THESIS

COMPARING CLAIMS AND DISPUTES PERFORMANCE BETWEEN TRADITIONAL PROJECT DELIVERY METHOD AND ALTERNATE PROJECT DELIVERY METHODS

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ABSTRACT

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Claims and disputes are common in construction projects and the costs associated with these adversarial relationships can reach up to $4-12 billion per year. While previous studies have indicated that project delivery methods (PDMs) might impact the frequency and severity of claims and disputes on construction projects, none provided any empirical evidence to support this perception, especially as related to the claim types in different project delivery methods. To address this issue and explore the different variables that might affect claims and disputes among many other project performances metrics, this empirical study was initiated. Data was collected by distributing a questionnaire to Departments of Transportation (DOTs) across the transportation sector. The data was analyzed using descriptive and inferential statistics. Results showed that while PDMs, procurement, and contractual methods have no significant impact on the claims and disputes performance, PDMs can impact other factors (e.g. contractor's performance and trust). These significant findings provide opportunities for further research in other areas such as trust and partnering, which were proven to strategically act as indirect mitigation practices to claims and disputes occurrence in construction projects. The research can also be used by practitioners to further understand the real reasons behind claims and disputes, avoid their triggers, and build a good model of trust for claims and disputes avoidance.

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DEDICATION

To my parents, Anitha Bashettiyavar, Mallikarjuna Bashettiyavar and my sister Jahnavi Bashettiyavar. You are my source of inspiration

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Chapter 1 – Introduction

The Construction industry is a vast field involving various stakeholders i.e. owners, architects, consultants, contractors and subcontractors with diverse knowledge, talent, experience views and interests (Cakmak & Cakmak, 2014). Hence, disagreements arise between the participants. If these disagreements or conflicts are not well managed and resolved in the initial stage, they might quickly escalate to claims and disputes; that can lead to litigation, destroy business relationships, and increase construction cost (Cakmak & Cakmak, 2014; S.-O. Cheung, Suen, & Lam, 2002; Gad, Momoh, Esmaeili, & Gransberg, 2015). Various authors have used the words conflicts, claims and disputes in the construction industry vaguely and interchangeably (Acharya, Dai Lee, & Man Im, 2006; Cakmak & Cakmak, 2014; McGeorge et al., 2007). Therefore, it is vital to define these words lucidly, so that one can have a clear understanding of these terms.

Conflict is the starting point for a claim or a dispute which is initiated wherever there is incompatibility of interests or when one party feels that the others have breached or broken their trust (Cakmak & Cakmak, 2014; McGeorge et al., 2007). Kumaraswamy (1997) bolsters this definition further by stating that a conflict is a serious disagreement between the stakeholders about something valuable, and that it also can be a clash of ideas, beliefs or interests. When the on field managers or the person responsible do not resolve conflicts between various stakeholders or individuals on a project, it leads to claims made by one party to another (McGeorge et al., 2007). The claim might be an increase in cost, extension of time or a request to compensate for inflicted losses (Mitkus & Mitkus, 2014).

A claim can be defined as the right to remedy through property, money or relief (Kumaraswamy, 1997). Some of the reasons for a claim are breach of contract, inaccurate design information, inadequate site investigation, change in scope of work, poor communication and unrealistic time targets (McGeorge et al., 2007). Consequently a dispute arises when the authorities concerned with the project have rejected a claim (McGeorge et al., 2007). Diekmann and Nelson (1985) states that once a claim has been submitted, the concerned authorities may accept it and sanction the required compensation or change order, or else disagree with the requested claim, which would result in construction contract dispute. The Construction Industry Institute (CII) defines dispute as "a problem or a disagreement between the parties that cannot be resolved by on-site managers" (McGeorge et al., 2007).

The construction industry accounts for USD $1.1 trillion of the U.S economy and contributes approximately 8-10 % to the country's gross domestic product (GDP). As of 2017Q1, nominal gross output has increased to $1.478 trillion (Brahm & Tarziján, 2014; Bureau of Economic Analysis, 2017; Gebken & Gibson, 2006; McGeorge et al., 2007). This indicates the scale of capital and money invested in the construction market, by various stakeholders involved in the projects. One of the primary reason to invest money in construction projects, apart from constructing facilities, is to make profits. The previous statement holds true only if a project progresses in a smooth and steady manner: a project free of conflicts, claims and disputes that tend to hamper relationships, decrease profits, and hinder the project progress. The frequency of construction related disputes are between 10 to 30 percent in all construction projects. Therefore, money spent to resolve these disputes is close to $4 to $12 billion dollars or more every year (Gebken & Gibson, 2006; McGeorge et al., 2007). The average cost of individual disputes in the USA during 2011 was $10.5 million (Sathy Rajendran, Clarke, & Whelan, 2013). McGeorge et al.

(2007) rightly points out that construction conflicts and disputes reduce the profits of the stakeholders involved in a project, as enormous investments are involved in order to resolve these disputes. These statistics indicate the enormous amount of losses the project stakeholders undertake due to conflicts, claims and disputes. Therefore, it is incumbent to resolve conflicts and disputes as soon as they occur.

Various dispute resolution methods and techniques have been proposed and implemented in the construction industry in order to avoid these disputes and litigations. The cost and time to resolve conflicts and disputes escalate if the parties involved use litigation. Litigation is a lengthy process where the parties are subjected to interrogations, request for admission, document production demands and depositions (Gad et al., 2015; Yates & Smith, 2007). To avoid this long expensive resolution process, arbitration is sometimes chosen as an alternative, which is considered less tedious and expensive in comparison to litigation. The Hong Kong International Arbitration center, noted that the dispute referred to the arbitration centers tripled over the last decade (S.-O. Cheung et al., 2002). However, McGeorge et al. (2007) indicates that there has been a growing dissatisfaction with arbitration as a dispute resolution method due to increased costs and waiting periods of hearing , the same shortcomings of litigation . In an attempt to overcome the shortcomings of arbitration and litigation, various alternate dispute resolution (ADR) processes have been proposed in order to avoid cost and time overruns and to avoid sour business relationships (S.-O. Cheung et al., 2002; Gebken & Gibson, 2006). Some of the ADR's forms implemented are conciliation, mediation, adjudication, negotiation and dispute resolution boards (S.-O. Cheung et al., 2002; Gad et al., 2015; Gebken & Gibson, 2006; McGeorge et al., 2007).

The project delivery method (PDM) selection has significant implications on collaboration and partnering between project participants, and therefore, impacting the project success. The

PDMs can be classified into traditional and alternate project delivery methods (Ibbs, Kwak, Ng, & Odabasi, 2003). Design-bid-build is the main traditional PDM. Design-build (DB), construction manager at risk (CMAR) (also known as construction manager/ general contractor (CM/GC)), and Integrated project delivery method (IPD) are some of the alternate project delivery methods that are currently used in the industry (Ibbs et al., 2003; Mante, Ndekugri, Ankrah, & Hammond, 2012; Neill, Pmp, & Leader, 2011). Gad et al. (2015) points out that selecting the appropriate PDM for a given project helps in preventing or reducing disputes. Therefore, project delivery methods such as DB, DBB and CM/GC or CMAR are considered and discussed in detail in this research. In addition, the procurement methods and the contract types chosen for a project has a considerable impact on the success of the project in terms of cost, schedule and collaboration between project participants (S. O. Cheung, Yiu, & Chim, 2006; Eriksson & Westerberg, 2011; Harper & Molenaar, 2014). Thus, a considerable amount of research and discussion about contracts and procurement methods is undertaken.

There is a plethora of research on the causes of conflicts, claims, and disputes and linking the selection of PDM to project cost and time performance (Egan, 1998; Farnsworth, Warr, Weidman, & Mark Hutchings, 2016; Ibbs et al., 2003; Kumaraswamy, 1997; Love, Skitmore, & Earl, 1998; Mante et al., 2012; McGeorge et al., 2007; Semple, Hartman, & Jergeas, 1994; Shrestha, O'Connor, & Gibson Jr, 2011). These causes of claims and disputes, as indicated by various authors, underline the importance of collaboration and partnership between all the parties involved in a project, which is established and administered by the choice of the PDM. In addition to selection of suitable PDM for a particular project, it is vital to adopt a procurement and contracting method, which is suitable for the project and works well in conjugation with the selected PDM. Gordon (1994) indicates that, selection of an appropriate contracting method can

reduce the project cost by an average of five percent. Therefore, three important aspects govern the performance of the project in terms of cost, schedule, conflicts, claims, and disputes, those are the way projects are procured, the type of PDM chosen, and the method of payment chosen for the completed work i.e. contract type (El Wardani, Messner, & Horman, 2006; M. H. M. Mehany, Gad, & Esmaeili, 2017).

DBB, DB, and CMAR are widely considered the most regularly and extensively used PDMs (Gad et al., 2015). There have been extensive empirically based research conducted on the cost and schedule performance of all the three PDMs (DBB, DB and CM/GC), while very fragmented research exits on claims and disputes performance in alternative PDMs (Farnsworth et al., 2016; Feuer, Glick, & Clevenger, 2015; Ibbs et al., 2003; Konchar & Sanvido, 1998; Neill et al., 2011; Perkins, 2009; Riley, Diller, & Kerr, 2005; Shrestha et al., 2011). Moreover, none has studied the impact of the selection of procurement and contract methods within PDMs on the claims and dispute performance of projects. Therefore, this research explores the impact that selection of a PDM (DB, DBB or CM/GC) might have on the performance of the projects in terms of claims and disputes. In addition, the research also investigates the impact that the contract and procurement methods chosen within a PDM might have on the performance of the project since all of them together acts as a mechanism that can determine the collaboration between the project stakeholders and ensure a smooth project progress. Since conflicts, claims or disputes is a probable event on any project, appropriate dispute resolution methods (DRMs) and ADR methods are essential mechanisms to resolve them if they do occur. Therefore, the various dispute resolution methods and ADRs are discussed in this research and they are included as one of the many variables that impact claims & disputes.

As mentioned above, the construction industry has transitioned from adopting traditional PDM to alternate PDMs such as DB and CM/GC. Therefore, this raises the first research question: *"Does alternate PDMs reduce claims and disputes by increasing collaboration in comparison to DBB?*" Based on the research question the hypothesis of the research was formulated which is: *"Alternate PDMs (DB and CMGC/CMAR) have lesser claims and disputes in comparison to the traditional PDM (DBB)"*.

In addition, the selection of procurement and contract methods determine the framework in which the team can collaborate and communicate. Therefore, the second research question is: "*Does the selection of procurement and contract methods within the PDM have any significant impact on the claims and dispute performance of the project?"*. In order to answer these research questions, the following objectives are formulated:

- Compare the performance of traditional PDM and alternative PDMs in terms of claims and disputes performance (frequency and severity).
- Determine if the choice of procurement and contract methods within the PDM can impact the claims and dispute performance (frequency and severity)
- Determine if the partnering process affect any of the project performance issues, including claims and disputes or their causes.
- Determine if the different trust types can impact any of the project performance issues addressed in this research
- Determine if there are any observational trends that can help in reducing claims and disputes and/or improve the overall project performance

Chapter 2 - Literature review

This chapter will discuss in detail the various components which are closely related to the research questions, hypothesis and the objectives of the research. Furthermore, it gives an in-depth insight on all the scholarly work which has been done relating to conflicts, claims, disputes, change orders, procurement methods, project delivery methods and contracting methods. In addition to the various variables/components discussed above, this research also explores the DRMs and ADR relating to the construction industry and gives an in-depth knowledge of the past work pertaining to this research area and the gap that this research attempts to fill in this area of study.

1.1 Conflicts

The construction industry is considered to be a volatile industry, which is marred with conflicts, claims and disputes (Gad et al., 2015). As rightly pointed out by Acharya et al. (2006), there would be no conflict in a perfect construction project, but a perfect construction project does not exist. Therefore, every project might have some conflict in different magnitude. A conflict can be defined as the serious difference between two or more ideas, beliefs or interests that refuse to exist together (Acharya et al., 2006) . Conflicts happen due to inequalities of power and reward amongst various parties involved in the construction, the trait of competition in humans, unforeseen conditions, changing needs of clients, and change orders from various participants to name a few (McGeorge et al., 2007; Price & Chahal, 2006). Initial stages of misunderstandings or problems between the various stakeholders of the project can lead to conflicts, and if conflicts are not well managed and resolved in its nascent stage, it leads to claims and disputes which are both time consuming and expensive.

It is vital to realize the risks in a project in order to reduce conflicts. In a construction project, there are many unknowns and unforeseen conditions, which are risks associated to the project. When the parties involved in a project are able to have far-sightedness and foresee the potential risks of a project, conflicts can be substantially reduced (Acharya et al., 2006; McCallum, 2000). When conflicts between parties escalate, reaching a level where an agreement cannot be achieved, it result in claims made by the stakeholders (e.g. contractor) to concerned authorities (e.g. owner). If the concerned authority disregards the claims made, it finally ends up as a dispute between the individuals or stakeholders involved (Acharya et al., 2006). The Figure 1 below shows the occurrence of risks, conflicts, claims and disputes in a sequential manner.

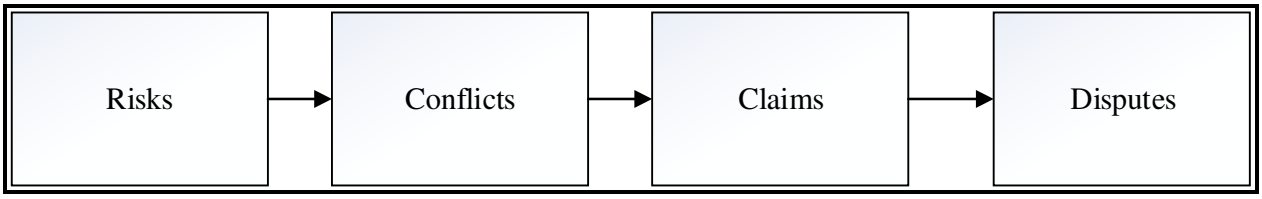

Figure 1: Occurrence of risks, conflicts, claims and disputes. Source: (Acharya et al., 2006)

To avoid conflicts in construction projects it is vital to understand and study the factors causing conflicts on construction projects. Several scholars provided a good classification of conflicts in construction industry where they categorized conflicts based on activities of project participants and improper communication between the projects participant's respectively (Acharya et al., 2006; Mitkus & Mitkus, 2014). Before the various categories of conflicts are discussed, it is important to establish the key participants or stakeholders in construction projects and their ultimate goals. Commonly, owners, contractors, sub-contractors and designers are the participants whose actions directly affect the performance of a project (Acharya et al., 2006; Oglesby, Parker, & Howell, 1989). The owners intends to obtain a project with the highest quality in the most economic approach, the designers intends to use their utmost imagination and skill to design a stunning

structure and the contractors and sub-contractors are working to complete the project on time and within budget while maximizing their profits (Acharya et al., 2006). Sometimes, the pursuit of achieving these goals leads to conflicts between various participants which can be categorized as conflict instigated by owners, contractors, consultants and third parties (Acharya et al., 2006). Table 1 indicates the type of conflicts generated by each stakeholder involved in a construction project while the predominant reasons for conflicts can be listed as (Acharya et al., 2006):

- Varying site conditions
- Obstruction by local people
- Change orders evaluation
- Erroneous or incomplete design
- Excessive work
- Lack of clear specifications

Table 1: Conflicts generated by various project stakeholders. Source: (Acharya et al., 2006).

Owner Evoked conflicts	Confusing requirements of owner
	Change orders
	Supremacy of owner/consultant
	Unclear project scope
	Lack of adequate funds by from owner
Consultant evoked conflicts	Defective Design
	Design related errors
	Excessive extra work
	Varying site conditions
	Varying quantities

Contractor evoked conflicts	Not keeping up with schedule
	Financial failure of the contractor
	Incompetency
	Defective maintenance
	Poor quality of work
Third party evoked conflicts	Strikes
	Adverse weather
	Third party delays
	Change in government codes
	Inflation

There is a sequential way conflicts commonly arise on a project. For example, a scope change or addition on a project may be accepted by a contractor if he is assured equitable payment on accomplishing the additional/changed task (Acharya et al., 2006; O'Brien, 1998). If the changes or change orders are unacceptable by the contractor, or being imposed onto him by owners or architects, it often leads to conflict. Considering the risks at various levels in the construction industry, these change orders are inevitable, either at the project design phase or construction phase, and they are mostly considered as the major cause of conflicts in the construction industry (Acharya et al., 2006; Assbeihat & Sweis, 2015; Perkins, 2009).

However, site conditions or scope change are not the only proponents of conflicts, lack of adequate communication and partnership between project participants are considered to be a major cause of conflicts. Mitkus and Mitkus (2014) stated that conflicts do not arise from site conditions but from the poor communication between stakeholders of a project and about 90% of construction conflicts are due to unsuccessful communication. They claimed that contract documents are the

primary cause of construction conflicts since they are the means of communication for the project participants. The contracts establish activities and relationships through contract and law. This is due to the fact that the contract documents represent the mutually agreed upon terms and conditions which include site conditions, quality of work, mutually agreed upon risk, etc. Therefore when the contracts fail to communicate the agreed terms and conditions to the parties involved in a project, conflicts tend to arise. Mitkus and Mitkus (2014) also pointed out that no conflict should arise if there is shared allocation of risks. For example, if the owner clearly specifies that the contractor must bear the expenses of changing site conditions, there is clearly no room for conflict in this respect. Similarly, if the owner lucidly specifies the desired level of quality performance, conflict would fail to exist within the quality conformance area. Hence, the above two examples indicate as to how the contracts behave as a means of communication between the various parties of a project. It is essential that conflicts between project participants are resolved at its nascent stage for the smooth functioning of the project. However, if these conflicts are not resolved, they tend to create a snowballing effect and form into claims.

1.2 Claims

A claim can be defined as an assertion of the right to property, money, remedy, lost time and relief or a compensation for the damages made by any party to the contract (Kumaraswamy, 1997; McGeorge et al., 2007; Semple et al., 1994). They also include the reasoning and rationale of entitlement to money or time. However, claims cannot be disregarded as a negative value added to a project which causes loss of time and money. Kumaraswamy (1997) stated that claims are sometimes necessary in a construction project as they help to contractually accommodate for the changing nature for construction projects such as differing site conditions, demand of higher quality than specified and unforeseen weather, to name a few. It is vital to resolve the claims

between the concerned parties, which depends on the level of conflict prior to the claim. If these claims fail to be resolved, it can leads to disputes as shown in Figure 2 which visualize and explain the relationship between conflicts, claims and disputes Kumaraswamy (1997).

Though claims are inevitable in the construction industry, they can be avoided or mitigated by studying and understanding its primary causes. A plethora of literature and research studies have identified the causes of claims, some of which can be summarized as in the following (Diekmann & Nelson, 1985; Hashem M. Mehany & Grigg, 2016; Kumaraswamy, 1997; McGeorge et al., 2007; Semple et al., 1994).

- Design errors: This mainly deals with inaccurate and inadequate design information furnished to the contractors. In addition, delayed design information can be caused by indecisiveness of owners or lack of discipline from the design team.
- Differing site conditions: This refers to the change in initial site conditions that are mentioned in the plans and specifications from the actual site condition that the contractor must work within such as unforeseen ground conditions, interference with utility lines, unrecorded high levels of underground water, etc.
- Changes: Changes might be owner generated, contractor generated, or third party generated changes. Semple et al. (1994) stated that more than half of the claims are due to increasing scope of work during construction phase.

