other sectors have investigated integration and relationships between buyers and sellers. The studies detailed below outline some of the more important studies related to this research and provided guidance for the direction of this research.

2.8.1 Project integration research

El Asmar et al (2013) uses quantitative methods to determine statistical significance in performance differences between IPD and common delivery methods of DBB, DB, and CMGC. Data collection consisted of literature analysis and a questionnaire used to interview industry professionals. The analysis of the collected data then used univariate statistics, such as t-tests, to determine if IPD provides statistically significant improvements for 31 performance metrics that address cost, schedule, quality, safety, project changes, communication, labor, environmental, and overall business performance areas of construction project performance. The results showed significant improvement in 14 of the performance metrics over six of the performance areas when using IPD over traditional delivery methods.

Another study by Kent and Becerik-Gerber (2010) used a web-based survey to collect data from a wide range of construction professional on the status of IPD use and the potential for future widespread adoption in construction projects. This data helped to develop benefits and issues that are due to IPD as well as the current knowledge and experience levels found in construction professionals in regards to IPD. The results illustrated that benefits of IPD are fewer change orders, realized cost savings, and shorter project duration. Appropriate projects were determined to be healthcare and industrial projects, which are the two construction sectors that have completed most of the IPD projects in the United States. Finally, issues associated with IPD were inadequate or poorly defined contractual relationships, lack of defining project goals early on, and not forming the integrated team soon enough during the design and development phase.

In a study completed by Matthews and Howell (2005), the focus was on how to maximize project value while minimizing waste and the difficulty in doing this with traditional contracts. Four problems associated with the traditional contracting approach are: (1) good ideas are held back; (2) traditional contracting limits cooperation and innovation; (3) there is an inability to coordinate effectively; and (4) there is pressure to optimize own organization's goals. The authors then use project integration and lean construction techniques to address each of the problems. The results of the study showed the potential benefits in using IPD, project integration, and lean construction in the form of addressing the four problems mentioned above and reducing project costs and waste, while increasing cooperation between organizations during construction.

Khalfan et al (2007) completed a study focused on how trust develops on construction projects. Using the knowledge presented in the Latham Report (Latham 1994) and Egan Report (1998), The Khalfan research study focused on methods that project managers use to develop and build trust between organizations on a construction project. Using case studies, the authors collected data from 5 projects and conducted 40 interviews with individuals associated with the project. Three main factors that emerged from the interviews that are important to building trust between organizations on a construction project are: (1) open and honest communication; (2) reliance on one another; and (3) delivery of successful outcomes. Additionally, the case studies showed that experience, problem solving process, sharing of goals, mutuality, and reasonable behavior affect how trust is built between construction organizations. Finally, one important aspect to note was the theme of repeat business. Many of the interview comments focused on how trust with another organization only occurred through multiple projects and that trust is not something that is inherently present from the very beginning of a project, it takes time and may require more than one project to get to a comfortable level of trust between the organizations.

2.8.2 Relational contracting research in construction

Drawing on recent approaches developed for promoting trust and cooperation on construction projects, Kumaraswamy et al (2005a) explored relational contracts by deriving factors that hypothetically facilitate relationally integrated teambuilding as well as factors that hypothetically deter integrated teambuilding. After outlining the different factors for and against integrated teambuilding based on previous research, the authors then developed and distributed a survey to different contractors. The respondents replied to questions by rating the perception of importance for each of the different factors on a seven-point likert scale. The data analysis utilized t-tests to determine significance of the facilitating and deterring factors, which found 27 of the 28 facilitating factors significant and 26 of the 31 deterring factors significant.

Using the results of the t-tests and interviews, the authors performed a factor analysis to help group the factors into manageable components. The grouping technique helps to sort homogenous factors together and those not in the same group as heterogeneous. The results found four components of facilitating factors as: (1) client's competencies and overall learning/training policy; (2) previous interactions, performance, competencies, and specific input and outputs of various partners; (3) compatible organizational culture, longer term focus, and emphasis on trust building; and (4) improved selection of project partners and better responsibility delegation. The five components of deterring factors are: (1) lack of trust, open communication and uneven commitment; (2) commercial pressure, absent or unfair risk/reward plan, incompatible personalities, and organizational cultures; (3) lack of general top management commitment and client's knowledge/initiative; (4) lack of good relationships among the team players; and (5) exclusion of some team players in risk/reward plan, errors, and cultural inertia. Yet the moderate level of explained variability of the factor analysis along with the lack of details and definition of the components, the overall conclusions of this study appear questionable at best.

In another similar study, Kumaraswamy et al (2005b) used the same questionnaire methodology and statistical testing as the research study described in the previous paragraph. This more recent study focused on determining factors that facilitate the use of relational contracting across the construction industry as a whole rather than on factors that influence teambuilding for a project. The authors determined 24 factors that facilitate the use of relational contracting and 28 factors that impede the use of relational contracting in the Singapore construction industry. The results showed that all 24 facilitating factors are significant and 23 of the 28 impeding factors are significant. Of the significant facilitating factors, 6 components were determined to facilitate relational contracting: (1) Top management and client's support for relational contracting; (2) alignment of various team objectives; (3) trust, open communication and teamworking culture; (4) clearly defined and equitable risk allocation; (5) relational contracting experience and adequate resources; and (6) flexible contracts. Of the 23 significant impeding factors, 7 components were determined to impede the use of relational contracting: (1) Unenthusiastic participation in relational contracting approaches; (2) inappropriate contract strategy and project planning; (3) inappropriate risk allocation; (4) exclusion of major subcontractors and suppliers in risk-reward plan; (5) persisting adversarial cultures of contracting parties; (6) lack of top management commitment; and (7) incompatible personalities and corporate cultures. Although the factors make sense and can be applied, the components are specific to the Singapore construction industry and might not explain the same variability if the study was applied to the U.S. construction industry. Another study by Ling et al (2006) found similar results that also only pertained to the Singapore construction industry.

A different study looked at the effect of relationships on project performance (Meng 2012). In this study, the author investigated how poor performance on construction projects links with supply chain relationships found on construction projects. Ten key indicators of mutual objective, gain and pain sharing, trust, no-blame culture, joint working, communication, problem solving, risk allocation, performance measurement, and continuous improvement define a supply chain relationship. The study then operationalized the ten indicators and distributed a survey to 400 construction practitioners. The survey response rate was 30%. Each respondent rated each of the ten statements that relate to each of the ten indicators on a 4-point likert scale, ranging from

“Strongly Disagree” to Strongly Agree”. Additionally the respondents needed to supply information on cost, time, and quality aspects of a project.

The data analysis used the relative frequencies of responses for each indicator, which determined that the breakdown of a supply chain relationship increases the occurrence of poor project performance. The authors then used Chi-square tests to find an association between relationship indicators and time certainty, cost certainty, and defect performance measures. The results found “joint working” as significant for time certainty, “communication”, “risk allocation”, “no-blame culture”, “performance measurement”, and “problem solving” as significant for cost certainty, and “problem solving” as significant for defects. Overall, this study determined that supply chain relationships affect budget more than time or quality in terms of performance. The findings in this study are practical and important to understanding supply chain relationships and project performance, but the indicators used are not specifically associated with relational contracting and the study did not take into account the effects of different delivery methods or the effect of contract structure and language on the relationship.

A study very recently completed by Ning and Ling (2013) used relational contract theory and network embeddedness theory to investigate what the authors call relational transactions and overall relationship quality. The authors utilized the contractual norms of role integrity, flexibility, contractual solidarity, propriety of means, and harmonization of the social matrix along with three factors from network embeddedness theory to investigate the effect of relationships on project objectives in terms of cost, duration, quality, and client satisfaction. The research method used a survey to collect perceptions from practitioners with experience on public projects by rating statements on a 5-point likert scale. A total of 1,440 surveys were distributed, but only 107 individual respondents replied, which is a low 7.2% response rate.

The authors utilized factor analysis for evaluating the data. After determining high reliability and validity, the conclusions made from the results found that relationship quality has a significantly positive influence on time performance and client satisfaction, but does not influence cost performance. Further, high propriety of means contributes to better cost performance and higher client satisfaction, high flexibility, and high contractual solidarity help improve time performance, and high propriety of means along with harmonization within the social matrix improve client satisfaction. The conclusions provide interesting information for this study, although the results fall short in only investigating five contractual norms and limited statement items to measure the norms.

2.8.3 Relational contracting research in other sectors

Kaufman and Stern (1988) conducted one of the first studies to use relational contract theory to develop a model of conflict that occurs when issues arise in commercial exchanges. The research focus was on how the contractual norms of solidarity, role integrity, and mutuality (reciprocity) affect a contracting party's perception of unfair treatment, and how causal attributions facilitate those effects. This research builds on the idea that inherently different interests exist between organizations in an exchange and therefore latent conflict can occur. The method of how organizations go about resolving conflict can range from joint problem solving to threats, deceit, and litigation.

Using a sample of marketing organizations in contractual litigation, the authors developed relational norm scales for solidarity, role integrity, and mutuality metrics using two pretests to verify that the metrics are reliable, valid, and unbiased. The analysis determined the mutuality scale as unreliable and was not included in the data collection or analysis. The authors then distributed the questionnaire with the measurement scale of solidarity and role integrity to the sample participants. The questions focused on the perceptions individuals with each organization hold towards the other organization in terms of unfairness and retained hostility. The results determined that a link exists between the perception of unfairness and the level of hostility that firms retained after the conflict episode concludes. The results showed that solidarity significantly relates to the level of perceived unfairness, while role integrity does not.

Another study, Kaufman and Dant (1992), advanced previous research. This study developed a method for measuring the structure of commercial exchange relationships through the contractual norms of solidarity, mutuality (reciprocity), flexibility, role integrity and three modified norms of restraint (restraint of power), conflict resolution (harmonization of conflict) and relationship focus (a combination scale of implementation of planning and effectuation of consent). The authors operationalized these norms with a set of statements that rank a commercial exchange relationship from a simple discrete transaction to a complex relational contract for buyer-seller commercial exchanges. The research then developed a questionnaire with multiple statement items for each norm using a seven-point likert scale that ranged from "Strongly Agree" to "Strongly Disagree". The authors pre-tested all of the scales were pre-tested for clarity, and randomized them on the final version of the questionnaire, which was then distributed to a convenience sample that consisted of sales and purchasing personnel drawn from training seminar participants.

The main function of the questionnaire was to test for reliability, unidimensionality, and validity. Cronbach's alpha provides the reliability of each norm scale, where all the norms in the study appeared in the acceptable range, meaning all are internally reliable and consistent. Tests for unidimensionality included internal and external consistency and the use of a factor analysis structure diagnostic using *LISREL VI*. All norm scales showed significance, meaning all are internally and externally consistent. Construct validity was then supported by content validity, as well as reliabilities, internal and external consistency, and single factor structure diagnostics. The inter-trait correlations calculated showed positive significance, which support internal validity, for all the norm scales except the correlation between role integrity and restraint. The authors removed conflict resolution from the final analysis due to issues encountered at the measurement model level. Then, from the unidimensionality, reliability, and validity assessments, the authors completed a confirmatory evaluation by assessing the structural models for fit. Using preliminary fit criteria, global fit criteria, and internal fit criteria procedure, the authors determined that the six contractual norms of solidarity, mutuality, flexibility, role integrity, restraint, and relationship focus could be operationalized to describe commercial exchange relationships between buyers and sellers.

Heide and Miner (1992) took a different approach in using relation contract theory and the associated contractual norms. The norms included in the study represented four domains of potential cooperation as flexibility, information exchange (reliance and expectations), shared problem solving (harmonization of conflict), and the restraint in the use of power (restraint of power). The authors then used a game theory methodology, more specifically the prisoner's dilemma, to determine if anticipated open-ended future interactions (called extendedness) and frequency of contact can increase the chances of a cooperative pattern of behavior occurring between organizations or if performance uncertainty decreases the chances of cooperation occurring.

Heide and Miner's study developed multiple statement-item scales to measure each of the four norms. The authors used construct domain definitions to generate the statement items from previous research and they modified the statement items to fit the context of this study. Further interviews helped to fill the gaps and administering a preliminary questionnaire to a convenience sample of buyers and suppliers to help refine the scales. The authors used inferential statistics to refine the scales using inter-item correlations, Cronbach's alpha, and factor analyses. The scales all exhibited consistency and positive correlation, which agrees with relational contract theory (Macneil 1980; 1985).

With the scales complete, a final version of the questionnaire was completed and distributed. The sample used was composed of purchasing relationships between industrial suppliers and original equipment manufacturers, which in past relationship observations are adversarial at times. The authors analyzed the data using regression models. The results showed that modeling cooperation of buyer-seller relationships using game theory exists strongly in terms of extendedness, and partially in terms of frequency. A reduction in cooperation due to performance uncertainty was inconclusive.

More recently, Cannon et al (2000) utilized the contractual norms to study the implications of governance structures that involve contractual agreements and contractual norms. As competition increases and intensifies, firms now need to rely on close relationships, which can increase efficiency, flexibility, and organizational learning. However, close relationships can leave organizations more vulnerable and susceptible to being taken advantage of by other firms. Therefore, governance structures need to be developed that protect the exchange while maximizing the benefits for all contracting organizations.

The Cannon study used five of the contractual norms: flexibility, solidarity, mutuality, harmonization of conflict, and restraint in the use of power. The authors define these as the cooperative norms that define the relational properties associated with adapting to changing conditions and protecting the continuity of the exchange when subjected to task uncertainty. The measurement scales for each of the normal are multi-item, similar to the other studies mentioned previously, and generated through reviewing literature and interviews with marketing and purchasing personnel. A series of pretest help to refine the scales and statistical procedures were used to assess item and scale reliability, unidimensionality and convergent and discriminant validity. The authors conducted a confirmatory factor analysis using *LISREL VIII* along with Cronbach's alpha and inter-item correlations. The final measurement scales utilized a seven-point likert-type scale, anchored by "very inaccurate" to very accurate".

An interesting part of this research was the inclusion of control variables. Using previous research, this study included importance and age of a relationship as these may influence the management and performance of the governance structure and agreement. Each participant that answered the questionnaire had four control variables, three for importance of relationship and one for age of relationship.

The analysis focused on interactions under two conditions: market dynamism and relationship-specific adaptations, and task ambiguity and relationship-specific adaptations. Using the cooperative norms, the analysis suggests that increasing relational content alone improves performance for relationships regardless of the level of uncertainty found in the contractual relationship. Therefore, the study concluded that increasing the relational content of a governance structure that contains contractual agreements could improve performance when uncertainty in the contract is high, but not when it is low.

None of these studies focused on the construction industry and only investigated marketing buyer-seller relationships. However, each of these studies provided valuable information for developing the statement items for each contractual norm factor as well as tests for reliability, consistency, and validity.

2.8.4 *Measurement of integration research*

Previous research measures project integration with different tools. The study by Pocock et al (1996) developed a degree of interaction metric for measuring integration. The thought behind this research is that the number and quality of interactions between designers and contractors are critical to the success of the project and measuring the interactions gives an idea of the degree of integration present. In traditional projects, the fragmentation of the construction industry does not allow worthwhile interactions to occur on a regular basis. The authors focus on developing a method for measuring the degree of interaction (DOI) that occurs between organizations on a construction project and then verifies the relationship between the DOI and project performance areas of cost growth (budget indicator), schedule growth (time indicator), and the number of modifications (quality indicator). The data collection consisted of a questionnaire distributed to 25 recently completed public projects that utilized traditional and alternative delivery methods. The data then represented the performance data as well as the DOI, which focused on a series of questions to find the quantity and quality of interactions that occurred on a project. The conclusions of the study showed that projects that had high level of DOI present had more consistency in budget and time. Low levels of DOI showed a wide range of values, which meant no consistency. The results did not provide evidence that project integration improved the consistency.

Nam and Tatum (1992) investigated non-contractual methods of integrating design and construction. Based on data collected from innovative construction projects and interviews with industry professionals, the authors describe with examples four methods on construction projects for instilling integration without the use of specific contractual arrangements or clauses. Owner's leadership is key to integrating a project. When an owner champions integration and regularly communicates this, the team understands the importance of integration. Additionally, owners used the possibility of future projects as a tool to encourage organizations associated with the current project to proceed in a cooperative and appropriate manner. This leads to the second method of instilling integration, long-term business relationships. As noted by Khalfan et al (2007), trust needs to develop over time, and this may require working together with the same organizations multiple times. As organizations work more and more together, informal bonds are developed and the two entities begin to work as one, which improves outcomes. The third key to integration is having a champion present on the project that pushes all to act in an integrated manner. According to this study, there is a need for three types of champions:

- a technical champion;
- a business champion; and
- an executive champion.

The final method for instilling integration is professionalism. Professionalism is the level of knowledge and skill an organization possesses to offer and perform a specific service. When formal professionalism exists, a level of mutual respect exists that leads to higher levels of trust and cooperation.

The measuring integration studies address quantifying project integration by measuring the number and quality of interactions between contracting organizations and utilizing different methods of applying integration to a project. Yet none of the studies provides a way to measure integration in terms of the contractual relationships found on construction projects and none compares integration to factors related to project success.

2.8.5 Formal point of departure

The previous research studies outlined above set the building blocks for my point of departure. Using portions of these studies, I will create a method of measuring integration through contractual relationships using contractual norms. After establishing a project integration measurement model, I will survey individuals to answer questions about construction projects in order to collect project integration and project success data. I will analyze the survey data to determine any correlations that exist between integration and project success. Figure 2-7 shows a summary of previous research related to this study.

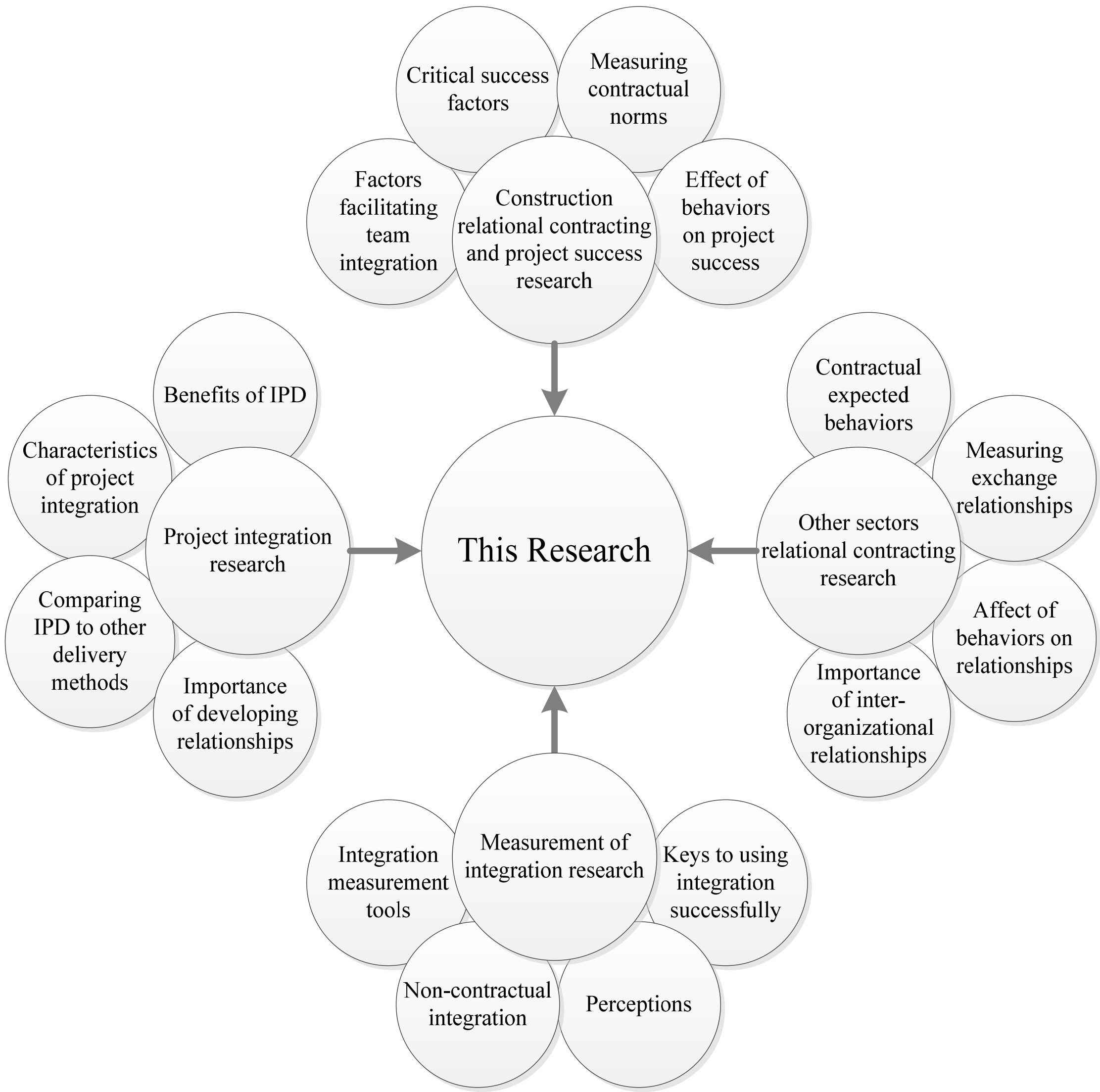

Figure 2-7: Summary of literature review used to develop the point of departure

This research intends to define project integration using the relational contract theory contractual norms. Then, I will operationalize eight contractual norms as constructs. Table 2-6 shows the contractual norms operationalized as measures in previous research compared to the norms used in this research. As one can see, no other research related to this study used more than six contractual norms, while this study uses eight contractual norms. Further, only Ning and Ling focused on construction industry relationships, while none of the previous research studies specifically addressed project integration, relational contracting, and measuring project integration to explore correlations with construction project success.

Table 2-6: Contractual norms used in other research compared to this study

	Kaufmann and Stern 1988	Heide and Miner 1992	Kaufmann and Dant 1992	Cannon et al 2000	Ning and Ling 2013	Harper 2014
Role integrity	✓		✓		✓	✓
Reciprocity	✓		✓	✓		✓
Flexibility		✓	✓	✓	✓	✓
Contractual solidarity	✓		✓	✓	✓	✓
Reliance and expectations		✓				✓
Restraint of power		✓	✓	✓		✓
Propriety of means					✓	✓
Harmonization of conflict		✓	✓	✓	✓	✓

Using the previous research studies as models, I will develop a series of statement item measures for use as observed variables that respondents will rate based on perceptions of certain behaviors that occurred in a relationship between organizations on recently completed construction projects. Statement items are single sentences that capture a specific attitude or perception by expressing a point of view, belief, preference, judgment, emotional feeling, and a position for or against something (Oppenheim 1992). I will collect data from multiple construction projects for the contractual norm measures as well as specific factors related to project success. The difference from prior studies is the measurement of project integration through contractual norms and discovering correlations with critical project success factors.

The final step will be to review the data analysis results as well as to draw conclusions about project integration and project success correlations. I will conduct structured follow-up interviews to validate the results and conclusions. I will review the inferences drawn from the statistical results along with comments from the follow-up interviews to confirm the results and provide contributions to the construction body of knowledge that I will developed based on the results.

2.9 Chapter 2 Summary

Chapter 2 introduced the concepts associated with this study and provided formal evidence of how each relates to this research study. The topics discussed were project integration, history of modern contracts, relational contract theory, the difference between discrete transactions and relational exchanges, describing the contractual norms and the commercial exchange spectrum, and defining project success. Based on this information, and previous research in project integration and relational contracting, this research intends to expand and depart from previous research in these areas. Chapter 3 explains how I intend to accomplish this.

CHAPTER 3. RESEARCH METHODOLOGY

This chapter describes the research methodology (see Figure 1-1) used to complete the study on relational contracting and project success. For reference, I am restating the research statement and questions below. The research methodology laid out in this chapter follows the order of the three research questions.

Research Statement:

- Construction project integration *influences* the success of a project.

Research Questions:

Q1 How can relational contracting norms *define* construction project integration? (Section 3.1)

Q2 How can relational contracting norms *measure* construction project integration? (Section 3.2)

Q3 How does construction project integration *relate* to project success? (sections 3.3 and 3.4)

3.1 Defining Project Integration

To answer research question Q1, section 3.1 describes the tasks used to define project integration through relational contract theory. Before investigating any correlations between project integration and project success, I had to define project integration using relational contract theory. Then, I obtained evidence to support the definitions. Figure 3-1 illustrates the tasks completed in answering question Q1.

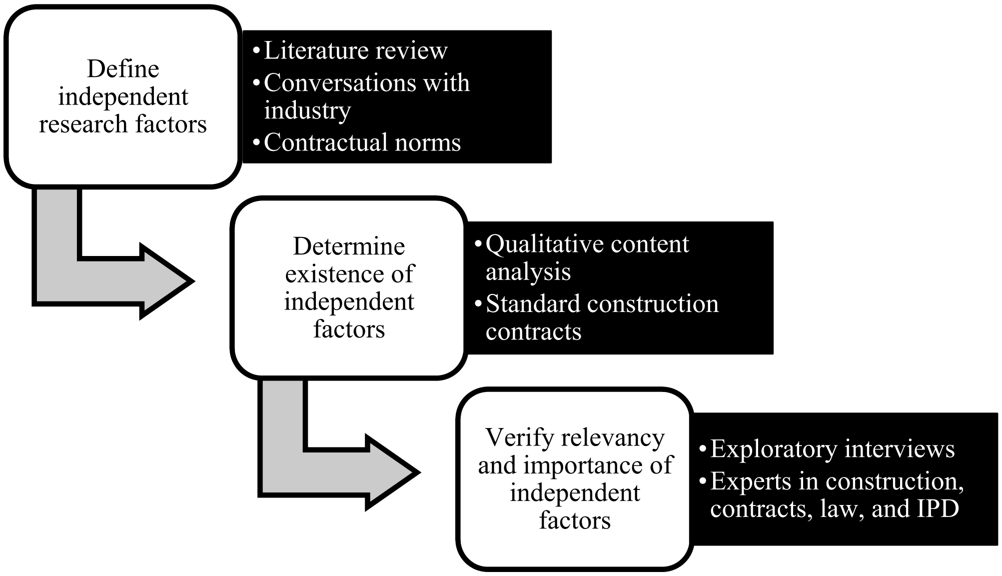

Figure 3-1: Methodology for defining contractual norms as research factors

3.1.1 Define independent research factors

I researched and determined the attributes for measuring relationships are the contractual norms from relational contract theory. These attributes are the measured perceptions from responding individuals that a researcher does not observe directly (Markus and Borsboom 2013). This research uses the contractual norms to measure integration through contractual relationships found on construction projects. As discussed in the literature review, section 2.6 defines each of the eight contractual norms in detail. The definitions are a combination of relational contract theory and project integration terms to make the contractual norms geared towards construction projects.

As mentioned in chapter 2, previous research in the marketing industry measured contractual norms to evaluate relationships between buyers and sellers. Using the business research framework along with psychometric theory (Nunnally and Bernstein 1994) for question design and development of the response scale, multiple statement items represent the observed variables for the contractual norm factors. The multiple statement items also relate to construction projects and the associated contractual relationships. Rating of each statement utilizes a five-point likert scale with “Strongly Disagree” as one anchor and “Strongly Agree” as the other anchor.

3.1.2 Determine existence of contractual norm factors

Defining the contractual norms assisted with determining the existence of the factors in construction contracts. I then needed to conduct a content analysis (CA) to investigate if the contractual norms are a part of construction contract language and if so to what extent. A similar study by Cheung et al (2006) investigated how relational construction contracts are in general, but that study did not use relational contract theory contractual norms as I am and that study only focused on contracts from the Hong Kong construction industry.

CA is a research method for interpreting the content of text data, with the use of a systematic and defined classification process of coding and identifying themes or patterns based on valid inferences and interpretations (Weber 1990). It allows research to explore beyond simple counting of words or extracting objective information by permitting researchers to understand social perceptions in a subjective and scientific manner (Zhang and Wildemuth 2005).

The CA process follows the procedure outlined in Figure 3-2. This research used an interpretive analysis throughout the CA process. An interpretive analysis is a method of theoretical sampling, use of analytic categories, and continuous cumulative and comparative analyses (Neuendorf 2002). The analyst constantly revises and discovers new words and phrase. This process derives categories for coding based on a theory or research findings, and in this study, the basis of coding is the contractual norms from relational contract theory (Hsieh and Shannon 2005). The goal then is to allow themes to emerge throughout the source documents based on the theory that the contractual norms are a part of construction contract language.

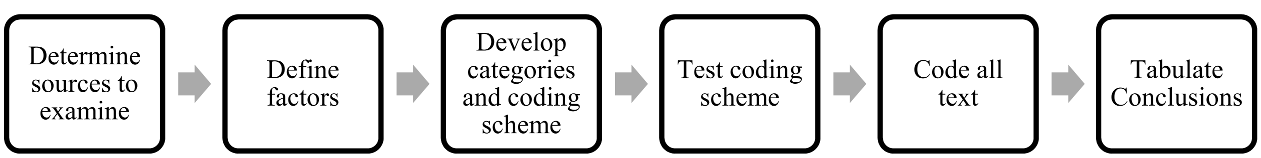

Figure 3-2: Content analysis process

The CA examined 11 standard construction contracts as the source documents. The standard construction contracts included in the CA are from the American Institute of Architects (AIA), Associated General Contractors (AGC) ConsensusDOCS, the Engineers Joint Contract Documents Committee (EJCDC), and the Design-Build Institute of America (DBIA). Further, two additional specific IPD contracts were included. Table 3-1 outlines the specific contracts used in the CA. The contracts range from the traditional DBB delivery method on one end to IPD on the other end.

Table 3-1: List of common construction contracts

	Contract	Description
Design-Bid-Build	AIA A101-2007 / A201-2007	Agreement between owner and general contractor / general conditions of the contract
	ConsensusDOCS 200	Agreement between owner and general contractor
	EJCDC C-520 / C-700	Agreement between owner and general contractor / general conditions of the contract
CMGC	ConsensusDOCS 500	Agreement between owner and construction manager /general contractor
Design-Build	AIA A141-2004 / Exhibit A	Agreement between owner and design-builder / general conditions of the contract
	ConsensusDOCS 415	Agreement between owner and design-builder
	DBIA 525 / 535	Agreement between owner and design-builder / general conditions of the contract
Integrated Project Delivery	AIA C191-2009	Multi-party integrated project delivery agreement
	ConsensusDOCS 300	Multi-party integrated project delivery agreement
	General IFOA	Multi-party integrated project delivery agreement
	IPD Standard Agreement	Multi-party integrated project delivery agreement

The basis for inclusion of a standard construction contract in the CA is the frequency of use. The AIA contracts are the most widely used contracts in construction today (Twomey 2009). ConsensusDOCS, developed in part by AGC and other prominent construction organizations, represents the fastest growing segment of contracts for use on construction projects (Hunter 2010). EJCDC has been producing construction contracts for engineers for over 30 years (Korman 2007). DBIA began producing contracts specifically for DB projects in 1998 that rival the AIA and ConsensusDOCS DB contract forms (Elvin 2007). The two independent integrated contracts are the most frequently used IPD contracts currently (Dal Gallo et al 2009; Lichtig 2006).

To begin the analysis, I created a new project in *NVivo*, which allows for organization and storage of documents and data as well as being able to link the documents and data to one another through coding and nodes (Richards 1999). I was able to obtain each contract document in an electronic format. I found the AIA, DBIA, and EJCDC contracts using an internet search. For the ConsensusDOCS, I requested sample copies, stating that the copies are for research purposes only. For the independent integrated contracts, I obtained each from the website of the organization that produces the contract. The collected documents are in *pdf* format. In the initial coding tests, I determined that *MS Word* documents were easier to work with, and therefore using *NVivo,* I convert the *pdf* documents to *MS Word* versions.

The factors for this CA are the contractual norms. Each contractual norm denotes a category or primary node for coding of the document text. To build the coding scheme, first I labeled the actual wording of each contractual norm as a primary node. Second, in reviewing the definition of each norm, I had to add words and phrases associated with the norm definitions to the coding scheme. Third, I performed word search queries for each of the eight contractual norms and a word frequency search. The word search queries showed instances of the exact contractual norm text in construction contracts. The word frequency search provided a list of the most common words and phrases in the source documents. I then added synonymous words and similar phrases that match up with the contractual norms to the coding scheme as child nodes. The child nodes symbolize specific coding for a primary node contractual norm (Richards 1999). Table 3-2 provides a list of the primary nodes and the child nodes from the interpretive CA.

Table 3-2: CA primary nodes and child nodes

Primary Nodes	Child Nodes
Role Integrity	achieve project goals, align individual interests, Benefit the project, best interest of the project, integrate, integration, no preferential treatment, perform with integrity
Reciprocity	fair and reasonable, good faith, joint, jointly, mutual trust, mutually acceptable, mutually agreed to, share equally, success tied to each other
Flexibility	amend, amending the contract, modify, modified, modification, without invalidating the agreement
Contractual Solidarity	assist, assisting, avoid conflict of interests, cooperate, cooperation, collaborate, collaboration, collaborative environment, get along, working together
Reliance and Expectations	expect, expectations, reliable, reliable promises, reliable commitments, reliably, reliance, rely on, share information
Restraint of Power	control, control over, limit authority, limited authorization, may authorize, has authority to
Propriety of Means	best efforts, means and methods, skill and attention, professional skill and care, skill and judgment, skill, knowledge, experience, standard of care
Harmonization of Conflict	arbitration, binding dispute resolution, direct discussions, good faith dispute resolution, mediation, mitigation, waiver of claims

The next step then was to utilize the primary node categories and child nodes to test the scheme before employing it across multiple documents. This iterative process allowed for coding of test sections in several of the contract documents and then checks the coding consistency between the different sections from different documents. Once clear and consistent coding themes emerged in a few of the documents, I conducted the full content analysis.

The coding was an exhaustive process of searching for the coding scheme words and combinations of words throughout each document. Even with testing and determining consistency, further iterations and refinements helped to code the text properly and accurately. For example, reliance and expectations contractual norm focuses on reliability, expectations, and promises, which are included as three child nodes respectively. However, when coding, I determined that sharing of information is a part of the reliance and expectation norm. Sharing of information then became a child node of reliance and expectations. Further, some of the search results did not match the context of the contractual norm. For restraint of power, each contract has a clause stating who controls the design documents. Although this does establish control, the overall control does not affect the agreement or the way organizations behave when interacting with each other. These types of instances were not included in the coding.

A review for consistency followed each coding theme. The contract documents contain similar, but differently worded clauses. To make sure that the clauses coded acknowledge the same contractual norm across sources, I performed a thorough review of similar clauses from each contract document. In the coding, I found that clauses worded exactly the same occurred across all of the AIA and all of the ConsensusDOCS contracts respectively. Therefore, a review took place exclusively with the AIA contracts and then the ConsensusDOCS contracts to make sure coding of the same clauses occurred across the AIA or ConsensusDOCS contracts. In many instances, all three AIA documents contained the exact same clause and all four ConsensusDOCS contained the exact same clause.

3.1.3 Confirm relevancy and importance of contractual norms

Relevancy is the ability of a contractual norm measure to define specific aspects of contractual relationships that exist on construction projects accurately. The definition of importance is the significance that a contractual norm has on integration of organizations found on construction projects. Knowing the relevancy and importance of each contractual norm helped to determine if a particular norm should be included in this study. If a norm is non-relevant or not important, then it does not provide useful data, and elimination occurs. Additionally, knowing if specific contractual norms overlap too much with one another norm could lead to potentially eliminating one of the norms.

Investigating relevancy and importance of the contractual norms occurred by conducting individual exploratory interviews with qualified experts. According to Oppenheim (1992), exploratory interviews assist with developing attitude measures by discovering the origins, complexities, and ramifications of the attitude, or behavior, in question as well as to gain vivid expressions from experts on such behaviors in a form that allows one to use the expressions as observed variables. The purpose of the interviews for this research was to explore the contractual norms and determine if the contractual norms are relevant and important to contractual relationships found on construction projects. Interviews helped to verify the results of the CA, to understand the relevancy between the contractual norms and construction project integration relationships, and to afford more evidence for research question Q1.

The interviews followed a semi-structured format that used open-ended questions to explore the contractual norms and to spark in-depth discussions. Open-ended questions allow for freedom and spontaneity in the answers, provide an opportunity for the interviewer to probe in-depth with the interviewee, and help to test hypotheses about an idea (Oppenheim 1992). Figure 3-3 shows the steps for conducting each interview.

Using open-ended questions can create discussions that are time consuming and require more effort on the part of the interviewee. Therefore, I first performed an initial interview as a pilot run and adjusted the questions and format to shorten the duration and improve the flow. The remaining interviews then took place under the same format with the refined questions and format.

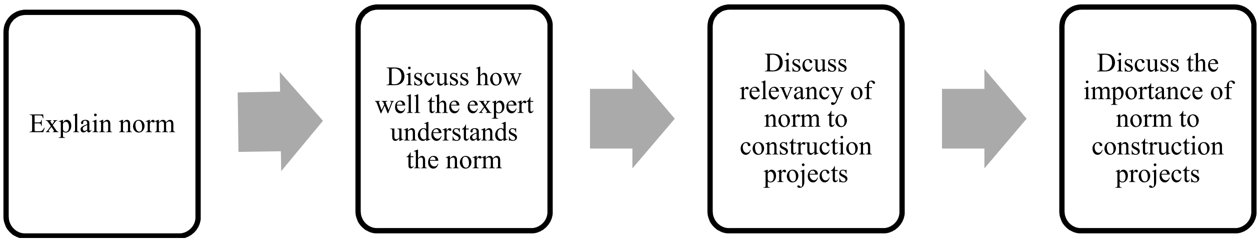

Figure 3-3: Steps for conducting expert interviews

The interviews occurred with eight construction industry experts from the areas of construction, contracting, and law. Initially, the list of potential interviewees included many potential experts. Then, each potential expert was qualified based on the criteria listed below. Each potential interviewee needed to satisfy at least five of the ten criteria. Table 3-3 lists the qualifications for the eight individuals interviewed. The qualified experts represented different areas of construction. Two individuals are academic professionals, one is a design professional working for a construction manager, one is a construction law professional, one represents a contractor, one is an owner, one is an architect, and one is a leader of a large non-profit construction organization.

Table 3-3: Qualifying criteria for expert interviews

Expert Interviewee Qualification Criteria	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8
Primary or secondary author of at least three peer-reviewed journal articles associated with project integration, construction contracting, or both	X	X		X	X	X	X	
Invited to present at a conference about construction contracting	X	X	X	X	X	X	X	X
Member or chair of nationally recognized committee		X	X	X	X	X	X	X
At least 10 years of professional experience in construction industry with focus on project integration		X	X	X	X		X	X
Faculty member at an accredited institution of higher learning with a research focus on project integration	X					X		
Writer or editor of a book or chapter on the topic of construction, contracting, and/or project integration		X			X			
Advanced degree in the field of CEM, construction, contracting, law (minimum of BS required)	X	X	X	X	X	X		X
Professional registration as a professional engineer (PE), licensed architect (AIA), and/or Attorney-at-law		X	X	X				X
Background in delivery methods, contracting and/or integrated project contracting	X	X	X	X	X	X	X	
Worked on at least two integrated projects, developed an IFOA contract, or conducted research in project integration and/or contracting	X			X			X	

I contacted each expert and provided the person with a cover letter that described the purpose of the interview, which included the definitions of each of the contractual norms. To begin the interview, I reviewed each of the contractual norms with the expert. Then, the initial question focused on how well the expert understood the contractual norm. Once I confirmed an understanding of the norm, the next question addressed how relevant the contractual norm is in describing behaviors between organizations on construction projects. Then, the final question addressed how important the expert believes the contractual norm explains relationships between contracting construction organizations. The specific questions asked were:

1) "How well do you understand <*contractual norm*> in describing behaviors found in relationships between contracting organizations on construction projects?"
2) "Do you think <*contractual norm*> describes behaviors found in contractual relationships on construction projects? If yes, how? If no, why not?"
3) "How important is <*contractual norm*> in explaining behaviors in contractual relationships found on construction projects?"