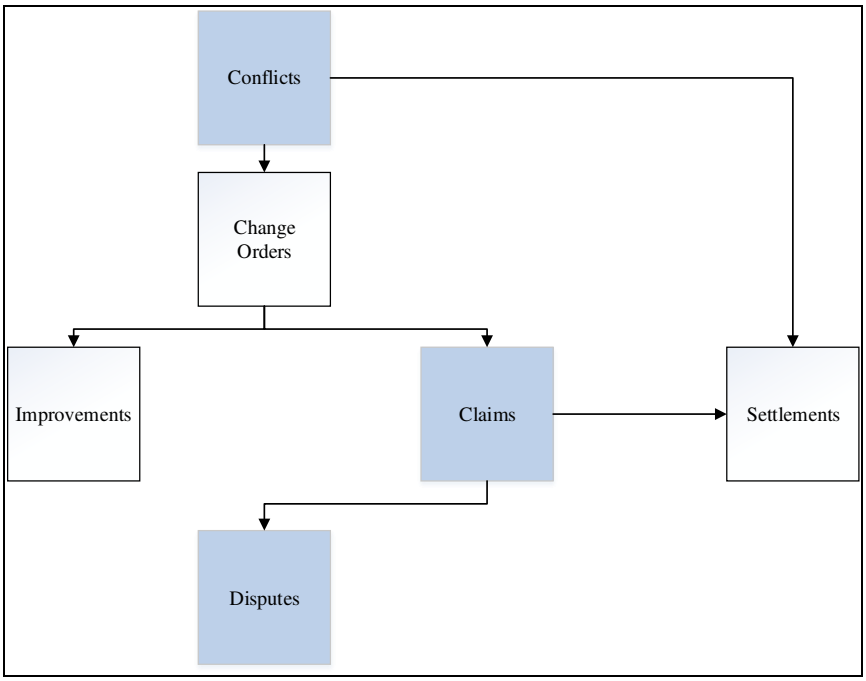

Figure 2: Conceptual model of claims and dispute occurrence. Adopted from (Kumaraswamy, 1997).

- Weather: Extreme weather such as high or low temperatures, rain, snow and wind, slow down work and sometimes bring the work to a halt (Hashem M. Mehany & Grigg, 2016). The contractor must review and add floats to his schedule by thoroughly studying the weather conditions prevalent in the region such as, historical weather, extreme weather conditions and unanticipated weather conditions that leads to delay of work or halt. Nevertheless, if either of the parties i.e. owner or contractor/ architect push the project into unanticipated weather conditions due to their incompetency or lack of decision making, then change orders take place which can be followed by claims and disputes.
- Strikes: Strikes caused by labor forces due to different reasons varying from political instability, lack of good working environment or insufficient pay.

Amongst the varied causes of claims discussed above, changes or change orders in a construction projects are considered the major cause of claims. Kumaraswamy (1997) ranked

change orders as the third leading cause of claims. Assbeihat and Sweis (2015) identified change orders as the main cause for cost and time delays that leads to claims, disputes and strained relationships between the various stakeholders. Charoenngam, Coquinco, & Hadikusumo (2003) found that Change orders contribute to 5.1% to 7.6% of the total project cost and are considered to be one of the major causes of project delays.

1.3 Change Orders

Change is defined as a modification to the original scope, execution time or cost of project. They are inevitable in a construction project due to the limited time, resource and budget allocated to the planning stage, and the uniqueness of each individual project (Assbeihat & Sweis, 2015; Hanna, Camlic, Peterson, & Nordheim, 2002). Owners, contractors, consultants, architects/engineers, subcontractors and suppliers frequently issue change orders (Assbeihat & Sweis, 2015; Charoenngam, Coquinco, & Hadikusumo, 2003). The types of change orders issued under each stakeholder and their role in instigating and/or handling the change orders can be summarized in the following (Assbeihat & Sweis, 2015; Charoenngam et al., 2003):

- Owner: The top three owner generated change orders are additional work (not specified in the contract), modification of design and insufficient coordination among the parties by the owner. The owner's responsibility is to approve, return for renegotiations, or reject the claims that are made by the contractors or sub-contractors.
- Architect/ Engineer: An architect or an engineer acts as a consultant to the owner in most cases, depending on the PDM chosen for the project. Ambiguities or errors in drawings and specifications, inaccurate quantity takeoffs, and less qualified staff working under the architect or engineer are classified as the top three causes of change orders. Depending on the PDM, an architect/engineer works as a mediator between owner and the contractor.

He/she validates the change order claims made by the contractor and submits it to the owner with recommendation.

- Contractor: A contractor sends the change order claims to the owner or the architect depending on the hierarchy pertaining to the project. Some of the causes of change orders on the contractor's behalf are errors and improper scheduling and planning that might lead to schedule change requests or not meeting schedules deadlines.
- Sub-contractors/ Laborers: Corresponds with the contractor on most occasions, a change order request from the sub-contractor is presented to the contractor before it is sent to the owner. The three primary causes of change orders by sub-contractors are fewer numbers of skilled laborers, modification in material specification and delays in material delivered.

As discussed earlier, conflicts that are unresolved lead to claims. When these claims reach a higher authority and met with disapproval, they lead to disputes amongst the parties.

1.4 Disputes

Disputes are not new to the construction industry as Gebken and Gibson (2006) noted that the construction industry has been a leader in dispute incidence and dispute resolution for several years. A dispute in construction projects originates when a claim, made by a stakeholder e.g. contractor has been rejected by another stakeholder e.g. owner of the project. The Construction Industry Institute (CII) defines a dispute as a problem or a disagreement between the parties involved in the project that cannot be solved by onsite personnel in charge (McGeorge et al., 2007).

Since disputes occur after claims are rejected, it is safe to assume that the causes of disputes are broadly similar to the causes of claims. In addition to the various causes of claims that have been discussed above, table 2 indicates some of the root causes of disputes and claims. If these root causes are defeated at their inception, claims and disputes can be avoided or mitigated.

Table 2: Root and proximate causes of claims and disputes. Table adopted from (Kumaraswamy, 1997)

Root causes	Proximate causes
Unfair and unclear risk allocation	Inaccurate design information
Unrealistic pricing	Inaccurate estimation
Unrealistic targets by clients	Change orders
Uncontrollable external events	Internal disputes and personality clash
Inappropriate contract type	Inappropriate contract selection and administration
Lack of professionalism of project participants	Exaggerated claims
Lack of decision making by clients	Slow client response

1.5 Alternate dispute resolution (ADR)

If conflicts and claims fail to be resolved, it results in disputes. Gebken and Gibson (2006), observed that approximately 2% of the contract amount was expended as transactional cost in dispute resolution. Assaf and Al-Hejji (2006) also noted that disputes are one of the main causes of project delays. In order to reduce these costs and time delays caused by disputes, it is vital for the stakeholders involved in the project to choose appropriate dispute resolution methods. In early construction days, most of the construction disputes were resolved on site between the parties concerned, between the owner/engineer and the contractor/sub-contractor (Treacy, 1995). However, with the increase in fast track and complex construction projects, disputes are becoming more complex and sometime unavoidable. Litigation, which is the final binding method of resolving disputes, is considered as the last resort for dispute resolution by many construction professionals due to lengthy delays, high associated costs and the strained relationship between

the parties which can definitely affect any repeat business chances (S.-O. Cheung et al., 2002; Hinchey, 2012; McGeorge et al., 2007; Treacy, 1995). This led to exploring other dispute resolution processes by industry experts that could replace litigation successfully, thus giving rise to alternate dispute resolution (ADR). Alternate dispute resolution can be defined as methods by which conflicts and disputes can be resolved privately without going through litigation in courts (McGeorge et al., 2007). With ADR, the parties involved in disputes have greater control over the process, in contrast to the litigation process. Some of the most often used ADR methods are arbitration, mediation, dispute resolution boards, conciliation, adjudication, negotiation, expert determination and other hybrid processes (S.-O. Cheung et al., 2002; Mante et al., 2012; McGeorge et al., 2007; Treacy, 1995). The vital attributes of ADR compared to litigation are reduced costs, increased level of privacy, increased speed, increased knowledge of construction related disputes, preservation of business relationship, and reduced formality to name a few (S.-O. Cheung et al., 2002). These attributes favor the ADRs over litigation in construction disputes. The federal courts are attempting to shift more cases to dispute resolution procedures (Treacy, 1995). Some of the most frequently used ADR methods are discussed in detail below (Treacy, 1995).

1.5.1 Negotiation

Negotiations is a common type of dispute resolution method in local as well as in the global arena since they are time and cost effective and preserve the business relationship (McGeorge et al., 2007; Yates & Smith, 2007). According to Ury and Fisher (1981), negotiations can be defined as a back and forth communication designed to overcome differences and reach an agreement. In this method if two parties/stakeholders are involved in a conflict or a disagreement they can come together to discuss their differences and settle on a solution. The solution might be awarding compensation for additional work done, increasing the time for work to be done or settling for the

achieved performance. Negotiations are conducted between the parties involved in a project, thus keeping the secrecy and independence of the negotiation. However, third party negotiators can be hired for the process too. The process of negotiation is non-binding, unless it has been established in the contract or if both parties involved in the negotiation agree to reach a legally binding solution at the end of the negotiation (McGeorge et al., 2007). This type of dispute resolution is apt when the parties are looking for a quick settlement, as failure to do so would result in other severe consequences (McGeorge et al., 2007). In contrast, negotiations are not suitable when the level of conflicts between the parties are high as it may further rupture the relationship between the parties (McGeorge et al., 2007). Therefore, negotiation should be considered when the parties are looking for a cost and time effective solution to resolve the dispute in addition to secrecy and independence, which is a key character of negotiation (Yates & Smith, 2007).

1.5.2 Early neutral evaluation

The main purpose of this type of ADR is to evaluate the dispute and explore the possibility of a settlement. A neutral evaluator, mostly a neutral lawyer/consultant, is selected to help assisting the parties to formulate a discovery plan. The neutral evaluator selected is often an expert in subject matter and has the ability to solve the problem in a quicker and cost-effective manner. In addition, through informal communication with the parties involved, this type of ADR helps the parties to further understand their case (Treacy, 1995).

1.5.3 Conciliation, facilitation and mediation

The functions of mediators and conciliators are similar in nature with slight variations between them (McGeorge et al., 2007; Yates & Smith, 2007). The mediator's main objective is to help the parties to resolve their problem mutually. Unlike judges and arbitrators, mediators cannot impose their decision on the parties (Treacy, 1995). This type of ADR is particularly useful for

local government disputes and customer complaints (McGeorge et al., 2007). Yates and Smith (2007) further point out that a mediator is a neutral third party who acts as an intermediary to facilitate communication between the litigating parties in order to achieve a successful negotiation and reach a reasonable solution. Further, he can also warn the parties regarding the ill effects of not reaching a settlement. Conciliation is similar to mediation, where a third party is elected in order to hear the appeal of the parties and recommends a settlement (Yates & Smith, 2007). If both the parties reject the solution of the conciliator, the case is forwarded to a trial. Therefore, the decision or solution of a conciliator is non-binding, similar to a mediator. McGeorge et al. (2007) states that a conciliator takes on a more active role than a mediator as they try to provide different solutions to the parties with the aim of resolving the dispute. Facilitation is like conciliation and mediation. The facilitator has a more active role in comparison to a conciliator or a negotiator, as alternative resolutions are provided to the parties rather than providing just one solution or leaving it for the parties to work it out themselves (Hinchey, 2012; McGeorge et al., 2007).

1.5.4 Special Masters or Expert Determination

This is an ADR method where a third party (expert, retired judge, law professor, etc.) who has the expertise to resolve disputes is selected by the parties and the selected representatives are called "special masters" (McGeorge et al., 2007; Treacy, 1995). This type of ADR is useful when the dispute is technical in nature or in a specialty area of work. Depending on the special master's appointment terms, he/she may ask for evidence, examine the parties under oath, and rule on the admissibility of the evidence (Treacy, 1995). If the master fails to bring about a resolution, the parties can go to a more formal method of dispute resolution. In such cases the expert can give the litigators, an idea as to what result can be expected from the more formal process. and the decisions made by experts are non-binding in nature (McGeorge et al., 2007; Treacy, 1995). The advantage

of this method is that expertise in a specialized field can be summoned to resolve complex and controversial disputes. In addition, masters are more readily available for hearings and discussions similar to mediators, facilitators and conciliators; therefore, saving time and money. Hinchey (2012) describes an ADR that is named as "rapid responders", which is similar to expert determination/special master, in its function and duties. As the master can convey the expected results from the formal court procedures, the litigators may be motivated to avoid the tedious process of litigation and negotiate for a solution (McGeorge et al., 2007; Treacy, 1995).

1.5.5 Dispute review boards or dispute resolution boards (DRB)

A dispute review or resolution board typically consists of three neutral third party members appointed by the contractors and owners with each other's consent (McGeorge et al., 2007; Treacy, 1995; Yates & Smith, 2007). McGeorge et al. (2007) recommends that the board should be set up weeks before the start or during the early stages of a project. Furthermore, the board should meet with the parties on a regular basis, have regular site visits and monitor progress. The members of the board should be impartial and should not hold individual meetings with other party members without the consent of the opposing party. During the meetings, the parties make presentations to the board, updating them regarding the progress and challenges of the project. In case of a dispute or conflict, each party presents its view in a formal manner and the board conducts a discussion and offers solutions to resolve the problem. The solution or decision by the board is non-binding in nature unless mentioned otherwise in the contract. The parties can refuse the decision and opt for arbitration or litigation. However, in the court the findings of the DRB is held valid (McGeorge et al., 2007; Treacy, 1995; Yates & Smith, 2007).

According to Treacy (1995) DRB was first implemented in tunnel and highway projects in Colorado in 1975, whereas McGeorge et al. (2007) identifies the beginning of DRB in the 1960s

on a Washington dam project. Since its inception, DRB has been very successful in resolving disputes. McGeorge et al. (2007) bolsters the previous statement by identifying the effectiveness ratio, which is the ratio of disputes settled to the number of disputes brought to the DRB, being more than 0.9. Therefore, some of the advantages of DRB are as in the following (McGeorge et al., 2007; Treacy, 1995; Yates & Smith, 2007):

- DRB achieves paramount savings in terms of cost and time.
- Selection of experts in construction and dispute resolution fields results in expert and quick judgement.
- The findings of the board have merit, as they are valid in the court, thus ensuring certain degree of productivity from DRB.
- The DRB also provides a platform for the sub-contractors to share their grievances and conflicts.
- DRB promises a high effectiveness ratio irrespective of the size of the project.

1.5.6 Arbitration

Arbitration was one of the earliest forms of ADR which has been in the industry for hundreds of years (McGeorge et al., 2007; Treacy, 1995). However, there has been some debate regarding the efficiency and effectiveness of arbitration to solve disputes in a smaller period and at a reduced cost. Therefore, many researchers have casted their doubt on whether or not arbitration should be considered as an ADR (S.-O. Cheung et al., 2002; McGeorge et al., 2007).

Arbitration is defined as a semi- judicial process in which a neutral third party or parties is elected to hear the case and make judgement based on those hearings (McGeorge et al., 2007). The process of arbitration is initiated either by a court-annexed arbitration or through a dispute resolution clause mentioned in the contract. In this method of dispute resolution, the decision made

by the arbitrator is final and binding unless either of the litigating parties wants to challenge the decision and proceed to litigation. Treacy (1995) further points out that arbitration more often ensures that the parties enter serious negotiations and resolve the dispute. The advantage of arbitration is ensuring confidentiality and secrecy and providing some level of control for the parties, as they can choose the arbitrators and challenge their decisions. Due to the growing concern of the effectiveness of arbitration, fast-track construction arbitration has been proposed to reduce the cost and time of the arbitration process (Hinchey, 2012).

1.5.7 Litigation

Litigation is the final step taken by parties to resolve disputes. Yates and Smith (2007) define litigation as process in which one party sues another in the court of law within a specific jurisdiction. Yates and Smith (2007) further recommends that the contract should specify the jurisdiction of the court hearing to avoid hearings from more than one court. It is often time consuming and expensive in comparison to the ADR methods. This process of dispute resolution is determined in a court in the presence of a judge and the parties involved have no control over the process. In litigation, the parties can be sure of neutral unbiased decisions and the decisions given by the court are final and binding (Hinchey, 2012). To summarize the attributes of an effective ADR, S.-O. Cheung et al. (2002) provide list of vital attributes of an efficient ADR, they are as follow:

- Preservation business relationships
- Enforceability of decisions upon the parties
- Neutrality of the third-party investigators
- Consensus to be reached between the parties
- The speed to obtain results while avoiding escalation of disputes and litigations

In assessing the performance of a project in terms of cost, schedule, conflicts, claims and disputes, the procurement methods, the type of PDM chosen and the method of payment chosen for the work done (contract type) must be taken into account, as they dictate the level of stakeholders' partnership which might impact the trust levels between project stakeholders. (El Wardani et al., 2006; Gordon, 1994; M. H. M. Mehany et al., 2017).

1.6 Procurement

Procurement can be defined as the process of obtaining project team members, this may be individuals, firms or companies that will participate in the completion of the project (Abdul Rashid et al., 2006; El Wardani et al., 2006). The degree of partnership and cooperation between the various project participants and the roles and responsibilities largely depend on the procurement method used by owners to procure the project participants (Eriksson & Westerberg, 2011). Procurements can be broadly classified into price-based procurement, best value procurement, subjective and qualitative procurement.

1.6.1 Price- based procurement method

In this type of procurement method cost is primarily the main criteria for selecting the teams involved in the project. The emphasis on cost for procurement of the team should be more than 50% at minimum to be considered a price based procurement method (El Wardani et al., 2006). One of the best examples of this type of procurement method is low bid selection and two-step sealed bidding. Since price represents an integral part of this procurement type, the design documents are generally complete. In a price-based procurement method, the owner invites a large number of contractors to bid on the project to obtain the lowest economic price possible in addition to good construction contractor skills. Therefore, this type of procurement method is characterized by competition that ensures price certainty (Abdul Rashid et al., 2006; Love, 2002). However,

several authors have indicated that low bid selection is characterized by a higher cost growth, change orders and time delays that are inherent characteristics of a claim and dispute filled project (El Wardani et al., 2006; Pesämaa, Eriksson, & Hair, 2009).

1.6.2 Best value Selection (BVS) procurement

As the name indicates, this procurement method procures the project team that offers the best value in terms of cost as well as technical capabilities(Alleman, Antoine, Gransberg, & Molenaar, 2017; El Wardani et al., 2006). This procurement method offers one-step request for proposal or two-step request for qualification, for shortlisting, followed by a request for proposal can be used. On submission of these proposals to the owner, negotiations can take place between the owner and qualified contractors. This competitive negotiation offers the owner a qualified contractor with a competitive lower price. The upfront pricing that this procurement method offers is one of its biggest advantage, as the owners feel comfortable realizing the cost of the project. In addition, the upfront pricing ensures that contractors understand the pre-construction and construction scope that should be expected (Alleman et al., 2017). Since this method of procurement adapts both qualitative and quantitative selection factors, schedule growth is very low (El Wardani et al., 2006). However, studies by Alleman et al. (2017) indicated that this procurement method has a potential drawback represented in higher award growth.

1.6.3 Qualitative Based Selection (QBS) procurement

In this procurement method, cost takes a back seat as a selection criterion. The key variables predominantly taken into consideration are past performance, technical qualifications, financial stability, project innovation and established relationship through previous projects (Alleman et al., 2017; El Wardani et al., 2006). This type of procurement method requires only request for qualification response that is reviewed and finally awarded to the “most qualified

contractor". Many transportation departments in the U.S. use qualitative procurement in conjugation with CM/GC project delivery (Alleman et al., 2017). The sole source and qualification-based selection are some of the best examples of this procurement method. The biggest advantage attached to this procurement method is the emphasis on innovation and other qualitative aspects in comparison to cost. Therefore, this type of procurement is best suited for complex projects and those projects in development stages (Alleman et al., 2017). However, there is increased time spent on negotiations since the pricing is not fixed as in the best value procurement. El Wardani et al. (2006) states that projects using this procurement method were delivered slightly behind schedule and with an increased budget.

Many researchers have indicated varying findings of cost, time, claims and disputes performance of various PDMs, therefore indicating that the performance of the project largely depends on the type of PDMs chosen. In addition, the level of collaboration between various stakeholders depends on the PDM chosen for the project, therefore effecting the choice of ADRs (Gad et al., 2015; M. H. M. Mehany et al., 2017).

1.7 Project Delivery Method (PDM)

PDM is defined as the process that is adopted by various stakeholders of a project to complete the facility. It defines the roles, responsibilities and relationships between the various participants in a project, and the sequence in which the project has to be completed (Gad et al., 2015). Some of the most frequently used PDMs are design-bid-build (DBB), design-build (DB), construction manager/general contractor (CMGC) which is also known as construction manager at risk (CMAR) to name a few. In this paper, special attention is given to DBB, DB and CMAR since they are the most used PDMs in the construction industry (Gad et al., 2015; Harper & Molenaar, 2014; Perkins, 2009).

1.7.1 Design Bid Build (DBB)

One of the most practiced and traditional PDM is DBB. It has been the traditional mode of PDM in the late 20th century (Cantirino & Fodor, 1999; Gad et al., 2015; Ndekugri & Turner, 1994; Shrestha et al., 2011). In DBB, the owner contracts separately with the designer and contractors. The architect/designer prepares the project construction documents represented in the plans specifications, and bid packages which will be made available to several contractors that will competitively bid the project, and based on their bids, a contractor for the project is chosen (Cantirino & Fodor, 1999). As the owner contracts separately with the designer and contractors in this PDM, any changes made or desired by the owner will cause a chain of change orders to all the stakeholders of the project. In addition, the communication between the designer and the contractor is often not good in this PDM, as they are separate entities and each are waiting for an opportunity to shift the risk in case of an error occurrence (Perkins, 2009). Therefore, there is a common lack of knowledge sharing between the designer and contractor and each one of them are working for their own profit motive instead of collaborating and knowledge sharing.

. Perkins (2009) reported that, changes in DBB are difficult to manage due to the asymmetrical negotiations between the parties involved in the project, leading to claims and disputes. Mante et al. (2012) indicated that due to the DBB PDM's lack of communication, price competition and fragmentation, it results in increased conflicts and disputes. Several other scholars have indicated that disputes are higher in traditional PDM (DBB) when compared to alternate project delivery methods (Mante et al., 2012; Yusof, Ismail, & Chin, 2011). In the late 1970s, the increasing size of projects, the high cost of short-term financing, more sophisticated owners, runaway inflation, and other factors spawned new approaches to the traditional construction delivery systems. Some of the new approaches are variations of the traditional approach, while

others are applications of old approaches to new situations (Cantirino & Fodor, 1999)]. Considering the preceding disadvantages of DBB PDM, alternate PDMs were developed and are extensively used in various construction projects.

1.7.2 Design Build (DB)

One of the most extensively used alternate PDM is the DB. Konchar and Sanvido (1998) noted that the interaction between designers and contractors in DBB happened only at the end or at the beginning of the construction phase of the project. This resulted in ineffective design, increased errors and omissions, more change orders, claims, disputes, higher costs and increased project duration. Owners and industry experts were unsatisfied with DBB as a PDM and therefore adapted DB as an alternative PDM. In DB, the owner contracts with a joint venture company, an in-house construction, design and engineering company or with two companies collaborating to provide design and construction services as one entity, to offer a single source of communication to the owner (Cantirino & Fodor, 1999; Konchar & Sanvido, 1998).

The DB concept is considered to be one of the oldest PDMs in the construction industry and due to the increased dissatisfaction with DBB, DB saw an increase in popularity in late 1980s and early 1990s (Cantirino & Fodor, 1999; Perkins, 2009). More than 40% of the non-residential projects are delivered using DB (Perkins, 2009; Tran & Molenaar, 2013). The reason for its popularity is the consolidation of design and construction services in one single entity, which increased the collaboration between designers and constructors and overcame one of the most glare flaws of DBB.

In DB, depending on the owner's procedures, the owner issues a RFP (Request for Proposal) that contains the design parameters/programs, the DB teams develop a conceptual design along with other deliverables (e.g. proposal schedule, conceptual estimate, etc..) as per owner's

requirements, and the owner then selects the most satisfactory DB team for the project accordingly (Perkins, 2009). In this PDM, the construction phase of the project starts before the completion of the design documents as both the architect and the constructor are working together Shrestha et al. (2011), therefore, offering a reduced schedule advantage in comparison to DBB PDM (Konchar & Sanvido, 1998; Ndekugri & Turner, 1994; Perkins, 2009; Shrestha et al., 2011). Ndekugri and Turner (1994) indicated that majority of contractors, clients and architects agrees that DB offers schedule advantages over DBB. Furthermore, Ndekugri and Turner (1994) stated that owners are more satisfied with the quality of design in DB projects. Ndekugri and Turner (1994) also indicated that there is a considerable decrease in disputes and litigation in DB PDM. The fact that 79%, 89% and 86% of contractors, clients and architects respectively agree with this, supports the statement. However, that study was based solely on opinions without actual project data analysis. The most common forms of disputes identified by Ndekugri and Turner (1994) were:

- Conflicting information in the employer's requirements
- Extent up to which the contractor is obliged to furnish everything in the drawings
- Valuation of design work variations
- Additional work which is not shown in the drawings and specifications

However, it is worthy to note that the cost advantage of DB over DBB is debated by several authors (Ibbs et al., 2003; Ndekugri & Turner, 1994; Perkins, 2009; Shrestha et al., 2011).

1.7.3 Construction manager/ General Contractor (CM/GC)

CMGC is also known as Construction Management at Risk (CMAR) is an alternate PDM that was first implemented in the early 1960s and used extensively in the 1970s due to increased costs, extended schedules and delays in traditional project delivery method (Feuer et al., 2015). In CMGC, the owner hires the general contractor early in the project design phase to offer

preconstruction and construction services to the owner (Cantirino & Fodor, 1999; Farnsworth et al., 2016; Feuer et al., 2015). The contractor acts as an advisor or consultant during the design and development phase of the project, providing insight into the cost estimates, schedule of the overall project, design changes, identification of risks and other safety and construction related services (Cantirino & Fodor, 1999; Farnsworth et al., 2016; Feuer et al., 2015). After the design and preconstruction phases of the project, and with the owner's agreement, the role of a contractor can change from an advisor/consultant to that of a general contractor. In this stage of the project, the general contractor performs construction services to the owner (Feuer et al., 2015).

This alternate PDM helps to reduce the risks associated with the construction phase of the project, which can be typically found in DBB. The important feature of CM/GC is the level of partnership and integrated team approach it promotes at the design and construction phases of the project. This level of integration can help reduce the number of change orders, which are considered a major cause of claims and disputes in construction (Farnsworth et al., 2016). Feuer et al. (2015) has conducted extensive research on the cost, schedule, quality and collaborative ability of CM/GC. All of which were rated higher than DBB by all research participants i.e. owners, designers and contractors. The schedule performance of CM/GC was rated better than DBB. However, there is a dearth of research with respect to disputes, conflicts and claims.

1.7.4 DBB, DB and CM/GC

Research on cost, schedule and quality performance of DBB, DB and CM/GC has been conducted extensively, therefore speculating that the performance of the project largely depends on the type of PDMs chosen (Farnsworth et al., 2016; Feuer et al., 2015; Gad et al., 2015; Ibbs et al., 2003; Konchar & Sanvido, 1998; M. H. M. Mehany et al., 2017; Neill et al., 2011; Perkins, 2009; Riley et al., 2005; Shrestha et al., 2011). However, a very limited and fragmented research

on the amount and degree of claims and disputes in each PDM has been conducted. Furthermore, research on choice of dispute resolution method based on PDM has not been explored (Gad et al., 2015; Mante et al., 2012; M. H. M. Mehany et al., 2017). The regular use of arbitration and litigation in any of the PDMs do not yield any proven success and usually result in straining the much valued relationship between the litigating parties (Mante et al., 2012; M. H. M. Mehany et al., 2017). For example, the relation between the contractor and architect is different in DB, DBB and CM/GC. DB and CM/GC promises increased partnership between the various stakeholders in the project whereas DBB is characterized by an adversarial relationship between the different parties (Perkins, 2009). Therefore, choosing DRM and ADR based on the PDM can help a great deal to reduce conflicts and disputes (Mante et al., 2012). Mante et al. (2012) furnished a table indicating the procurement methods and suitable DRMs based on the level of relationship/ collaboration between project participants as shown in table 3. Mante et al. (2012) studied the DRMs used in various departments of transportation (DOT) and concluded that they all have modified versions of stepped resolution methods and ADRs irrespective of PDM and all the studied DOTs use ADR in their projects. Nevertheless, Mante et al. (2012) fails to give any empirical data regarding the effectiveness of a particular choice of ADR by the DOTs for their project. M. H. M. Mehany et al. (2017) further asserts that the same DRMs / ADRMs are used by various DOTs irrespective of PDM chosen for the project. For example, out of 12 DOTs from which the data was collected, only five DOTs used different DRMs for different PDM, therefore indicating the lack of relationship between the selection of DRMs and ADRs (Gad et al., 2015; M. H. M. Mehany et al., 2017).

Table 3: Procurement methods and the likely DRM to be employed. Adopted from (Mante et al., 2012).

Traditional and management methods	Litigation
	Adjudication
	Arbitration
Integrated Methods	Mediation
	Conciliation
Collaborative method	Negotiation

In addition to selecting a suitable PDM for a particular project, it is vital to adopt a contracting method, which is suitable for the project and works well in conjugation with the selected PDM. Gordon (1994) indicated that selecting an appropriate contracting method can reduce the project cost by an average of five percent which further emphasizes the importance of selecting an appropriate contracting method for the project to increase the overall performance.

1.8 Contracts

Contracts can be defined as an agreement between the owner and the contractor, architect, or engineer, which elucidates the terms and conditions on which the owner will pay them for the work performed (Gordon, 1994; Puddicombe, 2009; Tajul & Sutrisna, 2010). There are various types of contracts available in the construction industry, each having its own distinctive merits and demerits. Therefore, it is important to select different contracts based on specific project types and owner requirements (Puddicombe, 2009). Some of the most commonly used contracting methods are traditional lump sum/fixed price contracts, cost plus or cost reimbursable contracts, guaranteed maximum price contracts and target price contracts (D. W. M. Chan, Chan, Lam, & Wong, 2011;

Gordon, 1994). In addition, various authors have discussed relational contracts, which help foster relationship between project stakeholders (S. O. Cheung et al., 2006; Harper & Molenaar, 2014).

1.8.1 Traditional Lump Sum / Fixed Price Contract

Lump sum or Fixed contracts are considered the most commonly used traditional contracting methods (Gordon, 1994). Some of the variations of this contracting method are unit price contract and fixed price with escalation (Nesius, 1998). This type of contract focuses on the end product to determine the payment to be made for the work done (Puddicombe, 2009). It is most suited when a project is well defined in terms of drawings, specifications and cost, therefore reducing the chances of change orders (Nesius, 1998). The reason behind the extensive use of lump sum contracts is attributed to the following (Gordon, 1994; Nesius, 1998):

- They are relatively simple to use and do not involve much complication from the owner's side
- Majority of the risk is transferred to the contractor in this type of contract, therefore ensuring that the project is delivered on time and within an agreed upon budget
- When lump sum contract is used, one should ensure that all the drawings are complete and construction ready before the start of the construction phase of the project. This helps to avoid change orders during the construction phase of the project
- In terms of cost, lump sum contract offers increased competitive bids from various contractors, therefore helping the owner to finish the project in an economical manner
- The level of owner involvement in this type of contract is least, as majority of the risks are transferred to the contractor

However, many authors have indicated various ill effects and disadvantages in using traditional lump sum contracting methods such as (D. W. M. Chan et al., 2011; Ghassemi & Becerik-Gerber, 2011; Gordon, 1994; Nesius, 1998) :

- The traditional contracting approach causes claims and disputes because it positions the stakeholders in adversarial positions during the project.
- Lack of incentives for better performance, limited trust, and lack of common objective towards the project effects the performance of the project
- Design changes cannot be handled well with lump sum type contracts as the prices are fixed and any changes requested by the owner or architect would lead to change orders and sometimes claims and disputes.
- Quality of performance is said to be lesser in lump sum contracts, therefore increasing the percentage of rework
- Though lump sum contract offers the lowest price for the owner to complete the project, this might not be the best overall price of the project. The contractor might quote low price to procure the work and later ask for changes, therefore leading to change orders, claims and disputes
- The design of the project must be fully complete before the start of the construction, therefore increasing the overall time to complete the project from inception to completion
- The level of collaboration between the owners and project stakeholders is very minimal in this type of contract arrangement

1.8.2 Cost reimbursable/ Cost plus contract

In cost plus contracts, the contractor is paid for the actual cost of work, in addition to an agreed upon fee for the completed work (Gordon, 1994; Nesius, 1998; Puddicombe, 2009). There

are numerous variations to this type of contract such as cost plus fixed fees contract, cost plus percentage fee and cost plus an incentive fee. This type of contracting method offers greater partnership between the owner and the contractor in comparison to traditional contracting method. The following are considered as some of the advantages of cost plus contracting method (Nesius, 1998) :

- In this contract type, the owner has greater control over the contractor's records and subsequently on the project in comparison to lump sum contracting
- Claims and disputes are reduced in this type of contract as owners and contractors can issue change orders in a more flexible manner without having legal repercussions unlike lump sum contract
- There is an increased risk sharing between the owner and the contractor, therefore the owner can control the project and reduce costs and schedule delays up to certain extent

However, some of the disadvantages associated with cost plus contracts are the greater amount of change orders (scope creep) from the owners as the contract is not as rigid as lump sum, and the lack of incentives for the contractors to achieving higher cost and schedule control benchmarks (Nesius, 1998).

1.8.3 Guaranteed maximum price contract (GMP) and target cost contract (TCC)

GMP is considered as another alternate to the traditional contracting methods. Over the years, there has been an increased use of this contracting method as it offers advantages such as reduced risks and claims, incentives for improved performance and integration of interests in construction projects (D. W. M. Chan, Chan, Lam, & Wong, 2010). Many authors consider GMP to be a hybrid of cost plus and lump sum contract (D. W. M. Chan et al., 2011; Gordon, 1994). In a GMP contract, the contractor establishes a maximum price within which the project will be

completed. If the cost of the project exceeds the GMP, the contractor is held responsible and bears the financial burden and risk to complete the project. However, if the project is completed within the GMP, then the cost savings can be shared between the owner and the contractor on a mutually agreed upon ratio (D. W. M. Chan et al., 2010, 2011; Puddicombe, 2009).

In addition to GMP, another alternative contracting method like GMP is target cost contract (TCC). This type of contracting presents the best estimate of the cost required to complete the project. However, changes to the initial target cost will be made if there are any specification changes made between the parties through an agreement. Finally, after the completion of the project, any cost savings achieved will be shared between the owner and the contractor similar to GMP contract. However, the difference between GMP and TCC is that cost overruns that occur in the project is also shared between the owner and the contractor (D. W. M. Chan et al., 2010, 2011).

Both GMP and TCC are currently used as an alternative to traditional contracting methods as they offer many advantages which traditional contracting and cost plus contracts cannot offer. The following are some advantages of GMP and TCC contracting methods (D. W. M. Chan et al., 2010, 2011):

- They offer a more viable cost options in terms of target cost or maximum price in comparison to lump sum contracting. In addition, there is mutual sharing of risks between the owner and the contractor as cost savings are shared between them, and in TCC cost overruns are shared as well.
- The quality of projects increases profoundly on using GMP or TCC type of contracting. For example, D. W. M. Chan et al. (2011) states that rework can be reduced by 27% under these types of contracting

- By using GMP/ TCC, claims, conflicts and disputes can be largely decreased due to the increased collaboration between project stakeholders.

Like any other contracting method GMP and TCC have certain drawbacks that must be considered before selecting them for a project. Some of the demerits are (D. W. M. Chan et al., 2010):

- The owners might bear increased risks in this contracting method in comparison to traditional contracting methods
- To cover the risks, the contractor may mark up the GMP price therefore increasing the initial tender price that in turn would increase the overall project cost. This does not happen in TCC as risks are thoroughly shared between the owner and the contractor
- GMP and TCC are not free of claims and disputes like any other contracts. Conflicts pertaining to change orders are a major source of disputes. Change orders that are pertaining to design development must be borne by the contractor, whereas change orders and variations should be borne by the owner.
- It has been observed that since GMP/TCC are not as extensively used as traditional contracting methods, quite often these contracts incur drafting errors during its inception. Therefore, lack of knowledge about these contracting methods is the foremost drawback

The advantages and disadvantages of all the contracting methods, is indicative of the fact that each contracting method have distinctive for and against. Therefore, selection of these contracts should be done with respect to the PDM chosen, the procurement methods, level of collaboration required and the type of project (Puddicombe, 2009).

Looking back at the literature and scholarly research on claims, disputes, PDMs, procurements and contracts one should take note that all the efforts points back to developing systems that foster collaboration and trust. Therefore, these systems/mechanism (e.g. Partnering

and Trust) are addressed in the literature review and subsequently addressed as some of the variables studied in this research to uncover any underlying significant relationships that might directly or indirectly affect project claims and disputes, project and contractor performance, and the overall project success.

1.9 Partnering and Trust in construction

To achieve a successful construction project, it is essential that the various project participants collaborate from the initial design through the handover stages of the project. Since the construction industry participants have been a constant victim of unfair risk allocations. It is vital to increase the level of collaboration between project participants and improve the trust level between them. This process of collaboration between project participants can be dubbed as "partnership".

Partnership can be defined as a way to achieve an optimum relationship between a client and a contractor, thus ensuring that products with quality are delivered within schedule and budget (Wong & Cheung, 2004). Partnering can be achieved through long term or short term agreements between project participants that facilitates the achievement of individual and complementary objectives (Bresnen & Marshall, 2000). Therefore, partnering can be summarized as a process of creating an effective working relationship between project participants in order to avoid adversarial positions during the course of the project (A. P. C. Chan, Chan, & Ho, 2003; Hosseini et al., 2016). Increased communication between project participants, innovation, improved site and project coordination between project participants, cost reduction, value engineering and improved schedule are considered to be some of the advantages of partnering during construction projects (Bresnen & Marshall, 2000; Wong & Cheung, 2004). However, trust is the key element to achieve successful partnership between the project participants.