3.2 Measuring Project Integration

The steps in this section outline the approach for answering research question Q2. Using previous research, I had to operationalize the contractual norms to measure integration on construction projects. A measurement is the acquisition of knowledge about an attribute of an object, and the representation of that knowledge via numbers (Wilson 2005). The attributes here are the contractual norms and the object is the integration of organizations on construction projects. Creating a measurement scale is a complex, multi-step process (Churchill 1979) that starts with reviewing and defining the research metrics or constructs. The measures address perceptions or attitudes that one organization feels about another organization (Oppenheim 1992). The constructs embody the principal items to measure in this research. Figure 3-4 outlines the tasks used to develop and test the constructs along with defining the dependent research factors, and developing the survey questionnaire to collect project data.

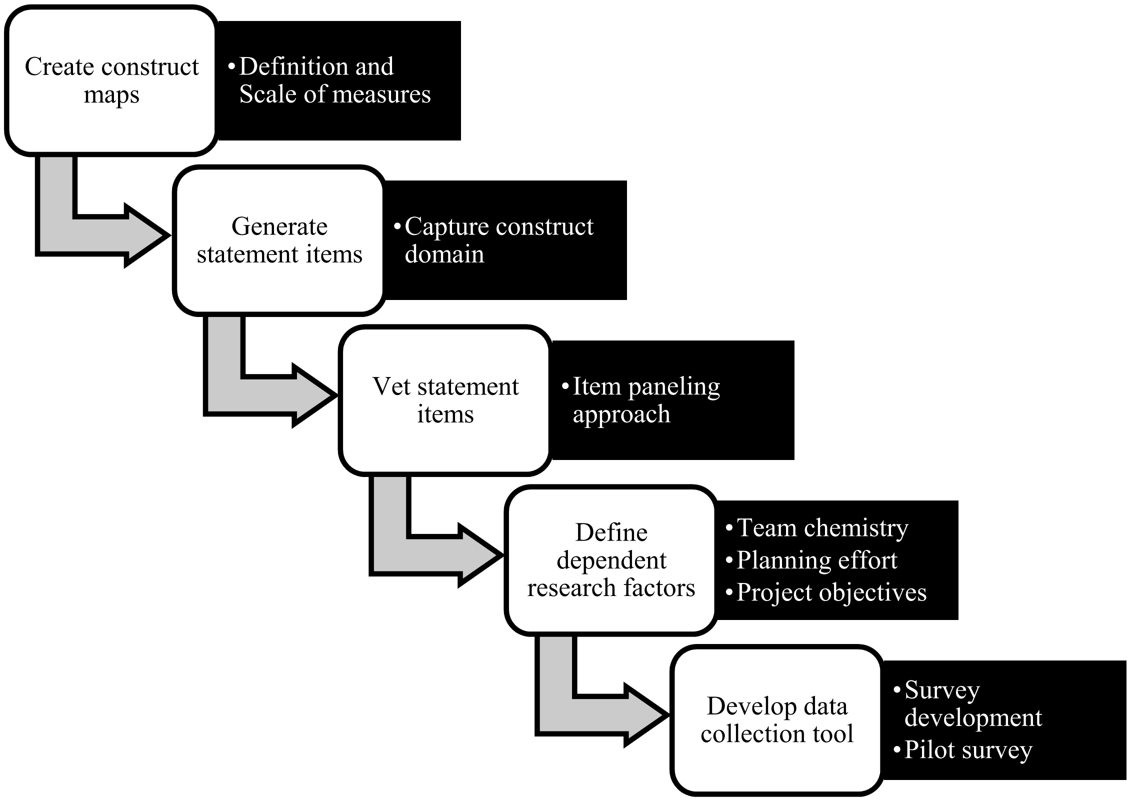

Figure 3-4: Methodology for operationalizing research factors and data collection

3.2.1 Create construct maps

Using measurement development methods suggested by Churchill (1979) and refined by Wilson (2005), the first step towards creating measures is to specify the domain and dimensions of each construct. To do this effectively, I created construct maps for the eight contractual norm measures. A construct map is an organizing tool for developing the scale of a measure (Wilson 2005). On one side of the map, the responses represent the scale or dimensions that a respondent can choose from when completing the survey. On the other side of the map is the interpretation of each response.

Using the definitions for each contractual norm measure, I first developed the extreme values using a high to low scale. Then, I determined the scale to use for responses. Using previous research in measuring perceptions and specifically the contractual norms of relational contract theory, the scale used is a likert-based scale. Next, I needed to determine the size and type of likert scale. A five-point scale ranging from "Strongly Agree" to "Strongly Disagree" provided the necessary scale for each contractual norm measure. Next, I filled in the middle values along the scale. As an example, Figure 3-5 shows the construct map for the reciprocity measure.

Higher Reciprocity

Interpretation	**Responses**
Organizations focused on positive outcomes for all organizations; sense of fairness and respect in all aspects of the relationship; preferential treatment did not occur	Strongly agree
Organizations focused on positive outcomes for most organizations; sense of fairness and respect in most aspects of the relationship; preferential treatment rarely occurred	Agree
Organizations focused on positive outcomes for their own organization with some consideration for others; sense of fairness and respect in some aspects of the relationship; preferential treatment occurred sometimes	Neither agree nor disagree
Organizations focused on positive outcomes for their own individual organization with little consideration for others; sense of unfairness and a lack of respect in most aspects of the relationship; preferential treatment occurred most of the time	Disagree
Organizations focused on positive outcomes for their own individual organization with no concern for others; sense of unfairness and a lack of respect in all aspects of the relationship; preferential treatment occurred all the time	Strongly disagree

Lower Reciprocity

Figure 3-5: Construct map for Reciprocity contractual norm measure

3.2.2 Generate statement items

With the construct maps in place for each contractual norm measure, the next step was to generate the observed variables called statement items. The key to generating multiple statement items for each measure is to create items that capture the domain specified (Churchill 1979). The construct maps provided crucial assistance in the statement item development as the construct maps helped to portray the theoretical construct and its manifestation to a real-world situation (Wilson 2005). According to Churchill (1979), *"most variables of interest are inherently complex and cannot be accurately measured with a single item as single item measures are considerably unique and subsequently have a low correlation with the measured factor."* The use of multi-item measures overcomes this pitfall.

To begin generating statement items, I used previous research studies that operationalized the contractual norms with multiple statement items. The format and context of the previous research studies allowed me to synthesize multiple initial statement items for each contractual norm. For example, I refined the statements from the marketing research studies into construction organization relationships rather than buyer-seller relationships. From here, I was able to create additional statements based on the definitions and dimensions of the scale such as creating reverse-measurement statement items that more closely match the more negative response categories.

3.2.3 Vet statement items

Using the process above, I generated 12-18 statement items for each contractual norm. To reduce these statements to a more manageable number as well as refine, add, or remove statement items, I employed an item paneling approach (Wilson 2005). This approach utilizes the same eight experts interviewed for the relevancy and importance of the contractual norms to construction projects. The experts proved vital during the relevancy and importance review stage and their familiarity with this research improved the insights gained for vetting the statement items.

The purpose of the item panel was to review each statement item to make sure that each item stimulates responses that constitute observations about the contractual norm I am attempting to measure (Wilson 2005). I first distributed the contractual norm portion of the pilot survey to each expert. Then, I scheduled phone interviews to review the pilot survey responses and comments made by each expert. For each statement item, I explained and justified the relationship of the statement item to the overall measure to each expert. The expert then provided feedback based on their actual responses and comments made during the interview. The use of the item panel approach with the expert interviews refined the statement items to seven statements per contractual norm, which turned out to be a much more manageable number of statement items to handle in the data collection and for the statistical analyses.

3.2.4 *Define dependent research factors*

With the contractual norms operationalized, the next step was to determine how to measure the dependent research factors associated with project success. As I discussed in the literature review, section 2.7 defines project success using three critical success factors (CSFs) of team chemistry, planning effort, and project objectives. Each CSF has associated previous research that proves their importance to construction projects (Ashley et al 1987; Sanvido et al 1992; and Diekmann and Girard 1995). These three studies also provided guidance the statement items to describe and measure the three CSFs.

Seven statement items related to construction projects and to previously working experience (TC1, TC 2, and TC 3), partnering approach (TC4) and potential future work endeavors (TC5, TC6, and TC7) are used to measure team chemistry. Rating of team chemistry statement utilizes a five-point likert scale with “Poor” as one anchor and “Excellent” as the other anchor.

Six statement items related to construction projects and to planning effort during design (PE3 and PE4) and planning effort during construction (PE5 and PE6) are used to measure planning effort. Rating of the planning effort statement items uses a five-point likert-scale ranging from “Strongly Disagree” to “Strongly Agree”.

Four statement items related to construction projects and budget (PO1), schedule (PO2), quality (PO3), and functionality (PO4) are used to measure project objectives. Since I am basing each of the project objectives on the level of satisfaction felt for a project due to achieving the project objectives, the four statement items use a five-point likert scale that ranges from “Very Dissatisfied” to “Very Satisfied”. Table 3-4 outlines all three CSFs and their associated success criteria measure.

Table 3-4: Dependent Factors – Critical Success Factors and success criteria measures

CSF	Success Criteria	Statement items
Team Chemistry	Previous working experience	TC1, TC2, TC3
	Use of partnering	TC4
	Potential future work endeavors	TC5, TC6, TC7
Planning Effort	Planning during design	PE3, PE4
	Planning during construction	PE5, PE6
Project objectives	Budget satisfaction	PO1
	Schedule satisfaction	PO2
	Quality satisfaction	PO3
	Functionality satisfaction	PO4

I then also included two established performance measures of cost growth and schedule growth (Konchar and Sanvido 1998). I collected specific project budget information as well as schedule information. Including the two common performance measures allows for investigation of relationships between budget satisfaction and schedule satisfaction to actual quantitative changes in budget and schedule for a specific project, which can then provide evidence that the satisfaction rating factors are sufficient for comparison to the contractual norms. The data collected for budget is the initial budget amount and the final budget amount. Then, the following equation calculates the budget growth (Konchar and Sanvido 1998).

E1. Cost Growth (CG) where final budget cost represents the total actual budget of the project and contract project cost represents the estimated budget of the project

$$CG = \frac{[(final\ budget - contract\ budget)]}{contract\ budget}$$

The data to collect for schedule is the estimated start and completion dates along with the actual start and complete dates. I then calculate the total estimated days and compare that to the total actual days using the schedule growth equation shown below (Konchar and Sanvido 1998).

E2. Schedule Growth (SG) where total days represents the actual number of days that it took to complete the project the total estimated days is the estimated number of days that were initially planned for the project	$$SG = \frac{[(total\ days - total\ estimated\ days)]}{total\ estimated\ days}$$

Comparison of budget satisfaction to cost growth and schedule satisfaction to schedule growth utilizes the use of Spearman's rank correlation coefficient or Spearman's rho, as shown in equation E3 below. Spearman's rho is the more appropriate correlation statistic to use as the comparison utilizes ordinal rank data for the satisfaction measures and continuous data for the growth measures.

E3. Spearman Rank Correlation Coefficient (ρ_{sp}) where $\sum D$ is the sum of the differences between ratings of each response and *n* is the total sample size of responses recorded per each statement item.	$$\rho_{sp} = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

Spearman's rho ranges from -1 to +1. When rho is close to or equal to one, there is a strong positive correlation. When rho is close to or equal to negative one, there is a strong negative correlation. Values that are close to or equal zero means there is no correlation present.

3.2.5 Survey construction projects

Data collection for this research study utilized a survey questionnaire. The survey contains items to collect data for contractual norm measures, the CSFs, and budget and schedule performance information. The development of the survey follows the steps outlined by Blair et al (2014). Figure 3-6 shows the survey design process used.

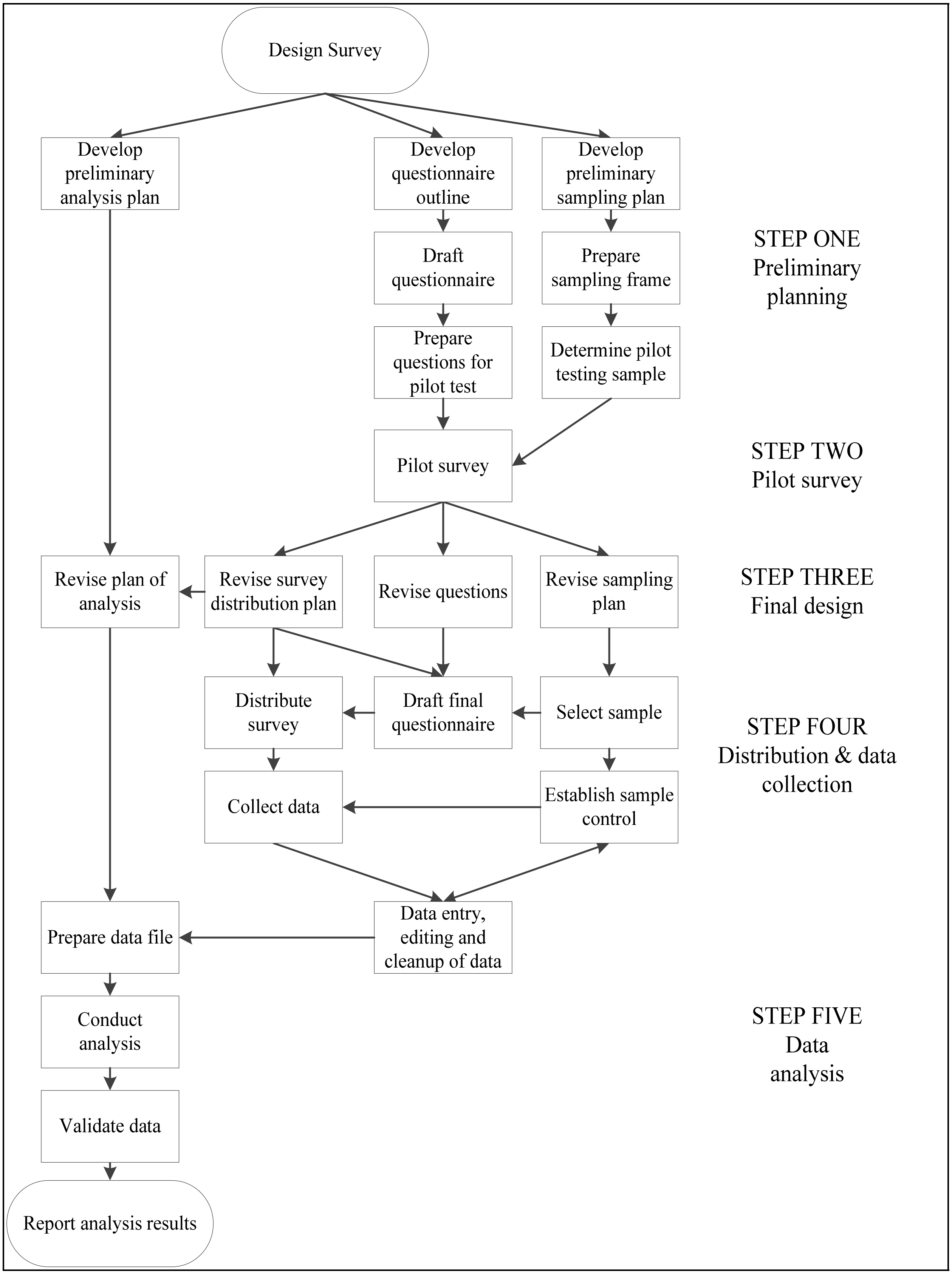

Figure 3-6: Survey design process

3.2.5.1 Preliminary planning

To begin, I developed a plan for what the survey looks like and what it needs to include. The basis for planning is the research questions that the survey is trying to answer. For this research, the survey is the tool to collect data to answer research question Q3.

Next, I developed a preliminary sampling plan. Sampling is of the utmost importance to any research study at this stage. Since this research investigates recently completed DBB, DB, CMGC, and IPD projects from across the United States, the sample includes representatives from owner's agent firms, such as owner representatives and construction manager agencies. These project representatives have specific knowledge about the project and are able to provide accurate feedback on the relationships that occur on construction projects. Using the Construction Manager Association of America (CMAA) and the Design-Build Institute of America (DBIA) directories, I randomly selected owner and owner agents. I then distributed the survey via email. Finally, I sent out follow up emails and phone calls in an attempt to increase the response rate.

As the unit of analysis is the project, it became vital to obtain responses from a variety of projects that utilize different delivery methods. The amount of DBB, DB, and CMGC construction projects completed recently in the United States should be quite large. Therefore, the availability of the sampling frame is not an issue for these three delivery methods. The caveat lies with collecting data from IPD projects. The U.S. construction industry has only completed a few dozen IPD projects, so I had to collect data for IPD projects using convenience sampling.

The type of information needed from respondents and how to best elicit that information are two key decisions to make early on in the survey design process (Blair et al 2014). The purpose of the survey is to collect responses for the eight contractual norms as well as the project success CSFs. Measuring both the contractual norms and the CSFs utilize five-point likert scales to rate various statement items. To gather the rating responses, this research used a web-based survey to collect the responses. Distributing the survey via the internet allowed for randomization of questions, tracking of distributed survey and finished responses, and the ability to collect all of the responses in one location for easy access during the analysis.

The preliminary planning also included thinking about how to analyze the data. For this study, the overarching research statement concentrates on determining if correlations exist between project integration and project success. Therefore, correlation and association statistics are appropriate. Additionally, using structural equation modeling methods help to find the potential relationships that exist and the strength of the correlation relationships.

3.2.5.2 Pilot Survey

Before distributing the survey to collect data from construction projects, it underwent testing with a conveniently selected sample of five construction managers/owner agents/owner representatives. The pilot survey asked the participants to rate each of the contractual norm statement items in terms of the inter-organizational relationships that occurred on the project. Additional statements focus on data collection for the three CSFs. I also collected project information for stratifying the data set. I encouraged respondents to provide comments throughout the test survey.

3.2.5.3 Final design

At the conclusion of the pilot study, I addressed any remaining issues and refined the survey into the final design. During this stage, any final revisions to the sampling plan, questionnaire, data collection plan, and data analysis plan occurred (Blair et al 2014). For example, the order of questions needed shuffling to improve the flow of the survey. Additionally, a common occurrence to be aware of is the possibility that a particular subgroup of the pilot sample may respond differently than the rest of the sample. In this case, changes in question wording can accommodate this issue. Finally, the data analysis plan allows for the elimination or addition of analyses or statistics to analysis the responses dataset.

3.2.5.4 Sample selection, distribution, and data collection

The results of the pilot survey helped to determine the sample of respondents needed for the survey questionnaire. As responses began to come in, I needed to monitor the results of the sampling and the data collection activities. It is critical to collect fully responsive surveys in order to conduct appropriate analyses on the data set. Then, the response rate needed to be somewhat consistent across the different delivery methods so that sample sizes are the same, which makes the statistical analysis easier to perform when stratifying the data set across the different delivery methods.

3.2.5.5 Data analysis

During this stage, the collected data is coded and analyzed. For this study, each of the statement items utilize five-point likert scales to gather perceptions about the contractual norms and CSFs, meaning the data analysis needs to use methods to statistically evaluate ordinal-count data. Further, the data file received a thorough review and check to identify if the coding is correct and to find any remaining data entry errors (Blair et al 2014). The following section discusses how I analyzed the survey responses data file.

3.3 Relating Project Integration to Project Success

Data collection for this research occurred through a questionnaire survey. The collected data then underwent a series of statistical analyses using factor analyses and structural equation modeling methods (see chapter 4). Information throughout this section addresses answering research question Q3 using the statistical analysis methodology, as shown in Figure 3-7.

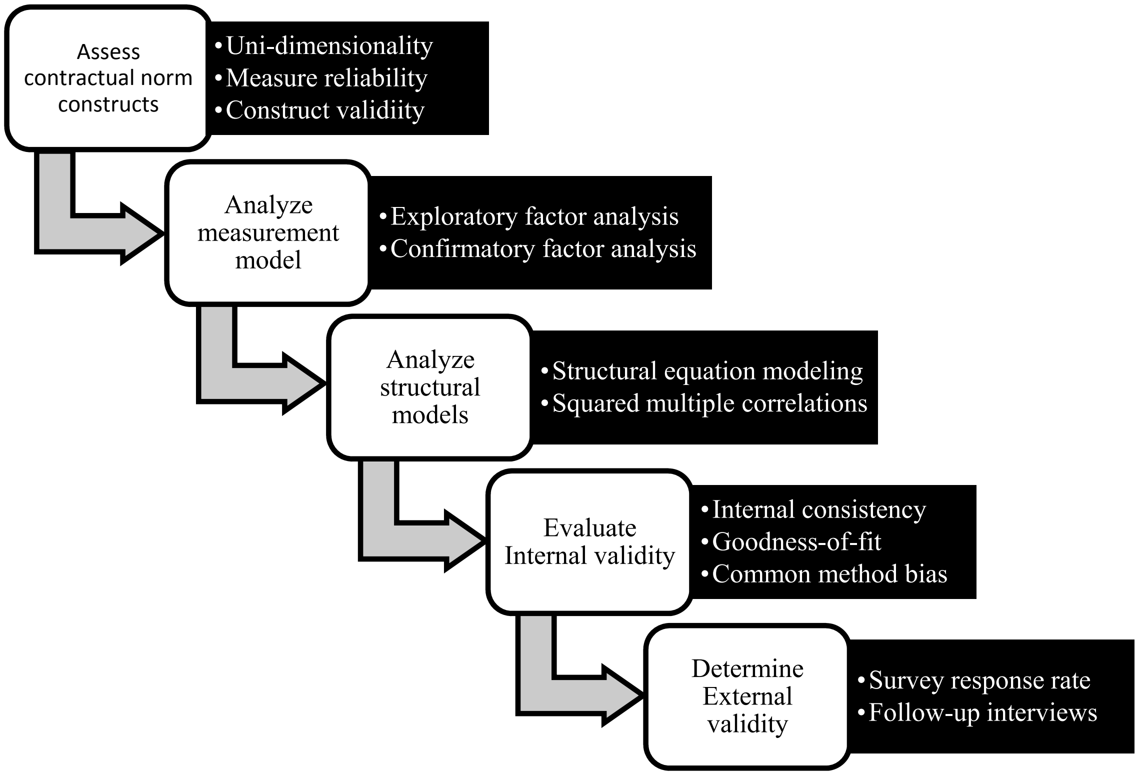

Figure 3-7: Methodology to answer research question Q3

3.3.1 *Assess unidimensionality of measures*

With the construct domain known and statement items generated and vetted with experts, the next step was to collect preliminary data through a pilot survey in order to refine the survey and to perform a series of exploratory statistical tests to assess the measures and statement items for unidimensionality, reliability, and validity. Oppenheim (1992) defines unidimensionality, as "*the scale should be about one thing at a time, as uniformly as possible*". This means that the statement items should be internally cohesive as they should 'hang together' to measure the same dimension with as little extraneous variance as possible.

The definition of metric unidimensionality for this research is the degree of internal and external consistency in which the different organizations and individuals participating in the survey properly interpret a contractual norm. Therefore, unidimensionality goes hand in hand with reliability and validity of measures, particularly discriminant validity. Assessing unidimensionality includes examining the uniformity of the language in each of the contractual norm statement items to make sure that each contractual norm scale only accounts for one-dimension. In other words, a proper measurement scale should consist of a set of statement items that correlate well with each other for each of the contractual norm constructs (DeVellis 2011) and do not correlate well with other statement items under other contractual norms.

Assessing unidimensionality occurred throughout the statement items vetting process, survey development process, and the statistical analyses. The most common way to evaluate unidimensionality statistically is the use of factor analyses. A factor analysis provides factor loadings for the observed variables on a specific latent factor, where significant factor loading values on all statement items for one contractual norm factor supports the claim that the scale and measures are one-dimensional. (Gardner 1995). The requirements of a scale to be unidimensional are that the average correlation with the total scores is high and the spread of correlations about this average is small (Nunnally and Bernstein 1994). Unidimensionality assessment for this research utilized exploratory and confirmatory factor analyses to review the factor structure and the residual values, along with the use of fit indices and the evaluation of factor loadings on the observed variables (Fabrigar and Wegener 2012).

3.3.2 Verify measure reliability

Reliability is an integral part of unidimensionality and validity, which represents testing the quality of the measures (Wilson 2005). Metric reliability is the degree to which results of the metric are consistent over time and the level of reproducibility when using a similar methodology. Luftig and Jordan (1998) provide a method for determining the types of reliability and validity to assess when creating qualitative measures, which includes testing for reliability based on internal consistency and equivalence. Each of these reliability attributes require statistics and therefore reliability tests are sometimes called statistical validity (Garson 2013).

3.3.2.1 Internal consistency

Internal consistency is the homogeneousness of ratings within the individual statement items under each contractual norm. Obtaining internal consistency can be done by constructing statements that can crosscheck each other without it being apparent to the participant (e.g. do not just reword the statement) and randomizing the statement items (Lucko and Rojas 2010). Further, determining unidimensionality of a scale requires internal consistency as well. Determining internal consistency statistically for each measure utilizes Cronbach's alpha, which is a proven test of internal consistency (Cronbach 1990, 1951). Maximizing Cronbach's alpha occurs only when every statement item in a scale shares a common variance with at least some of the other items in the scale (Gardner 1995).

Equation E4 below describes Cronbach's alpha. According to Garson (2013), the alpha value needs to be at least 0.70 to achieve "adequate" consistency in the scale and 0.80 to achieve "good" consistency in the scale. If reliability according to Cronbach's alpha falls below the 0.70 threshold, then the Spearman-Brown prediction formula (Wilson 2005) can assist with increasing the hypothetical reliability by increasing the number of statement items for each contractual norm measure.

E4. Cronbach's alpha (α) Where k = the number of statement items for each contractual norm, $\sum\sigma_k^2$ is the sum of all k item score variances and σ_t^2 is the total variance of the scores for the total measurement

$$\alpha = \frac{k}{1-k}\left(1 - \frac{\sum \sigma_k{}^2}{\sigma_t{}^2}\right)$$

For internal consistency of the statements in relation to each other and the multiple responses, I utilized inter-item correlations as a check for inconsistencies with the average of the other items. This resulted in removing a statement item from the measurement scale if the inter-item total correlation was less than 0.30 (Hair et al 2010). To calculate the inter-item correlation, I used the Spearman Rank Correlation Coefficient, previously shown as equation E3.

3.3.3 Validate measures

Metric validity is "the degree to which evidence and theory support the interpretation of test scores entailed by proposed uses of tests" (AERA 1999). Validation is one of the most fundamental considerations when developing and evaluating measures. Validity assessments attempt to demonstrate that a measure considers as much as possible of what it should by minimizing construct under-representation, and as little as possible of what it should not measure by minimizing construct-irrelevant variance (Messick 1989).

Construct under-representation occurs when a measure fails to capture the important aspects of the construct while construct irrelevant variance occurs when test scores are affected by external processes on the intended construct (AERA 1999). According to Markus and Borsboom (2013), validity of tests, or measures, focuses on three fundamental concepts of measurement, causation, and meaning. This research addresses the three fundamental validity concepts through assessments of construct validity, content validity, and nomological validity for the contractual norm factors.

3.3.3.1 Construct validity

Construct validity is the degree that the measureable observed variables represent a measure of the associated factor. Obtaining construct validity occurs when researchers use adequate definitions and measures of the factors in question (Creswell 2009; Cronbach and Meehl 1955). A good construct has a theoretical basis that the operationalized definition communicates clearly (Garson 2013). A poorly characterized construct lacks a theoretical basis or includes flaws in its operationalization so that the observed variables measure one thing according to one person and something else according to another person. High levels of construct validity provide evidence that a measure is measuring what it should measure. Low levels of construct validity mean that the measurements are a result of other unobserved variables influencing the measure or random noise (unexplained variance) (Fellow and Liu 2008). Two critical portions that make up construct validity are convergent validity and discriminant validity.

Convergent validity is the extent that the research results correlate with other observed variables that researchers know measure the same phenomena (Krippendorff 1980). When utilizing multiple statement items as observed variables to measure a contractual norm factor, each of the statement items need validation that the items in fact are measuring the same contractual norm. In other words, this research needed to demonstrate that the items in the measurement scale for each contractual norm converge on a single dimension of meaning (Garson 2013).

Discriminant validity, or divergent validity, is the extent that the statement items for the different contractual norm constructs correlate across to other constructs (Garson 2013). In other words, the assessment here is to determine statistically if two constructs are different or diverge from one another. If the statement items for one contractual norm correlate highly with another contractual norm, then an overlapping of constructs is occurring. Discriminant validity is an important validation to acquire as it relates to the unidimensionality of measures.

Determining construct validity utilizes Cronbach's alpha, shown previously in equation E4. Cronbach's alpha provides a measure of how valid is the construct in measuring what it intends to measure (Garson 2013). Then, using the software program *LISREL 9.1*, an exploratory factor analysis and a confirmatory factor analysis help to confirm discriminate validity.

Determining convergent validity uses goodness-of-fit indices. Table 3-5 lists the goodness-of-fit indices used for construct validity tests. These indices represent three fit indices categories of absolute fit, parsimony correction, and comparative fit. Previous studies show that researches should consider to report fit indices from each of these three categories when evaluating fit (Hu and Bentler 1999) as well as to report several fit statistics as there does not exist one fit index that provides the best fit value (McDonald and Ho 2002).

The common absolute fit assessment is the Chi-square goodness-of-fit index, equation E5. The standardized root mean square residual (SRMR), equation E6, is also an absolute fit statistic that averages the discrepancy between the correlations observed and the correlations predicted in the model using the residual correlations matrix (Brown 2006). SRMR ranges from zero to one, with values at zero being a perfect fit, so that the lower the value, the better the fit.

E5. Chi-square (χ^2) Where F_{ML} is the maximum likelihood function and N is the total sample size	$\chi^2 = F_{ML}(N-1)$
E6. Standardized Root Mean Square Residual (SRMR) Where $\sum\phi_i^2$ is the sum of the squared residual correlation matrix values and i is the total number of residual correlation matrix values	$SRMR = \sqrt{\frac{\sum \phi_i^2}{i}}$

Equation E7 is the root mean square error of approximation (RMSEA) is a parsimony correction assessment, which is similar to the absolute fit indices, except there is an incorporation of a penalty for poor model parsimony (Brown 2006). A parsimony correction assessment takes into account the number of knowns and number of unknowns and the higher the degrees of freedom, the smaller the penalty. The RMSEA does not have an upper bound and excellent fit occurs at zero, meaning the smaller the value the better the fit.

E7. Root Mean Square Error of Approximation (RMSEA) Where χ^2 is the Chi-square of the model, N is the total sample size , and df is the degrees of freedom of the model	$RMSEA = \sqrt{\frac{\chi^2 - \frac{df}{N-1}}{df}}$

The comparative fit index (CFI), shown as equation E8, is an incremental fit index that evaluates fit for the specific solution in relation to a more restricted and nested baseline model (Hu and Bentler 1999). The baseline model, called the null model, includes covariance values set to zero for all observed variables, but there is no restriction on individual variable variances. The comparison includes the Chi-square values for the target model and the baseline model. Then, CFI ranges from 1.0, which implies good fit of the model to the baseline, to 0.0, which is poor fit of the model.

E8. Comparative Fit Index (CFI) Where "max" means to select the largest value of the possible choices, $\chi^2{}_T$ is the Chi-square value of the target model or model under evaluation, df_T is the degrees of freedom of the target model, $\chi^2{}_B$ is the Chi-square value of the baseline or null model, and df_B is the degrees of freedom of the baseline model

$$CFI = 1 - \frac{\max[(\chi^2{}_T - df_T), 0]}{\max[(\chi^2{}_T - df_{BT}), (\chi^2{}_B - df_B), 0]}$$

The equation E9 is the non-normed fit index (NNFI), also known as the Tucker-Lewis Index or TLI. This incremental fit index differs from CFI in that it can compensate for the effects of model complexity. This measure is important for this research in that it can more accurately measure fit for non-normal data and the complexity of modeling multiple observed variables and latent factors (Hu and Bentler 1999). NNFI ranges from 0 to 1, with the higher the value the better the fit. One caveat to NNFI is that values can sometimes be greater than 1, which can be difficult to decipher in some instances (Diamantopoulos and Siguaw 2000).

E9. Non-Normed Fit Index (NNFI) Where $\chi^2{}_T$ is the Chi-square value of the model under investigation (target model), df_T is the degrees of freedom of the target model, $\chi^2{}_B$ is the Chi-square value of the baseline model, and df_B is the degrees of freedom of the baseline model

$$NNFI = 1 - \frac{\frac{\chi_T{}^2}{df_T}}{\frac{\chi_b{}^2}{df_b}}$$

The adjusted goodness-of-fit fit index (AGFI) from equation E10 is an absolute fit statistic that considers the percentage of variance explained in the model. It measures the relative amount of variance and covariance in the model and determines the fit of the data based on the variance and covariance amounts (Bollen 1989). Drawbacks to this fit statistic are that AGFI is sensitive to sample size and the number of observed variables in a model. As the number of observed variables increases and the sample size is small in relation to the number of observed variables, the AGFI will tend to decrease. Further, the larger the sample size, the AGFI tends to increase regardless of the data (Bollen 1989). The AGFI statistic ranges from 0 to 1 with values closer to 1 representing better fit.

E10. Adjusted Goodness-of-Fit Index (AGFI) Where m is the number of observed variables in the model, df is the total degrees of freedom, $v_{residual}$ is the residual variance in the covariance matrix and v_{total} is the total variance of the covariance matrix

$$AGFI = 1 - \frac{m(m+1)}{2df}(1 - \left(1 - \frac{v_{residual}}{v_{total}}\right))$$

Further verification of convergent validity occurs by reviewing the standardized regression coefficients associated between each observed variable and the latent factor. The rule of thumb used in this evaluation is first to find statistically significant regression coefficients and second to have regression coefficients in the standardized estimate model that exceed 0.50 and ideally are greater than 0.70. Loadings found to be greater than 0.50 show that most of the variance in the model is explainable and confirms a strong relationship between the observed variables and the associated latent factor (Hair et al 2010).

Establishment of convergent validity also uses two statistically calculated values of average variance extracted (AVE) and construct reliability (CR). These two statistics verify convergent validity of the latent factors with one another. AVE (Equation E11) is the mean variance extracted from the observed variables that load on a latent factor and ultimately summarizes convergence. The guideline for AVE is to have values of 0.50 or greater, which suggests appropriate construct convergence. CR (Equation E12) is another type of reliability, similar to Cronbach's alpha. However, CR produces slightly different results than Cronbach's alpha and researchers commonly use CR in factor analyses (Hair et al 2010). The threshold for CR is for values to be above 0.70 in order to achieve significant reliability.

E11. **Average Variance Extracted (AVE)** The total of all squared regression coefficients (L_i) divided by the number of observed variable items (m)	$AVE = \frac{(\sum L_i)^2}{m}$
E12. **Construct Reliability (CR)** The squared sum of the regression coefficients (L_i) for each construct and the sum of the error variance (e_i)	$CR = \frac{(\sum L_i)^2}{(\sum L_i)^2 + (\sum e_i)}$

Determining discriminant validity of a CFA model requires building a path diagram that includes just one latent factor for all of the observed variables to load on. Researchers call this model an indiscriminant model, which should show worse fit statistically than the CFA model and should have smaller standardized regression coefficients. When this occurs in comparison to the true model, then I have achieved discriminant validity of the measurement model.

3.3.3.2 Content validity

Content validity is the extent that the meaning of the measures relates to reality. It focuses on the representativeness or sampling adequacy of the content of a measuring instrument (Abowitz and Toole 2010). Here, the research asks if the measures, which are operationalizing concepts, are the observed variables that seem by common sense to relate to the concept. The statement items for a construct need to measure the full domain of meaning implied by the label and based on the definition of the construct (Garson 2013). The lack of content validity for the contractual norm measures means the results of the study that uses the measures may potentially be rejected (Lucko and Rojas 2010).

Determining content validity is a subjective process of reviewing the results from the expert interviews and the pilot survey. The knowledgeable observations from the expert interviews provide evidence that the experts agree with the definition and content of each contractual norm measure and agree with one another.

The pilot survey provides further content validity evidence for the contractual norm measures. I provided a draft of the pilot survey and the responses I collected come from a small sample (n = 5) taken from the larger sample of construction industry owner agent professionals. Review of the responses and any comments takes place with each pilot survey participant to determine the validity of the content in the pilot survey, which establishes the content validity of the main survey questionnaire.

3.3.3.3 Nomological validity

Beyond construct and content validity, another form of validity is important to this research study. Nomological validity is a form of convergent validity that links operationalized constructs to one another in a nomological network, which represents how each operationalized construct should act in relation to one another (Gerbing and Anderson 1988; Cronbach and Meehl 1955).

For the nomological network of project integration, I expect to see observable correlations between the contractual norm factors (role integrity, reciprocity, contractual solidarity, flexibility, reliance and expectations, restraint of power, propriety of means, and harmonization of conflict). This means that as one contractual norm increases or decreases, this should affect the other contractual norms in some way, either positively or negatively. A representation of the nomological network that forms from the contractual norms is the path diagram for the confirmatory factor analysis with the contractual norms as first order latent factors related to the second order latent factor of integration. The idea is that integration acts as a better mediator over the first order factors and in essence establishes the efficacy of the measurement model (Liu et al 2012).

The resulting covariance estimates and standardized regression coefficients from the CFA model provide the details of the nomological network based on the uni-dimensional factor scales. Similar to the connection between establishing discriminant validity and uni-dimensionality, establishing nomological validity and uni-dimensionality for the operationalized constructs of the contractual norms needs to occur in order to increase the validity of results.

3.3.4 Assessing measures of project integration

The main data analysis for this research is to use structural equation modeling and factor analyses. To analyze the contractual norm constructs and the relationship between the contractual norms and project success, a two-step approach is employed (Anderson and Gerbing 1988). The two-step approach utilizes first a confirmatory factor analysis to evaluate the measurement model, which in this case is the contractual norm constructs that measure project integration. The second step is then to conduct a structural equation model evaluation that analyzes the structural model of the contractual norm factors to the project success factors.

Assessing the reliability and validity as well as determining unidimensionality for the contractual norm measures includes three steps: Evaluating each scale for reliability and inter-item correlations, conducting an exploratory factor analysis, and using a detailed confirmatory factor analysis. In each step, the observed variables and scales are checked to make sure the observed variables are uni-dimensional to the scale and that the scales are reliable and have convergent and discriminant validity.

3.3.5 Assess measurement scales using exploratory factor analysis

An exploratory factor analysis (EFA) is a statistical technique to assist with defining the underlying structure of the observed variables included in the analysis (Hair et al 2010). This analysis includes the observed variables as individual statement items across the eight contractual norm latent factors. It is important to note that this is an exploratory analysis in that it helps to establish statistical uni-dimensionality, reliability, and validity, but one must still consider the overarching theory that guides this research. With the high number of observed variables and latent factors, the results of the EFA may not be statistically perfect (Kline 2011), yet, the EFA assists with moving towards the confirmatory factor analysis and finally to the structural equation modeling analysis between the contractual norm constructs and the project success factors.

The EFA follows a 6-stage process as outlined by Hair et al (2010). Figure 3-8 summarizes the EFA process used.

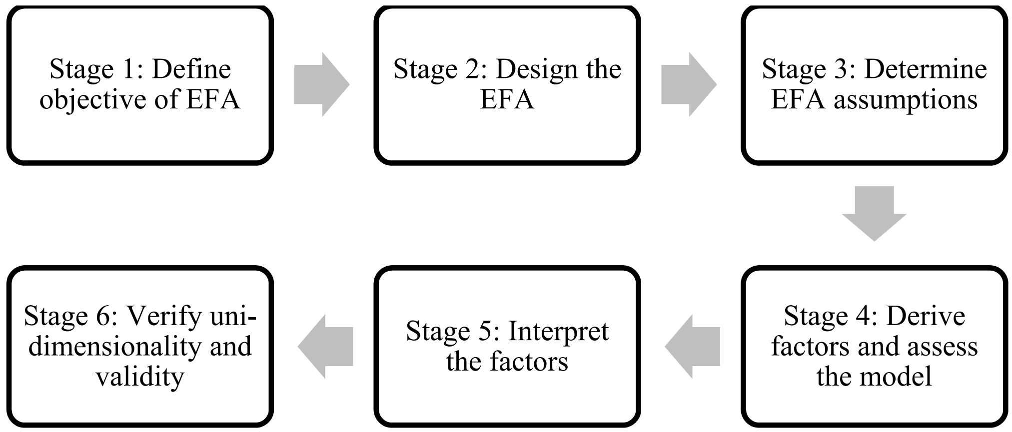

Figure 3-8: Exploratory factor analysis process

3.3.5.1 Objective of the EFA

In the first stage, I established the objective of conducting the EFA. The general purpose of using an EFA is to find a way to summarize the data information from the original number of observed variables into a more concise set of latent factors and observed variables while minimizing the loss of information (Fabrigar and Wegener 2012).