Trust is a dynamic word and is constantly changing between personnel working on the project, it is either growing or diminishing (Wong & Cheung, 2004). Trust can be defined as a factor that drives performance rather than enforcing it in the predefined agreements (Doloi, 2009; Zuppa, Olbina, & Issa, 2016). In addition, some of the elements of trust are interdependence, positive expectations, confidence, risk, state of mind, etc. (Zuppa et al., 2016). Though there are numerous types of trust such as competence trust, relational trust, institutional trust and integrity trust. The three important types of trust which have significance in the construction industry are competence trust, relational trust and organizational trust (Hasanzadeh, Gad, Nasrollahi, Esmaeili, & Gransberg, 2016; Wong & Cheung, 2004).

These three types of trust have a greater significance in construction because of the impact they have on the project performance, claims performance and design and construction performance (Hasanzadeh et al., 2016). Competence trust is based on the confidence gained from the knowledge of an individual or an organization's cognitive abilities to perform the required work (Hasanzadeh et al., 2016; Wong & Cheung, 2004). Relational trust is vital to improve the communication between the project participants as it helps eliminate friction defensiveness and unhealthy competition. Thus, relational trust help people bond and communicate in the most effective manner. Lastly, organizational trust, is based upon organizational policies, this trust facilitates formal and procedural arrangements (Wong & Cheung, 2004). Hasanzadeh et al. (2016) indicated the impact of trust on the construction projects in terms of improvement on the project performance, frequency and severity of claims and owners' satisfaction. In addition, some of the other advantages affiliated to trust are minimization of perceived risk, improved cooperation and increased communication, which can be achieved through partnering (Zuppa et al., 2016). This

research study will adopt the exact three types of trust introduced by Hasanzadeh et al. (2016) as in the following:

- **Competency trust** is based on the confidence gained from knowledge of an individual or an organization's cognitive abilities. The competence and the integrity of an individual or an organization are based on the knowledge of past performance, reputation, organizational role, and financial status.
- **Organizational trust** is developed through organizational policies and addresses formal and procedural arrangements.
- **Relational trust** is based on emotions that bond people together, thereby improving their performance and morale in a working relationship. This kind of trust enhances information exchange and team spirit, decreases defensiveness and unhealthy competitiveness, and eliminates friction.

1.9.1 Literature Review summary

This literature survey identified the definitions and the different cited causes of conflicts, claims and disputes along with the various ADRs that are used in the construction industry. Similarly, the different PDMs, procurement methods, and contract types have been identified along with the level of collaboration between the various project stakeholders. Upon the collaboration concepts and fundamentals, the literature review included the concepts of partnering and trust in construction. It was concluded from the literature that the performance of the project in terms of claims, disputes, cost and schedule largely depends on the PDM chosen, the method used to procure the project team, and the method of payment chosen (contract type). Several authors have researched the performance of projects under various procurement types, PDMs or contract types (Alleman et al., 2017; D. W. M. Chan et al., 2011; S. O. Cheung et al., 2006; El Wardani et al.,

2006; Eriksson & Westerberg, 2011; Gad et al., 2015; Harper & Molenaar, 2014; Hinchey, 2012; Ibbs et al., 2003; Mante et al., 2012; Shrestha et al., 2011; Tajul & Sutrisna, 2010). However, none have considered the performance of projects in terms of claims and disputes considering all three variables, i.e. procurement, PDMs and contracts. The construction industry, though very much focused on quantitative results, has failed to provide substantial results in terms of conflicts, claims and dispute as it relates to various project delivery methods (McGeorge et al., 2007). The alternate project delivery methods are meant to instigate collaboration and partnership between the various stakeholders of the project, however there is no abundant research regarding the conflicts, claims and disputes caused in each PDM. This shows that there is an immediate need for research to understand conflicts, claims and disputes in various PDMs in conjugation with the type of procurement method and the contract type used on projects along with the other variables that was identified in the literature survey and can affect the project collaboration dynamics e.g. partnering and trust. Therefore, justifying the importance of answering the aforementioned research questions and the research objectives.

Chapter 3 - Research Methodology

This Chapter will discuss the research methods adopted to answer the research questions and achieve the research objectives. It will also define the research sample and the data collection tools that were used in conducting the research. Finally, it will address the analytical methods used in obtaining the research methods.

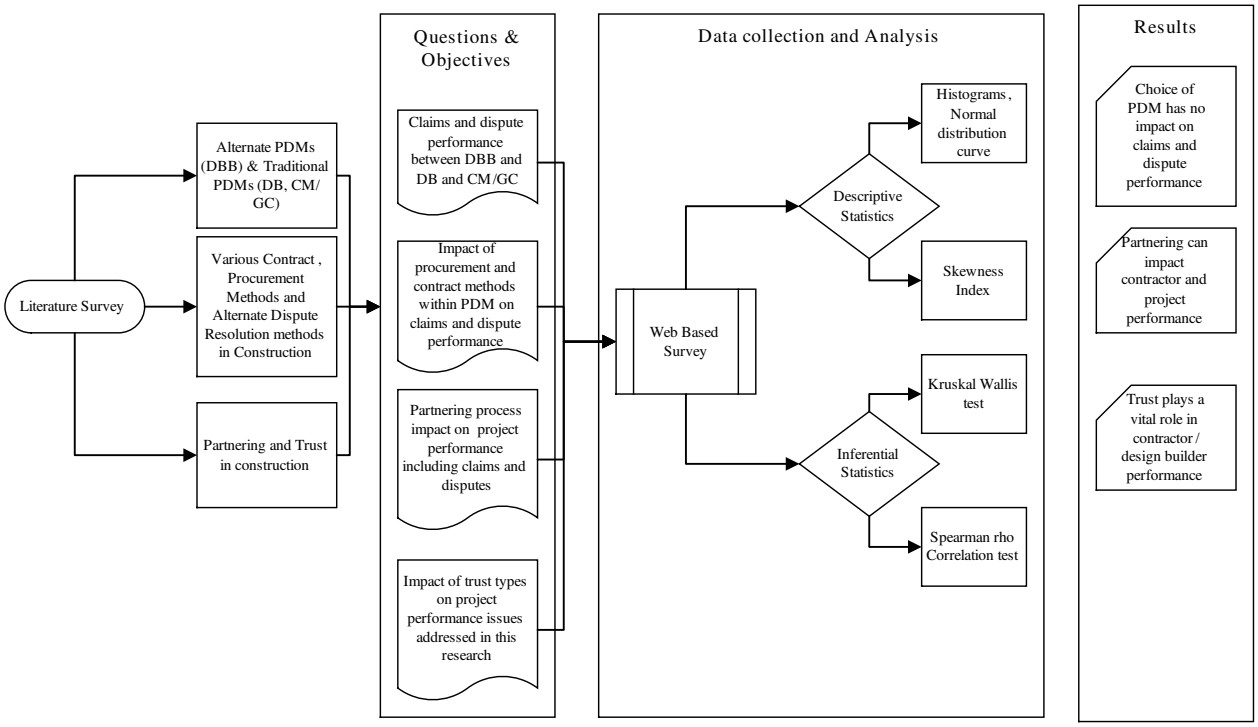

Figure 3: Research Methodology Flow Chart

1.10 Overview

Figure 3 visualize the overall research flow and methodology. The literature review gave a good understanding of what has been researched and the gaps that needs to be filled in future research work. Therefore, based on the findings from the literature review the problem statements,

the research hypothesis and the research questions were identified, and several research objectives were formulated to answer those research questions.

To test the hypothesis and achieve the objective set forth, data is collected and statistically analyzed. As indicated in the data collection and analysis section in figure 3, a web-based survey was utilized to collect quantitative data for this research and were analyzed using descriptive and inferential quantitative statistical analysis. The descriptive statistics included histograms, normality curves and skewness of the data sample and the inferential statistics included Kruskal Wallis tests and Spearman rho correlation tests. Based on the data collected and then analyzed, the expected results will address the impact that the choice of PDM has on the claims and dispute performance. In addition to this, the impact partnering might have on the contractor and project performance and finally, the important role that trust plays in impacting the contractor and design builder performance.

1.11 Methodology – Research type and Methodology Selection

A quantitative research methodology (survey design) is adopted to provide a quantitative or numeric description of trends, attitudes or opinions of the construction industry, by studying a sample of the population (Creswell, 2013). Therefore, the survey instrument is used as a data collection tool to provide quantitative description of trends of the entire population by studying a sample of the population (Creswell, 2013; Fowler Jr & Cosenza, 2009). The other method of data collection that can provide opinions of the population by studying a small sample is interview-based questionnaire survey, which is a qualitative research methodology. However, this type of research methodology is not selected, because, this research aims to collect quantifiable data pertaining to projects and not just the opinions of the project participants. Therefore, a quantitative research method was used in this research to provide quantitative results pertaining to the subject

matter since, simple opinions will not be a sufficient evidence for this research's matter and pursued objectives.

The objective of this study is to empirically investigate the debated different variables that impact claims and disputes in different projects and specifically the different kinds of PDMs. However, the research's systematic literature review suggests that PDMs, contracts and procurement methods alone cannot be the only driver behind claims and disputes occurrences. Instead, several factors discovered through the research literature review stage urge the need to explore several possible variables that can affect the different projects performance measures to produce a more holistic approach and research results. These variables include partnering, organizational (owner) satisfaction, change orders, contractor or design/builder performance, trust between stakeholders (mainly the owner and contractor or design/builder) and the overall project performance. Every one of these variables will be measured in a specific metric and the data is collected based on the metrics used to measure the variable. All the research variables and their metrics are listed as in table 4.

Table 4: Variables and their metrics

Variable	**Metrics Explored**
Project Delivery Method	DBB, DB and CMGC
Procurement Method	Open Bid, Prequalification, 1 Stage RFP, 2 Stage RFP, Sole Source
Contract Type	Lump sum, Unit Price, GMP
Partnering	Partnering agreements
Overall Satisfaction	Design Process, Construction process, Overall project success
Claims	Frequency, Severity, Cost impacts, Time impacts

Types of Claims	Contractual, Differing Site Conditions, Acceleration, Damage, Liability, Unforeseen Conditions
Change Orders	Occurrences, responsible party, Schedule impact, Cost impact
DRM	Types used
Contractor/Design-Builder Performance	Upper management effectiveness in support and responses, experience with this type of project, individual competence, Quality of the input shared during pre-con. phase, financial plan adequacy, team's prior experience as a unit, team communication, information sharing, risk identification and allocation, and adequacy of plans and specs produced.
Trust between the stakeholders	Competency trust, Organizational trust and Relational trust
Overall project performance	Cost and Schedule growth

1.11.1 Data collection tool - Web based Survey

This research will use a survey questionnaire as the data collection tool. Several researchers have successfully used survey questionnaires as reliable data collection tool for research relating to claims, disputes, and PDMs (Al-Dubaisi, 2000; Hasanzadeh et al., 2016; Hashem M. Mehany & Grigg, 2014; Maharjan, 2013; H. M. Mehany, 2014). Therefore, indicating that valid and reliable data can be obtained using this tool. There are two types of survey questionnaires that can be used to collect data, web based and paper-based survey; this research will be adopting a web-based survey, since it is reported to achieve higher completion rates than paper based (Denscombe, 2006). In addition, the survey research will be cross sectional and not longitudinal as the data will

be collected from each respondent once and at one point of time only, which is typical of cross sectional survey. Furthermore, the data collected through the survey will not last over a long period of time on multiple occasions which is typical of longitudinal survey (Creswell, 2013). Thus, indicating that the survey is cross sectional in nature. Qualtrics was selected as an online survey development portal platform that was used to develop the survey instrument. A five-point Likert scale from one (low) to five (high) was used for numerous questions to obtain project specific data, and some questions were used to obtain the opinions of the survey participants. In addition, a simple yes/no type questions with ordered choices were adopted for questions such as: occurrence of claims or disputes on projects.

Informed by the research literature review and due to the numerous variables included in this research study, the survey was divided into 5 different sections that captures all the required data (metrics) for every variable. The sections of the survey are as in the following:

- First Section: The first section of the survey instrument consisted of questions on project and respondents' demographic information such as project type, location, organization and years of experience. Since this section relates to questions pertaining to years of experience, position and other demographic information, it supports the validation process of the instrument as well (Lucko & Rojas, 2009).
- Second Section: The second section addressed the "project organization and overall assessment". This section included the type of PDM, procurement and contract used in the project along with the overall stakeholder satisfaction metric for the different stages/processes (Design, Construction) along with the overall project success.
- Third Section: The third section of the instrument contains questions pertaining to claims, disputes and change orders.

- Fourth Section: Section four poses questions about the team behavior and communication, partnering process, the type of DRMs used on project, the trust between stakeholders and the overall project performance.
- Fifth Section: Finally, the fifth section of the survey instrument primarily contains questions regarding the project performance in terms of the cost and schedule growth in the project in order to help to identify the overall performance of each project. The complete version of the survey instrument is in Appendix A.

1.11.2 Pilot testing

Pilot testing of survey instruments helps in validating the content of the instrument (content validity) (Carpenter, 2014). Therefore, the initial draft of the survey questionnaire was examined as a pretest that was pilot tested by 3 measurement experts. The feedback from the experts was incorporated into the final draft, along with other modifications for relevance and representativeness. The purpose of the pilot survey was to determine the ease of answering the questionnaire and the effectiveness of the survey design. In order to avoid bias and data corruption, the data collected from the survey was not utilized in the actual study (Carpenter, 2014).

1.11.3 Validity

It is essential to test the internal reliability and validity of the instrument to collect high quality data. Therefore, questions in section five of the survey instrument were used to cross check, if the participants have provided appropriate information. This helped in increasing the internal reliability of the survey instrument and improve the consistency of the answers/information provided through the survey instrument.

The research was externally validated by reviewing the scope of the research, which was established at the start of the research, e.g., the region and the sector of the industry to which results

are applicable. Therefore, based on the range of data obtained, i.e. population type and population size, the limitation of the research is established, thus externally validating the research.

1.11.3.1.1 Population Sample selection

State Departments of transportation (DOTs) and private companies were chosen as the target population for this research. The data was obtained through target sampling to ensure that the survey participants have projects that are either of the three PDMs (DB, DBB or CM/GC). The questionnaire survey was posted on the Qualtrics platform, and the link of the survey was sent to the targeted population via email. The contact information of the targeted population in various DOTs was obtained through my research committee members, faculty, industry contacts and online official websites of the DOTs.

The survey questionnaire was distributed to the different DOTs (about 40 with limitations) around the country and other organizations working on public (federal/state funded) projects except for the three privately funded projects. The respondents were asked to fill the survey using different DOTs and other public projects, with the purpose of collecting projects executed under different PDMs, contracts, and procurement methods along with other variations. At the completion of the survey, 40 different projects were collected; 18 DBB, 12 DB, 6 CMGC/CMAR, 3 Integrated project deliveries and 1 project which was designated as other with different procurement and contracting methods.

However, after using the aforementioned techniques of data collection methods, the data collection procedure was extremely difficult and required several follow up calls since most of the respondents were very reluctant to give such specific project data which affected the sample size for the study and consequently influenced the statistical analysis choices for this research. This will be revisited in the conclusion section as part of the research conclusive points.

1.11.4 Analytical Methods and Techniques

1.11.4.1 Descriptive Statistics

The data analysis used both descriptive and inferential statistics. The descriptive statistics were used to understand the overall data trends, variability and simple comparisons in addition to identifying frequency of occurrences e.g. specific type of claims or partnering methods. The inferential statistics were conducted to further investigate the descriptive insights by comparing or relating the different variables (Creswell, 2013). The descriptive statistics was also used to test the normality of the variables using the histograms and distribution curve diagrams to identify the skewness of the variables. The detailed descriptive statistics for all ordinal variables vs normality as enclosed in Appendix B indicates that the variables are skewed, and the histograms indicated that the variables do not conform to a normal distribution as shown in figure 4, therefore inferring that most of the variables are not normally distributed. The SPSS program was used as the statistical software of choice in this study, both inferential and descriptive statistics were conducted using SPSS.

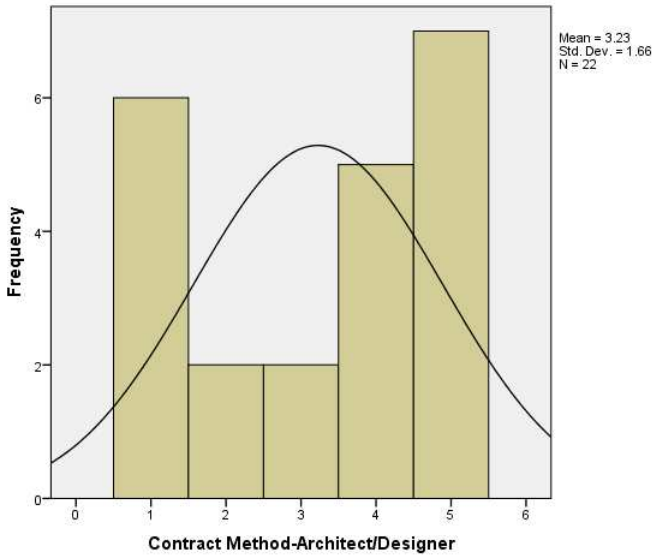

Figure 4: Example of variables being skewed

1.11.4.2 Inferential Statistics

1.11.4.2.1 Kruskal Wallis Test

Since the variables were not normally distributed and most of the variables were skewed, it is prudent to conduct non-parametric tests, therefore the Kruskal-Wallis (K-W) test was selected as the preferred inferential statistical analysis method instead of parametric ANOVA or t-tests (Kwan, Sutan, & Hashim, 2018; Leech, Barrett, & Morgan, 2012; Sathyanarayanan Rajendran, Gambatese, & Behm, 2009). In addition, the following characteristics of the variables found in this research fits the K-W test selection for the data analysis:

- There are more than 1 independent variables
- There are more than 1 dependent variables
- The independent variable are categorical scales (nominal / ordinal)
- The dependent variables are continuous scales (interval / ratio) which were converted to categorical scales

The Kruskal-Wallis can be used for non-normal variables with relatively small categorical sample sizes. It compares the overall population distribution for any number of groups. To interpret the (K-W) test output, the Chi-square's degree of freedom is reported after it is corrected for ties. If the value of p is less than 0.05 and 0.01, then there is a significant and partially significant difference between groups (Kruskal & Wallis, 1952; Morgan, Leech, Gloeckner, & Barrett, 2012). Since there were numerous "ties" in the data (observations with the same number of incidents), a chi-square approximation was used to calculate the p-value (Schumacker, 2015). Since K-W does not have a built-in post hoc tests, a Post-hoc analyses was conducted on significant groupings using pairwise Mann-Whitney (M-W) tests with a Bonferroni adjustment/correction as enclosed in

Appendix D. Since there were multiple comparisons in this data set, the Bonferroni correction kept the Type 1 error probability controlled.

1.11.4.2.2 Spearman Correlation Test

In addition to the K-W test, Spearman correlation was selected as the other inferential statistical analysis method for the different variables and metrics. The Spearman correlation test were conducted to determine the association/correlation between the variables. Spearman correlation was selected since the variables are not normally distributed and are ordinal in nature (Morgan et al., 2012). The following conditions found in this research study fits the Spearman rank – order correlation selection for the data correlational analysis:

- There is one independent variable which can be compared with one or more dependable variables. Therefore, series of independent variables were analyzed against dependent variables
- The independent and dependent variables are in categorical scales

Chapter 4 – Results

This chapter presents the results for the data analysis. The chapter will explain and demonstrate the different descriptive statistical results in the forms of frequency and trend charts while tabulating and explaining the statistically significant results from the inferential statistical analysis (Kruskal Wallis, Spearman correlation analysis).

1.12 Descriptive Analysis results

The descriptive results reported most of the claims to be contractual claims specifically related to the insufficient or defective plans or specifications followed by damage claims (liquidated damages for late performance) as shown in figure 5. All claim parameters (frequency, cost and time severity) did not show superiority of the alternative PDMs over the traditional DBB.

The results also showed a more frequent use of formal partnering agreements in DB and CMGC over DBB as shown in figure 6, with the contractually required and kickoff facilitated forms of partnering as the most commonly used partnering processes as shown in figure 7 respectively. The results also reported a higher number of change order occurrences in DB and DBB than CMGC as shown in figure 9. Finally, the descriptive results showed the highest overall (average) trust level (competent, organizational and relationship trust) in CMGC, followed by DB and DBB PDMs in descending order as shown in Figure 8. Based on the observations and figures, the underlying tendencies of the descriptive results did not show any apparent relationship between PDMs, procurement processes and contractual options and their effect on claims frequency or severity. However, other variables such as trust showed a consistent higher scores/values in certain PDMs over the others which warranted the importance of its inclusion as a tested variable in the

inferential statistical data analysis. Therefore, further inferential examination is required to test the statistical significance of the different metrics in the form of dependent and independent variables.

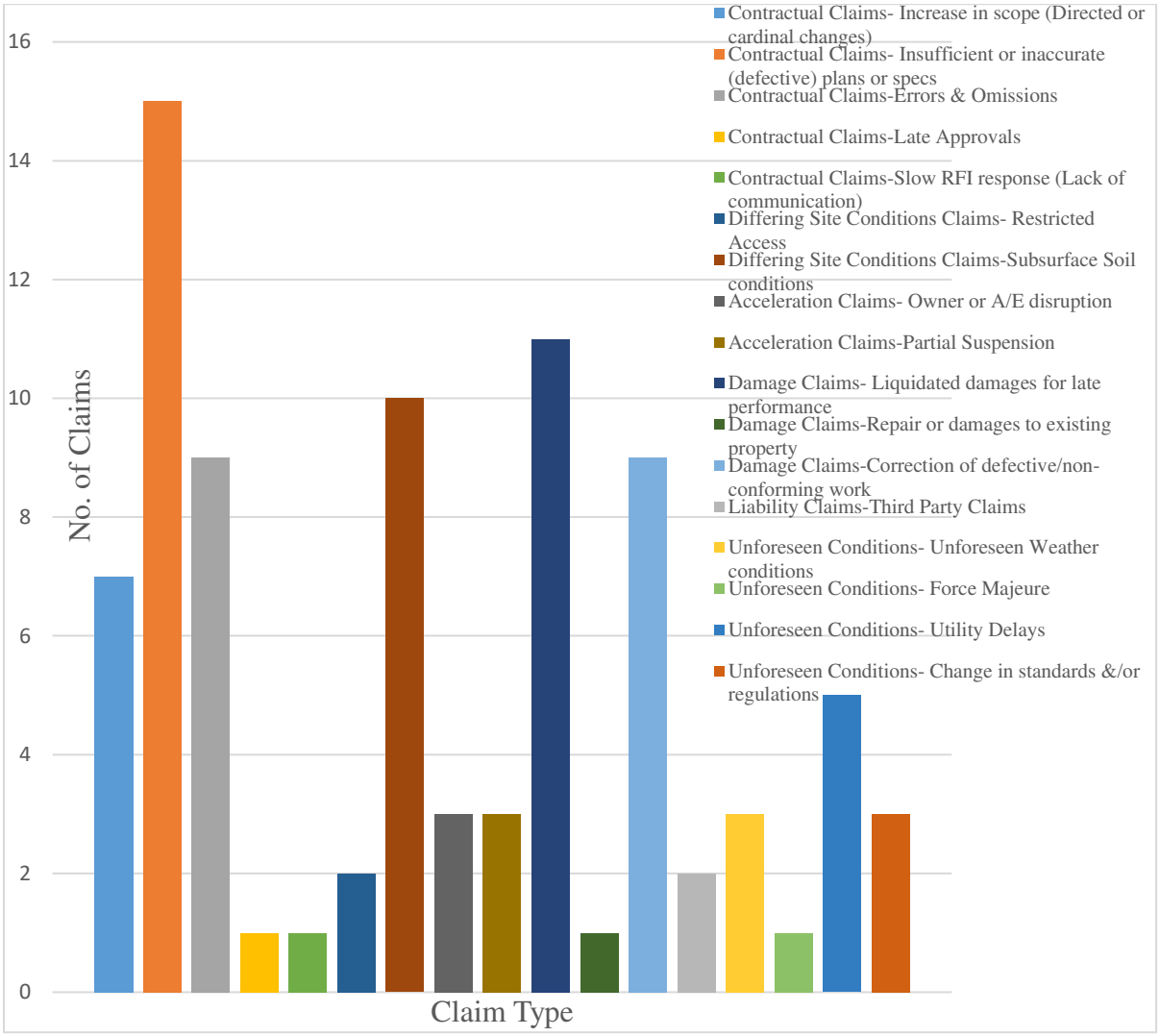

Figure 5: Number of claims based on types of claims

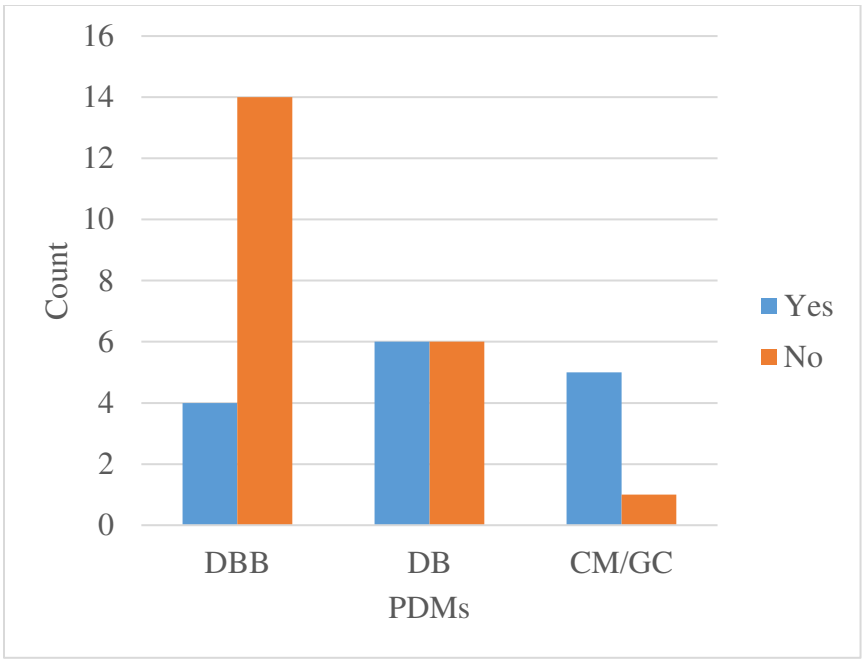

Figure 6: Formal Partnering trend per PDM type

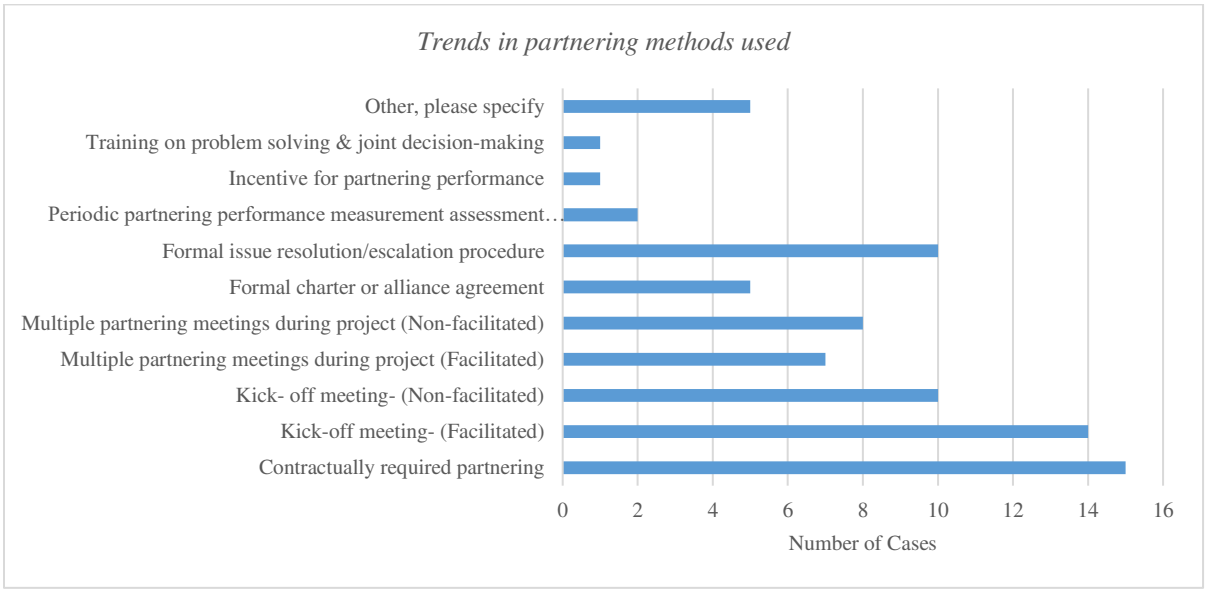

Figure 7: Trends in partnering methods used

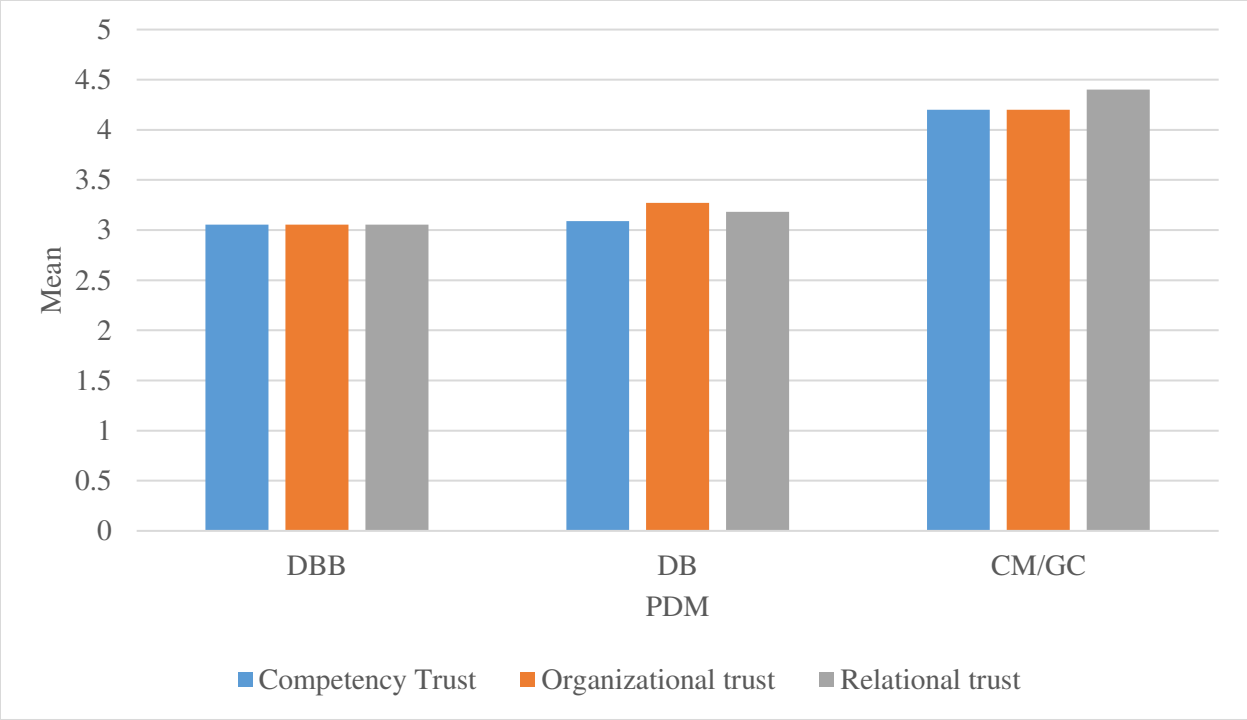

Figure 8:Average stakeholders trust score per PDM

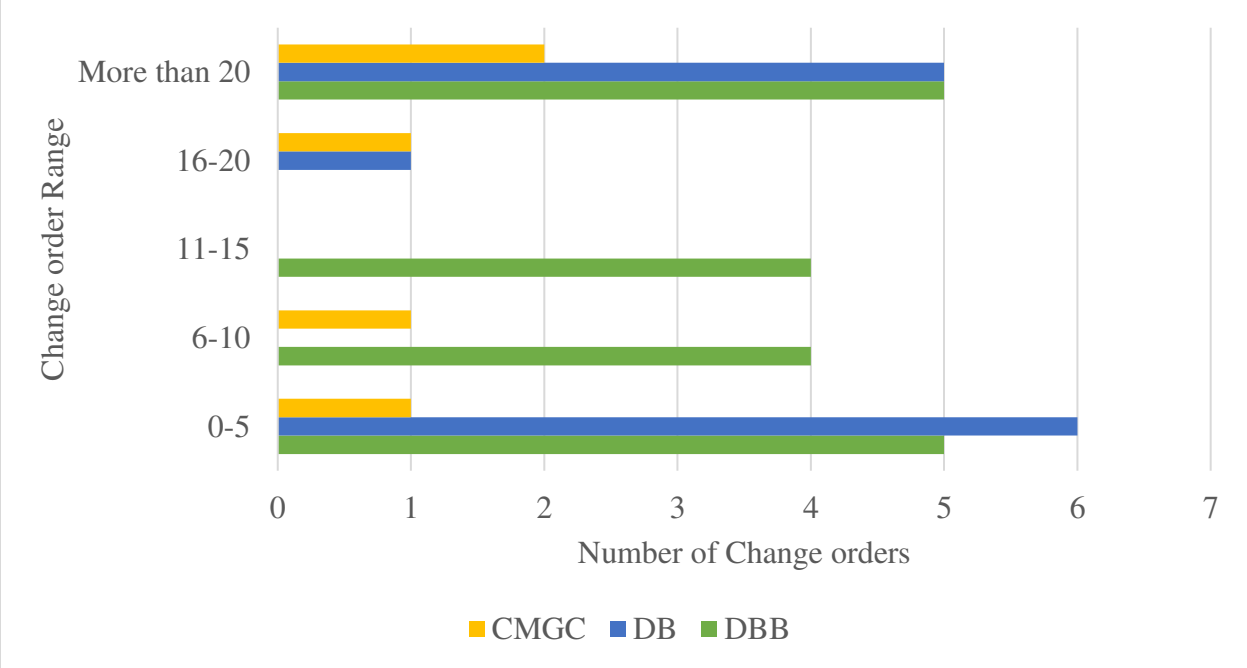

Figure 9: Range of Change Order occurrence based on type of PDM.

1.13 Inferential Statistics results

As stated in the methodology section, Kruskal-Wallis test was used to measure the impact of the different values of the variables and Spearman correlation test was used to observe any association/correlation between the different variables. The following combination of independent and dependent variables presented in table 5 were used in the analysis.

Table 5: Dependent and Independent variables

Independent Variable	**Dependent Variables**
PDMs type	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Stakeholder's trust and Project performance
Procurement Method	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Stakeholder's trust and Project performance
Contract types	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Stakeholder's trust and Project performance
Partnering	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Stakeholder's trust and Project performance
Change Orders	Claims, Overall satisfaction, Contractor/D-Builder performance, Stakeholder's trust and Project performance

Competency trust	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Partnering, Stakeholder's trust (the 2 other types) and Project performance
Organizational trust	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Partnering, Stakeholder's trust (the 2 other types) and Project performance
Relational trust	Claims, Overall satisfaction, Change orders, Contractor/D-Builder performance, Partnering, Stakeholder's trust (the 2 other types) and Project performance

Based on the above executed combinations of the test, there have been several statistically significant differences between the different variables tested. For instance, the Kruskal-Wallis analysis indicated that relational trust had a significant impact on the overall satisfaction in the construction process ($\chi 2$= 18.83, N=34), p – value = 0.001 < 0.01, frequency of claims which arouse on the field level ($\chi 2$= 10.54, N=34), p – value 0.032 < 0.05, severity of claims which arouse on the projects ($\chi 2$= 10.55, N=34), p – value 0.032 < 0.05 and the competence level of contractor's project individuals ($\chi 2$= 16.66, N=34), p – value 0.002 < 0.01. This means that projects which build a good relational trust between project participants with competent contractors have increased construction process satisfaction, experience lesser frequency of claims on field level, and encounter fewer disputes on projects. In addition, K-W test indicated that partnering variance differed significantly on risk identification and allocation (performance factor), (χ^2 =3.847, N=36), p - value <= 0.05, this substantiate that projects where partnering agreements are executed experience better performance in risk identification and allocation. The statistical significant relationships between various variables per the K-W test are reported in table 6 below.

Table 6: Statistically significant relationships, Kruskal-Wallis test

Independent Variable	**Dependent Variable**	**$\chi 2$**	**p-value**
Project Delivery Method	Overall Satisfaction- Construction Process	8.212	0.042*
	Unforeseen Conditions - Change in standards &/or regulations	11.523	0.003**
	Contractors', organization experience with this type of project	8.242	0.041*
	Experience and competence level of contractor's project individuals	9.088	0.028*
	Formality of communication among team members	8.085	0.044*
	Electronics file & information sharing used by project team	8.884	0.031*
	Risks identification and allocation	11.053	0.011*
	Adequacy of technical plans/specs	13.022	0.005**
	Relational trust	9.144	0.027*
Partnering	Risks identification and allocation	3.847	0.050*
Change Orders	Project in a state of Litigation (Yes/No)	4.218	0.040*
Competency Trust	Overall Satisfaction- Construction Process	11.758	0.019**
	Experience- Severity of claims which arose on project (in terms of TIME to resolve)	10.414	0.034*

	Unforeseen Conditions - Unforeseen Weather conditions	11.560	0.021*
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	19.572	0.001**
	Contractors', organization experience with this type of project	13.797	0.008**
	Quality of the input shared during pre-construction phase of project	12.375	0.015**
	Formality of communication among team members	15.737	0.003**
	Risks identification and allocation	10.024	0.040*
	Adequacy of technical plans/specs	10.421	0.034*
	Timeliness of communication	9.892	0.042*
Organizational trust	Experience- Frequency of claims which arouse at the field level	10.179	0.038*
	Project in a state of Litigation (Yes/No)	12.183	0.016*
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	12.449	0.014*
	Experience and competence level of contractor's project individuals	11.829	0.019*

	Level of experience and effort of financial planners, and adequacy of financial plan	12.312	0.015*
	Timeliness of communication	16.303	0.003**
	Electronics file & information sharing used by project team	13.914	0.008**
	Risks identification and allocation	11.457	0.022*
	Adequacy of technical plans/specs	18.155	0.001**
Relational Trust	Overall Satisfaction- Design Process	11.617	0.020*
	Overall Satisfaction- Construction Process	18.833	0.001**
	Overall Satisfaction- Overall success of this project	14.118	0.007**
	Experience- Frequency of claims which arouse at the field level	10.541	0.032*
	Experience- Severity of claims which arose on project (in terms of TIME to resolve)	14.014	0.007**
	Experience-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	10.554	0.031*
	Has the project ever been in a form of dispute or dispute resolution?	10.760	0.029*
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	11.826	0.019*

	Contractors', organization experience with this type of project	9.632	0.047*
	Experience and competence level of contractor's project individuals	16.656	0.002**
	What was the percentage of schedule growth?	11.952	0.018*
	Formal partnering agreement in the project? (Yes/No)	11.275	0.024*

* $p < 0.05$ and ** $p < 0.01$

On determining the variables which are significant through K-W test, a post hoc analysis was conducted using the M-W test for these significant variables. On conducting this test, only relational trust (independent variable) showed significance (p - value <0.017) with various variables in comparison to other independent variables. It is important to note that variables having a significance less than 0.017 have only been considered and reported. Since the M-W test is a post hoc analysis, the significance level is set by dividing 0.05 by 3 which is a Bonferroni correction (Morgan et al., 2012), thus giving us the value 0.017. The Mean ranks and the effect size of each variable related to relational trust per the M-W test is as shown in table 7. On conducting the M-W test in the SPSS, only the values of N, means ranks, sum of ranks and z are displayed; the r values are calculated by using the conversion formula $r = z/\sqrt{N}$. On calculating values of r, the interpretation of the strength of a relationship (effect sizes) table by (Cohen, 1988) was utilized to determine the effect sizes (Morgan et al., 2012). Tables 6 and 7 are reporting only the statistically significant relationships for Kruskal Wallis and Mann-Whitney tests while all the results are enclosed as in Appendices C and D respectively.