To begin, I had to specify the unit of analysis. This research is concerned with the referenced project and not the individual respondents. This is an R factor analysis, which identifies the dimensions not observed specifically called latent factors, based on the unit of analysis, which is the project.

The overarching theory of this research is relational contract theory and the eight contractual norms, which are established expected behaviors associated with all contracts regardless if the contract is a transaction or a relational experience (Macneil 1980). With that in mind, I utilized the EFA as a data summarization. The concept behind a data summarization EFA is to define the overall structure. This is useful for viewing the set of observed variables in a more generalized way, ranging from analyzing the individual observed variables, to the individual latent factor scales, and the overall grouping of all the observed variables to see how these latent factors represent a concept or theory. Therefore, the goal of data summarization factor analysis is to achieve defining the latent factors that adequately represent the initial set of observed variables (Hair et al 2010).

3.3.5.2 Design of the EFA model

In stage 2, I needed to consider the design of the EFA. I had to make three decisions during this stage. First, calculation of the correlation matrix needs to take place to meet the specified objectives of grouping observed variables. Second, the EFA has to account for the number of observed variables and the measurement properties of the observed variables. Third, achieving a sufficient sample size is a critical aspect so that the results are reliable and valid.

To start, I calculated the correlation matrix based on the cases using an R factor analysis. A critical component of factor analyses (and structural equation models) is that the main statistical calculations utilize the covariance matrix of the observed variables. For the analysis of the ordinal data collected from the survey, I am using a special type of correlation matrix called the polychoric correlation (PC) matrix that then helps to calculate the associated asymptotic covariance (AC) matrix. A typical correlation matrix for a factor analysis calculates the Pearson product-moment correlation coefficient between two observed variables, but this coefficient assumes that the observed variables in the pair are normally-distributed continuous variables (Bollen 1989). Ordinal data are not normally distributed nor continuous variables and therefore means, variances, and covariances of ordinal data have no interval or quantitative meaning (Jöreskog 1994). A polychoric correlation is a technique to calculate the correlation value that exists between two observed ordinal variables, based on the concept that the ordinal variables measure continuous latent factors (Flora and Curran 2004; Olsson 1979).

Related to the polychoric correlation is the use of the asymptotic covariance. I calculated the asymptotic covariance using the polychoric correlation matrix and estimated thresholds that bound the ordinal categories to a continuous underlying distribution (Jöreskog 1994). The statistical package *LISREL 9.1* determined the estimated thresholds using the univariate marginal distribution and the polychoric correlation matrix. The estimated thresholds and the polychoric correlations are asymptotically linear (Jöreskog 1994) and therefore the calculated covariance matrix is therefore asymptotic as well.

The second step in stage two is to include the observed variables termed to be reliable based on the results of the initial reliability analysis that uses Cronbach's alpha and the inter-item correlations. I accomplished this with the use of equations E3 and E4 to determine the reliability of the eight contractual norm scales and the reliability of each observed variable included in each scale.

For the last step in stage two, I considered the minimum sample size needed in order to complete a useful EFA. Generally, the minimum sample size should include 5 cases for each independent observed variable in the model (Hair et al 2010). For this research, there are 56 independent observed variables, meaning I needed to obtain a sample size of at least 280 fully responsive cases (5 x 56 = 280).

3.3.5.3 Addressing assumptions of EFA

Stage 3 addresses the assumptions in an EFA. The critical assumptions of an EFA are that they are more conceptual than statistical, but they do include statistics (Hair et al 2010). That is, although I am concerned with meeting statistical appropriateness, I am more concerned with the underlying character and composition of the observed variables and latent factors in the analysis.

To begin stage 3, I evaluated the overall measures for intercorrelations. In terms of factor analysis, a degree of collinearity (or intercorrelations) should exist in the model, lending itself to a nomological network of operationalized factors. I had to make sure that the observed variables show correlations with one another in order to produce latent factors and establish nomological validity. To do this, the polychoric correlation matrix needs to include intercorrelations between observed variable pairs above 0.30, with only a few that fall below this threshold. If the majority of the correlations fall below 0.30, then the factor analysis would not produce appropriate results.

I also used the statistics of Bartlett test of sphericity and the Kaiser-Meyer Olkin measure of sampling adequacy to check for intercorrelations. The Bartlett test of sphericity is a statistical test that approximates the Chi-square value and uses the degrees of freedom in the model to determine if the correlation matrix has significant correlations between most of the observed variables (Hair et al 2010). A large Chi-square and a significant p-value (<0.05) is the goal of the Bartlett test. The Kaiser-Meyer Olkin MSA is a statistical value that ranges from zero to one, with values closer to one representing adequate measures for predicting a latent factor without the inclusion of error/residual from other observed variables (Hair et al 2010).

3.3.5.4 Method of conducting the EFA

The fourth stage of the EFA is to determine the method for deriving the factors and assessing the factor model matrix. I accomplished this by determining the method of extracting the factors and the number of factors to extract that represent the underlying structure of the data model. The method of extraction can be one of two methods: principal component analysis (PCA) and principal axis factoring (PAF). A PCA is a method that considers the total variance and derives the latent factors using small portions of unique and error variance (Hair et al 2010). This method is more concerned with data reduction, which was not the goal of this research study. PAF is a method that only considers the shared or common variance and assumes that the unique error variances are not of interest in defining the structure of the model (Hair et al 2010). Researchers use PAF in situations of data summarization to identify the latent factors based on the observed variables, which is the purpose of this research. Therefore, I utilized PAF assessment in the EFA.

In selecting the number of latent factors to extract, there are multiple criteria for doing this. However, since I know the number of factors to include from the overarching relational contract theory, an *a priori* approach is used. That is, the eight contractual norms are the constructs for measuring integration and therefore the number of factors to extract is set to eight.

3.3.5.5 Interpreting the results of an EFA model

In stage five, I conducted the statistical EFA and interpreted the results. To do this however, there does not exist an unequivocal process that can determine the interpretation of factors, although the overarching relational contract theory provides a basis for the results and I needed to consider this theory when statistically analyzing the data. With the large number of observed variables and latent factors in this model, the EFA may not produce easily interpreted results, which is associated with the "garbage in – garbage out" motto. Therefore, it is important to not get lost in the statistics and include the conceptual theory in interpreting the EFA results.

Interpretation of factors is an iterative process of conducting the EFA multiple times with review of the factor matrix after each run to identify the significant loadings for each observed variable and then a review of any cross-loadings that show significance. In terms of convergent validity and taking into account the sample size of 314 cases, factor loadings are considered significant when values are greater than 0.30 (Hair et al 2010). I did not consider any factor loadings below the significant threshold.

A factor matrix can be difficult to interpret, especially when there are a high number of observed variables (greater than 30) and numerous latent factors in the model, which is the case here with this research. One way to simplify a factor matrix is to use factor rotation. Factor rotation is a process of rotating the reference axes about the origin to another position that simplifies the results. There are two factor rotations available, orthogonal and oblique. Orthogonal rotation involves rotating the axes so that the axes maintain a consistent 90 degrees to each other. Oblique rotation does not constrain the rotated axes to be 90 degrees between them. Orthogonal rotation is the more common approach, which allows independence to occur between factors. Oblique rotation on the other hand allows factors to correlate with one another to some extent. Oblique rotation plays more towards the nomological network of the latent contractual norm factors in that these factors do somewhat correlate as a part of the primary factor of integration. I used oblique rotation in the EFA.

Review of the oblique-rotated factor matrix involves looking for patterns in the observed variables across the factors as well as any cross-loadings that occurred. Cross loading occurs when an observed variable shows a significant factor loading on more than one latent factor. After reviewing the rotated factor matrix, I reviewed the communalities of each observed variable to determine if any of the observed variables are not adequately included in the factor analysis model. Communalities represent the amount of variance accounted for by the factor solution for each observed variable. Review of the communalities occurs to assess whether observed variables explain the latent factors in the model. For this research, communalities need to be greater than 0.40, taking into account the large number of observed variables in the model and the expected sample size (Fabrigar and Wegener 2012).

3.3.5.6 Establish uni-dimensionality, reliability, and validity of EFA model

The sixth stage involves evaluating the factor matrix for uni-dimensionality, convergent validity, and discriminant validity. Using the oblique-rotated factor matrix, I determined uni-dimensionality and discriminant validity by finding a pattern of observed variables that show factor loadings associated with one latent factor and no cross-loadings exist that I cannot explain. Significant factor loadings are any values found to be greater than 0.30, which helps to establish convergent validity. Instances when an observed variable had no significant loadings associated with any factor, is termed a non-significant observed variable and is subject to deletion from the analysis.

Discriminant validity can be determined using two different methods. The first is associated with the uni-dimensionality of the factor matrix as described above. The second method involves reviewing the factor correlation matrix. Review of the factor correlation matrix should show correlations between latent factors less than 0.70 to prove the existence of discriminant validity in the EFA model (Hair et al 2010).

3.3.6 Finalize measurement model using confirmatory factor analysis

A confirmatory factor analysis (CFA) is a type of structural equation model that deals with measurement models, specifically the relationships between the independent observed variables and latent factors. In applied research, CFA commonly helps researchers to evaluate and *confirm* theory-based multiple-item testing instruments using a variance-covariance structure (Brown 2006). The measures used in this research study are multiple statement items as observed variables (X_i), which are attempting to measure the latent factors of the eight contractual norms (ξ_i).

Creating and analyzing the CFA model requires the use of a six-step procedure. Using information from Hair et al (2010, Garson (2012), and Kline (2011), Hair et al (2010), and Brown (2006), I developed the procedure to use, as shown in Figure 3-9. I used a similar process for the structural equation modeling, which section 3.3.7 discusses in more detail.

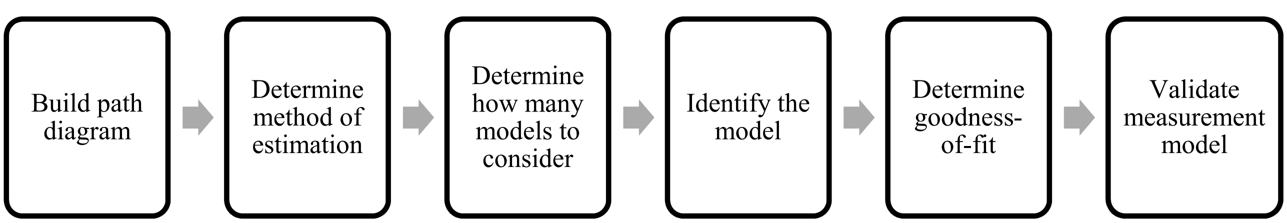

Figure 3-9: CFA model development procedure

3.3.6.1 Building the path diagram

Figure 3-10 illustrates the CFA path diagram model for one of the contractual norm factors, role integrity. This figure shows the observed variables, error variances and co-variances (δ_i), and the regression coefficients (also called factor loadings, λ_i). One other statistic, factor covariance ($\phi_{i,j}$), is also calculated, which is the covariance between each of the contractual norm factors. The path diagram is a graphical representation of the measurement model in question. The path diagram helps to establish an accurate model and to understand the relationships occur in the CFA. The CFA path diagram for this research is much more complex than the example shown in below.

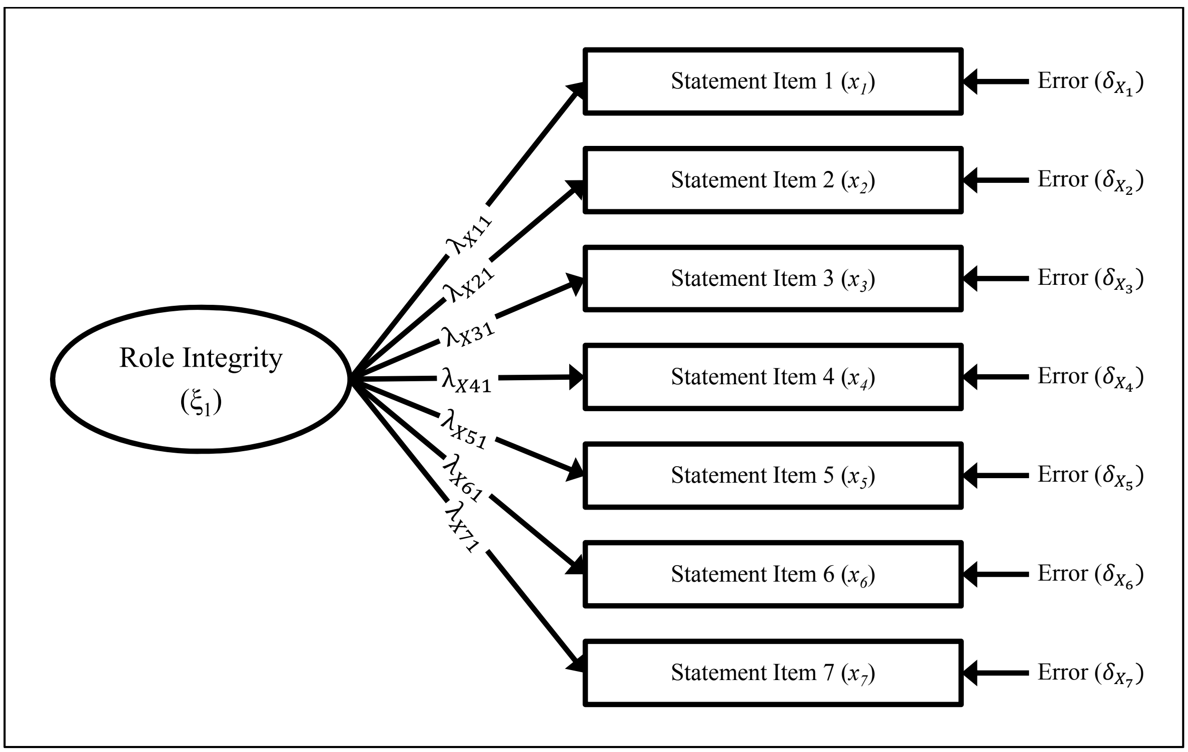

Figure 3-10: CFA model path diagram for role integrity latent factor

3.3.6.2 Determining the method of estimation

The data collection tool discussed in detail in the next section utilizes likert-scale ratings to measure the contractual norms. As previously mention, likert-scale measures are ordinal by design and a clear choice of handling ordinal data for structural equation modeling varies from treating the ordinal data as continuous (Vieira 2011), normalizing the ordinal data scores (Du Toit and Du Toit 2001), or understanding that ordinal data is not continuous data and should not be treated as such (Kline 2011; Bollen 1989). This research uses the third choice of treating the ordinal data as ordinal data and not as continuous or normalizing the scores. Therefore, in order to utilize the CFA appropriately with the ordinal data, I calculated the polychoric correlation matrix and the asymptotic covariance matrix for the observed variables that remain after completing the EFA. Section 3.3.5.2 discusses the polychoric correlation and asymptotic matrices in more detail.

Common CFA modeling utilizes maximum likelihood as the method of estimation. Maximum likelihood works best for CFA and structural equation modeling when the data is continuous and relies on the assumption that the data is normally distributed (Bollen 1989). Ordinal data is discrete data, which is not normally distributed, which makes maximum likelihood estimation inaccurate for this research. The use of maximum likelihood with ordinal data tends to inflate the error variances and can undermine the validity of conclusions drawn from the data (Flora and Curran 2004). Further, previous research shows that just using the polychoric correlations and asymptotic covariances with maximum likelihood estimation is inappropriate and produces incorrect test statistics and error terms (Flora and Curran 2004; Rigdon and Ferguson 1991).

To overcome the lack of multivariate normality, I initially used a different method of estimation called weighted least squares (Bollen 1989). Yet drawbacks exist with using weighted least squares (WLS) estimation, mainly that sample size need to be quite large, with some researchers suggesting a sample size greater than 1,000 (Forero et al 2009) and some conservative researchers suggest a sample size larger than 2,000 (Bollen 1989). Further, research studies reported that WLS inflates Chi-square statistics and negatively biases standard error estimates, particularly when sample size is small and the number of observed variables and latent factors in the model is large and complex (Dolan 1994; Potthast 1993). Another option, which I used throughout the CFA and structural equation modeling, is the use of a more robust version of WLS called diagonally weighted least squares (Flora and Curran 2004). Based on the work by Satorra and Bentler (1990), diagonally weighted least squares (DWLS) can compute robust Chi-square and other fit statistics by adjusting for non-normality (Mindrila 2010). I was able to determine from Flora and Curran (2004), and Satorra and Bentler (1990) that the use of *LISREL 9.1* for the CFA and structural equation modeling that DWLS is the most appropriate estimation technique for this research.

3.3.6.3 Identifying the CFA model

CFA models contain statistical values of regression coefficients, error variances, and factor variance. Regression coefficients are the regression slopes (factor loadings) for predicting the contractual norms latent factors from the observed variables. Error variance is the variability in a model that an observed variable or latent factor does not account for, or in other words, the measurement error. Factor variances describe the dispersion of the latent factor.

The statistical identification needs to be determined in order to know if a statistical software package can solve the model or not (Brown 2006). Determining statistical identification requires comparing the number of unknown parameters with the known elements of the input variance-covariance matrix. Over-identification occurs when the number of known elements is greater than the number of unknown parameters, which I need for the model to be solvable and the solution deemed admissible. One cannot solve under-identified models. Table 3-6 shows an example covariance input matrix for the role integrity contractual norm factor. This illustrates that there are 28 known pieces of information, as I can estimate the covariance between each pair of observed variables from the data set. Then, there are 14 unknown parameters, which are the 7 regression coefficients (λ_i) and the 7 error variances (δ_i). Therefore, there are more knowns (28) than unknowns (14), and the model is over-identified with 14 degrees of freedom (*df*) for the model.

Table 3-5: CFA covariance input matrix for Role Integrity

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	$\sigma_{1,1}$						
X_2	$\sigma_{1,2}$	$\sigma_{2,2}$					
X_3	$\sigma_{1,3}$	$\sigma_{2,3}$	$\sigma_{3,3}$				
X_4	$\sigma_{1,4}$	$\sigma_{2,4}$	$\sigma_{3,4}$	$\sigma_{4,4}$			
X_5	$\sigma_{1,5}$	$\sigma_{2,5}$	$\sigma_{3,5}$	$\sigma_{4,5}$	$\sigma_{5,5}$		
X_6	$\sigma_{1,6}$	$\sigma_{2,6}$	$\sigma_{3,6}$	$\sigma_{4,6}$	$\sigma_{5,6}$	$\sigma_{6,6}$	
X_7	$\sigma_{1,7}$	$\sigma_{2,7}$	$\sigma_{3,7}$	$\sigma_{4,7}$	$\sigma_{5,7}$	$\sigma_{6,7}$	$\sigma_{7,7}$

This CFA model uses eight latent factors. According to the framework used, 1) a minimum of three observable variables is required for each factor, 2) the latent factors need correlate with one another to some degree (i.e. nomological validity), and 3) the errors between each are to be uncorrelated so that goodness-of-fit evaluations can occur (Brown 2006).

3.3.6.4 Developing required CFA models

The CFA evaluation in this research requires the development of two models. The first model includes the eight contractual norms as the latent factors as first order factors. Once I confirmed the first-order CFA model, the second model created brings in the second-order factor of integration. The first order contractual norms then load onto the second order integration factor to determine that the contractual norms can in fact measure integration. After confirming the second-order model, including establishing unidimensionality, reliability, and validity, the measurement model statistically checks out, the next step is to compare the measurement model of project integration to project success using structural equation modeling.

3.3.6.5 Determining goodness-of-fit

This study utilizes guidelines found in Kline (2011), Hair et al (2010), Hooper et al (2008), Hu and Bentler (1999), and Bollen (1989) for evaluating the fit index statistics used (see equations

E5-E10). Obtaining reasonably good fit in terms of absolute fit and parsimony correction occurs based on thresholds outlined in Table 3-6 below. Social science researchers consider these threshold values as guidelines and achieving the fit thresholds across all six indices used in this research is not required for any of the factor models. Values that fall just outside of a threshold can still be considered acceptable as long as the other fit statistics do achieve the threshold and an explanation of the non-ideal value exists. Obtaining reasonable fit helps to establish convergent validity in the measurement model.

Table 3-6: Guidelines for achieving CFA statistical goodness-of-fit

	10 or less variables	**10 to 30 variables**	**30 or more variables**
χ^2 p-Value	Insignificant values possible	Significant values expected	Significant values expected
χ^2/ df	< 3	< 3	< 3
RMSEA	0.000 Excellent fit 0.000 – 0.050 Good fit 0.050 – 0.080 Acceptable	0.000 Excellent fit 0.000 – 0.050 Good fit 0.050 – 0.080 Acceptable	0.000 Excellent fit 0.000 – 0.050 Good fit 0.050 – 0.080 Acceptable
SRMR	< 0.080	< 0.080	< 0.080
CFI	≥ 0.95	≥ 0.92	≥ 0.90
NNFI	≥ 0.95	≥ 0.92	≥ 0.90
AGFI	≥ 0.90	≥ 0.90	≥ 0.90

Finally, standardized regression coefficients found in the CFA and structural equation models need to be greater than 0.50 to be included in the structural model and ideally, coefficients should be above 0.70. Coefficient values above 0.5 for all observed variables loading on a latent factor helps establish construct validity.

3.3.6.6 Validating the measurement model

Validity critical to the CFA analysis is establishing the two components of construct validity: convergent validity and discriminant validity. Convergent validity requires the use of the fit statistics and achieving good fit of the data to the model created. Also, convergent validity uses the average variance extracted (AVE) and construct reliability statistics (see equation E11). Discriminant validity uses a review of the standardized regression coefficients and the indiscriminant model to verify the existence of discriminant validity in the CFA model.

3.3.7 Analyze the relationship between integration and project success

Once I statistically assess the contractual norm scales and determine the scales to be reliable and valid, the next step is to proceed with a full structural equation model (SEM) statistical analysis using the confirmed contractual norms measurement model and adding the critical project success factors to create the structural model.

3.3.7.1 Structural equation modeling process

Conducting the SEM analysis follows the same procedure used for the CFA (see Figure 3-9), except now I add the project success factors to the model to compare and to understand the relationships that might exist between project integration contractual norms and CSFs. The regression coefficients, error variances, and squared multiple correlations (denoted as R^2) are the principal statistics to evaluate. Table 3-8 summarizes three types of factor analyses used to analyze the collected data.

Table 3-7: Factor analyses information

	EFA	CFA	SEM
Unit of analysis	The project	The project	The project
Type of data	Ordinal	Ordinal	Ordinal
Model identification	Analyze intercorrelations	Develop over-identified model for contractual norm measures	Develop over-identified model for contractual norms and CSFs
PC matrix / AC Matrix	Calculate with all contractual norm observed variables	Calculated with remaining observed variables from EFA	Calculate with contractual norms from CFA and include CSF observed variables
Method of estimation	Principal axis factoring with oblique rotation	Diagonally weighted least squares	Diagonally weighted least squares
Uni-dimensionality / Reliability / Validity	- Rotated pattern matrix - Cronbach's alpha - Inter-item correlations - Significant regression coefficients - Loading of similar observed variables on the same factor	- Goodness-of-fit statistics - Significant regression coefficients - Indiscriminant model	- Goodness-of-fit statistics - Significant regression coefficients - Squared multiple correlations (R^2) - Statistical validity - Follow-up interviews
Common method bias	NA	Harman's single factor test and common latent factor evaluation	Harman's single factor test and common latent factor evaluation
Spuriousness	NA	Review regression coefficients when building CFA models	Review regression coefficients when building SEM models

The EFA and CFA analyze the independent observed variables, which are the statement item measures associated with the contractual norm latent factors. For the SEM model, the independent and dependent observed variables are considered. For SEM, latent factors associated with independent variables are called exogenous factors while latent factors associated with dependent variables are called endogenous factors (Garson 2012). For this research, the contractual norms are the exogenous factors (ξ_i) and the CSFs of team chemistry, planning effort, and project objectives are the endogenous factors (η_i).

3.3.7.2 Structural equation analysis

The critical statistics associated with SEM is the evaluation of the standardized regression coefficients, the error variances, and the squared multiple correlations (called R^2). The SEM analysis produces a series of structural equations, similar to regression equations that relate the exogenous factors to each of the endogenous factors. The structural equations are the main results to analyze in order to determine the correlations the contractual norms have with project CSFs. Standardized regression coefficients and error variances found to be significant are key to understanding which contractual norms correlate with the different CSFs.

The statistical software package *LISREL 9.1* calculates the significance of the regression coefficients using t-scores. When a t-score shows significance at the 0.05 alpha level, then that regression coefficient or error variance does exist in relation to the CSF and influences that CSF. When a regression coefficient is non-significant, then that contractual norm does not influence the CSF. Further, when an error variance shows non-significance, the results become questionable, as this would mean that the structural model equation found no error in the data, which would be almost impossible considering that the data has to have at least sampling error (Bollen 1989).

After determining the significance of the regression coefficients and the error variances, the next evaluation is of R^2, which is the squared multiple correlation of the endogenous factors. R^2 represents the percentage of variance explained in a particular endogenous factor by the endogenous factors and associated observed variables (Garson 2012). Additionally, for this research, the *adjusted* R^2 is important for the structural equation models as this statistic takes into account the number of observed variables and exogenous latent factors in the model (Hair et al 2010). The R^2 and adjusted R^2 value for each structural equation describes the total amount of explained variance in the model by contractual norms that influence the outcome of project success. R^2 and adjusted R^2 range from 0 to 1, with values closer to one representing a way to measure how well the DWLS estimated structural equation performs in predicting the project success dependent factors (Mendenhall and Sincich 2003).

In this research, R^2 and adjusted R^2 values should range somewhere between 0.20 and 0.80 to be considered influential to project success. R^2 and adjusted R^2 values less than 0.20 imply that more than 80% of the variability is unexplained and that other major factors not considered in the model influence the CSF much more than the contractual norms. For values more than 0.80, the results might be questionable as this would imply that the contractual norms are explaining more than 80% of the variance in the model, which means that there is only a small influence from factors not considered in the model, which seems suspicious considering the research design and the fact that many other factors play into project success beyond proper behaviors.

While adjusted R^2 provides a better interpretation of the variance explained in each structural model equation, collinearity can still inflate the variance in each model (Hair et al 2010). Although the exogenous contractual norm factors are intercorrelated and represent a nomological network, if factors show high correlations with one another, there is the potential that the variance is biasing the model results. To check for variance inflation, the variance inflation factor (VIF) is calculated using equation E13 below. VIF uses a threshold of less than five to determine that collinearity is not an issue (Kline 2006).

E13. Variance inflation Factor (VIF) Where R_{adj}^2 is the adjusted squared multiple correlation for the structural model equation	$VIF = \frac{1}{1 - {R_{adj}}^2} < 5$

3.4 Assessing Validity of Results

During data collection, randomization and controlling all factors that may influence results helps to establish internal validity while continual replication and verification helps produce high external validity (Bernard 2013). Validity of results is critical to obtain so that results are not confounded due to an unaccounted external factor and so that other researchers can replicate the results and generalize them to a larger population. Validity of results requires the establishment of internal and external validity.

3.4.1 Validate results internally

Obtaining internal validity needs to occur before addressing external validity. When a research study has internal validity, the study demonstrates that a causal link between the hypothesized dependent factors and any changes seen in the dependent factors are more than likely due to the included independent factors and not some unknown or ignored source. Threats to internal validity occur when there are plausible other alternative explanations for any statistical association between factors (Abowitz and Tool 2010). In other words, lacking internal validity means that the results may be confounded with another factor or systematic error that I did not account for in this research study. Results without internal validity are in most cases useless.

3.4.1.1 Evaluate intercorrelations

EFA models need to achieve intercorrelation among the observed factors in order to conduct appropriate and accurate statistical equation modeling. To test for this, I will use the Bartlett test of sphericity. Additionally, I need to analyze the intercorrelations between the operationalized constructs for sampling adequacy. To do this, I utilize the Kaiser-Meyer Olkin measure of sampling adequacy (MSA).

3.4.1.2 Review internal consistency and goodness-of-fit

According to Creswell (2009), threats to interval validity "are experimental procedures, treatments, or experiences of the sample participants that threaten the researcher's ability to draw correct inferences from the data." Since the projects to study are in an uncontrolled environment, obtaining internal validity transpires in different ways. First, the use of SEM analysis isolates the effect of individual independent factors within a model (Montgomery et al. 2001). However, this is only the case if the data used contains internal consistency, which I test with Cronbach's alpha and Spearman's rho. Beyond internal consistency, I need to review goodness-of-fit statistics for the CFA and SEM models to satisfy internal validity (Lucko et al 2006). Further, establishing the nomological network of the operationalized constructs lends itself to internal validity of the project integration measurement tool.

3.4.1.3 Check for common method bias

Common method bias is a type of preconceived notion resulting from external sources. Common method bias is a concern for this research due to three potential sources of common method bias, listed in Table 3-8 (Podsakoff et al 2003). To reduce the effect of common method bias, I utilize reversed statement items, and a clear separation between dependent and independent variable statement items to control common method bias, and the use of Harman's single factor test as well as the unmeasured common latent factor method to test for common method bias statistically.

Table 3-8: Potential sources of common method bias for this research

Potential Source	Definition
Common rater effects	Any covariance that could result between the predictor and criterion observed variables due to the fact that the respondent providing the measures for these variables is the same
Independent and dependent variables measured using the same tool	Measuring different constructs measured at the same point in time may produce covariance that is independent of the content of the constructs themselves
Independent and dependent variables measured at the same point in time	Measuring different constructs with the same tool may produce covariance that is independent of the content of the constructs themselves

To check and control for common method bias in the measurement model, researchers can chose from many different approaches to designing a questionnaire and statistically testing common method bias. In order to determine the best methods for this research, Podsakoff et al (2003) provides a flowchart of the different methods. Based on the fact that the data for the independent and dependent observed variables has to be collected from the same source and that the source of the common method bias is generally unknown, the questionnaire design method of separating the independent variable statement items proximally from the dependent variable statement items and the use of reverse statement item measures are used to control for common method bias.

Separating the dependent observed variables from the independent observed variables requires the use of separate sections in the survey questionnaire to divide clearly the two from one another. Reverse statement items refer to statements that should have more responses in the negative categories such as “Strongly Disagree” and “Disagree”.

Statistically, I use two methods, Harman’s single factor test and the common latent factor method. Harman’s single factor test uses a factor analysis with the extraction set to one factor and a non-rotated solution. Review of the percentage of explained variance in the model should be less than 50% for the one extracted factor. This means that the one factor accounts for less than half of the variance in the model (MacKenzie and Podsakoff 2012; Podsakoff and Organ 1986).

The common latent factor method introduces an unmeasured latent factor to the CFA model. The unmeasured latent factor has all independent observed variables loaded onto it and the variance between the common latent factor and the observed variables is set to an arbitrary value. Then, the unstandardized regression coefficient for the loadings from the common latent factor will be the exact same. Squaring this value is then the shared common variance in the model. The smaller the common variance value, the better chance the model does not suffer from common method bias (Lowry et al 2013; MacKenzie and Podsakoff 2012). I also compare the common latent factor model to the CFA model to review the differences in the standardized regression coefficients. The difference in standardized regression coefficient values between the models should not exceed 0.223. The value of 0.223 represents less than 0.05 common variance in a model pair, although this value is not an established threshold (MacKenzie and Podsakoff 2012). However, having such a low common variance value would mean that common method bias is not an issue.

3.4.1.4 Test for spuriousness

A concern of CFA models that involve numerous latent factors is the presence of spurious relationships. A spurious relationship is one that occurs but is actually false or misleading (Hair et al 2010). If the size and nature of a relationship between two latent factors changes once I add an additional factor, then the relationship between the initial two factors might be false or spurious. To test for this, I create a CFA model in a manner of starting with two factors and proceeding to add one factor at a time. If any of the covariance estimated valued change considerably when adding another factor, then the model illustrates spurious relationships. If the covariance values do not change or only slightly change, then the model is non-spurious. A non-spurious relationship model allows appropriate conclusions to be drawn and can imply some causality in the results (Bollen 1989). In other words, the results and conclusions are stronger with non-spurious relationships than with spurious relationships present.

3.4.2 Validate results externally

Once internal validity is established, I then need to establish external validity. External validity refers to the overall ability to generalize causal effects to the population and use the results of the study (Luftig and Jordan 1998). The research questions for this study address project integration through contractual norms and comparing that to project success of construction projects. Along with the follow up interviews, the use of a wide spectrum of different delivery method projects and a random sample will assist with establishing external validity.

3.4.2.1 Achieving acceptable response rate

Since the data collection comes from a survey, the survey response rate is critical to ensure a large enough sample size to obtain external validity. High response rates for surveys in construction are a challenge that researchers continue to face (Lucko and Rojas 2010). Yet there are techniques to assist with improving the response rate. First, all individuals associated with CMAA and DBIA are contacted to determine their ability to respond. Each individual receives an introduction email cover letter explaining the research. Next, I provide the survey link via email to each potential participant. The use of reminders helps to increase the response rate. A similar process used in a study by Davis and Songer (2003) provided a response rate of 58.4%. This research aims to achieve a response rate of at least 20%.

3.4.2.2 Conducting follow-up interviews

Then, the use of follow-up interviews helps to improve internal and external validity (Bernard 2013). I interview seven survey participants along with the same eight interviewees I used to verify the relevancy and importance of contractual norms on construction projects. Presenting the results, I ask the interviewees to comment on why the correlations I found to exist between project integration and project success factors. The comments provide evidence confirming the statistical results. Further, the comments help to draw conclusions based on the confirmed results.

3.5 Chapter 3 Summary

Chapter three detailed the research methodology for this research study. Section 3.1 discussed the process of defining project integration through contractual norms. Section 3.2 discussed the development of the contractual norm measures, defining the project success factors and the development of the data collection tool. Section 3.3 discussed the tasks to analyze the measurement model and the structural model. Section 3.4 analyzed how to establish validity of the correlation results. The next two chapters detail the data analyses and results. Chapter 4 provides the analyses conducted on the collected data. Chapter 5 provides the fundamental results of this research study based on the data analysis.

CHAPTER 4. DATA ANALYSIS

The purpose of this chapter is to report results of the completed research and statistical analyses. For this research, the content analysis and expert interview results provided address question Q1. The factor analyses results provide evidence for answering questions Q2 and Q3. The data analyses in this chapter include a qualitative content analysis (CA), expert interviews, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and complex structural equation modeling (SEM).

4.1 Analyze Independent Research Factors

The initial step in this research was to define the independent research factors to measure project integration. The theory of relational contracting provided eight contractual norms (expected contractual behaviors) that I conceptualized to measure project integration. The sections below discuss how I was able to determine that the eight contractual norms do indeed have the ability to measure integration on design and construction projects.

4.1.1 Confirmation of independent research factors existing in construction projects

According to relational contract theory, the eight contractual of relational contract theory exist in all types of contracts. As the contractual norms increase in existence and intensity along the commercial exchange spectrum, the contract becomes more of a relational exchange (Macneil 1980). To determine the validity of relational contract theory towards construction contracts, the research conducted a CA with standard construction contracts using *NVivo*. The *NVivo* content analysis software package provides a range of tools for handling rich data sets by coding it visually and to various at categories (Richards 1999).

The inferences from the CA provide evidence that contractual norms are a part of construction contract language, and generally, standard construction contracts are relational. Table 4-1 provides the relative frequency of occurrences in each contract of each behavior norm based on the total occurrences across all of the standard contract documents. The relative frequencies provides evidence of contractual norms existing in construction contract language and establishes a link between relational contracting and construction contracts, a promising finding that helped to guide the expert interviews and development of the research concept and methodology. Patterns emerge from review of the frequencies of occurrences that provide evidence that IPD contracts are more relational than DBB, DB, or CMGC contracts. Note the zero frequencies as underlined and italicized. Refer to section 5.1 for a detailed discussion of the CA results.

Table 4-1: relative frequencies of contractual norm occurrences from the content analysis

Delivery Method	Contract	Role Integrity	Reciprocity	Flexibility	Contractual Solidarity	Reliance and Expectations	Restraint of Power	Propriety of Means	Harmonization of Conflict
DBB	**AIA A101/A201 2007**	*0%*	10%	20%	*0%*	10%	20%	10%	30%
	ConsensusDOCS 200	12%	24%	6%	5%	12%	*0%*	12%	29%
	EJCDC C-520/C-700	*0%*	10%	5%	*0%*	23%	29%	10%	23%
CMGC	**ConsensusDOCS 500**	10%	25%	5%	5%	*0%*	5%	15%	35%
DB	**AIA A141-2004**	*0%*	14%	14%	*0%*	24%	5%	10%	33%
	ConsensusDOCS 415	15%	25%	10%	*0%*	*0%*	*0%*	15%	35%
	DBIA 525/535	*0%*	24%	5%	10%	10%	*0%*	14%	37%
IPD	**AIA C191-2009**	19%	5%	14%	19%	6%	8%	15%	14%
	ConsensusDOCS 300	10%	21%	3%	29%	7%	9%	10%	11%
	General IFOA	10%	13%	7%	16%	20%	5%	10%	19%
	IPD Standard Agreement	14%	25%	7%	11%	7%	9%	9%	18%

4.1.2 Confirmation of relevancy and importance of independent research factors

I conducted each of the expert interviews in a semi-structured exploratory fashion, which helped to spark in-depth discussions on the contractual norms in relation to construction projects. I recorded and took notes for each interview. Each discussion provided thoughtful and interesting ideas that this research had not addressed or included up to this point in my methodology. Some shared the same or similar ideas about the contractual norms in relation to construction projects. Others provided information on how to improve the applicability of the contractual norms to construction project relationships. The experts interviewed provided comments on how well they understood the behavior norm as defined for this research. I reviewed the comments in detail and cross-compared the comments to all of the interviews to find similarities and difference. All of the interviewees understood the contractual norm and the connection to the construction industry. Discussion on the comments made that helped verify the CA as well as the importance and relevancy of the contractual norms to construction projects can be found in section 5.1 of the next chapter.

4.1.3 Confirmation of relationship between satisfaction and growth

The project objectives critical success factor utilized four success criteria of budget, schedule, quality, and functionality satisfaction. In order to show that the use of the budget and schedule satisfaction success criteria are appropriate to use in the SEM analyses, a correlation had to be determined between the budget satisfaction ratings and cost growth along with a correlation between schedule satisfaction and schedule growth.

4.1.3.1 Budget satisfaction and cost growth

As noted in section 3.3.1, budget performance data was not a required portion of the survey and respondents only provided initial and final budget information if it was readily available. Out of the 314 responses, 196 responses provided the optional budget performance information. From the 196 responses, I performed correlation analysis using Spearman's rho to find a relationship between budget satisfaction and budget performance. Table 4-2 shows the results of the budget correlation analysis. As the results illustrates, there is a significant negative correlation between budget satisfaction and cost growth, which means that as the cost growth increases, the satisfaction associated with the project budget decreases.

Table 4-2: Correlation between budget satisfaction and budget growth

Parameter	N	Spearman's rho	p-Value	R^2
Budget Satisfaction → Cost Growth	196	-0.299	0.001	0.089

4.1.3.2 Schedule satisfaction and schedule growth

For the correlation analysis of schedule satisfaction to schedule growth, 162 respondents provided the estimated and actual schedule information. The correlation analysis then used Spearman's rho to determine the relationship between schedule satisfaction and schedule growth. The results in table 4-3 confirm a significant relationship exists, which means as the schedule growth increases, then the overall satisfaction with achieving the schedule decreases. Confirming the negative correlations between satisfaction and growth provides evidence that evaluating project objectives in terms of satisfaction is sufficient for the structural model analyses with the contractual norms.