Table 7: Reporting post-hoc mean ranks using M-W analysis for relational trust

	Relational-trust-	N	Mean Rank	Sum of Ranks	z	r	Effect Sizes
Overall Satisfaction-Construction Process	Low	3	2.00	6.00	-2.449	-0.8165	Much larger than typical
	High	6	6.50	39.00			
	Total	9					
Experience-Frequency of claims which arouse at the field level	Low	3	8.00	24.00	-2.546	-0.84853	Much larger than typical
	High	6	3.50	21.00			
	Total	9					
Experience-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	Low	3	8.00	24.00	-2.449	-0.8165	Much larger than typical
	High	6	3.50	21.00			
	Total	9					
Experience and competence level of contractor's project individuals	Low	3	2.00	6.00	-2.558	-0.8528	Much larger than typical
	High	6	6.50	39.00			
	Total	9					

For the correlation analysis, Spearman Correlation test was conducted to identify the statistically significant associations between the different variables. Upon conducting this test, several statistically significant variables were identified which are vital to this study. For example, the project delivery method chosen on the projects had a significant correlation/association on the overall satisfaction in the construction process ($r(36) = 0.421$, $p = 0.008 < 0.01$). However, using Cohen's (1988) guidelines, the effect size based on the r score is only medium or typical for studies in this area which doesn't indicate a very strong relationship. Another result that supports the K-W findings was the relational trust's correlation/association with the overall satisfaction in the construction process ($r(36) = 0.581$, $p = 0.001 < 0.01$). The direction of correlation between the relational trust and the overall satisfaction in the construction process is positive therefore, indicating that better and higher relational trust levels can increase the overall satisfaction of the construction process (along with overall performance) which is vital to the success of the project. Using the Cohen's (1988) guidelines, the effect size is large or larger than typical for studies in this area which indicates a very strong relationship. Similarly, all the variables were tested, and all the significant relationships were reported as shown in table 8.

Table 8: Statistically significant relationships, Spearman rho correlation test

Independent Variable	Dependent Variable	r	r^2	p-value
Project Delivery Method	Contractual Claims - Increase in scope (Directed or cardinal changes)	-0.485*	0.24	0.049
	Damage Claims - Correction of defective/non-conforming work	-.537*	0.29	0.026
	Overall Satisfaction- Construction Process	.421**	0.18	0.008

	Relational trust	.331*	0.11	0.045
Competency Trust	Overall Satisfaction- Construction Process	.666**	0.44	0.000
	Overall Satisfaction- Overall success of this project	.455*	0.21	0.013
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	.703**	0.49	0.000
	Contractors', organization experience with this type of project	.582**	0.34	0.001
	Experience and competence level of contractor's project individuals	.780**	0.61	0.000
	Quality of the input shared during pre-construction phase of project	.555**	0.31	0.002
	Level of experience and effort of financial planners, and adequacy of financial plan	.446*	0.20	0.015
	Formality of communication among team members	.572**	0.33	0.001
Organizational Trust	Overall Satisfaction- Construction Process	.486**	0.24	0.008
	Has the project ever been in a form of dispute resolution, such as litigation?	.457*	0.21	0.013
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	.630**	0.40	0.000

	Contractors', organization experience with this type of project	.433*	0.19	0.019
	Experience and competence level of contractor's project individuals	.561**	0.31	0.002
	Quality of the input shared during pre-construction phase of project	.368*	0.14	0.050
	Level of experience and effort of financial planners, and adequacy of financial plan	.460*	0.21	0.012
	Formality of communication among team members	.574**	0.33	0.001
	Electronics file & information sharing used by project team	.556**	0.31	0.002
	Adequacy of technical plans/specs	.375*	0.14	0.045
Relational Trust	Overall Satisfaction- Construction Process	.581**	0.34	0.001
	Contractors' upper managerial support and responses (Effectiveness in responding and support)	.508**	0.26	0.005
	Contractors', organization experience with this type of project	.485**	0.24	0.008
	Experience and competence level of contractor's project individuals	.633**	0.4	0.000
	Formality of communication among team members	.459*	0.21	0.012

* $p < 0.05$ and

** $p < 0.01$

Similar to the reporting process for K.W and M-W tests, Tables 8 is only reporting the statistically significant relationships for Spearman Rho correlation test while all the results are enclosed as in Appendices E.

Chapter 5 - Discussion and Conclusion

1.14 Discussion

Though using K-W test and Spearman Rho was a suitable statistical analysis for the sample size obtained in this difficult data collection phase, the results cannot be ultimately generalized. Using the combination of descriptive and inferential statistics, this research study examined and uncovered very beneficial results that will serve the purpose of this scientific research efforts and for the development of major innovations and further research in this topic.

According to the reported results, the PDMs, procurement and contractual methods do not have any statistically significant impact/difference on the claims frequency or severity. An observation that can easily relate to the earlier studied literature which mostly confirmed that it was either explanatory claims or personal opinions (Hasanzadeh, Esmaeili, Nasrollahi, Gad Ghada, & Gransberg Douglas, 2018; Ndekugri & Turner, 1994). This can also be attributed to the fact that conflicts, claims and disputes are very situational in nature and are affected by more than one, two or three variables. However, the results show that PDM selection can affect the design and construction overall success in terms of stakeholder's satisfaction, the contractor performance and the competency and relational trust between the stakeholders. In addition, the Spearman Correlation analysis showed significant, yet weak association between the PDM chosen and the contractual claims such as increase in scope (directed or cardinal changes) and a significantly strong association to damage claims such as correction of defective/non-conforming work which can be attributed to the liability shift under DB projects. Thus, the Architecture, Engineering, and Construction (AEC) industry should be looking closely in developing more tools that facilitates

the PDM selection based on each project's uniqueness in scope, owner's priorities and much more. In other words, customer satisfaction and priorities, contractor anticipated performance levels and perceived trust should be considered as inputs in PDM selection models. From the inferential statistics (K-W test), it can be also concluded that partnering can greatly affect the contractor and project performance in terms of risk identification and allocation. Hence, partnering can indirectly have a great effect on claims and disputes due to the fact that "unclear allocation of risks" have been reported to be some of the most common reasons for claims and disputes in the literature (Kumaraswamy, 1997; Price & Chahal, 2006). Finally, it is undoubtedly important to understand the effect of "Trust" on the contractor/Design-Builder performance. An observation that should garner a considerable research effort in pursuing the issue of fostering trust between the different stakeholders. Particularly, owners, contractors, Design-Builders alike should put forth a considerable effort in building competence, organizational and relational trust to improve the overall project performance and operations and consequently claims and disputes probability will go down in such a project.

1.15 Conclusion

The current study intended to empirically investigate: (1) the impact of the different PDMs, procurement and contract methods on the claims and dispute performance (frequency and severity); (2) the impact of the partnering process and stakeholders on any of the project performance issues including claims and disputes or their causes; and (3) more importantly, determine if there are any observational trends that can help in reducing claims and disputes and improve the overall project performance. The data was collected using a web-based survey questionnaire that was distributed to state DOTs and other organizations working on public and private projects and later analyzed using descriptive and inferential statistics. Based on the

analysis, the hypothesis was rejected. The analysis also showed several other significant relationship and differences between the different variables as explained in detail in the research discussion. Nevertheless, some of the major contributions of this study can be concluded as in the following. First, the complexity of claims is beyond a certain PDM, procurement or contractual method because of its circumstantial nature and the involvement of the unpredicted human factors. Even if the hypothesis was proven true, it would have been just a useless statistical value since it is not feasible to use a specific PDM based on a single statistic to reduce claims and disputes. In other words, it is almost impossible to identify a PDM, procurement and/or a contract to serve as the magic formula to reduce claims and disputes in all projects. Instead, research should be focused on developing a more comprehensive model for PDM selection that address some of the human factors (e.g. owner priorities, experiences and collaboration readiness), along with more case studies to identify the reasons or predictors that leads to certain circumstances. Second, based on the "Trust" variables discussion results, research efforts should be directed towards finding the different mechanisms that can foster a trusting environment between stakeholders. Hence, increasing the contractor/Design-Builder and the overall project performance/success in many areas such as upper management responsiveness and support, quality of shared input during the preconstruction phase and risk identification, all of which are indirect causes towards a project with less conflicts, claims and disputes. Finally, more spotlight should be shed on the partnering agreements and its evolution into a more structured tool that help in a better risk identification and allocation process between the stakeholder which will help in reducing the probability of claims and disputes as well. It is also worthy to note that significant efforts are needed to establish easier and more accessible data collection protocols for claims and disputes data, especially within the public-sector domain, to benefit the future studies in this research domain.

1.16 Limitations

As mentioned earlier, the data collection process for this research was tedious, because the targeted sample were very reluctant to share sensitive data regarding claims and disputes on their projects. This research also focused on projects using only three PDMs i.e. DBB, DB and CM/GC. Thus, considering that only three PDMs have been studied, the results and findings of this research are limited only to the three PDMs. However, future research looking to compare PDMs performance should consider IPD and multi-prime PDMs along with DB, DBB and CM/GC.

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Appendix A – Survey Questionnaire (Qualtrics format)

Introduction

You have been asked to participate in a research study. It is important that you read and understand the following explanations of the procedures involved before you agree to participate. If you have any questions, please feel free to ask the investigator. Contact Info: Gautham Bashettiyavar- (970)-825-3398.

Purpose

The purpose of this research is to determine the claims and dispute performance of various project delivery methods i.e. design-bid-build, design-build and construction manager/ general contractor in the construction industry.

Procedures and Length of Participation

If you agree to participate in this study, you will be asked to complete a survey questionnaire. The survey questionnaire will be related to the detail of the projects that you have been a part of and your view and opinions of the project. The survey will last approximately for 15minutes.

Risks

There are no known risks to you as a result of participating in this study. This study has been reviewed and approved by Colorado State University, Institutional Review Board (IRB). The current survey is completely voluntary and participants have the choice to not answer a particular question if he/she does not wish to do so. Since no identifiable information is collected from the participants the survey is anonymous. You may decline to answer any or all questions and you

may terminate your involvement any time if you choose.

Benefits

It is expected that this study will help identify which among the three project delivery methods i.e. design bid build, design-build and construction manager/general contractor have lesser claims and disputes. The results of the research will be shared with the participants of the research.

Consent to Participate

I have read and understood the information in this form. I have been encouraged to ask questions and all of my questions have been answered to my satisfaction. By answering the questions, I agree to participate in this study. I understand that I can request a copy of this research for my own records. If you have concerns or complaints about the research, please contact Gautham Bashettiyavar gauthamb@colostate.edu or (970) 825-3398 or Dr. Mohammed Hashem M. Mehany at MSH@colostate.edu (970) 491-7963

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2 What is the state of your employment in the USA?

_____

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3 What type of organization are you employed by

- ○ State Department of Transportation (1)
- ○ Another public transportation agency; Name of Agency (2) _____
- ○ Federal Agency; Name of Agency: (3) _____
- ○ Private Sector (4)
- ○ Other; Please describe (5) _____

4 What group/section do you work in?

- ○ Design group/ section (1)
- ○ Construction group/ section (2)
- ○ Operations group/ section (3)
- ○ Maintenance group/ section (4)
- ○ Alternative project delivery group/ section (5)
- ○ Materials group/ section (6)
- ○ Contracts/ procurement group/ section (7)
- ○ Other, please specify: (8) _____

5 Years of experience in construction industry:

- ○ 1 to 5 (1)
- ○ 6 to 10 (2)
- ○ 11 to 15 (3)
- ○ 16 to 20 (4)
- ○ 21 to 25 (5)
- ○ 26 to 30 (6)
- ○ Above 30 (7)

6

Please complete the following sections of the survey for the project(s) you have undertaken over the past 8 years. If possible, please select projects that employed different project delivery methods (such as design- build, CM/GC, and design-bid -build).

End of Block: Personal Information

Start of Block: Project Organization, Procurement, Contracting and Overall Experience/Assessment

7 Please specify the type of project: (Eg. Roadway Construction, Industrial Construction, Bridge Construction, Heavy Civil, etc)

_____

8 Please specify the location of the project

_____

9 Please specify source of funding

- ○ Public (1)
- ○ Private (2)

10 Please specify the project letting year: (The year project was available to bid)

_____

11 Select the project delivery system that is best matching the delivery method of your project

- ○ Design-bid-build (1)
- ○ Design-build (2)
- ○ Construction manager/ General contractor (CM/GC) (3)
- ○ Integrated Project delivery (4)
- ○ Other, please specify: (5) _____

12 Please select how proposals were solicited from each project participant

	Open Bid (1)	Pre-qualification (2)	1-Stage RFP (3)	2-Stage RFP (4)	Sole Source (5)
Architect/Designer (1)	☐	☐	☐	☐	☐
General Contractor (GC), Construction manager/ General contractor (CM/GC) (2)	☐	☐	☐	☐	☐
Design-build (Design Builder) (3)	☐	☐	☐	☐	☐

13 Select the contract payment type used for the following participants:

	Lump Sum (1)	Unit Price (2)	Guaranteed maximum price (GMP) (3)	Cost Plus fee (4)	Cost plus % fee (5)
Architect/Designer (1)	○	○	○	○	○
General Contractor (GC), Construction manager/ General contractor (CM/GC) (2)	○	○	○	○	○
Subcontractors (3)	○	○	○	○	○
Design Builder in Design-build project (4)	○	○	○	○	○

14 Rate your overall satisfaction with the following (with 1= Not Satisfied to 5= exceed expectation)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Design Process (1)	○	○	○	○	○
Construction process (2)	○	○	○	○	○
Overall success of this project (3)	○	○	○	○	○

End of Block: Project Organization, Procurement, Contracting and Overall Experience/Assessment

Start of Block: Claims, Disputes and Change Orders

15 Based on your experience, how would you rate the following (with 1= low to 5= high)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Frequency of claims which arouse at the field level (1)	○	○	○	○	○
Severity of claims which arose on project (in terms of TIME to resolve) (2)	○	○	○	○	○
Severity of claims which arose on project (in terms of COST impact) (3)	○	○	○	○	○

Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project (4)	○	○	○	○	○

16 Were there any unresolved claims that escalated to a dispute requiring third party involvement?

- ○ Yes (1)
- ○ Maybe (2)
- ○ No (3)

Skip To: 23 If Were there any unresolved claims that escalated to a dispute requiring third party involvement? = No

17 Did you have any of the following types of claims on this project?

	Contractual Claims	
	Yes (1)	No (2)
Increase in scope (Directed or cardinal changes) (1)	○	○
Insufficient or inaccurate (defective) plans or specs (2)	○	○
Errors & Omissions (3)	○	○
Late Approvals (4)	○	○
Late Inspections (5)	○	○
Slow RFI response (Lack of communication) (6)	○	○

18 Did you have any of the following types of claims on this project?

	Differing Site Conditions Claims

	Yes (1)	No (2)
Restricted Access (1)	○	○
Subsurface Soil conditions (2)	○	○

19 Did you have any of the following types of claims on this project?

	Acceleration Claims	
	Yes (1)	No (2)
Owner or A/E disruption (1)	○	○
Partial Suspension (2)	○	○

20 Did you have any of the following types of claims on this project?

	Damage Claims

	Yes (1)	No (2)
Liquidated damages for late performance (1)	○	○
Repair or damages to existing property (2)	○	○
Correction of defective/non-conforming work (3)	○	○

21 Did you have any of the following types of claims on this project?

	Liability Claims	
	Yes (1)	No (2)
Implied Warranty (1)	○	○
Third Party Claims (2)	○	○

22 Did you have any of the following types of claims on this project?

	Unforeseen Conditions	
	Yes (1)	No (2)
Unforeseen Weather conditions (1)	○	○
Strikes (2)	○	○
Force Majeure (3)	○	○
Utility Delays (4)	○	○
Change in standards &/or regulations (5)	○	○

23 Were there any Change orders on this project

- ○ Yes (1)
- ○ Maybe (2)
- ○ No (3)

Skip To: 27 If Were there any Change orders on this project = No

24 Who was the Prime Originator of Change Orders?

- ○ The owner (1)
- ○ The Contractor (2)
- ○ Consultant (3)
- ○ All have equal contribution (4)
- ○ If Others, please mention: (5) _____

25 What is the average amount of Change orders in your project?

- ○ 0- 5 (1)
- ○ 6- 10 (2)
- ○ 11- 15 (3)
- ○ 16- 20 (4)
- ○ more than 20 (5)

---

26 What is the increase in completion schedule caused by change orders in your project (percentage of original schedule)?

- ○ < 10% (1)
- ○ 10% - 20% (2)
- ○ 21% -30% (3)
- ○ 31% - 40% (4)
- ○ 41% - 50% (5)
- ○ > 50% (6)

---

27 What method(s) of dispute resolution defined in the project contract conditions? (check all that apply)

- ☐ Negotiations (1)
- ☐ Mediation/conciliation (2)
- ☐ Arbitration (3)
- ☐ Dispute Review Board (4)
- ☐ Adjudication (5)
- ☐ Mini- trial (6)
- ☐ Expert determination (7)
- ☐ Litigation (8)
- ☐ Other(s), please specify: (9) _____

28 Has the project ever been in a form of dispute resolution, such as litigation?

- ○ Yes (1)
- ○ No (2)
- ○ I do not know (3)

Skip To: 32 If Has the project ever been in a form of dispute resolution, such as litigation? = No

29 If yes, what type of Dispute Resolution Method? (check all that apply)

- ☐ Negotiations (1)
- ☐ Mediation/conciliation (2)
- ☐ Arbitration (3)
- ☐ Dispute Review Board (4)
- ☐ Adjudication (5)
- ☐ Mini- trial (6)
- ☐ Expert determination (7)
- ☐ Litigation (8)
- ☐ Other(s), please specify: (9) _____

30 How long did it take to resolve the dispute from the day a decision was taken among parties to seek a Dispute Resolution Method?