Table 4-3: Correlation between schedule satisfaction and schedule growth

Parameter	N	Spearman's rho	p-Value	R^2
Schedule Satisfaction → Schedule Growth	162	-0.348	0.000	0.121

4.2 Analyze the Measurement Model

A total of 314 cases represent the sample size used in the analyses below. With the sample size known, first step of the data analysis focused on analyzing the contractual norm scales. I needed to evaluate the contractual norm scales for uni-dimensionality, reliability, and validity before conducting analyses to determine the functionality of the eight constructs.

4.2.1 Data collection

Establishing the contractual norms as measures and incorporating the project success factors, I distributed the data collection tool (the survey) first as a pilot to refine the survey. Then, I distributed the refined survey to over 2,000 construction managers/owners/owner representatives to collect the primary data. This section summarizes the findings of the pilot survey and the demographics of the survey responses.

4.2.1.1 Pilot survey

With the information gathered from the content analysis and the expert interviews, I drafted and distributed the pilot survey to eight construction managers for testing. In each instance, the respondent received the survey via email with instructions to complete the survey. After completing the survey, a phone interview took place between the respondent and the researcher.

The pilot surveys and phone interviews provided contributions to improve the survey for the main data collection. First, the respondents helped to disseminate the sections of the survey that would provide the data needed as well as the sections that needed improvement. The respondents suggested randomizing the contractual norm sections to reduce survey fatigue. Then, I reduced the statement items for each contractual norm to seven statement items for each contractual norm. Also, I have divided the project success factors by phase of the project rather than by CSF. Shuffling the order of the project success factor statement items helps to reduce the potential for common method bias. Finally, to reduce the complexity of respondents having to find specific project information, I was able to make the budget and schedule section optional. I incorporated all of these ideas into the final version of the survey questionnaire.

4.2.1.2 Survey questionnaire

The survey acted as the primary data collection tool for this research. As stated, the intent was to collect responses from a survey audience of owners and owner agents. Two distinct lists of contacts comprised the total survey distribution. The first was the list of construction managers/owners registered with the Construction Management Association of America (CMAA) as well as CMAA's registry of certified construction managers (CCM). The CMAA list provided

1,317 contacts. The second list included owners registered with the Design-Build Institute of America (DBIA). The DBIA list provided another 809 contacts. I distributed the survey via email to 2,216 contacts. Of these contacts, 1,567 respondents acknowledged receiving the survey, the rest of the invitations did not go through to the contact's email or the email was no longer active. At the close of four weeks of collecting responses, 499 respondents started or completed a survey. Of these 499 responses, I determined that 314 were fully responsive and were acceptable for the data analysis, which represents a response rate of 20%. I removed 137 survey responses that were not complete. Then, I removed 42 surveys that were complete, but the respondent took less than 10 minutes to complete the survey. The average time to complete the survey was 25 minutes, meaning respondents taking 10 minutes or less did not try to answer the questions accurately. Finally, I removed 6 responses that showed signs of common method bias, that is, the respondent marked "neutral" across all 56 contractual norm statement items and across all 20 of the project success statement items. The demographics of the responses are as follows along with details shown in table 4-4:

- All of the cases collected included project completed no earlier than 2009 and all of the projects were completed within the United States;
- The project cases represented seven types of projects: Education/institutional, government, medical, commercial, residential, industrial, and infrastructure projects; and
- Of the responses, 254 specified that their firm was the owner, owner's representative, or construction manager agency for the project, 32 specified their role as program manager, and the remaining 28 did not respond.

Table 4-4: Type of project and delivery method for survey responses

	DBB	DB	CMGC	Multi-Prime	IPD	Other	TOTAL
Education/ Institutional	32	12	21	2	0	11	78
Government	20	29	7	1	1	5	63
Medical	8	10	8	1	6	1	34
Commercial	13	12	8	2	0	4	39
Industrial	6	3	1	0	2	2	14
Infrastructure	52	18	4	2	0	5	81
Not Specified	2	1	0	0	0	2	5
TOTAL	133	85	49	8	9	30	314

I collected a wide range of project types and delivery methods from the individual responses. I found that the majority of projects utilized DBB, then DB, and finally CMGC. The number of IPD projects is nine, which is too small to analyze just the IPD projects. This is unfortunate, but somewhat expected since the U.S. construction industry has only completed a few dozen IPD projects. With the lack of a sufficient sample size for IPD projects, an analysis across the delivery method spectrum cannot accurately occur. Future research can investigate IPD projects further once more IPD are completed.

The initial thought was to collect responses from building construction projects only since IPD projects completed in the United States are currently found in vertical construction only, mostly in medical facilities. However, many CMAA and DBIA members are associated with firms that build infrastructure projects, mainly water/wastewater, highway, and rail projects. Also, with the state of the recessive economy from when these projects were completed (2008-2013), one can see that more infrastructure projects were completed than vertical construction projects due to the federal programs initiated to spark the construction economy (e.g. American Recovery and Reinvestment Act). This explains why the majority of the responses referenced an infrastructure project. Eliminating the 81 infrastructure projects would reduce the sample size to 233, which would reduce the sample size to less than the minimum sample size needed (280) for the factor analyses.

4.2.2 Initial scale reliability analysis

The first step was to utilize SPSS and the scale reliability function to calculate Cronbach's alpha. Also, the statistics collected included the inter-item correlations. As stated earlier, Cronbach's Alpha needs to be greater than 0.70 to show acceptable reliability (Cronbach 1990; 1951). Then, in terms of the inter-item correlations, observed variables that are less than 0.3 are questionable and I may remove them. Table 4-5 outlines the final results of the scale reliability tests conducted in SPSS.

Table 4-5: Initial scale reliability analysis

Observed Variable	Cronbach's Alpha	Inter-Item Correlations	Observed Variable	Cronbach's Alpha	Inter-Item Correlations
Role Integrity			**Reliance and Expectations**		
RI1	0.846	0.527	RE1	0.869	0.733
RI2		0.778	RE2		0.643
RI3		0.584	RE3		0.520
RI4		0.728	RE4		0.651
RI6		0.705	RE5		0.705
RI7		0.471	RE6		0.791
			RE7		0.499
Reciprocity			**Restraint of Power**		
RC1	0.926	0.815	RP1	0.867	0.529
RC2		0.662	RP2		0.699
RC3		0.837	RP3		0.613
RC4		0.782	RP4		0.649
RC5		0.653	RP5		0.596
RC6		0.789	RP6		0.747
RC7		0.840	RP7		0.649
Flexibility			**Propriety of Means**		
FL1	0.898	0.636	PM1	0.774	0.479
FL2		0.800	PM2		0.600
FL3		0.777	PM3		0.703
FL4		0.780	PM4		0.542
FL5		0.837	PM7		0.441
FL6		0.536			
FL7		0.626			
Contractual Solidarity			**Harmonization of Conflict**		
CS1	0.938	0.804	HC1	0.858	0.680
CS2		0.716	HC2		0.585
CS3		0.815	HC3		0.651
CS4		0.826	HC4		0.617
CS5		0.849	HC5		0.540
CS6		0.711	HC6		0.687
CS7		0.863	HC7		0.672

Of the eight scales, only role integrity and propriety of means had items dropped. For role integrity, RI5 had an inter-item correlation of 0.167, while the role integrity scale had a Cronbach's alpha of 0.796. With RI5 removed, Cronbach's alpha increased to 0.846. For the Propriety of Means scale, PM5 had an inter-item correlation of 0.228 and the scale had a Cronbach's alpha of 0.729. After dropping PM5, PM6 then showed an inter-item correlation of 0.285, while the scale improved with an alpha of 0.751. Finally, dropping PM6 provided a reliable scale with Cronbach's alpha of 0.774. In summary, the eliminated observed variables are RI5, PM5, and PM6, leaving 53 observed variables across 8 latent factors for the next step, the EFA.

4.2.3 Exploratory Factor Analysis

With the scales found to be reliable, the next step was to conduct the EFA. The objective of the EFA is to search for and define the fundamental constructs that underlie the remaining 53 observed variables from a sample size of 314. The EFA utilized a principal axis factoring method with oblique rotation. The following sections outline the statistical analyses performed during the EFA.

4.2.3.1 Intercorrelations analysis

To check for intercorrelations and to make sure that the collect data is appropriate for factor analysis, I first calculated the polychoric correlation matrix and the asymptotic covariance matrix using LISREL. In reviewing the polychoric correlation (PC) matrix for the 53 observed variables, there are 1,431 correlation coefficients that represent 1,431 combinations of observed variable pairs. Of these, there are 172 correlation coefficients less than 0.30. Having only 12% of correlation coefficients less than 0.30 allows accurate factor analyses to be conducted (Hair et al 2010). Appendix C provides the complete polychoric correlation coefficient matrix.

Next, I assessed intercorrelations further using Bartlett test of sphericity and Kaiser-Meyer-Olkin measure of sample adequacy (MSA). The results of these tests are in Table 4-6. As the table shows, the Bartlett test is significant (p-Value = 0.000), and the MSA value is 0.966, which falls in the marvelous range (Hair et al 2010). This means the overall data set is appropriate for an EFA.

Table 4-6: Intercorrelations statistical tests for polychoric correlation matrix

MSA and Bartlett's Test of Sphericity		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.966
Bartlett's Test of Sphericity	Approx. Chi-Square	13,116.614
	Degrees of Freedom	1,378
	Significance (p-Value)	0.000

In addition to analyzing the entire correlation matrix for intercorrelations, I had to analyze each of the observed variables for MSA. Using SPSS, the anti-image correlation matrix provides the MSA value for each observed variable. Table 4-7 details the MSA values for the observed variables. All MSA values are greater than 0.70, meaning I did not delete any further observed variables from the model and that I can continue the analysis using the 53 observed variables.

Table 4-7: Intercorrelations analysis for individual independent observed variables

Observed Variable	MSA	Observed Variable	MSA	Observed Variable	MSA	Observed Variable	MSA
RI1	0.960	RC1	0.981	FL1	0.957	CS1	0.984
RI2	0.980	RC2	0.969	FL2	0.970	CS2	0.978
RI3	0.965	RC3	0.981	FL3	0.975	CS3	0.979
RI4	0.974	RC4	0.981	FL4	0.949	CS4	0.969
RI6	0.975	RC5	0.970	FL5	0.952	CS5	0.974
RI7	0.951	RC6	0.975	FL6	0.925	CS6	0.974
		RC7	0.979	FL7	0.953	CS7	0.979
Observed Variable	**MSA**	**Observed Variable**	**MSA**	**Observed Variable**	**MSA**	**Variable**	**MSA**
RE1	0.969	RP1	0.942	PM1	0.932	HC1	0.965
RE2	0.966	RP2	0.925	PM2	0.947	HC2	0.957
RE3	0.973	RP3	0.951	PM3	0.957	HC3	0.975
RE4	0.956	RP4	0.913	PM4	0.965	HC4	0.970
RE5	0.969	RP5	0.969	PM7	0.972	HC5	0.951
RE6	0.966	RP6	0.923			HC6	0.968
RE7	0.947	RP7	0.915			HC7	0.960

4.2.3.2 Interpretation of factor model matrix

Using *SPSS*, the factor analysis was set up with the 53 observed variables. The extraction method was set to PAF with 8 latent factors the goal of the extraction. The rotation was then set to “Oblimin”, the *SPSS* version of oblique rotation. After each run, the analysis of the rotated factor matrix showed the significant factor loadings and I reviewed the communalities. If I found an observed variable to be non-significant, I dropped it from the model. If an observed variable has a communality below 0.4, I dropped that variable from the model. I dropped only one observed variable at a time, and then ran the EFA again. In each case that I dropped an observed variable, I re-specified the model and ran it again. This was done over dozens of iterations until a structured rotated factor matrix was found and communalities of all remaining observed variables are greater than 0.40.

After many iterations and re-specifications, table 4-8 summarizes the final EFA model. In total, the EFA eliminated 15 observed variables from the model. The Kaiser-Meyer-Olkin MSA for this matrix is 0.978, well within the acceptable range. Also, I found Bartlett’s test of sphericity to be significant with a p-Value of 0.000.

Table 4-8: Rotated Pattern Factor Matrix

	Factors								Communalities	
Var.	**1 (CS)**	**2 (FL)**	**3 (RP)**	**4 (RC)**	**5 (RE)**	**6 (HC)**	**7 (RI)**	**8 (PM)**	**Initial**	**Extract**
RI2							**0.469**		0.717	0.742
RI3				0.330			**0.300**		0.482	0.462
RI4							**0.384**		0.662	0.643
RI6							**0.547**		0.611	0.663
RC4				**0.433**					0.644	0.646
RC5				**0.554**					0.531	0.518
RC6				**0.545**					0.756	0.769
RC7				**0.485**					0.797	0.789
FL1		**0.534**							0.560	0.544
FL2		**0.646**							0.759	0.755
FL3		**0.620**							0.731	0.717
FL4		**0.791**							0.727	0.713
FL5		**0.801**							0.802	0.808
FL6		**0.565**							0.417	*0.365*
FL7		**0.522**							0.524	0.496
CS1	**0.353**				0.314				0.723	0.712
CS2	**0.320**								0.638	0.658
CS3	**0.333**								0.743	0.705
CS4	**0.446**								0.781	0.776
CS5	**0.396**						0.308		0.817	0.808
CS6	**0.346**								0.614	0.563
CS7	**0.386**								0.797	0.762
RE1					**0.536**				0.706	0.723
RE4					**0.456**				0.565	0.551
RE5					**0.499**		0.300		0.624	0.691
RE6					**0.518**				0.761	0.778
RP1			**0.685**						0.525	0.594
RP2			**0.502**						0.348	*0.380*
RP3			**0.683**						0.579	0.621
RP5			**0.469**						0.558	0.560
PM1								**0.560**	0.360	*0.385*
PM2				0.652				**0.382**	0.626	0.705
PM3				0.382				**0.487**	0.652	0.711
PM4								**0.483**	0.499	0.493
HC1						**0.459**			0.557	0.582
HC2						**0.761**			0.502	0.643
HC3						**0.673**			0.519	0.507
HC4						**0.654**			0.534	0.533

The EFA results in table 4-8 represent the model that this research hypothesized as it does illustrate that the EFA contains uni-dimensional factors and discriminant validity based on the significant factor loadings grouped together under the contractual norm factors. The value to signify a significant factor loading is 0.30, and I did not show any factor loadings less than this in the pattern matrix above. The significant loadings grouped toward the eight factors helps to demonstrate that the model has convergent validity as well.

I do need to discuss the discrepancies in the EFA model, which include the significant cross-loadings and the communalities listed as less than 0.30. In terms of cross-loadings, six factors (RI3, CS1, CS5, RE6, PM2, and PM3) show significant cross-loading with other factors. First, I did expect cross-loadings to some extent since the contractual norms are a part of a nomological network and I expect the norms to correlate with one another. Second, only RI3 and PM2 have cross-loadings that are larger than the factor loadings found in the grouping of observed variables under a latent factor. Yet when I drop these two observed variables, it effects other RI and PM statement items that are then cross-loading with other latent factors or show non-significant factor loadings. In this case, I would have had to drop even more items. Considering that I already removed 33% of the items using EFA, I felt removing more items would lessen the strength of the data set. So, I kept RI3 and PM2 in the model. In summary, the cross-loadings are not ideal to this research, yet, the cross-loadings were to be expected and the few that exist should not affect the steps of the analysis going forward.

Review of the communalities of the factors shows that FL6 (0.365), RP2 (0.380), and PM1 (0.385) are less than the guideline of greater than 0.40. However, reviewing the factor loadings of FL6 (0.565), RP2 (0.502), and PM1 (0.560) showed that all three are significantly loading with similar items of the same factor and therefore were kept in the model. Removing these items from the model negatively affected other items, which would make the results less ideal.

Another way to verify discriminate validity is to review the factor correlation matrix, shown in Table 4-9. For discriminant validity to exist, none of the factors should produce an absolute factor correlation coefficient greater than 0.70 (Hair et al 2010). In this case, there are no factors correlated above 0.70. The largest correlation is 0.563, which occurs between factor 1 and factor 2. This does show the establishment of discriminant for the EFA factor matrix.

Table 4-9: Factor Correlation Matrix

Factor	1	2	3	4	5	6	7	8
1	1.000	0.563	0.446	0.283	0.345	0.475	0.406	0.410
2	0.563	1.000	0.509	0.315	0.396	0.548	0.395	0.342
3	0.446	0.509	1.000	0.219	0.296	0.429	0.347	0.316
4	0.283	0.315	0.219	1.000	0.340	0.338	0.328	0.352
5	0.345	0.396	0.296	0.340	1.000	0.393	0.431	0.285
6	0.475	0.548	0.429	0.338	0.393	1.000	0.402	0.375
7	0.406	0.395	0.347	0.328	0.431	0.402	1.000	0.421
8	0.410	0.342	0.316	0.352	0.285	0.375	0.421	1.000

4.2.4 Final scale reliability analysis

With the factor matrix determining the items associated with each contractual norm scale, I had to re-evaluate the reliability of the scales with the remaining items. This analysis utilized Cronbach's alpha in *SPSS* for the scale overall and inter-item correlations for the individual items. Cronbach's alpha needs to be greater than 0.70 and the inter-item correlations need to be greater than 0.30. Refer to table 4-10 for a summary of the reliability analysis results. For the scales that had items removed, the Cronbach's alpha value improved. Also, all of the inter-item correlations are well above 0.30, with the lowest value occurring with RP2 at 0.471.

Table 4-10: Reliability Analysis of EFA model

Scale	Cronbach's Alpha	Inter-Item Correlations	Scale	Cronbach's Alpha	Inter-Item Correlations
Role Integrity			**Reliance and Expectations**		
RI2	0.851	0.759	RE1	0.877	0.775
RI3		0.599	RE4		0.667
RI4		0.731	RE5		0.716
RI6		0.685	RE6		0.794
Reciprocity			**Restraint of Power**		
RC4	0.884	0.720	RP1	0.778	0.610
RC5		0.680	RP2		0.471
RC6		0.785	RP3		0.670
RC7		0.818	RP5		0.592
Flexibility			**Propriety of Means**		
FL1	0.898	0.636	PM1	0.772	0.497
FL2		0.800	PM2		0.582
FL3		0.777	PM3		0.709
FL4		0.780	PM4		0.528
FL5		0.837			
FL6		0.536			
FL7		0.626			
Contractual Solidarity			**Harmonization of Conflict**		
CS1	0.938	0.804	HC1	0.797	0.590
CS2		0.716	HC2		0.626
CS3		0.815	HC3		0.632
CS4		0.826	HC4		0.612
CS5		0.849			
CS6		0.711			
CS7		0.863			

4.2.5 Confirmatory Factor Analysis

For the CFA, I utilized *LISREL 9.1* as the main software package for the CFA and SEM statistical evaluations. *LISREL 9.1* allows the calculation and utilization of the PC matrix and the asymptotic covariance (AC) matrix for the CFA of the measurement model and the SEM structural model. The PC matrix and the AC matrix better represent ordinal variables in the model and reduce the bias in estimating the results using maximum likelihood (ML) evaluation, which assumes multivariate normality (Kline 2011; Bollen 1989). Using the PC matrix and AC matrix requires the use of weighted least squares (WLS) estimation in the CFA and SEM. Traditional WLS estimation requires large samples sizes (n > 2,000) for the calculations to work properly in *LISREL 9.1*. Due to this constraint and the sample size of 314 for this research, I decided to use diagonally weighted least squares (DWLS) estimation instead of WLS. DWLS is a more robust variation of WLS that can handle smaller samples sizes ($n < 500$) and can effectively evaluate models that are complex or include many observed variables, meaning the DWLS estimation is the most appropriate method to use.

I used three tasks in conducting the CFA. First, I created and analyzed each contractual norm factor as an independent scale analysis. For the second and third tasks, I developed two CFA measurement models for evaluation. The first includes the eight contractual norms as first-order factors that include covariance values between each factor. The second model created uses the second-order factor of integration, which includes calculating regression coefficients from the integration factor to the first-order contractual norm factors. I completed the independent scale analysis first to make sure that a full CFA was a possibility. Then, I completed of the first-order CFA model analysis to make sure the model fits statistically and the standardized regression coefficients fall within the acceptable range. If the first order CFA model cannot achieve proper fit or includes low standardized regression coefficients, then developing the second order factor would be meaningless.

4.2.5.1 Independent scales CFA models

I created a path diagram for each contractual norm scale as well as calculated χ^2 and the associated p-Value, χ^2/df, RMSEA, SRMR, CFI, NNFI, and AGFI statistical fit values. I also checked for common method bias in each scale. For each scale to be acceptable, the fit statistic values must fall within the threshold as specified in Table 3-6. Table 4-11 summarizes the goodness-of-fit statistical values for each scale on an independent basis, taken from *LISREL 9.1*. Then, Figure 4-1 through Figure 4-8 below illustrates the path diagrams used for each scale.

Table 4-11: Independent Scales Goodness-of-fit statistics

Contractual Norm	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
RI	0.649 (0.7182)	2	0.325	0.0000	0.0082	0.999	0.999	0.998
RC	4.715 (0.0947)	2	2.358	0.0768	0.0163	0.997	0.992	0.991
FL	41.942 (0.0001)	14	2.996	0.0609	0.0316	0.991	0.986	0.985
CS	23.545 (0.0520)	14	1.682	0.0442	0.0245	0.997	0.996	0.999
RE	3.240 (1.9791)	2	1.620	0.0333	0.0193	0.999	0.996	0.997
RP	5.304 (0.0705)	2	2.652	0.0777	0.0281	0.994	0.981	0.993
PM	2.726 (0.2559)	2	1.363	0.0237	0.0201	0.999	0.996	0.997
HC	4.487 (0.1061)	2	2.244	0.0553	0.0262	0.997	0.990	0.992

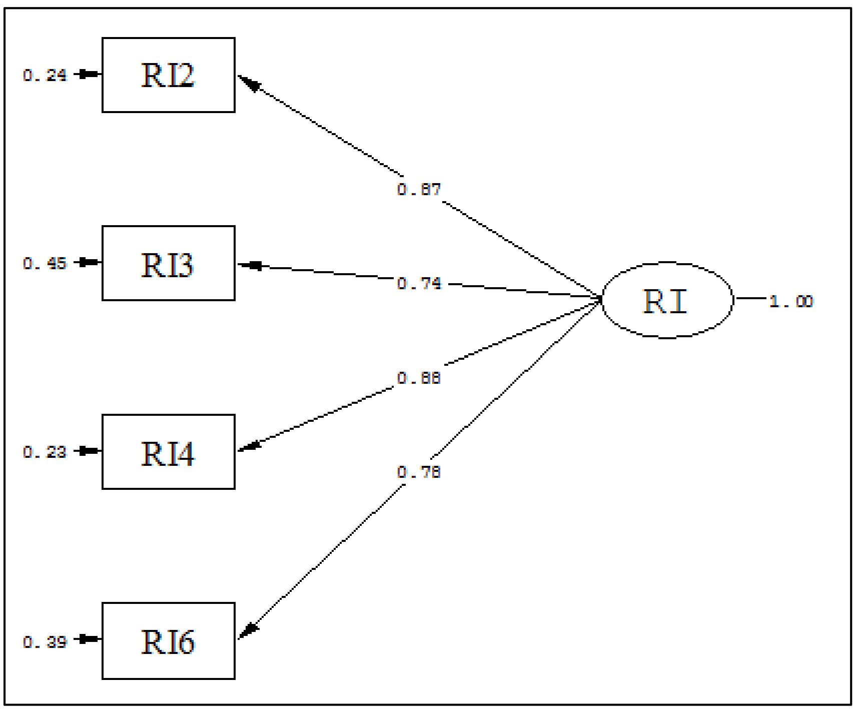

Figure 4-1: Path diagram for Role Integrity (RI) Scale

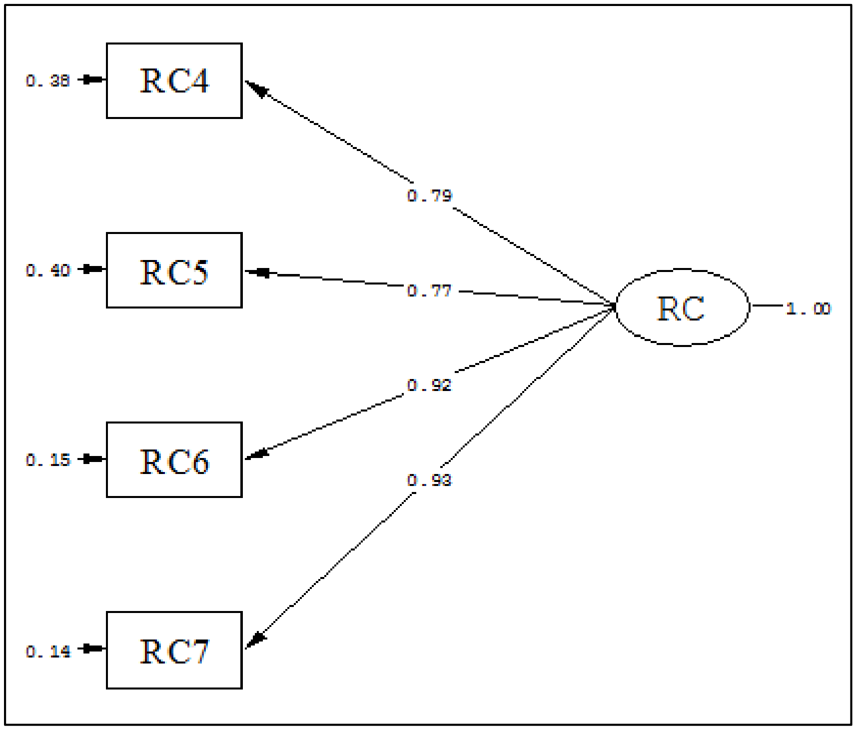

Figure 4-2: Path Diagram for Reciprocity (RC) scale

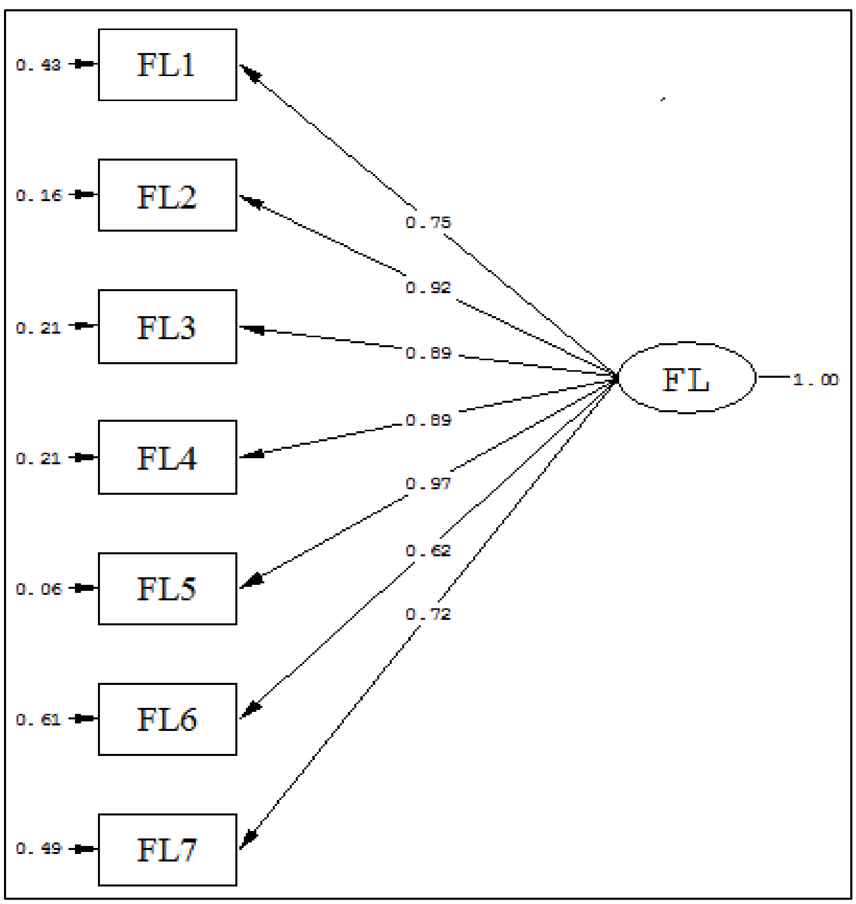

Figure 4-3: Flexibility (FL) scale path diagram

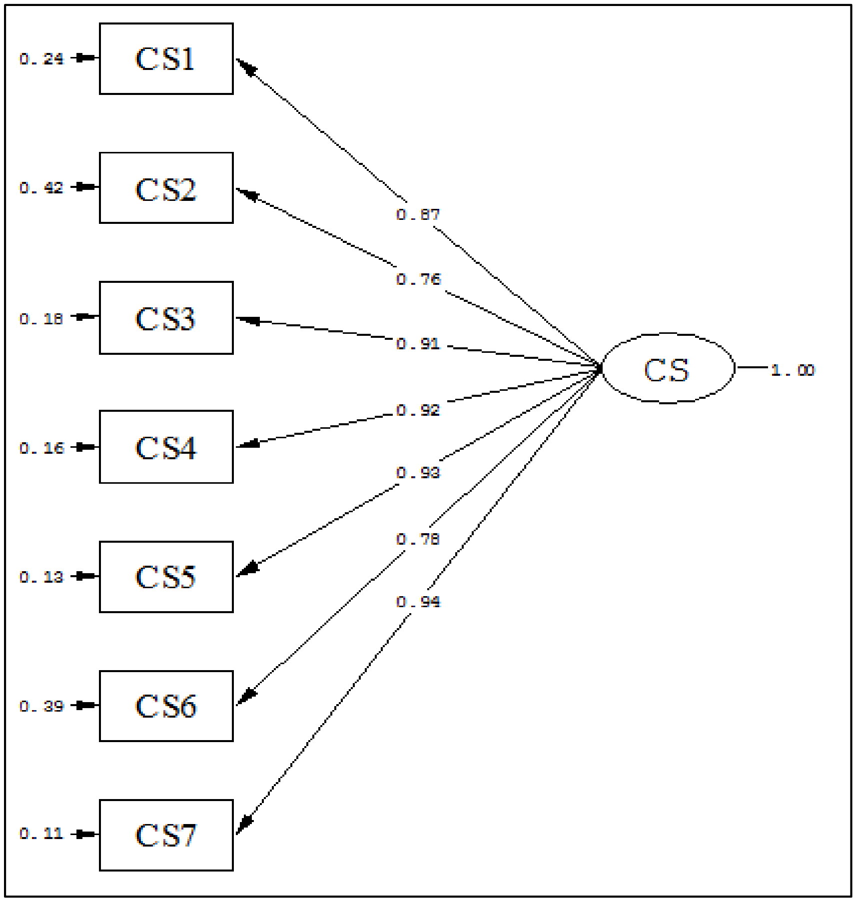

Figure 4-4: Contractual solidarity (CS) scale path diagram

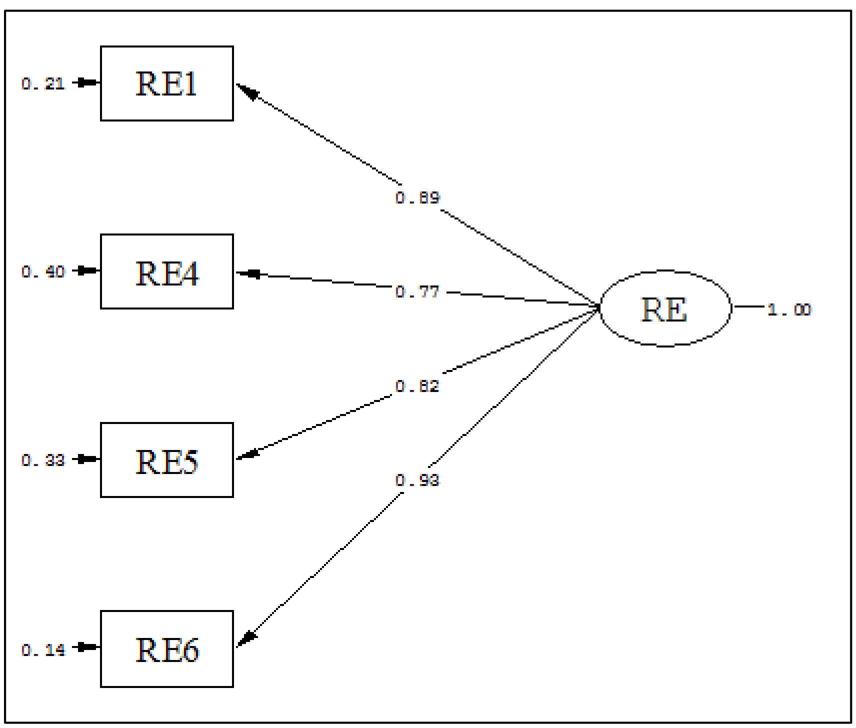

Figure 4-5: Reliance and expectation (RE) scale path diagram

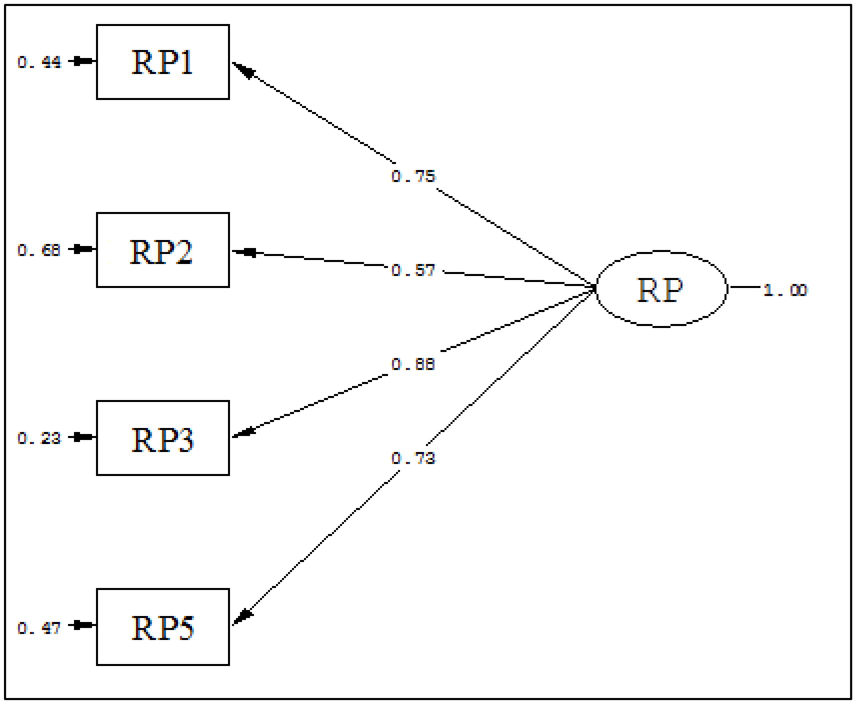

Figure 4-6: Restraint of power (RP) scale path diagram

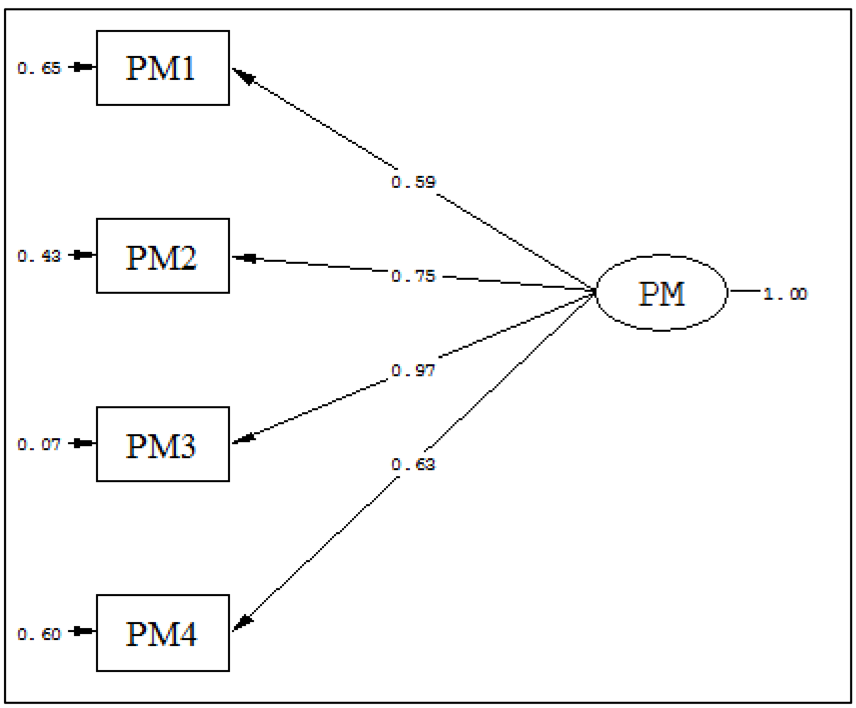

Figure 4-7: Propriety of means (PM) scale path diagram

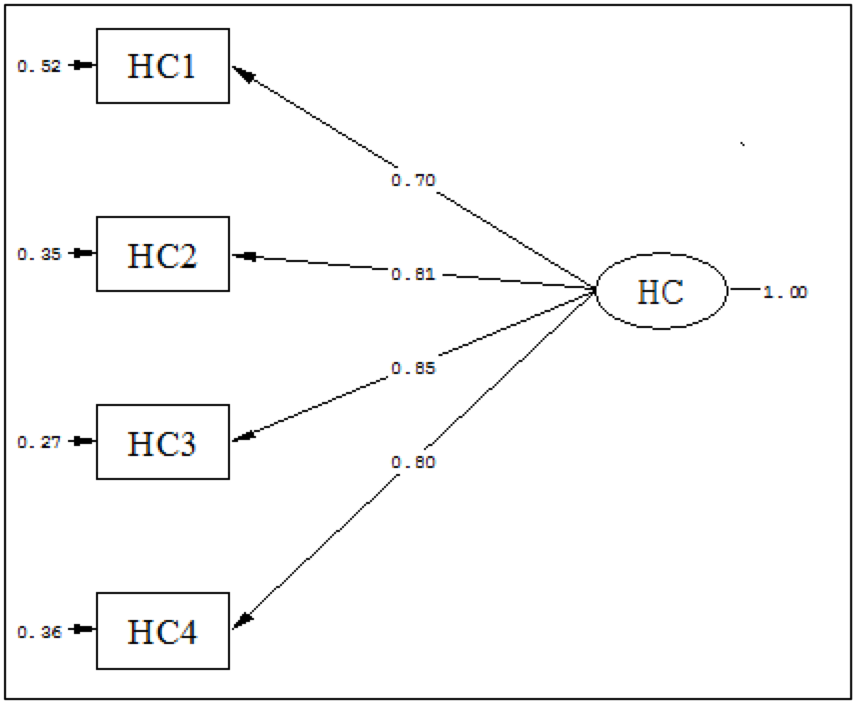

Figure 4-8: Harmonization of conflict (HC) scale path diagram

Review of the path diagrams shows that all standardized regression coefficients are greater than 0.50. The smallest coefficient occurs at RP2 for the RP scale, with a value of 0.57. One other regression coefficient falls below 0.60, and that is PM1 for the PM scale, with a value of 0.59. Then, two regression coefficients fall between 0.60 and 0.70, which are FL6 (0.62) and PM4 (0.63). Although these four observed variables illustrate factor loadings below 0.70, they are all greater than 0.50, which is the acceptable range. The remaining 34 observed variables provide factor loadings greater than 0.70. The results here are acceptable to proceed with the full model.

4.2.5.2 First-order contractual norms CFA models

The full CFA model includes eight latent factors combined into one path diagram. Building the path diagram used a process of starting with two latent factors and proceeding to add one factor at a time. I did this to determine if any of the relationships between the latent contractual norm factors are spurious. As I built the model, I examined each factor correlation. The correlations found after adding all eight factors to the model matched the correlations in the previous models, as figure 4-9 illustrates. This provides evidence that the relationships between the contractual norms are non-spurious.

	RI	RC
RI	---	0.84
RC	0.84	---

	RI	RC	FL
RI	---	0.84	0.76
RC	0.84	---	0.83
FL	0.76	0.83	---

	RI	RC	FL	CS
RI	---	0.84	0.76	0.91
RC	0.84	---	0.83	0.93
FL	0.76	0.83	---	0.82
CS	0.91	0.93	0.82	---

	RI	RC	FL	CS	RE
RI	---	0.84	0.76	0.91	0.84
RC	0.84	---	0.83	0.93	0.82
FL	0.76	0.83	---	0.82	0.74
CS	0.91	0.93	0.82	---	0.89
RE	0.84	0.82	0.74	0.89	---

	RI	RC	FL	CS	RE	RP
RI	---	0.84	0.76	0.91	0.84	0.73
RC	0.84	---	0.83	0.93	0.82	0.76
FL	0.76	0.83	---	0.82	0.74	0.71
CS	0.91	0.93	0.82	---	0.89	0.76
RE	0.84	0.82	0.74	0.89	---	0.69
RP	0.73	0.76	0.71	0.76	0.69	---

	RI	RC	FL	CS	RE	RP	PM
RI	---	0.84	0.76	0.91	0.84	0.73	0.83
RC	0.84	---	0.83	0.93	0.82	0.76	0.73
FL	0.76	0.83	---	0.82	0.74	0.71	0.67
CS	0.91	0.93	0.82	---	0.89	0.76	0.80
RE	0.84	0.82	0.74	0.89	---	0.69	0.79
RP	0.73	0.76	0.71	0.76	0.69	---	0.66
PM	0.83	0.73	0.67	0.80	0.79	0.66	---

	RI	RC	FL	CS	RE	RP	PM	HC
RI	---	0.84	0.76	0.91	0.84	0.73	0.83	0.80
RC	0.84	---	0.83	0.93	0.82	0.76	0.73	0.86
FL	0.76	0.83	---	0.82	0.74	0.71	0.67	0.80
CS	0.91	0.93	0.82	---	0.89	0.76	0.80	0.88
RE	0.84	0.82	0.74	0.89	---	0.69	0.79	0.81
RP	0.73	0.76	0.71	0.76	0.69	---	0.66	0.73
PM	0.83	0.73	0.67	0.80	0.79	0.66	---	0.71
HC	0.80	0.86	0.80	0.88	0.81	0.73	0.71	---

Figure 4-9: Building the first-order CFA model and testing for spuriousness

I now had the full first order CFA path diagram built. I then evaluated the CFA full model in the same manner as the independent scales in the previous section. I calculated the goodness-of-fit statistics and the standardized regression coefficients from the standardized model. Below, Table 4-12 summarizes the goodness-of-fit statistics for the first order CFA model.

Table 4-12: Goodness-of-fit statistics for first-order CFA model

Model	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
First-order CFA Model	1190.203 (0.0000)	637	1.868	0.0000	0.0413	0.992	0.991	0.995

Review of the goodness-of-fit statistics reveals that all values are within the threshold values except for the p-value associated with χ^2. Therefore, the model does show good fit for the observed variables and contractual norm latent factors. Figure 4-10 illustrates the path diagram for the first-order model with all eight contractual norm latent factors.

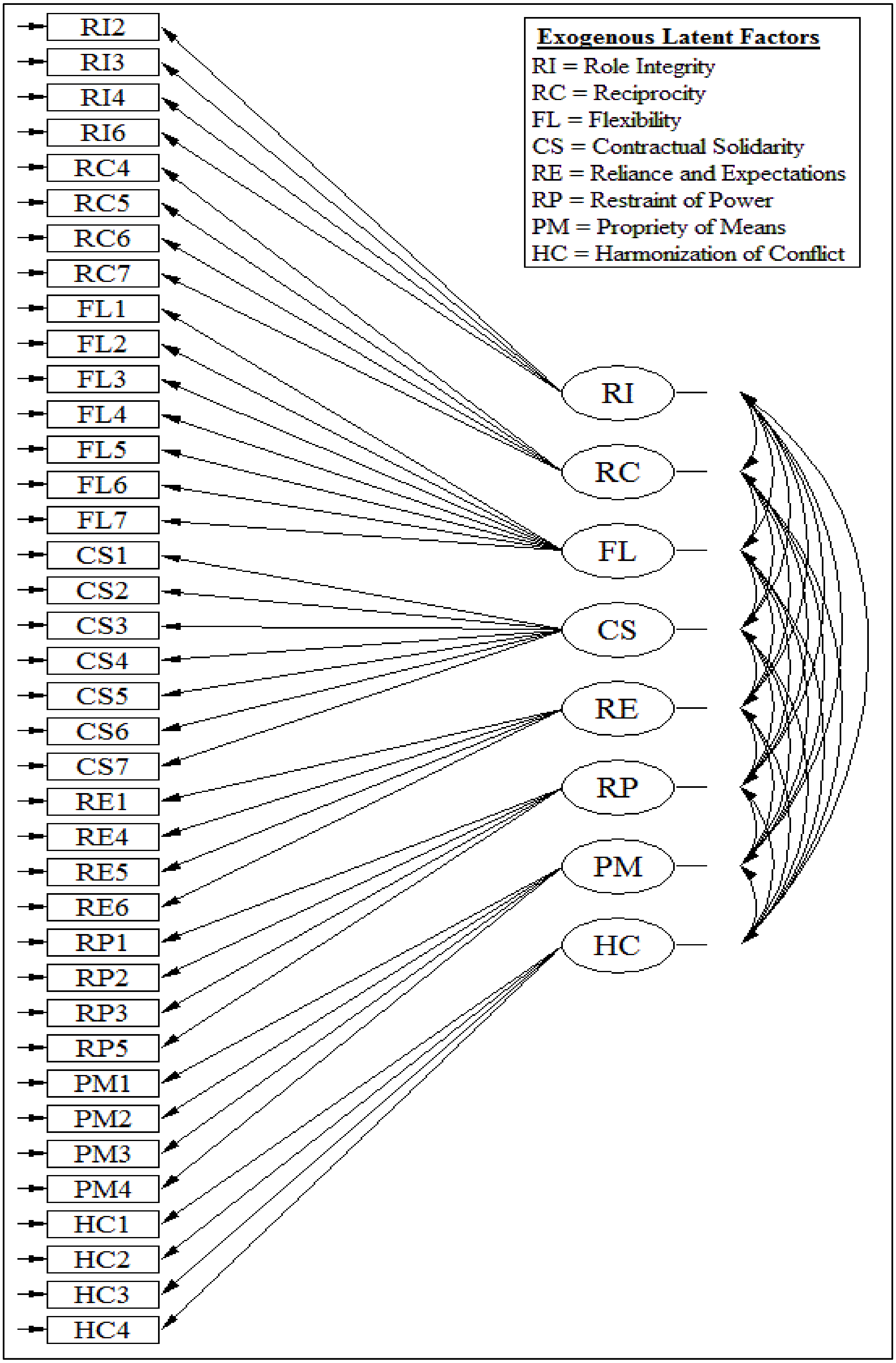

Figure 4-10: First-order CFA path diagram

Due to the complexity of the path diagram, Table 4-13 outlines the results of the factor-factor parameters and Table 4-14 outlines the factor-variable parameter results.

Table 4-13: First-order CFA model factor-factor results

Parameter	Standardized Regression Coefficient	Standard Error	t-score (significant >1.96)	R^2
RI ←→ RC	0.839	0.036	23.461	0.704
RI ←→ FL	0.760	0.043	17.865	0.578
RI ←→ CS	0.908	0.025	36.305	0.824
RI ←→ RE	0.843	0.041	20.738	0.711
RI ←→ RP	0.732	0.053	13.742	0.536
RI ←→ PM	0.826	0.039	21.262	0.682
RI ←→ HC	0.800	0.041	19.426	0.640
RC ←→ FL	0.830	0.026	32.231	0.689
RC ←→ CS	0.925	0.017	54.626	0.856
RC ←→ RE	0.822	0.026	31.689	0.676
RC ←→ RP	0.762	0.045	16.932	0.581
RC ←→ PM	0.730	0.044	16.444	0.533
RC ←→ HC	0.856	0.029	29.881	0.733
FL ←→ CS	0.818	0.028	28.891	0.669
FL ←→ RE	0.738	0.040	18.468	0.545
FL ←→ RP	0.711	0.050	14.362	0.506
FL ←→ PM	0.665	0.049	13.534	0.442
FL ←→ HC	0.805	0.035	23.326	0.648
CS ←→ RE	0.894	0.021	42.367	0.799
CS ←→ RP	0.762	0.042	18.010	0.581
CS ←→ PM	0.805	0.035	22.845	0.648
CS ←→ HC	0.877	0.027	32.260	0.769
RE ←→ RP	0.693	0.044	15.687	0.480
RE ←→ PM	0.792	0.035	22.924	0.627
RE ←→ HC	0.815	0.033	24.963	0.664
RP ←→ PM	0.662	0.052	12.841	0.438
RP ←→ HC	0.726	0.044	16.352	0.527
PM ←→ HC	0.708	0.049	14.428	0.501

Table 4-14: First-order CFA factor-variable estimates

Parameter	Standardized Regression Coefficient	t-score (significant > 1.96)	Error Variance	t-score (Significant > 1.96)	R^2
RI → RI2	0.902	39.679	0.186	*1.555*	0.814
RI → RI3	0.715	15.878	0.488	3.762	0.511
RI → RI4	0.864	31.400	0.253	2.070	0.746
RI → RI6	0.781	21.343	0.390	3.088	0.610
RC → RC4	0.863	28.394	0.256	2.060	0.745
RC → RC5	0.709	19.832	0.497	4.020	0.503
RC → RC6	0.900	38.059	0.190	*1.573*	0.810
RC → RC7	0.951	71.674	0.096	*0.831*	0.904
FL → FL1	0.745	13.535	0.444	3.172	0.555
FL → FL2	0.954	43.856	0.090	*0.750*	0.910
FL → FL3	0.925	39.248	0.145	*1.202*	0.856
FL → FL4	0.847	28.702	0.283	2.298	0.717
FL → FL5	0.946	43.157	0.106	*0.883*	0.895
FL → FL6	0.558	9.234	0.688	5.237	0.311
FL → FL7	0.757	17.713	0.427	3.286	0.573
CS → CS1	0.890	41.338	0.207	*1.743*	0.792
CS → CS2	0.782	20.145	0.388	3.034	0.612
CS → CS3	0.901	55.555	0.189	*1.623*	0.812
CS → CS4	0.912	50.290	0.168	*1.432*	0.832
CS → CS5	0.936	68.267	0.124	*1.077*	0.876
CS → CS6	0.786	21.084	0.383	3.015	0.618
CS → CS7	0.927	64.014	0.140	*1.208*	0.859
RE → RE1	0.879	36.385	0.228	*1.893*	0.773
RE → RE4	0.782	17.753	0.388	2.939	0.612
RE → RE5	0.810	21.720	0.344	2.695	0.656
RE → RE6	0.938	45.214	0.121	*1.012*	0.880
RP → RP1	0.715	14.212	0.489	3.659	0.511
RP → RP2	0.563	7.441	0.684	4.842	0.317
RP → RP3	0.768	16.810	0.411	3.093	0.590
RP → RP5	0.860	22.254	0.261	1.993	0.740
PM → PM1	0.556	8.255	0.691	5.113	0.309
PM → PM2	0.810	22.397	0.343	2.703	0.656
PM → PM3	0.842	24.534	0.291	2.301	0.709
PM → PM4	0.746	16.905	0.444	3.399	0.557
HC → HC1	0.796	23.598	0.366	2.931	0.634
HC → HC2	0.710	13.140	0.496	3.634	0.504
HC → HC3	0.813	21.602	0.339	2.641	0.661
HC → HC4	0.814	24.997	0.337	2.705	0.663

The results show that the standardized regression coefficients exceed 0.50. The smallest factors loadings occur at PM1 (0.556), FL6 (0.558), and RP2 (0.563). The remaining 35 factors are all greater than 0.70. The In addition, the t-score associated with each factor-factor pair and factor-variable pair exceeds the 1.96 value, which indicates a significant relationship with a p-value less than 0.05. The regression coefficients greater than 0.50 and the significant relationships associated with the high t-scores indicates that the first-order CFA has statistically obtained convergent validity.

Further results of convergent validity use the statistical calculated values of Average Variance Extracted (AVE) and Construct Reliability (CR). These two statistics verify convergent validity of the latent factors with one another. Table 4-15 shows these calculations. Following the guidelines for each statistic, all AVE values are greater than 0.50 and all CR values are greater than 0.70. This verifies convergent validity in the first-order CFA model of the contractual norms.

Table 4-15: Convergent validity statistics for first-order CFA model

Contractual Norm	AVE	CR
Role Integrity	0.595	0.853
Reciprocity	0.666	0.887
Flexibility	0.588	0.907
Contractual Solidarity	0.690	0.940
Reliance and Expectations	0.645	0.878
Restraint of Power	0.555	0.789
Propriety of Means	0.500	0.722
Harmonization of Conflict	0.502	0.801

To determine if the model has obtained discriminant validity, I modified the first-order CFA model so that the 38 observed variables load onto just one latent factor to create an indiscriminate CFA model. Then, I calculated the indiscriminate model standardized regression coefficients and goodness-of-fit statistics using *LISREL* so that I could compare the first-order

CFA model to the indiscriminant model. Table 4-16 compares the goodness-of-fit statistics while table 4-17 compares the standardized regression coefficients between the first-order CFA model and the indiscriminant model.

The goodness-of-fit comparison proves that the first-order CFA model has discriminant validity. All of the fit statistics for the discriminant model are worse than the fit statistics for the first-order model. Reviewing the standardized regression coefficients between the first-order and discriminant models shows that all of the values are lower for the discriminant model. The discriminant model also shows regression coefficients below the 0.50 threshold. This information along with the fit statistic comparison establishes discriminant validity in the first-order CFA model. This means that the first-order CFA model factors diverge from one another and the model requires the eight contractual norms as factors.

Table 4-16: Comparison of first-order CFA model and the indiscriminant CFA model

Model	**χ^2 (p-value)**	**df**	**χ^2 / df**	**RMSEA**	**SRMR**	**CFI**	**NNFI**	**AGFI**
First-order CFA Model	1190.203 (0.0000)	637	1.868	0.0000	0.0413	0.992	0.991	0.995
Indiscriminant Model	1853.158 (0.0000)	665	2.787	0.0000	0.0612	0.982	0.981	0.989

Table 4-17: Standardized regression coefficients comparison for indiscriminant model

Parameter	Standardized Regression Coefficient		
	First-order model	**Indiscriminant model**	**Difference**
RI → RI2	0.902	0.832	-0.070
RI → RI3	0.715	0.660	-0.055
RI → RI4	0.864	0.801	-0.063
RI → RI6	0.781	0.721	-0.060
RC → RC4	0.863	0.813	-0.050
RC → RC5	0.709	0.672	-0.037
RC → RC6	0.900	0.855	-0.045
RC → RC7	0.951	0.897	-0.054
FL → FL1	0.745	0.666	-0.079
FL → FL2	0.954	0.853	-0.101
FL → FL3	0.925	0.833	-0.092
FL → FL4	0.847	0.770	-0.077
FL → FL5	0.946	0.856	-0.090
FL → FL6	0.558	*0.494*	-0.064
FL → FL7	0.757	0.677	-0.080
CS → CS1	0.890	0.870	-0.020
CS → CS2	0.782	0.763	-0.019
CS → CS3	0.901	0.884	-0.017
CS → CS4	0.912	0.895	-0.017
CS → CS5	0.936	0.919	-0.017
CS → CS6	0.786	0.766	-0.020
CS → CS7	0.927	0.913	-0.014
RE → RE1	0.879	0.811	-0.068
RE → RE4	0.782	0.713	-0.069
RE → RE5	0.810	0.739	-0.071
RE → RE6	0.938	0.854	-0.084
RP → RP1	0.715	0.578	-0.137
RP → RP2	0.563	0.455	-0.108
RP → RP3	0.768	0.621	-0.147
RP → RP5	0.860	0.693	-0.167
PM → PM1	0.556	*0.463*	-0.093
PM → PM2	0.810	0.680	-0.130
PM → PM3	0.842	0.705	-0.137
PM → PM4	0.746	0.626	-0.120
HC → HC1	0.796	0.722	-0.074
HC → HC2	0.710	0.645	-0.065
HC → HC3	0.813	0.738	-0.075
HC → HC4	0.814	0.738	-0.076

Evaluating uni-dimensionality of the CFA model requires review of the standardized residuals matrix (found in Appendix C). In reviewing the standardized residual matrix, absolute values above 2.58 represent a significance and a p-value less than 0.01, which means that the measures could be suspect to a lack of uni-dimensionality. The review of the standardized residual matrix only shows six pairs of observed variables that are above the threshold of 2.58 (Vieira 2011). The remaining 1,425 pairs are all non-significant and therefore the model does contain uni-dimensional factors based on the standard residual matrix review.

With uni-dimensionality, reliability and validity established for the first order CFA model, the next step was to check for common method bias. As I outlined in section 3.4.1.3, common method bias is a concern for research studies that collect data for the independent factors (contractual norms) and the dependent factors (the critical success factors) from the same common method (the survey questionnaire). In order to check statistically for common method bias, I used Harman's single factor test and used a common latent factor to determine statistically if common method bias is an issue (Podsakoff et al 2003).

I calculated Harman's single factor value using SPSS and conducting a factor analysis with the contractual norm observed variables. Instead of extracting a number of factors as was used in the EFA model, the approach to find Harman's single factor value is to extract only one factor and not to use rotation. The total variance explained by the single factor extracted is then Harman's single factor value of the unrotated solution. This value needs to explain less than half of the variance in the model in order to alleviate common method bias in the model. Table 4-18 outlines the results of Harman's single factor test. The one extracted factor accounts for 48.6% of the explained variability in the model, which is less than 0.50. According to Harman's single factor test, common method bias is not an issue.

Table 4-18: Harman's single factor test results

Factor	Eigenvalue	Total Sum of Squared Loadings	Percentage of Variance Explained
1	19.454	19.989	0.486

To verify the results of Harman's single factor test and further determine common method bias is an issue, I used an unstandardized and standardized common latent factor approach. The unstandardized common latent factor approach uses an additional latent factor with all observed variables load onto this common latent factor. The model is run and the unstandardized regression coefficient result for the loadings from the observed variables to the common latent factor should be the same for all observed variable paths. The square of the unstandardized regression coefficient represents the common variance shared across the observed variables for the contractual norm latent factors. Doing this, the resulting unstandardized regression coefficient is 0.37. Squaring this value equals 0.136. This means that the 38 observed variables share 13.6% common variance. That means that 87% of the variance is either explained by the observed variables regressing on the latent factors or due to error. The low common variance provides further evidence that common method bias is not an issue.

The last test of common method bias compares the common latent factor model to the first order CFA model by reviewing the differences between the standardized regression coefficients. The concept is that the common latent factor model should provide different regression coefficient values than the CFA model, but the absolute value difference should be less than 0.223, which represents less than 5% common shared variance. Table 4-19 provides the results of the model comparison.

Table 4-19: Comparison of first order CFA model to common latent factor model

Parameter	Standardized Regression Coefficients		
	First-order model	**Common latent factor model**	**Difference**
RI → RI2	0.902	0.839	0.0630
RI → RI3	0.715	0.580	0.1350
RI → RI4	0.864	0.714	0.1500
RI → RI6	0.781	0.703	0.0780
RC → RC4	0.863	0.771	0.0920
RC → RC5	0.709	0.759	0.0500
RC → RC6	0.900	0.888	0.0120
RC → RC7	0.951	0.875	0.0760
FL → FL1	0.745	0.659	0.0860
FL → FL2	0.954	0.877	0.0770
FL → FL3	0.925	0.866	0.0590
FL → FL4	0.847	0.831	0.0160
FL → FL5	0.946	0.913	0.0330
FL → FL6	0.558	0.647	0.0890
FL → FL7	0.757	0.632	0.1250
CS → CS1	0.890	0.750	0.1400
CS → CS2	0.782	0.788	0.0060
CS → CS3	0.901	0.832	0.0690
CS → CS4	0.912	0.808	0.1040
CS → CS5	0.936	0.832	0.1040
CS → CS6	0.786	0.659	0.1270
CS → CS7	0.927	0.821	0.1060
RE → RE1	0.879	0.676	0.2030
RE → RE4	0.782	0.643	0.1390
RE → RE5	0.810	0.646	0.1640
RE → RE6	0.938	0.790	0.1480
RP → RP1	0.715	0.812	0.0970
RP → RP2	0.563	0.552	0.0110
RP → RP3	0.768	0.774	0.0060
RP → RP5	0.860	0.765	0.0950
PM → PM1	0.556	0.495	0.0610
PM → PM2	0.810	0.594	0.2160
PM → PM3	0.842	0.624	0.2180
PM → PM4	0.746	0.773	0.0270
HC → HC1	0.796	0.883	0.0870
HC → HC2	0.710	0.641	0.0690
HC → HC3	0.813	0.716	0.0970
HC → HC4	0.814	0.664	0.1500

Review of the differences between the first order model and the common latent factor model shows that no pair has a difference greater than 0.223. With these results, along with Harman's single factor test and the common shared variance of only 13.6%, common method bias does not affect the measurement model and does not confound the results.

4.2.5.3 Second-order integration CFA model

With the first-order CFA model confirmed to have good model to data fit, the next step is to produce the second-order CFA model. This analysis follows the same CFA procedure, but the path diagram changes to include "Integration" as the second order factor that combines all of the first-order factors into one construct. Figure 4-11 illustrates the second-order path diagram. Table 4-20 details the goodness-of-fit statistics.

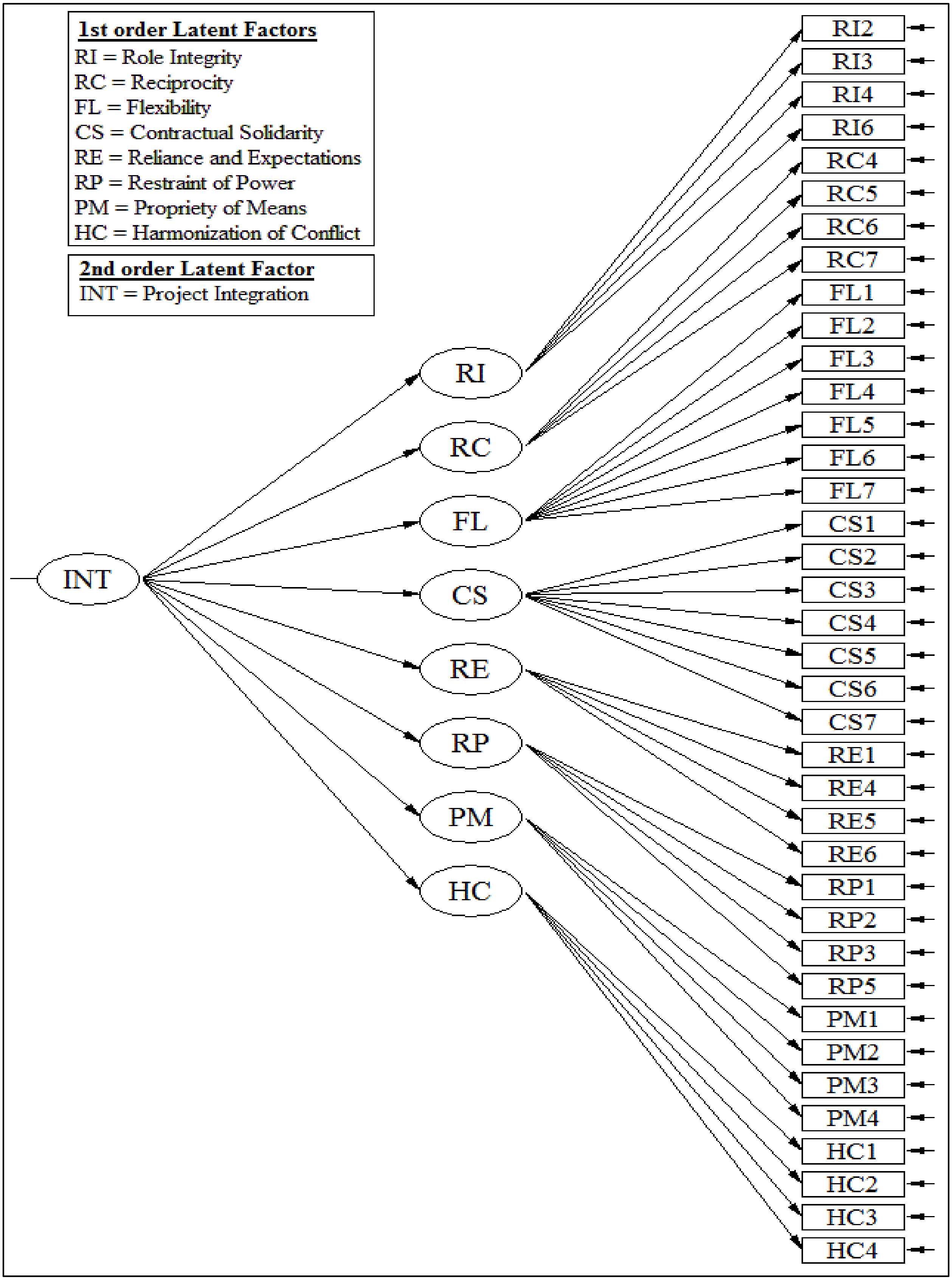

Figure 4-11: Second-Order CFA path diagram

Table 4-20: Second-order CFA model goodness-of-fit statistics

	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
First-order CFA Model	1190.203 (0.0000)	637	1.868	0.0000	0.0413	0.992	0.991	0.995
Second-order CFA Model	1217.575 (0.0000)	657	1.853	0.0000	0.0441	0.992	0.991	0.995

The goodness-of-fit statistics for the second-order CFA model show similar or only slight differences from the first-order CFA model. All fit statistics fall within the guideline threshold values as well. This illustrates that the second-order model appropriately models the measurement scale for integration.

Review of Table 4-21 presents the regression coefficients and error variance values between the first-order contractual norm factors and the second-order integration (INT) factor and Table 4-22 summarizes the regression coefficients for each observed variable and its associated first-order contractual norm factor.

Table 4-21: Second-order CFA model factor-factor results

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (Significant >1.96)	R^2
RI → INT	0.920	33.683	0.153	2.902	0.846
RC → INT	0.941	26.277	0.115	5.351	0.885
FL → INT	0.849	12.074	0.279	5.397	0.721
CS → INT	0.978	38.864	0.044	2.745	0.956
RE → INT	0.901	24.333	0.188	5.562	0.812
RP → INT	0.797	11.462	0.364	4.498	0.635
PM → INT	0.825	7.571	0.320	3.692	0.681
HC → INT	0.904	20.114	0.183	4.232	0.817

Table 4-22: Second-order CFA model factor-variable estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
RI → RI2	0.903	---	0.185	*1.546*	0.815
RI → RI3	0.715	14.530	0.489	3.772	0.511
RI → RI4	0.865	27.067	0.252	2.060	0.748
RI → RI6	0.780	20.309	0.392	3.106	0.608
RC → RC4	0.864	---	0.254	2.045	0.746
RC → RC5	0.709	17.655	0.498	4.030	0.503
RC → RC6	0.900	23.413	0.190	*1.576*	0.810
RC → RC7	0.951	28.774	0.096	*0.832*	0.904
FL → FL1	0.745	---	0.445	3.181	0.555
FL → FL2	0.953	13.439	0.092	0.769	0.908
FL → FL3	0.926	12.994	0.142	*1.178*	0.857
FL → FL4	0.847	12.607	0.283	2.299	0.717
FL → FL5	0.946	12.808	0.105	*0.877*	0.895
FL → FL6	0.557	7.370	0.690	5.252	0.310
FL → FL7	0.757	12.470	0.428	3.293	0.573
CS → CS1	0.891	---	0.207	*1.737*	0.794
CS → CS2	0.781	18.703	0.389	3.043	0.610
CS → CS3	0.900	36.646	0.189	*1.625*	0.810
CS → CS4	0.912	34.035	0.168	*1.430*	0.832
CS → CS5	0.936	36.910	0.124	*1.074*	0.876
CS → CS6	0.785	20.672	0.383	3.020	0.616
CS → CS7	0.927	35.945	0.140	*1.209*	0.859
RE → RE1	0.879	---	0.227	*1.888*	0.773
RE → RE4	0.781	15.479	0.389	2.947	0.610
RE → RE5	0.810	19.471	0.344	2.691	0.656
RE → RE6	0.938	27.540	0.121	*1.015*	0.880
RP → RP1	0.715	---	0.489	3.660	0.511
RP → RP2	0.563	6.552	0.683	4.840	0.317
RP → RP3	0.768	12.693	0.411	3.094	0.590
RP → RP5	0.860	11.454	0.261	1.996	0.740
PM → PM1	0.554	---	0.693	5.130	0.307
PM → PM2	0.811	7.838	0.342	2.692	0.658
PM → PM3	0.842	8.270	0.291	2.298	0.709
PM → PM4	0.746	7.570	0.444	3.401	0.557
HC → HC1	0.797	---	0.365	2.927	0.635
HC → HC2	0.709	11.559	0.497	3.653	0.503
HC → HC3	0.813	16.197	0.338	2.638	0.661
HC → HC4	0.814	17.735	0.337	2.702	0.663

The review of the regression coefficients and the t-scores in table 4-22 confirms that all regression coefficients are greater than 0.50 and the t-scores are all significant for the regression coefficients, which establishes that the second-order model has convergent validity for the first-order factors to the second-order factors as well as the observed variables to the associated first-order factors. Calculating the AVE and CR values cannot occur since there is just the single second-order factor. Also, developing an indiscriminant model with one latent factor would result in the same indiscriminant model used in the previous section for the first-order CFA model.

Finally, review of the standardized residual matrix revealed 8 observed pairs with absolute values greater than 2.58. The remaining 1,423 pairs are less than this value and are non-significant, which means the second order model shows appropriate uni-dimensionality. The results of this section confirm the second-order CFA measurement model as appropriate and the model has statistically established uni-dimensionality, reliability, and validity.

In terms of common method bias for the second order CFA model, Harman's single factor test results are the same as the first order CFA model since the same observed variables are used. For the common latent factor tests, the shared common variance for the second order CFA model is 11.6%, which is less than the shared common variance of the first order CFA model and provides further evidence of common method bias not an issue with the second order CFA model.

For the comparison of the second order CFA model standardized regression coefficients to the common latent factor model, table 4-23 summarizes the results. None of the differences between the two models is greater than 0.25. This result confirms that common method bias is not causing issues with results in the second order CFA model.

Table 4-23: Comparison of second-order CFA model to common latent factor model

Parameter	Standardized Regression Coefficient		
	Second-order model	Common latent factor model	Difference
RI → RI2	0.903	0.839	0.064
RI → RI3	0.715	0.580	0.135
RI → RI4	0.865	0.714	0.151
RI → RI6	0.780	0.703	0.077
RC → RC4	0.864	0.771	0.093
RC → RC5	0.709	0.759	0.050
RC → RC6	0.900	0.888	0.012
RC → RC7	0.951	0.875	0.076
FL → FL1	0.745	0.659	0.086
FL → FL2	0.953	0.877	0.076
FL → FL3	0.926	0.866	0.060
FL → FL4	0.847	0.831	0.016
FL → FL5	0.946	0.913	0.033
FL → FL6	0.557	0.647	0.090
FL → FL7	0.757	0.632	0.125
CS → CS1	0.891	0.750	0.141
CS → CS2	0.781	0.788	0.007
CS → CS3	0.900	0.832	0.068
CS → CS4	0.912	0.808	0.104
CS → CS5	0.936	0.832	0.104
CS → CS6	0.785	0.659	0.126
CS → CS7	0.927	0.821	0.106
RE → RE1	0.879	0.676	0.203
RE → RE4	0.781	0.643	0.138
RE → RE5	0.810	0.646	0.164
RE → RE6	0.938	0.790	0.148
RP → RP1	0.715	0.812	0.097
RP → RP2	0.563	0.552	0.011
RP → RP3	0.768	0.774	0.006
RP → RP5	0.860	0.765	0.095
PM → PM1	0.554	0.495	0.059
PM → PM2	0.811	0.594	0.217
PM → PM3	0.842	0.624	0.218
PM → PM4	0.746	0.773	0.027
HC → HC1	0.797	0.883	0.086
HC → HC2	0.709	0.641	0.068
HC → HC3	0.813	0.716	0.097
HC → HC4	0.814	0.664	0.150

4.3 Analyze the Structural Model

So far, I have used the EFA and CFA to confirm the measurement model for the contractual norm factors and the ability to measure project integration accurately using relational contract theory. The results of the first-order and second-order measurement models show that the contractual norms reliably measure integration using unidimensional and valid measures. The next and final step of the research analysis is to perform the SEM to test the structural models that compare project integration to project success.

4.3.1 Structural equation modeling

The initial steps in performing a SEM analysis I completed in the EFA and CFA analyses. The next step in the SEM is to introduce the endogenous factor of project success to observe the relationships that may or may not occur between the exogenous contractual norm factors and the endogenous project success factor, the CSFs, and the associated success criteria measures. Also, SEM allows for a correlation analysis of the second-order exogenous factor of integration (INT) to project success overall, the CSFs of team chemistry, planning effort, and project objectives, and the success criteria for each of the CSFs.

4.3.1.1 Contractual norms and project success structural model

The first structural model investigated the correlations between the contractual norm factors and project success as a whole. The path diagram developed places all endogenous observed variables to one latent factor called project success (denoted as PS), which represents the endogenous latent factor, as shown in Figure 4-12. The results of the contractual norms and project success structural model are in tables 4-24, 4-25, 4-26, and 4-27.

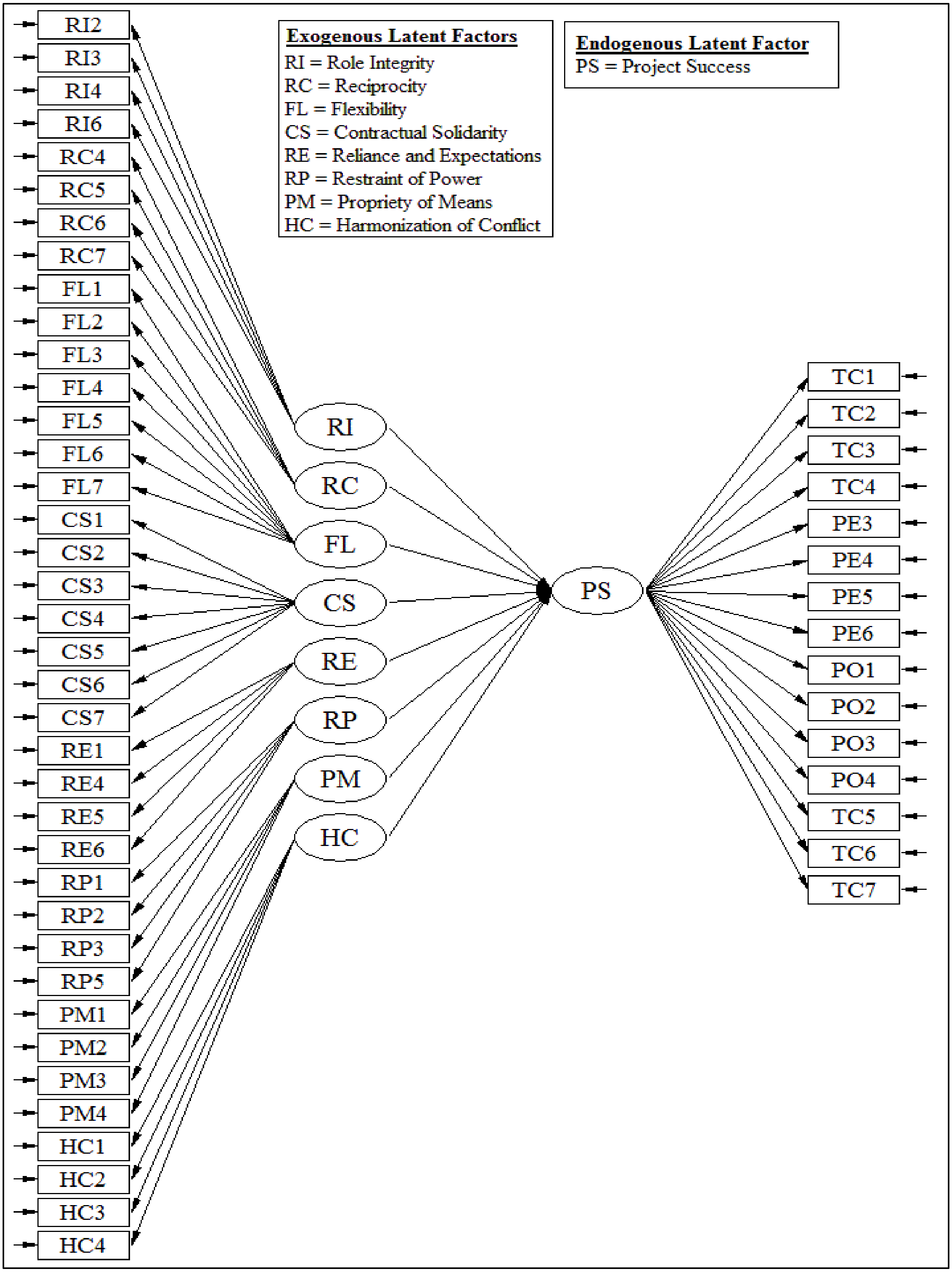

Figure 4-12: Path diagram for contractual norms – project success SEM

Table 4-24: Contractual norms – project success SEM fit statistics

	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
SEM PS Model	2402.218 (0.000)	1394	1.723	0.069	0.053	0.989	0.988	*0.780*

Table 4-25: Contractual norms – project success SEM exogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
RI → RI2	0.890	39.103	0.307	4.433	0.721
RI → RI3	0.725	15.674	0.575	6.566	0.478
RI → RI4	0.872	34.271	0.339	4.731	0.692
RI → RI6	0.779	22.394	0.494	6.323	0.551
RC → RC4	0.831	26.379	0.409	5.317	0.628
RC → RC5	0.733	21.995	0.563	7.561	0.488
RC → RC6	0.900	37.358	0.290	4.087	0.736
RC → RC7	0.937	66.536	0.222	3.565	0.799
FL → FL1	0.756	13.884	0.528	5.293	0.520
FL → FL2	0.918	36.021	0.257	3.507	0.767
FL → FL3	0.903	37.557	0.285	4.007	0.741
FL → FL4	0.862	34.024	0.357	5.014	0.675
FL → FL5	0.939	46.535	0.218	3.211	0.802
FL → FL6	0.613	10.646	0.725	8.035	0.341
FL → FL7	0.724	17.010	0.576	6.914	0.476
CS → CS1	0.884	39.538	0.319	4.635	0.710
CS → CS2	0.769	19.452	0.509	6.141	0.538
CS → CS3	0.894	51.739	0.300	4.675	0.727
CS → CS4	0.915	51.505	0.262	4.037	0.762
CS → CS5	0.934	67.834	0.228	3.691	0.792
CS → CS6	0.778	19.584	0.495	5.917	0.550
CS → CS7	0.930	63.917	0.236	3.779	0.786
RE → RE1	0.884	39.900	0.318	4.637	0.711
RE → RE4	0.775	18.824	0.499	5.864	0.546
RE → RE5	0.811	21.341	0.443	5.306	0.598
RE → RE6	0.926	51.570	0.243	3.718	0.779
RP → RP1	0.735	15.922	0.559	6.341	0.492
RP → RP2	0.565	7.807	0.781	7.868	0.290
RP → RP3	0.809	19.423	0.445	5.069	0.595
RP → RP5	0.800	22.342	0.460	5.724	0.582
PM → PM1	0.585	9.459	0.758	8.275	0.311
PM → PM2	0.806	24.198	0.451	5.804	0.590
PM → PM3	0.894	32.027	0.301	4.003	0.726
PM → PM4	0.672	15.684	0.648	8.043	0.411
HC → HC1	0.749	22.669	0.539	7.201	0.510
HC → HC2	0.739	14.411	0.554	5.879	0.496
HC → HC3	0.840	25.396	0.394	4.986	0.642
HC → HC4	0.816	26.088	0.434	5.710	0.606

Table 4-26: Contractual norms – project success SEM endogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
PS → TC1	0.378	---	0.957	13.352	0.130
PS → TC2	0.451	6.906	0.896	12.441	0.185
PS → TC3	0.441	6.353	0.905	12.361	0.177
PS → TC4	0.611	5.984	0.727	9.221	0.339
PS → TC5	0.673	6.165	0.648	8.573	0.411
PS → TC6	0.516	6.232	0.834	10.943	0.242
PS → TC7	0.670	6.286	0.651	8.633	0.408
PS → PE3	0.717	6.379	0.586	7.530	0.468
PS → PE4	0.650	6.349	0.678	8.590	0.384
PS → PE5	0.670	6.003	0.650	8.374	0.409
PS → PE6	0.760	6.227	0.522	6.883	0.525
PS → PO1	0.727	6.272	0.572	7.155	0.480
PS → PO2	0.723	6.390	0.578	7.630	0.475
PS → PO3	0.757	6.428	0.527	6.952	0.521
PS → PO4	0.708	6.397	0.599	7.317	0.455

Table 4-27: SEM contractual norms – project success equation

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
RI → PS	0.155	0.946	0.344	**0.276**	**3.054**	**0.002**	**0.724**	**0.717**	**3.623**
RC → PS	0.100	0.471	0.638						
FL → PS	0.078	0.692	0.489						
CS → PS	0.233	0.764	0.445						
RE → PS	**0.318**	**2.254**	**0.024**						
RP → PS	0.067	0.703	0.482						
PM → PS	**0.246**	**2.577**	**0.010**						
HC → PS	**0.364**	**2.510**	**0.012**						

Review of the results show that the project success structural model has sufficient goodness-of-fit, as shown in table 4-24, with only AGFI below the threshold. Table 4-27 shows the relationships between each of the contractual norms and the project success latent factor. The error variance value is significant for project success equation, the adjusted R^2 value is 0.717 with a VIF less than five (3.623). The factor relationships found to be significant at the 0.05 level are in **bold** type. In summary:

- Reliance and Expectations (RE), Propriety of Means (PM), and Harmonization of Conflict (HC) correlate with Project Success (PS).