- ○ Less than a week (1)
- ○ 1-2 weeks (2)
- ○ 2 weeks- 1 month (3)
- ○ 1-3 months (4)
- ○ 3-6 months (5)
- ○ 6 months- 1 year (6)
- ○ More than a year (7)

---

31 What was the total final dollar amount of the largest dispute that was settled beyond the project/field level with involvement of a third party?

- ○ $0 - $20,000 (1)
- ○ $20,001- $50,000 (2)
- ○ $50,001- $100,000 (3)
- ○ $100,001- $250,000 (4)
- ○ $250,001- $500,000 (5)
- ○ $500,001- $750,000 (6)
- ○ $750,001- $1,000,000 (7)
- ○ $1,000,000- $5,000,000 (8)
- ○ $5,000,001- $10,000,000 (9)
- ○ >$10,000,000 (10)

32 Were there any policies or laws that necessitated the selection of the dispute resolution method stated in the project contract?

- ○ Yes (1)
- ○ No (2)
- ○ I do not know (3)

Skip To: End of Block If Were there any policies or laws that necessitated the selection of the dispute resolution method... = Yes

33 If No, on what basis were the dispute resolution methods stated in the contract document selected?

- ○ It's the normal practice used by our company (1)
- ○ It's the normal used by other contracting party (2)
- ○ The dispute resolution method(s) was selected for other reasons, please specify: (3) _____

End of Block: Claims, Disputes and Change Orders

Start of Block: Team Behavior & Communication

34 Did the project team use a formal partnering agreement in the project?

- ○ Yes (1)
- ○ No (2)
- ○ I do not know (3)

35 What were the characteristics of the partnering process? (mark all that apply)

- [ ] Contractually required partnering (1)
- [ ] Kick-off meeting- (Facilitated) (2)
- [ ] Kick- off meeting- (Non-facilitated) (3)
- [ ] Multiple partnering meetings during project (Facilitated) (4)
- [ ] Multiple partnering meetings during project (Non-facilitated) (5)
- [ ] Formal charter or alliance agreement (6)
- [ ] Formal issue resolution/escalation procedure (7)
- [ ] Periodic partnering performance measurement assessment utilized (8)
- [ ] Incentive for partnering performance (9)
- [ ] Training on problem solving & joint decision-making (10)
- [ ] Other, please specify: (11) _____

36 Please rate the following from 1 (Low) to 5 (High) :

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Contractors' upper managerial support and responses (Effectiveness in responding and support) (1)	○	○	○	○	○
Contractors', organization experience with this type of project (2)	○	○	○	○	○
Experience and competence level of contractor's project individuals (3)	○	○	○	○	○

Quality of the input shared during pre-construction phase of project (4)	○	○	○	○	○
Level of experience and effort of financial planners, and adequacy of financial plan (5)	○	○	○	○	○
Team's prior experience as a unit (6)	○	○	○	○	○
Formality of communication among team members (7)	○	○	○	○	○

Timeliness of communication (8)	○	○	○	○	○
Electronics file & information sharing used by project team (9)	○	○	○	○	○
Risks identification and allocation (10)	○	○	○	○	○
Adequacy of technical plans/specs (11)	○	○	○	○	○

37 Please evaluate the level of trust between your organization and contractor (GC/DB/CM) from 1(Low) to 5 (High):

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Competency trust- (is based on the confidence gained from knowledge of an individual or an organization's cognitive abilities) (1)	○	○	○	○	○

Organization trust- (is developed through organizational policies and addresses formal and procedural arrangements) (2)	○	○	○	○	○

Relational trust- (is based on emotions that bond people together, thereby improving their performance and morale in a working relationship. This enhances information exchange and team behavior) (3)	○	○	○	○	○

End of Block: Team Behavior & Communication

Start of Block: Cost and Schedule growth

38 What was the original contract price?

- ○ $0 – $1000,00 (1)
- ○ $100,001- $200,000 (2)
- ○ $200,001- $300,000 (3)
- ○ $300,001- $400,000 (4)
- ○ $400,001- $500,000 (5)
- ○ $500,001- $1,000,000 (6)
- ○ $1,000,001-$5,000,000 (7)
- ○ $5,000,001- $10,000,00 (8)
- ○ >$10,000,000 (9)

---

39 What was the original duration of the project?

- ○ <2 months (1)
- ○ 2 months- 6 months (2)
- ○ 6 months- 1 year (3)
- ○ 1 year- 1.5 years (4)
- ○ 1.5 years- 2 years (5)
- ○ > 2 years (6)

---

40 What was the percentage of cost growth?

- ○ 0% - 9% (1)
- ○ 10%-20% (2)
- ○ 21%-30% (3)
- ○ 31% - 40% (4)
- ○ 41% - 50% (5)
- ○ >50% (6)

---

41 What was the percentage of schedule growth?

- ○ 0% - 9% (1)
- ○ 10%-20% (2)
- ○ 21%-30% (3)
- ○ 31% - 40% (4)
- ○ 41% - 50% (5)
- ○ >50% (6)

---

42 Would you be willing to be contacted for an interview to discuss additional information regarding the projects you provided?

- ○ Yes (1)
- ○ No (2)

Skip To: Q46 If Would you be willing to be contacted for an interview to discuss additional information regardin... = No

43 If yes, please provide your contact information:

_____

_____

_____

_____

_____

Q46 Provide information for the next Project

- ○ Yes (1)
- ○ No (2)

Appendix B- Descriptive Statistics

Table 9: Normality and Mean, Median and Mode of PDMs and Claims variables

Statistics

		PDM - Selected Choice	Experiance-Frequency of claims which arouse at the field level	Experiance-Severity of claims which arose on project (in terms of TIME to resolve)	Experiance-Severity of claims which arose on project (in terms of COST impact)
N	Valid	40	39	39	39
	Missing	0	1	1	1
Mean		1.93	2.10	2.54	2.38
Median		2.00	2.00	2.00	2.00
Mode		1	1	1	1
Std. Deviation		1.071	1.252	1.411	1.462
Skewness		1.077	.814	.243	.613
Std. Error of Skewness		.374	.378	.378	.378
Range		4	4	4	4

Minimum		1	1	1	1
Maximum		5	5	5	5

Statistics

		Experiance-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	Claims that escalated to a dispute requiring third party involvement	Contractual Claims - Increase in scope (Directed or cardinal changes)	Contractual Claims - Insufficient or inaccurate (defective) plans or specs
N	Valid	38	40	19	19
	Missing	2	0	21	21
Mean		2.53	2.08	1.63	1.21
Median		2.00	2.50	2.00	1.00
Mode		1	3	2	1
Std. Deviation		1.538	.971	.496	.419
Skewness		.442	-.156	-.593	1.545
Std. Error of Skewness		.383	.374	.524	.524
Range		4	2	1	1
Minimum		1	1	1	1

Maximum	5	3	2	2

Statistics

		Contractual Claims - Errors & Omissions	Contractual Claims - Late Approvals	Contractual Claims - Late Inspections	Contractual Claims - Slow RFI response (Lack of communication)
N	Valid	19	17	17	17
	Missing	21	23	23	23
Mean		1.53	1.94	2.00	1.94
Median		2.00	2.00	2.00	2.00
Mode		2	2	2	2
Std. Deviation		.513	.243	.000	.243
Skewness		-.115	-4.123		-4.123
Std. Error of Skewness		.524	.550	.550	.550
Range		1	1	0	1
Minimum		1	1	2	1
Maximum		2	2	2	2

Statistics

		Differing Site Conditions Claims - Restricted Access	Differing Site Conditions Claims - Subsurface Soil conditions	Acceleration Claims - Owner or A/E disruption	Acceleration Claims - Partial Suspension
N	Valid	18	19	19	19
	Missing	22	21	21	21
Mean		1.89	1.47	1.84	1.84
Median		2.00	1.00	2.00	2.00
Mode		2	1	2	2
Std. Deviation		.323	.513	.375	.375
Skewness		-2.706	.115	-2.041	-2.041
Std. Error of Skewness		.536	.524	.524	.524
Range		1	1	1	1
Minimum		1	1	1	1
Maximum		2	2	2	2

Statistics

	Damage Claims - Liquidated damages for late performance	Damage Claims - Repair or damages to existing property	Damage Claims - Correction of defective/non-conforming work	Liability Claims - Implied Warranty

N	Valid	19	19	19	19
	Missing	21	21	21	21
Mean		1.42	1.95	1.53	2.00
Median		1.00	2.00	2.00	2.00
Mode		1	2	2	2
Std. Deviation		.507	.229	.513	.000
Skewness		.348	-4.359	-.115	
Std. Error of Skewness		.524	.524	.524	.524
Range		1	1	1	0
Minimum		1	1	1	2
Maximum		2	2	2	2

Statistics

		Liability Claims - Third Party Claims	Unforeseen Conditions - Unforeseen Weather conditions	Unforeseen Conditions - Strikes	Unforeseen Conditions - Force Majeure
N	Valid	19	18	18	18
	Missing	21	22	22	22
Mean		1.89	1.83	2.00	1.94
Median		2.00	2.00	2.00	2.00

Mode	2	2	2	2
Std. Deviation	.315	.383	.000	.236
Skewness	-2.798	-1.956		-4.243
Std. Error of Skewness	.524	.536	.536	.536
Range	1	1	0	1
Minimum	1	1	2	1
Maximum	2	2	2	2

Statistics

		Unforeseen Conditions - Utility Delays	Unforeseen Conditions - Change in standards &/or regulations
N	Valid	18	19
	Missing	22	21
Mean		1.72	1.84
Median		2.00	2.00
Mode		2	2
Std. Deviation		.461	.375
Skewness		-1.085	-2.041
Std. Error of Skewness		.536	.524
Range		1	1
Minimum		1	1

Maximum	2	2

Table 10: Descriptive Statistics for all Ordinal variables in the study

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PDM - Selected Choice	39	4	1	5	1.90	1.071	1.147	1.162	.378	.738	.741
Procurement Method-Architect/Designer Open Bid	19	4	1	5	2.79	1.084	1.175	.172	.524	-.466	1.014
Procurement Method-GC,CM/GC	29	3	1	4	1.45	.910	.828	1.999	.434	2.954	.845

Procurement Method-Design-build	15	3	1	4	2.73	1.033	1.067	.167	.580	-1.458	1.121
Contract Method-Architect/Designer	22	4	1	5	3.23	1.660	2.755	-.329	.491	-1.618	.953
Contract Method-GC,CM/GC	32	2	1	3	1.97	.595	.354	.005	.414	.107	.809
Contract Method-Subcontractors	23	2	1	3	1.96	.638	.407	.033	.481	-.239	.935
Contract Method-Design Builder in Design-build project	15	3	1	4	2.00	1.195	1.429	.579	.580	-1.400	1.121

Overall Satisfaction-Design Process	38	4	1	5	3.37	1.025	1.050	-.340	.383	.045	.750
Overall Satisfaction-Construction Process	39	4	1	5	3.38	.935	.874	-.257	.378	-.017	.741
Overall Satisfaction-Overall success of this project	39	4	1	5	3.44	.995	.989	-.490	.378	.372	.741
Experiance-Frequency of claims which arouse at the field level	39	4	1	5	2.10	1.252	1.568	.814	.378	-.437	.741

Experiance-Severity of claims which arose on project (in terms of TIME to resolve)	39	4	1	5	2.54	1.411	1.992	.243	.378	-1.427	.741
Experiance-Severity of claims which arose on project (in terms of COST impact)	39	4	1	5	2.38	1.462	2.138	.613	.378	-1.041	.741

Experiance-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	38	4	1	5	2.53	1.538	2.364	.442	.383	-1.354	.750
Who was the Prime Originator of Change Orders? - Selected Choice	40	4	1	5	2.75	1.481	2.192	.056	.374	-1.661	.733
Amount of CO in your project?	39	4	1	5	2.85	1.663	2.765	.257	.378	-1.619	.741

Increase in completion schedule caused by change orders in your project (percentage of original schedule)?	38	5	1	6	1.66	1.146	1.312	2.322	.383	5.931	.750
How long did it take to resolve the dispute day a decision was taken among parties to seek a Dispute Resolution Method?	6	2	5	7	6.00	.894	.800	.000	.845	-1.875	1.741

Final dollar amount of the largest dispute that was settled	6	1	6	7	6.67	.516	.267	-.968	.845	-1.875	1.741
If No, on what basis were the DRM's stated in the contract document selected?	17	2	1	3	1.41	.795	.632	1.594	.550	.803	1.063
Contractors' upper managerial support and responses (Effectiveness in responding and support)	38	4	1	5	3.29	1.137	1.292	-.494	.383	-.135	.750

Contractors', organization experience with this type of project	38	4	1	5	3.71	1.293	1.671	-.851	.383	-.172	.750
Experience and competence level of contractor's project individuals	38	4	1	5	3.71	1.206	1.454	-.575	.383	-.543	.750
Quality of the input shared during pre-construction phase of project	37	4	1	5	3.49	1.017	1.035	-.296	.388	-.333	.759

Level of experience and effort of financial planners, and adequacy of financial plan	37	4	1	5	3.32	1.132	1.281	-.327	.388	-.278	.759
Team's prior experience as a unit	38	4	1	5	3.26	1.131	1.280	-.317	.383	-.485	.750
Formality of communication among team members	37	3	2	5	3.41	.832	.692	.318	.388	-.299	.759
Timeliness of communication	37	4	1	5	3.65	1.006	1.012	-.432	.388	-.051	.759

Electronics file & information sharing used by project team	37	4	1	5	3.38	1.163	1.353	-.920	.388	.212	.759
Risks identification and allocation	36	4	1	5	3.17	1.028	1.057	-.186	.393	-.354	.768
Adequacy of technical plans/specs	37	4	1	5	3.35	1.033	1.068	-.456	.388	-.099	.759
Competency trust-	38	4	1	5	3.29	1.088	1.184	-.354	.383	-.104	.750
Organization trust-	37	4	1	5	3.24	1.065	1.134	-.373	.388	-.017	.759
Relational trust-	38	4	1	5	3.39	1.104	1.218	-.482	.383	-.008	.750
What was the original contract price?	38	4	5	9	8.32	1.118	1.249	-1.532	.383	1.319	.750

What was the original duration of the project?	38	4	2	6	4.50	1.157	1.338	-.332	.383	-.589	.750
What was the percentage of cost growth?	36	3	1	4	1.42	.806	.650	2.191	.393	4.508	.768
What was the percentage of schedule growth?	36	4	1	5	1.72	1.111	1.235	1.516	.393	1.400	.768
Valid N (listwise)	0										

Table 11: Frequency Distribution Chart for all relevant variables

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PDM - Selected Choice	39	4	1	5	1.90	1.071	1.147	1.162	.378	.738	.741
Procurement Method-Architect/Designer Open Bid	19	4	1	5	2.79	1.084	1.175	.172	.524	-.466	1.014

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Contract Method-Design Builder in Design-build project	15	3	1	4	2.00	1.195	1.429	.579	.580	-1.400	1.121

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Who was the Prime Originator of Change Orders? - Selected Choice	40	4	1	5	2.75	1.481	2.192	.056	.374	-1.661	.733
Amount of CO in your project?	39	4	1	5	2.85	1.663	2.765	.257	.378	-1.619	.741

Increase in completion schedule caused by change orders in your project (percentage of original schedule)?	38	5	1	6	1.66	1.146	1.312	2.322	.383	5.931	.750
How long did it take to resolve the dispute day a decision was taken among parties to seek a Dispute Resolution Method?	6	2	5	7	6.00	.894	.800	.000	.845	-1.875	1.741

Final dollar amount of the largest dispute that was settled	6	1	6	7	6.67	.516	.267	-.968	.845	-1.875	1.741
If No, on what basis were the DRM's stated in the contract document selected?	17	2	1	3	1.41	.795	.632	1.594	.550	.803	1.063
Contractors' upper managerial support and responses (Effectiveness in responding and support)	38	4	1	5	3.29	1.137	1.292	-.494	.383	-.135	.750

Contractors', organization experience with this type of project	38	4	1	5	3.71	1.293	1.671	-.851	.383	-.172	.750
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Quality of the input shared during pre-construction phase of project	37	4	1	5	3.49	1.017	1.035	-.296	.388	-.333	.759

Level of experience and effort of financial planners, and adequacy of financial plan	37	4	1	5	3.32	1.132	1.281	-.327	.388	-.278	.759
Team's prior experience as a unit	38	4	1	5	3.26	1.131	1.280	-.317	.383	-.485	.750
Formality of communication among team members	37	3	2	5	3.41	.832	.692	.318	.388	-.299	.759
Timeliness of communication	37	4	1	5	3.65	1.006	1.012	-.432	.388	-.051	.759

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Risks identification and allocation	36	4	1	5	3.17	1.028	1.057	-.186	.393	-.354	.768
Adequacy of technical plans/specs	37	4	1	5	3.35	1.033	1.068	-.456	.388	-.099	.759
Competency trust-	38	4	1	5	3.29	1.088	1.184	-.354	.383	-.104	.750
Organization trust-	37	4	1	5	3.24	1.065	1.134	-.373	.388	-.017	.759
Relational trust-	38	4	1	5	3.39	1.104	1.218	-.482	.383	-.008	.750
What was the original contract price?	38	4	5	9	8.32	1.118	1.249	-1.532	.383	1.319	.750

What was the original duration of the project?	38	4	2	6	4.50	1.157	1.338	-.332	.383	-.589	.750
What was the percentage of cost growth?	36	3	1	4	1.42	.806	.650	2.191	.393	4.508	.768
What was the percentage of schedule growth?	36	4	1	5	1.72	1.111	1.235	1.516	.393	1.400	.768
Valid N (listwise)	0										

Appendix C- Kruskal Wallis

Table 12: K-W Test for (IV) Competency Trust vs (DVs) Claims, Satisfaction, CO, Partnership & Project perfromance

Test Statistics[a,b]

	Overall Satisfaction-Design Process	Overall Satisfaction-Construction Process	Overall Satisfaction-Overall success of this project	Experiance-Frequency of claims which arouse at the field level	Experiance-Severity of claims which arose on project (in terms of TIME to resolve)
Chi-Square	7.303	11.758	5.428	9.200	10.414
Df	4	4	4	4	4
Asymp. Sig.	.121	.019	.246	.056	.034

Test Statistics[a,b]

	Experiance-Severity of claims which arose on project (in terms of COST impact)	Experiance-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	Claims that escalated to a dispute requiring third party involvement	Contractual Claims - Increase in scope (Directed or cardinal changes)	Contractual Claims - Insufficient or inaccurate (defective) plans or specs
Chi-Square	4.011	6.521	8.096	8.539	2.257
Df	4	4	4	4	4
Asymp. Sig.	.404	.163	.088	.074	.689

Test Statistics[a,b]

	Contractual Claims - Errors & Omissions	Contractual Claims - Late Approvals	Contractual Claims - Late Inspections	Contractual Claims - Slow RFI response (Lack of communication)	Differing Site Conditions Claims - Restricted Access

Chi-Square	4.392	2.400	.000	2.400	2.975
Df	4	4	4	4	4
Asymp. Sig.	.355	.663	1.000	.663	.562

Test Statistics[a,b]

	Differing Site Conditions Claims - Subsurface Soil conditions	Acceleration Claims - Owner or A/E disruption	Acceleration Claims - Partial Suspension	Damage Claims - Liquidated damages for late performance	Damage Claims - Repair or damages to existing property
Chi-Square	1.859	2.800	2.800	1.492	5.333
Df	4	4	4	4	4
Asymp. Sig.	.762	.592	.592	.828	.255

Test Statistics[a,b]