4.3.1.2 Contractual norms and critical success factors structural model

The second structural model investigated the correlations between integration and project success as defined by team chemistry, planning effort, and project objectives. The path diagram is set up to have the exogenous contractual norm latent factors relate to the three endogenous CSFs of team chemistry, planning effort, and project objectives. Refer to Figure 4-13 for the full path diagram. Tables 4-28 through 4-31 provide the results of the CSF structural model analysis.

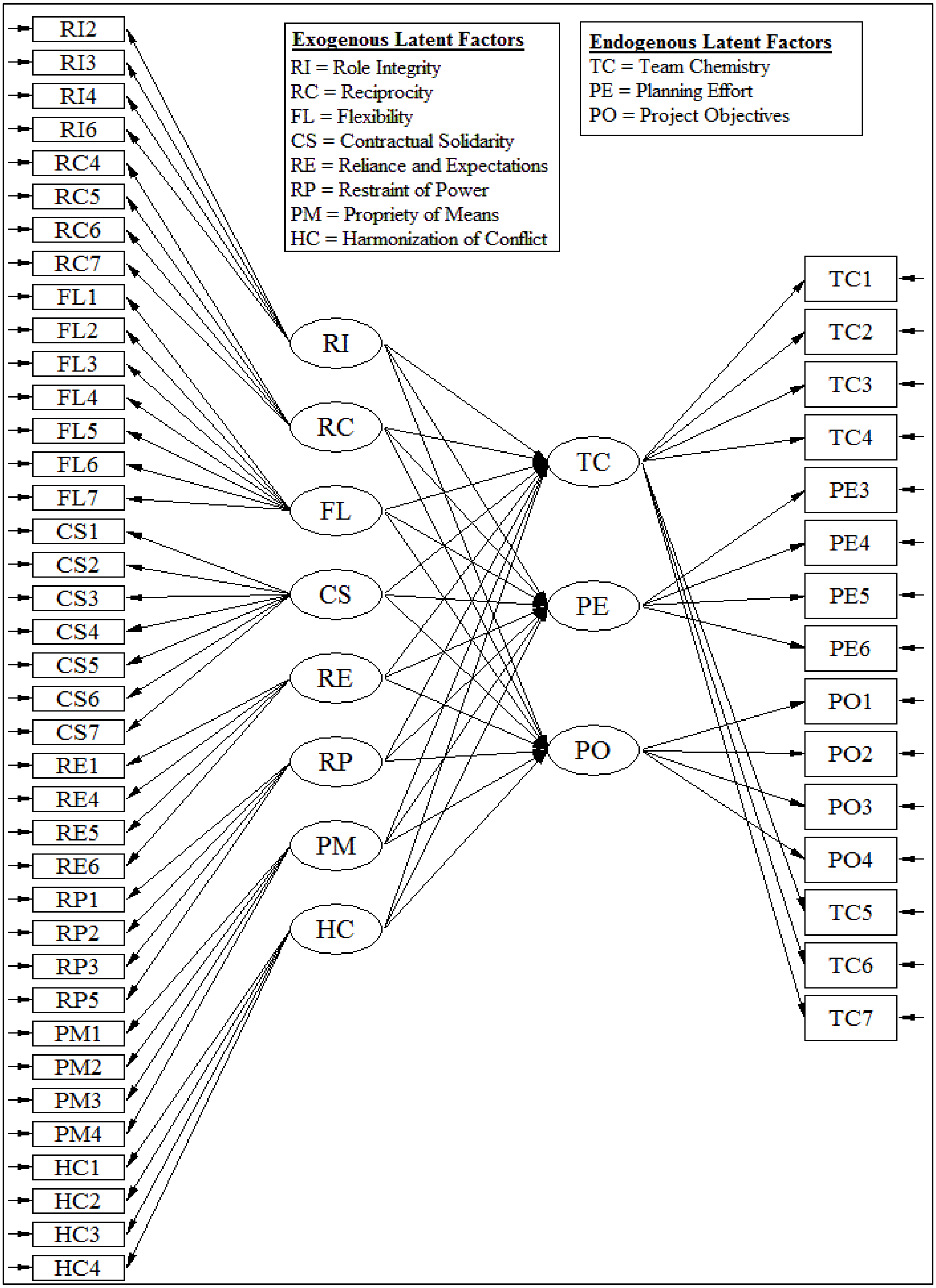

Figure 4-13: Path diagram for contractual norms – CSF SEM

Table 4-28: Contractual norms – CSF SEM fit statistics

	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
SEM CSFs Model	1974.823 (0.000)	1273	1.5513	0.0642	0.0591	0.992	0.991	0.914

Table 4-29: Contractual norms – CSF SEM exogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
RI → RI2	0.884	38.358	0.319	4.593	0.710
RI → RI3	0.719	15.399	0.583	6.653	0.470
RI → RI4	0.871	34.683	0.342	4.801	0.689
RI → RI6	0.772	21.721	0.503	6.403	0.542
RC → RC4	0.832	26.564	0.407	5.308	0.630
RC → RC5	0.724	21.451	0.576	7.731	0.476
RC → RC6	0.891	35.596	0.307	4.278	0.721
RC → RC7	0.929	65.864	0.237	3.816	0.785
FL → FL1	0.757	13.908	0.528	5.293	0.520
FL → FL2	0.919	36.360	0.256	3.509	0.767
FL → FL3	0.904	37.842	0.284	4.001	0.742
FL → FL4	0.862	34.040	0.358	5.024	0.675
FL → FL5	0.939	46.314	0.219	3.223	0.801
FL → FL6	0.611	10.581	0.727	8.056	0.339
FL → FL7	0.723	16.973	0.577	6.921	0.475
CS → CS1	0.882	40.119	0.323	4.727	0.706
CS → CS2	0.771	19.762	0.506	6.152	0.540
CS → CS3	0.886	50.549	0.315	4.898	0.714
CS → CS4	0.910	52.409	0.271	4.207	0.753
CS → CS5	0.928	66.462	0.240	3.868	0.782
CS → CS6	0.771	19.852	0.506	6.155	0.540
CS → CS7	0.921	58.219	0.252	3.977	0.771
RE → RE1	0.884	39.692	0.319	4.640	0.710
RE → RE4	0.776	18.910	0.498	5.867	0.547
RE → RE5	0.808	21.006	0.447	5.333	0.594
RE → RE6	0.923	51.371	0.249	3.808	0.774
RP → RP1	0.739	16.125	0.554	6.294	0.496
RP → RP2	0.566	7.829	0.779	7.837	0.292
RP → RP3	0.811	19.470	0.442	5.031	0.598
RP → RP5	0.795	21.747	0.468	5.793	0.574
PM → PM1	0.586	9.576	0.756	8.288	0.313
PM → PM2	0.806	24.494	0.450	5.817	0.591
PM → PM3	0.891	31.584	0.306	4.051	0.722
PM → PM4	0.671	15.630	0.650	8.075	0.409
HC → HC1	0.746	22.620	0.544	7.273	0.506
HC → HC2	0.731	14.503	0.566	6.114	0.485
HC → HC3	0.831	24.767	0.410	5.173	0.628
HC → HC4	0.816	26.212	0.435	5.738	0.605

Table 4-30: Contractual norms – CSF SEM endogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
TC → TC1	0.519	---	0.830	10.343	0.245
TC → TC2	0.599	9.626	0.742	9.585	0.326
TC → TC3	0.624	9.248	0.711	8.976	0.354
TC → TC4	0.424	5.899	0.920	12.393	0.163
TC → TC5	0.794	8.824	0.470	6.115	0.573
TC → TC6	0.667	8.809	0.655	7.645	0.405
TC → TC7	0.818	9.052	0.431	5.733	0.608
PE → PE3	0.637	---	0.695	8.222	0.369
PE → PE4	0.605	9.440	0.734	8.974	0.333
PE → PE5	0.809	10.291	0.445	5.199	0.595
PE → PE6	0.914	12.036	0.265	3.852	0.759
PO → PO1	0.741	---	0.551	6.605	0.499
PO → PO2	0.805	16.382	0.452	5.974	0.589
PO → PO3	0.840	16.220	0.394	5.296	0.642
PO → PO4	0.765	13.855	0.515	6.120	0.532

Table 4-31: SEM contractual norms – CSF equations for project success

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
TC → RI	0.906	1.393	0.164	**0.096**	**3.392**	**0.001**	**0.644**	**0.635**	**2.809**
TC → RC	**1.885**	**2.457**	**0.014**						
TC → FL	0.219	0.789	0.430						
TC → CS	**3.022**	**2.418**	**0.003**						
TC → RE	0.689	1.880	0.060						
TC → RP	0.224	1.006	0.314						
TC → PM	0.351	1.283	0.200						
TC → HC	0.516	1.580	0.114						
PE → RI	0.800	1.524	0.128	**0.345**	**7.954**	**0.000**	**0.572**	**0.561**	**2.336**
PE → RC	**1.139**	**1.979**	**0.048**						
PE → FL	0.320	1.504	0.133						
PE → CS	**2.233**	**2.340**	**0.019**						
PE → RE	**0.654**	**2.396**	**0.017**						
PE → RP	0.097	0.533	0.594						
PE → PM	0.210	1.020	0.308						
PE → HC	**0.773**	**2.798**	**0.005**						
PO → RI	1.267	1.846	0.065	**0.184**	**4.787**	**0.000**	**0.663**	**0.654**	**2.967**
PO → RC	1.576	1.944	0.052						
PO → FL	0.390	1.251	0.211						
PO → CS	**3.390**	**2.660**	**0.008**						
PO → RE	**0.822**	**2.140**	**0.032**						
PO → RP	0.193	0.793	0.428						
PO → PM	0.293	1.031	0.303						
PO → HC	**1.012**	**2.825**	**0.005**						

The results in Table 4-28 show that the SEM analysis of the CSF model has achieved proper fit based on the values being within the threshold guidelines. Table 4-31 shows the relationships between each of the contractual norms and the CSFs. The error variance values are significant at the 0.05 level for team chemistry, planning effort, and project objectives CSFs equations. Further, the adjusted R^2 values are all reasonable and the VIFs are less than five in regards to team chemistry, planning effort, and project objectives. The factor relationships found to be significant at the 0.05 level are in **bold** type. In summary:

- Reciprocity (RC), and Contractual Solidarity (CS) correlate with Team Chemistry (TC);
- Reciprocity (RC), Contractual Solidarity (CS), Reliance and Expectations (RE), and Harmonization of Conflict (HC) correlate with Planning Effort; and
- Contractual Solidarity (CS), Reliance and Expectations (RE), and Harmonization of Conflict (HC) correlate with achieving project objectives satisfactorily.

4.3.1.3 Contractual norms and success criteria

The second structural model developed takes the three CSFs and separates them down to the individual success criteria measures. For team chemistry, the success criteria are previous working experience (PW), use of partnering (PAR), and future work endeavors (FW). For planning effort, the success criteria are planning effort during design (PED), and planning effort during construction (PEC). For project objectives, the success criteria are budget satisfaction (BS), schedule satisfaction (SS), quality performance satisfaction (QS), and functionality of the final product satisfaction (FS). Figure 4-14 illustrates the path diagram while Table 4-32 through Table 4-37 summarize the results.

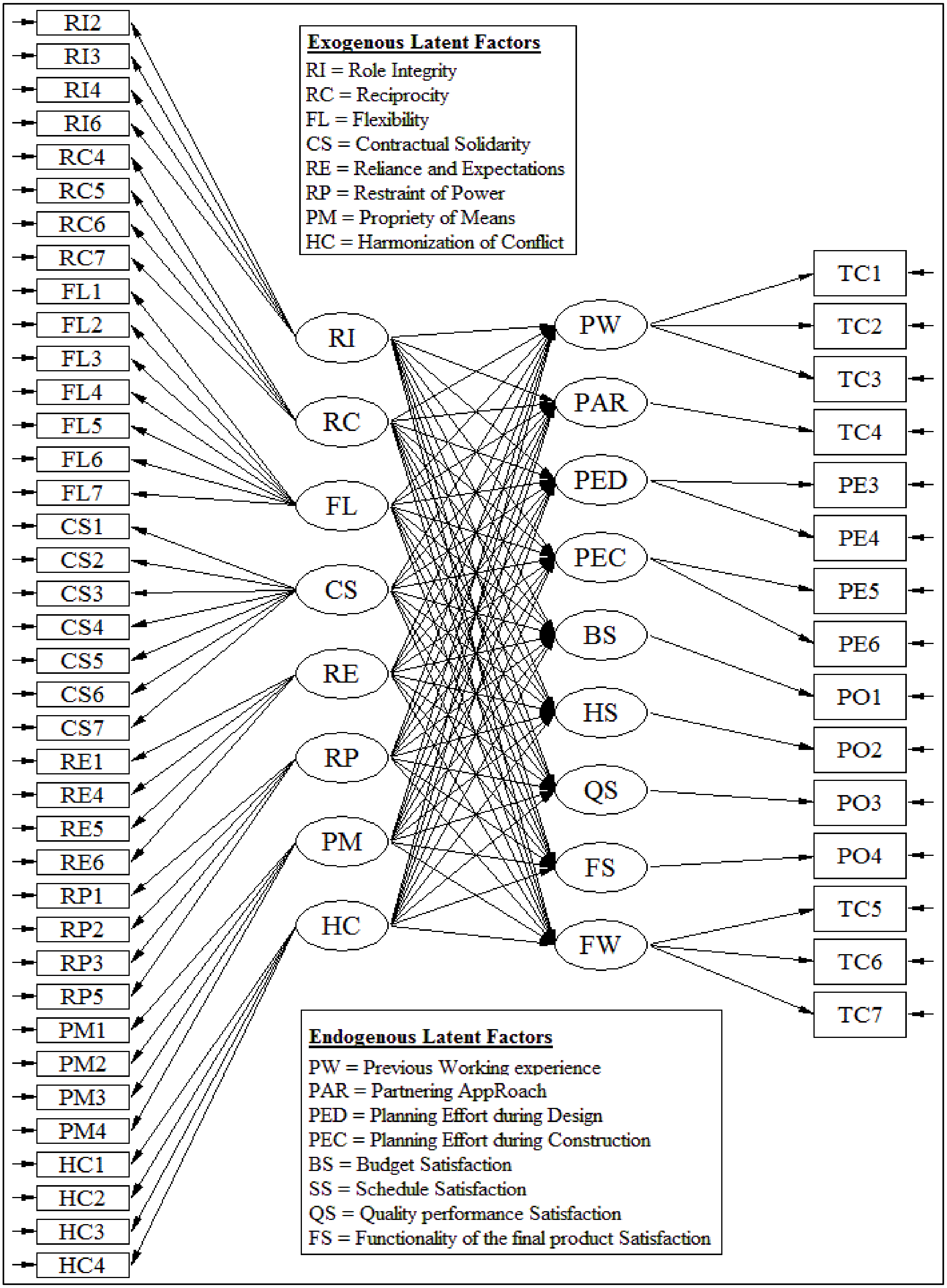

Figure 4-14: Path diagram for contractual norms – success criteria SEM

Table 4-32: Contractual norms – success criteria SEM fit statistics

	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
SEM Success Criteria Model	1974.076 (0.0000)	1327	1.6158	0.0617	0.0507	0.993	0.992	0.909

Table 4-33: Contractual norms – success criteria SEM exogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
RI → RI2	0.820	---	0.356	7.381	0.673
RI → RI3	0.677	15.465	0.596	6.819	0.458
RI → RI4	0.807	25.016	0.383	5.011	0.652
RI → RI6	0.727	21.543	0.518	6.711	0.529
RC → RC4	0.785	---	0.413	7.944	0.616
RC → RC5	0.694	20.273	0.571	6.963	0.481
RC → RC6	0.853	24.924	0.299	3.719	0.728
RC → RC7	0.869	28.610	0.268	4.123	0.756
FL → FL1	0.722	---	0.525	14.314	0.521
FL → FL2	0.876	27.440	0.256	2.294	0.767
FL → FL3	0.861	28.186	0.284	2.796	0.742
FL → FL4	0.821	27.735	0.359	3.721	0.674
FL → FL5	0.894	30.031	0.220	2.272	0.800
FL → FL6	0.585	14.096	0.724	7.898	0.342
FL → FL7	0.688	22.717	0.579	7.051	0.474
CS → CS1	0.844	---	0.322	9.445	0.713
CS → CS2	0.733	21.026	0.510	5.937	0.537
CS → CS3	0.846	43.731	0.312	4.290	0.716
CS → CS4	0.870	41.637	0.267	3.714	0.757
CS → CS5	0.885	44.319	0.237	2.623	0.784
CS → CS6	0.736	23.052	0.503	7.149	0.542
CS → CS7	0.881	41.238	0.245	2.949	0.777
RE → RE1	0.844	---	0.314	7.055	0.712
RE → RE4	0.747	20.704	0.486	5.154	0.558
RE → RE5	0.777	23.152	0.436	4.871	0.603
RE → RE6	0.864	37.197	0.279	4.277	0.747
RP → RP1	0.700	---	0.560	10.321	0.490
RP → RP2	0.548	11.415	0.771	7.684	0.300
RP → RP3	0.767	24.991	0.451	4.548	0.589
RP → RP5	0.755	20.991	0.471	4.319	0.570
PM → PM1	0.564	---	0.755	14.605	0.318
PM → PM2	0.754	23.174	0.475	3.807	0.568
PM → PM3	0.834	25.694	0.334	3.078	0.696
PM → PM4	0.652	19.729	0.633	8.068	0.425
HC → HC1	0.702	---	0.563	13.463	0.493
HC → HC2	0.604	13.277	0.698	8.326	0.365
HC → HC3	0.732	20.216	0.510	5.534	0.536
HC → HC4	0.719	21.034	0.531	6.348	0.517

Table 4-34: Contractual norms – success criteria SEM endogenous estimates

Parameter	Standardized Regression Coefficient	t-score (significant >1.96)	Error Variance	t-score (significant >1.96)	R^2
PW → TC1	0.631	---	0.665	6.949	0.398
PW → TC2	0.710	13.792	0.546	5.214	0.504
PW → TC3	0.714	14.500	0.539	5.183	0.510
PAR→ TC4	0.864	---	0.284	---	0.746
FW → TC5	0.788	---	0.419	5.214	0.621
FW → TC6	0.633	12.967	0.660	6.846	0.401
FW → TC7	0.785	15.516	0.423	4.229	0.616
PED → PE3	0.837	---	0.328	*<u>1.921</u>*	0.700
PED → PE4	0.657	3.891	0.624	4.627	0.432
PEC → PE5	0.799	---	0.397	3.614	0.639
PEC → PE6	0.931	12.022	0.146	*<u>1.391</u>*	0.867
BS → PO1	0.900	---	0.210	---	0.810
SS → PO2	0.874	---	0.261	---	0.764
QS → PO3	0.934	---	0.141	---	0.873
FS → PO4	0.949	---	0.113	---	0.900

Table 4-35: SEM contractual norms – success criteria equations for Team Chemistry CSF

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
PW → RI	**1.708**	**2.270**	**0.023**	**0.282**	**3.201**	**0.001**	**0.359**	**0.342**	**1.560**
PW → RC	**1.342**	**3.169**	**0.002**						
PW → FL	0.331	1.597	0.110						
PW → CS	**2.923**	**3.428**	**0.001**						
PW → RE	0.235	1.025	0.305						
PW → RP	**0.435**	**2.099**	**0.036**						
PW → PM	0.101	0.320	0.749						
PW → HC	**1.085**	**3.265**	**0.001**						
FW → RI	**1.718**	**2.099**	**0.036**	**0.238**	**2.520**	**0.012**	**0.654**	**0.645**	**2.890**
FW → RC	**1.396**	**3.617**	**0.000**						
FW → FL	**0.453**	**2.193**	**0.028**						
FW → CS	**3.409**	**4.032**	**0.000**						
FW → RE	0.294	1.294	0.196						
FW → RP	-0.425	-1.927	0.054						
FW → PM	0.133	0.358	0.721						
FW → HC	**1.842**	**4.036**	**0.000**						
PAR → RI	**1.978**	**2.264**	**0.024**	**0.545**	**4.332**	**0.000**	**0.500**	**0.487**	**2.000**
PAR → RC	**5.204**	**2.070**	**0.038**						
PAR → FL	**0.941**	**6.333**	**0.000**						
PAR → CS	4.347	1.914	0.056						
PAR → RE	**2.652**	**2.610**	**0.009**						
PAR → RP	**0.844**	**4.472**	**0.000**						
PAR → PM	**1.412**	**3.080**	**0.002**						
PAR → HC	**5.465**	**3.055**	**0.002**						

Table 4-35 shows the contractual norms that correlate with the three success criteria of the CSF Team Chemistry, the **bold** text showing the significant correlations. For all three structural equations, the error variance is statistically significant. The adjusted R^2 values for each equation are justifiable and reasonable and the VIFs are less than 5. Here I summarize the results, while chapter 5 will discuss the results in further detail:

- Role Integrity (RI), Reciprocity (RC), Contractual Solidarity (CS), Restraint of Power (RP), and Harmonization of Conflict (HC) correlate with previously working together experience;
- Role Integrity (RI), Reciprocity (RC), Flexibility (FL), Contractual Solidarity (CS), Harmonization of Conflict (HC) correlate with the potential for future work endeavors;
- Role Integrity (RI), Reciprocity (RC), Flexibility (FL), Reliance and Expectations (RE), Restraint of Power (RP), Propriety of Means (PM), and Harmonization of Conflict (HC) correlate with the use of partnering/team building approach

Table 4-36: SEM contractual norms – success criteria equations for planning effort CSF

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
PED → RI	**3.089**	**2.442**	**0.015**	*0.004*	*0.045*	*0.964*	*0.995*	*0.995*	*200.00*
PED → RC	**6.862**	**2.281**	**0.023**						
PED → FL	**0.880**	**7.991**	**0.000**						
PED → CS	5.455	1.868	0.062						
PED → RE	**2.868**	**2.543**	**0.011**						
PED → RP	**1.238**	**5.892**	**0.000**						
PED → PM	**2.440**	**4.176**	**0.000**						
PED → HC	**6.446**	**3.240**	**0.001**						
PEC → RI	**0.690**	**3.169**	**0.002**	**0.300**	**2.828**	**0.005**	**0.574**	**0.563**	**2.347**
PEC → RC	0.760	1.358	0.174						
PEC → FL	**0.585**	**3.658**	**0.000**						
PEC → CS	**0.781**	**2.417**	**0.016**						
PEC → RE	0.266	0.713	0.476						
PEC → RP	0.039	0.410	0.682						
PEC → PM	0.205	1.345	0.178						
PEC → HC	**2.518**	**3.509**	**0.000**						

Table 4-36 outlines the correlations between the contractual norms and the two planning effort success criteria. Reviewing the error variance t-scores shows that the error variance for planning effort during design is non-significant. Also, the adjusted R^2 and VIF are extremely high, meaning the results for the planning effort during design structural model cannot be inferred as significant or valid results. For the planning effort during construction, the error variance is significant, the adjusted R^2 value of 0.563 is a reasonable value, and the VIF is 2.347 < 5.00. A summary of the results for planning effort success criteria are:

- Although there are significant regression coefficients for the planning effort during design, this equation provides questionable results and I determined the results to be inconclusive due to the lack of significant error variance and the very high R^2 / VIF values.

- Role Integrity (RI), Flexibility (CS), Contractual Solidarity (CS), and Harmonization of Conflict (HC) correlate with planning effort during construction

Table 4-37: SEM contractual norms – success criteria equations for project objectives CSF

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
BS → RI	**1.288**	**3.490**	**0.000**	**0.520**	**4.740**	**0.000**	**0.525**	**0.513**	**2.105**
BS → RC	0.267	0.401	0.689						
BS → FL	**0.911**	**4.163**	**0.000**						
BS → CS	**2.430**	**6.024**	**0.000**						
BS → RE	0.499	1.088	0.277						
BS → RP	0.047	0.389	0.697						
BS → PM	0.263	1.278	0.201						
BS → HC	**3.368**	**3.663**	**0.000**						
SS → RI	**3.104**	**2.862**	**0.004**	**0.483**	**4.526**	**0.000**	**0.558**	**0.546**	**2.262**
SS → RC	**2.192**	**4.257**	**0.000**						
SS → FL	**0.853**	**3.054**	**0.002**						
SS → CS	**5.318**	**4.533**	**0.000**						
SS → RE	**0.888**	**3.512**	**0.000**						
SS → RP	**0.687**	**3.034**	**0.002**						
SS → PM	0.711	1.575	0.115						
SS → HC	**2.317**	**4.033**	**0.000**						
QS → RI	5.801	2.734	0.006	*0.218*	*1.367*	*0.172*	*0.801*	*0.796*	*5.025*
QS → RC	3.106	3.017	0.003						
QS → FL	1.114	2.404	0.016						
QS → CS	8.583	3.607	0.000						
QS → RE	1.132	4.698	0.000						
QS → RP	**1.148**	**2.776**	**0.005**						
QS → PM	1.491	1.809	0.070						
QS → HC	**3.134**	**3.527**	**0.000**						
FS → RI	**4.003**	**3.028**	**0.002**	**0.444**	**2.898**	**0.004**	**0.456**	**0.381**	**1.838**
FS → RC	**1.343**	**4.957**	**0.000**						
FS → FL	**1.030**	**2.743**	**0.006**						
FS → CS	**5.859**	**5.225**	**0.000**						
FS → RE	0.048	0.113	0.910						
FS → RP	**0.628**	**2.245**	**0.025**						
FS → PM	0.450	0.825	0.409						
FS → HC	**3.781**	**3.528**	**0.000**						

A summary of the results of the correlations between the contractual norms and the four project objectives satisfaction success criteria are shown in Table 4-37. First, I found the error variance as significant for budget, schedule, and functionality satisfaction, but not significant for quality satisfaction. Also, the adjusted R^2 and VIFs for budget, schedule, and functionality satisfaction are reasonable values, while the adjustedR^2 for quality satisfaction is rather high while the VIF is greater than 5. The structural equation for quality satisfaction is inconclusive and does not provide worthwhile results. A summary of the project objective success criteria relationships are:

- Role Integrity (RI), Flexibility (FL), Contractual Solidarity (CS), and Harmonization of Conflict (HC) correlate with satisfactorily achieving the budget project objective;
- Role Integrity (RI), Reciprocity (RC), Flexibility (FL), Contractual Solidarity (CS), Reliance and Expectations (RE), Restraint of Power (RP), and Harmonization of Conflict (HC) correlate with satisfactorily achieving the schedule project objective;
- The results of the quality satisfaction equation are questionable and therefore are inconclusive. No reliable conclusions can be drawn for the relationship of quality satisfaction and project integration; and
- Role Integrity (RI), Reciprocity (RC), Flexibility (FL), Contractual Solidarity (CS), Restraint of Power (RP), and Harmonization of Conflict (HC) correlate with satisfactorily achieving a functional product project objective.

4.3.1.4 Project integration and project success, CSFs, and success criteria

With the results of the above structural models, the results demonstrate the contractual norms that are significant predictors for project success in terms of overall success, critical success factors, and the success criteria. However, these results did not recognize the overall relationship of project success to project integration. In order to compare integration to success, I developed a structural model with the second order latent factor of integration (INT) modeled against project success. Table 4-38 shows the fits statistics while table 4-39 illustrates the overall correlations for three models: 1) between integration and project success (PS), 2) between integration and the critical success factors (TC, PE, and PO), and 3) between integration and the success criteria measures (PW, FW, PAR, PED, PEC, BS, SS, QS, and FS).

Table 4-38: Project integration – project success SEM fit statistics

	χ^2 (p-value)	df	χ^2 / df	RMSEA	SRMR	CFI	NNFI	AGFI
1) SEM INT – PS	2804.570 (0.000)	1324	2.118	*0.0820*	0.0575	0.982	0.981	*0.848*
2) SEM INT – CSF	2684.669 (0.000)	1322	2.031	0.0799	0.0693	0.984	0.983	*0.859*
3) SEM INT – Success Criteria	2388.551 (0.000)	1316	1.815	*0.0910*	*0.0855*	*0.871*	*0.899*	*0.810*

Table 4-39: SEM Project integration – project success equations

Parameter	Standardized Regression Coefficient	t-score	p-value	Error Variance	t-score	p-value	R^2	Adj. R^2	VIF
PS → INT	0.816	6.440	0.000	0.333	3.188	0.001	0.667	0.657	3.003
TC → INT	0.680	8.840	0.000	0.538	4.527	0.000	0.462	0.446	1.859
PE → INT	0.736	10.015	0.000	0.459	5.158	0.000	0.541	0.527	2.178
PO → INT	0.759	13.413	0.000	0.424	6.208	0.000	0.576	0.563	2.358
PW → INT	0.726	4.701	0.000	0.473	6.974	0.000	0.527	0.513	2.114
FW → INT	0.804	3.377	0.000	0.353	6.040	0.000	0.647	0.637	2.833
PAR → INT	0.520	28.138	0.000	0.729	15.627	0.000	0.571	0.558	2.331
PED → INT	0.706	11.318	0.000	0.563	4.969	0.000	0.437	0.420	1.776
PEC → INT	0.667	11.616	0.000	0.555	6.415	0.000	0.445	0.429	1.802
BS → INT	0.626	12.831	0.000	0.609	15.296	0.000	0.391	0.373	1.642
SS → INT	0.690	16.408	0.000	0.524	13.892	0.000	0.476	0.461	1.908
QS → INT	0.760	18.094	0.000	0.422	9.458	0.000	0.278	0.257	1.385
FS → INT	0.706	13.684	0.000	0.502	10.344	0.000	0.498	0.483	1.992

The results in the tables above show that the integration-project success model achieves fit, but the fit for the integration-project success SEM has two statistics that are outside the specified threshold (RMSEA and AGFI), and the fit for the integration-success criteria are mostly outside of the fit thresholds, most likely due to the complexity of the structural model. The correlations show that a significant relationship exists between integration and the three project success models. The squared multiple correlations range from 0.278 to 0.667 and all VIF values are less than the threshold of five. The results here confirm evidence to support the hypothesis for research question Q3, but only in terms of project success overall and the CSFs. Due to the lack of fit, the integration-CSF and integration-success criteria models do not provide conclusive reliable and valid results.

4.4 Analyze Validity

The results for the measurement model in the previous section established validity based on the statistical analyses. For the results of the structural model, validity needs to exist internally and externally. The sections below outline how the research established validity of the SEM results.

4.4.1 Internal validity

Internal validity (also called statistical validity) threats are any plausible alternative explanations for any of the statistical associations found between observed variables (Abowitz and Tool 2010). Establishing internal validity requires the use of proper statistical analyses and obtaining acceptable results. To do this, I examined several statistical processes, namely the intercorrelation evaluation from the EFA, internal consistency from the reliability analyses, goodness-of-fit statistics for the measurement model and the structural models, reviewing the standardized regression coefficients for the measurement models and the structural models, testing for spuriousness while building the measurement model, and checking for common method bias of the measurement model.

4.4.1.1 Intercorrelations evaluation

To check for intercorrelations and to make sure that the collect data is appropriate for factor analysis, the polychoric correlation matrix shows 1,431 correlation coefficients that represent 1,431 combinations of observed variable pairs. Of these pairs, there are 172 correlation coefficients less than 0.30. This means that there are only 12.02% of the total correlation coefficients less than 030. Further, intercorrelations were assessed Bartlett test of sphericity and Kaiser-Meyer-Olkin MSA. The Bartlett test is significant (p-Value = 0.000), and the MSA value is 0.966, which falls in the marvelous range (Hair et al 2010). This means the overall data set is appropriate for conducting factor analyses.

4.4.1.2 Internal consistency and goodness-of-fit

Evaluating the isolated individual contractual norm scales for reliability and in the CFA provided excellent results that each scale measures what it is supposed to measure and collected accurate data to match. Each of the scales checked out for internal consistency, which are the reliability calculations shown in table 4-10. All of the scales had Cronbach's alpha values of greater than 0.70 and six of the eight scales were above 0.80. The CFA independent contractual norm models for each of the eight contractual norms provided fit statistics (table 4-11) that fall within the acceptable thresholds. Then, Table 4-20 summarizes the fit statistics for the first order and second order CFA models, which demonstrate acceptable fit. Review of the standardized regression coefficients for the two CFA models (See Table 4-13and Table 4-14 for the first order CFA model and Table 4-21 and Table 4-22 for the second order CFA model) reveals no regression coefficients less than 0.5 and the majority of loadings being greater than 0.70. With established internal consistency and goodness-of-fit, the results of the measurement models do show signs of internal validity.

Internal validity of the SEM structural models relies on the goodness-of-fit statistics and review of the standardized regression coefficients. Review of the structural model goodness-of-fit results (see Table 4-24 for the contractual norms-project success model, Table 4-28 for the contractual norms-CSF model, Table 4-32 for the contractual norms-success criteria model, and Table 4-38 for the project integration-project success models) show that the structural models have obtained good data fit, except for the integration-success criteria structural model. Reviewing the standardized regression coefficients for all models reveals standardized regression coefficients greater than 0.50. Internal validity exists in the structural models based on the goodness-of-fit and regression coefficient result reviews.

4.4.1.3 Common method bias and spuriousness

Eliminating bias in the data also provides internal validity. Testing for spuriousness and checking for common method bias tend to reduce the confounding of results if both do not exist in a model. In checking for common method bias, the first order CFA model and second order CFA model statistical analyses of Harman's single factor test and the common latent factor method both showed that common method bias should not be an issue. The common variance shared between all of the contractual norm observed variables is only 13.6% for the first order CFA model and 11.6% for the second order CFA model.

Testing for spuriousness results, shown in

Figure 4-9, provides evidence that the CFA models are non-spurious. Spurious models would show large changes in regression coefficient values when adding additional latent factors to a model. This is not occurring with the CFA models in this research. The non-spurious models allow for accurate conclusions.

4.4.2 External validity

Establishing external validity takes more effort and requires the use of external sources to verify the results. First, the survey response rate achieved was 20%, which is the response rate I expected for this research. This, along with the various types of projects and delivery methods associated with the collected responses help to establish external validity.

To gain substantial external validity, as well as firmly establish internal validity, I used of follow-up interviews with seven survey respondents and the same eight expert interviewees. Each interviewee received a summary of the results prior to the formal interview. Then, each interview occurred via a phone call that lasted between 30-90 minutes depending on the amount of feedback each interviewee was willing to provide. Overall, the feedback gained from the 15 interviews provided general acceptance of the results found in this research.

For one, many of the interviewees acknowledged the importance of establishing a relationship so that organizations are able to get along and work together in a cooperative and collaborative manner. One interviewee stated, *"The effect of having an established relationship with a contractor can make or break a project. It goes back to having the right people involved in a project as you then know that everyone will act like they should."* However, the follow-up interviewees had a difficult time thinking of ways to build relationships prior to working together. Most mentioned either using partnering, which the statistical results show the importance of this to integrating a team, or by working together multiple times.

A few of the expert interviewees stated that the findings relate to the current condition of the construction industry. In most cases, organizations consider construction projects as just long duration transactions, not relational exchanges. However, in order to improve the construction industry, the culture will need to change. The relational exchange aspect needs to become commonplace so that organizations know that they are all tied together and depend on one another. The current state of the industry does not lend itself to relational contracts.

The final item discussed was the use of the measurement model to measure project integration on construction projects. I inquired from the interviewees if it would be helpful to measure integration during design and construction of the project. Most agreed that the measurement tool does a good job of measuring integration of the project team based on expected behaviors, and that measuring during a project could provide new and significant findings as well as aligning the organizations on a project. One comment made stated that if one organization seems to be interacting and behaving detrimentally to the project, the measurement tool should be able to help determine why this is occurring. Then, once the issue is determined, alignment of that organization with the other contractual organizations can occur. *"Bringing a project team together and getting them on the same page is crucial to obtaining project success."*

4.5 Chapter 4 Summary

This chapter summarizes the analyses completed for the CA and expert interviews, which answers research question Q1 that contractual norms associated with relational contracting can define project integration. The CA helped to determine relevancy of the contractual norms in standard construction contracts. The expert interviews then verified the existence of the contractual norms in relationships between organizations on construction projects. These findings helped to support the tasks associated with addressing research questions Q2 and Q3. Using the CA and interview results, I was able to create the data collection tool, the survey, shown in appendix B.

Then, the full survey produced 314 responsive cases. I used the 314 cases to conduct an EFA and a CFA. The EFA and CFA confirmed the measurement model of the contractual norm latent factors as an appropriate model to measure project integration, which provides evidence for answering research question Q2.

Finally, the SEM allowed the data set to compare the contractual norm constructs to project success factors as well as integration to project success factors. The SEM models illustrated a correlation between integration and project success in terms of team chemistry, planning effort, and the satisfaction of achieving project objectives. The next chapter, chapter 5, describes the results of the data analyses in detail.

CHAPTER 5. DISCUSSION OF RESULTS

The data analyses from chapter 4 provided results that I now discuss in detail. The evidence shown in this chapter supports answering the three research questions. Section 5.1 provides evidence that supports research question Q1. Section 5.2 illustrates the project integration measurement model to answer research question Q2. Section 5.3 outlines the SEM results that answer research question Q3. As a reminder, the three research questions are:

Q1 How can relational contracting norms *define* construction project integration?

Q2 How can relational contracting norms *measure* construction project integration?

Q3 How does construction project integration *relate* to project success?

5.1 Defining Project Integration

The literature review, expert interviews, and the content analysis (CA) provided evidence that construction contracts are relational exchanges. Additionally, the CA results proved that integrated IPD contracts are more relational than the standard contracts associated with DBB, DB, and CMGC. The discussion in the next two sections supports the answer to research question Q1 and verifies the hypothesis that relational contract theory defines project integration using contractual norms.

5.1.1 Construction contract language

Shifting from the DBB method to the IPD method of delivery, construction contracts become more relational and therefore, are more integrated, which emulates the relational contract theory commercial exchange spectrum (see Table 2-5). The construction contracting spectrum and the commercial exchange spectrum are analogous in that DBB projects show similarities to discrete transactions, while IPD projects show similarities to relational exchanges.

The relative frequency matrix from the CA analysis, shown in Table 4-1, provides evidence of the relationship between project integration and relational contract theory. The four IPD contract documents used in the CA exhibit instances of all eight contractual norms, while each of the common DBB, DB, and CMGC contracts exclude at least one of the norms and exhibit lower frequencies of the norms. Therefore, I can conclude from this evidence that the more relational the contract, the more integrated the project is in terms of specific contract language.