	Damage Claims - Correction of defective/non-conforming work	Liability Claims - Implied Warranty	Liability Claims - Third Party Claims	Unforeseen Conditions - Unforeseen Weather conditions	Unforeseen Conditions - Strikes
Chi-Square	1.859	.000	2.672	11.560	.000
Df	4	4	4	4	4
Asymp. Sig.	.762	1.000	.614	.021	1.000

Test Statistics[a,b]

	Unforeseen Conditions - Force Majeure	Unforeseen Conditions - Utility Delays	Unforeseen Conditions - Change in standards &/or regulations	Change orders on this project	Who was the Prime Originator of Change Orders? - Selected Choice
Chi-Square	2.600	6.060	1.443	1.533	4.068
Df	4	4	4	4	4

Asymp. Sig.	.627	.195	.837	.821	.397

Test Statistics[a,b]

	Amount of CO in your project?	Increase in completion schedule caused by change orders in your project (percentage of original schedule)?	Has the project ever been in a form of dispute resolution, such as litigation?	Did the project team use a formal partnering agreement in the project?	What were the characteristics of the partnering process?Contractually required partnering
Chi-Square	3.423	1.635	7.808	3.938	.000
Df	4	4	4	4	4
Asymp. Sig.	.490	.803	.099	.414	1.000

Test Statistics[a,b]

	What were the characteristics of the partnering process?Kick-off meeting-(Facilitated)	What were the characteristics of the partnering process?Kick-off meeting-(Non-facilitated)	What were the characteristics of the partnering process?Multiple partnering meetings during project (Facilitated)	What were the characteristics of the partnering process? Multiple partnering meetings during project (Non-facilitated)	What were the characteristics of the partnering process?Formal charter or alliance agreement
Chi-Square	.000	.000	.000	.000	.000
Df	4	4	3	3	3
Asymp. Sig.	1.000	1.000	1.000	1.000	1.000

Test Statistics[a,b]

	What were the characteristics of the partnering process?Formal issue resolution/escalation procedure	What were the characteristics of the partnering process? Periodic partnering performance measurement assessment utilized	What were the characteristics of the partnering process?Other, please specify:	Contractors' upper managerial support and responses (Effectiveness in responding and support)	Contractors', organization experience with this type of project
Chi-Square	.000	.000	.000	19.572	13.797
Df	3	1	2	4	4
Asymp. Sig.	1.000	1.000	1.000	.001	.008

Test Statistics[a,b]

	Experience and competence level of contractor's project individuals	Quality of the input shared during pre-construction phase of project	Level of experience and effort of financial planners, and adequacy of financial plan	Team's prior experience as a unit	Formality of communication among team members
Chi-Square	20.987	12.375	8.522	9.048	15.737
Df	4	4	4	4	4
Asymp. Sig.	.000	.015	.074	.060	.003

Test Statistics[a,b]

	Timeliness of communication	Electronics file & information sharing used by project team	Risks identification and allocation	Adequacy of technical plans/specs	What was the percentage of cost growth?
Chi-Square	9.892	2.054	10.024	10.421	7.686
Df	4	4	4	4	4

Asymp. Sig.	.042	.726	.040	.034	.104

Test Statistics[a,b]

	What was the percentage of schedule growth?
Chi-Square	4.163
Df	4
Asymp. Sig.	.384

a. Kruskal Wallis Test

b. Grouping Variable: Competency trust

Appendix D – Mann- Whitney

Table 13: M-W (IV) Competency Trust vs (DV) Everything

Test Statistics[a]

	Overall Satisfaction-Design Process	Overall Satisfaction-Construction Process	Overall Satisfaction-Overall success of this project	Experiance-Frequency of claims which arouse at the field level
Mann-Whitney U	6.000	3.000	3.000	.500
Wilcoxon W	12.000	9.000	9.000	15.500
Z	-.516	-1.410	-1.429	-2.239
Asymp. Sig. (2-tailed)	.606	.158	.153	.025
Exact Sig. [2*(1-tailed Sig.)]	.786[b]	.250[b]	.250[b]	.036[b]

Test Statistics[a]

	Experiance-Severity of claims which arose on project (in terms of TIME to resolve)	Experiance-Severity of claims which arose on project (in terms of COST impact)	Experiance-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	Claims that escalated to a dispute requiring third party involvement
Mann-Whitney U	.500	3.500	3.000	1.500
Wilcoxon W	15.500	18.500	18.000	7.500
Z	-2.254	-1.238	-1.439	-2.049
Asymp. Sig. (2-tailed)	.024	.216	.150	.040
Exact Sig. [2*(1-tailed Sig.)]	.036[b]	.250[b]	.250[b]	.071[b]

Test Statistics[a]

	Contractual Claims - Increase in scope (Directed or cardinal changes)	Contractual Claims - Insufficient or inaccurate (defective) plans or specs	Contractual Claims - Errors & Omissions	Contractual Claims - Late Approvals
Mann-Whitney U	.500	1.000	.000	1.500

Wilcoxon W	1.500	2.000	6.000	2.500
Z	-1.000	-.577	-1.732	.000
Asymp. Sig. (2-tailed)	.317	.564	.083	1.000
Exact Sig. [2*(1-tailed Sig.)]	.500[b]	1.000[b]	.500[b]	1.000[b]

Test Statistics[a]

	Contractual Claims - Late Inspections	Contractual Claims - Slow RFI response (Lack of communication)	Differing Site Conditions Claims - Restricted Access	Differing Site Conditions Claims - Subsurface Soil conditions
Mann-Whitney U	1.500	1.500	1.000	.500
Wilcoxon W	2.500	2.500	7.000	6.500
Z	.000	.000	-.577	-1.000
Asymp. Sig. (2-tailed)	1.000	1.000	.564	.317
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	.500[b]

Test Statistics[a]

	Acceleration Claims - Owner or A/E disruption	Acceleration Claims - Partial Suspension	Damage Claims - Liquidated damages for late performance	Damage Claims - Repair or damages to existing property
Mann-Whitney U	1.000	1.000	.500	1.000
Wilcoxon W	7.000	7.000	1.500	7.000
Z	-.577	-.577	-1.000	-.577
Asymp. Sig. (2-tailed)	.564	.564	.317	.564
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	.500[b]	1.000[b]

Test Statistics[a]

	Damage Claims - Correction of defective/non-conforming work	Liability Claims - Implied Warranty	Liability Claims - Third Party Claims	Unforeseen Conditions - Unforeseen Weather conditions
Mann-Whitney U	1.000	1.500	1.500	1.500
Wilcoxon W	7.000	2.500	2.500	2.500
Z	-.577	.000	.000	.000

Asymp. Sig. (2-tailed)	.564	1.000	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	1.000[b]

Test Statistics[a]

	Unforeseen Conditions - Strikes	Unforeseen Conditions - Force Majeure	Unforeseen Conditions - Utility Delays	Unforeseen Conditions - Change in standards &/or regulations
Mann-Whitney U	1.500	1.500	1.000	1.500
Wilcoxon W	2.500	2.500	2.000	2.500
Z	.000	.000	-.577	.000
Asymp. Sig. (2-tailed)	1.000	1.000	.564	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	1.000[b]

Test Statistics[a]

	Has the project ever been in a form of dispute resolution, such as litigation?	Did the project team use a formal partnering agreement in the project?	What were the characteristics of the partnering process?Contractually required partnering	What were the characteristics of the partnering process?Kick-off meeting-(Facilitated)
Mann-Whitney U	2.500	7.000	2.000	1.500
Wilcoxon W	8.500	13.000	5.000	7.500
Z	-1.972	-.176	.000	.000
Asymp. Sig. (2-tailed)	.049	.860	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	.143[b]	1.000[b]	1.000[b]	1.000[b]

Test Statistics[a]

	What were the characteristics of the partnering process?Kick-off meeting-(Non-facilitated)	Contractors' upper managerial support and responses (Effectiveness in responding and support)	Contractors', organization experience with this type of project	Experience and competence level of contractor's project individuals
Mann-Whitney U	.500	.000	2.500	.000
Wilcoxon W	1.500	6.000	8.500	6.000
Z	.000	-2.366	-1.972	-2.582
Asymp. Sig. (2-tailed)	1.000	.018	.049	.010
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	.036[b]	.143[b]	.036[b]

Test Statistics[a]

	Quality of the input shared during pre-construction phase of project	Level of experience and effort of financial planners, and adequacy of financial plan	Team's prior experience as a unit	Formality of communication among team members

Mann-Whitney U	1.000	2.500	6.000	.000
Wilcoxon W	7.000	8.500	12.000	6.000
Z	-2.051	-1.578	-.464	-2.366
Asymp. Sig. (2-tailed)	.040	.115	.643	.018
Exact Sig. [2*(1-tailed Sig.)]	.071[b]	.143[b]	.786[b]	.036[b]

Test Statistics[a]

	Timeliness of communication	Electronics file & information sharing used by project team	Risks identification and allocation	Adequacy of technical plans/specs
Mann-Whitney U	6.500	7.500	7.500	4.500
Wilcoxon W	21.500	22.500	22.500	10.500
Z	-.344	.000	.000	-1.183
Asymp. Sig. (2-tailed)	.731	1.000	1.000	.237
Exact Sig. [2*(1-tailed Sig.)]	.786[b]	1.000[b]	1.000[b]	.393[b]

Test Statistics[a]

	Organization trust-	Relational trust-	What was the percentage of cost growth?	What was the percentage of schedule growth?
Mann-Whitney U	.000	.000	2.000	2.000
Wilcoxon W	6.000	6.000	12.000	12.000
Z	-2.291	-2.351	-1.789	-1.764
Asymp. Sig. (2-tailed)	.022	.019	.074	.078
Exact Sig. [2*(1-tailed Sig.)]	.057[b]	.036[b]	.229[b]	.229[b]

Test Statistics[a]

	Change orders on this project
Mann-Whitney U	7.500
Wilcoxon W	22.500
Z	.000
Asymp. Sig. (2-tailed)	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]

a. Grouping Variable: Competency trust-

b. Not corrected for ties.

Table 14: M-W (IV) Relational Trust vs (DV) Everything

Test Statistics[a]

	Overall Satisfaction-Design Process	Overall Satisfaction-Construction Process	Overall Satisfaction-Overall success of this project	Experiance-Frequency of claims which arouse at the field level
Mann-Whitney U	6.000	.000	1.000	.000
Wilcoxon W	12.000	6.000	7.000	21.000
Z	-1.069	-2.449	-2.198	-2.546
Asymp. Sig. (2-tailed)	.285	.014	.028	.011
Exact Sig. [2*(1-tailed Sig.)]	.548[b]	.024[b]	.048[b]	.024[b]

Test Statistics[a]

	Experiance-Severity of claims which arose on project (in terms of TIME to resolve)	Experiance-Severity of claims which arose on project (in terms of COST impact)	Experiance-Severity (in terms of cost impact and time to resolve) of largest dispute which arose on project	Claims that escalated to a dispute requiring third party involvement

Mann-Whitney U	.000	1.000	.000	1.500
Wilcoxon W	21.000	22.000	21.000	7.500
Z	-2.558	-2.208	-2.449	-2.236
Asymp. Sig. (2-tailed)	.011	.027	.014	.025
Exact Sig. [2*(1-tailed Sig.)]	.024[b]	.048[b]	.024[b]	.048[b]

Test Statistics[a]

	Contractual Claims - Increase in scope (Directed or cardinal changes)	Contractual Claims - Insufficient or inaccurate (defective) plans or specs	Contractual Claims - Errors & Omissions	Contractual Claims - Late Approvals
Mann-Whitney U	1.000	.500	.000	1.500
Wilcoxon W	7.000	6.500	6.000	2.500
Z	-.577	-1.000	-1.732	.000
Asymp. Sig. (2-tailed)	.564	.317	.083	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	.500[b]	.500[b]	1.000[b]

Test Statistics[a]

	Contractual Claims - Late Inspections	Contractual Claims - Slow RFI response (Lack of communication)	Differing Site Conditions Claims - Restricted Access	Differing Site Conditions Claims - Subsurface Soil conditions
Mann-Whitney U	1.500	1.500	1.000	.500
Wilcoxon W	2.500	2.500	7.000	6.500
Z	.000	.000	-.577	-1.000
Asymp. Sig. (2-tailed)	1.000	1.000	.564	.317
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	.500[b]

Test Statistics[a]

	Acceleration Claims - Owner or A/E disruption	Acceleration Claims - Partial Suspension	Damage Claims - Liquidated damages for late performance	Damage Claims - Repair or damages to existing property
Mann-Whitney U	1.000	1.000	1.000	1.000
Wilcoxon W	7.000	7.000	7.000	7.000
Z	-.577	-.577	-.577	-.577

Asymp. Sig. (2-tailed)	.564	.564	.564	.564
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	1.000[b]

Test Statistics[a]

	Damage Claims - Correction of defective/non-conforming work	Liability Claims - Implied Warranty	Liability Claims - Third Party Claims	Unforeseen Conditions - Unforeseen Weather conditions
Mann-Whitney U	1.000	1.500	1.500	1.500
Wilcoxon W	7.000	2.500	2.500	2.500
Z	-.577	.000	.000	.000
Asymp. Sig. (2-tailed)	.564	1.000	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	1.000[b]	1.000[b]

Test Statistics[a]

	Unforeseen Conditions - Strikes	Unforeseen Conditions - Force Majeure	Unforeseen Conditions - Utility Delays	Unforeseen Conditions - Change in standards &/or regulations
Mann-Whitney U	1.500	1.500	.500	1.500
Wilcoxon W	2.500	2.500	6.500	2.500
Z	.000	.000	-1.000	.000
Asymp. Sig. (2-tailed)	1.000	1.000	.317	1.000
Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	.500[b]	1.000[b]

Test Statistics[a]

	Has the project ever been in a form of dispute resolution, such as litigation?	Did the project team use a formal partnering agreement in the project?	What were the characteristics of the partnering process? Contractually required partnering	What were the characteristics of the partnering process? Kick-off meeting-(Facilitated)

Mann-Whitney U	3.000	6.000	3.000	2.000
Wilcoxon W	9.000	27.000	9.000	12.000
Z	-2.138	-1.414	.000	.000
Asymp. Sig. (2-tailed)	.033	.157	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	.167[b]	.548[b]	1.000[b]	1.000[b]

Test Statistics[a]

	What were the characteristics of the partnering process?Kick-off meeting-(Non-facilitated)	What were the characteristics of the partnering process? Multiple partnering meetings during project (Non-facilitated)	Contractors' upper managerial support and responses (Effectiveness in responding and support)	Contractors', organization experience with this type of project
Mann-Whitney U	.500	1.000	.000	3.500
Wilcoxon W	1.500	4.000	6.000	9.500
Z	.000	.000	-2.395	-1.697
Asymp. Sig. (2-tailed)	1.000	1.000	.017	.090

Exact Sig. [2*(1-tailed Sig.)]	1.000[b]	1.000[b]	.024[b]	.167[b]

Test Statistics[a]

	Experience and competence level of contractor's project individuals	Quality of the input shared during pre-construction phase of project	Level of experience and effort of financial planners, and adequacy of financial plan	Team's prior experience as a unit
Mann-Whitney U	.000	3.000	5.000	8.000
Wilcoxon W	6.000	9.000	11.000	14.000
Z	-2.558	-1.633	-1.104	-.272
Asymp. Sig. (2-tailed)	.011	.102	.270	.785
Exact Sig. [2*(1-tailed Sig.)]	.024[b]	.167[b]	.381[b]	.905[b]

Test Statistics[a]

	Formality of communication among team members	Timeliness of communication	Electronics file & information sharing used by project team	Risks identification and allocation

Mann-Whitney U	1.500	7.000	8.000	9.000
Wilcoxon W	7.500	28.000	29.000	30.000
Z	-2.070	-.577	-.275	.000
Asymp. Sig. (2-tailed)	.038	.564	.784	1.000
Exact Sig. [2*(1-tailed Sig.)]	.048[b]	.714[b]	.905[b]	1.000[b]

Test Statistics[a]

	Adequacy of technical plans/specs	What was the percentage of cost growth?	What was the percentage of schedule growth?	Change orders on this project
Mann-Whitney U	7.500	3.000	3.000	9.000
Wilcoxon W	13.500	24.000	24.000	30.000
Z	-.463	-2.138	-2.121	.000
Asymp. Sig. (2-tailed)	.643	.033	.034	1.000
Exact Sig. [2*(1-tailed Sig.)]	.714[b]	.167[b]	.167[b]	1.000[b]

Test Statistics[a]

	Competency trust-	Organization trust-
Mann-Whitney U	.000	.000

Wilcoxon W	6.000	6.000
Z	-2.449	-2.320
Asymp. Sig. (2-tailed)	.014	.020
Exact Sig. [2*(1-tailed Sig.)]	.024[b]	.036[b]

a. Grouping Variable: Relational trust-

b. Not corrected for ties.

Appendix E- Spearman rho correlation

Table 15: Spearman Correlation- (IV) PDM vs (DV) Overall satisfaction

Correlations[c]

			PDM - Selected Choice	Overall Satisfaction-Construction Process
Spearman's rho	PDM - Selected Choice	Correlation Coefficient	1.000	.421**
		Sig. (2-tailed)	.	.008
	Overall Satisfaction-Construction Process	Correlation Coefficient	.421**	1.000
		Sig. (2-tailed)	.008	.
	Overall Satisfaction-Design Process	Correlation Coefficient	-.156	.322*
		Sig. (2-tailed)	.349	.049
	Overall Satisfaction-Overall success of this project	Correlation Coefficient	.150	.651**
		Sig. (2-tailed)	.370	.000

Correlations[c]

			Overall Satisfaction-Design Process	Overall Satisfaction - Overall success of this project
Spearman's rho	PDM - Selected Choice	Correlation Coefficient	-.156	.150
		Sig. (2-tailed)	.349	.370
	Overall Satisfaction-Construction Process	Correlation Coefficient	.322*	.651**
		Sig. (2-tailed)	.049	.000
	Overall Satisfaction-Design Process	Correlation Coefficient	1.000	.421**
		Sig. (2-tailed)	.	.008
	Overall Satisfaction-Overall success of this project	Correlation Coefficient	.421**	1.000
		Sig. (2-tailed)	.008	.

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

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N = 38

Table 16: Table - Spearman Correlation-(IV) PDM VS (DV) TRUST

Correlations[c]

			PDM - Selected Choice	Competency trust-
Spearman's rho	PDM - Selected Choice	Correlation Coefficient	1.000	.223
		Sig. (2-tailed)	.	.184
	Competency trust-	Correlation Coefficient	.223	1.000
		Sig. (2-tailed)	.184	.
	Organization trust-	Correlation Coefficient	.126	.747**
		Sig. (2-tailed)	.459	.000
	Relational trust-	Correlation Coefficient	.331*	.710**
		Sig. (2-tailed)	.045	.000

Correlations[c]

	Organization trust-	Relational trust-

Spearman's rho	PDM - Selected Choice	Correlation Coefficient	.126	.331*
		Sig. (2-tailed)	.459	.045
	Competency trust-	Correlation Coefficient	.747**	.710**
		Sig. (2-tailed)	.000	.000
	Organization trust-	Correlation Coefficient	1.000	.695**
		Sig. (2-tailed)	.	.000
	Relational trust-	Correlation Coefficient	.695**	1.000
		Sig. (2-tailed)	.000	.

*. Correlation is significant at the 0.05 level (2-tailed).

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

c. Listwise N = 37