Role integrity occurs when organizations align individual goals with the project goals and perform with the best interest of the project in mind. Contractual solidarity occurs when organizations cooperate, collaborate, and work through issues together by putting the project first. However, when reviewing the relative frequencies of role integrity and contractual solidarity across all of the contracts, I found that role integrity and contractual solidarity frequently exist in IPD contract language, but generally do not exist in DBB, DB, or CMGC contracts. The lack of role integrity and contractual solidarity means that DBB, DB, and CMGC contracts do not speak directly of cooperating, working together, and aligning individual goals with the project goals, but rather to the competitive and fragmented nature of the construction industry. Further, DBB, DB, and CMGC contracts lend themselves to a more competitive atmosphere while IPD contracts exhibit a more cooperative atmosphere.

Another contractual norm, harmonization of conflict, represents contract language of how to address disputes/conflict as they arise in different contracts. The DBB, DB, and CMGC contracts provide more occurrences of harmonization of conflict than IPD projects, which mean that common construction contract language provides an excess of information on what to do when issues or disputes arise because DBB, DB, and CMGC contracts expect issues to arise between contracting organizations. IPD contracts contain less dispute resolution language because relational contracts want resolution of issues to occur internally in order to benefit the project.

DBB, DB, and CMGC contracts, therefore, are tools for resolving issues when they arise, but IPD contracts are a tool for establishing and integrating the project team.

5.1.2 Industry experts

The expert interviews provided evidence supporting the results from the CA. Comments by the experts stated that the contractual norms are appropriate in describing relationships between contracting organizations found on construction projects and that behaving properly on a construction project correlates with achieving a successful project.

All of the interviewees acknowledge that each of the contractual norms are relevant and important to contractual relationships on construction projects. However, a few of the norms showed more relevancy and importance. Six interviewees acknowledged that role integrity is very important and relevant to construction projects and that other contractual norms are more supplemental to role integrity. For example, reciprocity occurs when organizations develop mutual respect and understanding of one another. Nevertheless, many stated that mutual respect would not occur unless each organization performs their role with honesty and integrity. The experts agreed to the importance of role integrity to contractual relationships, yet, from the CA results, role integrity exists in IPD contract language but role integrity is non-existent or sparsely acknowledged in DBB, DB, and CMGC contracts.

Five interviewees agreed that role integrity, reciprocity, contractual solidarity, and reliance and expectations are important norms, especially for integrated projects. The same five interviewees also agreed that reciprocity and contractual solidarity are somewhat similar in context and overlap in meaning. Other experts acknowledged the importance of restraint of power, flexibility, propriety of means, and harmonization of conflict. Overall, the eight experts acknowledged that each contractual norm is important and relevant to explaining construction contractual relationships.

One reoccurring discussion that all the experts mentioned was repeat business and future endeavors, which supports the correlation found between integration and team chemistry. For instance, construction organizations that perform work together repeatedly on multiple projects will tend to establish a relationship, which creates a trustworthy and effective team. Once construction organizations develop a relationship by working together on many projects, the contract between the organizations becomes more of a formality than a reference. The organizations know they can complete a successful project from previous experience (team chemistry), they trust one another (reciprocity), and each knows the other is looking out for them (contractual solidarity).

Other comments by several experts discussed the concept of cooperation vs. competition. Most experts agreed that cooperation is key to developing an integrated construction project. If individuals and organizations cannot get along and work together, then integration is difficult to accomplish, although one expert noted a need to balance cooperation and competition on projects. The thought behind this is that in a team environment, there is a natural tendency to cooperate and get along (Bowles and Gintis 2011), but there are usually one or two individuals who are more outspoken and take a more leadership position of the team and the rest fall in line with this person. When this particular dynamic develops, one person may influence others and will suggest ideas and solutions, which everyone else agrees to in order to cooperate. However, an outspoken individual can impede innovation and in-depth discussions on how to solve an issue. If one other person speaks up with another idea for the same problem, then further discussion takes place and a more economical and timesaving solution may develop. In some situations, it might prove beneficial to invite competition to keep the team thinking and working towards the most optimal solution for the project, instead of the most cooperative solution.

5.2 Measuring Project Integration

The results for the CFA measurement models are exceptional in that the statistical analyses proved that operationalizing the contractual norms was a successful task and that the contractual norms can and do measure project integration accurately, which answers research question Q2 and proves the hypothesis that project integration can be measured using contractual norms from relational contract theory.

Further support for the measurement tool comes from the follow-up interviews conducted. The follow-up interviews made some interesting comments that relate to the measurement model and the ability to measure project integration. In general, the interviewees view the integration measurement tool as a beneficial assessment to align the interests of primary organizations during a project and to compile lessons learned at the conclusion of a project.

Several follow-up interviewees acknowledged the importance of the ability to measure project integration. The ability to measure project integration provides a tool for construction professionals to understand how well the different organizations on a construction project are getting along. Comments made about the measurement tool focused on the lack of understanding that construction professionals have when it comes to the human factors that affect achieving a high performing and successfully completed job. Many stated that the contract does not provide a way to resolve issues and work together, but rather the steps to take in order to punish one another for issues or problems that arise. One survey respondent from an IPD project stated that the IPD project team discussed the multi-party agreement with all of the contracting organizations in detail at the beginning of the project and then did not refer to the contract again throughout the project. This demonstrates the importance of developing a team atmosphere so that the contract is more of a formality than a tool for resolving issues.

Other comments from the follow-up interviews mentioned that construction projects are difficult to manage and complete due to the complexity, the many different organizations involved, and the differences that exist from project to project. However, the efforts to form a team on a project can remain the same. Several interviewees see the measurement tool as something to use with any project regardless of the contract or delivery method. The integration measurement tool can inform the project organizations about disconnects that might be occurring between the different organizations and individuals working on a project. Aligning the project team can make a substantial difference as to the outcome of a project.

The second order CFA measurement model (path diagram shown in Figure 4-11) is an illustration of the measurement tool that measures project integration on construction projects. I used the measurement model in this research to measure project integration for completed projects, although measuring integration during a project can be beneficial. Understanding of any positives and/or negatives associated with a contractual relationship during a project can help the project team to resolve differences and re-focus on completing the project successfully.

5.3 Relating Project Integration to Project Success

This section details the results that support answering research question Q3 and accepting the hypothesis that project integration does relates to project success. Table 5-1 shows the statistical results of the structural model analyses. The summary of results show integration relates the strongest towards the use of partnering on a project (7 of 8 norms correlate) and to the success in achieving schedule satisfaction (7 of 8 norms correlate) at the conclusion of the project. Partnering is therefore a tool to assist with integrating a project team and schedule performance relies on proper planning, which takes an integrated team effort to effectively plan a project.

Table 5-1: Summary of structural models

		Adjusted R^2	Role Integrity (RI)	Reciprocity (RC)	Flexibility (FL)	Contractual Solidarity (CS)	Reliance and Expectations (RE)	Restraint of Power (RP)	Propriety of Means (PM)	Harmonization of Conflict (HC)
	Project Success (PS)	0.717					✓		✓	✓
CSFs	**Team Chemistry (TC)**	0.635		✓		✓				
	Planning Effort (PE)	0.561		✓		✓	✓			✓
	Project Objectives (PO)	0.654				✓	✓			✓
Success Criteria	**Previous Working (PW)**	0.342	✓	✓		✓		✓		✓
	Future Work (FW)	0.645	✓	✓	✓	✓				✓
	Partnering (PAR)	0.487	✓	✓	✓	✓	✓		✓	✓
	Planning Design (PED)	---	---	---	---	---	---	---	---	---
	Planning Construction (PEC)	0.563	✓		✓	✓				
	Budget (BS)	0.513	✓		✓	✓				✓
	Schedule (SS)	0.546	✓	✓	✓	✓	✓	✓		✓
	Quality (QS)	---	---	---	---	---	---	---	---	---
	Functionality (FS)	0.381	✓	✓	✓	✓		✓		

In reference to the contractual norms, review of table 5-1 illustrates that reciprocity, contractual solidarity, and harmonization of conflict correlate and highly influence both the CSFs and success criteria measures, but not so in terms of overall project success. Therefore, in terms of integrating a project team, it is of the utmost importance to establish contractual solidarity and reciprocity between contracting organizations. The CA results contradict the importance of contractual solidarity, which showed contractual language related to contractual solidarity is non-existent in common construction contracts associated with DBB, DB, and CMGC. Establishing contractual solidarity is key to project integration and project success, but contractual solidarity might be difficult to establish when using DBB, DB, and CMGC contracts.

The importance of establishing reciprocity illustrates that demonstrating mutual respect and a dependency on one another is critical to a successful project. The CA and expert interviews confirmed the importance of reciprocity and establishing joint responsibility to complete a successful project. The CA reported that contractual language for reciprocity exists in all types of contracts, with ConsensusDOCS, DBIA, and IPD contracts, which showed more instances of reciprocity than the AIA and EJCDC contracts. Several comments by the interviewees stressed the importance of establishing a respectful relationship and a dependency on one another. The evidence shows that the construction industry understands the importance of establishing a respectful working relationship in order for contracting organizations to work together well, and as a result, achieve a successfully completed project.

In terms of harmonization of conflict, the CA provides evidence that the common contracts for DBB, DB, and CMGC have more instances of harmonizing conflict than IPD contracts. The data analysis results showed that harmonization of conflict generally correlates with project success. In terms of integration, establishing a harmonious relationship with other organizations is paramount for project success and does not need to rely necessarily on the contract. The interesting discovery is that harmonization of conflict is important to achieving project success, but how a project goes about achieving harmony in response to conflict can be quite different between projects that are highly integrated than projects with little or no integration of the project team.

5.3.1 Contractual norms and project success

Table 5-2 outlines the contractual norms that influence project success overall. Harmonization of conflict, which is the concept of mutual accommodation and resolving disputes internally, shows that when problems arise, it is better to solve the issues internally in order to achieve project success. Reliance and expectations is when organizations make and fulfill promises, which means that as long as organizations are willing to make and fulfill promises to complete tasks and activities, the chance of achieving project success increases. Finally, propriety of means correlated with project success. This means that when organizations possess the necessary skills and processes to complete a project without undermining other organizations, achieving a successful project becomes much easier. However, when reviewing all of the SEM results, propriety of means only correlates with one success criteria (schedule satisfaction). Reliance and expectations, and harmonization of conflict commonly correlate with the other project success factors. This means then that the propriety of means results might be questionable and I will need to conduct further investigation of propriety of means in future research.

Table 5-2: Summary of results for project success structural model

	Correlated Norm	Result
Project Success	Reliance and expectations	Making and fulfilling promises
	Propriety of means	Possessing exceptional means and methods
	Harmonization of conflict	Mutual accommodation, resolving disputes internally

5.3.2 Contractual norms and critical success factors

The results shown in table 5-3 illustrate that the following contractual norms influence project success in regards to the three CSFs of team chemistry, planning effort, and project objectives: reciprocity, contractual solidarity, reliance and expectations, and harmonization of conflict. Establishing reciprocity requires an atmosphere of mutual respect, a sense of trust and joint responsibility between contracting organizations to achieve a successful project. Establishing contractual solidarity means that contracting organizations cooperate when things do not go as planned, and collaborate and assist one another to complete a project. Establishing reliance and expectations occurs when contracting organizations make promises to one another and then fulfill the promises. Establishing harmonization of conflict requires the contracting organizations to be mutually accommodating to one another and have a sense that the best approach to disputes is to settle them internally and without using the formal contract agreement.

Table 5-3: Summary of results for CSF structural model

	Correlated Norm	Result
Team Chemistry	Reciprocity	Mutual respect and trust, joint responsibility
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
Planning Effort	Reciprocity	Mutual respect and trust, joint responsibility
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
	Reliance of expectations	Making and fulfilling promises
	Harmonization of conflict	Mutual accommodation, resolving disputes internally
Project Objectives	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
	Reliance and expectations	Making and fulfilling promises
	Harmonization of conflict	Mutual accommodation, resolving disputes internally

Achieving project success requires the establishment of reciprocity, contractual solidarity, reliance and expectations, and harmonization of conflict. Developing team chemistry, creating an effective planning effort, and achieving project objectives satisfactorily necessitates organizations to behave appropriately and integrate into a team, which increases the probability of attaining a successful project. The CA results contradict the relationship between contractual solidarity and project success, but the CA results confirm the importance of reciprocity and harmonization of conflict.

Comparing the results of reliance and expectations relating to project success criteria to the CA results are somewhat sporadic. Reliance and expectations does occur frequently in DBB contracts, and exists in IPD contracts, but with fewer occurrences than DBB contracts. The occurrences of reliance and expectation language in DB and CMGC contracts range from 0% to 24%, which demonstrates no consistency. With a lack of evidence from the CA on the importance of reliance and expectations, I inquired with the follow-up interviewees about reliance and importance. The follow-up interviews provided comments that making and fulfilling promises, which is the definition of reliance and expectations, is a very important aspect to a contractual relationship. In order to build respect and trust between organizations, performance needs to occur based on what each organization agrees to do. Fulfilling a promise instills a sense of belief between organizations that each will do what they say they will do. Breaking a promise takes any chance away of establishing a mutual and trustworthy relationship. Therefore, although reliance and expectations as language in contracts is inconclusive, the correlations found in the analyses, and the follow-up interviews prove that making and fulfilling promises is important in the development of a working relationship between contracting organizations.

5.3.3 Contractual norms and success criteria

Table 5-4 includes the results of the success criteria structural model analysis, which illustrates the significant correlations found between integration and the success criteria measures used with team chemistry, planning effort, and project objectives. Role integrity, or performing with the best interest of the project in mind, and contractual solidarity (cooperation and collaboration) correlate well with all seven success criteria, making role integrity and contractual solidarity important expected behaviors to establish on a project. The relationship found between role integrity and contractual solidarity does not match the findings from the CA. As I previously discussed, contractual solidarity exists in IPD contracts, but not in DBB, DB, and CMGC contracts. Similar results show that role integrity exists in IPD contracts but not DBB, DB, and CMGC contracts. Projects using IPD type contracts will have an easier time of establishing role integrity and contractual solidarity, which leads to increasing the chance of completing a successful project, than projects that use common contracts associated with the DBB, DB, and CMGC delivery methods.

Table 5-4: Summary of success criteria structural model results

	Correlated Norm	Result
Previously Worked together	Role integrity	Performing with the best interest of the project in mind
	Reciprocity	Mutual respect, sense of trust
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
	Restraint of power	Refrain from exploiting another organization
	Harmonization of conflict	Mutual accommodation, resolving disputes internally
Future work endeavors	Role integrity	Performing with the best interest of the project in mind
	Reciprocity	Mutual respect, sense of trust
	Flexibility	Adapting to changing conditions, incorporating changes in order to achieve project goals
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
	Harmonization of conflict	Mutual accommodation, resolving disputes internally
Use of partnering	Role integrity	Performing with the best interest of the project in mind
	Reciprocity	Joint responsibility, mutual respect
	Flexibility	Adapting to changing conditions
	Contractual solidarity	Collaborating and assisting one another
	Reliance and expectations	Making and fulfilling promises
	Propriety of means	Possessing exceptional means and methods
	Harmonization of conflict	Mutual accommodation
Planning effort construction	Role integrity	Performing with the best interest of the project in mind
	Flexibility	Adapting to changing conditions, Incorporating changes in order to achieve project goals
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another

	Correlated Norm	Result
Budget satisfaction	Role integrity	Performing with the best interest of the project in mind
	Flexibility	Incorporating changes in order to achieve project goals
	Contractual solidarity	Cooperating in the face of problems, collaborating with one another
Schedule Satisfaction	Role integrity	Performing with the best interest of the project in mind
	Reciprocity	Joint responsibility
	Flexibility	Adapting to changing conditions
	Contractual solidarity	Collaborating with one another
	Reliance and expectations	Making and fulfilling promises
	Restraint of power	Refraining from exploiting one another
	Harmonization of conflict	Mutual accommodation
Functionality satisfaction	Role integrity	Performing with the best interest of the project in mind
	Reciprocity	Joint responsibility
	Flexibility	Adapting to changing conditions, Incorporating changes in order to achieve project goals
	Contractual solidarity	Cooperating in the face of problems, Collaborating with one another
	Reliance and expectations	Making and fulfilling promises

The results shown in Table 5-4 provide additional evidence of the importance of establishing integration of the project team in order to achieve a successful project. Each of the eight contractual norms correlates at least once with one of the seven success criteria that provided conclusive results.

Investigating the success criteria results individually confirms the following conclusions. First, when comparing previous working experience to the potential for future work endeavors, I initially hypothesized that the same contractual norms would exist between the two. The results do show that both rely on role integrity, reciprocity, contractual solidarity, and harmonization of conflict. However, previously working experience also includes a correlation to restraint of power, whereas potential for future work endeavors does not. Then, the potential for future work endeavors includes a correlation with flexibility, whereas previous working experience does not. Restraint of power is important to establishing a previous working relationship while flexibility is important to gain repeat business.

The partnering success criteria measure correlates significantly with role integrity, reciprocity, flexibility, contractual solidarity, reliance and expectations, propriety of means, and harmonization of conflict. I only found restraint of power does not correlate with the use of partnering on a project. Hence, integration of a project team relies heavily on establishing a working relationship prior to designing and constructing a project. This confirms that partnering can emphasize integration of the different organizations on a project. Further, partnering instills a sense of respect between organizations, and organizations will then tend to act in appropriate ways once the project starts, which then leads to a better chance of producing successful project outcomes. The partnering results correlate with relational contracting principles (Rahman and Kumaraswamy 2004b).

The follow-up interviews provided further evidence of the correlations found between project integration and partnering. All of the interviewees agreed with the results of partnering being highly correlated with the contractual norms. One interviewee stated, *"...partnering is key to establishing a relationship when people have not worked together in the past. It is difficult to trust and respect another party if we don't know anything about each other. Partnering provides a way to establish responsibility and cooperation at the beginning of a project that then creates that atmosphere of a team building a project, not multiple organizations completing their own* *tasks*". This fundamental finding informs the construction industry of the importance of partnering, which helps to integrate the project team.

Planning effort during construction correlates with role integrity, flexibility, and contractual solidarity, which means that effective planning requires contracting organizations to consider the project primarily, to adapt to changes that occur on a project, to work together when issues arise, and to help one another throughout the project. Thus, for effective planning to occur, contracting organizations need to act appropriately with one another to ensure proper planning for a project.

Achieving budget satisfaction requires establishing role integrity, flexibility, contractual solidarity, and harmonization of conflict. In other words, contracting organizations need to act appropriately so that the success of a project remains as the most important aspect to consider, changes can occur and incorporated without dispute or disruption, cooperation and collaboration occur throughout the project, and that organizations willingly accommodate one another.

Achieving schedule satisfaction relates to role integrity, reciprocity, flexibility, contractual solidarity, reliance and expectations, restraint of power, and harmonization of conflict. Only propriety of means shows no correlation with schedule satisfaction. This shows a strong tie between project integration and achieving the schedule required for a project. Integrating the project team leads to better communication and understanding of what each organization is doing currently and what others will be doing in the near future. This helps to better schedule a project and more importantly to reduce the time to complete a project. Many studies show that IPD and DB provide time-savings (i.e. FHWA 2006; Kent and Becerik-Gerber 2010), which makes sense since in a DB project the contractor and designer are one entity and in IPD projects, all of the organizations act as one conducive unit. Therefore, this study adds new evidence to previous research that focused on time savings associated with alternative delivery methods.

Further, many of the follow-up interviewees agreed that achieving schedule performance takes proper coordination between organizations/trades on a project, as this has to do with planning of the project. Planning effort relates to project integration through reciprocity, reliance and expectations, and harmonization of conflict, while planning during construction relates to role integrity, flexibility, and contractual solidarity. Scheduling satisfactions relates to the same contractual norms as the planning effort CSF and planning effort during construction success criteria measure. This research found that planning effort and schedule performance go hand in hand, and both are influenced by the integration of a project team.

The proper functionality of a project in terms of how satisfied the end user is with the final product correlates with proper behaviors of role integrity, reciprocity, flexibility, contractual solidarity, and reliance and expectations. Therefore, achieving functionality satisfaction requires contracting organizations to perform with the interest of the project in mind, to have joint responsibility of completing the project successfully, adapting to changes without any headaches, cooperating and collaborating, and making and fulfilling promises. When these actions occur, the project has a much better chance of achieving the anticipated functionality.

5.3.4 Project integration and project success

Analyzing the results from section 4.3.1.4, project integration as the exogenous latent factor significantly correlates with project success factors. However, the issue with the three models using the second-order integration exogenous factor is that fit was not achieved for the integration-success criteria model and the fit is not ideal for the integration-CSF model (refer to table 4-38 for the fit statistic results). Therefore, in terms of integration and overall project success, a clear correlation exists as shown in table 5-5. But, the results for integration in terms of critical success factors might be determined questionable by other researchers and the results for integration and success criteria are inconclusive at best.

Table 5-5: Correlations between project success and project integration

	Project Integration		
	R^2	**Adj.** R^2	**VIF**
Integration - Project success SEM	0.667	0.657	3.003

5.4 Chapter 5 Summary

Chapter 5 provided a discussion of the results found from the data analyses carried out in chapter 4. The CA and comments from the expert interviews and the follow-up interviews provided evidence that contractual norms exist in construction contract language and therefore I can define project integration using the relational contract theory contractual norms. The EFA and CFA confirmed the measurement model and determined that contractual norms can measure project integration. The SEM analyses showed that important relationships exist between project integration and project success. The expert and follow-up interviews provided evidence to clarify the CA and factor analyses results. The results and subsequent discussions in this chapter provide the material that contributes to the construction industry body of knowledge. The next chapter, chapter 6, presents the contributions, limitations, future research, and final thoughts for this research project.

CHAPTER 6. CONCLUSIONS

The results of this dissertation research contribute to construction industry knowledge in regards to project integration, relational contracting, and the influence that project integration has on project success. Practitioners and researchers alike will benefit from this study. The information in this chapter discusses the practical and theoretical contributions, limitations of this study, and opportunities for future research based on this study.

6.1 Contributions

This study contributes to the body of knowledge by successfully elaborating on current concepts of integrated projects (e.g. El Asmar et al 2013; Kent and Becerik-Gerber 2010; Matthews and Howell 2005) and relational contracting as it applies to construction projects (e.g. Ning and Ling 2013; Meng 2012; Kumaraswamy et al (2005). Also, this research adds to the construction project success research (e.g. Ashley et al 1987, Sanvido et al 1992, Diekmann and Girard 1995) by discovering the link between integration and achieving a successful project. The previous chapters addressed and provided evidence for answering each of the three research questions. From the results, I can now discuss the contributions that this study makes to the construction industry body of knowledge. Figure 6-1 illustrates the contributions in four areas of measuring project integration, integration and project success, project integration research, and relational contracting research.

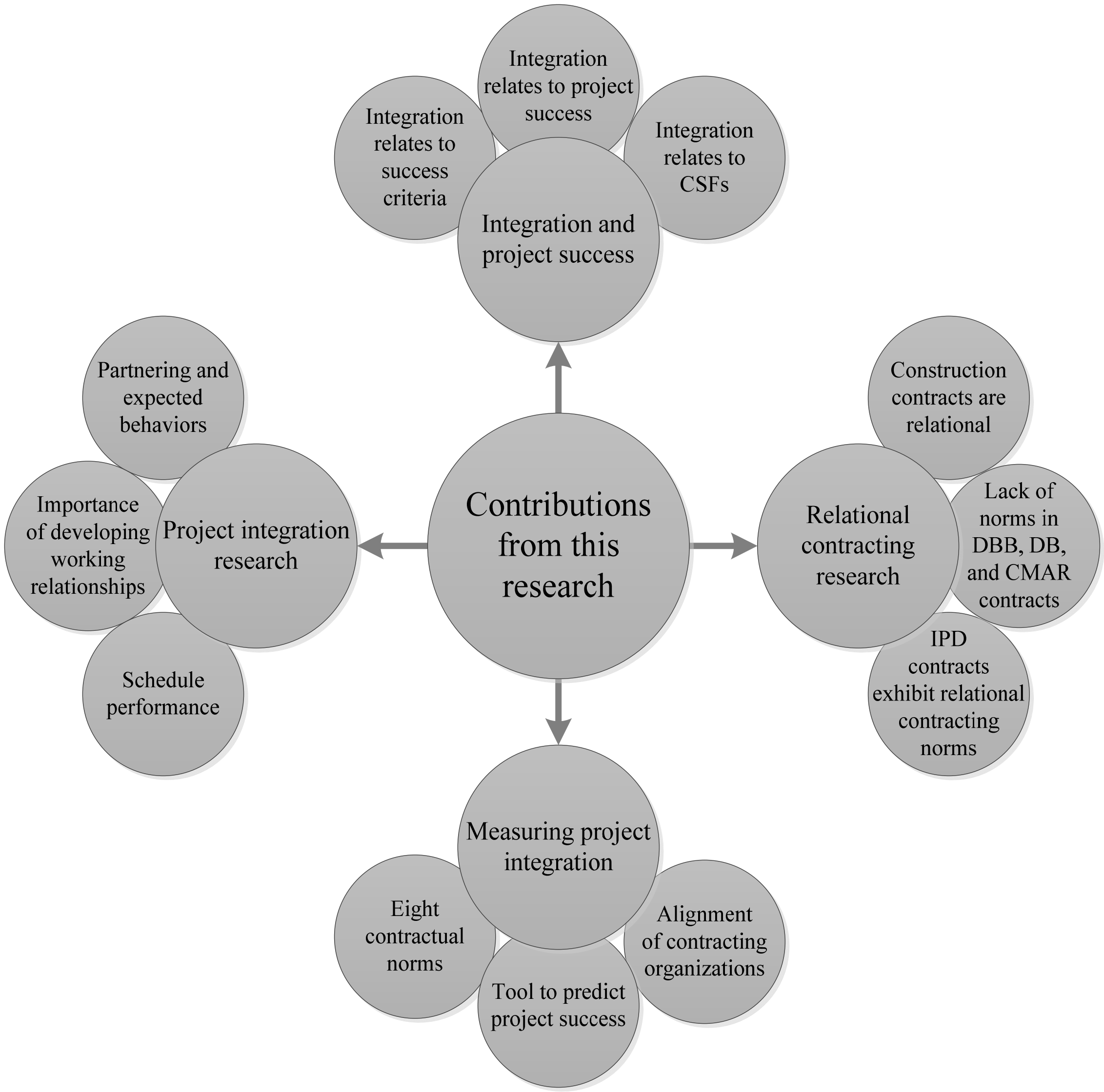

Figure 6-1: Contributions from this research study

6.1.1 Practical contributions

Practical contributions are the applications that benefit industry professionals for use on construction projects. The main practical contributions focus on the areas of measuring project integration and the relationship between integration and project success. The fundamental practical contributions are:

- Measuring project integration based on the contractual relationships present on construction projects allows practitioners and researchers to measure integration in many different scenarios. One advantage in measuring project integration is the application of the project integration measurement tool during the design and construction of a project. Midstream evaluations determine if a project team is integrating or not, which can provide valuable information on how well the project team is getting along and can signal specific aspects of the contractual relationship that need improvements. Knowing this during the project allows for the team to make adjustments and for alignment to occur across the many contracting organizations, which can then increase the probability of achieving a successful project. Without the use of the project integration measurement tool, it is difficult for projects to adjust for human factors that impact a project's outcome.

- Integration of project teams relates to project success. The project integration measurement tool has the ability to predict project success in three areas of 1) team chemistry, 2) planning effort, and 3) project objectives. Measuring integration can help to attain a successful project by understanding the improvements to make during a project so that the chances of completing a project successfully increase.
- Contracts used for DBB, DB, and CMGC generally do not promote project integration. Frequencies of the contractual norms are lower for these contracts in comparison to IPD type contracts. However, the structural model results proved the importance of establishing appropriate behaviors and acknowledged the importance that human factors have on achieving a successful project. In practical terms, for the construction industry to use integration on more projects, different contract language needs to be introduced into DBB, DB, and CMGC contracts or less importance needs to be put on the contract with more attention going towards establishing a working relationship.
- Partnering is a critical process used in IPD to integrate the project team. The importance of partnering in terms of project integration was found to be significant in that partnering

helps to establish the contractual norms at the beginning of a project. With the results of partnering relating to the contractual norms means that partnering can be a technique to integrate a team of organizations on any type of project regardless of the delivery method in place.

6.1.2 Theoretical contributions

Theoretical contributions are findings from this research that relate to areas of construction research. The contributions listed below outline the fundamental results that add to the construction research body of knowledge. These contributions add to the areas of project integration research and relational contracting research. The theoretical contributions are:

- An association exists between relational contracting and project integration in terms of inter-organizational expected behaviors. Therefore, construction contracts are relational exchanges, which means that the people and organizations involved in the relational contract can influence the successfulness of the project. However, most common delivery methods do not attempt to improve relationships between organizations on a project, and therefore projects tend to fail when the human factors are not considered.
- In terms of the specific contract language, IPD contracts are more relational than DBB, DB, and CMGC contracts. The IPD contracts contain the eight behaviors with higher frequencies, while each of the DBB, DB, and CMGC contracts are missing at least one contractual norm and the frequencies were much lower. Thus, integrated project contracts are more relational than DBB, DB, and CMGC contracts as integrated project contracts emulate the concepts associated with relational contract theory. This important finding provides empirical evidence that commonly used contracts for DBB, DB, and CMGC do

not promote integration and therefore makes it difficult to develop an integrated project team.

- Organizations' behaving appropriately when interacting with other organizations is a critical attribute to the success of a project. The correlations between the contractual norms and each of the three CSFs (team chemistry, planning effort, project objectives) provides evidence that implementing the integration of a project team and behaving in an appropriate manner can positively affect the success of a project, while the lack of integration and organizations acting in a detrimental way can negatively affect project success.
- Partnering correlated significantly with seven of the eight contractual norms. The one not correlated with partnering is propriety of means. Partnering is therefore a crucial technique to help establish an integrated project team at the outset of a construction project. Most IPD projects use partnering or team building exercises that emphasize a joint responsibility to complete a project successfully. The evidence here shows the importance of partnering and further exploration about project integration and partnering needs to occur.
- Predicting scheduling performance relies on integration of the project team. The correlations found between scheduling satisfaction and the contractual norms show that having a favorable integrated team of individuals can predict schedule performance. This finding relates with previous research that shows DB and IPD project tend to finish ahead of schedule.
- Contractual solidarity is the concept of working together and cooperating in the face of issues that arise on a project and collaborating with one another throughout the project. Contractual solidarity was one of the most important contractual norms, as it correlates significantly with critical success factors and success criteria. However, the evidence from

the content analysis showed that most DBB, DB, and CMGC contracts lack language to help establish a sense of solidarity between contracting organizations.

- Role integrity embodies the idea of working towards the greater good of the project and aligning personal organizational goals with the goals of the project. The evidence shows that role integrity might be the most important norm to establish on a construction project with the other norms just supplemental to role integrity. Yet similar to contractual solidarity, the contract language found in DBB, DB, and CMGC contracts do not highlight the importance of performing with integrity.
- Harmonization of conflict is the concept of keeping the project team together when issues or problems arise. The idea is that harmonizing conflict can occur internally and without external litigation techniques. The results show that harmonizing conflict correlates significantly with many of the CSFs and success criteria, which means that if project organizations are willing to work through issues and conflicts internally and together, there is a better chance that the project organizations can complete the project successfully. Once external dispute resolution techniques are brought in to resolve an issue, the relationship between organizations breaks down and the potential for achieving a successful project decreases.

6.2 Limitations

I employed many checks and balances throughout the research study in order to produce the most reliable and validated conclusions. However, a few limitation need to be addressed in order to understand the methodology, analyses, and results. The main limitations are:

- The results of the structural models associated with the two success criteria of planning effort during design and quality satisfaction objective are inconclusive due to the questionable statistical results. The lack of results could be due to the sample size, the questions asked in the survey, or other unknown measurement or statistical errors. I will need to conduct further investigations in order to find results for each of these success criteria through future research or through more use of the integration measurement tool.

- The sample size for the factor analyses and structural models was 314 fully responsive cases. According to many statistical references (e.g. Hair et al 2010; Bollen 1989), the sample size for factor analyses and SEM should be a minimum of five cases per independent observed variable. I started the analyses with 56 statement items for the contractual norms, meaning I needed a sample of at least 280 cases, which I did achieve. However, since the data collected for each case utilized ordinal data, a more conservative estimate of sample size should have been at least 10 case per independent observed variable, meaning I needed a sample size of 560. Although I have shown the results to be reliable and valid, increasing the sample size may have assisted with explaining further results that at this point are inconclusive.
- The survey responses answered questions based on a specific project. Yet the responses for that project all came from the same person. An initial thought in this research was to collect at least three responses from the same project, with one response from the owner organization, one from the design team, and one from the construction team. However, accomplishing the three survey per project approach was determined to be very difficult and could possibly confound results if each of the three organizations found out that the other had provided information about them. Also, the time needed to collect three responses per project and to reach the minimum sample size of 280 would have been extensive.

However, collecting the one response per project from owner's and owner agents instills limited biases in the responses.

- Another option considered during the methodology development was to conduct case studies to collect the project data and to observe the project team first hand. Although this was not the approach used here, case studies could potentially provide a richer data set that includes physical observations. Future research may consider conducting case studies in an effort to confirm the results from this survey-based research study.
- The lack of IPD projects completed in the United States limited the total cases in the sample size to only nine IPD projects. Due to this very small size, I was unable to perform the factor analyses and structural modeling with just the sample of IPD projects. A requirement of SEM is that the sample size must be larger than the number of parameters estimated in a model. With the eight latent factors and 38 observed variables in the measurement and structural models, a sample size of nine is much too small.
- The contractual norms and project success measures create a nomological network for measuring integration or, as termed by relational contract theory, understanding the relationalism of the project. Due to the nomological network, there are apparent correlations that exist between the contractual norms and between the critical success factors. However, the intercorrelations can introduce variance inflation in the statistical evaluations. But, to avoid "getting lost in the statistics" and looking at the nomological network holistically, the intercorrelations are crucial to setting up a nomological network and establishing nomological validity. Therefore, the intercorrelations should not inflate the variance to completely obscure the results of this study.

- The propriety of means contractual norm was found to be significant for project success overall and one success criteria (schedule satisfaction) and does not correlate with any other project success factor. In reviewing the steps used to create the propriety of means construct, I noticed that of the eight norms measured, propriety of means was the only one that had very limited use in previous research. Therefore, I had to develop the propriety of means measurement scale and statement items from scratch rather than synthesized from previous research as I did for the other seven contractual norms. Statistically, propriety of means had the smallest Cronbach's alpha value (0.772) when compared to the other seven contractual norms. Additional research will look into improving the propriety of means measure.

6.3 Future Research

Throughout this study, many topics and stimulating comments have sparked ideas for furthering relational contracting research with future studies. Also, the results of the study provide new avenues for conducting further project integration and project success research studies. The list below provides a few of the ideas that I will focus on for future research in order to benefit the construction industry.

- Additional use of the integration measurement tool can occur for different scenarios, different projects, and at different phases during design and construction of a project. Measuring integration can assist with aligning the contracting organizations as well as to highlight the areas that need improvements so that the project has a much better chance of completing successfully.
- Conduct content analysis of modified and actual project contracts rather than the standard contracts. In most projects, the contracting organizations modify the standard contract language to address the actual project and organizations involved better. Future research

can investigate modified construction contracts to see if the changes/modifications to the contracts change the language enough to be more or less integrated.

- This dissertation study collected one response per project. In order to strengthen the results and provide more validation, a future study will look to collect project data from multiple organizations per project. I will look to measure integration for a project by surveying at least one individual from each of the primary organizations on a construction project, which are the owner, designer of record, and the contracted builder.
- Instead of investigating integration across different delivery methods, it makes sense to look at contracting as a continuum and investigate across different procurement methods. How one procures a project may lend itself to the project being more competitive or more cooperative regardless of the contract in use. Investigating integration in different procurement methods might provide additional interesting results, and I can do this using the current data set that collected the procurement method information for each project.
- Communication was one aspect not directly studied in this research. Communication relates to the contractual norms, but as an action that associates with the contractual norms. Some of the interview comments mentioned the importance of good communication and that the lack of communication causes all sorts of problems on a project. Future research can look at how to measure communication to go along with the eight contractual norm measures. Interactions with one another require communication and proper behavior, so there is room to investigate communication along with the contractual norms.
- One concept not directly investigated in this dissertation is how relational contracting has the ability to move or take cost out of the system. As several construction organizations embark on an integrated project, each organization brings a different level of equity to the

team. Yet integrated projects can overcome the differences in equity and can move forward with cost not a part of the overall contracting system. A study can dive into this topic to try to understand how organizations with more equity can play along equally with others and are willing to accept sharing of risks and rewards.

- In some instances, if the team does not function as one entity and is not willing to work together, then the project will run into issues and problems. In these cases, it does not matter what delivery method or if integration is used. One emerging aspect of project integration is this idea of integrated project leadership, or IPL. This relatively new topic for construction focuses on how a champion or leader has to be in place on integrated projects so that the whole team functions as it should. This person does more than just manage the project, they lead and drive the individuals to emphasize the project and complete successfully. Additional research can use the contractual norms and the integration measurement tool to study the individuals that lead projects to see how these individuals tend to act when managing and leading a construction project.
- Similar to the IPL future study, there is a need to investigate when it is appropriate to use project integration or relational contracts. In many projects, project integration would not benefit the project or be as cost effective as it would be with other projects. However, it is difficult to know which projects could benefit from a relational contract or from the use of IPD as the delivery method. The investigation can include researching the types of projects that have used IPD and a cost analysis showing when project integration is beneficial to a project.
- One underlying theme that literature and the interviewees supported was the establishment of long-term relationships between organizations. When organizations meet and work

together for the first time, no history between the organizations exists, so there is an initial lack of trust and respect as well as little to expect from one another other than what the contract says. This makes it more difficult to implement project integration, as the contractual norms will be on the low side when organizations first work together on a project. Yet the norms may increase as the organizations work together over a period of time and develop a history of experiences. This can take several projects and many years to develop. This research did find correlations between the norms and the two success criteria of previous working together experience and the potential for future work, so there is some initial evidence for future research. Therefore, future research can look at how long term relationships affect achieving project success.

- One potential study can investigate how to develop positive relationships between organizations in a short amount of time so that the contractual norms are high and the relationship can carry the project towards a successful completion. There are previous studies (e.g. Nam and Tatum 1992; Khalfan et al 2007) about how to establish trust and collaboration with entities that never worked together previously, but these studies did not consider relational contract theory or contractual norms. Based on a comment made by an expert in the interview process, "relationships grow based on proper behaviors, not on what the contract says". Since the partnering success criteria showed high correlations to the contractual norms, future research would need to investigate integrating a project team using partnering and how partnering effects the integration of the team and ultimately affects the success of a project.
- Finally, research that looks more towards an in-depth analysis of the direct and indirect effects of the contractual norms on project success and CSFs can take place. The results of

this study provide the relationships that exist between integration and project success and the strength of those relationships, but the statistical analyses used cannot prove any causal relationships. Performing a research study that investigates the direct and indirect effects would provide more cause and effect results that could influence the widespread use of project integration.

6.4 Chapter 6 Summary

The focus of this chapter was to provide contributions from this research and additional direction for conducting future research in construction contracting. Section 6.1 discusses the major contributions found in this research study, divided into two categories: 1) practical contributions and 2) theoretical contributions. Section 6.2 outlines several paths for moving forward with additional research on integration of project teams, relational contracts, and integrated project delivery.

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APPENDIX A. ACRONYMS AND ABBREVIATIONS

AC – Asymptotic Covariance

AIA – American Institute of Architects

AIA-CA – American Institute of Architects-CAlifornia council

ASCE – American Society of Civil Engineers

CA – Content Analysis

CCM – Certified Construction Manager

CFA – Confirmatory Factor Analysis

CMA – Construction Manager Agency

CMAA – Construction Managers Association of America

CMAR – Construction Manager at Risk

CMB – Common Method Bias

CMGC – Construction Manager / General Contractor (same as CMAR)

ConsensusDOCS – Consensus of Design, Owner, Contractor, Subcontractor organizations

CS – Contractual Solidarity

DB – Design-build

DBB – Design-bid-build

DWLS – Diagonally Weighted Least Squares estimation

EFA – Exploratory Factor Analysis

EJCDC – Engineers Joint Contract Documents Committee

ENR – Engineering News Record

FL – Flexibility

HC – Harmonization of Conflict

IPD – Integrated Project Delivery

LCI – Lean Construction Institute

ML – Maximum Likelihood estimation

PC – Polychoric Correlation

PE – Planning Effort

PM – Propriety of Means

PO – Project Objectives

RC – Reciprocity

RE – Reliance and Expectations

RI – Role Integrity

RP – Restraint of Power

SEM – Structural Equation Modeling

TC – Team Chemistry

WLS – Weighted Least Squares estimation

APPENDIX B. SURVEY QUESTIONNAIRE

Project Success and Relational Behaviors Survey

Welcome to the Survey on project success and relational behaviors. Thank you for agreeing to participate in this questionnaire survey. Your input is crucial for understanding the effect that behaviors and interactions with primary organizations has on overall project success. Primary organizations are the owner (or the client that your firm represented), the design team, and the construction team. Please think about your organization's interactions and behaviors with these organizations and the behaviors observed when interacting with the primary organizations. Your responses should be project specific, so please focus on the relationships with the primary organizations in terms of the project that you most recently completed. The survey has three sections:

- Provide project information (5 to 10 minutes to complete) – Basic information about your most recently completed project
- Rate project success (5 to 10 minutes to complete) – Rate specific project success questions based on the final outcome of the project
- Rate 8 relational behaviors (10 to 15 minutes to complete) – Rate individual statements for each behavior in terms of the project in question

This survey should take approximately 20-30 minutes and it is recommended that you complete the survey all at once, although the survey will be available for three weeks for you to complete. Your participation is voluntary and your responses will be kept confidential. Your responses will not be reported in any manner that can be associated with any specific individual, organization, project, agency, or program. If you have any questions or concerns about this survey or this research project, please contact Christofer Harper (University of Colorado) at 303-887-3055 or by email at harperc@colorado.edu.

1) I understand the above information and voluntarily consent to participate in the research questionnaire

☐ Yes, continue with survey

☐ No, opt out of survey

SECTION 1 - PROJECT INFORMATION

Please provide the following information for your most recently completed project. This project will be the focus of the questions throughout this survey. We are collecting this information to allow us the ability to compare different project types and groups from across the United States. Please answer all of the questions to the best of your knowledge. If you are unsure, please select "Other".

1) Name of the Project: ____________________

2) Location of Project (City, State): ____________________

3) Specify the type of project (e.g. Hospital, institutional, commercial, industrial, infrastructure) or intended use: ____________________

4) Specify the delivery method used:

- ☐ Design-Bid-Build
- ☐ Design-Build
- ☐ Construction Manager at Risk (or CMGC)
- ☐ Integrated Project Delivery
- ☐ Other, Please specify: ____________________

5) Specify the procurement procedure used for selecting the primary contractor:

- ☐ Low bid
- ☐ Best value
- ☐ Qualifications-based
- ☐ Other, Please specify: ____________________

6) Specify the payment method used with primary contractor:

- ☐ Lump sum
- ☐ Cost reimbursable
- ☐ Unit price
- ☐ Other, please specify: ____________________

7) Specify the contract used between the Owner and primary contractor (please specify):

- ☐ AIA ____________________
- ☐ ConsensusDOCS ____________________
- ☐ Other ____________________

8) Please state your organization's role:

- ☐ Owner/Owner's staff
- ☐ Owner's representative
- ☐ Construction Manager Agency
- ☐ Other, please specify: ____________________

9) Please state how many years you have worked in the construction industry: _______________

10) Are you willing to participate in a follow-up interview?

- ☐ Yes, name and email/phone number: ____________________
- ☐ No thanks

SECTION 2 - PROJECT SUCCESS

This section contains a series of statements that you will rate for your most recently completed project for the following project phases (in chronological order):

- Previous Work
- Project Planning & Development Phase Design Phase
- Construction Phase
- Project Outcomes
- Future work

Please rate each statement to the best of your knowledge. There are no right or wrong answers.

Previous work together – Please rate the quality of the relationship that existed between organizations before this project began.

1) The prior experience of the owner and design team working together

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

2) The prior experience of the owner and the construction team working together

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

3) The prior experience of the design team and construction team working together

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

Project Planning & Development Phase – Please rate how much you agree with the following items that occurred during project planning and development.

1) Organizations effectively shared critical planning and development information

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) Based on the type of project, the scope of work was properly defined

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) An effective team building / partnering approach was carried out before the project began

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) Organizations shared information that was beyond this project

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Design Phase – Please rate how much you agree with the following items that occurred during design of the project

1) Organizations effectively shared critical design information with one another

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

2) Constructability reviews during design helped to eliminate issues during construction of the project

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

3) The design team was easy to work and interact with

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

Construction Phase – Please rate how much you agree with the following items that occurred during construction of the project

1) Progress of work was communicated effectively throughout the duration of construction

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) Organizations effectively shared critical construction information with one another

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) The construction team was easy to work and interact with

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Project Outcomes – Please rate the satisfaction level you observed in terms of the following project objectives being achieved at the conclusion of the project.

1) Budget Objectives

 Very Dissatisfied Dissatisfied Neither Satisfied Very Satisfied

2) Schedule Objectives

 Very Dissatisfied Dissatisfied Neither Satisfied Very Satisfied

3) Quality requirements & performance objectives

 Very Dissatisfied Dissatisfied Neither Satisfied Very Satisfied

4) Functionality of the completed project

 Very Dissatisfied Dissatisfied Neither Satisfied Very Satisfied

Future Work – Please rate the following statements in terms of the possibility that the construction team and design team have in working with the same owner on future projects.

1) The same owner and the same construction team will work together again on future projects

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

2) The same owner and the same design team will work together again on future projects

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

3) The same construction team and the same design team will work together again on future projects

☐ Poor ☐ Fair ☐ Neutral ☐ Good ☐ Excellent

SECTION 3 - RELATIONAL BEHAVIORS

The following sections will ask you to rate a series of statements based on your experience in interacting with the primary organizations on your most recently completed project. Please answer each statement to the best of your knowledge. There are no right or wrong answers here, so be as accurate as you can.

Role Integrity

Role integrity is the extent to which organizations involved in a project seek to overcome a "me first" rationality in order to act with integrity, align individual goals with project objectives, and avoid reference to the contract. Role integrity is established when organizations sense that they are dealing with others who can be expected to behave properly and perform with the best interest of the project in mind. Please rate the following seven statements using the scale below.

1) Organizational relationships extended across many complex responsibilities and multiple tasks

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) A trust existed that each organization was keeping the project's best interests in mind

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) Organizations had a clear understanding of their own and each other's roles and responsibilities

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) The focus of organizations was to successfully complete project goals and objectives

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

5) When unanticipated situations occurred, organizations tended to reference the contract first for a remedy

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

6) Focusing on achieving project goals was more important than individual goals

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

7) The focus of organizations was to accomplish their own individual goals

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Reciprocity

Reciprocity is the attitude that each organization's success is dependent on all other organizations and that one organization cannot prosper at the expense of another. It establishes the sentiment of joint responsibility, fairness, and mutuality between organizations. Please rate the following seven statements using the scale below.

1) A high level of mutual respect existed on the project

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) The perception among organizations was that no individual organization got a better deal than another did

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) Organizational relationships were based on mutual respect and a feeling that each other could be trusted

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) Organizations were concerned with everyone obtaining successful outcomes

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

5) Organizations were willing to do favors for one another such as absorb costs that could have been shared

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

6) When organizations had a difference of opinion, they worked out the issue respectfully and jointly

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

7) Organizations respected one another and considered each other's interests when making decisions

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Flexibility

The ease in which a change can be made to the original contract agreement. Establishing flexibility requires incorporating changes with little difficulty into the original agreement as long as the changes are necessary and justifiable in order to obtain project goals. Please rate the following seven statements using the scale below.

1) Fair adjustments over the long term were acceptable and necessary

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) Organizations accommodated one another when special problems or needs occurred

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) Organizations anticipated the ability to make cooperative adjustments to cope with changing circumstances or conditions

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) Organizations were open to modifying agreements and accepting changes when necessary

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

5) Organizations were willing to make adjustments in the face of problems or special circumstances

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

6) When confronted with an unexpected situation, deviations from standard procedures were acceptable

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

7) There was a mutual understanding of what would happen in the case of unanticipated events occurring

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Contractual Solidarity

The extent to which organizations involved in a project believe that success occurs as a result of working together versus competing against one another. It dictates that organizations cooperate with one another in the face of adversity as well as collaborate and assist one another throughout the project.   Please rate the following seven statements using the scale below.

1) Organizations were apt to be conscientious, responsive, and resourceful in order to maintain cooperative relationships

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) Sustaining the working relationship was more important than achieving individual outcomes

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) Organizations did not mind assisting one another in order to benefit the project

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) There was a common understanding that organizations had to work together and continuously cooperate to achieve a successful project

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

5) Organizations were committed to one another and especially to the success of the project

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

6) Organizations collaborated in project goal setting and project planning

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

7) There existed a supportive atmosphere for getting things done

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Reliance and Expectations

The reliance interest is the level of confidence that organizations will keep and follow through on promises made. The expectation interest is associated with what has been promised and whether it was completed or not. Establishing reliance and expectations occurs when promises are made, kept, and completed properly. Please rate the following seven statements using the scale below.

1) Organizations were sincere in their promises and could be expected to meet obligations

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

2) Exchange of information occurred frequently and informally, and not just according to the contract agreement

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

3) Organizations felt it was important not to use information to disadvantage another organization on the project

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

4) Organizations kept each other informed about any events or changing conditions that may affect others or the project

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

5) It was expected that promises made by an organization would be fulfilled

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

6) Organizations could count on one another to be reliable and sincere

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

7) There were many expectations between organizations on this project, which went beyond the mere providing of design and/or construction services stated in the contract

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

Restraint of Power

Restraining the use of power is the degree to which the contracting organizations typically refrain from exploiting each other when given the opportunity to do so. It is expected that cooperation will manifest in an organization's willingness to forgo short-term improvements gained at a severe cost to other organizations or the project itself. Please rate the following seven statements using the scale below.

1) An organization with more authority in a specific situation would refrain from using it

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

2) An organization used their power over another organization in order to get their way

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

3) Each organization limited its use of authority they might have had over another organization

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

4) The more powerful organization would commonly use whatever authority necessary

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

5) None of the project organizations made demands that could be damaging to other organizations

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

6) Organizations attempted to take advantage of other organizations

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

7) Organizations liked to make demands that could be damaging to other project organizations or the project itself

☐ Strongly Disagree ☐ Disagree ☐ Neither ☐ Agree ☐ Strongly Agree

Propriety of Means

A requirement of organizations is to possess adequate means to perform their obligations. Multiple possibilities usually exist at the project level to achieve proper outcomes, so the means and methods an organization employs cannot affect the quality of the project or be detrimental to any other organization. Please rate the following seven statements using the scale below.

1) Organizations tried to avoid fluctuations in means and methods as this could have affected the ability of other project organizations

 Strongly Disagree Disagree Neither Agree Strongly Agree

2) Organizations possessed the necessary skills, knowledge, and experience to achieve expected promises and project objectives

 Strongly Disagree Disagree Neither Agree Strongly Agree

3) Achieving project objectives was a result of organizations using proper means and methods

 Strongly Disagree Disagree Neither Agree Strongly Agree

4) Any means used by an organization to achieve results did not create conflict with another organization or the project

 Strongly Disagree Disagree Neither Agree Strongly Agree

5) Organizations tended to use means for the home office's own benefit

 Strongly Disagree Disagree Neither Agree Strongly Agree

6) Organizations used means and methods without taking the project goals and objectives into account

 Strongly Disagree Disagree Neither Agree Strongly Agree

7) Organizations achieved promises by using means and methods that went above and beyond the requirements of the contract

 Strongly Disagree Disagree Neither Agree Strongly Agree

Harmonization of Conflict

Harmonizing conflict is the extent to which an atmosphere of mutual accommodation toward cooperative ends exists in contractual relationships. There exists a level of harmony on a construction project where organizations are either willing to work through disputes as a team internally or are not willing to work through disputes as a team and refer to the contract for dispute resolution procedures. Please rate the following seven statements using the scale below.

1) When unexpected situations developed, organizations tended to work it out together rather than hold each other to the contract terms

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

2) While each organization may have had procedures for dealing with disputes, each dispute was treated on its own individual merit

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

3) Organizations would rather settle disputes jointly and internally than go through litigation

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

4) Organizations were willing to review the history and facts of a particular issue before making a joint decision

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

5) Organizations generally put aside the contractual terms in order to work through difficult problems when they occurred

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

6) Organizational relationships could best be described as tense

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

7) There were significant disagreements present between organizations on this project

□ Strongly Disagree □ Disagree □ Neither □ Agree □ Strongly Agree

BUDGET AND SCHEDULE INFORMATION

Do you know your project's budget and schedule information?

- ☐ Yes, enter information below
- ☐ No, go to end of survey

1) What was the total baseline cost budget for construction? (This amount should include contingency and correspond to the estimate at the time of contract award. This is the original baseline budget and should not include any change orders): ____________________

2) What was the total actual construction cost? (This cost should include amounts expended for in-house salaries, overhead, travel, and other indirect costs, but it should exclude the cost of land): ____________________

3) Please enter the planned and actual construction schedule dates below to the best of your knowledge.

Date (mm/dd/yy)

a) Baseline construction schedule start date: ____________________

b) Baseline construction schedule stop date: ____________________

c) Actual construction schedule start date: ____________________

d) Actual construction schedule stop date: ____________________

APPENDIX C. STATISTICAL MATRICES

Polychoric Correlation Matrix for contractual norm observed variables

	RI2	RI3	RI4	RI6	RC4	RC5	RC6	RC7	FL1	FL2	FL3	FL4	FL5	FL6	FL7	CS1	CS2	CS3	CS4	CS5	CS6	CS7	RE1	RE4	RE5	RE6	RP1	RP3	RP5	PM1	PM3	PM4	HC1	HC2	HC3	HC4
RI2	1.00																																			
RI3	0.64	1.00																																		
RI4	0.76	0.67	1.00																																	
RI6	0.69	0.57	0.68	1.00																																
RC4	0.70	0.50	0.68	0.57	1.00																															
RC5	0.55	0.37	0.49	0.43	0.63	1.00																														
RC6	0.68	0.52	0.64	0.55	0.70	0.72	1.00																													
RC7	0.76	0.56	0.64	0.62	0.76	0.69	0.86	1.00																												
FL1	0.43	0.51	0.47	0.38	0.47	0.43	0.54	0.59	1.00																											
FL2	0.65	0.54	0.66	0.56	0.71	0.63	0.72	0.77	0.69	1.00																										
FL3	0.63	0.55	0.59	0.54	0.67	0.55	0.72	0.77	0.71	0.87	1.00																									
FL4	0.59	0.48	0.60	0.51	0.60	0.45	0.60	0.64	0.66	0.74	0.75	1.00																								
FL5	0.65	0.50	0.60	0.51	0.69	0.54	0.69	0.73	0.70	0.83	0.81	0.90	1.00																							
FL6	0.29	0.22	0.33	0.31	0.39	0.35	0.46	0.37	0.43	0.59	0.54	0.58	0.58	1.00																						
FL7	0.54	0.47	0.51	0.46	0.52	0.41	0.46	0.61	0.58	0.66	0.61	0.59	0.71	0.47	1.00																					
CS1	0.74	0.52	0.68	0.62	0.71	0.58	0.73	0.81	0.56	0.70	0.68	0.57	0.68	0.34	0.54	1.00																				
CS2	0.65	0.42	0.57	0.62	0.63	0.54	0.66	0.72	0.42	0.59	0.61	0.56	0.62	0.38	0.48	0.72	1.00																			
CS3	0.73	0.58	0.68	0.66	0.72	0.61	0.75	0.77	0.57	0.76	0.68	0.64	0.73	0.43	0.59	0.78	0.69	1.00																		
CS4	0.77	0.63	0.75	0.61	0.72	0.59	0.79	0.77	0.52	0.71	0.73	0.60	0.68	0.39	0.56	0.78	0.71	0.83	1.00																	
CS5	0.81	0.58	0.76	0.68	0.78	0.62	0.76	0.81	0.48	0.74	0.67	0.60	0.70	0.38	0.57	0.81	0.70	0.85	0.87	1.00																
CS6	0.60	0.46	0.61	0.48	0.65	0.49	0.61	0.71	0.50	0.66	0.62	0.51	0.63	0.31	0.55	0.72	0.58	0.63	0.69	0.72	1.00															
CS7	0.76	0.59	0.73	0.66	0.74	0.60	0.77	0.79	0.59	0.72	0.67	0.62	0.71	0.43	0.62	0.81	0.68	0.86	0.87	0.86	0.78	1.00														
RE1	0.65	0.50	0.63	0.55	0.64	0.45	0.64	0.70	0.49	0.63	0.61	0.52	0.57	0.32	0.54	0.76	0.59	0.65	0.67	0.74	0.62	0.72	1.00													
RE4	0.54	0.44	0.52	0.55	0.58	0.35	0.51	0.62	0.50	0.57	0.54	0.46	0.58	0.27	0.55	0.63	0.57	0.61	0.63	0.69	0.53	0.64	0.67	1.00												
RE5	0.60	0.47	0.62	0.65	0.55	0.36	0.55	0.62	0.50	0.55	0.47	0.48	0.51	0.28	0.51	0.70	0.55	0.64	0.62	0.67	0.54	0.68	0.71	0.68	1.00											
RE6	0.72	0.55	0.70	0.59	0.71	0.53	0.70	0.78	0.50	0.67	0.65	0.54	0.68	0.28	0.54	0.79	0.63	0.73	0.75	0.76	0.71	0.77	0.84	0.70	0.74	1.00										
RP1	0.42	0.34	0.43	0.38	0.46	0.42	0.54	0.52	0.36	0.51	0.53	0.45	0.47	0.41	0.32	0.47	0.54	0.43	0.46	0.48	0.42	0.45	0.42	0.34	0.37	0.46	1.00									
RP3	0.49	0.39	0.46	0.46	0.51	0.42	0.52	0.52	0.42	0.49	0.51	0.42	0.50	0.35	0.38	0.43	0.45	0.56	0.49	0.61	0.43	0.56	0.39	0.41	0.48	0.45	0.67	1.00								
RP5	0.62	0.49	0.53	0.53	0.56	0.42	0.59	0.64	0.43	0.56	0.56	0.46	0.57	0.32	0.45	0.54	0.53	0.64	0.57	0.67	0.52	0.61	0.50	0.45	0.53	0.57	0.51	0.65	1.00							
PM1	0.42	0.34	0.37	0.37	0.37	0.27	0.33	0.38	0.20	0.36	0.39	0.30	0.35	0.12	0.35	0.42	0.42	0.39	0.34	0.42	0.33	0.40	0.43	0.35	0.30	0.38	0.28	0.31	0.36	1.00						
PM3	0.57	0.51	0.66	0.56	0.51	0.35	0.56	0.58	0.42	0.52	0.54	0.48	0.48	0.22	0.45	0.63	0.49	0.60	0.64	0.62	0.54	0.62	0.64	0.53	0.54	0.56	0.29	0.35	0.50	0.56	1.00					
PM4	0.57	0.40	0.49	0.54	0.51	0.47	0.54	0.56	0.32	0.50	0.49	0.44	0.45	0.29	0.44	0.49	0.54	0.51	0.52	0.62	0.47	0.51	0.45	0.51	0.41	0.49	0.36	0.42	0.53	0.43	0.60	1.00				
HC1	0.58	0.43	0.49	0.51	0.60	0.55	0.68	0.64	0.46	0.60	0.61	0.55	0.59	0.46	0.47	0.61	0.63	0.63	0.64	0.64	0.51	0.65	0.54	0.50	0.49	0.55	0.56	0.51	0.51	0.33	0.41	0.41	1.00			
HC2	0.48	0.46	0.48	0.47	0.45	0.43	0.54	0.49	0.51	0.45	0.49	0.43	0.50	0.29	0.40	0.54	0.51	0.52	0.62	0.54	0.45	0.56	0.48	0.49	0.52	0.49	0.37	0.41	0.43	0.31	0.46	0.47	0.62	1.00		
HC3	0.58	0.44	0.59	0.53	0.60	0.47	0.66	0.65	0.53	0.64	0.65	0.55	0.65	0.40	0.43	0.64	0.52	0.62	0.70	0.63	0.55	0.65	0.57	0.54	0.56	0.61	0.34	0.38	0.46	0.31	0.49	0.40	0.57	0.66	1.00	
HC4	0.55	0.50	0.59	0.51	0.59	0.47	0.64	0.63	0.50	0.64	0.60	0.54	0.60	0.32	0.50	0.65	0.55	0.62	0.66	0.66	0.60	0.67	0.64	0.59	0.57	0.61	0.36	0.44	0.43	0.26	0.52	0.39	0.53	0.62	0.71	1.00

Polychoric Correlation Matrix for project success observed variables

	TC1	TC2	TC3	TC4	TC5	TC6	TC7	PE1	PE2	PE3	PE4	PE5	PE6	PO1	PO2	PO3	PO4
TC1	1.00																
TC2	0.49	1.00															
TC3	0.52	0.55	1.00														
TC4	0.19	0.16	0.20	1.00													
TC5	0.32	0.56	0.40	0.28	1.00												
TC6	0.50	0.33	0.32	0.29	0.54	1.00											
TC7	0.34	0.37	0.59	0.30	0.64	0.62	1.00										
PE1	0.22	0.30	0.28	0.64	0.44	0.37	0.40	1.00									
PE2	0.24	0.21	0.12	0.50	0.25	0.41	0.30	0.61	1.00								
PE3	0.21	0.23	0.23	0.58	0.37	0.42	0.41	0.84	0.62	1.00							
PE4	0.23	0.08	0.22	0.54	0.35	0.33	0.42	0.60	0.44	0.61	1.00						
PE5	0.13	0.27	0.26	0.41	0.44	0.20	0.40	0.49	0.31	0.36	0.42	1.00					
PE6	0.22	0.30	0.24	0.49	0.41	0.30	0.48	0.55	0.43	0.55	0.48	0.82	1.00				
PO1	0.25	0.28	0.24	0.46	0.47	0.31	0.43	0.52	0.51	0.47	0.48	0.47	0.51	1.00			
PO2	0.19	0.29	0.28	0.39	0.53	0.23	0.47	0.42	0.34	0.41	0.50	0.54	0.52	0.67	1.00		
PO3	0.27	0.43	0.38	0.38	0.57	0.31	0.53	0.47	0.39	0.44	0.41	0.51	0.60	0.54	0.67	1.00	
PO4	0.27	0.26	0.28	0.39	0.47	0.37	0.45	0.47	0.50	0.47	0.42	0.44	0.49	0.53	0.56	0.74	1.00

Standardized residual matrix for first order CFA model

	RI2	RI3	RI4	RI6	RC4	RC5	RC6	RC7	FL1	FL2	FL3	FL4	FL5	FL6	FL7	CS1	CS2	CS3	CS4	CS5	CS6	CS7	RE1	RE4	RE5	RE6	RP1	RP2	RP3	RP5	PM1	PM2	PM3	PM4	HC1	HC2	HC3	HC4
RI2	---																																					
RI3	-0.04	---																																				
RI4	-0.67	0.96	---																																			
RI6	-0.22	0.18	0.16	---																																		
RC4	1.20	-0.29	1.15	0.03	---																																	
RC5	0.32	-0.93	-0.45	-0.66	0.31	---																																
RC6	0.02	-0.34	-0.34	-0.87	-2.18	2.98	---																															
RC7	1.05	-0.22	-1.02	-0.10	-1.49	0.28	0.13	---																														
FL1	-1.15	1.64	-0.28	-0.87	-0.97	-0.19	-0.21	-0.05	---																													
FL2	0.00	0.31	0.56	-0.14	0.55	1.45	0.15	0.53	-0.26	---																												
FL3	-0.16	0.85	-0.27	-0.19	0.23	0.15	0.80	1.33	0.29	-0.34	---																											
FL4	0.11	0.40	0.77	0.21	-0.20	-0.95	-0.70	-0.72	0.52	-1.61	-0.81	---																										
FL5	-0.02	-0.23	-0.40	-0.77	0.19	-0.34	-0.44	-0.33	-0.11	-1.55	-1.74	4.61	---																									
FL6	-1.40	-1.25	-0.56	-0.38	-0.13	0.28	0.67	-1.08	0.16	0.91	0.36	1.99	0.98	---																								
FL7	0.47	0.92	0.29	0.24	-0.45	-0.68	-1.82	0.22	0.32	-1.22	-1.66	-0.91	-0.21	0.69	---																							
CS1	0.13	-1.11	-0.39	-0.22	0.03	-0.15	-0.45	0.83	0.27	0.21	0.07	-0.74	-0.19	-0.95	-0.22	---																						
CS2	0.14	-1.37	-0.91	1.21	0.04	0.53	0.08	0.68	-0.77	-0.40	0.26	0.37	0.24	0.32	-0.08	0.48	---																					
CS3	-0.31	-0.05	-0.70	0.48	-0.09	0.54	-0.04	-0.57	0.26	1.42	0.01	0.25	0.68	0.30	0.66	-0.73	-0.26	---																				
CS4	0.69	0.76	0.89	-0.72	-0.25	-0.10	1.00	-0.87	-0.55	-0.01	0.91	-0.57	-0.59	-0.41	-0.19	-0.97	-0.10	0.31	---																			
CS5	1.45	-0.49	0.61	0.28	0.90	0.10	-0.53	-0.27	-1.47	0.22	-0.76	-1.01	-0.56	-0.71	-0.21	-0.79	-0.74	0.42	0.44	---																		
CS6	-0.92	-0.81	-0.12	-1.38	0.55	-0.44	-0.84	0.47	0.24	0.95	0.44	-0.54	0.40	-0.64	1.10	0.48	-0.64	-1.53	-0.54	-0.29	---																	
CS7	-0.07	-0.32	0.14	-0.01	0.04	-0.16	-0.17	-0.65	0.43	-0.18	-0.56	-0.50	-0.21	0.14	0.99	-0.37	-1.07	1.31	0.92	-0.24	1.26	---																
RE1	-0.35	-0.39	-0.12	-0.45	0.36	-1.15	-0.35	0.42	0.03	0.23	0.16	-0.50	-0.72	-0.69	0.98	1.57	-0.48	-1.32	-0.91	0.01	0.01	-0.20	---															
RE4	-0.97	-0.54	-0.78	0.56	0.49	-1.72	-1.10	0.19	1.03	0.41	0.14	-0.42	0.55	-0.72	1.92	0.08	0.36	-0.35	-0.22	0.73	-0.31	-0.16	-0.47	---														
RE5	-0.26	-0.26	0.54	2.51	-0.38	-1.88	-0.90	-0.22	0.78	-0.41	-1.42	-0.49	-0.86	-0.81	1.04	1.22	-0.31	-0.19	-0.74	-0.15	-0.46	0.19	-0.02	0.97	---													
RE6	0.30	-0.31	0.46	-0.60	1.09	-0.44	0.18	1.72	-0.21	0.26	0.13	-0.82	0.66	-1.59	0.32	1.62	-0.61	-0.66	-0.44	-0.65	1.46	-0.20	0.58	-0.79	-0.45	---												
RP1	-0.75	-0.50	-0.45	-0.50	-0.19	0.57	0.95	0.01	-0.24	0.44	1.05	0.39	-0.13	2.02	-0.85	-0.24	2.24	-0.96	-0.70	-0.55	-0.21	-1.08	-0.27	-0.78	-0.46	-0.01	---											
RP2	0.30	-0.17	-0.72	0.19	-0.65	-1.00	0.08	0.78	0.79	0.48	1.09	0.35	-0.09	0.47	0.37	0.22	0.21	-0.19	-1.05	-0.45	0.10	-0.51	0.83	-0.31	1.65	0.72	1.04	---										
RP3	-0.29	-0.20	-0.42	0.27	0.15	0.03	-0.07	-0.66	0.19	-0.47	0.12	-0.68	-0.23	0.69	-0.46	-1.42	-0.12	0.73	-0.79	1.30	-0.50	0.35	-1.20	-0.15	0.80	-0.90	2.32	0.05	---									
RP5	1.25	0.65	-0.36	0.72	-0.10	-0.74	0.01	0.26	-0.37	-0.47	-0.18	-1.14	-0.20	-0.40	-0.17	-0.80	0.38	1.18	-0.58	1.32	0.08	-0.01	-0.52	-0.34	0.98	0.33	-2.05	-0.81	-0.22	---								
PM1	0.03	0.17	-0.46	0.19	0.36	-0.22	-0.56	-0.12	-1.00	0.04	0.76	-0.23	0.03	-1.21	0.99	0.27	1.27	-0.28	-1.12	-0.01	-0.40	-0.30	0.73	0.11	-0.88	-0.55	0.30	-1.31	0.40	0.56	---							
PM2	-1.45	1.93	0.63	-1.73	0.28	-1.43	0.01	-1.03	1.19	-0.51	-0.84	-0.02	-0.50	-0.05	0.52	0.41	-1.67	-0.18	0.65	0.88	0.85	-0.79	2.01	-0.91	0.47	0.35	-0.21	-0.63	1.10	0.69	-0.49	---						
PM3	-1.13	0.25	1.37	0.28	-0.43	-1.41	0.17	-0.03	0.07	-0.26	0.40	0.12	-0.78	-1.31	0.48	0.46	-0.61	-0.16	0.55	-0.21	0.14	-0.13	1.34	0.18	-0.09	-1.39	-1.67	-1.92	-1.26	0.32	1.71	1.86	---					
PM4	0.31	-0.65	-0.80	1.08	0.75	1.54	0.99	0.78	-0.64	0.42	0.62	0.27	-0.23	0.15	1.07	-0.81	1.26	-0.67	-0.52	1.27	-0.04	-0.95	-1.07	0.79	-1.19	-1.17	0.04	-1.69	0.57	2.11	0.22	-2.82	-0.59	---				
HC1	0.05	-0.36	-0.96	0.24	0.18	1.27	1.58	-0.17	-0.32	-0.22	0.40	0.06	-0.41	1.78	-0.34	-0.32	1.85	-0.03	0.06	-0.34	-0.65	0.11	-0.65	-0.06	-0.72	-1.25	3.34	1.36	1.36	0.30	0.26	-1.30	-1.01	-0.17	---			
HC2	-0.57	0.90	-0.15	0.45	-1.16	0.00	-0.14	-1.46	1.15	-1.25	-0.50	-0.80	-0.59	-0.46	-0.39	-0.16	0.42	-0.74	0.90	-0.71	-0.51	-0.30	-0.35	0.65	0.86	-0.89	-0.01	-0.35	0.14	-0.29	0.40	0.20	0.65	1.77	1.04	---		
HC3	-0.08	-0.51	0.41	0.38	0.00	-0.46	0.80	-0.27	0.56	0.26	0.93	0.01	0.72	0.53	-1.00	0.04	-0.67	-0.49	1.00	-0.73	-0.13	-0.16	-0.23	0.28	0.34	-0.35	-1.30	-0.24	-1.04	-0.73	-0.11	-0.29	0.05	-0.39	-1.65	1.51	---	
HC4	-0.69	0.67	0.51	-0.02	-0.17	-0.40	0.30	-0.77	0.21	0.22	-0.08	-0.26	-0.35	-0.69	0.15	0.36	-0.13	-0.50	0.28	-0.23	0.92	0.21	1.25	1.36	0.66	-0.25	-1.08	-0.22	-0.22	-1.53	-0.95	0.72	0.68	-0.64	-2.64	0.80	1.35	---

Standardized residuals for second order CFA model

	RI2	RI3	RI4	RI6	RC4	RC5	RC6	RC7	FL1	FL2	FL3	FL4	FL5	FL6	FL7	CS1	CS2	CS3	CS4	CS5	CS6	CS7	RE1	RE4	RE5	RE6	RP1	RP2	RP3	RP5	PM1	PM2	PM3	PM4	HC1	HC2	HC3	HC4
RI2	---																																					
RI3	-0.03	---																																				
RI4	-0.71	0.96	---																																			
RI6	-0.21	0.21	0.18	---																																		
RC4	0.65	-0.55	0.72	-0.26	---																																	
RC5	-0.02	-1.12	-0.73	-0.89	0.31	---																																
RC6	-0.54	-0.61	-0.74	-1.20	-2.21	3.01	---																															
RC7	0.39	-0.51	-1.43	-0.45	-1.52	0.30	0.13	---																														
FL1	-1.34	1.47	-0.47	-1.03	-0.65	0.08	0.11	0.30	---																													
FL2	-0.36	0.08	0.24	-0.39	1.17	1.88	0.72	1.27	-0.24	---																												
FL3	-0.54	0.59	-0.60	-0.47	0.80	0.52	1.44	2.14	0.29	-0.35	---																											
FL4	-0.22	0.19	0.46	-0.04	0.29	-0.60	-0.19	-0.17	0.53	-1.59	-0.85	---																										
FL5	-0.40	-0.44	-0.71	-0.99	0.77	0.09	0.18	0.33	-0.10	-1.53	-1.79	4.59	---																									
FL6	-1.54	-1.35	-0.71	-0.50	0.14	0.49	0.95	-0.81	0.18	0.95	0.37	2.01	1.00	---																								
FL7	0.20	0.73	0.03	0.04	-0.05	-0.37	-1.41	0.72	0.33	-1.19	-1.67	-0.90	-0.21	0.71	---																							
CS1	0.28	-1.00	-0.27	-0.10	0.07	-0.08	-0.35	0.94	0.15	-0.05	-0.16	-0.90	-0.41	-1.03	-0.38	---																						
CS2	0.25	-1.28	-0.80	1.31	0.09	0.60	0.16	0.76	-0.87	-0.53	0.08	0.22	0.09	0.26	-0.19	0.48	---																					
CS3	-0.09	0.07	-0.55	0.62	-0.01	0.62	0.07	-0.45	0.14	1.15	-0.25	0.06	0.43	0.21	0.48	-0.73	-0.25	---																				
CS4	0.89	0.87	1.02	-0.58	-0.19	-0.02	1.11	-0.75	-0.67	-0.21	0.63	-0.75	-0.81	-0.50	-0.35	-0.99	-0.09	0.31	---																			
CS5	1.65	-0.37	0.76	0.43	0.96	0.18	-0.42	-0.15	-1.59	-0.01	-1.01	-1.19	-0.81	-0.80	-0.37	-0.81	-0.73	0.41	0.43	---																		
CS6	-0.79	-0.72	-0.01	-1.27	0.60	-0.38	-0.76	0.57	0.14	0.77	0.26	-0.67	0.24	-0.71	0.98	0.48	-0.62	-1.52	-0.54	-0.29	---																	
CS7	0.14	-0.21	0.29	0.15	0.11	-0.08	-0.05	-0.53	0.30	-0.40	-0.79	-0.69	-0.45	0.06	0.81	-0.38	-1.06	1.32	0.92	-0.25	1.27	---																
RE1	-0.13	-0.26	0.07	-0.27	-0.06	-1.40	-0.77	-0.12	-0.22	-0.15	-0.23	-0.86	-1.08	-0.88	0.64	1.79	-0.31	-1.09	-0.70	0.24	0.17	0.03	---															
RE4	-0.78	-0.40	-0.61	0.71	0.18	-1.91	-1.38	-0.18	0.81	0.06	-0.20	-0.68	0.24	-0.88	1.64	0.25	0.50	-0.17	-0.03	0.94	-0.17	0.01	-0.46	---														
RE5	-0.07	-0.13	0.70	2.65	-0.72	-2.10	-1.22	-0.60	0.54	-0.75	-1.75	-0.79	-1.17	-0.98	0.75	1.41	-0.17	-0.02	-0.56	0.04	-0.32	0.38	-0.03	0.98	---													
RE6	0.58	-0.12	0.69	-0.36	0.57	-0.75	-0.38	0.78	-0.51	-0.29	-0.43	-1.22	0.08	-1.78	-0.06	1.96	-0.39	-0.33	-0.10	-0.32	1.70	0.13	0.57	-0.77	-0.45	---												
RP1	-0.75	-0.51	-0.47	-0.50	-0.07	0.67	1.06	0.14	0.02	0.81	1.40	0.73	0.23	2.24	-0.58	-0.42	2.05	-1.13	-0.90	-0.74	-0.37	-1.27	-0.52	-0.99	-0.68	-0.32	---											
RP2	0.27	-0.18	-0.73	0.18	-0.56	-0.93	0.17	0.87	0.98	0.73	1.34	0.58	0.15	0.63	0.56	0.09	0.09	-0.32	-1.17	-0.59	-0.02	-0.65	0.61	-0.47	1.44	0.48	1.04	---										
RP3	-0.31	-0.21	-0.43	0.25	0.27	0.15	0.08	-0.50	0.47	-0.05	0.51	-0.31	0.19	0.94	-0.15	-1.59	-0.28	0.47	-1.00	1.01	-0.66	0.09	-1.44	-0.38	0.49	-1.18	2.32	0.05	---									
RP5	1.11	0.61	-0.37	0.68	0.06	-0.59	0.19	0.44	-0.03	0.03	0.31	-0.64	0.33	-0.12	0.24	-1.05	0.17	0.84	-0.86	0.97	-0.14	-0.30	-0.85	-0.61	0.60	-0.12	-2.05	-0.81	-0.22	---								
PM1	0.56	0.57	0.07	0.65	0.00	-0.48	-0.89	-0.48	-1.18	-0.19	0.48	-0.45	-0.23	-1.35	0.79	0.27	1.27	-0.27	-1.11	0.00	-0.40	-0.29	1.13	0.41	-0.52	-0.12	0.33	-1.27	0.43	0.60	---							
PM2	-0.37	2.64	1.57	-0.98	-0.34	-1.83	-0.61	-1.66	0.86	-0.99	-1.30	-0.45	-0.98	-0.31	0.11	0.37	-1.67	-0.21	0.60	0.81	0.82	-0.81	2.73	-0.38	1.09	1.18	-0.16	-0.60	1.10	0.70	-0.48	---						
PM3	-0.07	0.92	2.31	1.02	-0.99	-1.83	-0.48	-0.73	-0.23	-0.69	-0.10	-0.32	-1.24	-1.53	0.08	0.42	-0.62	-0.19	0.50	-0.24	0.12	-0.16	2.06	0.74	0.55	-0.54	-1.59	-1.86	-1.17	0.36	1.73	1.84	---					
PM4	1.18	-0.07	-0.01	1.77	0.19	1.08	0.39	0.18	-0.90	0.03	0.17	-0.09	-0.60	-0.08	0.74	-0.83	1.24	-0.68	-0.54	1.22	-0.06	-0.96	-0.53	1.27	-0.67	-0.49	0.08	-1.64	0.59	2.06	0.24	-2.83	-0.59	---				
HC1	-0.41	-0.66	-1.30	-0.12	0.23	1.32	1.61	-0.07	0.04	0.31	0.96	0.56	0.13	2.06	0.06	-0.43	1.74	-0.14	-0.06	-0.45	-0.72	-0.01	-0.64	-0.05	-0.71	-1.20	3.25	1.37	1.36	0.35	0.02	-1.67	-1.38	-0.55	---			
HC2	-0.88	0.65	-0.43	0.18	-1.09	0.07	-0.07	-1.36	1.42	-0.89	-0.16	-0.48	-0.23	-0.24	-0.10	-0.21	0.38	-0.78	0.83	-0.77	-0.54	-0.35	-0.33	0.66	0.86	-0.86	0.04	-0.32	0.18	-0.21	0.21	-0.13	0.27	1.39	1.05	---		
HC3	-0.51	-0.80	-0.01	0.03	0.06	-0.39	0.86	-0.17	0.91	0.74	1.46	0.47	1.28	0.80	-0.62	-0.08	-0.74	-0.58	0.87	-0.83	-0.21	-0.26	-0.22	0.28	0.33	-0.34	-1.23	-0.21	-0.97	-0.65	-0.35	-0.70	-0.36	-0.72	-1.66	1.52	---	
HC4	-1.12	0.33	0.08	-0.37	-0.10	-0.33	0.38	-0.64	0.55	0.82	0.49	0.21	0.20	-0.41	0.55	0.23	-0.21	-0.60	0.16	-0.34	0.82	0.09	1.20	1.34	0.64	-0.23	-1.00	-0.19	-0.17	-1.39	-1.18	0.22	0.16	-0.98	-2.65	0.81	1.34	---